NUREG–1476

Final Environmental Impact Statement to Construct and Operate a Facility to Receive, Store, and Dispose of 11e.(2) Byproduct Material Near Clive, Utah

Docket No. 40–8989
Envirocare of Utah, Inc.

U.S. Nuclear Regulatory Commission

Office of Nuclear Materials Safety and Safeguards

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MASTER

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ABSTRACT

A Final Environmental Impact Statement related to the licensing of Envirocare of Utah, Inc.'s proposed disposal facility in Tooele County, Utah, (Docket No. 40-8989) for byproduct material as defined in Section 11e.(2) of the Atomic Energy Act, has been prepared by the Office of Nuclear Material Safety and Safeguards. This statement describes and evaluates (1) the purpose of and need for the proposed action, (2) alternatives considered, and (3) environmental consequences of the proposed action. The Nuclear Regulatory Commission has concluded that the proposed action evaluated under the National Environmental Policy Act of 1969 and 10 CFR Part 51, is to permit the applicant to proceed with the project as described in this Statement.

SUMMARY

This Final Environmental Impact Statement (FEIS) was prepared by the staff of the U.S. Nuclear Regulatory Commission (NRC) with input from Pacific Northwest Laboratory (PNL) and Oak Ridge National Laboratory (ORNL), consultants to NRC, and issued by the Commissions's Office of Nuclear Material Safety and Safeguards (NMSS).

1. This action is administrative.

2. After an assessment of environmental impacts and alternatives, the proposed action permits the applicant (Envirocare of Utah, Inc.) to construct and operate a facility to receive, store, and dispose of uranium and thorium byproduct material [as defined by Section 11e.(2) of the Atomic Energy Act of 1954, as amended; hereafter referred to as 11e.(2) byproduct material]. This facility is located adjacent to: (1) the Department of Energy's (DOE's) South Clive, Utah, disposal cell containing approximately 1.91 X 10^6 m^3 (2.5 X 10^6 yd^3) of uranium mill tailings from the former Vitro South Salt Lake, Utah, facility that was cleaned-up and moved to this site pursuant to the Uranium Mill Tailings Radiation Control Act of 1978; and (2) the applicant's existing facility licensed by the State of Utah to dispose of naturally-occurring radioactive material (NORM), low-level radioactive waste, and mixed waste.

   Envirocare estimates that the proposed commercial facility will dispose of 2.29 X 10^6 m^3 (3 X 10^6 yd^3) of 11e.(2) byproduct material transported to the site from various sources. The 11e.(2) byproduct material will be disposed of in a cell excavated to a depth of approximately 2.4 m (8 ft) and lined with compacted clay. The waste will be placed in layers, compacted to a height of 11.2 m (37 ft), and covered with a 2.1-m (7-ft) thick radon barrier and a 60-cm (2-ft) thick erosion protection barrier. The 11e.(2) byproduct material disposal embankment will be constructed in a continuous "cut and cover" operation. The waste received will be disposed of in cells located in a separate facility from that used to dispose of the other categories of radioactive waste regulated by the State of Utah.

   At the conclusion of operations, the site and facility will be decontaminated and decommissioned. At license termination, the title to the disposal site will be transferred to the U.S. Department of Energy (DOE)—or another Federal Agency designated by the President or the State at its option—for long-term care to ensure the health and safety of the public. At that time the custodial agency will become a licensee of the NRC for long term monitoring and maintenance.

3. Concerns receiving special attention are listed in detail in Appendix B. These concerns include staff, public, and individual issues for which analysis and assessment were necessary. The major categories of concern were that:

   a. The waste to be disposed of should be limited by license either: to be exclusively 11e.(2) byproduct material; or, if a mixture of 11e.(2) byproduct material will be authorized with other materials, that the percentage of 11e.(2) byproduct material allowed be specified. Any Resource Conservation Recovery Act (RCRA) hazardous material is not authorized for disposal under an NRC license.

   b. The impacts or long-term effects on the adjacent public lands should be assessed.

   c. The radiological, groundwater, and air quality impacts should be assessed.

4. For the proposed action, the following alternatives were considered:

   a. Alternative 1: disposal at South Clive site – above-ground.

   b. Alternative 2: disposal at South Clive site – below-ground.

   c. Alternative 3: disposal at Skunk Ridge site.

   d. Alternative 4: no action.

The staff evaluated the applicant's license application in relationship to the above alternatives. The staff conclusions and recommendations are as follows:

   a. The staff considers the above-ground disposal site at South Clive (Alternative 1) to be adequately remote from people.

   b. The proposed tailings disposal site cover design provides adequate long-term protection from wind erosion.

   c. The conceptual design to prevent long-term water erosion appears adequate.

   d. Available data indicate that the bottom of the proposed embankment is separate from the nearest confined aquifer by about 9.75 m (32 ft) and the nearest unconfined aquifer by about 3 m (10 ft). The applicant proposes to place a native clay liner 60-cm (2-ft) thick at the bottom of the disposal embankment. The unconfined aquifer is classified by the State of Utah Groundwater Quality Protection Regulations as a Class IV aquifer, based on total dissolved solids (TDS) above 10,000 mg/L (0.62 lb/ft^3), a classification equivalent to the U.S. Environmental Protection Agency's (EPA's) Class III. The staff is of the opinion that seepage from the site will be minimal and poses no threat to water resources.

e. The staff is of the opinion that the applicant's plans to minimize windblown transport of the tailings during operations are acceptable.

f. The thickness of the final embankment cover would minimize the potential for root or burrowing penetration into the 11e.(2) byproduct material and would reduce gamma radiation to approximately background levels. Radon exhalation would be reduced to levels required by the EPA standards or below.

With the implementation of the disposal facility (Alternative 1) as described in the license application, the staff concludes that all of the NRC performance objectives for tailings management would be met and that this is the preferred alternative of the staff.

5. From the analysis and evaluation made in this Environmental Impact Statement, it is proposed that in the license authorizing construction and operation of a facility to receive, store, and dispose of 11e.(2) byproduct material, the applicant be required to conform to the following conditions:

   a. Before engaging in any activity not evaluated by the NRC staff, the applicant shall prepare and record an environmental evaluation of such activity. When the evaluation indicates that such activity may result in a significant adverse environmental impact that was not evaluated or that is significantly greater than that evaluated in this Statement, the applicant shall provide a written evaluation of such activities and obtain approval of NRC for the activities.

   b. If unexpected harmful effects or evidence of irreversible damage not otherwise identified in this Statement are detected during construction or operation, the applicant shall provide to NRC an acceptable analysis of the problem and a plan of action to eliminate or significantly reduce the harmful effects or damage.

   c. The applicant shall be required by license condition to conduct tests to verify the compatibility with tailings solution of the clay that will be used to construct the bottom liner, as required by Appendix A to 10 CFR Part 40.

6. With conformity to other local, State, and Federal regulations, the expansion of Envirocare's South Clive site to allow construction and operation of a facility to receive, store, and dispose of 11e.(2) byproduct material will produce only minimal environmental consequences above that produced by current operations.

7. The position of the NRC is that, after weighing the environmental, economic, technical, and other benefits from the licensing of the proposed facility against the environmental and other costs and considering available alternatives, the proposed action evaluated under the National Environmental Policy Act of 1969 (NEPA) and 10 CFR Part 51 is to permit the applicant to proceed with the project as described in this Statement, subject to all requirements and conditions presented above.

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
μg	microgram
AEA	Atomic Energy Act of 1954
AEC	Atomic Energy Commission
ANL	Argonne National Laboratory
ASTM	American Standard for Testing and Materials
Bi	bismuth
BLM	Bureau of Land Management
Bq	Becquerel
BRC	Bureau of Radiation Control
C	Coulomb
CFR	Code of Federal Regulations
cfs	cubic feet per second
Ci	Curie
cm	centimeter
Cs	cesium
DEIS	Draft Environmental Impact Statement
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
EUI	Envirocare of Utah, Inc.
FEIS	Final Environmental Impact Statement
FR	Federal Register
ft	feet
g	gram
gal	gallon
ha	hectare
hr	hour
IAEA	International Atomic Energy Agency
IHI	Industrial Health, Inc.
in.	inch
IRCP	International Commission on Radiological Protection
kg	kilogram
km	kilometer
L	liter
LARW	Low-Activity Radioactive Waste
LASL	Los Alamos Scientific Laboratory
lb	pound
LLW	Low-Level Waste (radioactive)
m	meter
MCE	maximum credible earthquake
mi	mile
mph	miles per hour
N	Newton
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NMSS	Nuclear Material Safety and Safeguards
NOI	notice of intent
NORM	Naturally-Occurring Radioactive Material
NRC	Nuclear Regulatory Commission
NRCP	National Council on Radiation Protection and Measurement
ORNL	Oak Ridge National Laboratory
Pb	lead
PERM	passive environmental radon monitor
P.L.	Public Law
PM_{10}	particulate matter less than in 10 microns in diameter
PMF	probable maximum flood
PMP	probable maximum precipitation
PNL	Pacific Northwest Laboratory
Po	polonium
POC	point of compliance
R	Roentgen
Ra	radium
RCRA	Resource Conservation and Recovery Act of 1976
Rn	radon
RPISU	radon progeny integrated sampling unit
s	second
SCS	Soil Conservation Service
SI	saturation index
SRMA	special recreation management area
Sv	Sievert
TDS	total dissolved solids

Th	thorium
Tl	thallium
TLD	thermoluminescent detector
U	uranium
UMTRAP	Uranium Mill Tailings Remedial Action Project
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USPCI	United States Pollution Control, Inc.
WMA	wildlife management area
WSA	wilderness study area
yd	yard
yr	year

FOREWORD

The information in this report will be considered by the U.S. Nuclear Regulatory Commission staff in the review of the license application by Envirocare of Utah, Inc., to receive, store, and dispose of uranium and thorium byproduct material [as defined by Section 11e.(2) of the Atomic Energy Act of 1954, as amended], received from other persons, at a site near Clive, Tooele County, Utah. This report documents the environmental consequences of the proposed action.

ACKNOWLEDGMENTS

This Final Environmental Impact Statement was prepared principally by the U.S Nuclear Regulatory Commission staff in the Division of Low-Level Waste Management and Decommissioning, Office of Nuclear Materials Safety and Safeguards. In preparing this report the staff relied heavily on the Environmental Report submitted by the applicant, Envirocare of Utah as part of its licensing application, on contractor inputs provided by the Battelle Pacific Northwest Laboratory, Richland, Washington, and by the Oak Ridge National Laboratory, Oak Ridge, Tennessee, and on a U.S. Department of Energy Final Environmental Impact Statement relating to disposal of large quantities of uranium mill tailings.

1.0 PURPOSE AND NEED FOR ACTION

1.1 Introduction

This Final Environmental Impact Statement (FEIS) is issued by the U.S. Nuclear Regulatory Commission (NRC or the Commission), Office of Nuclear Material Safety and Safeguards (NMSS), in response to a request by Envirocare of Utah, Inc., (the applicant or Envirocare) for a license to dispose of byproduct material (uranium and thorium mill tailings and related wastes) at a site located in Tooele County, Utah, approximately 105 km (65 mi) by air west of Salt Lake City, Utah. This document has been prepared in accordance with Commission Regulation Title 10, *Code of Federal Regulations* (CFR), Part 51, which implements requirements of the National Environmental Policy Act of 1969 (NEPA; P.L. 91–190).

The principal objectives of the NEPA process are to build into agency decision-making an appropriate and careful consideration of environmental aspects of proposed actions and to make environmental information available to public officials and citizens before decisions are made and actions are taken. The process is intended to help public officials make decisions based on an understanding of environmental consequences and to take actions that will protect, restore, and enhance the environment.

The NEPA states, among other things, that it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the nation may:

- fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
- assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
- attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
- preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;
- achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and
- enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Furthermore, with respect to major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of the NEPA calls for preparation of a detailed statement on:

- the environmental impact of the proposed action;
- any adverse environmental effects which cannot be avoided should the proposal be implemented;
- alternatives to the proposed action;
- the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and
- any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Pursuant to 10 CFR Part 51, the NRC Division of Low-Level Waste Management and Decommissioning is issuing a detailed statement on the foregoing considerations with respect to an application for a source material license to dispose of uranium and thorium byproduct material received from other persons.

In accordance with 10 CFR Part 51, Section 45, Envirocare submitted an Environmental Report (ER) (EUI 1992b) on March 28, 1992, to the NRC to support its license application. This ER has subsequently been revised and now provides background material for this Environmental Impact Statement (EIS). In conducting the required NEPA review, Commission representatives (the staff) met with Envirocare to discuss items of information in the ER (EUI 1992b), to seek additional information that may be needed for an adequate assessment, and generally to ensure that the Commission had a thorough understanding of the proposed project. In addition, the staff sought information from other sources to assist in the evaluation, conducted field inspections of the project site and surrounding area, and conducted a public scoping to assist in identifying the significant issues to be analyzed in depth. On the basis of the foregoing activities and other such activities or inquiries as were deemed useful and appropriate, the staff has made an independent assessment of the considerations specified in 10 CFR Part 51.

That evaluation led to the issuance of a Draft Environmental Impact Statement (DEIS) by the Office of NMSS in February 1993. The DEIS was distributed to Federal, State, and local governmental agencies, and to other interested parties, for comment. A summary notice was published in the *Federal Register* (FR) regarding the availability of the applicant's environmental report and the DEIS (see 58 FR 11642, February 26, 1993, and 58 FR 13597, March 12, 1993).

After comments on the DEIS were received and considered, this FEIS was prepared. It includes a discussion of questions and comments submitted by reviewing agencies or individuals (see Appendix A). Further environmental considerations were made on the basis of these comments in combination with the previous evaluation. The total environmental costs were then evaluated and weighed against the environmental, economic, technical, and other benefits to be derived from the proposed project. It was concluded (see Section 6.0) that the overall benefit-cost balance for the 11e.(2) byproduct material disposal facility is favorable and that the indicated action is that of licensing the proposed facility.

This FEIS was made available to the U.S. Environmental Protection Agency (EPA), to those agencies commenting on the DEIS, and to the public.

1.2 The Applicant's Proposal

Envirocare has applied to the NRC for a license to construct and operate a facility to receive, store, and dispose of uranium and thorium byproduct material (as defined by Section 11e.(2) of the Atomic Energy Act of 1954, as amended) at a site located in Tooele County, Utah. The site (hereafter referred to as South Clive) lies approximately 1.6 km (1 mi) south of Clive, a railroad siding for the Union Pacific railway system.

The applicant proposes to dispose of high-volume, low-activity 11e.(2) byproduct material transported in bulk to the site by rail and truck. The purpose of the proposed action is to expand the range of wastes that can be disposed of at an existing facility in order to receive, store, and dispose of 11e.(2) byproduct materials similar in composition and radioactivity to wastes already located at the site.

1.3 Background Information

A discussion of the South Clive site and the regulatory basis upon which NRC intends to license the disposal of the 11e.(2) byproduct material is presented below.

1.3.1 UMTRCA and the DOE Vitro Cell

The South Clive site, at which the applicant proposes to dispose of the 11e.(2) byproduct material, was originally selected and used by the U.S. Department of Energy (DOE) for the disposal and stabilization of approximately 1.91 X 10^6 m^3 (2.5 X 10^3 yd^3) of uranium mill tailings and related wastes from a South Salt Lake, Utah, location, known as the Vitro site. The DOE disposal and stabilization activity was undertaken pursuant to the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). Congress enacted UMTRCA to provide for the disposal, long-term stabilization, and control of uranium and thorium mill tailings and the associated contaminated material in a safe and environmentally sound manner. UMTRCA established two programs to protect public health, safety, and the environment from uranium and thorium mill tailings. The Title I Program designated 24 sites that were then inactive (i.e., at which all milling had stopped and which were not under license), including the Vitro site in Salt Lake City. The Title II Program was established for closure of active sites (those uranium and thorium milling sites under license by the NRC or Agreement States).

Title I of UMTRCA directed the DOE to select and perform remedial actions at the inactive sites in accordance with EPA standards and with the concurrence of the NRC. In addition, UMTRCA required that the property comprising the remedial action disposal site be maintained in perpetuity under a license issued by the NRC. The licensee would be the DOE or such other agency as may be designated by the President of the United States.

After an extensive evaluation of many site alternatives, the DOE selected the South Clive site for disposal of the Vitro material. This DOE disposal site is located on State land approximately 1.6 km (1 mi) south of Clive, a railroad siding for the Union Pacific railway system. The site selection process and decision criteria used by DOE for selecting the South Clive site is documented in the DOE Final Environmental Impact Statement on remedial actions for the Vitro site (DOE, 1984b). This DOE document has been used by both Envirocare in developing its ER and by NRC staff in developing this EIS for the 11e.(2) byproduct material disposal application.

The DOE Vitro remedial action involved excavation of the uranium tailings and other contaminated material and then transportation of this waste to the South Clive site by rail. The DOE Vitro cell encompasses approximately 40 ha (100 acres) of a section of land [a section contains 259 ha (640 acres)] originally owned by the State of Utah. The remainder of this section, 219 ha (540 acres), is now private land owned by the applicant.

The DOE Remedial Action Plan was concurred in by the NRC in 1985, and work was largely completed in 1988. DOE has not yet submitted a Completion Report on the Vitro cell to NRC for its concurrence. Once NRC has concurred in the Completion Report, the State of Utah will transfer the deed and title for the disposal site land to DOE. DOE will be responsible for the long-term care and maintenance of the disposal site under license to the NRC pursuant to 10 CFR Part 40.27.

1.3.2 The South Clive Disposal Site

The remaining 219 ha (540 acres) in this South Clive section were acquired by the applicant for the purpose of disposing of high-volume, low-activity radioactive wastes. The State of Utah, as an NRC Agreement State, has regulatory authority over the disposal of all but the 11e.(2) byproduct material.

Envirocare is currently licensed by the State of Utah's Department of Environmental Quality to dispose of Naturally-Occurring Radioactive Material (NORM) waste and low activity, low-level radioactive waste (LLW) pursuant to Section 274b. of the Atomic Energy Act of 1954, as amended, at the South Clive site. In addition, Envirocare has a license to dispose of those radioactive wastes which have been mixed with, or contain hazardous material, as regulated under the State of Utah's authority for disposal of Resource Conservation and Recovery Act (RCRA) material as delegated by EPA. The authority to regulate the disposal of 11e.(2) byproduct material was not requested by the State of Utah and, as a result, regulatory authority for the disposal of 11e.(2) byproduct material in the State of Utah remains with the NRC.

The applicant proposes to conduct its 11e.(2) byproduct material disposal operations within an area of the Envirocare-owned South Clive site. The applicant has requested authority to dispose of up to 2.29×10^6 m^3 (3×10^6 yd^3) of 11e.(2) byproduct material at the South Clive site. The disposal of 11e.(2) byproduct material considered in this EIS will occur in disposal cells separate from those used for disposal of the other categories of radioactive waste regulated by the State of Utah.

1.3.3 Title II, The NRC Regulatory Requirements, and DOE's Responsibilities

The Title II program of UMTRCA is directed towards the active uranium and thorium milling facilities licensed by NRC or Agreement States. The program for the active uranium and thorium milling sites covers the final disposal of tailings and the control of effluents and emissions during milling operations and after termination of operations, to stabilize and control tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public. Title II provides for: (1) NRC authority to control radiological and nonradiological hazards; (2) EPA authority to set generally applicable standards for both radiological and nonradiological hazards; and (3) eventual State or Federal ownership under an NRC license. Furthermore, UMTRCA required that EPA establish standards for this program, and that the standards for nonradioactive hazards protect human health and the environment in a manner consistent with those standards established under Subtitle C of the Solid Waste Disposal Act, as amended.

NRC has issued modifications to its regulations for the purpose of conforming them to generally applicable requirements promulgated by EPA. These EPA requirements, contained in Subparts D and E of 40 CFR Part 192 [see 48 FR 45926; October 7, 1983], are applicable to the management of uranium and thorium 11e.(2) byproduct material. The affected Commission regulations are contained in Appendix A to 10 CFR Part 40.

The license application from Envirocare for disposal of 11e.(2) byproduct material received from other persons did not readily comport with all of the requirements of 10 CFR Part 40, Appendix A. Because of the unique first-of-a-kind nature of the Envirocare application, the regulatory framework for the staff review had to be established by Commission action. The Commission established the applicability of its regulations to this specific application for the commercial disposal of 11e.(2) byproduct material in a Notice of Receipt of an Application for Byproduct Material Waste Disposal License, published in the *Federal Register* (56 FR 2959) on January 25, 1991, as follows:

- The Commission has determined that 10 CFR Part 40, including Appendix A, applies to the review of this application to dispose of 11e.(2) byproduct material. The applicant may request an exemption from any requirements in 10 CFR Part 40 that it believes should not apply.

- NRC staff will prepare an EIS pursuant to the requirements of 10 CFR Part 51. The EIS will be based on the staff evaluation of an environmental report to be prepared by the applicant.

- Certain administrative and recordkeeping requirements delineated in 10 CFR Part 61, Subpart G, must be included in the license. These requirements are given in 10 CFR Parts 61.80 and 61.82.

- The waste manifest requirements contained in 10 CFR Part 20.311 will be made applicable by a license condition. The licensee will be allowed to accept waste only if it is accompanied by a manifest prepared according to 10 CFR Part 20.311. Based on the application, the NRC staff may consider, as part of the licensing process, exemptions from certain specific packaging, classification, and labeling requirements contained in 10 CFR Part 20.311, for land burial, that may not be germane to 11e.(2) byproduct material waste shipped to the facility. The staff will also require that more information be obtained from the generator on the chemical constituents than the "principle chemical form" as specified in 10 CFR Part 20.311(b) in order to address the data and groundwater protection requirements of Appendix A to 10 CFR Part 40.

- The general requirements of other Commission regulations: 10 CFR Part 19, "Notices, Instructions, and Reports to Workers: Inspections and Investigations;" 10 CFR Part 20, "Standards for Protection Against Radiation;" and 10 CFR Part 21, "Reporting of Defects and Noncompliance," will apply according to their terms.

Furthermore, in UMTRCA, Congress enacted measures to control the environmental hazards by placing long-term custodial care of the uranium or thorium mill tailings sites, after the completion of all reclamation activities, in the hands of the government. The state in which the tailings are located can assume the custodial role. If the state does not, the Federal government must take custody of the tailings. DOE is the Federal Agency currently designated as the "custodial agency;" although, the President can designate another Federal Agency to assume the custodial role. The custodial agency or the State will become a licensee, in perpetuity, of the NRC for the uranium mill tailings sites after completion of all reclamation activities to ensure that these tailings disposal areas are monitored and maintained.

The State of Utah has indicated that it does not intend to assume the long-term custodial role. As a result, DOE has indicated to the NRC that it will take title to this 11e.(2) disposal site upon termination of the Envirocare license if the State does not do so. DOE has also informed the NRC, on a related issue, that it would not object to NRC permitting licensees to dispose of low-activity source material in a 11e.(2) byproduct material disposal cell, as long as there would be no outstanding environmental compliance issues under any applicable environmental law (e.g., RCRA or under the Comprehensive Environmental Response, Compensation, and Liability Act). The applicant has not requested, and it is not expected that it will request, disposal of source material in the 11e.(2) disposal site. However, the NRC will require license conditions to ensure that potential compliance issues identified by DOE will not occur. The NRC does not want to create a situation in which DOE could object to taking title to the 11e.(2) site for these reasons.

1.4 Need for the Proposed Action

The need for the proposed action is to provide a secure disposal site for large-volume, low-radioactivity 11e.(2) byproduct wastes that would otherwise represent an environmental hazard through dispersal from their existing locations.

1.5 Results of Scoping Process

In accordance with 10 CFR Part 51.29 ("Scoping—Environmental Impact Statement") NRC utilized a scoping process to identify significant issues concerning this proposed project.

During the review of the applicant's ER, NRC staff identified major areas of concern that would require careful assessment in the subsequent EIS. The NRC also issued in the *Federal Register* (56 FR 25142; June 3, 1991), a notice of intent (NOI) to prepare an EIS on the license application.

NRC received 5 letters commenting on the scope of the EIS. These comment letters were reviewed for their contributions to the scope of the EIS, particularly to "the range of actions, alternatives, and impacts to be considered" in the EIS (40 CFR Part 1508.25). The issues raised in these scoping letters are provided in Appendix B. The staff has addressed each of the comments on the Envirocare license application in the appropriate sections of this EIS as noted. No comments were received suggesting disapproval of the license application.

1.6 Status of Reviews and Actions by Federal and State Agencies

The only regulatory action required from the NRC is the licensing decision on Envirocare's application to receive, store, and dispose of 11e.(2) byproduct material pursuant to the directions of the Commission as published in the *Federal Register* (56 FR 2959; January 25, 1991) and discussed in Section 1.3.3, above. In addition, before construction and operation can be completely implemented, the State of Utah requires that permits or licenses be obtained prior to the initiation of various stages of construction and operation of the disposal facility.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 Factors Considered in Selecting and Evaluating Disposal Sites

In this section, the staff has examined alternatives considered by the applicant, as well as alternatives considered by the U.S. Department of Energy (DOE) in its selection of the South Clive site for the disposal of the South Salt Lake, Utah, Vitro uranium mill tailings and associated wastes.

The applicant, in developing its Environmental Report (ER) (EUI 1992b), analyzed three disposal site locations in the State of Utah: the South Clive site, in Tooele County, Utah; the Skunk Ridge site, located northeast of the South Clive site, in Tooele County, Utah; and the Blanding site, located in San Juan County, Utah. In addition, the applicant considered disposal at a hypothetical existing mill tailings site located in the northeastern United States.

The applicant, in choosing its alternatives to the proposed action, on which to base a comparative evaluation, stated that it had not conducted the type of comprehensive search for alternative sites that was performed for the DOE Vitro selection. The applicant argued that it already had a State of Utah permitted facility at the South Clive site, and was not looking to establish a facility at a new location. It is only seeking to expand its existing facility at South Clive, Utah, to accept 11e.(2) byproduct material regulated by the U.S. Nuclear Regulatory Commission (NRC). The applicant indicated it has considered, but would not pursue, the construction or operation at sites other than at its South Clive site.

Based on the above position by the applicant, the staff concluded that the Environmental Impact Statement (EIS) for the disposal of 11e.(2) byproduct material should rely more heavily on the data and analysis prepared for the DOE (DOE 1984b) in its site selection of alternatives for the disposal of the Vitro uranium mill tailings than on the alternatives presented by the applicant in its ER. The DOE and State of Utah selection process for a uranium mill tailings disposal site was extensive and detailed. The staff believes that while the DOE Vitro Final Environmental Impact Statement (FEIS) was published in 1984, most of the data and analysis are valid for the proposed action.

The active search by the Federal government for alternative disposal sites for the Vitro uranium mill tailings began in 1975. Altogether, 29 potential sites or areas were initially considered for disposal of the Vitro uranium mill tailings in a study completed in 1976. The 29 sites were either nominated by state agencies, Federal agencies, private individuals, or chosen by government contractor on the basis of their knowledge of suitable areas within 240 km (150 mi) of Salt Lake City.

As discussed in the DOE Vitro FEIS, Utah's governor, in early 1980 directed the State Division of Environmental Health to recommend a final disposal site for the Vitro tailings. A committee of eight members, representing all pertinent Bureaus in the Division of Environmental Health and the Utah Geological and Mineral Office, was established to make the requisite studies and recommendations. The 29 sites were studied, and all but the three top-ranking candidates were eliminated. Eight new candidates were added, making a total of eleven sites. The Utah committee recommended a natural depression 13 km (8 mi) north of Clive (North Clive) in Tooele County, as a primary site for final disposal of the tailings at the Vitro site. As secondary sites, the committee recommended a site 1.6 km (1 mi) south of Clive (South Clive) and a site 4.8 km (3 mi) west of Delle (West Delle) in Tooele County, Utah.

In April 1981, a DOE contractor made an independent analysis of the three sites recommended by the State of Utah. At the conclusion of this evaluation, the DOE determined that the South Clive site was superior to the other areas proposed by the State. The relative ranking of the three sites, for seven environmental and geotechnical disciplines, with "1" being the best, are shown in Table 2.1.

In addition to the three sites that the State of Utah recommended as disposal sites in Tooele County, Utah, the DOE in its FEIS (DOE 1984b) also evaluated two additional sites in the State of Utah: a site in Carbon County, Utah; and a site in Grand County, Utah. DOE selected South Clive as the preferred site to dispose of the Vitro waste. In accordance with Appendix A to Subpart A of 10 CFR Part 51, NRC staff adopts Appendix B, "The Selection of an Off-Site Disposal Site," and Appendix C, "Alternatives That Were Considered But Rejected," of the DOE FEIS and concurs in this decision. These two Appendices from the DOE FEIS (DOE 1984b) are reproduced in this EIS as Appendix B.

Since the publication of the DOE FEIS, the following actions and alterations have occurred which enhance the South Clive site as a disposal site for 11e.(2) byproduct material:

- *Infrastructure*. As part of the activities to dispose of the Vitro material, DOE constructed features such

Table 2.1 Relative Ranking of the "Best" Three Sites

	Tooele County Sites		
Discipline	South Clive	North Clive	West Delle
Vegetation	2	1	3
Wildlife	1	2	3
Soils and reclamation	2	3	1
Hydrology and water quality	1	2	3
Meteorology and air quality	1	2	3
Human resources	1	3	2
Geotechnical engineering	1	3	2
Composite score (lower is better)	9	16	17

as a railroad spur to the site and a railroad car turnover facility and brought utilities to the site. The applicant has maintained and improved upon these infrastructure features. The State of Utah has improved the access to the site from Interstate 80.

- *Existing radioactive waste disposal*. Within the land section containing the proposed South Clive 11e.(2) byproduct material site, are uranium mill tailings from the Vitro site and low-level and naturally-occurring and accelerator-produced material wastes that Envirocare is disposing under license from the State of Utah. Thus, use of this site for disposal of 11e.(2) byproduct material would not result in introduction of radioactive material to an otherwise pristine site.

- *Operating radioactive waste disposal facilities*. By virtue of the operation of Envirocare's other radioactive disposal facilities, the South Clive site already contains most of the structures (such as offices and laboratories) and facilities (such as fences, roads and utilities) needed to operate an 11e.(2) byproduct material disposal facility. Such structures and facilities would have to be constructed at a pristine site.

Based on the above considerations, the NRC staff has concluded that the South Clive site is the preferred alternative site for disposal of 11e.(2) byproduct material within the State of Utah. Alternative sites outside the State of Utah are not considered in this document since the NRC staff considers that they would not represent reasonable alternatives. The applicant has stated that it would not pursue construction or operation of an 11e.(2) byproduct material disposal facility at other sites. Therefore, such alternate sites are tantamount to the "no action" alternative and need not be further considered.

2.2 Alternatives

Four alternatives were selected and evaluated by the applicant with respect to their potential environmental impacts from the construction, operation, and closure of an 11e.(2) byproduct material disposal facility. The four alternatives fall into three classes: two different design scenarios that involve granting a license for disposal at the South Clive site; a site alternative, which considers in general terms a different arid western site; and a no-action alternative.

A site in the arid west is preferable to other areas of the United States because (1) the major pathway for radioactive contamination is through water sources, which are less prevalent in the arid west; (2) the lower population density of remote regions in the arid west poses a lower risk to residents than would be present in more densely populated areas; and (3) the lower density of certain wildlife species in the arid west presents a lower risk of disturbance to native wildlife.

The applicant has provided an estimate of the 11e.(2) byproduct material characteristics in the ER (EUI 1992b). The waste is expected to contain three predominant radionuclides: ^{230}Th, ^{232}Th, and ^{226}Ra. Additional compositional details can be found in Section 5.2.8.4.

The generation point of the 11e.(2) waste is currently not known. However, most rail and truck shipments that now arrive at the existing South Clive facility have minimal travel time through populated areas. All waste that is shipped to South Clive must be properly packaged in accordance with the U.S. Department of Transportation

(DOT) standards for the respective waste. This has proven to minimize the concern of citizens along the transportation routes.

2.2.1 Alternative 1—Disposal at the South Clive Site in an Above-Ground Embankment.

For Alternative 1, 11e.(2) byproduct waste would be transported by either train or truck to the South Clive site. The design for the disposal embankment for this alternative is based on a modified version of the embankment DOE used to dispose of 1.91 X 10^6 m^3 (2.5 X 10^6 yd^3) of uranium mill tailings material from the Vitro Chemical Company site in Salt Lake City, Utah, at the South Clive site. The DOE Vitro cell encompasses approximately 40 ha (100 acres) of a section of land [a section contains 259 ha (640 acres)] originally owned by the State of Utah. The remainder of this section, 219 ha (540 acres), is now private land owned by the applicant.

Upon receipt of 11e.(2) byproduct waste, disposal would proceed in the following manner on the 44.5 ha (110 acres) of the site:

(1) Existing terrain would be excavated to a depth of about 2.4 m (8 ft), stockpiling the excavated overburden for future capping of the embankment.

(2) A 60-cm (2-ft) clay liner would be placed under all areas to receive waste, consisting of 30 cm (1 ft) of scarified and recompacted in situ material and 30 cm (1 ft) of compacted processed clay. This liner would provide a seepage liner/retardant for the bottom and sides of the excavation. The bottom of the clay liner would be approximately 3 m (10 ft) above the local groundwater level.

(3) The 11e.(2) byproduct waste would be placed in the lined excavation in layers and compacted in place to a maximum height of 11 m (37 ft) above original ground elevation.

(4) After reaching the maximum height of compacted waste, a 2 m (7 ft) thick layer of compacted overburden material (previously stockpiled) would be placed on top of the waste to form a radon barrier.

(5) A barrier, consisting of a 15-cm (6-in.) filter zone of small-diameter rock and a 45-cm (1.5-ft) erosion protection layer of larger specification-sized rock, would be placed over the embankment.

Once the site preparations have been completed, the following sequence would be followed during disposal operations:

(1) acceptance of waste at the facility,

(2) disposal of waste in the embankment,

(3) covering of waste with clay material, and

(4) final cover with a rock erosion barrier.

It is anticipated that the operational activities would last for approximately 20 years.

After the embankment(s) is filled and covered, the area would be restored by removal of the railroad spurs and by filling in excavated areas to restore the natural grade. The restored surrounding areas would be revegetated except for the rock-covered mound(s) proper, and a permanent fence would be installed around the embankment(s).

2.2.2 Alternative 2—Disposal at the South Clive Site in a Below-Ground Embankment

This alternative would place the embankment entirely below grade, with the bottom of the clay liner for the excavation at an elevation of about 1300 m (4255 ft), or about 5 m (17 ft) below the land surface. The below-grade design would entail a deeper excavation than Alternative 1, and the surface of the site would be returned to the original ground level. Erosion control would be much simpler with an original ground level final configuration. This alternative would locate the bottom of the embankment within 1.5 m (5 ft) of the highest measured level of the water table. Alternative 2 would hold less waste and have a lower disposal rate per unit of land area than Alternative 1. No detailed design has been made for this alternative.

Once the site preparations have been completed, the same sequence would be followed as with Alternative 1. It is anticipated that the operational activities would last for approximately 20 years.

The below-grade design provides the following benefits: (1) no rock required for cover, (2) no drainage ditches would be required, and (3) overall waste isolation might be improved. While the below-grade design (Alternative 2) is viable, it is not preferred over Alternative 1 for two reasons: (1) the design places the wastes closer to the water table and any leached material could reach the groundwater sooner than for Alternative 1, and (2) the Alternative 2 design requires a greater amount of acreage to dispose of the same volume of waste, increasing unit costs and land requirements.

2.2.3 Alternative 3—Disposal at the Skunk Ridge Site, Located Northeast of the South Clive Site, in Tooele County, Utah

An alternate site has been considered in Tooele County, Utah, known as Skunk Ridge (EUI 1992b). The selected location is Section 4, Township 1 North, Range 9 West, SLM, on public land administered by the Bureau of Land Management (BLM). The availability of the land was not investigated by the applicant. This location is about 29 km (18 mi) northeast of the South Clive site and the characteristics of the sites are similar.

The Skunk Ridge site is situated in a small flat valley halfway between a low ridge (Skunk Ridge) 2.4 km (1.5 mi) to the west and the Lakeside Mountains, which rise about 215 m (700 ft) above the valley floor, 2.4 km (1.5 mi) to the east. The site is not within the West Desert Hazardous Industry area. There are no existing facilities at the site.

For this alternative, the site would need to be prepared, the material would be transported from locations throughout the United States, and closure and long-term surveillance would be similar to those described for Alternative 1. The potential environmental impact from construction and operation at the Skunk Ridge site would differ to some extent from Alternative 1, since the soils, groundwater, and topography may require a different containment cell design.

Once the site preparations have been completed, the following sequence would be followed during disposal operations:

(1) acceptance of waste at the facility,

(2) disposal of waste in the cell,

(3) covering of waste with clay material radon barrier, and

(4) final cover with a rock erosion barrier.

It is anticipated that the operational activities would last for approximately 20 years.

The groundwater at the Skunk Ridge site is slightly saline, although potable, and estimated to be at a depth of 69 to 128 m (225 to 420 ft), based on an existing pumping well within 1.6 km (1 mi) of the site. At Skunk Ridge, any leakage through the cell liner would cause leaching of 11e.(2) byproduct waste material from the site toward and possibly into an aquifer that is producing a usable water supply.

2.2.4 Alternative 4—No Action

This alternative is a decision for no new licensing at the South Clive site for an 11e.(2) byproduct material disposal facility.

In terms of the potential environmental impacts at the South Clive facility, Alternative 4 would not be significantly different on the site than Alternative 1 because Envirocare currently operates a facility that accepts wastes similar to 11e.(2) byproduct material in composition and radioactivity. A no-action decision by the NRC would not affect the existing licenses and permits. The differences would be in the classification of material accepted at the site, and possibly in the annual volumes and in how the waste streams were generated. A no action decision would mean that candidate material would be disposed of at its current locations, at licensed Title II uranium mill sites, or at some other 11e.(2) byproduct material disposal facility yet to be licensed or built.

Alternative 4 would occur if the requested license is not granted. This alternative would be a continuation of the current operations of the South Clive site. Because Envirocare's existing permits allow for the disposal of radioactive materials that are very similar to 11e.(2) byproduct materials and the proposed disposal methods are very similar to the existing disposal methods, the potential environmental impacts at the South Clive facility under Alternative 4 would be similar to those under Alternative 1.

The applicant's current operation is limited by the capacity of its material-handling facilities and by an overall annual limit on the amount of material that can be accepted at the low-activity facility. Even though granting the license would increase the overall annual limit of material to be received by Envirocare, the final amount of material would be determined by the amount contracted for disposal, the site capacity, and the material-handling facilities.

2.3 The Applicant's Proposed Plan (Alternative 1)

2.3.1 Description of Facility

The construction drawings [found in Appendix O of the Environmental Report (EUI 1992b)] detail the anticipated layout of the site with disposal cells, staging area, office area(s), train track, train car rollover, fences, boundaries, buffer area, and ditches. The construction drawings also include the site topography. Figure 2.1 shows a plan view of the site features.

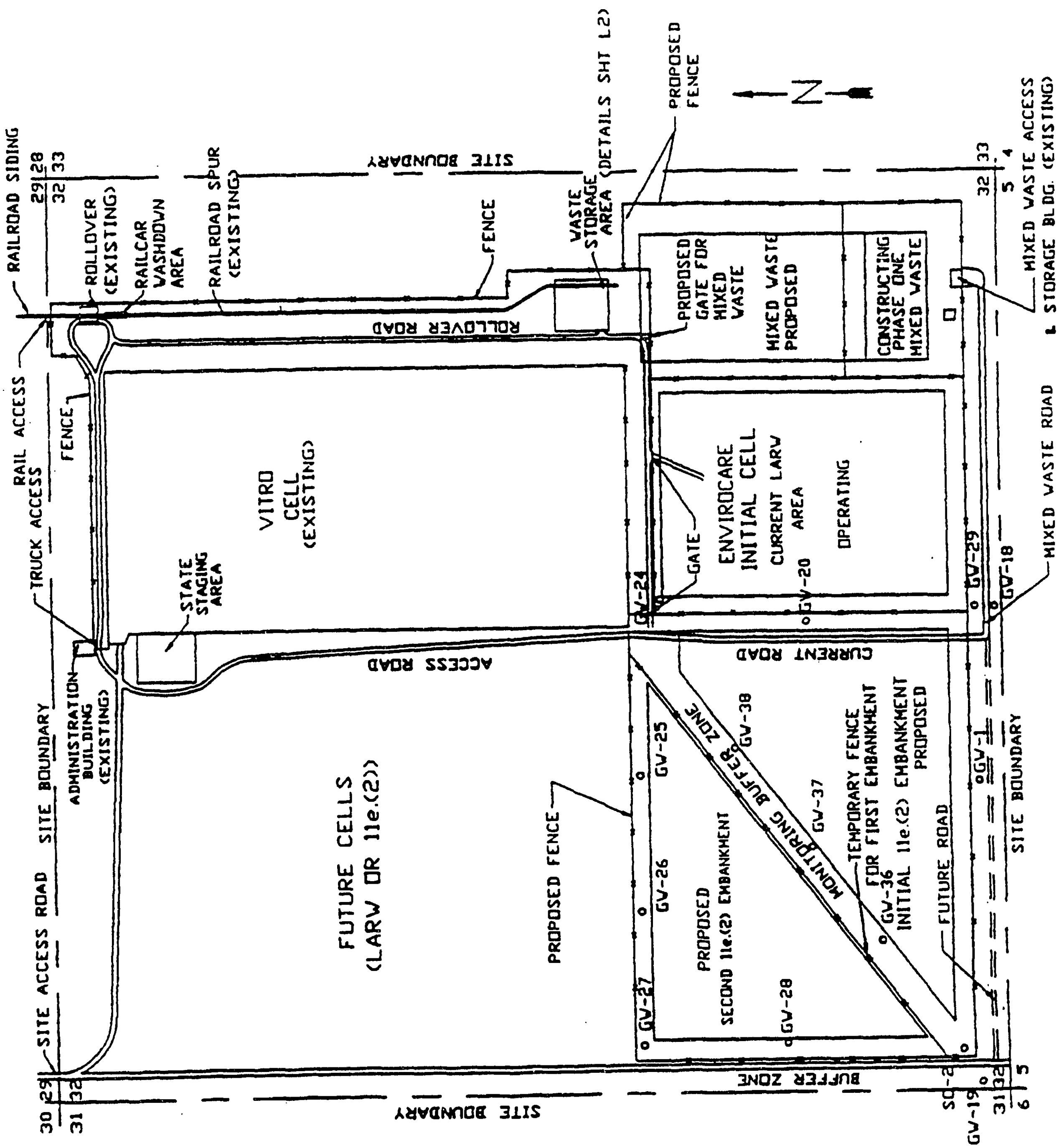


Figure 2.1 Plan View of Envirocare Site

2.3.2 Principal Features

2.3.2.1 Restricted Areas

All areas utilized for 11e.(2) byproduct material receiving, unloading, hauling/handling, and placement in the embankment will be considered a restricted-access (or controlled) area. As such, any person entering the controlled area must check in and out through the restricted-area access portal in the administration building or through the main truck/vehicle entrance gate. Figure 2.1 shows the controlled-area boundaries.

Additionally, frisking will be required for persons leaving the controlled area. Radiation exposure to persons working within the controlled area will be monitored using monitoring film badges to measure exposure.

Figure 2.1 shows the fence that will be constructed around the restricted area perimeter. The fence will be conspicuously posted with signs which read "Caution—Radioactive Materials".

2.3.2.2 Site Boundary and Buffer Zone

The property to be used in this disposal project is owned by Envirocare and encompasses most of Section 32 of Township 1S, Range 11W. With the exception of approximately 40 ha (100 acres) that were used for the Vitro Remedial Action project, all of the section is owned by Envirocare.

The entire area will not be fenced at the outset of the proposed disposal activities. However, all controlled areas will be fenced. Upon final closure of a disposal cell or embankment, that cell will be fenced and posted, leaving a minimum of 24 m (80 ft) as a buffer zone between the edge of the embankment and the fence. This will provide space inside of the fence for an inspection roadway and for sample collection from monitoring wells located within the fence.

A buffer zone of 91 m (300 ft) will be maintained between the closest edge of any embankment and the outside site boundary or property line. A buffer zone of 30 m (100 ft) will be maintained between the closest edge of any embankment and the Vitro (DOE) site fence.

2.3.2.3 Utility Supplies and Systems

Utilities at South Clive are somewhat limited, due to the remoteness of the site. Potable water must be brought in from other locations, such as Grantsville. Site personnel, temporary workers, and visitors will use the restroom facilities available at the Clive administration building, the storage building, and the security trailer. Showers are also provided in these facilities. Gray water from showers, mop drain, and hand washing sinks will be collected and piped to tanks. This water will be applied as dust suppressant to the disposed 11e.(2) byproduct material or to the adjacent LARW cell or will be placed in the evaporative tanks. Any sludge in the evaporative tanks will be properly disposed of.

The site has a power line for the administration building, trailers, monitoring stations, and yard lights. Cellular telephones with Salt Lake City-based numbers and long-distance capability are used at the site for off-site communication.

2.3.2.4 Disposal Units

The details for design and construction of these cells can be found in Section 2.3.3 below. The site layout can be found in the construction drawings. These drawings will be updated and submitted to the NRC and Utah Division of Radiation Control semi-annually.

2.3.2.5 Covers

The embankment cover design includes key features that will contribute to water resources protection at the disposal site, after the facility closure. The embankment cover consists of a 2-m (7-ft) thick radon cover, a 15-cm (6-in.) filter zone, and an 45-cm (18-in.) thick, graded-rock cover for protection against erosion. The radon cover is designed to minimize the infiltration of precipitation and runoff water into the cell and reduce the emanation of radon. The filter zone is intended to trap dew and condensation, thereby reducing the potential for drying of the clay in the radon cover. The rock cover is intended to protect the integrity of the radon cover and the disposal cell by providing protection against water and wind erosion.

The clay cover material to be used for the radon barrier will be excavated from the cell area before placing waste. Soil in that area has been shown [see Appendix S of the Environmental Report (EUI 1992b)] to contain less than 0.074 Bq/g (2 pCi/g) of ^{226}Ra. Rock selected for the erosion barrier will not exceed that concentration. Therefore, the cover will not contribute to radon exhalation at a rate greater than normal background in the area.

Section 2.3.3 below describes the cover design, thickness, materials, slopes, and other aspects for the radon and erosion barriers for the 11e.(2) byproduct material disposal site. Figure 2.2 illustrates these features.

2.3.2.6 Support Facilities

With the exception of potable water, electricity, and fuel for equipment, all of which must be brought in to the site, the disposal facility operations will be self-supporting. The disposal material, of course, must also be transported to the site via railroad or truck.

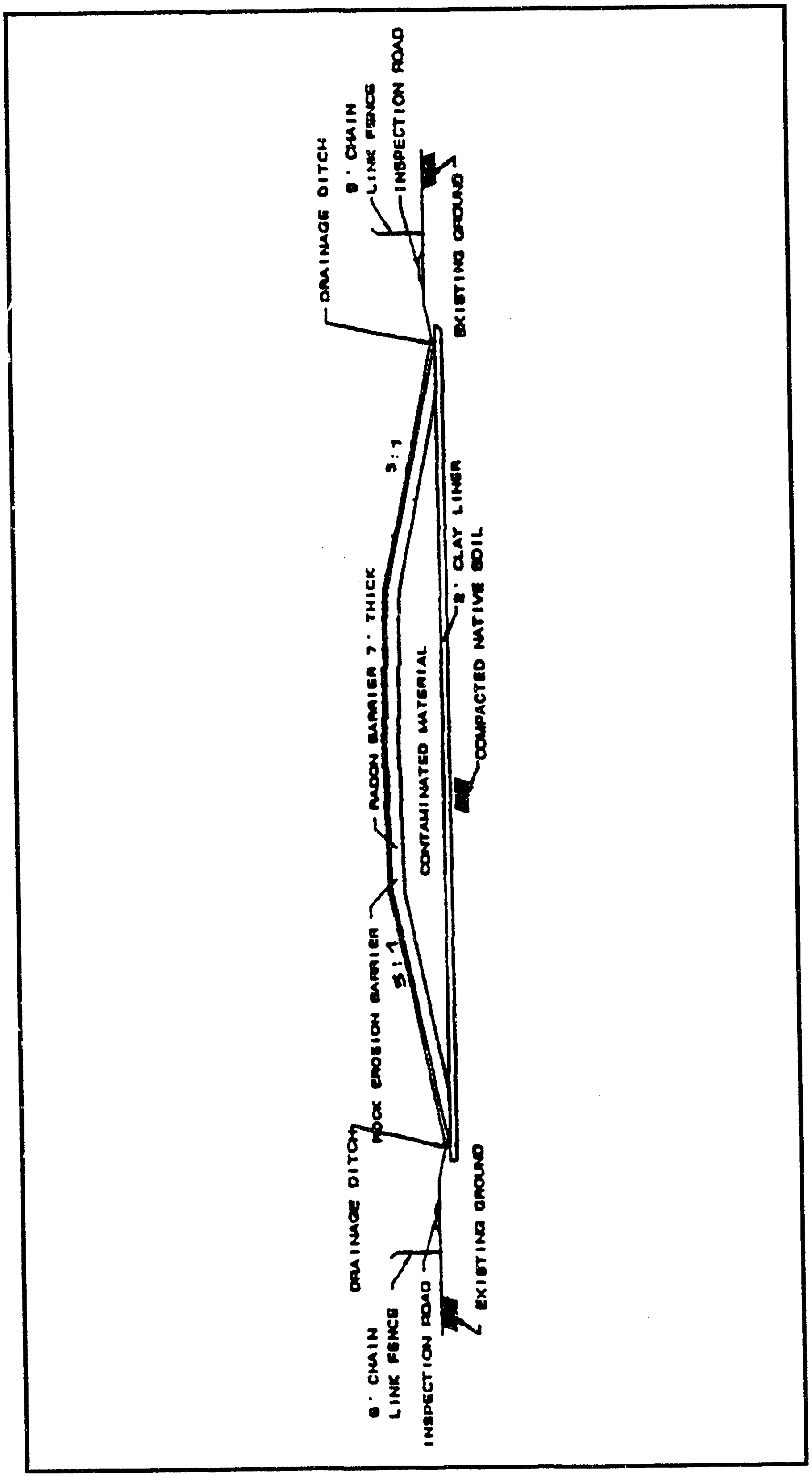


Figure 2.2 Envirocare Cross-Section of the Embankment

Administration Buildings. The Clive Administration Building will house the site administrative offices, laboratories, change/locker rooms, showers, and lunch room and will be used as access control.

Envirocare's 560 m^2 (6,000 ft^2) metal storage building will be used for waste and equipment storage and for an indoor washdown facility.

The Clive Administration Building and Storage Building are shown on the construction drawings and Figure 2.1.

Storage and Waste Handling Area. All radioactive disposal material will remain within the controlled/restricted area. Figure 2.1 shows the location of the disposal cell(s), staging area(s), office area(s), train track, rail car rollover, fences, buffer area, decontamination area, ditches, etc.

Decontamination Areas. The procedures for decontamination and release of equipment and vehicles exiting the controlled area include the removal of all contaminated materials by use of shovels, spray washers, brooms, and other decontamination devices. All decontamination areas are shown on construction drawings.

The Department of Transportation (DOT) regulations for removable contamination and gamma doses for transportation containers are codified in 49 CFR Part 173. The State of Utah also has decontamination requirements that are, in some cases, more stringent than DOT's. Prior to exiting the site, trucks and rail cars used in transportation of disposal material will be radiologically surveyed and decontaminated to satisfy the applicable regulations.

Physical Security. Except where another structure (e.g., a building or a gate) is in place to provide security, the controlled area will be enclosed with a 1.8-m (6-ft) chain-link fence to prevent intrusion by unauthorized persons and/or large animals. The fence will be posted at regular intervals with "Caution—Radioactive Material" signs.

Equipment and Equipment Storage. The equipment to be used in the disposal operation is common heavy equipment that can be found on any earth-moving construction site (i.e., bulldozers, scrapers, front-end loaders, graders, compactors, and water trucks). This construction equipment will be used for preparation of the excavation to contain the disposal material, handling the material after it has been dumped at the rollover, transporting the material to the disposal cell, spreading it in the embankment, and constructing the radon and erosion barriers upon completion of the embankment.

The only specialized piece of equipment unique to this operation is the railcar rollover, designed to clamp down on top of railcars and rotate them 180 degrees to dump their contents.

A portion of the metal building will be available for equipment storage when necessary. However, normal operations of construction activities allow this type of equipment to remain out of doors during all weather conditions.

Excavated Materials Area. The size of the cut and fill is shown in the construction drawings. Table 2.2 is a summary of the quantities estimated from the initial phase of operations.

Excavated overburden from the first of the embankment will be stockpiled in the general area of the planned last section of that embankment. It will be used upon completion of the embankment to construct the compacted radon barrier for that last section.

Table 2.2 Material Volumes—Construction of 11e.(2) Cell

Item Description	Quantity (cubic yards, yd^3)
Excavation	
Excavation of Cell	500,000
Excavation for Perimeter Ditches	18,000
Contaminants	1,600,000
Cover	
Radon barrier soil (silty sand)	450,000
Erosion barrier, ditches and perimeter road (pit run rock)	180,000

Note: 1 yd^3 = 0.765 m^3

The excavated topsoil has a very high clay content which forms a very hard, crusty surface that is highly resistant to wind erosion when sprayed with water. The excavated material may be in that stockpile for a period of 5 to 10 years before it is used for embankment cover. As such, it will also be exposed to the rain, infrequent though it may be, which will help create this crust on the surface.At the end of the project no excess material is anticipated, due to embankment design, and no potential effects in the immediate vicinity of the overburden storage are foreseen.

Overburden and topsoil stockpiles will be protected from erosion by chemical suppressants if required.

An Air Quality Permit has been obtained from the Bureau of Air Quality, Utah Department of Health. Included in the potential sources of fugitive dust was a category "Storage Piles, Cover Material," encompassing 0.9 ha (2.3 acres), with a total projected fugitive dust emission rate of 6,570 kg/yr (7.24 tons/yr).

2.3.2.7 Site Utilization Plan

The construction drawings show the proposed layout of the site and the planned sequence of development for disposal cells.

2.3.2.8 Erosion and Flood Control Plan

Section 2.3.3 describes the principal design features built into the project, including surface features that have been designed to direct surface drainage away from disposal units, embankment design, peak flood flows, depths of flow, velocities, rainfall intensity, infiltration rates, and times of concentration.

Surface Water Control Features. The Envirocare site receives less than 15 cm (6 in.) per year of precipitation. Most of the precipitation in the Great Salt Lake Desert is lost by evapotranspiration or temporarily stored as soil moisture. Some precipitation runs off the steep consolidated-rock slopes of the mountains. However, very little of this runoff reaches the base of the mountains because it infiltrates the alluvial stream channels downslope from the consolidated-rock slopes (Stephens 1974).

As stated in the Vitro EIS (DOE 1984b), there are no perennial water bodies within 45 km (28 mi) of the South Clive site. The Vitro EIS also states the following:

> "No surface-water bodies are present on the South Clive site. The nearest stream channel ends about 3 km (2 mi) east of the site and is typical of all drainages along the transportation corridors within about 32 km (20 mi) of the South Clive site. Stream flows from higher elevations usually evaporate and infiltrate into the ground before reaching lower, flatter land. The stream channels are well defined in their upper reaches, but as they approach the flatlands the size of the channel reduces until there is no evidence of a stream."

The South Clive facility is located at approximately 1300 m (4270 ft) above sea level. The elevation of the Great Salt Lake is not expected to exceed 1285 m (4217 ft). This shows that the Envirocare facility will stay at least 15 m (50 ft) above the elevation of the Great Salt Lake and will not be affected by any flooding from the Great Salt Lake (EUI 1992b).

The South Clive site is not within a 100-year floodplain (EUI 1992b). Information related to 100-year floodplain areas is provided in a U.S. Environmental Protection Agency (EPA) guidance manual on hazardous waste treatment, storage, and disposal facility location standards (EPA–530–SW–85–024). The manual lists flood-prone locations and conditions likely to exist in a 100-year floodplain, including:

- areas protected by flood control structures (i.e., areas below dams or behind flood or tide dikes);
- coastal high hazard areas (i.e., barrier islands, eroding shorelines, wind and lunar tide zones);
- channel encroachment areas (i.e., areas subjected to erosion as a stream channel migrates); or
- wetlands (generally associated with bodies of water).

Even though the South Clive site is not in the 100-year floodplain, several major design items have been included to protect against flooding. These structures are identified in Section 2.3.3.

Appendix F of the Environmental Report (EUI 1992b) discusses the flow rates produced during severe rainfall and flooding events, and presents the rock-sizing analysis used to size the rock to be used on the embankment. Appendix F also presents additional calculations that were performed by Envirocare to assure that the addition of the Envirocare facility would not affect the previous flooding analysis by DOE for the Vitro disposal site at South Clive (DOE 1984b).

During the construction of the embankments, a perimeter berm will be constructed around the site to prevent any off-site run-on. This berm is described in Section 2.3.3.

Precipitation runoff from uncompleted portions of the embankment will be diverted and caught in the excavated, but unfilled, portion of the cell which precedes the compacted disposal material. The perimeter berm will be constructed as shown on the design drawings. The design of the berm is discussed in Section 2.3.3. Construction of the initial berm will take place during the excavation of the cell area before any contaminated material is brought to the cell. As the site is expanded, the outermost berm will be constructed before the original berm is removed. This will assure that a properly constructed berm is always in place around the facility.After the final rock layer has been placed on the embankment, the perimeter berm will be removed and replaced by the perimeter ditch. The perimeter ditch is also shown on the design drawings. The ditch is a "V" ditch which is 1.2 m (4 ft) in depth and 12 m (40 ft) wide.

The 11e.(2) byproduct material disposal cell will be protected by a surface water drainage system after completion of the cells. Drainage systems designed into the disposal site will ensure long-term stability. Ditches around the base of the embankment(s) will intercept runoff from the embankment and direct the flow into the natural drainage patterns west of the site. The ditches are described in Section 2.3.3.

2.3.2.9 Other Features

Intruder Barriers. The entire working area(s) of the project will be fenced to ensure intruders do not gain access to the site inadvertently. The fences will be posted with appropriate warning signs, and all entrances into the work areas will be locked or guarded by personnel when unlocked. All fences will be chain link. Fencing will be built with posts cemented in concrete and will be topped with three strands of barbed wire. Appendix X of the Environmental Report (EUI 1992b) contains the details of the Site Security Plan.

Intrusion by large animals, such as grazing sheep or cattle, will be eliminated by the fence(s). The 60-cm (2-ft) thick erosion barrier will severely limit, if not eliminate, intrusion and burrowing by small animals.

Markers/Boundaries and Markers/Survey Program. The final site boundary markers are the USGS quadrant "brasscap" markers, which provide adequate documentation of the exact location of the disposal site(s).

All disposal cells will be surveyed in by qualified engineering contractors, and their exact location will be documented. All locations will be tied into the U.S. Geological Survey (USGS) survey control stations.

Final markers will also be placed at the head and toe of each completed embankment.

2.3.3 Principal Design Features

This section describes the principal design features of the South Clive disposal facility that provide long-term isolation of disposed waste, minimize the need for continued active maintenance after site closure, and improve the site's natural characteristics in order to protect public health and safety.

The material for disposal will be placed into one of the two disposal cells or embankments constructed largely above grade. Figure 2.2 shows a typical cross-section of the embankment.

The principal objective of the embankment design is to provide control measures which meet EPA standards and the requirements of the NRC. These standards include specific limitations on the release of all contamination. To comply with the requirements for long-term stabilization, Envirocare has designed the facilities to effectively control any radioactive release for up to 1,000 years.

The environment, site personnel, and the public will be protected from unsafe levels of radiation throughout the site operational period and final site closure. Assurance of long-term stabilization of the site through erosion control and flood protection will be provided. Refer to Appendix A of the Environmental Report (EUI 1992b) for a detailed safety analysis.

The radiation controlled areas of the site will be fenced both during construction and after operation to prevent public access. Additionally, site custodial maintenance and surveillance will be performed to assure continued long-term compliance requirements of 10 CFR Part 61 Subpart C, 10 CFR Part 61.52(a)(7)–(10), 10 CFR Part 61.53(d), 40 CFR Part 192.32(b) and 40 CFR Part 192.41 are met.

The 11e.(2) byproduct material disposal embankment will be constructed in a continuous "cut and cover" operation as described below:

(1) Existing terrain will be excavated to a depth of approximately 2.4 m (8 ft) below ground level with the overburden stockpiled for the future use of capping the embankment.

(2) After the overburden is removed, a 60-cm (2-ft) clay liner will be constructed under all areas where waste material is to be placed. The clay liner will consist of 30 cm (1 ft) of in situ clay which is scarified and recompacted and 30 cm (1 ft) of processed, compacted clay. The clay in the liner will be compacted to 95% of maximum dry density as determined by the Standard Proctor Method (ASTM D-698). The clay liner will provide a seepage liner/retardant on the bottom of the embankment.

(3) The material for disposal will be placed on the liner and compacted in place to a maximum height of 11 m (37 ft) (above original ground elevation).

(4) When the embankment is filled to the maximum height, a 2-m (7-ft) thick layer of silty clay material (the overburden, mentioned in Item 1 above, which has been excavated from an area of cell construction) will be placed on top and compacted to form a radon barrier.

(5) An erosion barrier consisting of a 45-cm (1.5-ft) thick layer of specification-sized rock will cover the entire 15-cm (6-in.) filter zone of small diameter rock, which will underlay the rock erosion barrier.

All construction will be done in accordance with Envirocare's Construction Quality Assurance/Quality Control Plan (CQA/QC) (EUI 1992b).

2.3.3.1 Water

Infiltration. Water Infiltration was studied in detail in Envirocare's Groundwater Flow Model, which is described in Appendices M and P of the Environmental Report (EUI 1992b). Several detailed models were run and described in these Appendices. The models include both unsaturated and saturated flow modeling.

The models indicate that the amount of precipitation that infiltrates the embankment and percolates to the shallow groundwater under existing conditions, is generally very small. These results are consistent with the studies that were performed by the DOE on the same issue which stated that the infiltration amount was negligible (DOE 1984b).

The staff believes that the final cover system will be less permeable than the present ground due to compaction during construction. This cover system, in a climate of low-average annual precipitation of 15 cm (6 in.), will result in very little infiltration into the disposal materials, the underlying natural ground, or the groundwater.

Contact with Standing Water. There is no surface water on the site, nor in the vicinity of the site. The low annual precipitation in this desert area makes it unlikely that a condition creating "standing water" will occur.

Site Drainage. The drainage system consisting of ditches around the perimeter of the embankment, along with general site grading, is shown on the construction drawings in the Environmental Report (EUI 1992b).

The 100-year, 1-hour storm event will result in a peak flow of approximately 0.9 m^3/s (32 ft^3/s) in the embankment perimeter ditch at the South Clive site. A flow depth of approximately 60 cm (2 ft) and a flow velocity of approximately 45 cm/s (1.5 ft/s) was calculated. Thus, a ditch depth of 90 cm (3 ft) will provide 30 cm (1 ft) of freeboard. Larger flows due to a probable maximum flood (PMF) will not be contained within the ditches; however, erosion will not occur since the ditches are designed for flow velocities produced by a PMF.

The probable maximum precipitation (PMP) rainfall intensity on the embankment of about 1.3 m/hr (50 in./hr) for a 5-minute duration will provide a peak sheet flow rate of 0.074 m^3/s per m (0.8 cfs per ft) for the embankment slope. This flow rate was used in the design of the riprap erosion protection for the embankment cover system (EUI 1992a).

2.3.3.2 Radon Barrier

The compacted, clay layer will act as a radon barrier for the 11e.(2) byproduct material embankment. The compaction of the clay will produce a soil barrier that retards radon gas from leaving the cell and also protects the disposal material from receiving significant amounts of moisture. The rock cover will reduce the potential for drying of the compacted clay by trapping dew and condensation.

The material excavated will be placed on top of the final compacted lift of the tailings to a depth of 2 m (7 ft) or as directed to form a radon barrier (Figure 2.2).

The radon barrier material will be placed in layers not exceeding 30 cm (12 in.) (uncompacted depth) and will be compacted before the next layer is placed. Each lift will be compacted to not less than 95% of maximum dry density as determined by the Standard Proctor Method (ASTM D-698).

At the time of compaction, the moisture content of the material will be at plus or minus 3% of optimum moisture content as determined by the Standard Proctor Method (ASTM D-698). The radon barrier will be constructed in a manner that it will be well drained at all times.

Whenever the site is covered with snow of sufficient depth to impair construction of the radon barrier, snow will be removed to beyond the limits of active construction. Where any material is frozen, the contractor will remove the frozen material before any compacted layers are placed. Severe cold weather will curtail or shut down the disposal operation.

The radon barrier density will be tested by the sand cone method only, at a minimum of one test for every 380 m3 (500 yd^3) of radon barrier material placed. At least one test will be taken on each lift in each area of construction [i.e., the Envirocare radon barrier will be placed in phases (areas) and each lift must be tested in every area as it is constructed]. A compaction test will be performed for every full shift of compaction operation. It should be noted that this is a minimum number of tests and that, in most situations, more tests will be taken. A test may also be taken whenever the inspector or site engineer feels it would be beneficial.

2.3.3.3 Erosion Barrier

To protect the embankment from the effects of water erosion, the embankment slopes will be limited to 20%. The top of the embankment will be convex with gentle (2% or less) slopes to promote drainage.

To ensure that the embankments will withstand water erosion during the design life, the surfaces of the radon barrier will be graded, the corners rounded, and the entire embankment radon barrier will be covered with a rock erosion barrier.

Over the design life, the embankment cover may be subjected to severe rainfall events. The most severe potential rainfall event is a PMP event which would have a peak 5-minute intensity of approximately 1.3 m/hr (50 in./hr) on the embankment. To protect against the erosive effects of a PMP, the side slopes of the embankment will be covered with a 60-cm (2-ft) thick layer of properly graded rock as a barrier. The rainfall rates for the PMP were developed using National Weather Service techniques (Hansen, et al. 1977) and NRC guidelines (NRC 1983) and are discussed in Appendix E of the Environmental Report (EUI 1992b).

As a result of the long, open reach in the South Clive area, wind velocities at the site must be considered. The rock layer used to protect against water erosion would also provide protection against wind erosion.

Rock which meets the gradation and durability requirements of the technical specifications will be placed on top of the embankments as an erosion barrier. The top of the embankment will be covered with rock with a 4-cm (1.5-in.) mean diameter, and the side slopes will have a covering with a mean diameter of at least 11 cm (4.5 in.). Underlying both top and side slope layers will be a 15-cm (6-in.) thick filter zone of rocks having a mean diameter of approximately 2 cm (0.75 in.). The filter zone also protects the radon barrier from deep penetration by the larger diameter rock used for the outer cover.

The rock layer will also discourage plant root intrusions and burrowing animals.

2.3.3.4 Site Drainage Control

The drainage of the South Clive embankment area, along with general site grading, will ensure long-term stability. Drainage ditches around the base of the embankment will direct the flow into the natural drainage patterns west of the site. The ditches will have triangular cross sections with side slopes of 1 vertical to 5 horizontal.

The ditches will have gentle slopes and depths great enough to carry the runoff from the 100-year, 1-hour storm event as discussed above. Rock erosion protection in the ditches will prevent damage to the ditches and the embankment cover. Outer slopes of the access road adjacent to the embankment will be covered with a rock erosion protection layer in order to prevent the formation of gullies that could head cut into the embankment.

The construction drawings show the cross-section of the ditches and roadway designed for the two embankments.

2.3.3.5 Disposal Unit Cover Integrity

Envirocare's final embankment cover has been designed to meet the requirements of Appendix A to 10 CFR Part 40. These criteria require that containment and protection be provided for up to 1,000 years to the extent practicable, but in any event for 200 years. This protection is achieved by the placement of a properly sized riprap layer consisting of rock of sufficient durability to remain effective for long periods of time.

2.3.3.6 Structural Stability

Appendix J of the Environmental Report (EUI 1992b) provides the data and calculations which were used in evaluating the slope stability and liquefaction potential for the Vitro embankment. It was concluded that "due to the short- and long-term unsaturated embankment conditions, the dense nature of the granular site soils, and a depth to groundwater in excess of 7.6 m (25 ft) below existing grade, liquefaction in the embankment or foundation soils will not occur at the site due to Maximum Credible Earthquake acceleration."

2.3.3.7 Site Closure and Stabilization

Long-term stability, monitoring, and site surveillance are required pursuant to 10 CFR Part 40. Long-term monitoring and site surveillance costs have been estimated, including closure and remediation costs, and will be placed in trust by Envirocare to cover the costs, as they occur. These costs, and the amount in trust, will be adjusted annually to account for inflation and other additional costs. This surety will be required by a condition in the license.

Site closure and stabilization will include the decontamination and decommissioning of the entire site. This will include the removal of all facilities, including roads, rail spurs, rail car rollover, storage pads, wash pads, and administrative buildings. Any material that does not meet the standards for unrestricted release will be placed into the embankment. Closure will also entail decontaminating the site; these materials will be included in the embankment. Site remediation will be performed on the decontaminated and decommissioned areas.

2.3.3.8 Long-Term Maintenance

The design of the embankment provides for minimal long-term maintenance. In addition, the 60-cm (2-ft) thick rock erosion barrier provides adequate protection to ensure design performance of the radon barrier.

2.3.3.9 Construction Considerations

Site Preparation. A construction staging area, site drainage system, access roads, and other such facilities have been constructed for the current operation.

Any existing wells located in areas to be used for the embankment(s) will be backfilled using cement, grout, or other appropriate materials by qualified water-well drilling contractors in accordance with applicable state statutes.

Control and Diversion of Water. Due to the lack of significant precipitation and the total lack of surface water systems in the project area, it is highly unlikely that the control of surface water in the proposed excavation and/or fill area would be a significant problem. However, a small berm will be sequentially constructed to protect off-site release of contaminated runoff.

The existing water table is a minimum of 3 m (10 ft) below the bottom of the embankment. Table 2.3 shows the ground-water elevations of 13 test wells on the site taken during the period September 1982 through January 1984. These data indicate that even during the highest recorded levels for Great Salt Lake, the water table did not rise to a level that would encroach into the embankment.

Envirocare prepared a study of the impacts of the new Envirocare facility on the velocity of flood waters as they pass the site. Appendix E in the Environmental Report (EUI 1992b) contains this study. The rock size that will be used for the Envirocare embankment is more than sufficient to withstand the velocities obtained.

Construction of Disposal Units. The construction drawings show the layout of the site, indicating the locations of proposed disposal cells, staging areas, rail spur, rotary dumper, and office areas.

The disposal material will be placed in the embankment in layers not exceeding 30 cm (12 in.) (uncompacted depth) and will be compacted before the next layer is placed. Effective spreading equipment will be used on each lift to obtain uniform leveling, and manipulating will be required to assure uniform density. At the time of compaction, the moisture of the embankment material will be such that the specified compaction will be obtained.

Each lift will be compacted to not less than 90% of maximum density as determined by the Standard Proctor Method (ASTM D-698). Compaction will be performed with equipment designed for compaction purposes and will be adequate to meet the compaction requirements with a reasonable number of passes. No fill will be placed upon the embankment until that area of the embankment has been approved by a qualified representative of Envirocare (site engineer, engineer's assistant, or a field testing inspector), who will check to see that the proper density has been achieved and that the embankment is stable before fill is placed on top of the embankment.

Solid debris (or drums) will be placed in the lower lifts of the embankment and will consist of less than 10% of the total lift. The debris will be distributed and manipulated so that adequate space is provided for the proper placing and compacting of embankment material between the debris in horizontal 30-cm (12-in.) layers. Drums containing contaminated material will be crushed with a roller/compactor prior to covering with embankment material. Large pieces of contaminated concrete may be broken into manageable pieces by means of a headache ball, a backhoe jackhammer, or some other means of impact.

2.3.4 Design of Auxiliary Systems and Facilities

2.3.4.1 Utility Systems

Please refer to Section 2.3.2.3.

2.3.4.2 Auxiliary Facilities

Figure 2.1 shows the layout of the entire site, including the proposed 11e.(2) byproduct material disposal embankment areas, rail spur, roads, fences, water-holding and sediment ponds, construction staging areas, office areas, and access area.

2.3.4.3 Fire Protection System

Due to the remoteness of the South Clive site, the availability of any municipal fire protection is limited. The nearest services of this type are in the Tooele-Grantsville area approximately 55 to 80 km (35 to 50 mi) away.

Fires in the office or other construction building area would be controlled using portable fire extinguishers and/or water as available. If necessary for control, water could be obtained from nearby wells that produce water for dust suppression. The water truck used on the embankment would also be used in an emergency to provide water for fire control. There will be a water truck on site whenever the site is in operation.

Table 2.3 Groundwater Elevations of Test Wells

Boring number	Ground surface elevation(a) (feet)	Elevation(a) top of casing (feet)	Ground-water elevations (feet)(a) — Date of measurement: 9-22-81	9-23-81	9-24-91	9-29-81	9-30-82	2-12-82	2-26-82	3-8-82	3-17-82	4-2-92	7-14-82	9-26-83	10-13-83	1-18-84
SC-1	4276.1	4279.4					4250.1	4247.2	4248.3	4248.2	4248.5	4248.6	4248.3		4248.6	
SC-2	4269.2	4276.6	4248.4					4248.4	4249.1	4248.6	4248.6	4248.6		4248.2	4248.2	4250.2
SC-3	4277.3	4280.5			4248.0			4247.8	4248.0	4248.0	4248.1	4248.0	4247.2		4248.3	
SC-4	4280.7	4284.8				4246.6		4245.8	4246.6	4246.6	4246.0	4246.8	4246.4		4246.7	
SC-5	4273.5	4276.3		4247.4	4247.5			4247.5	4247.4	4247.4	4247.8	4247.9	4247.6	4247.0	4248.0	4248.5
SC-6	4272.6	4276.5							4248.0	4247.8	4248.1	4248.0	4248.0		4248.6	4247.6
SC-7	4270.1	4274.7							4248.4	4248.8	4248.5	4248.5	4248.1		4249.6	4249.1
SC-8	4277.8	4282.9							4247.9	4247.9	4248.0	4247.9	4247.5	4247.8	4248.3	
SC-9	4278.8	4283.2							4247.7	4247.6	4247.7	4247.8	4247.3	4248.3	4247.8	
SC-10	4280.0	4284.1							4247.4	4247.6	4247.6	4247.6	4247.2	4248.0	4248.0	
SC-11	4276.0	4280.8							4247.6	4247.5	4247.1	4247.7	4247.2		4248.0	
SC-12	4274.9	4277.5							4247.5	4247.5	4247.6	4248.3	4248.1		4249.9	
SC-13	4274.4	4279.5							4248.5		4248.6	4248.8			4249.4	

Notes: (a)Above mean sea level.
1 ft = 0.3048m

Potential fires in the disposal area would be limited to construction equipment which will be equipped with fire extinguishers. Operators will be trained in dealing with equipment fires.

The storage building is equipped with a fire-water storage tank and delivery system.

There are no adverse radiological effects anticipated from any fires at the facility.

2.4 Permits

For other portions of the site, Envirocare holds the following permits:

- Radioactive material disposal license from the Utah Bureau of Radiation Control; License No. UT2300249. This license is for the disposal of low-activity radioactive wastes (LARW).
- Resource Conservation and Recovery Act (RCRA) hazardous waste disposal permit from the Utah Bureau of Solid and Hazardous Waste; EPA Identification Number UTD982598898. This permit is for the disposal of certain RCRA-type waste materials, as mixed wastes, in conjunction with the LARW wastes.
- RCRA Part B hazardous waste permit from the EPA. Envirocare has received an approved Hazardous and Solid Waste Amendments (HSWA) land-disposal restricted Waste Analysis Plan from EPA.
- Solid waste disposal permit from the Utah Bureau of Solid and Hazardous Waste.
- An approval order (for construction activities) from the Utah State Department of Health, Bureau of Air Quality.
- Conditional use permit from the Tooele County Corporation. This permit was issued pursuant to Tooele County Zoning Ordinances. The current permit for activities at the South Clive site was issued to the Utah Department of Health, and upon application by Envirocare, will be transferred.
- Groundwater quality discharge permit from the State of Utah Bureau of Water Pollution Control.

3.0 DESCRIPTION AND EVALUATION OF ALTERNATIVES

This section provides brief, comparative descriptions of the alternatives considered for the proposed action. Sections 3.1 through 3.4 describe the four alternatives selected and evaluated with respect to their potential environmental impacts from the construction, operation and closure of an 11e.(2) byproduct material disposal facility. Section 3.5 discusses alternatives that were considered but eliminated from detailed evaluation. An evaluation of the four viable alternatives is presented in Section 3.6; it includes a technical comparison of the alternatives, as well as a comparison of benefits and disadvantages of each alternative. A more detailed evaluation of the potential impacts from the proposed action is contained in Section 5.

The proposed action is to construct and operate a facility to receive, store, and dispose of uranium and thorium Section 11e.(2) byproduct material at a site near Clive, Utah. The purpose of the proposed action is to expand the range of wastes that can be disposed of at an existing facility in order to receive, store, and dispose of Section 11e.(2) byproduct materials similar in composition and radioactivity to wastes already located at the site. The proposed action is for the licensing of a facility on private land already owned by Envirocare of Utah. No additional Federal, state, or private land is associated with the licensing of the proposed action.

The four alternatives that were developed and reviewed for the disposal of 11e.(2) byproduct are as follows:

(1) Alternative 1—Disposal at the South Clive site in an above-ground embankment,

(2) Alternative 2—Disposal at the South Clive site in a below-ground embankment,

(3) Alternative 3—Disposal at the Skunk Ridge site, located northeast of the South Clive site, in Tooele County, Utah, and

(4) Alternative 4—No Action.

The four alternatives considered can be grouped into three classes: (1) design alternatives, which include two alternative scenarios that differ only in design and involve granting a license for disposal at the South Clive site; (2) a site alternative, which considers in general terms a different arid western site, and (3) a no-action alternative.

3.1 South Clive Site, Above Grade: Alternative 1

The South Clive site is located approximately 135 km (85 mi) west of Salt Lake City, Utah, in Tooele County. Approximately 45 ha (110 acres) of this site have been designated as proposed 11e.(2) byproduct material disposal area (Figures 3.1 and 3.2).

For Alternative 1, 11e.(2) byproduct material would be transported by either train or truck to the South Clive site. The design for the disposal embankment for this alternative is based on an improved version of the embankment that the U.S. Department of Energy (DOE) used to dispose of approximately 1.91×10^6 m^3 (2.5×10^6 yd^3) of uranium mill tailings material from the Vitro Chemical Company site in Salt Lake City, Utah, at the South Clive site. The DOE Vitro cell encompasses approximately 40 ha (100 acres) of a section of land [a section contains 259 ha (640 acres)] originally owned by the State of Utah. The remainder of this section, 219 ha (540 acres), is now privately owned by the applicant.

Upon receipt of 11e.(2) byproduct material, disposal would proceed in the following manner on the 44.5 ha (110 acres) of the site:

1. Existing terrain would be excavated to a depth of about 2.4 m (8 ft), stockpiling the excavated overburden for future capping of the embankment.

2. A 60-cm (2-ft) clay liner would be placed under all areas to receive waste, consisting of 30 cm (1 ft) of scarified and recompacted in situ material and 30 cm (1 ft) of processed clay. This liner would provide a seepage liner/retardant for the bottom and sides of the excavation. The bottom of the clay liner would be approximately 3 m (10 ft) above the local groundwater level.

3. The 11e.(2) byproduct material would be placed in the lined excavation in layers and compacted in place to a maximum height of 11 m (37 ft) above original ground elevation.

4. After reaching the maximum height of compacted waste, a 2-m (7-ft) thick layer of compacted overburden material (previously stockpiled) would be placed on top of the waste to form a radon barrier.

5. A barrier, consisting of a 15-cm (6-in.) filter zone of small-diameter rock and a 45 cm (1.5 ft) erosion barrier of larger specification-sized rock, would be placed over the embankment.

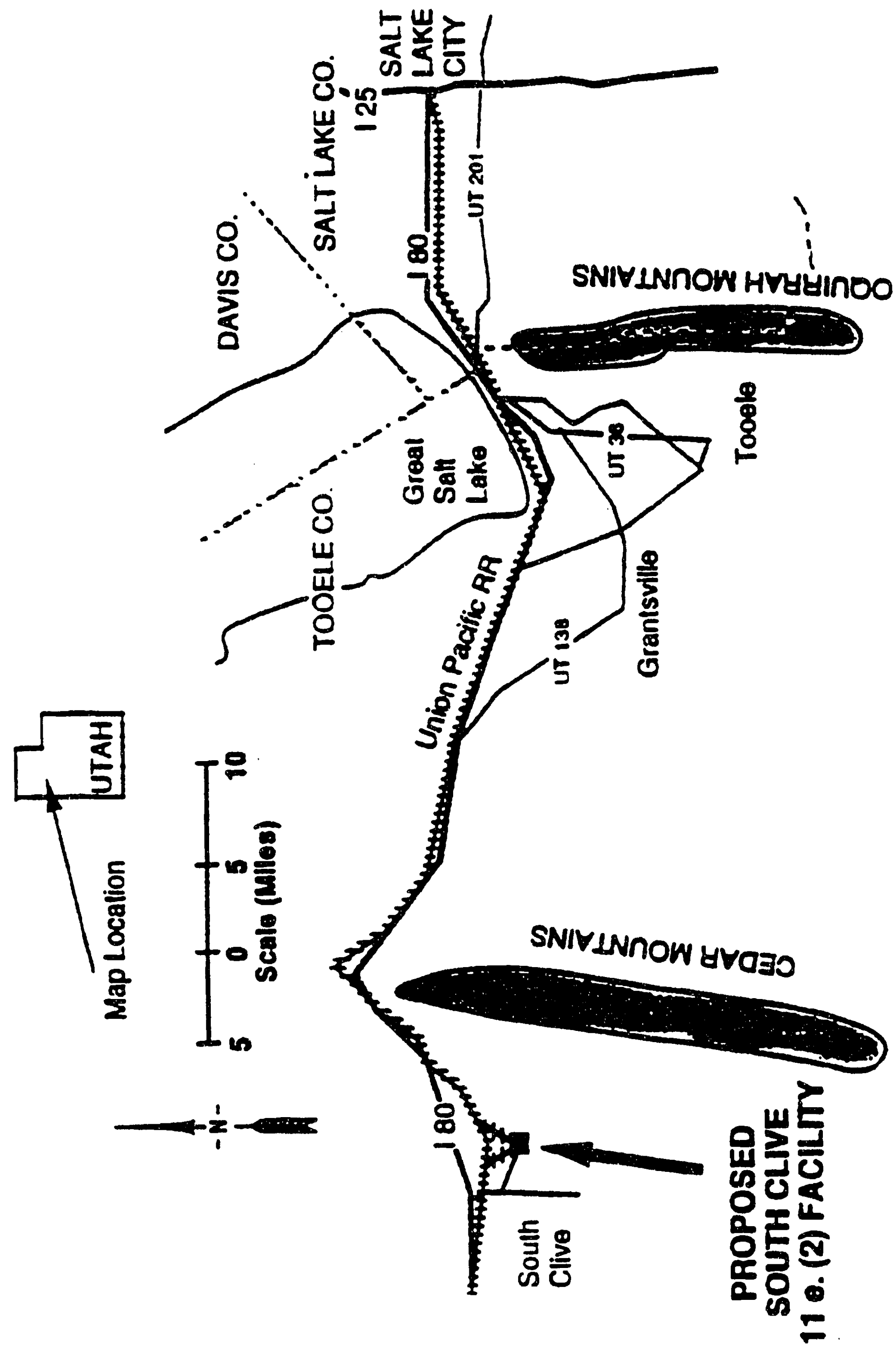


Figure 3.1 South Clive Site Location

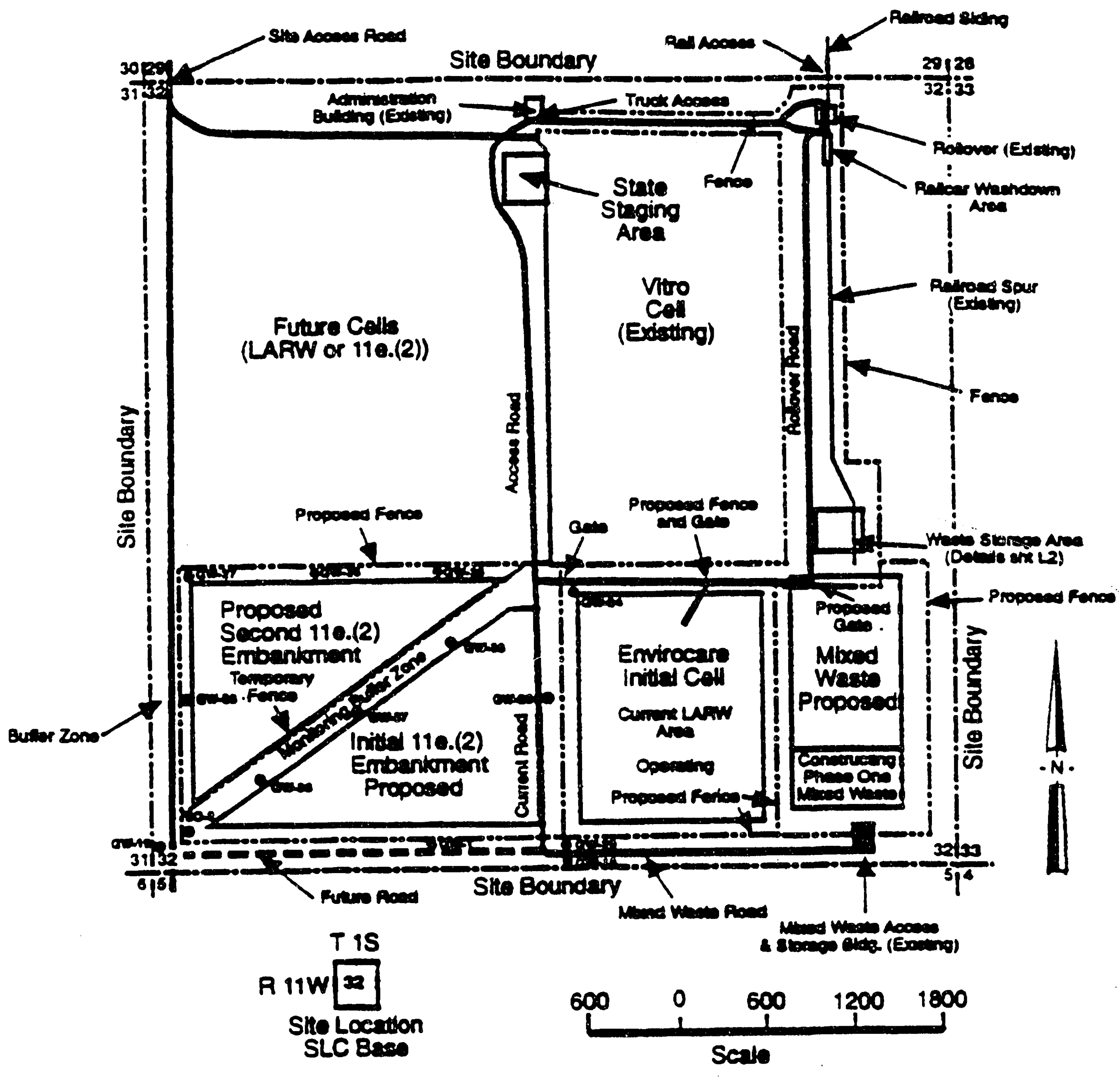


Figure 3.2 Envirocare Site Plans

After the embankment(s) is filled and covered, the area would be restored by removal of the railroad spurs and filling in excavated areas to restore the natural grade. The restored surrounding areas would be revegetated except for the rock covered mound(s) proper, and a permanent fence would be installed around the embankment(s).

Once the site preparations have been completed, the following sequence would be followed during disposal operations:

(1) acceptance of waste at the facility,

(2) disposal of waste in the embankment,

(3) covering of waste with clay material, and

(4) final cover with a rock erosion barrier.

It is anticipated that the operation activities would last for approximately 20 years.

3.2 South Clive Site, Below Grade: Alternative 2

This alternative would place the embankment entirely below grade, with the bottom of the clay liner for the excavation at an elevation of about 1300 m (4255 ft), or about 5 m (17 ft) below the land surface. The below-grade design would entail a deeper excavation than Alternative 1, and the surface of the site would be returned to the original ground level. This alternative would locate the bottom of the embankment within 1.5 m (5 ft) of the highest measured level of the water table. Alternative 2 would hold less waste per unit of land area than Alternative 1. There would also be an aesthetic benefit in not having a mound 14 m (46 ft) above the existing surface of the land. However, there would still be a mound for the DOE Vitro uranium mill tailings embankment at the South Clive site. Erosion resistance would be superior for the land surface configuration in comparison to the mound from Alternative 1. No detailed design was provided by the applicant in its Environmental Report (EUI 1992b) for this alternative.

Once the site preparations have been completed, the same sequence would be followed as with Alternative 1. It is anticipated that the operation activities would last for approximately 20 years.

3.3 Skunk Ridge Site: Alternative 3

The alternative site to the South Clive Site is also located in Utah in the arid region of the western United States.

For the disposal of 11e.(2) byproduct material, a site in the arid region of the western United States is preferable to a site in other parts of the United States because of the following considerations: (1) the major pathway for radioactive contamination is through water sources, which are less prevalent in the arid west; (2) the lower population density of remote regions in the arid west creates a lower risk to residents than in more densely populated areas; and (3) the general lower density of species of wildlife in the arid desert areas of the west presents lower risk and disturbance to native wildlife.

An alternate site has been considered in the region of Tooele County, Utah, known as Skunk Ridge (EUI 1992b). The selected location is Section 4, Township 1 North, Range 9 West, SLM, on public land administered by the Bureau of Land Management (BLM). This location is about 29 km (18 mi) northeast of the South Clive site and the characteristics of the sites are similar. The Skunk Ridge site is located at the extreme north end of Skull Valley, just south of the drainage divide that separates Skull Valley from Sink Valley (Figure 3.3).

Skull Valley is 80 km (50 mi) long and 32 km (20 mi) wide and is bounded on the east and west by north-south trending mountains. Rocks exposed in the mountains are Paleozoic limestones, quartzites, and Tertiary volcanics. The mountains are fringed by alluvial fan deposits. The valley itself is composed of unconsolidated Quaternary and Tertiary deposits that are up to 1830 to 2130 m (6,000 to 7,000 ft) deep.

The Skunk Ridge site is situated in a small flat valley halfway between a low ridge (Skunk Ridge) 2.4 km (1.5 mi) to the west and the Lakeside Mountains, which rise about 215 m (700 ft) above the valley floor 2.4 km (1.5 mi) to the east. The site is not within the West Desert Hazardous Industry area. There are no existing facilities at the site.

For this alternative, the site would need to be prepared, the material would be transported from locations throughout the United States, and closure and long-term surveillance would be similar to those described for Alternative 1. The potential environmental impact from construction and operation at the Skunk Ridge site would differ from Alternative 1, since the soils, groundwater and topography may require a different containment cell design than that proposed in Alternative 1.

Once the site preparations have been completed, the following sequence would be followed during disposal operations:

(1) acceptance of waste at the facility,

(2) disposal of waste in the cell,

(3) covering of waste with clay material radon barrier, and

(4) final cover with a rock erosion barrier.

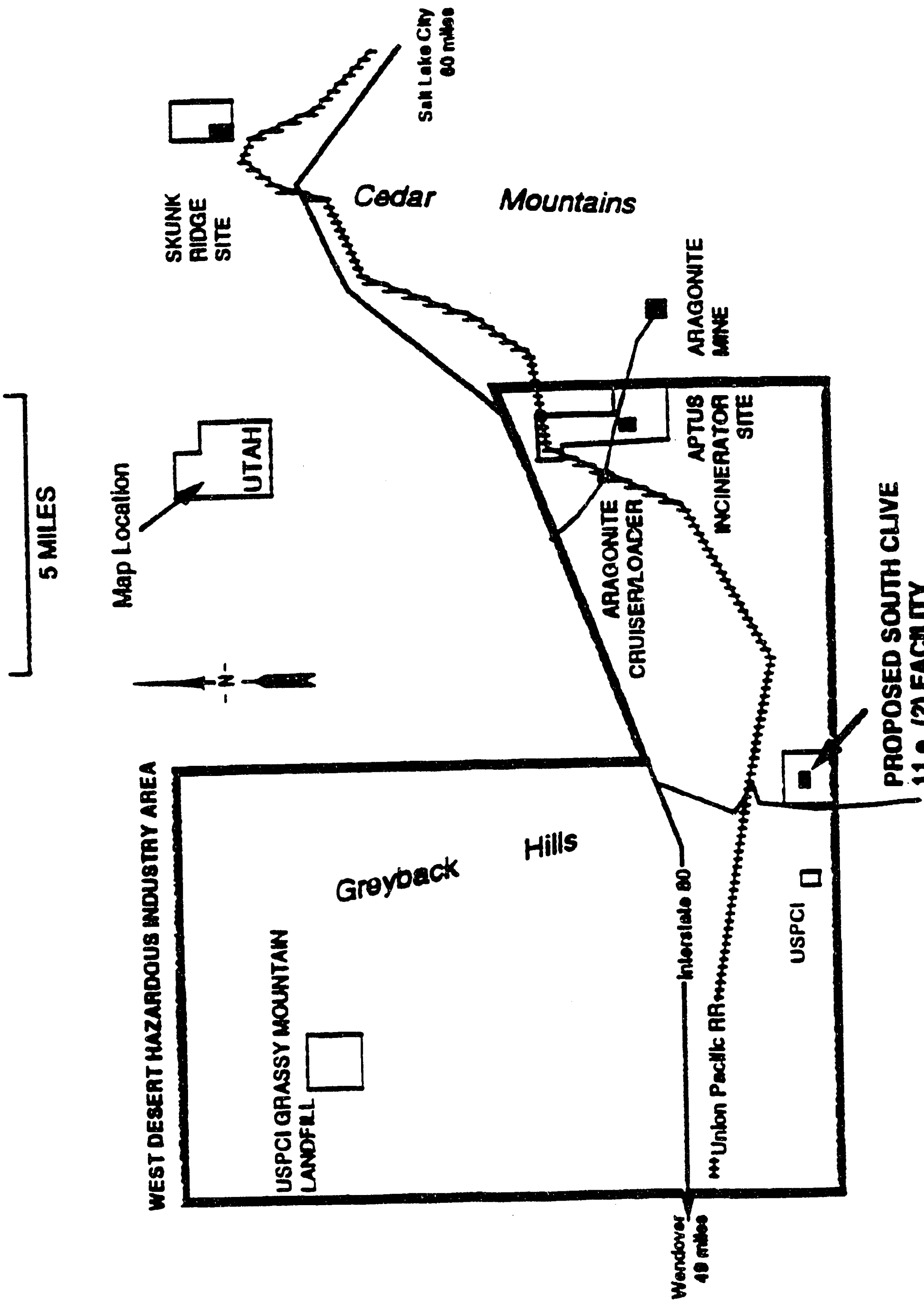


Figure 3.3 South Clive and Skunk Ridge Site Locations

It is anticipated that the operation activities would last for approximately 20 years.

3.4 No Action: Alternative 4

This alternative is a decision for no licensing at the South Clive site for 11e.(2) byproduct material disposal facility.

Envirocare's current operation is limited by the capacity of its material-handling facilities and by an overall annual limit on the amount of material that can be accepted at the low-activity facility. Even though granting the license would increase the overall annual limit of material to be received by Envirocare, the final amount of material would be determined by the site capacity and material-handling facilities.

Alternative 4 would occur if the requested license is not granted. This alternative would be a continuation of the current operations of South Clive. Since Envirocare's existing permits allow for the disposal of radioactive materials that are very similar to 11e.(2) byproduct material, and the proposed disposal methods are very similar to the existing disposal methods, Alternative 4 would have little impact at South Clive. 11e.(2) byproduct material that would have been disposed of at South Clive would continued to be stored or disposed of at the existing location, disposed of at NRC or Agreement State licensed uranium mill tailings facilities, or eventually disposed of at some other licensed 11e.(2) byproduct material disposal facility, if such were to be licensed.

3.5 Alternatives Considered but Rejected

The following alternatives, presented by the applicant in its Environmental Report (EUI 1992b), were considered but rejected: (1) a below-grade design that placed waste within 60 cm (2 ft) of the water table at South Clive; (2) an additional site near Blanding, Utah, and (3) a hypothetical northeastern United States site containing 11e.(2) byproduct material to represent in-place remediation.

A second below-grade design that would place waste within 60 cm (2 ft) of the water table was rejected, even though it would add 0.9 m (3 ft) to the depth of waste within the embankment and reduce slightly the amount of land required, because the benefits did not seem to outweigh the additional risk to the groundwater.

A site that had been given some previous investigation near Blanding, San Juan County, Utah, was mentioned by the applicant but rejected because it was within 4.8 km (3 mi) of the city of Blanding, drainage could contaminate streams (tributary) to the Colorado River system, and transportation of waste would presently require a 105-km (65-mi) haul by truck to the site from rail facilities.

A hypothetical northeastern U.S. site was mentioned by the applicant as a site alternative in a contrasting setting that would also represent the numerous present sites of 11e.(2) byproduct material where in-place remediation might be an alternative. Some of these might need only a radon barrier emplaced while others might not be suitable for remediation and the waste would have to be moved to a site away from its present location. This alternative was rejected by staff because of lack of definitive information on which an evaluation could be made and the fact that Envirocare owned the South Clive site and had indicated it would not pursue other site alternatives.

3.6 Evaluation of Alternatives

The Clive, Utah, location of the Envirocare facility was initially chosen by the State of Utah and the DOE for the disposal of uranium mill tailings from Vitro Chemical Company's Salt Lake site under the Uranium Mill Tailings Radiation Control Act of 1978. At that time, the Clive location was chosen from 29 sites that were studied as potential sites for the Vitro tailings and an environmental impact statement was prepared by DOE on disposal at the South Clive site (DOE 1984b). The Vitro remedial action used only 40.5 ha (100 acres) of the 259-ha (640-acre) section. The remaining 218.5 ha (540 acres) have been acquired by Envirocare and portions are used for operating its low-activity radioactive waste facilities. A further portion will be used for the location of the proposed disposal facility for 11e.(2) byproduct material.

3.6.1 Technical Evaluation

Within the western United States, a site alternative and a design alternative at the South Clive site were evaluated. The alternatives are located in an arid region, with no surface water and with relatively stable geologic conditions. The groundwater at the Skunk Ridge site (Alternative 3) is slightly saline and estimated to be at a depth of 70 to 130 m (225 to 420 ft), based on an existing pumping well within 1.6 km (1 mi) of the site. At Skunk Ridge, any leakage through the cell liner would cause leaching of 11e.(2) byproduct material from the site toward and possibly into an aquifer that is producing a usable water supply.

The location of an 11e.(2) byproduct material disposal facility at the South Clive site reduces the risk of contamination of usable water. At South Clive, the unconfined near-surface aquifer has total dissolved solids of up to 75,000 ppm, is highly saline, and background levels for several parameters already exceed U.S. Environmental Protection Agency (EPA) drinking water standards. This aquifer has a very low horizontal gradient, and is recharged primarily from the lower aquifers. The water from this aquifer is not a usable water supply, in terms of water quality or the volume of water that could be delivered through a well. Groundwater flow models indicate that any leachate from the facility would take over 600 years to reach the unconfined aquifer (EUI 1992b). These models are based upon Alternative 1. Alternative 2 is less desirable than Alternative 1 since it places the wastes closer to the water table, which could shorten the time for any leached material to reach the groundwater.

Two alternate designs for the operation of the facility (EUI 1992b) were evaluated: Alternative 1, which is constructed primarily above grade, and Alternative 2, which is constructed below grade. In evaluating designs for 11e.(2) byproduct material facilities, 10 CFR Part 40, Appendix A, requires that the applicant consider below-grade designs for the disposal of 11e.(2) byproduct material. The regulations provide that in some instances, below-grade disposal may not be the most environmentally sound approach, such as may be the case if a groundwater formation is relatively close to the surface. In choosing an above-grade disposal facility, the licensee must show that the proposed design would provide reasonably equivalent isolation of the tailings from erosional forces. The erosion barrier for Alternative 1 has been designed to meet the design criteria for above-grade embankments and would provide reasonably equivalent isolation from erosional forces as provided by Alternative 2.

It is possible that a site with characteristics similar to the South Clive site, with similarly poor quality groundwater but at a much greater depth, may exist that is superior to the South Clive site for the proposed action, because the prime option of below-grade disposal would then be feasible. While the below-grade design (Alternative 2) is viable, it is not preferred over Alternative 1 at the South Clive site for two reasons: (1) the design places the wastes closer to the water table and any leached material could reach the groundwater sooner than for Alternative 1, and (2) the Alternative 2 design requires a greater amount of acreage to dispose of the same volume of waste, increasing unit costs and land requirements. Any site other than South Clive would require construction of the infrastructure which presently exists at South Clive.

Other sites within the United States may be found that are acceptable for the disposal of 11e.(2) byproduct material. These sites may include some of those currently licensed by compacts pursuant to the low-level disposal laws or at existing mill tailing sites that are suitable for in-place remediation.

Therefore, on the basis of lower potential for radioactive releases to the environment, primarily through pathways associated with surface water and groundwater, and the generally lower occurrence and density of human population, the arid western United States is preferable to other locations in the United States for the siting of an 11e.(2) byproduct material facility. Based upon the foregoing, no other alternative is clearly superior to Alternative 1.

3.6.2 Benefit/Cost Evaluation

This section compares the benefits and qualitative costs of each alternative. The analysis shows that Alternative 1 provides the most benefits and is the lowest-cost alternative, and Alternative 4 provides the least benefits with highest potential costs.

3.6.2.1 Alternative 1, South Clive Site, Above Ground

Benefits. Alternative 1 consolidates numerous sources of waste in an embankment which provides the required protection for the surrounding environment.

Alternative 1 would be beneficial because it would consolidate numerous sources of waste at one location where other types of wastes [low-level radioactive and Resource Conservation and Recovery Act (RCRA) wastes] are currently being consolidated. The waste would be consolidated in an area remote from populated areas. The area is zoned for the handling of hazardous waste and excludes residential facilities (see Section 4.1).

The embankment design provides appropriate protection for the groundwater. The absence of surface waters at the site minimizes the possibility for surface-water contamination. The low rainfall and low probability of catastrophic storm events (e.g., tornados, hurricanes, etc.) minimize the erosion of the embankment from meteorological conditions.

The combination of site condition and embankment design make Alternative 1 the most beneficial alternative.

Costs. Alternative 1 consolidates the waste at an existing, operating site. This eliminates the startup costs such as purchasing land, accumulating baseline monitoring, installing rail unloading facilities and rail spurs, and other necessary site facilities.

Economic railroad and highway transportation is located near the Alternative 1 site. A rail spur connected to the Union Pacific Railroad is located on the site. The site is located approximately 5 km (3 mi) from Interstate 80.

Materials for the construction of the embankment are readily available. Located at the site are clays suitable for the construction of the clay liner and the radon barrier. Rock suitable for the erosion barrier is located approximately 8 km (5 mi) to the north of the site. Envirocare owns a large quantity of rock at this location.

The above-grade embankment design combines a high disposal rate (cubic yards/acre) with a liner/cover design which requires little active maintenance.

The presence of the facilities and materials for construction of the embankment near the site makes Alternative 1 the lowest-cost alternative considered, except for Alternative 4, the no action alternative.

3.6.2.2 Alternative 2, South Clive Site, Below Ground

Alternative 2 is the same as Alternative 1, except that the embankment is entirely below-grade. The bottom of the clay liner is at an elevation of 1296.1 m (4252.2 ft), 60 cm (2 ft) above the highest measured depth for groundwater, and the top of the embankment is at ground surface level.

Benefits and Disadvantages. Alternative 2 provides the same benefits of consolidation of the waste in a remote, unpopulated area. The design of the embankment minimizes the possibility of surface-water contamination. Both Alternative 1 and Alternative 2 embankment designs are designed for the same meteorological conditions.

Alternative 2 provides less protection from groundwater contamination because the waste is placed close to the groundwater, and is less beneficial than Alternative 1.

Alternative 2 requires more land than Alternative 1 and has a lower disposal rate (cubic yards/acre) because of lesser thickness of waste in the embankment. Given available land at the site, Alternative 2 can only provide for a capacity of 2.1 X 106 m3 (2.75 X 10^6 yd^3), where Alternative 1 provides for a capacity of 2.29 X 10^6 m^3 (3.0 X 10^6 yd^3) with land left over for future expansion.

Costs. The startup costs, availability of economical transportation to the site, and availability of embankment construction materials would be the same as for Alternative 1.

3.6.2.3 Alternative 3, Skunk Ridge Site

Alternative 3 is for the disposal of 11e.(2) byproduct material in Section 4, Township 1 North, Range 9 West, Salt Lake Base and Median, on public land administered by the BLM. This location is about 30 km (18 mi) northeast of the South Clive site.

Benefits and Disadvantages. Alternative 3 consolidates numerous sources of 11e.(2) byproduct material at one location.

A disadvantage of Alternative 3 is that the waste would be placed at a site which currently does not contain contaminated materials. The Alternative 3 site is outside the area which has been zoned by Tooele County for the handling of hazardous waste. The area does not exclude the possibility of zoning the area for residential or commercial facilities.

Groundwater protection may be harder to achieve, if higher permeability clays are found near the Alternative 3 site. Additional work would have to be done to characterize the groundwater at the Skunk Ridge site before an embankment could be designed.

The possibility for surface-water contamination is greater at the Alternative 3 site than the Alternative 1 site. Surface water from the nearby mountains may flow through the Skunk Ridge site. The Alternative 3 site has a higher annual precipitation rate than the Alternative 1 site.

The time it would take to begin disposal under Alternative 3 would also be longer because of land and material acquisition, site investigation, design and engineering, local permits, and zoning. Use of this site could delay cleanups in other parts of the country.

Water for construction and operations would need to be hauled from the same well that supplies the South Clive site or a nearer site if one could be developed.

Alternative 3 is less beneficial than Alternative 1.

Costs. Alternative 3 requires large startup costs. Startup costs include purchasing land, accumulating baseline monitoring, installing rail unloading facilities and rail spurs, and installing other necessary site facilities.

Alternative 3 would require the purchase of land from the BLM. The zoning of the site would have to be changed to allow for the handling of radioactive waste. Additionally, permits from the State of Utah may be required at this site. Additional design and engineering work would be required at this site.

Economic railroad and highway transportation is located near the Alternative 3 site; however, an access road, rail spur, and rail unloading facilities would have to be constructed.

Materials for the construction of the embankment may not be readily available at the site. Without further site characterization, it is not possible to determine whether the clays at this site are suitable for construction of the clay liner and radon barrier, and a source of clay would have to be found and purchased. The nearest known source of rock for the rock cover is located approximately 24 km (15 mi) to the west. The rock is the same source as is available for Alternative 1. Rock would have to be hauled from this source, or another source of rock would have to be located and purchased.

The cost of Alternative 3 is higher than Alternative 1 because of higher construction costs and higher startup costs. The time it would take to begin disposal would also be longer because of land and material acquisition, site investigation, design and engineering, local permits, and zoning.

3.6.2.4 Alternative 4, No Action

Alternative 4 is the no-action alternative. The wastes would continue to remain where they are currently located, and an 11e.(2) byproduct material site would not be licensed at South Clive. The South Clive facility would continue to operate under existing permits.

Benefits and Disadvantages. Alternative 4 would leave the wastes in their present locations. The waste would likely be remediated in place, unless another off-site location were to be developed. The benefits associated with a large disposal facility would be deferred if not lost.

Costs. The costs of Alternative 4 have the potential for being the greatest of any alternative. Although the individual cleanup of a specific site may be smaller than the other alternatives, this alternative may have the effect of requiring all of the potential sites to develop individual disposal facilities, without taking advantage of a large licensed facility, as contemplated in 10 CFR Part 40, Appendix A, Criterion 2.

3.6.3 Findings

The technical evaluation in Section 3.6.1 and the benefit/cost evaluation in Section 3.6.2 have resulted in a narrowing of the focus for the assessment of alternatives in the remainder of this EIS. Alternative 2 (the South Clive, below ground option), Alternative 3 (the Skunk Ridge option), and Alternative 4 (no action) are therefore dropped from further, detailed assessment. An evaluation of the potential impacts from the proposed action (Alternative 1) is presented in Section 5.

4.0 AFFECTED ENVIRONMENT

The proposed disposal site is located within a 259-ha (640-acre) section in Tooele County, which was originally studied and selected for the disposal of uranium mill tailings from the Vitro Chemical Company. Approximately 40 ha (100 acres) of this section were used for the Vitro project. The remaining 219 ha (540 acres) of the section were sold to Envirocare by the State of Utah. The southeast portion of the site is presently being used by Envirocare for the disposal of Low-Activity Radioactive Waste. The eastern portion of this southeast section has been permitted for the disposal of mixed radioactive and hazardous waste. The southwestern portion of the site is the area of proposed action described in this Environmental Impact Statement (EIS). In this area, the initial 11e.(2) byproduct disposal cell will be constructed following issuance of a license resulting from an 11e.(2) byproduct application. The site layout is shown in Figure 4.1.

The initial cell of the Low-Activity Radioactive Waste (LARW) facility licensed by the State of Utah is currently in operation and, when completed, will cover about 24 ha (60 acres). The 11e.(2) byproduct waste section will cover approximately 45 ha (110 acres).

Approximately 40 ha (100 acres) of the section were used for the permanent disposal of uranium mill tailings from the remedial action taken at the former Vitro Chemical Company site in Salt Lake County. The disposal of these tailings was part of a cooperative project undertaken by the U.S. Department of Energy (DOE) and the Utah Department of Health. Title to the property used for the placement of the Vitro mill tailings will be deeded to the DOE by the State of Utah upon completion of the remedial action. Figure 4.1 shows the location of the Vitro disposal cell constructed in this project. The DOE property has been fenced and isolated from available land to be used in the South Clive disposal project.

The South Clive facility is located within the Tooele County Hazardous Waste Zone, approximately 30 km (20 mi) from any residents. Figure 3.1 shows the location of Envirocare's facility in relation to Salt Lake City and the surrounding area. The site is approximately 130 km (80 mi) west of Salt Lake City and 5 km (3 mi) south of Interstate 80. The actual property, which is owned by Envirocare and which is to be included in the location for licensed activities, is Section 32, Township 1 South, Range 11 West, Tooele County, Utah, *except* for the area occupied by the Vitro waste disposal embankment.

Figure 4.1 shows the anticipated layout of the site with disposal cells, staging area, office area(s), train track, train car rollover, fences, boundaries, buffer area, and ditches. Site topography is shown on Figure 4.2.

There are no chemical, sanitary, or other waste discharges associated with either the current operations at the South Clive site or the proposed operations.

4.1 Land Use

Most of the land within a 16-km (10-mi) radius of the site is public domain administered by the Bureau of Land Management (BLM). The climate is arid, with an average rainfall of approximately 13 cm (5 in.) per year.

The federal government owns and controls the greatest percentage of land in Tooele County, 82% of the county land area of 1.79×10^6 ha (4.43×10^6 acres). The greatest portion 790,300 ha (1,952,852 acres) of the federal land is public domain administered by the BLM. The U.S. Department of Defense controls the next greatest portion of 630,855 ha (1,558,862 acres), with national forests occupying 61,600 ha (152,223 acres) (BLM 1988). Approximately 6% of the county land area is administered by the State of Utah, which leaves approximately 12% in private ownership (BLM 1988). The South Clive site occupies 219 ha (540 acres) of private land owned by Envirocare.

On January 12, 1988, the Tooele County Commission established the West Desert Hazardous Industry Area. The area around the South Clive site has been designated as a hazardous industries zone by Tooele County. This designation limits the future uses of land in the vicinity of the South Clive site by prohibiting residential housing.

Tooele County amended the uniform zoning ordinance by adding the "Hazardous Industrial District" zoning classification (MG–H). This is the classification to which hazardous industry sites within the West Desert Hazardous Industry Area would be rezoned to provide for appropriate locations where hazardous industrial processes necessary to the economy may be conducted and to prohibit such activities in all other zoning classifications of Tooele County.

Previous to the Vitro project, there were no industrial, residential, or municipal activities near the site. The only use for the land was for grazing, hunting, and occasional recreation vehicle use. Since that time, several hazardous waste industries have located in the South Clive area.

United States Pollution Control, Inc. (USPCI), a hazardous waste firm, is constructing a hazardous waste incinerator 1.6 km (1 mi) to the west of the South Clive location. Aptus, Inc., has constructed a hazardous waste

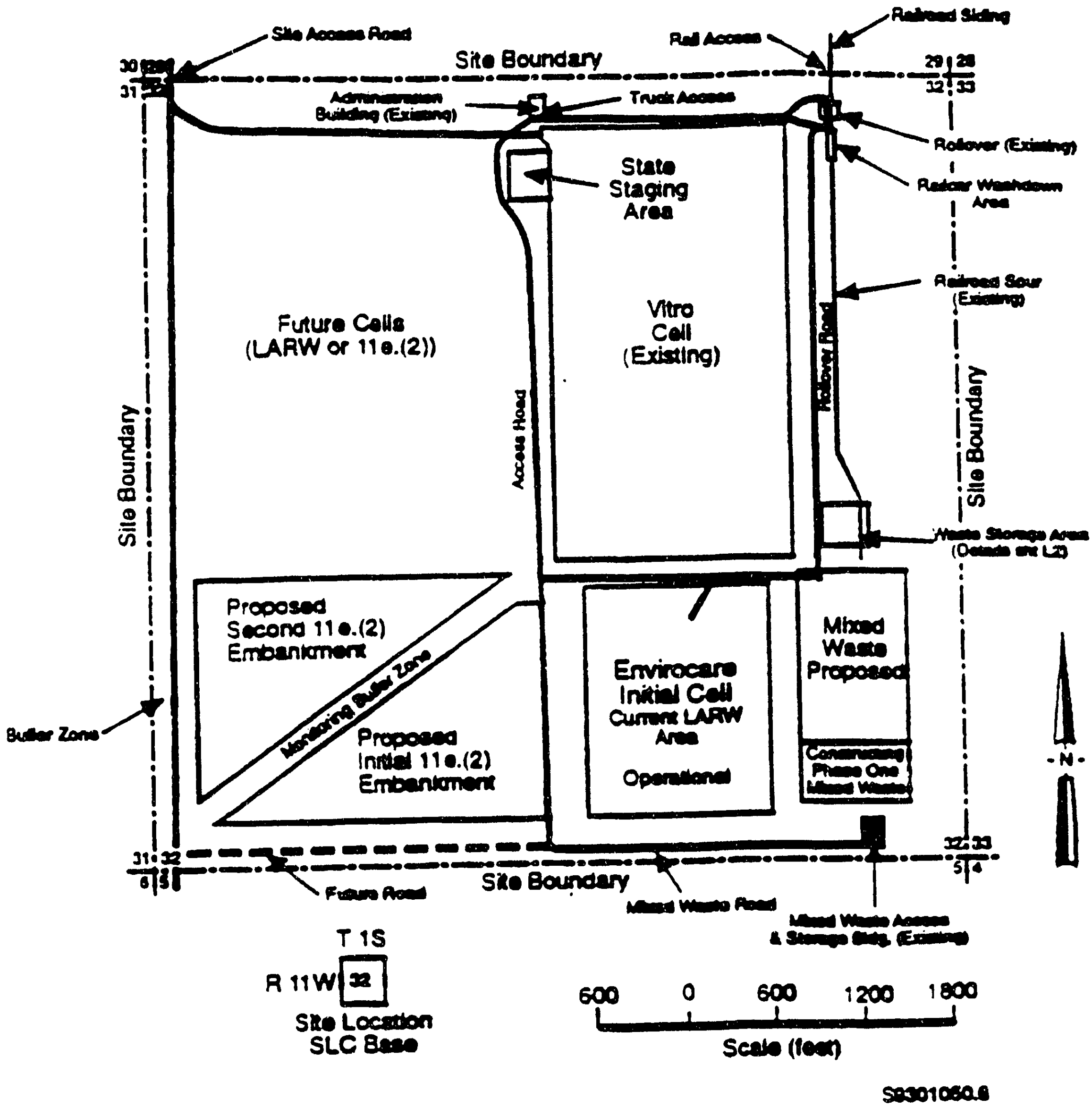


Figure 4.1 South Clive Site Layout

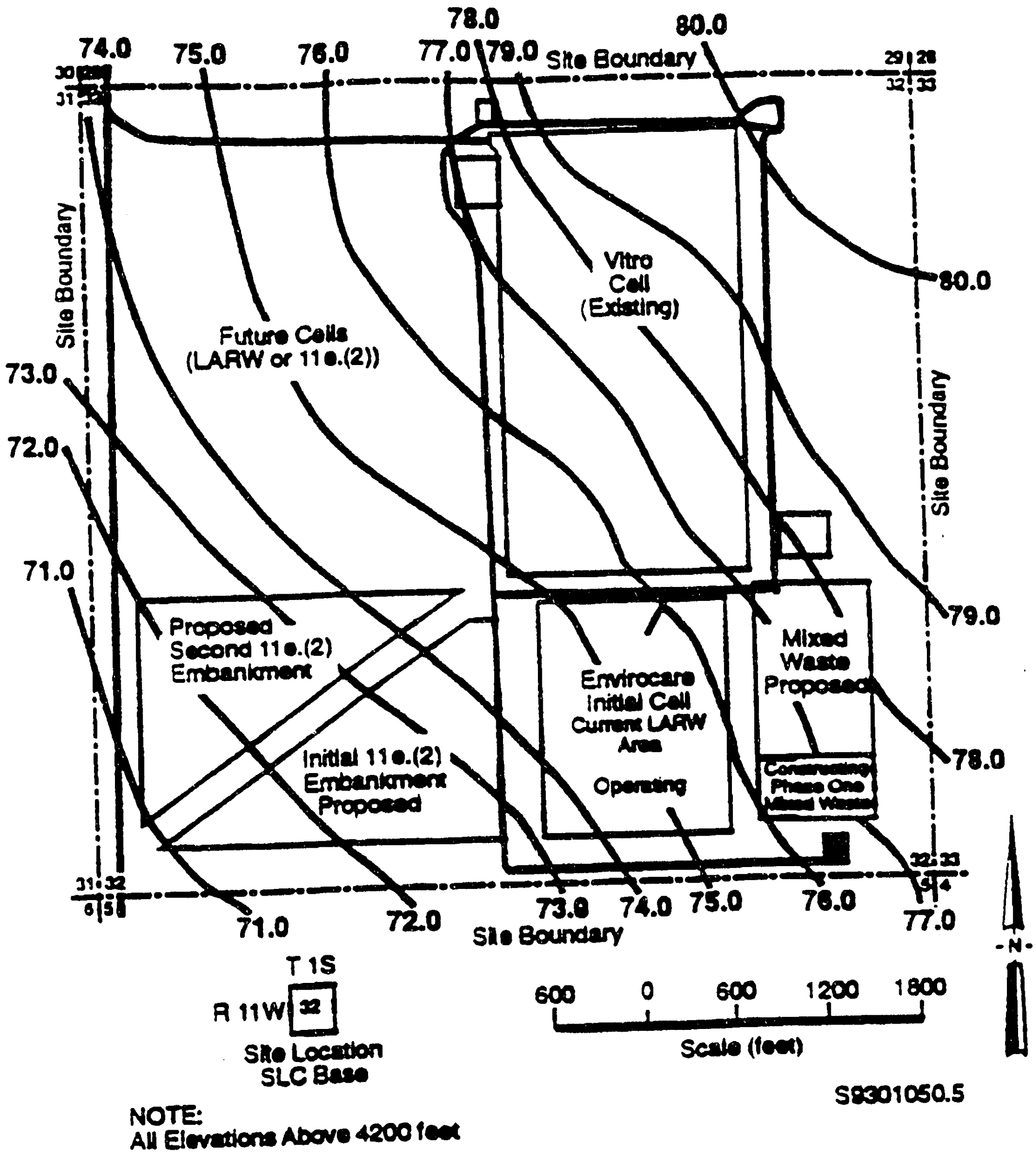


Figure 4.2 Initial Site Topography

incinerator approximately 11 km (7 mi) to the northeast of the Envirocare facility. Figure 3.3 shows the location of these facilities in relation to the Tooele County alternatives.

The BLM has several sheep and cattle grazing allotments in the Clive area. The South Clive site occupies 219 ha (540 acres) of private land. The land surrounding the site is currently utilized for grazing purposes and dispersed recreation. Historically, the immediate area around the Clive site has not been heavily utilized for grazing. However, more recently cattle have been attracted to the area, and there is some livestock use in the area. Cattle utilize the area more during winter periods when snow is present and when puddles of water exist during wet periods.

Tables 4.1 through 4.5 show the nearest cattle, game animals, residences, and vegetable gardens as well as the relative location of the site boundary. Table 4.6 is a summary of the nearby dwellings, towns, and other receptors as required by U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 3.8, Appendix B, pages B–4 and B–5. As can be seen from the tables, there are no residents, game animals, or vegetable gardens within 8 km (5 mi) of the site. There is some cattle grazing in the area. This grazing is allowed approximately 3 months out of the year. All site boundaries are within 2 km (1.25 mi) of the center of the 11e.(2) byproduct embankment.

The only route to the site is a 4.3-km (2.7-mi) road from the Aragonite exit off I–80, which is a four-lane, divided highway. Regional access to the site is also provided by I–15 and I–84, which runs in a north/south direction. Recently the Utah Department of Transportation completed an upgrade of the Clive Interchange. The interchange now includes a complete, paved interchange in both directions.

Traffic on I–80 has been increasing at an annual rate of approximately 7%. There are currently 20 trains per day on Union Pacific's tracks west of Salt Lake City (EUI 1992b).

The remoteness of the site from the urbanized areas of Tooele County and the zoning for hazardous waste makes the surrounding area an improbable location for any other significant industrial use that might be impacted by the disposal project.

4.2 Geology/Seismicity

4.2.1 Regional Geology

The South Clive site is located in the extreme eastern margin of the Great Salt Lake Desert which is part of the Basin and Range Province of North America. The Basin and Range topography is typified by block-faulted (normal faults) mountain ranges that generally trend north to south. These predominant structural features and alluvium-filled basins are discontinuous and were created by extensional normal faulting. The unconsolidated to semi-consolidated valley fill is generally about 240 to 300 m (800 to 1000 ft) thick throughout the central portions of the valleys in the Great Salt Lake Desert.

The block-faulted mountains mainly consist of Paleozoic limestones, dolomites, shales, quartzites, and sandstones. Tertiary basaltic lava flows and pyroclastics are also found in isolated areas of the Great Salt Lake Desert. The valley sediments are composed of alluvial fans, playa deposits, and unconsolidated and semi-consolidated valley fill. The alluvial fans grade laterally into fine-grained alluvium and thin toward the center of the valleys, where they are present as a veneer overlying and adjacent to fine-grained Lake Bonneville lakebed deposits.

Table 4.7 shows the stratigraphic units typical of the region containing the South Clive site.

4.2.2 Site Geology

The site rests on Quaternary lakebed deposits of Lake Bonneville. Site subsurface logs indicate that lacustrine deposits extend to at least 75 m (250 ft) underneath the site. The underlying Tertiary and Quaternary age valley fill is composed of semi-consolidated clays, and sands and gravels where it comes in contact with bedrock.

The South Clive site is located in a relatively flat topographic area and is bounded by the Great Salt Lake Desert to the west at approximate elevations of 1295 to 1310 m (4250 to 4300 ft). The desert area extends for approximately 95 km (60 mi) to the Nevada-Utah border on the west. The eastern border of the desert is formed by the Cedar Mountains, which rise to elevations of 2350 m (7700 ft) [approximately 1060 m (3500 ft) above the desert floor]. The proximity of this mountain range results in a surficial drainage pattern for the site, which is generally in a westerly direction.

In the vicinity of the site, low-lying hills rise 15 to 30 m (50 to 100 ft) from the desert floor. To the east and southeast, the site is bounded by the north-south trending Lone Mountain, a peak on the west flank of the Cedar Mountains, which rises to a height of 1634 m (5362 ft). To the north of the site are the Grayback Hills, composed of Tertiary volcanic rocks, consisting mainly of basalt lava flows and pyroclastics. The site has topographic relief of approximately 3 m (11 ft), sloping in a southwest direction at a gradient of approximately 0.0019.

No active Holocene faults are known to have occurred in the vicinity of the site. The nearest Holocene faulting is located 29 km (18 mi) north in the northwest Puddle

Table 4.1 Nearest Grazing Animals (3 months out of year)

Compass Directions	Distance in kilometers 0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	>5
N – 0.0	x	–	–	–	–	–
NNE – 22.5	x	–	–	–	–	–
NE – 45.0	x	–	–	–	–	–
ENE – 67.5	x	–	–	–	–	–
E – 90.0	x	–	–	–	–	–
ESE –112.5	x	–	–	–	–	–
SE – 135.0	x	–	–	–	–	–
SSE – 157.5	x	–	–	–	–	–
S – 180.0	x	–	–	–	–	–
SSW – 202.5	x	–	–	–	–	–
SW – 225.0	x	–	–	–	–	–
WSW – 247.5	x	–	–	–	–	–
W – 270.0	x	–	–	–	–	–
WNW – 292.5	x	–	–	–	–	–
NW – 315.0	x	–	–	–	–	–
NNW – 337.5	x	–	–	–	–	–

x = Animals located.
– = No inventory taken.

Source: EUI 1992b
Note: 1 kilometer = 0.62 mile

Table 4.2 Nearest Game Animals

Compass Directions	Distance in kilometers					
	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	>5
N - 0.0	–	–	–	–	–	x
NNE - 22.5	–	–	–	–	–	x
NE - 45.0	–	–	–	–	–	x
ENE - 67.5	–	–	–	–	–	x
E - 90.0	–	–	–	–	–	x
ESE -112.5	–	–	–	–	–	x
SE - 135.0	–	–	–	–	–	x
SSE - 157.5	–	–	–	–	–	x
S - 180.0	–	–	–	–	–	x
SSW - 202.5	–	–	–	–	–	x
SW - 225.0	–	–	–	–	–	x
WSW - 247.5	–	–	–	–	–	x
W - 270.0	–	–	–	–	–	x
WNW - 292.5	–	–	–	–	–	x
NW - 315.0	–	–	–	–	–	x
NNW - 337.5	–	–	–	–	–	x

x = Animals located.
– = No animals located.

Source: EUI 1992b
Note: 1 kilometer = 0.62 mile

Table 4.3 Nearest Residence

Compass Directions	Distance in kilometers					
	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	>5
N – 0.0	–	–	–	–	–	x
NNE – 22.5	–	–	–	–	–	x
NE – 45.0	–	–	–	–	–	x
ENE – 67.5	–	–	–	–	–	x
E – 90.0	–	–	–	–	–	x
ESE –112.5	–	–	–	–	–	x
SE – 135.0	–	–	–	–	–	x
SSE – 157.5	–	–	–	–	–	x
S – 180.0	–	–	–	–	–	x
SSW – 202.5	–	–	–	–	–	x
SW – 225.0	–	–	–	–	–	x
WSW – 247.5	–	–	–	–	–	x
W – 270.0	–	–	–	–	–	x
WNW – 292.5	–	–	–	–	–	x
NW – 315.0	–	–	–	–	–	x
NNW – 337.5	–	–	–	–	–	x

x = Residences located.
– = No residences located.

Source: EUI 1992b
Note: 1 kilometer = 0.62 mile

Table 4.4 Nearest Site Boundary

Compass Directions	Distance in kilometers					
	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	>5
N – 0.0	x	–	–	–	–	–
NNE – 22.5	x	–	–	–	–	–
NE – 45.0	x	–	–	–	–	–
ENE – 67.5	x	–	–	–	–	–
E – 90.0	x	–	–	–	–	–
ESE –112.5	x	–	–	–	–	–
SE – 135.0	x	–	–	–	–	–
SSE – 157.5	x	–	–	–	–	–
S – 180.0	x	–	–	–	–	–
SSW – 202.5	x	–	–	–	–	–
SW – 225.0	x	–	–	–	–	–
WSW – 247.5	x	–	–	–	–	–
W – 270.0	x	–	–	–	–	–
WNW – 292.5	x	–	–	–	–	–
NW – 315.0	x	–	–	–	–	–
NNW – 337.5	x	–	–	–	–	–

x = Boundary located.
– = Beyond site boundary.

Source: EUI 1992b
Note: 1 kilometer = 0.62 mile

Table 4.5 Nearest Vegetable Garden

Compass Directions	Distance in kilometers					
	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	>5
N - 0.0	–	–	–	–	–	x
NNE - 22.5	–	–	–	–	–	x
NE - 45.0	–	–	–	–	–	x
ENE - 67.5	–	–	–	–	–	x
E - 90.0	–	–	–	–	–	x
ESE -112.5	–	–	–	–	–	x
SE - 135.0	–	–	–	–	–	x
SSE - 157.5	–	–	–	–	–	x
S - 180.0	–	–	–	–	–	x
SSW - 202.5	–	–	–	–	–	x
SW - 225.0	–	–	–	–	–	x
WSW - 247.5	–	–	–	–	–	x
W - 270.0	–	–	–	–	–	x
WNW - 292.5	–	–	–	–	–	x
NW - 315.0	–	–	–	–	–	x
NNW - 337.5	–	–	–	–	–	x

x = Vegetable garden located.
– = No vegetable garden located.

Source: EUI 1992b
Note: 1 kilometer = 0.62 mile

Table 4.6 Locations of Sources

Distance in kilometers	East, km	North, km
Nearest resident	>15	>15
Nearest resident in prevailing wind direction	>15	>15
Ranch	>15	>15
Farm	>15	>15
Orchard	>15	>15
Grazing location 1	1	1
Grazing location 2	1	1
Garden	>15	>15
Ranger bunk house	>15	>15
Mine camp	>15	>15
Other nearby residents (industrial or recreational facilities)	>15	>15
Restricted area boundaries (N, S, E, W, NE, SW, SE, NW)	1	1

Source: EUI 1992b

Note: Distance for all locations are given with respect to the location of the South Clive site.
1 kilometer = 0.62 mile.

Table 4.7 Generalized Stratigraphic Column, Clive, Utah

Era	Period/Epoch	Formation	Thickness (ft)
Cenozoic	Quaternary/Pleistocene	Lake Bonneville Group	500 to 800
Paleozoic	Permian	Pequop	2,800
	Devonian	Pilot Shale	330
		Guilmete	2,840
		Simonson Dolomite	600
	Silurian	Laketown Dolomite	1,310
	Ordovician	Fish Haven Dolomite	350
		Eureka Quartzite	490
		Crystal Peak Dolomite	150
		Swan Peak Quartzite	540
		Kanosh Shale	400
		Garden City Limestone	3,590
	Cambrian	"Notch Peak"	1,000 ±
		Worm Creek Quartzite	60
		Undiff. Middle and Upper Cambrian	1000 ±

Sources:
- EIU 1992b.
- Hintze, L. F. 1973. *Geologic History of Utah.* Brigham Young University Geologic Studies, Utah.
- *Hydrologic Reconnaissance of the Northern Great Salk Lake Desert.* 1974. Technical Publication No. 42, Utah Department of Natural Resources.

Note: 1 ft = 0.3048 m

Valley, east of the Grassy Mountains. Most of the faulting occurred between 1 million and 25 million years ago. Recent seismic activity is believed to be the result of rebound from the de-watering of ancient Lake Bonneville over 15,000 years ago.

Natural resources in Tooele County include limestone, metallic minerals, potassium salts, tungsten, salt, clays, and sand and gravel. Gravel quarries have been located in the alluvial fans that flank the Ceder Mountains (DOE 1984b). Mineral extraction by evaporation of brine occurs near Knolls, about 16 km (10 mi) northwest of the site. Limestone is quarried in the Cedar Mountains about 8 km (5 mi) east of the site. Presently no oil or gas production takes place in the area. There is no coal production in the area or geologic formations with coal resources. No mineral leases are located on the site.

4.2.3 Seismotectonic Setting—South Clive

Table 4.8 shows the historical earthquake data base, from 1850 through 1978, for magnitude 5.5 and larger earthquakes. The 1934 Hansel Valley event is the only moderate to large historical earthquake to pose a significant hazard to the site, but this hazard is less than that associated with nearer seismogenic structures.

In the past 10 years, two major seismic studies have been conducted for sites in the South Clive area. Those two investigations were: (1) for the Vitro tailings disposal facility adjacent to the South Clive site (DOE 1984b) (reproduced in Appendix H, Section H-2 of EUI 1992b), and (2) for a proposed site for the superconducting supercollider that would have formed a 24-km (15-mi) diameter elliptical ring around the South Clive site (Arabasz et al. 1989) (reproduced in Appendix K of EUI 1992b). During this same 10-year period, a major study of Quaternary faulting in the region was conducted by scientists from the U.S. Geological Survey (Barnhard and Dodge 1988).

Table 4.8 Earthquakes in the Utah Region, 1850 through 1978

Local Date		Lat. (°N)	Long. (°W)	Intensity I_o	Intensity M_L	Location
1884	Nov 10	42.0	111.3	VIII	(6)	Bear Lake Valley
1887	Dec 5	37.1	112.5	VII	(5–1.2)	Kanab
1900	Aug 1	40.0	112.1	VII	(5–1/2)	Eureka
1901	Nov 13	38.8	112.1	IX	6–1/2+)	Richfield
1902	Nov 17	37.4	113.5	VIII	(6)	Pine Valley
1909	Oct 5	41.8	112.7	VIII	(6)	Hansel Valley
1910	May 22	40.8	111.9	VII	(5–1/2)	Salt Lake City
1914	May 13	41.2	112.0	VII	(5–1/2)	Ogden
1921	Sept 29	38.7	112.2	VIII	(6)	Elsinore
1921	Oct 1	38.7	112.2	VIII	(6)	Elsinore
1934	Mar 12	41.7	112.8	IX	6.6	Hansel Valley (Kosmo)
1959	Jul 21	37.0	112.5	VI	5.5+	Utah–Arizona border (Kanab)
1962	Aug 30	42.0	111.7	VII	5.7	Cache Valley (Logan)
1966	Aug 16	37.5	114.2	VI	5.6	Nevada–Utah border
1975	Mar 28	42.1	112.5	VIII	6.0	Idaho–Utah border (Pocatello Valley)

Source: Arabasz et al. 1979
Note: Table includes earthquakes with maximum Modified Mercalli intensity (I_o) of VII or greater, or with Richter magnitude (M_L) 5.5 or greater.

The site area does not have recorded historical seismicity, but nearby seismogenic areas and geologic structures could pose a hazard to the site. Seismogenic sources (active faults) that could pose a hazard to the site include fault zones along the east flank of the Cedar Mountains, the east flank of the Newfoundland Mountains, the west flank of the Stansbury Mountains, and Puddle Valley. Other fault zones in the site region do not show evidence of being active. The density of possible seismogenic sources is considerably less than along the Wasatch Front located about 130 km (80 mi) east of the site.

The NRC has defined capable faults, as applied to the siting of power plants, in 10 CFR Part 100, Appendix A, Section III(g) as a fault having one or more of the following characteristics:

(1) Movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years.

(2) Macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault.

(3) A structural relationship to a capable fault according to characteristics (1) or (2) of this paragraph such as movement on one could be reasonably expected to be accompanied by movement on the other.

By the criteria of 10 CFR Part 100, Appendix A, III(g)(1) there is no evidence of a capable fault within 16 km (10 mi) of the site.

The known and suspected active or capable faults in the area are tabulated in Table 4.1 of Appendix K in the Environmental Report (EUI 1992b). Only five active or possibly active faults were detected within a 72-km (45-mi) radius of the site. Those faults, their distance from the South Clive site, the expected maximum magnitude of earthquake they could produce, and the expected peak acceleration [calculated using the equations published by Joyner and Boore (1988)] are tabulated in Table 4.9. Also listed in the table is the assumed maximum earthquake that would affect the site without producing surface fault rupture. That assumed earthquake is a magnitude 6.5 event centered 16 km (10 mi) from the site.

No other faults were identified by Arabasz et al. (1989) or Barnhard and Dodge (1988) that could move in sympathy with or be triggered by movement on a nearby capable fault. Thus, by 10 CFR Part 100, Appendix A, Section III(g)(3), there is no evidence of a capable fault at the site.

The above tabulation shows that the local earthquake magnitude and peak acceleration ($M = 6.5$ and $a_{max} = 0.37$ g) are consistent with earthquake magnitudes on nearby capable faults (Faults 1, 2, and 3) and with peak accelerations at the mean plus one standard deviation. By comparison with Figure 4.3, the expected return period for an acceleration of 0.37 g at a point within the superconducting supercollider ring, which would include the South Clive site, is much greater than 10,000 years, and by extrapolation would appear to have a return period of about 50,000 years. The latter recurrence interval yields an estimated 90% probability that a 0.37-g design acceleration would not be exceeded in 5,000 years at the South Clive site.

The magnitude 6.5 earthquake with a peak acceleration of 0.31 g q 0.06 g is assumed as the maximum nearby event for design, as noted above and specified in Appendix J of the Environmental Report EUI (1992b). Because there are no known capable faults in the near vicinity [within 16 km (10 mi)], the largest earthquake likely to occur without producing surface fault rupture was conservatively chosen as the design earthquake.

Figure 4.4 shows epicenters of the earthquakes that have been located instrumentally. The small circles on the map indicate epicenters located since 1962, when instrumental coverage became sufficient to locate nearly all earthquakes down to a magnitude of near 0. This figure shows no epicenters in the area in which the South Clive site lies. Thus, there are no epicenters that would indicate that an active fault lies beneath the South Clive area. Thus, by 10 CFR Part 100, Appendix A, Section III(g)(2), there is no macroseismic evidence of a capable fault in the near vicinity of the site.

Independent examination of the site and aerial photographs of the area found no evidence of Quaternary faulting. A copy of these findings is included in Appendix H, Section H-1 of the Environmental Report (EUI 1992b).

4.2.4 Maximum Credible Earthquakes and Recurrence Interval at South Clive

To assess the hazard to the site and to determine site design criteria, a Maximum Credible Earthquake (MCE) was established for each seismogenic fault which could affect the site (EUI 1992b). The MCEs calculated for the seismogenic sources affecting the South Clive site range in value from 6.8 to 7.3, as tabulated above. Calculations based on these seismogenic sources yield mean maximum expected accelerations in bedrock at the site of from 0.19 g to 0.31 g with expected variations of $\pm$0.06 g. The MCEs were calculated using total-length fault rupture and recurrence intervals in excess of 10,000 years for each individual fault, which is a characteristic interval for other Basin and Range tectonic features.

Table 4.9 Possibly Capable Faults within 72 km (45 Miles) of South Clive

Fault No.	Name	Nearest Distance [mi (km)]	Maximum Magnitude (M_S)	Maximum Acceleration (Mean)	Fraction of gravity (Mean + 1 σ)
1	E. flank Cedar Mts	12 (19)	6.6	0.18	0.34
2	W. flank Lakeside Mts	18 (29)	6.5	0.11	0.21
3	NW Puddle Valley	18 (29)	6.6	0.19	0.36
4	E. flank Newfoundland Mts.	26 (42)	6.8	0.09	0.17
5	W. flank Stansbury Mts.	34 (54)	7.3	0.09	0.17
-	Local earthquake without surface rupture	10 (15)	6.5	0.22	0.42

Source: EUI 1992b.

Note: 1 mile = 1.6 km

Some larger magnitudes and higher accelerations were used in preliminary studies for this investigation (Appendix U of EUI 1992b). Those higher values were used to test the sensitivity of soil materials beneath the site to liquefaction. The values cited in the above paragraph (0.31 g to 0.37 g) are the most probable maximums and are the values used for design of the proposed facility. These design accelerations were used in analyses of slope stability and ground settlement at the site (Appendices J and L of EUI 1992b).

4.3 Meteorology

The project region is in the Intermountain Plateau climatic zone that extends between the Cascade-Sierra Nevada Ranges and the Rocky Mountains, and is classified as a middle-latitude dry climate or steppe. The climate is characterized by hot and dry summers, cool springs and falls, and moderately cold winters. Table 4.10 has been included to show the correlation in temperature and precipitation between Wendover, Tooele, and Dugway. The South Clive site is between Dugway and Wendover [approximately 32 km (20 mi) from Dugway and 80 km (50 mi) from Wendover].

4.3.1 Weather Patterns

Mountain ranges tend to restrict the movement of weather systems into the Tooele County area, but the area is occasionally affected by well-developed storms in the prevailing regional westerlies. The mountains act as a barrier to frequent invasions of cold continental air. Precipitation is generally light during the summer and early fall and reaches a maximum in spring when storms from the Pacific Ocean are strong enough to move over the mountains. During the late fall and winter months, high-pressure systems tend to settle over the areas for as long as several weeks at a time. Under these conditions, smoke and haze accumulate in the lower levels of the stagnant air, frequently becoming associated with fog and obstructing visibility.Aside from the altitude and the mountains, the most influential natural condition affecting the regional climate is the Great Salt Lake. This large inland body of water, which never freezes because of its high salt content, tends to moderate downwind temperatures.

4.3.2 Temperature

Temperature data from the Wendover meteorological station [about 80 km (50 mi) due west of the South Clive site] show that temperatures have ranged from −28 to 44 °C (−19 to 112 °F) (EUI 1992b). Normal monthly average temperatures have ranged from −2.7 °C (27.1 °F) in January to 26.7 °C (80.0 °F) in July, with an annual average of 11.5 °C (52.7 °F). The daily normal average minimums ranged from −7.3 to 19.2 °C (18.8 to 66.6 °F) for January and July, respectively, while the normal average daily maximums ranged from 2 to 33 °C (36 to 92 °F) for the same months.

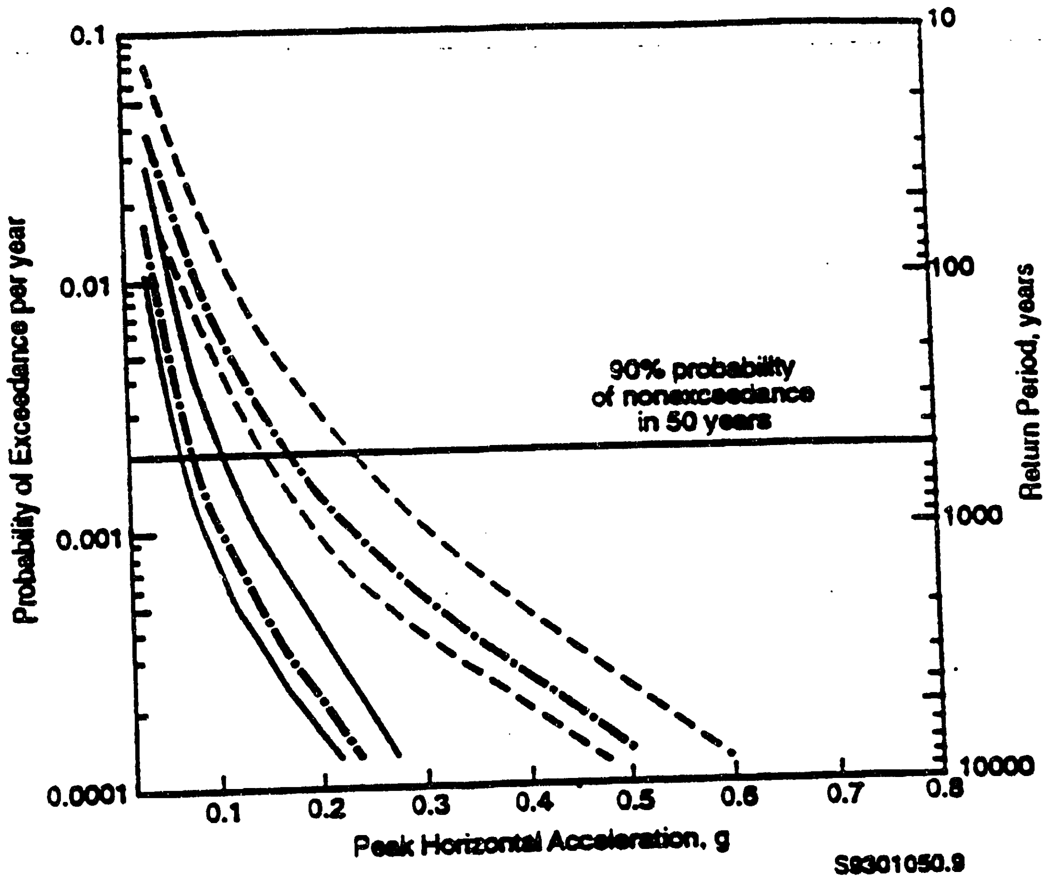


Figure 4.3 Preliminary Estimates of Ground-Shaking Hazard, Center of Cedar Mountains Site. (*Note:* **The solid curves were calculated using peak acceleration relationships. The dashed curves were calculated using upper-bound peak acceleration relationships. The three different curves in each set correspond to different sets of seismicity parameters.)** (*Source:* **EIU 1992b.)**

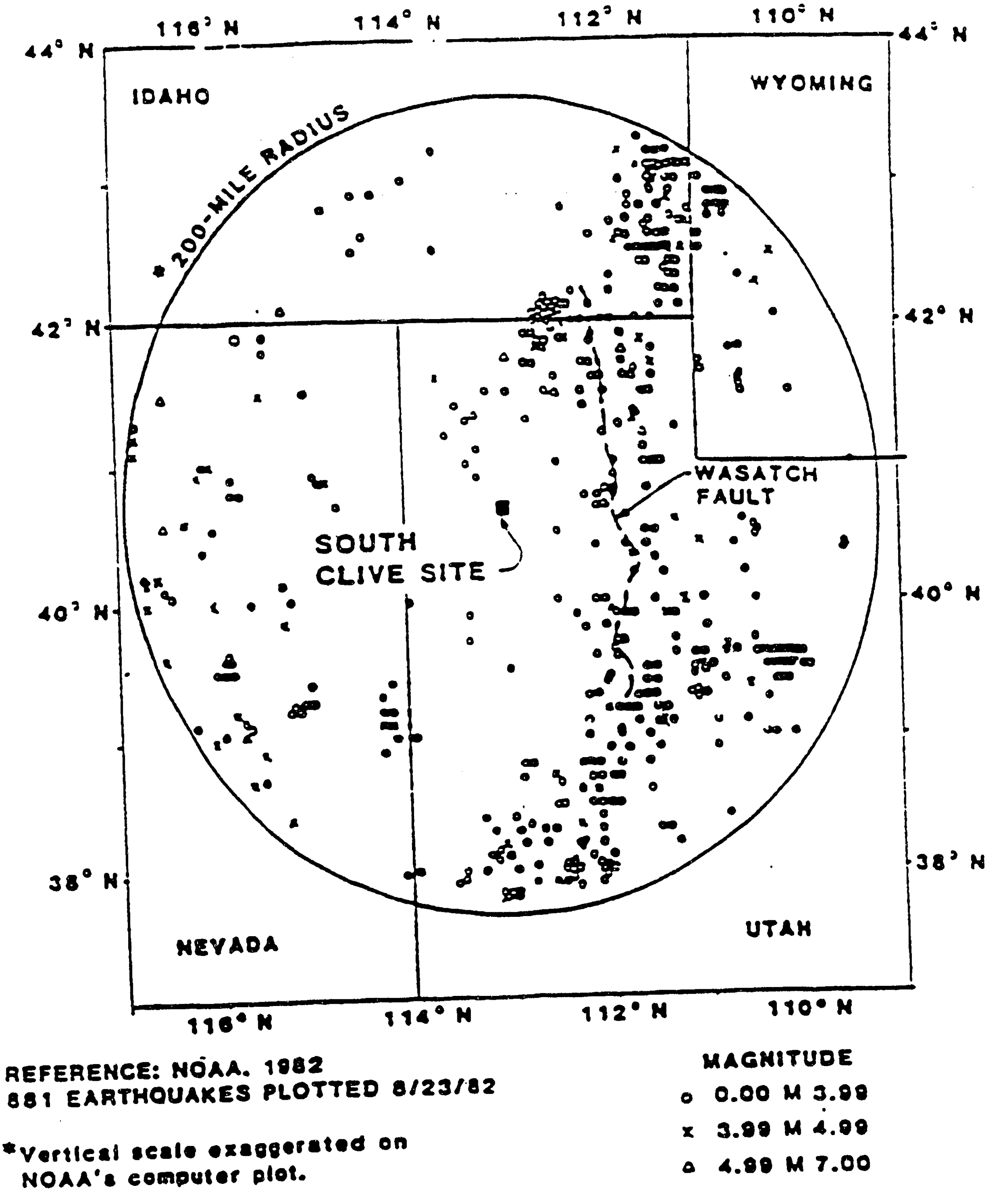


Figure 4.4 Earthquake Epicenters within 320-km (200-Mile) Radius of the South Clive Site

Table 4.10 Average Temperature and Precipitation Summary

	Dugway		Tooele		Wendover	
Month	Temp (°F)	Ppt (inches)	Temp (°F)	Ppt (inches)	Temp (°F)	Ppt (inches)
January	27.7	0.47	28.8	0.50	27.1	0.31
February	34.5	0.52	33.0	0.57	32.7	0.30
March	40.2	0.54	40.1	0.76	41.7	0.38
April	48.6	0.79	48.6	0.85	52.2	0.58
May	59.3	0.66	57.4	0.68	61.7	0.58
June	68.8	0.65	66.8	0.39	70.1	0.49
July	78.5	0.42	75.4	0.30	80.0	0.34
August	75.9	0.49	73.5	0.35	77.8	0.40
September	64.5	0.48	63.9	0.36	66.8	0.35
October	52.3	0.55	51.6	0.62	53.5	0.51
November	38.8	0.54	39.3	0.60	38.1	0.27
December	28.9	0.57	30.4	0.53	30.3	0.31
Annual	51.5	6.68	50.7	6.54	52.7	4.82

Source: EUI 1992b.

Notes: "ppt" is precipitation
"Temp" is temperature
1 inch = 2.54 cm
°C = (°F - 32)/1.8

4.3.3 Precipitation

Normal annual precipitation at the South Clive site is estimated to be approximately 15 cm (6 in.) based on Utah Department of Natural Resources Technical Publication No. 71. Detailed precipitation was not available for the site; however, significant data were available for Wendover and Dugway, which exhibit similar climates. Based on elevation, topography and vegetation, Wendover is more typical of the South Clive site than Dugway, even though Dugway is closer. Based on average annual precipitation, the Wendover data should be increased by 29% for the site. The lowest average monthly precipitation at Wendover is 0.69 cm (0.27 in.) in November, while April and May have the highest with 1.5 cm (0.58 in.).

The maximum recorded 24-hour precipitation at Wendover was 3.38 cm (1.33 in.) and the maximum monthly precipitation was 7.64 cm (3.01 in.). There have been many months during the period of record in which no precipitation was recorded. Snowfall is light; the maximum monthly amount recorded in 35 years was 37.1 cm (14.6 in.) in January; all other monthly maximums have been less than 25 cm (10 in). The maximum 24-hour snowfall was 21.6 cm (8.5 in.) in February of 1967. Annual snowfall is estimated at 5 cm (2 in.) equivalent rainfall. Based on a 39-year data record for Wendover, the South Clive site has an annual average of 48 days with 0.25 mm (0.01 in.) or more of precipitation; they are evenly distributed throughout the year. Thunderstorms occurred on 29 days per year over a 5-year period, the monthly maximum being 8 days in June. Snowfalls of 2.5 cm (1.0 in.) or more occurred an average of 3 days per year over a 25-year period.

4.3.4 Winds

An on-site weather station which measures wind velocity, direction, temperature and pressure at 5-minute intervals has been installed at the Envirocare facility at South Clive. The weather station is operated by the U.S. Army located in Dugway, Utah. Data have been obtained for all four seasons of the year. The data can be found in Appendix G of the Environmental Report (EUI 1992b). Table 4.11 contains wind direction and wind speed information based on percent frequency of occurrence. Table 4.12 contains monthly average wind speed, wind direction, air temperature and atmospheric pressure for 12 months beginning June 1991 and ending May 1992. The station reported gusts in excess of 20 m/s (44.7 mph) for 115 separate 5-minute measurement intervals throughout the 12 months. The station did not record any gusts in excess of 30 m/s (67.1 mph).

Table 4.11 Wind Direction Information

	Windspeed in knots					
Direction	0 – 3	4 – 6	7 – 10	11 – 16	17 – 21	>21
	Percent frequency of occurrence					
N–NNE	0.358	2.365	3.479	2.668	1.100	0.330
NNE–NE	0.261	1.788	2.957	2.406	0.894	0.193
NE–ENE	0.165	2.090	4.125	2.406	1.224	0.316
ENE–E	0.330	3.617	3.438	1.733	1.141	0.303
E–ESE	0.220	1.210	1.141	0.688	0.151	0.041
ESE–SE	0.193	0.866	0.605	0.399	0.083	0.041
SE–SSE	0.261	0.880	0.853	0.454	0.124	0.069
SSE–S	0.248	1.678	2.970	2.461	1.059	0.426
S–SSW	0.206	2.241	3.699	3.603	2.585	0.701
SSW–SW	0.248	1.540	2.021	1.911	0.729	0.248
SW–WSW	0.234	0.990	1.485	0.949	0.206	0.055
WSW–W	0.206	1.086	1.183	0.674	0.220	0.069
W–WNW	0.083	0.866	1.238	0.646	0.151	0.083
WNW–NW	0.206	1.086	1.416	1.045	0.344	0.138
NW–NNW	0.179	1.031	1.760	1.279	0.371	0.303
NNW–N	0.179	0.963	1.251	0.976	0.426	0.083
Total	3.577	24.297	33.621	24.298	10.808	3.399

Source:

Based upon Envirocare's on-site meteorological monitoring station for the period May 1992 through April 1993, which includes 7272 data points. During the winter and spring seasons 20.7% and 19.3% of the data is missing. Data loss for summer and fall seasons are 0.27% and 0.78% respectively.

Note: 1 knot = 1.15 miles/hr = 0.51 m/s

Table 4.12 Monthly Average Wind Data, U.S. Army Dugway Proving Ground, Clive Station

Month/Year	Wind Speed (miles/hr)	Wind Direction (°)	Temperature (°F)	Atmospheric Pressure (mbar)
June/1991	9.71	192.14	67.41	867.20
July/1991	8.39	166.76	80.24	867.20
Aug/1991	8.50	181.02	77.22	869.93
Sept/1991	6.82	71.57	63.12	872.81
Oct/1991	7.02	308.37	50.47	871.94
Nov/1991	6.26	179.18	36.32	874.04
Dec/1991	3.83	51.34	24.57	874.95
Jan/1992	3.38	104.42	21.09	875.39
Feb/1992	6.60	178.64	37.40	870.70
Mar/1992	6.49	132.27	45.48	867.69
Apr/1992	8.63	262.23	56.37	868.77
May/1992	9.46	235.01	62.55	869.19

Sources: EUI 1992b.
Monthly meteorologic data provided by Meteorologic Division, U.S. Army Dugway Proving Grounds.

Note: 1 mile/hr = 0.447 m/s
°C = (°F−32)/1.8
1 mbar = 1.02 X 10^{-7} kg/m^2

4.3.5 Evaporation

The average annual pond evaporation at South Clive is 1.5 m (60 in.). Pond evaporation between the months of May and October averages 0.9 m (36 in.), 80% of the average annual total lake evaporation (EUI 1992b). The average annual Class A pan evaporation for the Salt Lake City area is 1.4 m (56 in.). Because of higher temperatures and lower humidity than Salt Lake City, pan evaporation at South Clive can be expected to exceed this figure by as much as 15 cm (6 in.).

4.3.6 Average Inversion Height

The average annual inversion height for South Clive has been estimated at 1980 m (6500 ft) above sea level, or about 460 to 610 m (1500 to 2000 ft) above the valley floor.

4.3.7 Air Quality

The National Ambient Air Quality Standards (NAAQS) are used to classify the counties as being below the NAAQS (attainment) or above the NAAQS (nonattainment). Portions of Tooele County, including the South Clive site, are in attainment status for all NAAQS. Total suspended particulate measurements at the South Clive site have yielded monthly means that range from 5 to 42 μg/m^3 (5.6 X 10^{-4} to 4.7 X 10^{-3} grains/ft^3); the average annual mean is about 18 μg/m^3 (2.0 X 10^{-3} grains/ft^3) (EUI 1992b).

4.4 Hydrology

4.4.1 Surface Water

The area containing the South Clive site lies within the Great Basin drainage, a closed basin having no outlet. The South Clive site drains into the normally dry Ripple Valley depression on the eastern fringe of the Great Salt Lake Desert.

No surface-water bodies are present on the South Clive site. The nearest stream channel ends about 3 km (2 mi) east of the site and is typical of all the drainages along the transportation corridors within about 30 km (20 mi) of the South Clive site. Stream flows from higher elevations

South Clive site. Stream flows from higher elevations usually evaporate and infiltrate into the ground before reaching lower, flatter land. The stream channels are well defined in their upper reaches, but as they approach the flatlands, the size of the channel reduces until there is no evidence of a stream.

None of the ephemeral surface water bodies in the vicinity of the South Clive site are used for drinking purposes and most have no beneficial use. The nearest body of water with respect to the South Clive site that is utilized is 45.2 km (28.1 mi) to the east.

4.4.1.1 Description of the Watershed

The South Clive site lies to the west of the Cedar Mountains in a relatively flat basin. The streams within the watershed do not normally reach the site. There is no outlet for the watershed and any water that flows by the site would pond in a playa several miles to the west. The watershed above the site covers approximately 11,900 ha (46 mi^2) (Figure 4.5).

4.4.1.2 Historical Floods

No data on historical floods are available for the South Clive site.

4.4.1.3 Synthetic Flood Analyses

Appendix F of the Environmental Report (EUI 1992) contains the calculations for runoff peak flow values attributable to the Probable Maximum Flood (PMF), resulting from the Probable Maximum Precipitation (PMP) of 24.6 cm (9.7 in.) of rain over a 6-hour period on the South Clive watershed. The calculated peak flow is 2125 m^3/s (75,000 ft^3/s).

The PMF would most likely flow predominantly to the south of the South Clive site with the fringes of the flow encroaching upon the site. The maximum depth of flow at the South Clive site was calculated to be less than 60 cm (2 ft).

Runoff from such a hypothetical event as the PMP or PMF [the heaviest reported rainfall in the area is 3.3 cm (1.3 in.) over a 24-hour period] would be diverted from encroaching into the disposal cell by using a berm surrounding the disposal area. In extreme events, such as a PMF, sheet flow could pass over the South Clive site but it would be nonchannelized.

4.4.1.4 Surface Water Quality and Utilization

Surface water quality data are generally unavailable for Tooele County, which is a reflection of the lack of water and population centers. The only water quality station is at Big Spring near Timpie (S–4 on Figure 4.6). The spring feeds a waterfowl management area and has no other uses. The water is very hard and very high in dissolved solids, primarily sodium chloride (table salt). Moderate concentrations of arsenic, nickel, copper, and silver are also present.

4.4.2 Groundwater

4.4.2.1 Hydrogeologic Setting

The proposed disposal site is located in the eastern part of the semi-arid Great Salt Lake Desert. The site region is a sediment-filled basin, characteristic of the Basin and Range physiography. The basin fill in the site area is estimated to consist of approximately 75 m (250 ft) of largely unconsolidated lacustrine and alluvial deposits underlain by semi-consolidated alluvial and fluvial gravel, sand, and clay (Figure 4.7).

The aquifer system that may be impacted by the proposed disposal site occurs in the top 30 m (100 ft) of the basin fill, where two aquifers have been identified and designated as a shallow unconfined aquifer and a deep confined aquifer (EUI 1992b). These aquifers are separated by confining clay and silt beds with the main confining bed located at a depth of about 12 m (40 ft). The unconfined aquifer has poor quality, highly-saline water, with up to 75,000 mg/L (0.63 lb/gal) total dissolved solids (TDS). Water in the confined aquifer has a TDS content of about 20,000 mg/L (0.17 lb/gal).

The local groundwater recharge from meteoric sources in the site area and the Great Lake Desert is generally limited. The recorded annual pan evaporation is more than 1.5 m (60 in.), which is significantly higher than the recorded annual precipitation of less than 15 cm (6 in.) (EUI 1992b). Due to a relatively higher precipitation and a more favorable lithology near the mountains, it is likely that the recharge occurs largely in the areas adjoining the mountain ranges and moves as subsurface flow toward the center of the basin. This is supported by the high salinity and the isotopic composition of the area groundwater, which are indicative of long flow paths and/or long residence time.

There is evidence that the site is located in a regional groundwater discharge setting, with largely upward flow and flow gradients. This is because (1) water level and density measurements in several wells completed to different depths in the site area indicate a consistent increase of the potentiometric head with depth; (2) the salinity and isotopic composition of the subsurface water are indicative of long flow paths, long residence time, or both; and, (3) the site is located in a regionally low physiographic and topographic setting, which is characteristic of regional groundwater flow discharge zones.

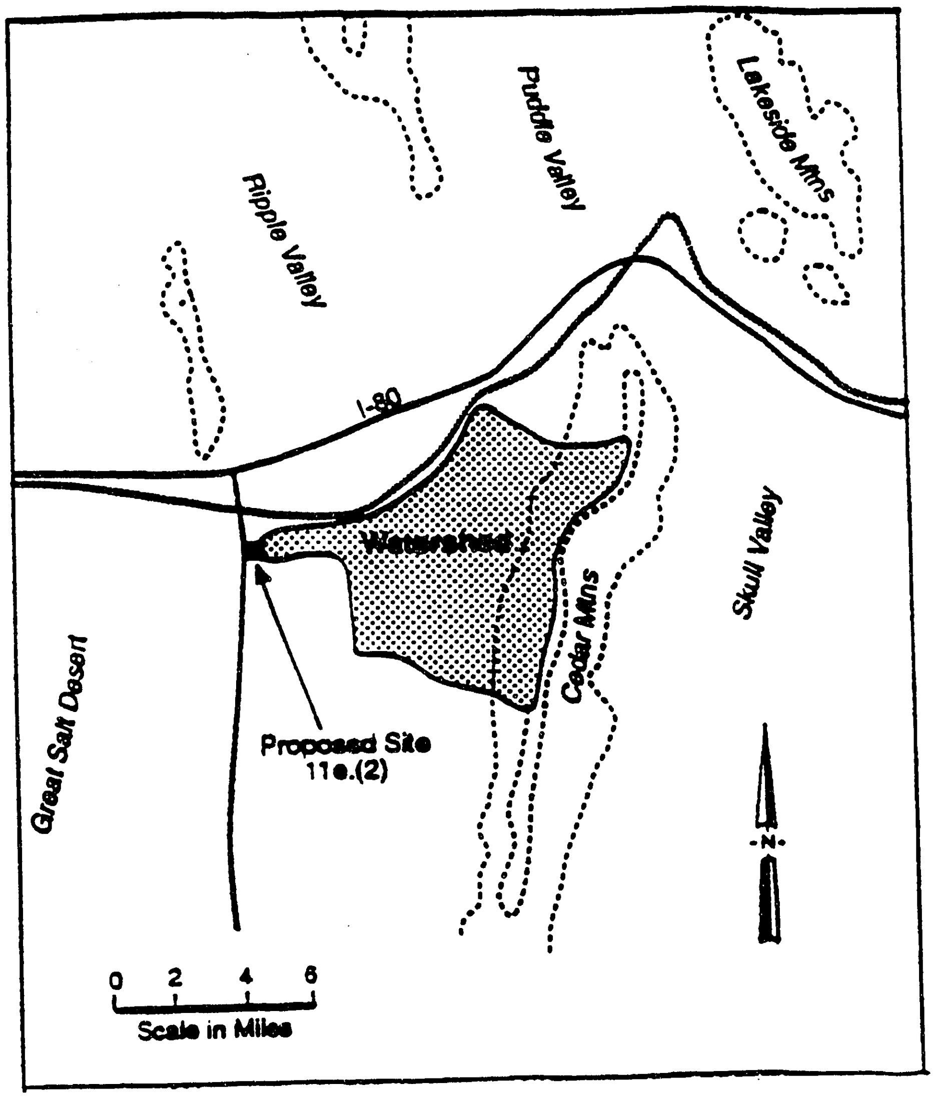


Figure 4.5 South Clive Watershed

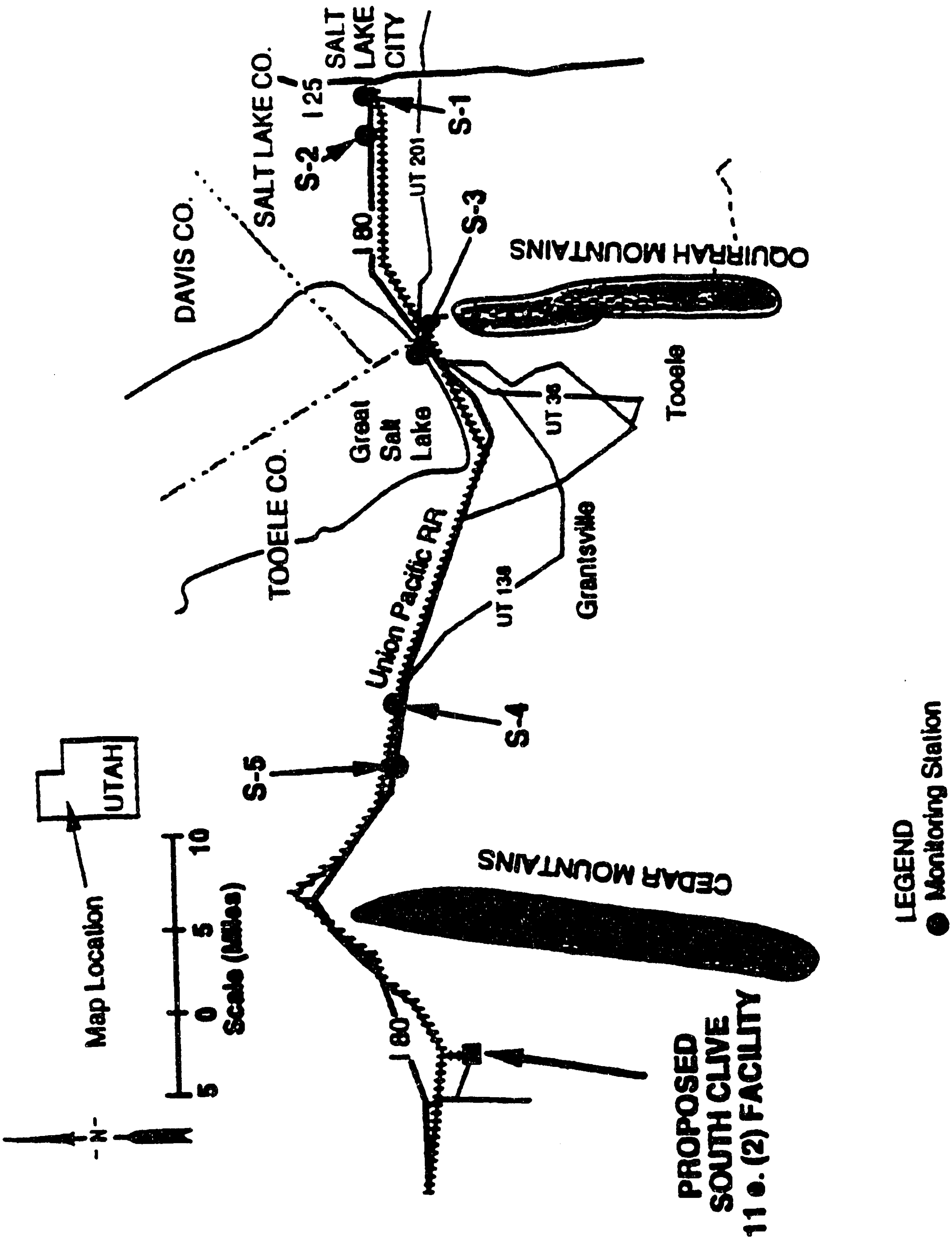


Figure 4.6 Locations of Surface-Water Quality Sampling Stations

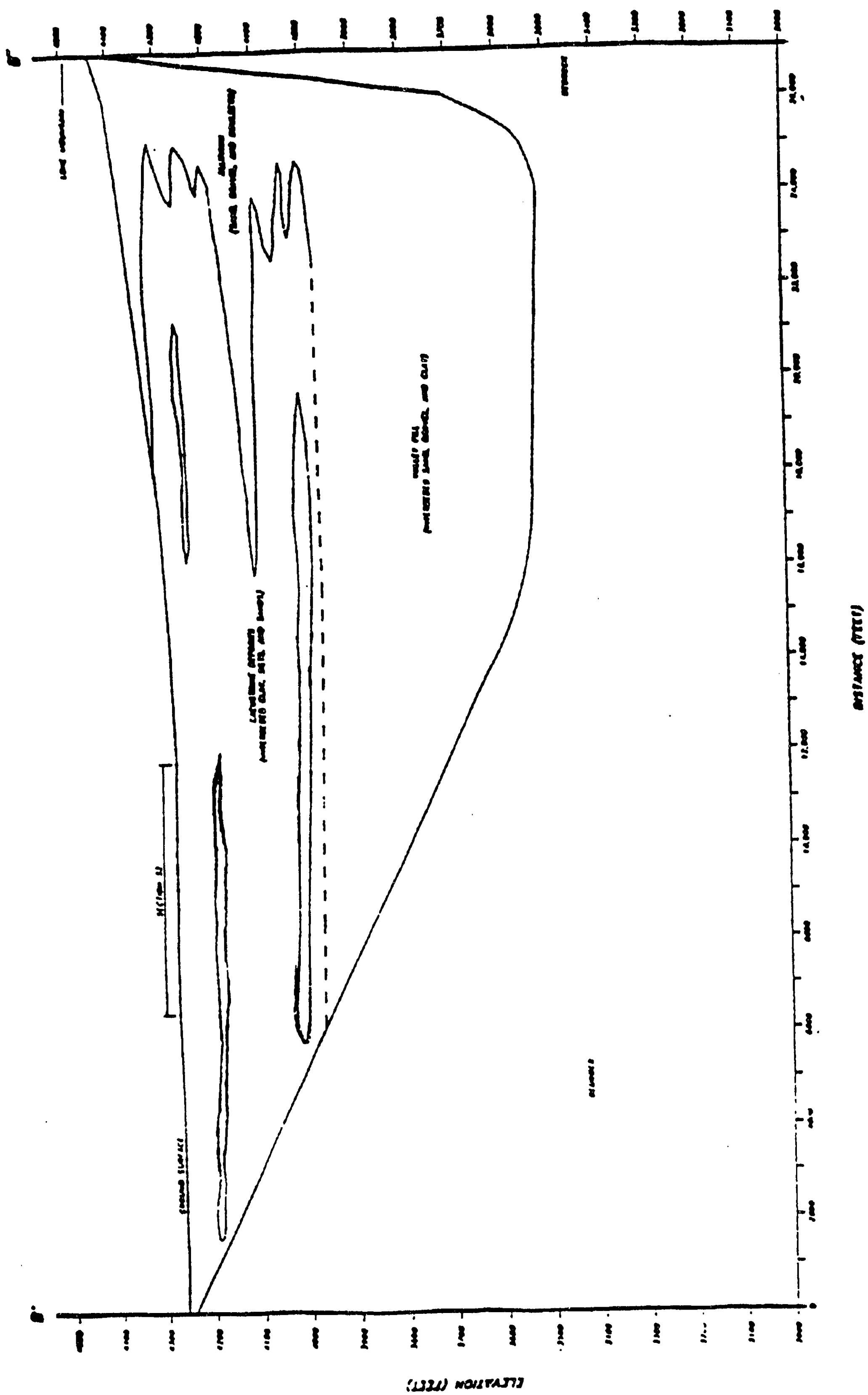


Figure 4.7 Stratigraphic Cross-Section

4.4.2.2 Hydrogeologic Units

The hydrogeologic units in the disposal site area were delineated based on data obtained from borehole and monitor-well drilling conducted at the site by Envirocare and in the immediate vicinity of the site by other parties.

Four lithostratigraphic units have been identified in the basin fill to about a 30-m (100-ft) depth beneath the site. These include from the top, a silty clay layer, a clayey sand layer with occasional silty to sandy clay lenses, a lower layer of clay, and a lower layer of sand (Figure 4.7). The layers dip gently westward and generally range from a few feet to 9 m (30 ft) in thickness, except for the lower sand layer, which has a thickness of up to 23 m (75 ft) or more. There is no available data to delineate the lithostratigraphy below a 30-m (100-ft) depth.

Both of the sand layers in the lithostratigraphic profile constitute water-bearing units in the site area. Groundwater occurs under unconfined conditions in the upper sand layer, and under confined conditions in the lower sand layer. These aquifers have been designated in this EIS as shallow and deep aquifers, respectively.

The top clay layer is unsaturated and the lower clay layer constitutes the confining bed separating the shallow and deep aquifers. Although the lower clay layer appears to be the most prominent confining bed between the sand layers, there may be other less prominent clay and/or silt beds within the sand layers that may also be contributing to the confinement of the deep aquifer.

4.4.2.3 Hydraulic and Transport Properties

The hydraulic properties of the various hydrogeologic units were determined from field and laboratory tests. The field testing by Envirocare involved conducting slug-injection tests in 24 wells to determine the hydraulic conductivity for the saturated lithostratigraphic units; namely, the upper and lower sand layers and the lower clay layer. The laboratory tests were conducted on selected samples obtained from the upper clay and upper sand layers to determine the field bulk density, water content, porosity, water retention characteristics, and the unsaturated hydraulic conductivity.

The saturated hydraulic conductivities obtained from the slug-injection tests indicate that the hydraulic conductivity was 1.9×10^{-3} cm/s (7.5×10^{-4} in./s) for the upper sand layer (i.e. shallow aquifer); 2.8×10^{-5} to 4.4×10^{-4} cm/s (1.1×10^{-5} to 1.7×10^{-4} in./s) for tested intervals intersecting both the shallow aquifer and the underlying confining bed; 5.0×10^{-5} to 1.7×10^{-4} cm/s (2.0×10^{-5} to 6.7×10^{-5} in./s) for the lower clay layer (i.e. confining bed); and 1.2×10^{-3} cm/s (4.7×10^{-4} in./s) for the lower sand layer (i.e. confined aquifer).

Moisture-content measurements were conducted by Envirocare on a total of 50 lithologic samples obtained at different intervals from the ground surface to a maximum depth of 11 m (36 ft). The total porosity was computed for 25 samples from the moisture-content data. The computed total porosity ranged between 0.36 and 0.58 for the top clay layer (10 samples); between 0.36 and 0.57 for the upper sand layer (7 samples); and between 0.38 and 0.59 for the lower clay representing the main confining bed (8 samples). The effective porosity values were estimated at 0.20 (lateral) and 0.10 (vertical).

No measurements or tests were carried out to determine site-specific contaminant transport properties (i.e., diffusion, distribution coefficient) in the disposal site area.

4.4.2.4 Groundwater Flow Regime

Water Levels. Measured water levels in the unconfined aquifer indicate that the water table ranges from 5.5 to more than 9 m (18 to more than 30 ft) below ground in the disposal site vicinity, and that the highest water table below the proposed disposal cell is 5.5 m (18 ft). Historical water level fluctuations obtained from available data for the past 10 years in the general area of the site range from 60 to 90 cm (2 to 3 ft). Recent measurements indicate that water level fluctuations were about 15 to 30 cm (0.5 to 1 ft) over the past 1 to 2.5 years (EUI 1992b).

The measured water levels and the freshwater-equivalent heads in the confined aquifer are higher than the corresponding levels in the unconfined aquifer. This is indicative of a local upward hydraulic gradient and flow from the confined aquifer to the unconfined aquifer. The upward hydraulic gradient was determined to range from 0.10 to 0.48, from measured water levels in well clusters with wells completed to different depths at three locations in the disposal site area (EUI 1992b).

Lateral Groundwater Flow. The total potentiometric heads were evaluated in freshwater-equivalent heads from measured water levels, and measured and estimated specific gravity data. The specific gravity was either measured or estimated for individual wells from the TDS content or the electrical conductivity of the water. Horizontal groundwater gradients were determined to range from 0.0001 to 0.002.

The computed freshwater-equivalent heads were used to prepare potentiometric-head contour maps for February, May, and October 1991 and January 1992. Figure 4.8 provides the potentiometric-head contour map for January 1992. The computed freshwater-equivalent heads for the unconfined aquifer indicated that the lateral subsurface flow in the area of the disposal site is generally toward the north, and locally toward the northeast and northwest. It is noted, however, that the land slopes toward the southwest, or that the computed flow gradients

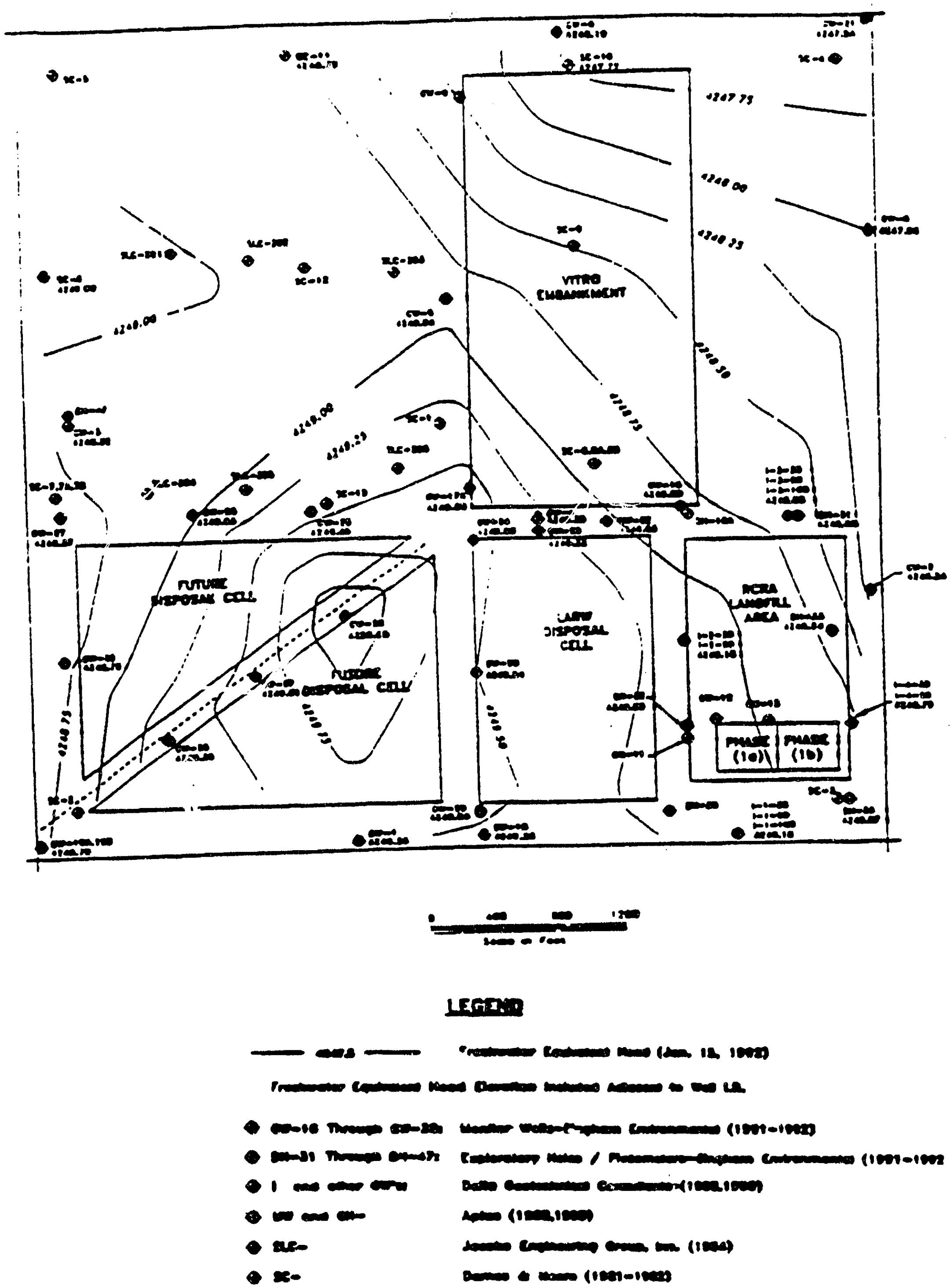


Figure 4.8 Potentiometric Head Contour Map

are in opposite direction to the prevailing land slope. This is not typical of unconfined flow conditions, where recharge is principally from local precipitation or local surface water sources.

The apparent nonconformity between the computed potentiometric heads and the land slope in the disposal site area could be attributed to a significant recharge component that the unconfined aquifer may be receiving in upward flow from the underlying confined aquifer, compared to an essentially insignificant local recharge from meteoric sources. Under these conditions, the potentiometric-head gradients would be largely controlled by the magnitude and distribution of the upward flow over the site area, and less by the land topography. But there was no analysis carried out to delineate the magnitude and distribution of the upward flow over the site area in support of this conclusion.

In consideration of the inconsistency between the land slope and the computed flow gradients in the unconfined aquifer, the use of estimated specific gravity values in evaluating the freshwater-equivalent heads for some wells, and the largely small computed groundwater gradients in the area of the site, the direction of groundwater flow may differ locally from that indicated by the freshwater-equivalent heads.

Lateral subsurface flow velocity was determined to be about 6 m (20 ft) per year or about 6.5 km (4 mi) over the design life of the disposal cell of 1,000 years. This velocity value was determined using the following equation and conservative values for the aquifer coefficients:

$$v = Ki/n,$$

where:

- v = Flow Velocity
- K = Lateral Hydraulic Conductivity, 1.9×10^{-3} cm/s (7.48×10^{-4} in./s)
- i = Lateral Hydraulic Gradient, 0.002
- n = Effective Porosity, 0.2

Vertical Groundwater Flow. The available potentiometric head data indicate that wells screened in the confined aquifer at more than a 14-m (45-ft) depth, exhibit higher measured and freshwater-equivalent heads than wells screened in the unconfined aquifer, which indicates that there is an upward vertical flow component in the site area, from the confined aquifer to the unconfined aquifer. The measured head differences range from 7 to 45 cm (3 to 18 in.). However, the specific gravity of the water in the unconfined aquifer [up to 75,000 mg/L (0.63 lb/gal) TDS] was determined to be 1.035, compared to a specific gravity of 1.019 for the water in the confined aquifer [about 20,000 mg/L (0.17 lb/gal) total dissolved solids]. It was estimated that these differences in the specific gravity of the water could cause a downward gradient of up to 6 cm (0.2 ft) or more than 5 cm (2 in.) (EUI 1992b). Therefore, the measured water levels and the measured or estimated specific gravity were used to determine the freshwater-equivalent heads in order to delineate the total potentiometric heads in the uppermost aquifer. Accordingly, it was determined that the total potentiometric heads (i.e., freshwater equivalent heads) in the confined aquifer were higher than the corresponding heads in the overlying unconfined aquifer.

The upward vertical flow velocity across the confining bed(s) was determined to be about 6 m/yr (20 ft/yr), using a vertical hydraulic conductivity ranging from 5×10^{-5} to 1.7×10^{-4} cm/s (1.9×10^{-5} to 6.7×10^{-5} in./s), a vertical hydraulic gradient of 0.04, and an effective porosity of 0.10, based on the available database for the site area.

4.4.2.5 Groundwater Quality, Use, and Geochemistry

Groundwater quality data are available for the disposal site area from previous investigations, including data collected by DOE for the Vitro disposal cell, and by the Aptus Corporation. In addition, Envirocare has collected and analyzed water samples from on-site wells on a quarterly basis for several years to meet the requirements of the existing permits. A total of seven on-site wells have been used in this monitoring, and six new monitoring wells have been installed in the immediate vicinity of the proposed disposal cell. Water samples from these wells were analyzed for inorganic constituents, radioactive constituents, and selected solute and stable/unstable isotope ratios. The results of the analyses to date are provided for individual wells in the Environmental Report (EUI 1992b).

Although the available groundwater quality database depicts some inconsistencies, the data conclusively indicate that the groundwater in the proposed disposal site area is of a poor quality and unsuitable for most known uses. The unconfined uppermost aquifer has a TDS content of 20,000 to 75,000 mg/L (0.17 to 0.63 lb/gal); the TDS content in the confined aquifer is about 20,000 mg/L (0.17 lb/gal). According to the EPA classification, both aquifers are considered Class III, since they both have a TDS content in excess of 10,000 mg/L (0.08 lb/gal). Furthermore, the concentration of some of the inorganic constituents in the uppermost aquifer (sulfate, chloride, iron, and manganese) is significantly higher than the EPA's secondary groundwater standards.

Sodium is the most predominant cation and chloride is the most predominant anion, as can be seen in the Stiff and Tri-linear Diagram plots in Figures 4.9 and 4.10, respectively. The high levels of TDS and sodium and chloride

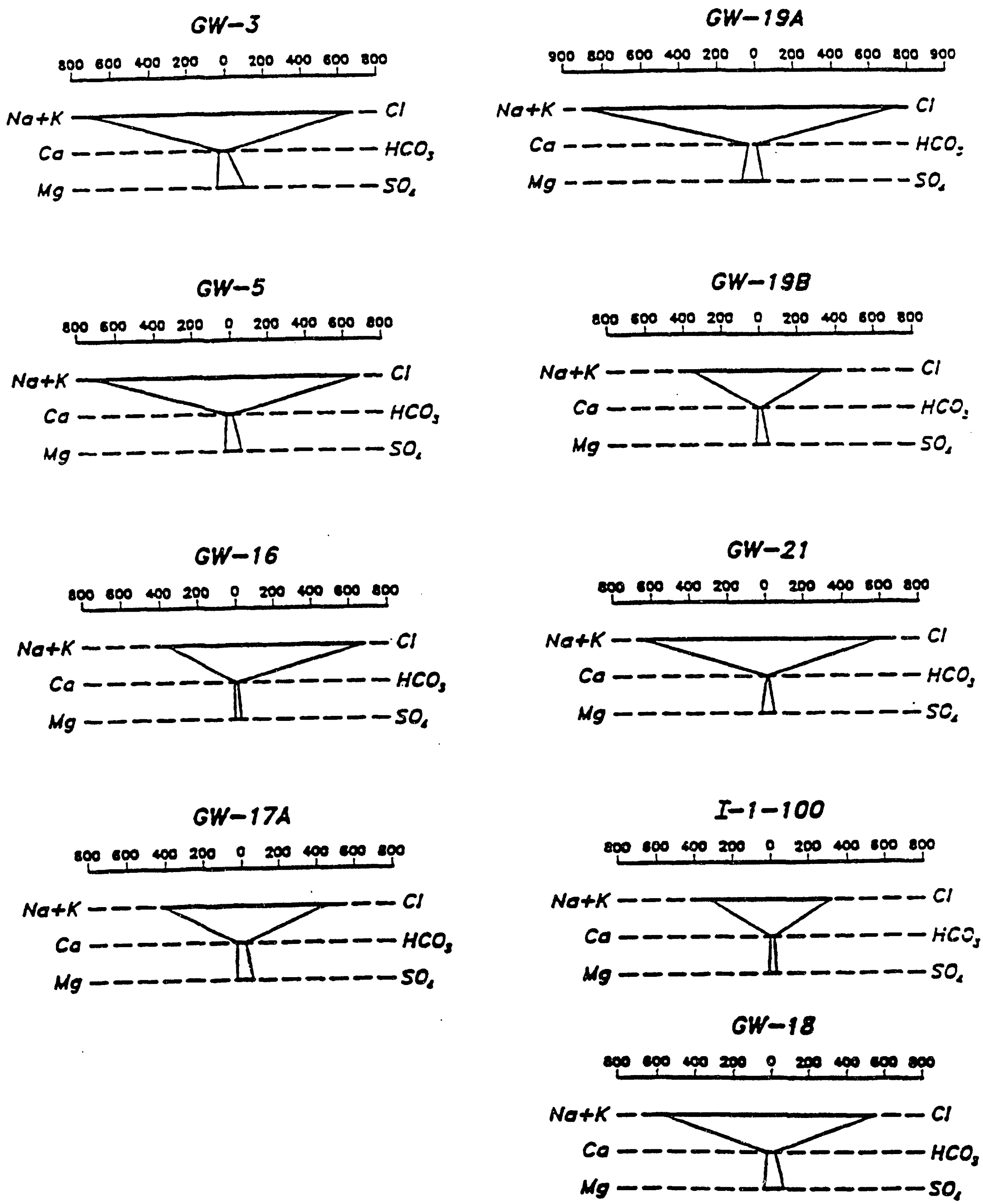


Figure 4.9 Stiff Water Quality Plot

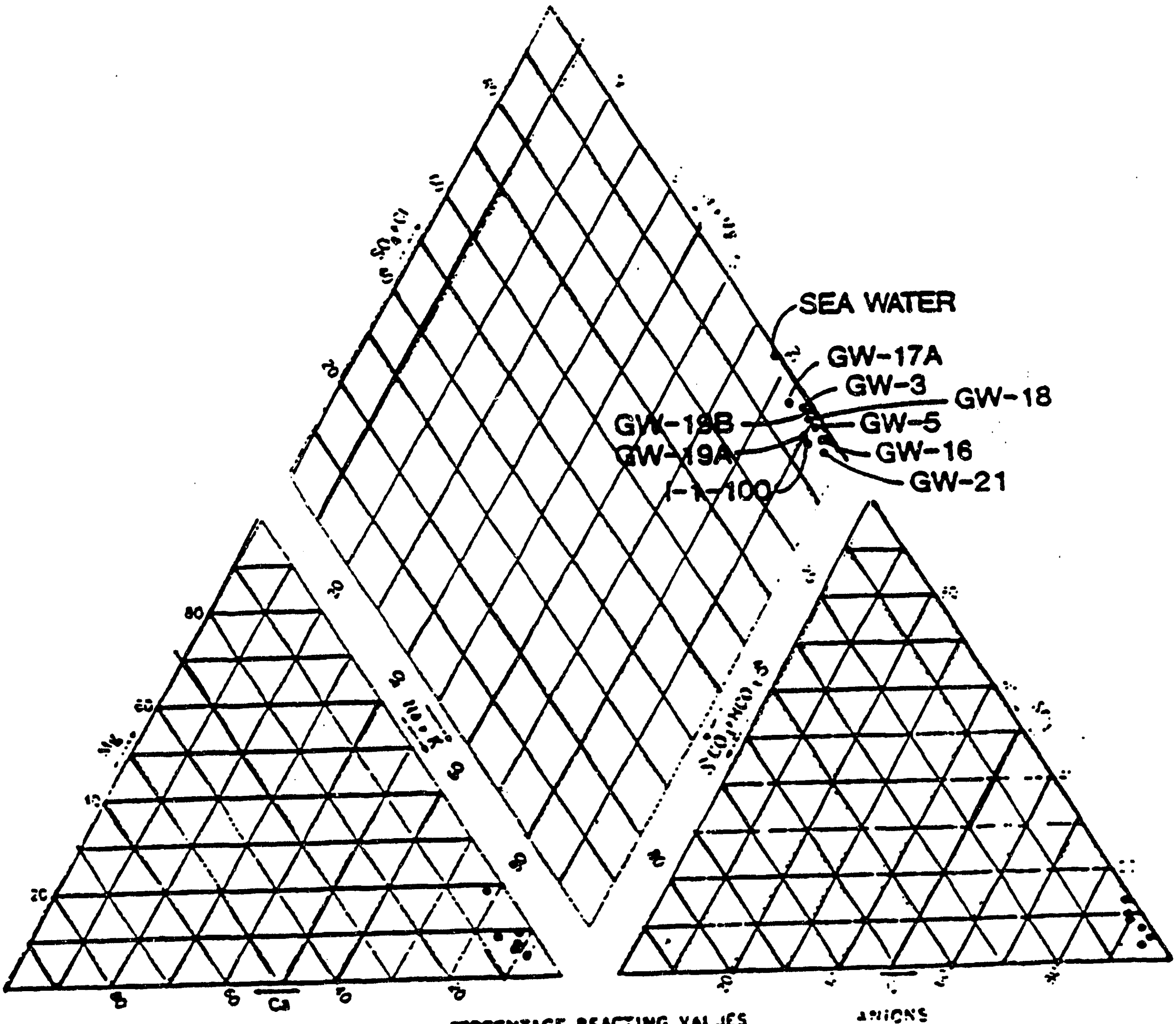


Figure 4.10 Tri-linear Water Quality Plot

concentrations in the water are characteristic of long flow paths, residence time, or both. The sodium and chloride concentrations decrease with increasing depth, which provides additional evidence that there is minimal or no downward vertical movement from the unconfined to the confined aquifers.

Radionuclide analysis by Envirocare included Gross Alpha, Gross Beta, ^{226}Ra, ^{228}Ra, ^{222}Rn, ^{210}Pb, ^{210}Po, ^{137}Cs, ^{230}Th, and total uranium on samples obtained from seven on-site wells. Plots of the concentrations of selected radionuclides (Gross Alpha, Gross Beta, ^{226}Ra, and total uranium) showing the change in the radionuclide concentrations during the past several years indicate that above-normal concentrations were recorded for some radionuclides (^{226}Ra and total uranium in Monitoring Well GW-3, for example), although above-normal levels could not be confirmed in repeat analyses.

The stable/unstable ratios were determined for selected isotopes by Envirocare, in order to characterize groundwater recharge sources, geochemistry, and flow. The following isotopes were analyzed: hydrogen (H-2/H-1), oxygen (O-18/O-16); carbon (C-13/C-12); and sulphur (S-34/S-32). Tritium (H-3) and carbon 14 (C-14) were also determined for selected wells to evaluate the age of the water. The results show that there are low tritium concentrations (1.8 - 4.9 TU) in the groundwater, which suggests a pre-1953 recharge and subsequently long subsurface flow paths, long residence time, or both. Radiocarbon dating of the water was inconclusive.

The groundwater quality assessment by Envirocare also involved determining the saturation index (SI) for selected minerals, which is a measure of the water's tendency to precipitate (positive SI) or dissolve (negative SI) a mineral. Envirocare concluded that groundwater in the site area has a tendency to precipitate such minerals as aragonite, calcite, dolomite, fluorite, and magnesite, and a tendency to dissolve such minerals as halite, gypsum, anhydrite, and mirabilite but that the dissolution/precipitation tendencies of some minerals are complex. The dissolution and precipitation of minerals in the groundwater in the site area is controlled generally by complex mineralogical and geochemical factors that cannot be thoroughly analyzed from the available data.

4.5 Ecology

4.5.1 Vegetation

The vegetation of the South Clive site is a homogeneous, semi-desert low shrubland, primarily composed of shadscale (*Atriplex confertifolia*). The shrubland is part of the Northern Desert Shrub Biome of the Cold Desert Formation and has been described as a Saltbush (Shadscale)-Greasewood Shrub complex. Plant communities identified on the site are Shadscale-Gray Molly (*Kochia americana var. vestita*), a transitional community type of Shadscale-Gray Molly-Black Greasewood (*Sarcobatus vermiculatus*), and Black Greasewood-Gardner Saltbush (*Atriplex nuttallii*).

Representative of the desert shrub/saltbush community are low widely spaced shrubs, totaling approximately 10% ground cover (Cronquist et al. 1972). Dominant shrubs on the Clive site include shadscale, Nuttall's saltbush, and winterfat (SCS 1987). Vegetation patterns of the South Clive site are correlated with soil salinity and corresponding shifts in presence or abundance of species. All three communities are low in species diversity. Seep-weed or inkweed (*Suaeda torreyana*) and scattered perfoliate pepperweek (*Lepidium perfoliatum*) are the only prominent understory species of the Shadscale-Gray Molly community. This community occurs over most of the South Clive site, although black greasewood becomes prominent enough on the eastern quarter to form a Shadscale-Black Greasewood-Gray Molly community. Except for black greasewood and occasional stands of halogeton (*Halogeton glomeratus*), the composition is similar to the more prominent Shadscale-Gray Molly community.

The Black Greasewood-Gardner Saltbush community type is floristically the most diverse but only occurs in the extreme northeast corner and eastern edge of the South Clive site. In addition to Gardner saltbush, the flora is composed of all species found in the other communities, except halogeton.

The South Clive site occurs in the Desert Alkali range site, which is rated by the Bureau of Land Management (BLM) as being poor for grazing or forage production. However, the vegetation forms an important ground cover and deterrent to soil erosion and provides habitat for wildlife species. Annual production of the three community types ranged from 170 to 580 kg/ha (152 to 517 lb/acre), air dry. Annual production for the range site is given as 56 to 224 kg/ha (50 to 200 lb/acre) and 560 to 1680 kg/ha (500 to 1500 lb/acre) during unfavorable and favorable years, respectively. Livestock-carrying capacity with such production would range from 1.2 to 32 ha (3 to 80 acres) per animal-unit month.

4.5.2 Terrestrial Wildlife

Two habitat types (shadscale flats and greasewood) occur on the South Clive site. Animal species typical of the site include black-tailed jackrabbit (*Lepus californicus*), deer mouse (*Peromyscus maniculatus*), horned lark (*Eremophila alpestris*), and desert horned lizard (*Phrynosoma platyrhinos*); species diversity is low. All of these animal species could use the site for breeding or nesting. Jackrabbits, deer mice, and grasshopper mice (*Onychomys leucogaster*) were the only mammals collected during field surveys for this EIS.

The South Clive site is located within the yearlong range of the pronghorn antelope. The West Desert Herd Unit 2A occurs south of I-80 and includes the South Clive site (BLM 1988b). Pronghorn are rare in the project area south of I-80. The area is considered poor pronghorn habitat. I-80 acts as a barrier to most pronghorn movement south from the Puddle Valley Herd Unit. No critical pronghorn habitat occurs on the West Desert Herd Unit near the Clive site (EUI 1992b).

Mourning doves are spring and summer residents, arriving in February or March and migrating out of the area in August or September. Doves are most abundant in edge or ecotone areas, particularly interspersions of agricultural, sagebrush, and pinyon-juniper types. Mourning doves are the only gamebird occurring on the Clive site.

A variety of non-game mammals, birds, and reptiles are supported by habitats found in the project area and associated utility, railroad, and access road right-of-ways. Species that may occur include the Townsend's ground squirrel, Ord's kangaroo rat, desert woodrat, western harvest mouse, side-blotched lizard, gopher snake, Brewer's sparrow, black-throated sparrow, and horned lark (BLM 1987).

4.5.3 Aquatic Biota

Aquatic ecosystems do not occur on or near the South Clive site.

4.5.4 Endangered, Threatened or Other Special Status Species

No important plant or animal species, as defined by NRC (1980), are known to occur on the South Clive site and no known important habitats have been identified in the area.

No threatened or endangered plant species are known to occur in the vicinity of the South Clive site. Similarly, no threatened or endangered animal species are known to occur on the South Clive site. However, the Utah Division of Wildlife Resources reports that the area is used for foraging by bald eagles (*Haliaeetus leucocephalus*) during the winter.

The bald eagle and American peregrine falcon are federally-listed endangered species that could occur within the project area (USFWS 1987). The bald eagle is a winter resident from late November to mid-March in the project vicinity. The majority of wintering eagles are found in Rush Valley with others occurring in Skull and Cedar Valleys. No bald eagle roosts are located within the project area; however, the black-tailed jackrabbit is the primary food source of bald eagles in Tooele County (BLM 1988), and eagles may potentially hunt within this area.

One historical aerie of the American peregrine falcon was located near Timpie Springs Wildlife Management Area (WMA) in the northern end of the Stansbury Mountains. The nest site became inactive following the construction of I-80 in the late 1960s (BLM 1988). In an attempt to re-establish a breeding pair of peregrines, the Utah Division of Wildlife Resources, in cooperation with the U.S. Fish and Wildlife Service (USFWS), erected a hack site at the Timpie Springs WMA, approximately 42 km (26 mi) from the Clive site. The hack site became active in 1983 and 1984, and a peregrine pair was observed using the site in Spring 1987. The hack site was occupied in 1989 by a nesting pair of peregrines. Peregrines are known to arrive in the area in March and, if nesting, may remain until September. Due to the distance between the South Clive site and the aerie, it is unlikely that any peregrines utilize the project area (EUI 1992b).

Since publication of the Draft Environmental Impact Statement (DEIS), the USFWS has been consulted and has confirmed that the list of threatened and endangered species, as given above, is correct and complete. The USFWS also concurs with the conclusion that the proposed project would not affect either the bald eagle or the peregrine falcon (Robert D. Williams, State Supervisor, U.S. Department of the Interior, Fish and Wildlife Services, Utah State Office, Salt Lake City, letter to John J. Surmeier, Chief, Uranium Recovery Branch, Nuclear Regulatory Commission, Washington, DC, June 21, 1993).

The Cedar Mountains contain a wild horse herd protected under the Wild and Free Roaming Horse and Burro Act of 1971. The Cedar Mountain herd presently contains an estimated 125 horses and extends from 6 km (4 mi) north of Eight Mile Spring to the southern portion of the Cedar Mountain range (BLM 1988). Wild horses are seldom encountered on the South Clive site. The state sensitive kit fox may occur throughout the West Desert Hazardous Industry Area (BLM 1990).

4.6 Socioeconomic Characteristics

An estimated 25,442 people resided within 80 km (50 mi) of the South Clive site at the time of the 1990 census, but most of the area is uninhabited. The closest residents lived 24 to 32 km (15 to 20 mi) to the northeast of the site. The largest number lived 48 to 80 km (30 to 50 mi) to the east and southeast of the site in the Tooele-Grantsville area. Tooele City is the largest community in the county and Grantsville is the second largest city. Table 4.13 presents estimates of the 1990 population within 80 km (50

Table 4.13 Population Wheel for South Clive Site Preliminary 1990 Census Data

Direction	Distance in miles									
	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25-30	30-35	35-40	40-45	45-50
N										
NNE										
NE										
ENE				8						
E					11		2,771	1,821	1,398	852
ESE					30		26	125	14,801	3,223
SE					21	20	7	52	124	12
SSE										
S										
SSW										
SW										
WSW										
W										1,140
WNW										
NW										
NNW										
Total	0	0	0	8	62	20	2,804	1,998	16,323	5,227

Source: EUI 1992b.

Note: 1 mile = 1.6 km

mi) of the South Clive site by compass direction and radial distance (EUI 1992b).

Tooele County is a rural area with a 1987 population density of approximately 0.016 persons/ha (4.1 persons/mi2). The majority of the population is concentrated in or near the communities of Tooele city, Grantsville, Wendover, and Dugway. It is projected that Tooele County will increase its population at an annual rate of 1.4% until the year 2000. It is expected that the largest percentages of growth will occur in Tooele City, Grantsville, and Wendover. Population projections for the county indicate that the number of people living in Tooele County by the year 2000 will exceed 34,000 for about a 31% increase over 1980 levels (Bureau of Economic and Business Research 1988; BLM 1990).

Economic data reveal that the Tooele County economy is stable due to federal military employment but, like most rural areas in Utah, has a relatively high unemployment rate and an underdeveloped secondary economy. The average annual unemployment rate in Tooele county in 1987 was 7.5%, which was slightly higher than the state unemployment rate of 6.3% for the same period (Bureau of Economic and Business Research 1988). The basic-to-nonbasic employment multiplier for Tooele County (assuming that all federal and mining employment, 75% of all employment in the manufacturing sector, and 10% of all state and local government employment can be classified as basic) is estimated to be 1.5 jobs for every job created in the basic sectors.

Mining makes up the second largest and most important employment sector of Tooele County providing 7.3% of the wage and salary jobs.

4.7 Radiation

Radiation levels prior to disposal of the Vitro waste at the South Clive site have been determined from monitoring programs conducted by Dames & Moore and Argonne National Laboratory (ANL). Monitoring has also been conducted at two additional points near Clive, one to the north and one to the southeast (Figure 4.11). The data described below are the result of 3 months of monitoring (December 1981 through February 1982) (DOE 1984b).

Using the track etch method, ANL measured ambient air concentrations of ^{222}Rn at the three locations surrounding Clive (EUI 1992b). The 3-month average ^{222}Rn concentration at the South Clive site was 0.011 Bq/L (0.31 pCi/L). In natural undisturbed settings, ^{222}Rn levels in air typically range from 0.004 to 0.037 Bq/L (0.1 to 1 pCi/L). All of the values obtained for the Clive area were below 0.037 Bq/L (1 pCi/L).

A general survey of gamma radiation levels was also conducted by ANL in the area surrounding Clive. The measurements were performed quarterly using thermoluminescent dosimeters (TLDs). During the 3-month period, the average exposure rates for Clive-South, Clive-Southeast, and Clive-North were 4.2×10^{-9}, 3.6×10^{-9} and 3.0×10^{9} C/kg-hr (16.2, 14.1, and 11.6 µR/hr), respectively. Surface-soil samples [to a depth of 5 cm (2 in.)] were collected at 300-m (980-ft) intervals in each of eight compass directions out to a distance of 1500 m (0.9 mi) from the center of the South Clive site. All of the samples were analyzed for ^{226}Ra. Samples collected 1500 m (0.9 mi) from the center were also analyzed for ^{230}Th, ^{238}U, and ^{210}Pb. The surface-soil radionuclide concentrations found at the South Clive site are in secular equilibrium, with the exception of slightly elevated concentrations of ^{210}Pb. The surface-soil concentrations of ^{226}Ra ranged from 0.033 to 0.044 Bq/g (0.9 to 1.2 pCi/g) dry weight; those of ^{238}U ranged from 0.026 to 0.037 Bq/g (0.7 to 1.0 pCi/g); those of ^{230}Th ranged from 0.044 to 0.059 Bq/g (1.2 to 1.6 pCi/g); and those of ^{210}Pb ranged from 0.041 to 0.085 Bq/g (1.1 to 2.3 pCi/g). These concentrations agree with the approximately 0.037 Bq/g (1 pCi/g) average for surface soils of the contiguous United States (LASL 1978).

Subsurface-soil samples were collected at the center of the South Clive site and at a distance 750 m (0.5 mi) from the center in each of the four compass directions and at three depth intervals. The ranges of radionuclide concentrations found in samples from depths at 0 to 20 cm (0 to 8 in.), 40 to 60 cm (16 to 24 in.), and 80 to 100 cm (31.5 to 39 in.) were not significantly different from the ranges of radionuclide concentrations found in the surface-soil samples.

Samples of vegetation and wildlife taken near the South Clive site were assayed to determine natural radionuclide concentrations in the local biota. These results show vegetation concentrations averaging 0.2 Bq/kg (5.4 pCi/kg) (wet weight) for uranium, 0.72 Bq/g (6.0 pCi/kg) (wet weight) for ^{230}Th, 0.11 Bq/kg (3.1 pCi/kg) (wet weight) for ^{226}Ra, 7.3 Bq/kg (198.0 pCi/kg) (wet weight) for ^{210}Pb, and 1.8 Bq/kg (48.0 pCi/kg) (wet weight) for ^{210}Po. The greater concentrations of ^{210}Pb and ^{210}Po are attributed to deposition of these radon daughters from the atmosphere.

The results of analyses on rabbit flesh show a similar pattern with the averages for ^{238}U, ^{230}Th, and ^{226}Ra being 0.019, 0.019, 0.022 Bq/kg (0.5, 0.5, and 0.6 pCi/kg) (wet weight), respectively. The ^{210}Pb and ^{210}Po averages were 0.15 and 0.30 Bq/kg (4.0 and 8.0 pCi/kg) (wet weight), respectively.

4.8 Cultural Resources

4.8.1 History

No events of historical significance are known to have occurred on the site. The Donner Trail probably passed north of the site, but the trail's exact location is unknown. An intensive cultural resource inventory was performed for the Vitro project [see Attachment 2.1 of the Environmental Report (EUI 1992b)].

4.8.2 Scenic Qualities

The South Clive site is located in the Basin and Range physiographic province which is characterized by broad, flat basins occasionally interrupted by small mountain ranges. The area within a 16-km (10-mi) distance of the South Clive site is typical of this province. Vistas of 48 km (30 mi) are common because of the flatness of the terrain.

The BLM Visual Resource Inventory and Evaluation system (BLM 1978) was used to rate the scenic quality of the South Clive site relative to the physiographic province. This rating system employs a scale of 0 to 33, with higher ratings (19 or above) indicating that special management attention is required. The rating of 12 for the South Clive Site is a low-to-medium rating for scenic quality, indicating that no special management attention is necessary.

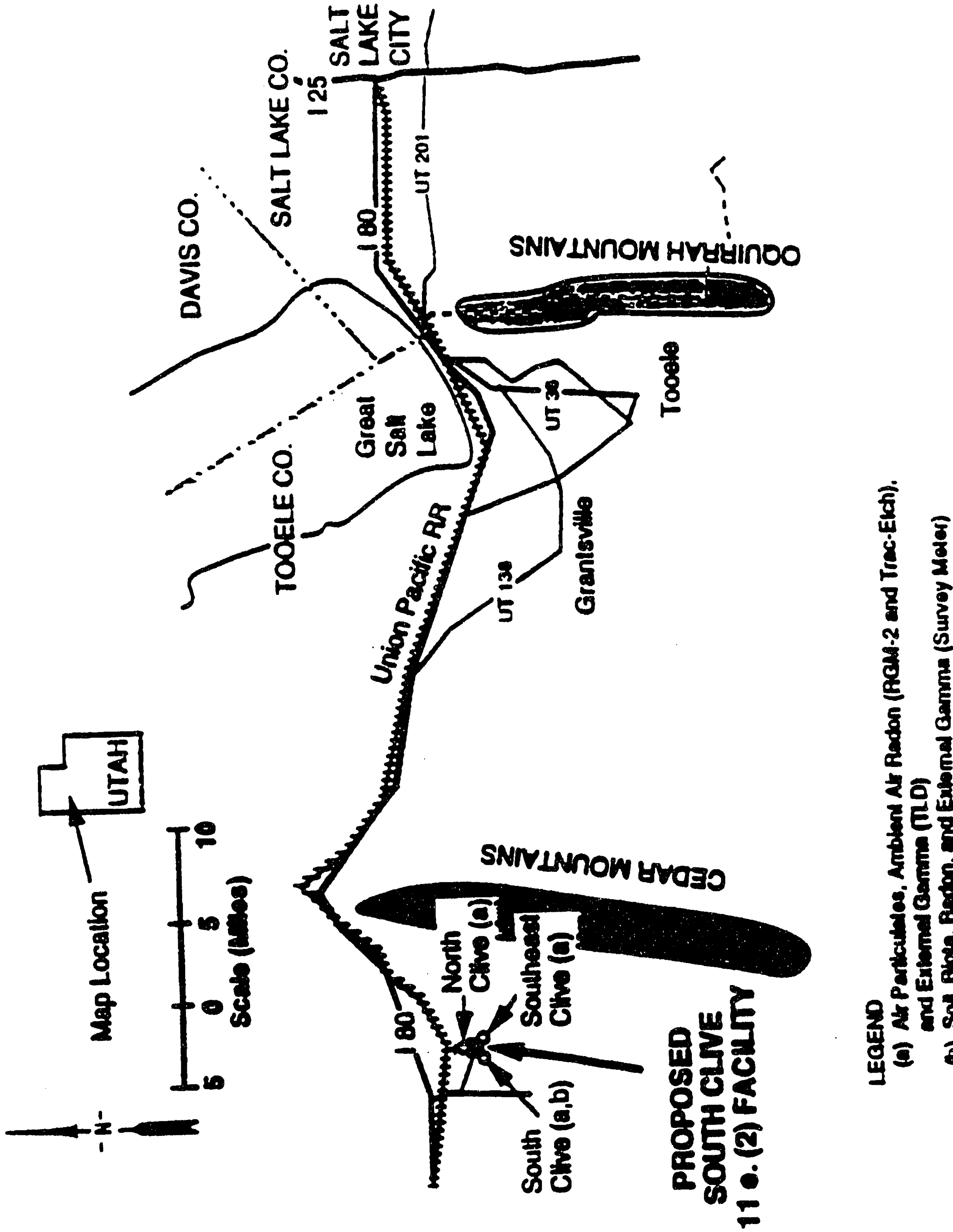


Figure 4.11 Location of Radiological Monitoring Stations

The Interstate is about 3 km (2 miles) to the north of the proposed disposal area. The South Clive site is about 1300 m (4270 ft) above sea level, but elevations of 1370 to 1670 m (4500 to 5500 ft) can be found nearby to the south, southwest, and southeast of the site. This local topographical relief provides a visual backdrop for the site when viewed from the Interstate. The existing Vitro site—which is mostly an above-grade mound—is not easily noticeable from the Interstate. Although the proposed Envirocare disposal mound would be about 3 m (10 ft) higher, it would have the same general visual impact as the Vitro site.

4.8.3 Places of Archaeological, Historical, or Cultural Significance

On August 24–26, 1981, an intensive cultural resource inventory of an area inclusive of the South Clive site was conducted by the Archaeological-Environmental Research Corporation (EUI 1992b). Prior to the field survey a record search was conducted. The record search consisted of a review of the cultural resource information and maps at the State Historic Preservation Office, Antiquities Section, Salt Lake City. No cultural resource sites were identified during the inventory, but one isolated artifact was found. This artifact consisted of four pieces of broken purple glass from some unknown glass object. It does not appear that such a find indicates the existence on the site of significant archaeologic artifacts. Ground visibility during the cultural resource survey was 98%. There were no other adverse factors, e.g., weather, affecting the accuracy of the survey party. Documentation of this inventory is provided in Attachment 2.1 of the Environmental Report EUI (1992b).

The historical sites closest to the South Clive site are the Ground to Air Pilotless Aircraft Launch Site and Blockhouse—listed in the National Register of Historic Places—located approximately 16 km (10 mi) west of Clive at Knolls; and the site of the Iosepa Settlement Cemetery, approximately 37 km (23 mi) by air southwest of Clive.

4.9 Other Environmental Features

4.9.1 Ambient Sound Levels

No measurements of ambient sound levels were made at the South Clive site; instead, sound levels were characterized at the site on the basis of proximity to highways and industrial areas, and the like, according to typical values of ambient sound levels that have been measured in similar situations (National Academy of Sciences 1977).

The area south of Clive is rural, undeveloped, and populated by few people. On the basis of population density, the day-night sound levels near the stabilization area would be less than 35 dB (EUI 1992b).

4.9.2 Recreation

Recreation activities in the area of South Clive are limited. About the only type of recreation activity in the South Clive area is off-road vehicle use. The area receives an estimated 500 to 1,000 visits annually, mostly in the Aragonite and Knolls areas (EUI 1992b). The South Clive facility is approximately 3 km (2 mi) from the 15,280-ha (37,760-acre) Knolls Special Recreation Management Area (SRMA). An SRMA is an area where a commitment has been made, within the parameters of multiple use, to provide specific recreation activity and experience opportunities on a sustained yield basis (BLM 1988). The Knolls SRMA is currently increasing in use by off-road vehicle operators.

5.0 ENVIRONMENTAL CONSEQUENCES, MONITORING AND MITIGATION

This chapter discusses the environmental consequences of construction, operation, and closure of the proposed 11e.(2) byproduct material disposal facility for Alternatives 1 and 2.

5.1 Construction

All areas utilized for 11e.(2) byproduct material receiving, unloading, hauling/handling, and placement in the embankment would be considered a restricted-access (or controlled) area. Controlled areas would be fenced and conspicuously posted with signs reading "Caution—Radioactive Materials." Entrance would be through the administration building restricted-access portal or through the main truck/vehicle entrance gate.

With Alternatives 1 and 2, there would be limited site preparation and construction activities. With the existing Low-Activity Radioactive Waste (LARW) facility at the South Clive site, most of the site preparation and construction activities have already been completed, such as the following items:

- roads to the facility,
- roads at the facility,
- vehicle washdown area,
- rail spur(s) to the facility,
- railcar rollover facility,
- railcar washdown facility,
- asphalt storage pad,
- security trailer,
- maintenance building, and
- storage building.

Before the operation phase of the 11e.(2) byproduct material disposal facility, the construction activities would be limited. The only construction activities that would need to be completed before disposal operations were initiated would be:

- fence construction around the 11e.(2) byproduct material disposal area,
- extension of roads into the 11e.(2) byproduct material disposal area,
- excavation of the new 11e.(2) byproduct material cell area,
- construction of a perimeter berm around the 11e.(2) byproduct material cell area, and
- construction of a clay liner for the 11e.(2) byproduct material cell.

The applicant anticipates that the construction activities that would need to be completed before operations would take approximately 6 months.

5.1.1 Land Use

Alternatives 1 and 2 would not seriously conflict with land-use plans for the South Clive site during site preparation and construction. The proposed site location is on private land owned by Envirocare. Most of the land within a 16-km (10-mi) radius of the South Clive site is public domain administered by the U.S. Bureau of Land Management (BLM) and is used for sheep grazing, transportation, hunting, and recreational-vehicles driving. There is no pubic use of the proposed site.

Actual construction at the South Clive site would have minimal effects on land use in the area due to the small amount of land that would actually be developed, the industrial-type activity which is already occurring in the area [i.e., United States Pollution Control, Inc., (USPCI) incinerator, Aptus incinerator, and USPCI landfill], and the abundant supply of federal land which would still be available for grazing purposes and recreation. No grazing allotments would be removed because there are no grazing allotments currently available on the Envirocare property. The proposed sites are within the Hazardous Industries District of Tooele County.

5.1.2 Geology

The extraction of clay material for the clay liner would be obtained during project construction. Since there are no unique geological features or paleontological resources on the areas identified for development, no destruction or disturbance would result from construction.

Impacts to soils resulting from construction activities would include accelerated soil erosion and decreased productivity from vegetation removal, compaction, and horizon mixing. Soil loss from wind erosion could occur in areas of fine surface textures and dunal areas. Horizon mixing could create revegetation problems by bringing the more saline and alkaline material from the subsoils and substratum to the seedbed surface. The application of mechanical erosion control and revegetation techniques recommended by local agencies [e.g., BLM and Soil Conservation Services (SCS)] would reduce overall wind erosion. Overall disturbance would be relatively small [about 45 ha (10 acres)].

5.1.3 Air Quality

Construction on the site would have minimal effect on air quality in the area. Construction activities during cell excavation and clay liner placement would generate some fugitive dust. Based on an emission factor for construction activities of 2690 kg/ha-month (1.2 tons/acre-month) from the U.S. Environmental Protection Agency (EPA) (1985), a 10-ha (25-acre) disturbed area at any given time, and a 6-month construction schedule, fugitive dust emissions might total 1.6 X 10^5 kg (180 tons). A dust emissions control program would be implemented during all operations. This program includes the application of water sprays and surfactants to disturbed areas.

In addition to construction activity, fugitive dust would be generated by wind erosion of disturbed areas. It is anticipated that there would never be more than 10 ha (25 acres) of construction activities open at any given time (EUI 1992b). EPA (1985) provides an emission factor for wind erosion of 850 kg/ha-yr (0.38 tons/acre-yr) for exposed areas. This would result in fugitive dust emissions of approximately 8617 kg/yr (9.5 tons/yr) for wind erosion.

5.1.4 Hydrology

There are no perennial surface-water systems associated with the South Clive site, and activities under Alternative 1 would have no effect. Dewatering would not be necessary because the bottom of the excavation would be about 3 m (10 ft) above the water table. Some dewatering might be necessary for Alternative 2. Drainage ditches, as shown on Figure 5.1, would have the capacity to carry the runoff from the 100-year, 1-hour storm event. This event is estimated to result in a 60-cm (2-ft) flow depth in the 90-cm (3-ft) deep drainage ditches, leaving 30 cm (1 ft) of freeboard. Because of the lack of surface water and low-intensity precipitation events, surface water effects are expected to be minimal.

All precipitation that comes in contact with the waste materials and water necessary for decontamination would be controlled and either collected in evaporator tanks or used for engineering purposes during embankment construction.

During construction of the facility, the same amount of groundwater would be used for Alternative 1 or 2. Groundwater would be obtained from Envirocare's well, located to the northwest of the site, for dust suppression and engineering purposes. The applicant anticipates that during the course of excavation and clay liner placement, water use would be 56,780 L (15,000 gal) of water per day, and would total an estimated 6.8 X 10^6 L (1.8 X 10^6 gal) of water over the course of the construction phase of the project.

The available data on groundwater quality indicate that the groundwater has a high total dissolved solids content, ranging from 20,000 to 75,000 mg/L (0.17 to 0.63 lb/gal) in the unconfined, uppermost aquifer and about 20,000 mg/L (0.17 lb/gal) in the confined aquifer. According to the EPA classification, both aquifers are considered Class III since they both have a total dissolved solids (TDS) content in excess of 10,000 mg/L (0.08 lb/gal). Furthermore, the concentration of some of the inorganic constituents in the uppermost aquifer (sulfate, chloride, iron, and manganese) is significantly higher than the EPA's secondary groundwater standards. The staff concludes, therefore, that the groundwater in the disposal site area is of a poor quality and is not suitable for most known uses without significant treatment.

The construction and operation of the disposal cell will mainly involve excavation of soils and other natural materials to pre-specified design depths, construction of the clay liner, placement and compacting of the waste in 30-cm (12-in.) thick layers, and placement of the embankment cover. Envirocare has developed a plan for protection of surface water and groundwater during the facility construction and operation (EUI 1992b). The plan includes quality control/quality assurance measures that will be employed during construction to ensure that the waste is properly compacted, preventive measures to control entry of the precipitation and runoff water into the cell, and preventive and corrective measures to prevent contamination of ground water in the event of a spill or inadvertent entry of excess water into the cell.

The disposal cell is designed and will be constructed and operated in conformance with all of the applicable regulations for groundwater protection provided in Appendix A to 10 CFR Part 40, which will be enforced through the conditions of a U.S. Nuclear Regulatory Commission (NRC) license. Specifically, the regulatory requirements for groundwater protection in Appendix A to 10 CFR Part 40 require identifying site-specific hazardous constituents, establishing their concentration limits (standards), and locating a point of compliance (POC) where the established limits will have to be met. A period of compliance is established by NRC, based on information and data provided by Envirocare. These requirements will be enforced through license conditions when the license for the proposed facility is issued.

The regulations also require Envirocare to propose and implement a corrective action program to meet the established standards in the event that any hazardous constituent concentrations are exceeded during the facility operation. Finally, the regulations require Envirocare to establish and operate groundwater monitoring programs to ensure that groundwater quality is protected during the

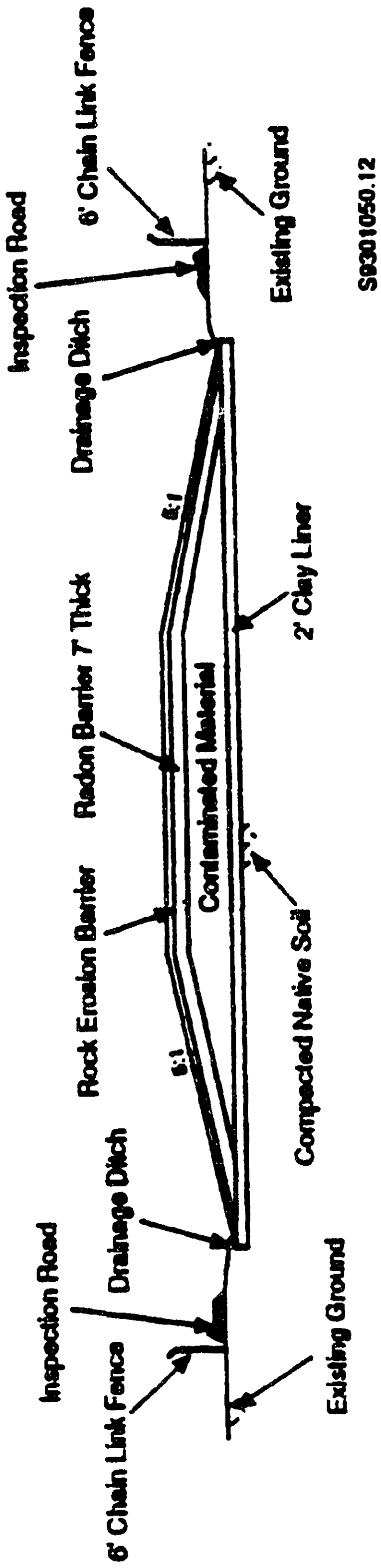


Figure 5.1 Cross Section of the Embankment

facility operation. These include: (1) a preoperational monitoring program to establish the background groundwater quality and a POC for the disposal facility; (2) a detection monitoring program to detect and identify site-specific hazardous constituents, and establish their concentration limits; (3) a compliance monitoring program to ensure that the hazardous constituent concentrations do not exceed the established standards at the POC; and (4) a compliance monitoring program to ensure that the concentrations will be restored to the standards in the event that the standards are exceeded and a corrective action is implemented, as required by the regulations.

In addition, the embankment design includes a bottom liner that is intended to minimize seepage of contaminants from the disposal cell to the water table and retard upward flow of moisture and subsurface water into the cell. The bottom liner will consist of 60 cm (2 ft) of compacted clay. The bottom 30 cm (1 ft) will consist of native clay, compacted to 95% of standard Proctor maximum dry density (ASTM D-698) and tested to ensure that the required compaction has been achieved. The top 30 cm (1 ft) will consist of processed clay, thoroughly mixed and kneaded until a homogeneous mixture is obtained. The top 30 cm (1 ft) of the liner will be placed in two 15-cm (6-in.) lifts, each compacted to 95% of standard Proctor maximum dry density (ASTM D-698) and tested to ensure the standard is met. Envirocare has conducted tests to ensure that the design compaction and densities of this clay are attainable. Furthermore, field permeability tests were performed for Envirocare on the compacted clay; these included three single-ring tests and one sealed double-ring test. The permeability determined by these tests ranged from 4.3×10^{-8} to 8.1×10^{-8} cm/s (1.7×10^{-8} to 3.2×10^{-8} in./s) (EUI 1992b).

On the basis of the above, it is concluded that there are little or no foreseen impacts on the groundwater availability or quality during the construction/operation of the proposed disposal facility, as long as the applicable regulations in Appendix A to 10 CFR Part 40 are met. In addition, the regulations in Appendix A to 10 CFR Part 40 provide mechanisms for detection of any contamination and for restoration of groundwater quality through corrective actions in the event that the established standards are exceeded at any time during the facility construction/operation.

5.1.5 Ecology

Construction procedures for the proposed project would include vegetation removal for site clearance. Some vegetation would be completely destroyed by clearing, and other plants may be damaged but would survive. Construction of the facility would affect only the desert shrub/saltbush vegetation community.

Overall disturbance following construction would be relatively small [about 45 ha (10 acres)]. No federal or state-listed threatened, endangered, or special status plant species are known to occur within the Clive area (BLM 1983, 1988).

Construction of the facility could result in the displacement or death of smaller, less mobile wildlife species on site. Small mammals and reptiles would be more subject to mortality from construction than other groups, but impacts would be minor on a regional basis. Many of the affected species, especially small mammals, have high reproductive potential, are common in surrounding habitats, and therefore, would be minimally impacted. Larger mammals, birds, and some reptiles would be able to avoid the construction areas; therefore, impacts to these animals should be minimal. Larger mammals such as pronghorn, bobcat, kit fox, and coyote, which may forage or travel through the habitats affected by the facility or crossed by the right-of-ways, would avoid the disturbance during construction. These mammals would be excluded from the facility during operations by on-site fencing and should return to these areas following restoration. Loss of pronghorn habitat and traffic effects on pronghorn individuals would not be significant due to the minimal amount of area affected.

Acreage disturbed for the life of the project would be unavailable for wildlife utilization. However, this is not expected to be a significant impact following facility restoration; wildlife species should re-invade the area of the facility following restoration and the natural revegetation process.

No federally listed threatened or endangered wildlife species, species proposed for listing, or designated or proposed critical habitats are known to occur in any areas that would be disturbed (EUI 1992b). The state-sensitive-listed kit fox could be temporarily displaced due to construction activities, but a significant amount of their habitat would not be lost.

5.1.6 Socioeconomic Impacts

Direct employment generated from the acceptance of additional wastes for Alternatives 1 and 2 would be approximately the same as the current site operations. The number of employees working at the sites would be somewhat higher. The average number of employees anticipated for Alternatives 1 and 2 would be

Administrators	20
Technicians	15
Construction	25
Total	60

Currently, all of the construction workers and some of the technicians are from Tooele County. The remainder of the workers reside in Salt Lake City. This level of employment would represent a maximum addition to Salt Lake County's total current employment of under 0.04%. Assuming that a maximum of one-half of the jobs are created in Tooele County, they would represent an addition of under 0.4% to Tooele County employment.

The staff assumes that the operation of the South Clive site also affects the employment in supplying firms due to purchase of construction material, supplies, and machinery (such as heavy equipment, trucks, and rail cars). This effect is also small.

The effect of project workers' wages would also increase employment in other economic sectors due to the "employment multiplier" process. If an average employment multiplier of 1.5 is realized in the Salt Lake and Tooele County economies, a maximum of 90 service-sector jobs would be supported (by basic sector employment in the region in response to the respending of wages by 60 project employees).

The maximum effect of the project on regional employment would be 150 jobs (50 new jobs in addition to current conditions). These figures include incremental employment in the supply industries of 10 jobs. If one-half of the new direct and indirect jobs were filled by Tooele County residents, Tooele County employment would increase by approximately 0.9%.

The creation of up to 150 jobs during the construction phase of the project would not result in significant immigration into the area in response to the employment opportunities.

For all of the alternatives, a majority of construction-related employment opportunities would be absorbed by the local labor force. This is due, in part, to the unemployment rate in Tooele County which in 1987 was 7.5% (Bureau of Economic and Business Research 1988), as well as the high unemployment rate among skilled construction workers in the region. In addition, it is estimated that 5.3% of the available rental residential units in Tooele County (8,566 units) are vacant (EUI 1992b). Therefore, the results in immigration into Tooele County and the effects on housing and social structure are expected to be minimal and for rentals would be positive.

Since the South Clive site is over 56 km (35 mi) from the nearest community and since Alternative 1 would not create a significant population increase to the area, there should be minimal effects on schools, hospitals, water supplies, sewage facilities and other local facilities.

Effects on the economic structure of Tooele County or San Juan County would range from no effect to a very small effect. The effects would be basically the same for any of the alternatives.

Any waste disposal at the South Clive site would result in wage payments to residents of both Salt Lake County and Tooele County, increasing personal income in both counties. This effect, while beneficial, would be very small given the present magnitude of personal income in the combined counties.

5.1.7 Radiation

The radiological effects during the construction phase for the 11e.(2) byproduct material disposal cell would be only the natural background plus any increment added from the existing operations. The excavation(s) would be in new and used location(s) on the South Clive site and would not involve any contaminated material.

5.1.8 Cultural Resources

The effects of the alternatives on scenic, historical, and cultural resources are not expected to be significant (EUI 1992b).

There are no historical or cultural resources of significance at the South Clive site or along the transportation corridors. Hence, Alternatives 1 and 2 would not affect historical or cultural resources.

5.1.9 Other

Construction and operation of the South Clive site would have minimal effect on recreational activity in the area. The site is located on private land owned by Envirocare. No public land would be used for either of these alternatives. There would be no effect on the Cedar Mountains wilderness study area (WSA), the Knolls Special Recreation Management Area, the Horseshoe Springs ACEC, or the Bonneville Salt Flats ACEC from the construction at the South Clive site.

Minimal visual effects at the South Clive site would result from construction activities. Construction of the rail spur and truck-access roads have been completed, and thus there would be no visual effects due to their construction under Alternatives 1 and 2. During the construction phase there would be increased activity in the area, but it is unlikely that the visual impact would be significant to travelers on Interstate-80 or others in the area, based on the following:

(1) Most of the facilities would be located about 3 km (2 mi) from the nearest common vantage point on Interstate-80.

(2) The facility would most often be seen by viewers from a distance.

(3) The Vitro embankment and corresponding features are already present.

Other than embankment mounds for Alternative 1, scenic effects would be the same for both alternatives. As described previously, a scenic-quality rating of 12 was assigned to the South Clive site, indicating that no special management attention regarding visual resources is required.

5.1.10 Resources Committed

For Alternative 1, approximately 45 ha (110 acres) of the present terrain would be occupied by a flat-topped mound, approximately 14 m (46 ft) high, with side slopes of 1 vertical to 5 horizontal. For Alternative 2, the cell would be near the original topography. Neither of the proposed alternatives will create a major effect upon the local topography.

The excavation of the cell and the placement of the clay liner would require the use of electricity, fuel, water, manpower, and construction materials. The use of water, manpower, and soils would not be a commitment of non-renewable resources, but the uses of electricity and engine fuel would be. Engine fuel and electricity are available at the South Clive sites.

Alternatives 1 and 2 would be situated upon private land owned by Envirocare. No state or Federal resources would be committed.

Both alternatives would require the same types of resource input. These include electricity, engine fuel, backfill and cover material, manpower, water, and land. The only resources among this list that are irretrievably lost after use are electricity and engine fuel; the amounts of these resources that would be used in Alternatives 1 and 2, as compared to the No Action Alternative, are shown in Table 5.1. The use of water is not a permanent commitment of a resource. Even the use of backfill and cover material, and land in general, would not be completely permanent commitments.

Soils removed during the excavation would be reused in the construction of the reclamation cover. In addition, about 137,610 m^3 (180,000 yd^3) of gravel or quarried bedrock would be needed for the erosion barrier, access roads, and drainage ditches at the South Clive disposal area. This material is available from a quarry 8 km (5 mi) northwest of the South Clive site or in the Cedar Mountains to the east of the site.

Soils similar to those used in the cover are in great abundance for miles around the site. The rock quarry is the only quarry of this type of rock in the general area. Other quarries in the area contain large amounts of gravel, but it is unknown whether any of those quarries contain rock of the size required for the side slopes of the embankment. Rock from this quarry would be used for Alternatives 1 and 2.

5.2 Operation

The effects of disposal operations for Alternatives 1 and 2 have been examined and no significant adverse impacts have been found related to the environment for any of the alternatives, within the scope of review stated for each alternative and impact (EUI 1992b).

5.2.1 Land Use

The operational effects on land use would be the same as discussed in Section 5.1.1.

5.2.2 Geology

The only additional effect on geology and soils, in addition to those described during construction (see Section 5.1.2), would be from soils affected by a spill of contaminated material. In the event of a spill, only a small amount of soil would be contaminated [estimated at less than 7.5 m^3 (10 yd^3)]. If soil was contaminated during a spill, the soil would be removed and disposed of in the embankment. The area would be reclaimed in accordance with Envirocare's reclamation plan for other areas disturbed during construction (EUI 1992b).

Table 5.1
Energy Requirements for Alternatives 1 and 2

Resource	Alternatives 1 and 2 (South Clive Site)	No Action Alternative
Electricity (kwh)	400,000	0
Engine fuel (gal)	2,520,000	0

Source: EUI 1992b.
Note: 1 gal = 3.8 L

5.2.3 Air Quality

Minimal effects on air quality would occur due to the operation of the site. The operation would employ dust suppression procedures to reduce wind blown particulates. Exhaust emissions would be associated with the construction equipment and railroad switch engine used to operate the site. Envirocare operates under a permit from the Utah Division of Air Quality that requires there be minimal impact on air quality. Personnel air samples collected on equipment operators expected to have the highest potential for dust exposure have consistently shown total 8-hour averages of less than 1 mg/m^3 (0.11

grains/ft^3) during operation of the existing Low-Activity Radioactive Waste facility located at the South Clive site. Release of radionuclides to the atmosphere during the operation of the site is discussed below.

Release of radionuclides under normal conditions during operation of the site is usually limited to the following mechanisms:

- exhalation of radon gas from embankment area(s) that have not been covered with the compacted clay radon barrier, and
- windblown materials from the embankment and unloading area.

These release mechanisms have been modeled to estimate the maximum exposure dose at the property boundary, and to the surrounding population (EUI 1992b). Results of this modeling are described in Appendices A-1 and A-2 of the Environmental Report (EUI 1992b) and Section 5.2.8 of this Environmental Impact Statement (EIS).

5.2.4 Hydrology

There are no perennial surface-water systems associated with the South Clive site; therefore, there would be no effect on surface waters.

There are two possible ways for temporary surface waters to be contaminated: (1) rainwater that comes in contact with the waste material, and (2) water that accumulates during decontamination of vehicles and equipment. Envirocare has obtained a Groundwater Discharge Permit from the Utah Division of Water Pollution Control. This permit requires significant controls to limit the contamination of any surface waters. All precipitation that comes in contact with the waste materials must be controlled and either placed in evaporative tanks or used for engineering purposes during embankment construction.

The water necessary for decontamination is obtained from a well located northwest of the site and owned by Envirocare. This water is collected on a concrete pad and sump and pumped into a tank. The water is then placed in evaporator tanks or used for engineering purposes on the embankment. The applicant estimates that during the expected 20 years of operation that 2.95 X 10^8 L (78 X 10^6 gal) of water will be used for dust control and decontamination purposes.

Dewatering of the waste material brought to the site will not be necessary because the moisture content of the incoming waste is monitored to restrict wet materials or free liquids.

With Alternative 1, degradation of water quality in either the unconfined or confined aquifer systems in the vicinity of the South Clive site is highly unlikely. The groundwater at the site is already characterized as brackish or briny, with levels of many constituents (major ions, metals, total dissolved soils, uranium) exceeding EPA primary or secondary drinking water standards, often by large amounts.

During operation of the facility, the same amount of groundwater would be used for Alternative 1 or 2. Groundwater would be obtained from Envirocare's well, approximately 6 km (4 mi) to the northwest of the site, for dust suppression and engineering purposes. It is anticipated that during the operation of the facility, 56,780 L (15,000 gal) of water per day would be required. Over the course of the project (20 years), it is estimated that up to 2.95 X 10^8 L (78 X 10^6 gal) of water would be used.

The proposed disposal facility will be operated as the facility is constructed. The waste will be placed in the disposal cell and compacted, and such operations will be continued until the cell is filled to the design capacity, prior to the construction of the embankment cover. Accordingly, the impacts on groundwater due to facility operation are the same as those resulting from the facility construction and discussed in Section 5.1.4.

5.2.5 Ecology

No additional effects on vegetation or wildlife habitat would be expected to result from operation of the facility beyond those described for the construction phase (see Section 5.1.5).

5.2.6 Socioeconomic Impacts

Socioeconomic impacts as a consequence of operation would be expected to be the same as for construction for Alternatives 1 and 2 (see Section 5.1.6).

5.2.7 Cultural Resources

There are no historical or cultural resources of significance at the South Clive site, or along the transportation corridors. Hence, Alternatives 1 and 2 would not affect historical or cultural resources during the operation and closure of the facility (EUI 1992).

5.2.8 Radiological Health Impacts

5.2.8.1 Introduction

This section presents a generic assessment of the potential radiological impacts on humans and the surrounding environment resulting from operation of the proposed 11e.(2) byproduct material disposal facility. The major issues to be addressed in this review and assessment include: potential sources of exposure to workers and individual members of the public, potential releases of radiological contaminants, pathways leading to environmental contamination, approaches and methodologies NRC staff employed in conducting the radiological impact assessment, and conclusions and results of the assessment. The potential radiation doses can, in a statistical sense, increase the potential for individual and population health effects (e.g., excess fatal cancers) above those expected from normal causes. It is assumed that environmental systems will be adequately protected against any adverse radiological impacts if workers and members of the public are adequately protected against the same impacts.

The major sources of exposures resulting from radionuclide releases under normal operating conditions are: (1) radon gas from the decay of radium compounds, (2) windblown material and resuspension of radioactive materials, (3) direct gamma radiation, and (4) water infiltration of radionuclides and subsequent transport and exposure. The principal pathways by which an individual can be exposed to these sources are: (1) inhalation of radon and radon daughters, (2) inhalation or ingestion of windblown radioactive particulates, (3) exposure to direct gamma radiation from the 11e.(2) byproduct material during the disposal operation, (4) ingestion of groundwater contaminated by water infiltrated through the waste, and (5) ingestion of contaminated food produced in areas contaminated with 11e.(2) byproduct material (either from direct soil or crop contamination or contamination associated with crop irrigation).

In general, site-specific assessments of potential radiological impacts for the proposed Envirocare 11e.(2) byproduct material disposal facility are not sufficiently advanced to estimate occupational and public doses with confidence. In lieu of such assessments, potential radiological health impacts have been estimated by a comparison of the proposed operations with the operations of the disposal facility for uranium mill tailings from the South Salt Lake Uranium Mill Tailings Remedial Action Project (UMTRAP). This disposal facility is located immediately adjacent to the proposed disposal facility for 11e.(2) byproduct material. Although some differences exist between the two disposal facilities for disposal operations and estimated source terms, the facilities are sufficiently similar to estimate potential radiological impacts of the proposed 11e.(2) byproduct material disposal facility. In addition, because disposal operations at the UMTRAP facility are essentially complete, the environmental and occupational data collected during waste disposal operations at that facility provide reliable information to confirm the validity of the estimates of the projected radiological impacts.

The UMTRAP disposal site at South Clive contains the Vitro Chemical Company mill tailings, which were moved from South Salt Lake, Utah. The State of Utah, under contract to the U.S. Department of Energy (DOE), disposed of the Vitro tailings at the Clive site from July 1985 through November 1987. Cover placement began in June of 1986 and was completed in 1988. Actual radiological field monitoring data, pertaining to exposures to both on-site workers and off-site individuals, and to environmental monitoring, were collected by the State of Utah during the UMTRAP site disposal operation in support of the cooperative project with the DOE.

The Vitro UMTRAP disposal mound at South Clive is approximately 340 X 735 X 9.7 m (1115 X 2410 X 32 ft). It contains 2.13 X 10^6 m^3 (2.79 X 10^6 yd^3) of contaminated material consisting of uranium mill tailings, contaminated soil, and a small amount of construction rubble. The disposal cell was excavated 2.1 m (7 ft) deep, the cover is 2.1 m (7 ft) thick, and the erosion protection rock layer is about 60 cm (2 ft) thick (DOE 1984a, 1988).

In comparison, the proposed 11e.(2) disposal embankment will be 540 X 550 X 9.3 m (1776 X 1809 X 30.6 ft) [see Appendix A of the license application (EUI 1992a)]. The area of the footprint of the embankment will be approximately 2.98 X 10^5 m^2 (3.2 X 10^6 ft^2). The total waste volume for the embankment will be 2.76 X 10^6 m^3 (3.6 X 10^6 yd^3) and the disposal rate of waste material will be up to 4.5 X 10^8 kg/yr (500,000 tons/yr). The cell will be constructed in the following manner:

(1) The existing terrain will be excavated to a depth of approximately 2.4 m (8 ft). The excavated overburden will be stockpiled for use in capping the embankment in the future.

(2) A 60-cm (2-ft) thick clay liner will be placed on the bottom of the excavated cell. This liner will consist of 30 cm (1 ft) of in-situ clay scarified and recompacted to 95% of standard proctor, and 30 cm (1 ft) of processed compacted clay.

(3) The material for disposal will be placed on the liner in 30-cm (1-ft) lifts and compacted in place to a maximum height of 11 m (37 ft) above original ground elevation.

(4) When the embankment is filled to the maximum height, a radon barrier cover will be constructed over the waste. This cover will consist of: (a) a 2-m (7-ft) layer of compacted clay, (b) a filter zone composed of a 15-cm (6-in.) layer of small diameter rock, and (c) an erosion protection layer consisting of 45 cm (1.5 ft) of specific-sized rock.

The design of the two disposal embankments is very similar. The proposed Envirocare facility will receive waste in railcars and trucks. The procedures proposed for placement of contaminated material in the 11e.(2) byproduct material disposal facility are also very similar to the methods used in constructing the Vitro tailings disposal embankment.

5.2.8.2 Estimated Radiological Impacts of Vitro Disposal Facility

DOE estimated the potential radiological impacts associated with the disposal of uranium mill tailings at the South Clive UMTRAP disposal site in the *Final Environmental Impact Statement* (FEIS) (DOE 1984b).

In the Vitro EIS, DOE characterized the tailings as having the following average concentrations of principal radionuclides: 1.48 Bq/g (40 pCi/g) of ^{238}U [Range: 0.74 to 3.96 Bq/g (20 to 107 pCi/g)], 20.7 Bq/g (560 pCi/g) of ^{226}Ra [Range: 3.7 to 74 Bq/g (100 to 2000 pCi/g)], and 20.7 Bq/g (560 pCi/g) of ^{230}Th (assumed secular equilibrium with ^{226}Ra). Although DOE noted that the ^{230}Th concentrations were probably depleted somewhat by acid leaching at the mill, DOE assumed equilibrium concentrations as a conservative estimate.

Doses from Radon Inhalation. To estimate ^{222}Rn concentrations in air above the uranium mill tailings, DOE assumed that the flux of ^{222}Rn would be directly proportional to the concentration of ^{226}Ra in the tailings. Therefore, the assumed flux of ^{222}Rn from uncovered tailings was estimated at 20.7 Bq/m^2-s (560 pCi/m^2-s) (DOE 1984b). DOE also estimated a ^{222}Rn concentration in air immediately above the tailings of about 0.41 Bq/L (11 pCi/L), but assumed a concentration of 1.1 Bq/L (30 pCi/L) as a conservative estimate of the long-term average radon concentration in air above the uncovered uranium mill tailings (DOE 1984b). DOE assumed that ^{222}Rn decay products would be at 25% equilibrium with the ^{222}Rn. Assuming the 1.1 Bq/L (30 pCi/L) average concentration, DOE estimated total worker doses from radon inhalation of 2.2 and 3.2 person-Sv (220 and 320 person-rem), respectively, for truck haulage and train haulage to the Clive site. The train option was assumed to increase worker exposure by prolonging exposure time. Both estimates were based on a conversion factor of 2.0 X 10^{-5} Sv/(hr-Bq/L) [7.4 X 10^{-5} rem/(hr-pCi/L)] for ^{222}Rn exposure. Using a risk coefficient of 2.0 X 10^{-5} fatal lung cancers/person-rem ^{222}Rn dose, the total doses correspond to an excess of 0.004 and 0.006 lung cancer deaths among the workers, for the truck and train options, respectively.

Using an average emanation factor of 0.2, DOE estimated that the total ^{222}Rn released from interstitial spaces in the tailings during excavation and disposal was 1.1 X 10^{13} Bq (300 Ci), which would be in addition to the ambient radon flux described above. Therefore, DOE estimated that the total radon flux at the Vitro site would be 2.86 X 10^{14} Bq (7725 Ci) in the first year of the project, 1.73 X 10^{14} Bq (4675 Ci) in the second year, and 6.01 X 10^{13} Bq (1625 Ci) in the third year (DOE 1984b). However, at the Clive disposal site, DOE did not estimate the health consequences of off-site release of the ^{222}Rn because no residents lived within 18 m (30 km) of the site.

During disposal of the Vitro tailings at the South Clive UMTRAP site, the State of Utah measured radon concentrations using Passive Environmental Radon Monitors (PERMs) at four stations around the site boundary (CL001, CL005, CL010, CL015) (Utah BRC 1986 and 1987). The State also used Radon Progeny Integrated Sampling Units (RPISUs) to estimate radon decay product concentrations at one location (CL001). In addition, the State monitored a "background" station using PERMs and RPISUs in the southeast corner of the section (CL999).

Monitoring data collected from the PERMs along the site boundary indicated a gradual increase in radon concentrations during disposal operations in 1986. PERM data for the period of October–November 1986 showed maximum radon concentration values ranging from 0.021 to 0.062 Bq/L (0.58 to 1.67 pCi/L) (Utah BRC, 1986). During this same period, the recorded "background" concentration was 0.020 Bq/L (0.54 pCi/L); however, this "background" concentration had shown similar increases throughout 1986 starting at 0.0085 Bq/L (0.23 pCi/L) in the first quarter (Utah BRC 1986).

The RPISUs data list the radon decay product concentrations in air and may be used to estimate the percent equilibrium between the radon (^{222}Rn) and radon decay products (^{218}Po, ^{214}Bi, ^{214}Pb, ^{210}Tl, ^{210}Pb, ^{210}Po, and ^{210}Bi). In general, the RPISU data collected at the Clive site at CL001 and CL999 show that radon decay product concentrations remained at levels below 1.1 X 10^{-4} Bq/L (0.003 pCi/L) during 1986, reaching a maximum value of 1.2 X 10^{-4} Bq/L (0.0033 pCi/L) at CL001 during October-November 1986 (Utah BRC, 1986). This value corresponds to approximately 0.6% of the radon concentration measured at the same location using the PERM. Therefore, the data show that the radon is not in equilibrium with its decay products in air at the site boundary. Monitoring data from the Clive site indicate that radon decay product concentrations are a small percentage of the radon concentrations.

Using the dose conversion factor of 0.12 Sv/(Bq/L) [0.44 rem/(pCi/L)] of effective radon decay product concentration from ICRP Report No. 50 (ICRP 1987) and a range of equilibrium factors, the estimated annual effective dose equivalents associated with the maximum measured radon concentration of 0.062 Bq/L (1.67 pCi/L) at the site boundary would be as shown in Table 5.2.

Table 5.2 Annual Effective Dose Equivalents

Equilibrium Factor	Estimated Dose (mrem/yr)
0.5	370
0.25	184
0.10	74
0.005	4
0.001	1

Note: 1 mrem/yr = 0.01 mSv/yr

DOE assumed 25% equilibrium between radon and decay products in the Vitro EIS (DOE 1984b). This assumption is conservative when compared with the measured equilibrium ratios observed at the Clive site during tailings disposal. Using this conservative assumption, the estimated maximum dose to an off-site individual from radon inhalation would be about 1.8 mSv/yr (180 mrem/yr), assuming that the individual is present 100% of the year and located at the site boundary where the maximum radon concentration exists. Using a more realistic estimate of the equilibrium fraction of 0.005 based on site-specific data, the radon dose to an individual at the facility boundary would be about 0.04 mSv/yr (4 mrem/yr).

These projected doses from inhalation of radon released during disposal of the Vitro tailings at the South Clive site could have exceeded NRC's public dose limit of 1 mSv/yr (100 mrem/yr) in 10 CFR Part 20.1301, depending on the physical and chemical characteristics associated with the release. In addition to radon released from the 11e.(2) byproduct material, radon may also be released from the other waste disposal facilities for Naturally-Occurring Radioactive Material (NORM) waste, low-level radioactive waste, and Vitro uranium mill tailings. The cumulative impact of these releases may contribute further to doses to off-site individuals. If a license is issued for the proposed 11e.(2) byproduct material disposal facility, Envirocare will need to demonstrate continued compliance with the public dose limit in 10 CFR Part 20.1301 in accordance with 10 CFR Part 20.1302 considering actual physical and chemical characteristics of the effluents (e.g., aerosol size distributions, radioactive decay equilibrium, operational characteristics).

With respect to occupational exposures to radon and its decay products, DOE assumed a concentration of 1.1 Bq/L (30 pCi/L) in air above the uranium tailings at the Clive disposal site. The State of Utah did not measure radon concentrations in air within the tailings disposal area during disposal operations. Therefore, there is no monitoring data against which to compare the assumed concentration of radon in air. Using the 25% equilibrium factor described above, 1.1 Bq/L (30 pCi/L) of ^{222}Rn corresponds to about 7.5 mSv/yr (750 mrem/yr), assuming 2000 hours residence within the disposal area at the assumed concentration. Assuming 50 workers engaged in disposal activities within the area where the 1.1 Bq/L (30 pCi/L) radon concentration exists, the annual collective dose to workers from radon inhalation would be about 0.375 person-Sv (37.5 person-rem). For 20 years of continuous exposure at these levels, the total collective dose to workers from radon inhalation is estimated to be about 7.5 person-Sv (750 person-rem). This value corresponds to about 281 Working Level Months-People. Using the radon risk conversion factor of 350 excess lifetime fatal lung cancers per 1 X 10^6 person-working level months, this dose is expected to yield a mathematical expectation of approximately 0.1 fatal cancers over the lifetime of the 11e.(2) byproduct material facility from radon inhalation.

5.2.8.3 Doses from Exposure to Radioactive Materials

Workers and members of the public may be exposed to radioactive materials released from the proposed facility during dumping of the radioactive waste from trains and trucks, emplacement of the material in the disposal embankment, and wind erosion and resuspension of contaminated materials within the embankment. The individuals would receive the dose by inhaling the radioactive particles into the lungs, direct gama radiation exposure, or ingestion of radioactive materials.

Using a dust release estimate of 4 X 10^5 kg/yr (441 tons/yr), DOE estimated particulate releases for the disposal of the tailings at the Clive site as follows: 8.14 X 10^9 Bq/yr (0.22 Ci/yr) from ^{226}Ra, 5.9 X 10^8 Bq/yr (1.6 X 10^{-2} Ci/yr) from ^{238}U, and 8.14 X 10^9 Bq/yr (0.22 Ci/yr) from ^{230}Th (DOE, 1984b). Although DOE did not explicitly calculate occupational doses from particulate inhalation for disposal at the Clive site, DOE estimated in the Vitro EIS (DOE 1984b) that particulate doses for on-site disposal of the tailings would be low compared with other exposure pathways (radon inhalation and direct gamma). For on-site disposal, DOE estimated occupational doses of 0.0249 mSv/yr (2.49 mrem/yr) for inhalation of particles due to earth moving equipment during remedial action (DOE 1984b). DOE also estimated committed doses to lungs from inhalation of ^{226}Ra, ^{230}Th, and ^{238}U particles from excavation of uranium mill tailings at the Vitro site of 0.145, 0.064, and 0.04 mSv/yr (14.5, 6.4, and 4.0 mrem/yr), respectively (DOE 1984b). DOE did not assess potential population doses due to particulate releases because no residents live in the vicinity of the Clive site and the projected doses from airborne particulates would be negligible compared with the dose from radon.

During disposal of the Vitro tailings at the Clive site, the State of Utah monitored airborne particulate concentrations at the site boundary using Hoffman high-volume sampling units. The State analyzed the samples for gross alpha and estimated concentrations of key radionuclides based on ratios developed by EPA-Las Vegas. On average, the State estimated ^{230}Th accounted for about 7.6% of the total gross alpha activity (with a range of 3.2% to 12.9%) (Utah BRC 1986). The State used ^{230}Th as the key indicator because its concentration limit in Appendix B of 10 CFR Part 20 was the most restrictive for key radionuclides present in the tailings.

During 1986, the maximum value of gross-alpha activity was reported as 6.7 X 10^{-6} Bq/L (0.18 pCi/m^3) at the boundary of the Clive site (location H9-NE) (Utah BRC 1986). Using the average ^{230}Th percentage of gross activity (7.6%), this measurement corresponds to 0.52 X 10^{-7} Bq/L (0.014 pCi/m^3) of ^{230}Th. This concentration would have to be reduced to account for the fraction of material less than 30 fm (0.0012 in.) that would be respirable [estimated to be less than 35% (NRC 1980b)] in the Vitro EIS. Continuous inhalation of air at this concentration would be expected to yield a dose of about 0.123 mSv/yr (12.3 mrem/yr) to an off-site individual based on the ratio of the value with the limit in Appendix B of 10 CFR Part 20 for ^{230}Th (W-class) in air. Doses from inhalation of the other radionuclides present in the air would be expected to be less given that the dose conversion factor for ^{230}Th is considerably higher than for the other radionuclides present.

If all of the gross-alpha activity present were ^{230}Th, the maximum projected dose from inhalation of the radioactive particulates to an off-site individual would be about 1.60 mSv/yr (160 mrem/yr). This dose from particulate inhalation would be limiting, based on the monitoring data collected during the disposal of the Vitro tailings because of the conservative assumption that ^{230}Th accounted for all of the gross-alpha activity present in the samples. Actual doses from inhalation of airborne particulates are expected to have been considerably less due to the presence of other radionuclides with lower dose conversion factors.

With respect to occupational exposures to particulates, the maximum monthly average concentration of gross-alpha particle activity in air measured on-site was about 9.25 X 10^{-5} Bq/L (2.5 pCi/m^3). These samples were collected in July 1986. Reducing the airborne particulate concentration to account for the respirable fraction, the derived concentration would be about 32.6 X 10^{-6} Bq/L (0.88 pCi/m^3). By multiplying by the 7.6% fraction of ^{230}Th, the estimated airborne concentration of ^{230}Th would be about 2.5 X 10^{-6} Bq/L (0.067 pCi/m^3), which would correspond to an occupational dose of about 0.38 mSv/yr (38 mrem/yr). If all of the activity present in the airborne particulates were ^{230}Th, the corresponding worker dose would be about 5 mSv/yr (500 mrem/yr). Assuming 50 workers are continuously exposed at the higher level for 20 years, the collective worker dose would be approximately 5 person-Sv (500 person-rem). Assuming a risk conversion factor of 5 X 10^{-4} excess fatal cancers per person-rem, this collective dose would correspond to a mathematical expectation of 0.25 fatal cancers over the lifetime of the 11e.(2) byproduct material facility.

The State of Utah also monitored particulate concentrations in the breathing zone of workers at the Clive site. Personnel sampling results for 1986 indicate maximum average monthly gross-alpha concentrations of about 2.0 X 10^{-4} Bq/L (5.5 pCi/m^3) during July, with a range of 1.1 X 10^{-5} to 2.0 X 10^{-4} Bq/L (0.3 to 5.5 pCi/m^3) during the year and a mean exposure of about 7.4 X 10^{-5} Bq/L (2 pCi/m^3). This mean value corresponds approximately to the average area airborne concentrations described above.

Monitoring data collected by the State of Utah during 1987 showed considerably lower airborne particulate concentrations, with a maximum average value in July–August of 2.2 X 10^{-6} Bq/L (0.06 pCi/m^3) gross-alpha activity (Utah BRC 1987). These lower concentrations are more representative of airborne concentrations after emplacement of the contaminated material during cover placement activities.

Doses from Direct Gamma Radiation. For direct gamma exposure, DOE assumed that the gamma exposure rate (in μR/hr) is 2.5 times the ^{226}Ra concentration (in pCi/g). With an average ^{226}Ra concentration of 20.7 Bq/g (560 pCi/g), DOE projected that the ambient exposure rate above the uncovered uranium tailings would be about 3.6 X 10^{-7} C/kg-hr (1400 μR/hr) (DOE 1984b). DOE reduced worker exposures by a factor of 10 for shielding by the steel in construction equipment and by a factor of 10 for each foot of soil cover on top of the tailings (DOE 1984b). DOE generally assumed that workers could be exposed annually up to 0.228 yr (8 hr/day at 250 workdays/yr). DOE assumed that about 7.1 X 10^4 hr of worker exposure would occur at 3.6 X 10^{-7} C/kg-hr (1400 μR/hr) and about 2.6 X 10^4 hr would occur at the shielded exposure rate 3.6 X 10^{-8} C/kg-hr (140 μR/hr), corresponding to whole body collective doses of 0.994 and 0.036 Sv (99.4 and 3.64 person-rem) for total unshielded and shielded doses for the truck haulage option. Using the risk coefficient of about 1.2 X 10^{-2} fatal cancers/person-Sv (1.2 X 10^{-4} fatal cancers/person-rem), DOE estimated direct gamma exposure would result in approximately 0.012 excess fatal cancers among the workers at the Clive site (DOE 1984b). Because of the lack of residents near the Clive site, DOE did not estimate any radiological impacts due to direct gamma exposure to the public.

The State of Utah monitored worker exposure to direct gamma radiation during the placement of the uranium mill tailings at the Clive site. Although the dosimetry results available to NRC do not distinguish between dosimetry for the Vitro site and the Clive site, average worker exposure for 1986 was 0.5 mSv (50 mrem) for a total of 294 workers who worked on the project for more than 3 months (Utah BRC, 1986). Maximum individual exposures from direct gamma were less than 7.5 mSv (750 mrem) for a calendar quarter, although reported doses may be elevated as a result of storage of the dosimeters near a nuclear density gauge (Utah BRC 1986). The collective gamma dose to workers, based on the dosimetry for the stabilization of the Vitro tailings at Clive, is about 0.147 person-Sv (14.7 person-rem) for 1986. Using a dose conversion factor of 5×10^{-2} excess fatal cancers/persons-Sv (5×10^{-4} excess fatal cancers/person-rem), this direct gamma dose would correspond to a mathematical expectation of 0.007 deaths from exposure during 1986.

Doses from Ingestion of Radioactive Materials. After closure of the 11e.(2) byproduct material disposal embankment, water infiltration into the disposal units could leach radionuclides and other hazardous constituents from the waste. These constituents can be transported through the unsaturated zone down to the water table and then laterally into the groundwater. Humans, may in theory, be exposed to such constituents through ingestion of contaminated drinking water and/or contaminated diet[a]. The exposure rate resulting from this type of release will depend on several factors (e.g., infiltration rate, composition of waste, constituent-specific transport properties, design of the disposal cell, and natural site characteristics).

The issue of potential food chain pathway for human exposure from sheep grazing in the area is not considered significant because of the low level of potential contamination and the scarcity of vegetation.

Groundwater quality at the South Clive disposal site is extremely poor due to a very low annual precipitation, high evaporation, low infiltration, and an abundance of evaporite minerals in the near surface sediments in the Great Salt Lake Desert. The groundwater in the uppermost aquifer at the site contains up to 75,000 ppm of TDS. Also the confined aquifer has a TDS of up to 20,000 ppm. Groundwater at the site is, therefore, unsuitable for known uses in this general location.

In consideration of the proposed design of the disposal cell and the natural characteristics of the site, it can be expected that the infiltration into and through the embankment and leaching of radiological contaminants from the waste will be extremely low.

Based on the findings of the performance assessment carried out by the applicant to date, there are no foreseen impacts on the groundwater quality in the disposal site area after the facility closure. The applicant's performance assessment of groundwater is continuing and will be carefully monitored and evaluated by the NRC staff prior to issuing a license.

[a] Plants may become contaminated through the root uptake of radioactivity in the soil from deposition of air-borne or water-borne radionuclides. Animal products may become contaminated due to animal consumption of contaminated feed or water from wells.

5.2.8.4 Comparison of the Sites and Estimated Radiological Impacts

The proposed operations and source term of the 11e.(2) byproduct material disposal facility are similar to the operations and source characteristics for the Vitro tailings disposal facility at the Clive site. There are, however, some differences that may affect estimated occupational and public doses associated with the 11e.(2) byproduct material disposal facility. Based on a comparison between the two facilities, the principal differences that may affect radiological impacts are:

(1) The operational life of the Vitro disposal site at Clive was limited to approximately 3 years. In contrast, the proposed 11e.(2) facility will remain operational for 15 to 30 years and waste disposal will occur throughout this period. Placement of the final cover is not expected to occur at the 11e.(2) facility until the waste embankment has been filled to its average height of 7 m (23 ft) or about 4 to 5 years after facility operations begin. During the time before placement of the cover, the waste will continue to emanate radon gas and emit gamma radiation without abatement by the cover. In addition, traffic and wind erosion of the waste will suspend radioactive particulates in the air. Thus, worker and public exposures during this period may be greater than experienced at the Vitro disposal site over the complete construction process. This increase was considered somewhat in the analysis above by placing greater weight on doses and releases of radioactive material that occurred during active placement of the tailings at the Vitro disposal site prior to placement of the cover materials. In addition, Envirocare is planning to follow procedures for reducing and mitigating these releases by dust suppression through water, polymer, and $MgCl_2$ application, and other methods.

(2) At the time the uranium mill tailings were disposed of at the Vitro site, there were no other radioactive waste disposal operations in the immediate vicinity of the site. However, the proposed 11e.(2) disposal facility will be located immediately adjacent to the Vitro site and Envirocare's disposal facilities for low-level radioactive waste and NORM wastes. These activities could contribute additional exposure to workers and off-site individuals. Further, workers at these disposal facilities may also receive increased doses as a result of radon and particulate releases and direct gamma radiation from the proposed 11e.(2) disposal facility.

(3) Waste disposed at the Vitro site consisted of uranium mill tailings and associated debris, whereas waste to be received at the 11e.(2) facility is expected to be more variable in its characteristics and contain ^{232}Th and associated decay products, which were not abundant in the Vitro tailings. The increased variability is due to a greater number of waste generators and more variety in the type of activities generating the waste. A greater abundance of ^{232}Th in the waste is anticipated due to Envirocare's intent to solicit waste from generators of thorium-rich wastes (e.g., Kerr-McGee's West Chicago thorium mill). This difference appears to be the most significant in terms of estimating potential difference in radiological impacts between the two facilities and is described in more detail below.

It is difficult to prospectively determine the characteristics of the waste that will be received over the lifetime of the proposed Envirocare 11e.(2) byproduct material disposal facility. Since this facility will be a commercial disposal facility, the sources and characteristics of the waste for disposal are expected to vary during the operation of the disposal facility. In addition, greater variability in the characteristics is anticipated due to the greater number of generators that will contribute to the disposal facility. Nevertheless, either the specific characteristics of the waste to be disposed of, or rational and appropriate estimates to bound the waste characteristic are needed.

The applicant has provided an estimate of the 11e.(2) byproduct material characteristics in the Environmental Report (EUI 1992b). The waste is expected to contain three predominant radionuclides: ^{230}Th, ^{232}Th, and ^{226}Ra. The sources of 11e.(2) byproduct material proposed for disposal at the facility are summarized as follows:

(1) About 90% of the waste will be building debris, scrap metals, glass, wood, uranium mill tailings, thorium mill tailings, and mine residues. The weighted average concentration (in this 90% fraction of the waste) of ^{230}Th and ^{226}Ra will be 11.1 Bq/g (300 pCi/g) each, and the anticipated maximum concentration for each will be 74 Bq/g (2000 pCi/g). The ^{232}Th weighted average concentration and anticipated maximum concentration is reported as 33.3 and 222 Bq/g (900 and 6000 pCi/g), respectively.

(2) Approximately 5% of the waste is anticipated to be generated in the decommissioning of 11e.(2) facilities licensed by NRC or Agreement States. The weighted average concentration, in this waste fraction, for ^{230}Th and ^{226}Ra will be 25.9 Bq/g (700 pCi/g) each and the maximum concentration for each will be 74 Bq/g (2000 pCi/g). The ^{232}Th will have an average concentration of 74 Bq/g (2000 pCi/g) and a maximum concentration of 222 Bq/g (6000 pCi/g).

(3) About 5% of the waste will come from licensed uranium mills or mine tailings operations. The average concentration of ^{230}Th and ^{226}Ra will be 25.9 Bq/g (700 pCi/g) each and the maximum concentration for each will be 74 Bq/g (2000 pCi/g).

Based on the waste characteristics presented by Envirocare, NRC staff derived the weighted average concentrations for the bulk 11e.(2) byproduct material for the three radionuclides as shown in Table 5.3.

Table 5.3 Weighted Average Radionuclides

Radionuclide[a]	Weighted Average Concentration (pCi/g)
^{226}Ra	340
^{230}Th	340
^{232}Th	910

Notes:
[a]Assuming secular equilibrium with decay products.
1 pCi/g = 0.037 Bq/g

Other representative estimates of the characteristics of candidate 11e.(2) byproduct material streams are provided in the following references: (1) Kerr-McGee thorium milling waste (NRC 1989), (2) a model uranium milling operation (NRC 1980), and (3) the Vitro UMTRAP waste (DOE 1984b). These characteristics are summarized in Table 5.4.

Therefore, in addition to the key radionuclides considered in DOE's assessment of the radiological impacts for the disposal of the Vitro tailings at the Clive site, the waste proposed for the 11e.(2) disposal facility may also contain elevated levels of ^{232}Th and associated decay products.

For the radon pathway, the increased concentration of ^{232}Th in the waste may increase worker and off-site individual exposures due to release and inhalation of ^{220}Rn (commonly referred to as thoron). The ^{220}Rn has a half-life of about 55.6 seconds, which is significantly less than ^{222}Rn's half-life of 3.82 days. The shorter half-life for the ^{220}Rn should limit the significance of worker and off-site individual exposure to this radionuclide. Given the magnitude of the doses associated with ^{222}Rn, it is expected that the dose from inhalation of ^{220}Rn will be much less significant than the dose from ^{222}Rn. For example, NCRP Report No. 94 (NCRP 1987) reported estimates that the dose rate from ^{220}Rn decay products would be about one fifth of the dose rate from ^{222}Rn decay products. Therefore, a dose from ^{220}Rn is not considered further in this

Table 5.4 Representative Average Radionuclide Concentrations (pCi/g)

Potential Waste Soruce	^{226}Ra	^{230}Th	^{232}Th	^{238}U
Kerr-McGee, West Chicago, Ill.	47	45	366	43
NRC Model Uranium Mill	280	280	-	39
UMTRAP (Vitro) Uranium Mill Tailings	560	560	-	40

Note: 1 pCi/g = 0.037 Bq/g

analysis because it is expected to be much less than from ^{222}Rn.

For the airborne particulate pathway, the presence of ^{232}Th and decay products in the particles will contribute significantly to the dose via inhalation of the particulates. The projected average concentration of the ^{232}Th in the waste is nearly two times greater than the ^{230}Th concentration assumed at the Vitro disposal site. The Allowable Limit on Intake for ^{232}Th in Appendix B of 10 CFR Part 20 is six times lower than that for ^{230}Th. Using the measured gross-alpha activity values of 6.7 X 10^{-6} Bq/L (0.18 pCi/m^3) and 9.25 X 10^{-5} Bq/L (2.5 pCi/m^3) for boundary and on-site locations at the Vitro disposal site, estimated doses from airborne particulates can be calculated for the proposed 11e.(2) facility by assuming that all of the gross alpha activity present could be from ^{232}Th. In this situation, the projected doses to off-site individuals and workers would be approximately 9.72 mSv/yr (972 mrem/yr) and 30 mSv/yr (3 rem/yr) (assuming 35% respirable particles, 100% occupancy for off-site exposure, 22.8% occupancy for on-site exposure).

These estimated doses were calculated by ratio and proportion from the Allowable Limit on Intake in Appendix B of 10 CFR Part 20, using measured gross-alpha activity values at the site boundary and on-site locations. These estimates are made for the period of active disposal, and they represent the result of a string of assumptions purposely meant to be conservative (i.e., not to underestimate the magnitude of any radiological impacts). Mathematical estimates of dose to both groups result in values which would be unacceptable in practice. However, the doses are clearly overestimates, based on maximum sampled concentrations, hypothetical individuals, and other maximizing assumptions. The estimated doses could be considerably less for actual site conditions and waste characteristics.

As a mitigation measure for reducing on-site exposure, workers in the disposal area must wear respirators, thus precluding the greatest proportion of inhaled particles. Inhalation doses are reduced by factors of 10 to 1000 depending on respirator type and correctness of use.

The appropriate regulations are found in 10 CFR Part 20. There are no off-site individuals within many kilometers of the site. Hence, with no off-site individuals nearby, there can be no actual 9.72 mSv/yr (972 mrem/yr) dose. Doses to off-site individuals are expected to be negligible due to dispersion and deposition of any airborne particulates near the site.

Furthermore, Envirocare is, through mitigative measures, required to perform off-site monitoring to ensure compliance with the above regulations during disposal operations. Consequently, if conditions and zoning laws change to allow people to live near the proposed disposal site, Envirocare will have to take steps to ensure that the dose limits to actual residents are not exceeded.

After closure, dust will be considerably reduced. Similar disposal operations took place during the emplacement of the Vitro material. Measurements of gross-alpha activity in the air, made during operation and after closure of the facility, demonstrated that, after closure, only about 1% of the activity was found in the same location on-site. Off-site exposure should be similarly reduced [to 0.097 mSv/yr (9.7 mrem/yr)]. Therefore, in regard to demonstration of compliance with regulations, on-going measurements during disposal, coupled with the fact that the nearest public individual is many kilometers from the site, will afford the opportunity for compliance under 10 CFR Part 20. After closure, and before acceptance of the site by the custodial agency, an extensive measurement program will demonstrate radon flux rate levels and dose rates at the site boundaries. Envirocare must be in compliance with all applicable regulations before the custodial agency takes possession of the facility.

For direct gamma exposure, the presence of ^{232}Th and decay products in the waste could considerably increase the direct gamma exposure to workers. For example, 0.037 Bq/g (1 pCi/g) of ^{226}Ra in equilibrium with its decay products in soil corresponds to an exposure rate of about 4.64 X 10^{-10} C/kg-hr (1.8 μR/hr) at 1 m (3.3 ft) above the surface, whereas 0.037 Bq/g (1 pCi/g) of ^{232}Th in equilibrium with its decay products corresponds to a rate of about 7.28 X 10^{-10} C/kg-hr (2.82 μR/hr) (NCRP 1988). DOE estimated an exposure rate of about 3.6 X 10^{-7} C/kg-hr (1400 μR/hr) without shielding in the disposal area for the tailings. Assuming, for illustration, that

0.0185 Bq/g (0.5 pCi/g) ^{232}Th would occur with each 0.037 Bq/g 0.037 Bq/g (1 pCi/g) of ^{226}Ra, the average exposure rate would increase by about 80%. Thus, the 3.6 X 10^{-7} C/kg-hr (1400 μR/hr) would increase to about 6.5 X 10^{-7} C/kg-hr (2520 μR/hr) without shielding. Actual exposure rates would depend directly on the concentration of key radionuclides in the waste, which cannot be determined prospectively.

If this same factor of 80% were applied to the worker dosimetry collected during the construction of the Vitro tailings disposal site in 1986, the average worker dose would increase to about 0.9 mSv (90 mrem) and the collective dose over 20 years would increase to about 0.265 person-Sv (26.5 person-rem). This increase would approximately double the number of excess estimated cancer deaths associated with direct gamma exposure of workers from 0.007 to 0.013.

Worker exposure to gamma radiation will be mitigated by two design features. First, each 30 cm (1 ft) of compacted soil covering the disposal cell will reduce the projected maximum ambient gamma exposure rate of 3.6 X 10^{-7} C/kg-hr (1400 μR/hr) by a factor of 10. Second, steel construction equipment—such as trucks, bulldozers, and earth moving vehicles—will also provide significant shielding and protection from gamma radiation for the operators of such equipment.

5.2.9 Hypothetical Accidents

The radiological and physical safety risks associated with the transportation and disposal of 11e.(2) byproduct material have been evaluated. Based on the evaluations, the environmental risks associated with accidents are not large. This is primarily due to the nature of 11e.(2) byproduct material and the type of facility under consideration.

The types of waste to be accepted under Alternatives 1 and 2 are 11e.(2) byproduct material. The disposal site operation is designed for and anticipates large-volume bulk wastes from other geographic sites, primarily delivered by gondola-type railcars.

It is anticipated that each of the alternatives considered will be operated in a manner similar to the existing Envirocare facility. The facilities associated with each of the alternatives will be similar and can be described as a landfill/construction type project. Envirocare's existing facility is representative of this type of operation and is described here as an example.

Most of the adjacent land within a 16 km (10-mi) radius is public land administered by the BLM, with scattered State and privately owned lands. Lands within a 16 km (10-mi) radius of the facility are rarely used because of their remoteness from urbanized areas, the poor soil conditions, the briny groundwater, and the sparse vegetation characteristics of the region.

The site is distant from recreation areas, wilderness areas, scenic rivers, volcanic areas, subsidence-prone areas, archeological findings, underground mines, salt domes, salt beds, earth hazards, landslide areas, farmland, dam failure areas, lakes, reservoirs, estuaries, wetlands, intermittent streams, and surface water.

The maximum credible radiologic accident during the life of the facility would be the accidental dumping of a load in some location other than those licensed. Envirocare has implemented at its present facility several programs to minimize the possibility of any such accidents (EUI 1992b). If a spill were to occur, Envirocare is equipped to quickly clean up any spilled material. The spill material would then be properly disposed in the licensed embankment. During the cleanup, it is expected that several yards of previously clean material would be excavated and would also be disposed. It is possible that a small amount of vegetation may also be destroyed during cleanup, but the area disturbed would be less than 30 X 30 m (100 X 100 ft) (EUI 1992b).

If there were an off-site population at risk, the maximum credible dose from an accident at the site could be in the range of 0.3 to 10 person-mSv (0.03 to 1.0 person-rem) based on geographic proximity. Since there is no present or anticipated off-site population in the vicinity of the site, the actual off-site dose would be zero.

Expected fatalities associated with the disposal of 11e.(2) byproduct material are about 0.03 fatalities per year (EUI 1992b).

5.2.9.1 Radionuclide Release

Because there would be no movement of radioactive materials through piping or other plumbing at the proposed facility, there would be no releases of radioactivity from piping breaks. Flammable or explosive fuels are not stored in close proximity to the wastes, and the principal flammable material is in the fuel tanks of the individual work vehicles. A vehicle fire, even on a loaded haul truck, would not be expected to release any significant quantity of the load as airborne dust.

The possible release scenarios, all of low probability, are arranged below in order of decreasing probability:

(1) off-site/on-site truck accident,

(2) train derailment,

(3) flooding, and

(4) tornado.

As noted in the Rogers and Associates analysis, Appendix A of the Environmental Report (EUI 1992b), the doses associated with accidental releases have not been the limiting factor in other radiological assessments. As a result, Rogers and Associates did not deem it necessary to calculate such doses for their South Clive evaluation.

5.2.9.2 Truck Turnover or Collision

There are two kinds of truck movements to be considered at the South Clive site. These are arriving waste shipments and haul trucks moving material from the rollover or storage to the trench.

The conservatively high estimate of the volume of material to be disposed in a single year is stated by the applicant to be 4.5 X 10^8 kg (500,000 tons). This would require 100 truck round trips per day on-site assuming 18,140-kg (20-ton) trucks and 250 days per year of operation. The probability of an accident in any one year for this maximum amount is

1.3 X 10^{-6} accidents/km X 100 trips/day
X 250 days/year X 1 km/trip
= 3.25 X 10^{-2} accidents/yr or about 3.3%

Assuming that 9 X 10^7 kg (100,000 tons) of the maximum disposal amount per year of 4.5 X 10^8 kg (500,000 tons) is transported to the site by 18,140-kg (20-ton) trucks, an average distance of 800 km (500 mi), produces the following probability of an off-site accident in any one year.

1.3 X 10^{-6} accidents/km X 5000 trips
X 800 km/trip = 5.2 accidents/yr or about 520%

In view of the installed capability for material handling at the site, the NRC staff believes the accident evaluation to be extremely conservative as to the amount of material to be disposed.

Most of the material from a truck spill would be deposited on the ground in the immediate vicinity of the truck. Based on an NRC analysis (NRC 1980b), for a wind speed of 4.5 m/s (10 mph), about 0.1% of the material would become airborne immediately (for dry material). However, if the material were moist, the release fraction would be less. For a 18,140-kg (20-ton) truck, it is postulated that about 18.1 kg (40 lb) might become airborne. This compares with about 10.9 kg (24 lb) of dust, which becomes airborne daily per hectare of a mill tailings pile surface. If the spill were not cleaned up or if the dust were not controlled promptly, the release fraction over a 24-hour period might increase to as much as 0.9% or 63 kg (360 lb). Because of differences in moisture and waste composition between the model-mill assumptions and a postulated disposal accident on the Clive site, it is expected that a lower release fraction would be the case at the South Clive site.

To provide a bounding estimate of the effects of a theoretical truck accident, the applicant has evaluated the NRC's analysis involving a yellowcake shipment (EUI 1992b). Yellowcake does not contain the same radionuclides or radioactivity as 11e.(2) byproduct material; however, the higher activity of yellowcake gives a conservative estimate of the effects of an accident involving 11e.(2) byproduct material. The assumptions used by the NRC are for a yellowcake shipment, a 24-hour release period, all particles in the respirable range, and a population density of 0.029 persons/ha (7.5 persons/mi^2). NRC estimated 50-year dose commitments to the lungs of the general public in the range of 7 to 90 person-mSv (0.7 to 9 person-rem). The yellowcake specific activity is about 2.2 X 10^4 Bq/g (6 X 10^5 pCi/g) while the maximum uranium concentrations expected at South Clive would be about 1036 Bq/g (2.8 X 10^4 pCi/g), or a factor of 21 lower. The dose to the postulated off-site public would drop, for 11e.(2) byproduct material, to 0.3 to 4 person-mSv (0.03 to 0.4 person-rem).

An independent dose assessment by Pacific Northwest Laboratory (PNL) was also done for the truck accident spill. Potential releases from a truck spill accident were similar to those presented in the Environmental Report, based on generic NRC scenarios for uranium milling (NRC 1980b). The spill was assumed to result in dumping the contents of a 18,140-kg (20-ton) truck, of which 0.1% (40 lb or 18 kg) becomes airborne over the short term, and 0.9% is resuspended within 24 hours if the spill is not stabilized or cleaned up within that time. The release estimates assume that the waste materials are dry and that the wind is blowing at a speed of 4.5 m/s (10 mph); therefore, they represent an upper bound to the consequences of this accident. The dose was estimated to a downwind individual at a distance of 100 m (328 ft) over the short term, and to the nearest off-site permanent resident for the 24-hour scenario. Atmospheric conditions used to estimate downwind dispersion for the accident were a wind speed of 4 m/s (8.9 mph) to correspond to the NRC release scenario, and either stability class F for the short-term release (a typical condition for 99.5% worst-case analyses) or class E (somewhat less conservative conditions) for the 24-hour release.

The dose to an unprotected worker or individual located 100 m (328 ft) from the accident during the short-term phase of the release would be 4.5 mSv (450 mrem). The inhalation pathway accounts for essentially all of this dose, which would be mitigated to some extent if respiratory protection were immediately available. The dose to the closest off-site resident [24 km (15 mi) ENE] following a 24-hour release would be 5 X 10^{-9} mSv (5 X 10^{-7} mrem) for all pathways, including ingestion of locally produced food. If the accident occurred during a period when crops were not growing (winter), the dose would be approximately 20% lower.

5.2.9.3 Train Derailment

Because of the short length of track involved, the small amount of train movement, the low train speeds compared to truck speeds, and the relatively small number of cars compared to truck shipments, the probability of a derailment on-site should be much less than the probability of a truck accident. Although the amount of material released to the atmosphere would be larger [90,700-kg (100-ton) railcar versus 18,140-kg (20-ton) truck times the number of railcars, i.e., 1.5 to 10 person-mSv (0.15 to 1.0 person-rem) dose], no dose to the off-site public would be expected.

As a routine procedure, railcars are emptied at the site with the use of a rollover. The effects of dust-carried contamination in this procedure are controlled by maintaining a check for a minimum of 7% moisture content in the material and wind velocity under 18 m/s (40 mph), reducing the dispersal effects. The routine emptying of the railcars empties the entire railcar; whereas, a one-car derailment (should it occur) would likely only spill part of the contents, and the potential effects of such an accident would be even less than those of the routine procedure. In the case of an accident, as with a truck accident, there would be immediate assistance available to wet down, cover, or clean up any spilled wastes and to provide equipment for respiratory protection.

Rogers and Associates performed a risk analysis involving a derailment of a train carrying 11e.(2) byproduct material in an urban area and a rural area, and a risk assessment to individuals at 100 m (328 ft) and 1000 m (0.62 mi) from the derailment of a train carrying 11e.(2) byproduct material [see Section 5 of Appendix I in the Environmental Report (EUI 1992b)]. Based on 1990 transportation data, they determined that 0.31 accidents would occur transporting 152,900 m^3 (200,000 yd^3) of waste 3700 km (2300 mi) to the South Clive site.

The highest dose, related to a train accident, to the urban and rural populations would come from contamination of drinking water. These doses are estimated to be 1.76 person-mSv (0.176 person-rem) for urban populations and 1.79 person-mSv (0.179 person-rem) for rural populations. The associated risk is 5.02 X 10^{-8}/year for both rural and urban populations.

5.2.9.4 Flooding

Flood control features for both the Vitro and Clive sites have been designed and constructed to prevent erosion or off-site transport of wastes from the sites by overland flooding. Details of the flood control features are provided in Appendix F of the Environmental Report (EUI 1992). No off-site transport of radioactive waste by flooding is anticipated.

5.2.9.5 Tornado

From NRC (1980a), the probability of tornado occurrence in Utah is 1 to 5 X 10^{-4}. NRC (NRC 1980b) also estimated the consequences of a tornado striking a model uranium mill. In this case, about 11,430 kg (12.6 tons) of yellowcake is entrained in the vortex, the vortex dissipates at the site boundary, all of the yellowcake is respirable in size, and the cloud is dispersed as a volume source by the prevailing winds. Settling velocity is negligible. The model predicts a maximum exposure at 4 km (2.5 mi) from the mill, where the 50-year dose commitment is estimated to be 8.3 X 10^{-9} Sv (0.83 μrem). At the fenceline [a distance of 490 m (1600 ft)], the dose is estimated to be 2.2 X 10^{-9} Sv (0.22 μrem). Since the 11e.(2) byproduct material involved in the proposed option would have specific activities considerably less than this, the doses would be correspondingly less. For on-site workers caught in the tornado, the dose received is trivial compared to the mechanical hazards associated with a tornado in any location.

The Rogers and Associates analysis [see Appendix A of the Environmental Report (EUI 1992b)] of airborne exposure to the hypothetical off-site residents was based on an average wind speed of 3 m/s (6.7 mph). However, the analysis also assumed wind blowing toward the receptor 100% of the time. Although, as shown by the wind rose data of Appendix G in the Environmental Report (EUI 1992b), wind speeds at the site exceed 8.24 m/s (18.4 mph) a small fraction of 1% of the time, the occurrence is infrequent and the duration is short. When consideration is given to the parameters of the Rogers and Associates analysis, the original dose determinations are conservative relative to the actual conditions of area of exposed material, and exposure duration and residency. Relating these to the tornado evaluation, the anticipated dose to an off-site resident as a result of infrequent severe winds would be measured in microrem per year. Assuming an order of magnitude increase in airborne concentrations during severe wind conditions of 10 times the average wind speed occurring 1% of the time, the time-weighted average exposure would increase by only 10%.

5.2.9.6 Non-Radiological Risks

Industrial Health Incorporated (IHI) performed an analysis of projected fatalities associated with the excavation, transportation, and disposal of 11e.(2) byproduct material. This analysis is included as Appendix I-1 of the Environmental Report (EUI 1992b). The analysis is based upon U.S. Department of Labor statistical data from 1989 and U.S. Department of Transportation (DOT) statistical data from 1990. IHI determined that for Standard Industrial Classification Code 16, which includes construction activities, there were 0.000293 fatalities per worker year.

This means that for an estimated 20 construction workers at any of the alternatives there would be 0.00586 expected fatalities per year. For rail transportation, based on 152,900 m^3 (200,000 yd^3) and a 3700-km (2300-mi) haul, it was determined that there would be an estimated 0.26 fatalities per year.

5.2.10 Other Impacts

Increased Traffic. It is anticipated that the annual increase in rail and truck traffic to the site, based on a realistically expected disposal rate of 3.63 X 10^7 kg/yr (40,000 tons/yr), would be about 30% if additional waste streams were accepted at the South Clive facility. Using that estimate, approximately 1300 rail shipments a year (1000 cars for existing facility and 300 cars for 11e.(2) facility) would be anticipated at the South Clive site with Alternatives 1 and 2. This 300 car addition would mean an increase of approximately 2% in the average rail traffic on the Union Pacific mainline that runs from Salt Lake City to Wendover. Discussions with representatives of Union Pacific indicated that no difficulties would be encountered in scheduling or completing the anticipated levels of rail traffic. The number of truck shipments per year of 11e.(2) material to achieve the 3.63 X 10^7 kg/yr (40,000 tons/yr) rate, in addition to the rail transportation, would be 450 trucks per year. (The existing disposal facility has 1500 truck shipments a year for a total for the combined facilities of 1950 trucks per year.) Based on 1989 traffic counts, this increase of 450 trucks per year would account for a 0.2% increase in traffic on Interstate–80. This volume is well below the highway's capacity.

If the maximum amount of material of 4.53 X 10^8 kg/yr (500,000 tons/yr) proposed in the application were to be received, the transportation impact would be considerably larger. Assuming 80% of the material to be received by rail and 20% by truck would require a total rail shipment of 5000 cars per year and total truck shipment of 6500 trucks per year for both disposal facilities at the South Clive site. This would be an increase over existing transportation levels at the site of 400% for rail and 333% for truck. This would be an overall increase in total rail traffic on the Union Pacific line of 33% and an increase in total traffic on Interstate–80 of 22%. While these are very large increases, there is no reason to believe that there would be insurmountable problems in placing this additional traffic load on the transportation facilities. The probability of the maximum quantity proposed for disposal of 4.53 X 10^8 kg/yr (500,000 tons/yr) being achieved is not large.

Socioeconomics. The generation point of the waste currently is not known. However, most rail and truck shipments that now arrive at the South Clive LARW facility have minimal travel time through populated areas. During both the Vitro project and the operation of the LARW facility, there have been no socioeconomic effects from the shipment of waste through populated areas (EUI 1992b). All waste that is shipped to South Clive must be properly packaged in accordance with the DOT standards for the respective waste. This has proven to minimize the concern of citizens along the transportation routes.

Visual. Minimal visual effects at the South Clive site would result from operation activities. During the operation phase, there would be increased activity in the area, but it is unlikely that the visual impact would be significant to travelers on Interstate–80 or others in the area, based on the following:

- Most of the facilities would be located about 3 km (2 mi) from the nearest common vantage point on Interstate–80.
- The facility would most often be seen by viewers from a distance.
- The Vitro embankment and corresponding features are already present.

A scenic-quality rating of 12 was assigned to the South Clive site, indicating that no special management attention regarding visual resources is required.

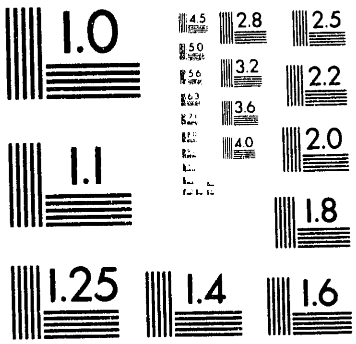
Recreation. Operation of the South Clive site would have minimal effect on recreation activity in the area. The proposed site is located on private land owned by Envirocare. The use of any public land is not anticipated for these alternatives. There would be no effect to the Cedar Mountains WSA, the Knolls Special Recreation Management Area (SRMA), the Horseshoe Springs ACEC, or the Bonneville Salt Flats ACEC from construction at the South Clive site.

5.2.11 Resources Committed

For Alternative 1, approximately 45 ha (110 acres) of the present terrain would be occupied by a flat-topped mound, approximately 12 m (40 ft) high, with side slopes of 1 vertical to 5 horizontal. For Alternative 2, the cell would be near the original topography. Neither of the proposed alternatives would create a major effect on the local topography.

The excavation of the cell and the placement of the clay liner would require the use of electricity, fuel, water, personnel, and construction materials. The use of water, personnel, and soils would not be a commitment of nonrenewable resources, but the uses of electricity and engine fuel would be. Engine fuel and electricity are available at the South Clive sites.

Alternatives 1 and 2 would be situated on private land, owned by Envirocare. No State or Federal resources would be committed.


1.0
4.5
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3.2
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4.0
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2.2
2.0
1.1
1.8
1.25
1.4
1.6

2 of 2

Both alternatives would require the same type of resource inputs. These include electricity, engine fuel, backfill and cover material, personnel, water, and land. The only resources among this list that are irretrievably lost after use are electricity and engine fuel. The use of water is not a permanent commitment of a resource. Even the use of backfill and cover material, and land in general, would not be completely permanent commitments.

5.3 Closure

Site closure and stabilization would include decontamination and decommissioning of the entire site. This would include the removal of all facilities, including roads, rail spurs, railcar rollover, storage pads, wash pads, and administrative buildings. Any material that did not meet the standards for unrestricted release would be placed into the embankment(s). Closure would also entail decontaminating the site, with contaminated materials being included in the embankment(s). Remediation would then be performed on the decontaminated and decommissioned areas.

Closure of an 11e.(2) byproduct material disposal embankment or cell would begin once the embankment(s) were filled and the radon and erosion barriers were completed. For Alternatives 1 and 2, South Clive site closure would consist generally of the following activities:

- The perimeter berm, emplaced during construction to prevent run-on of surface drainage, would be replaced by the perimeter ditch for collection of surface runoff from the embankment. The ditch would be a "V" ditch 1.2 m (4 ft) deep, 12 m (40 ft) wide and would be lined with 45 cm (18 in.) of riprap.

- The railcar rollover/dumper and the railroad spur would be removed, and fill would be placed in the excavated areas to restore decontaminated areas to natural grade. Excess cover material that was excavated during construction would be spread in these areas with dozers and then compacted.

- The disturbed areas would be restored and revegetated, except for the embankment area. Site requirements in terms of soil characteristics, fertilizer, and mulch would be assessed, and the area seeded with native grasses.

- A fence would be installed around the embankment(s). Fences would be 1.8-m (6-ft) chain-link with posts cemented in concrete and topped with 3 strands of barbed wire. The fence would be posted at regular intervals with warning signs as described in the Site Security Plan.

- Custody and ownership of the site would be transferred to DOE, or to another Federal Agency as designated by the President, or to the State at its option for long-term survcillance and monitoring. The custodial Agency would also become a licensee of the NRC for these activities as required pursuant to the Uranium Mill Tailings Radiation Control Act (UMTRCA) and regulated under 10 CFR Part 40.28.

5.3.1 Land Use

The closure of the 11e.(2) byproduct material disposal facility would continue to keep approximately 45 ha (110 acres) of land from other uses.

5.3.2 Geology/Seismicity

The effects of facility and site closure on the local geology and soils would be similar to those described for construction and operation. Stockpiled and temporarily stored piles of materials would be removed.

5.3.3 Air Quality

An effect of closure for a given facility at South Clive would be a cessation of the effects due to 11e.(2) byproduct material disposal facility operations. The radon barrier on an embankment would control the exhalation of radon that occurred during normal operations.

5.3.4 Hydrology

There would be no effects on surface water for the 11e.(2) byproduct material disposal Alternatives 1 and 2 because of the total lack of surface water. The effects of precipitation and water used for decontamination are described for construction and operation.

There are no effects on the groundwater expected from the closure of the 11e.(2) byproduct material disposal facility at South Clive. The NRC requirements under 10 CFR Part 40, Appendix A require the design of the disposal embankment or cell to minimize any leaching through the liner and to contain the waste for up to 1,000 years, but in any case, for at least 200 years.

The embankment design includes two key features that will contribute to water resources protection at the disposal site after the facility closure. These include an embankment cover and a bottom liner that are designed to contain the waste and minimize the mobility of contaminants. The bottom liner has already been discussed in Section 5.1.4. The embankment cover consists of a 2-m (7-ft) thick radon cover, a 15-cm (6-in.) filter zone, and a 45-cm (18-in.) thick, graded-rock cover for protection against erosion. The radon cover is designed to minimize the infiltration of precipitation and runoff water into the cell. The filter zone is intended to trap dew and condensation, thereby reducing the potential for drying of the clay in the radon cover. The rock cover is intended to protect the integrity of the radon cover and the disposal cell by providing protection against water and wind erosion.

Based on the findings of the performance assessment carried out by Envirocare to date, there are no foreseen impacts on the groundwater flow or the groundwater quality in the disposal site area after facility closure. As noted above, the groundwater at the site contains up to 75,000 ppm of dissolved solids and, as a result, is not potable. The applicant's performance assessment of groundwater is continuing and will be carefully monitored and evaluated by the NRC staff prior to issuing any license.

5.3.5 Ecology

Upon closure of the facilities and sites, reclamation would be completed. Revegetation would be slow in the arid, western sites after restoration, but wildlife species are expected to migrate back into the area (with the exception of the fenced embankments), utilizing the habitat as before.

5.3.6 Socioeconomic Impacts

These effects are grouped with those under construction of the waste facility (see Section 5.1.6).

5.3.7 Radiation

At the termination of disposal activities, the entire facility and all equipment used in the embankment construction would be decontaminated and brought to radiation and removable-contamination levels in accordance with NRC requirements.

Decontamination of equipment would be a carryover of ongoing decontamination practices during disposal activities. Activities would be conducted using the principle of ALARA ("as low as reasonably achievable") during the decontamination and decommissioning phases. The total dose to the maximally exposed individual during the institutional control period shall not exceed 0.25 mSv (25 mrem per year) (or the current NRC and EPA exposure guidelines) from all radiation sources (both fixed and removable). Envirocare will be required to adhere to the acceptable contamination levels defined in Table 5.5 [taken from Regulatory Guide 1.86, Table 1 (AEC 1974)].

Portable high-pressure water washing systems and/or portable steam generators would be utilized as necessary to decontaminate construction equipment, train track rails, and railcar rollover/dumper. If necessary to reach decommissioning level, sandblasting would be used to remove contamination. The limits specified in Table 5.5 would be achieved before releasing equipment from the site.

Upon completion of disposal activities at the site, an environmental survey would be performed on properties adjacent to the property owned by Envirocare, including the entire length of the railroad spur, to determine the extent (if any) of "off-site migration" of radioactive materials as a result of disposal operations. At a minimum, the entire Envirocare property would be monitored around the perimeter, at distances of 15 m (50 ft) and 30 m (100 ft) beyond the property line.

Monitoring would be accomplished by taking gamma-level measurements with shielded microR scintillation meters fitted with a sliding lead shield to facilitate "delta measurements." Soil samples would also be taken as needed to document the presence or absence of ^{230}Th.

Any contaminated off-site areas would be cleaned to background levels, or as low as reasonably achievable.

The South Clive facility would also be decontaminated to levels as close to background as reasonably achievable. For ^{226}Ra, an upper limit for remaining contamination would be the EPA standards for cleanup at uranium mill tailings sites. This limit is:

- 0.185 Bq/g (5 pCi/g) average concentration above background for surface areas [over the first 15 cm (6 in.) below the surface] and

- 0.555 Bq/g (15 pCi/g) above background for areas more than 15 cm (6 in.) below the surface.

For other isotopes, the cleanup would be to the limits as required by the NRC.

Initial cleanup of the site could be performed by construction equipment such as scrapers and dozers. Final cleanup could be performed by backhoes with straight-edged buckets and hand equipment such as shovels and brooms. Following the final cleanup of the site, documentation of the cleanup would be prepared and provided to the NRC.

All data collected during the South Clive site closure activities would become a part of the permanent decommissioning record and would be retained by Envirocare or provided to the custodial agency. These records would be available for review by the NRC.

All completed disposal embankments would be fenced using permanent chain-link wire mesh fence, meeting the materials and construction specifications as discussed in Appendix O of the Environmental Report (EUI 1992b),

Table 5.5 Acceptable Surface Contamination Levels

Radionuclide[a]	Column I Average[b,c,f]	Column II Maximum[b,d,f]	Column III Removable [b,e,f]
U-nat, U-235, U-238 and associated decay products	5,000 dpm alpha/100 cm^2	15,000 dpm alpha/100 cm^2	1,000 dpm alpha/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/ 100 cm^2	3,000 dpm/100 cm^2	200 dpm/ 100 cm^2
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000 dpm beta-gamma/100 cm^2	15,000 dpm beta-gamma/100 cm^2	1,000 dpm beta-gamma/100 cm^2

Sources: EUI 1992b.
AEC 1974; Regulatory Guide 1.86, Table 1.

Notes:

(a) Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.
(b) As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive materials as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
(c) Measurements of average contamination should not be averaged over more than one square meter. For objects of less surface area, the average should be derived for each such object.
(d) The maximum contamination level applies to an area of not more than 100 cm^2.
(e) The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping the area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally, and the entire surface should be wiped.
(f) The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters shall not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 mg/cm^2 of total absorber.

"Construction Technical Specifications." The entire section owned by Envirocare would not be fenced at the onset of the disposal activities; however, all controlled areas would be fenced. Upon final closure of a disposal cell or embankment, that cell would be fenced and posted, leaving a minimum 24-m (80-ft) buffer zone between the edge of the embankment and fence, providing space inside the fence for an inspection roadway and for sample collection from monitoring wells located inside the fence.

A buffer zone of 91 m (300 ft) would be maintained between the closest edge of any embankment and the outside site boundary or property line. A buffer zone of 30 m (100 ft) would be maintained between the closest edge of any embankment and the Vitro site fence.

5.3.8 Cultural Resources

Closure would have no further effects on these resources other than those described for construction and operation.

5.3.9 Other Environmental Impacts

Visual. Minimal visual effects at the South Clive site would result from closure activities. It is unlikely that the visual impact would be significant to travelers on Interstate-80 or others in the area, based on the following:

- Most of the facilities would be located about 3 km (2 mi) from the nearest common vantage point on Interstate-80.
- The facility would most often be seen by viewers from a distance.
- The Vitro embankment and corresponding features are already present.

A scenic-quality rating of 12 was assigned to the South Clive site, indicating that no special management attention regarding visual resources would be required.

For Alternative 1 at the South Clive site, the only effect would be a rock-covered mound covering about 45 ha (110 acres), similar to the existing mound from DOE's disposal of the Vitro material. Alternative 2 would have no mound and would only be marked by permanent fences.

Recreation. Closure would have no additional effect on recreation at the South Clive site (Alternatives 1 and 2) because the facility would be on private land owned by Envirocare and not available to the public for recreational use. After closure the land will be owned by DOE, under license from the NRC, and access will be restricted.

5.3.10 Resources Committed

No additional resources would need to be committed other than those required for operation.

5.4 Proposed Operational Monitoring Programs at South Clive Site

The following is a summary of the operational environmental monitoring and surveillance plan that would be implemented by Envirocare. This plan is consistent with the "Criteria for Adequate Radiation Control Programs (Environmental Monitoring and Surveillance)" established by the Conference of Radiation Control Program Directors, Inc.

The intent of the plan is to characterize the general radiological and environmental profile of the South Clive site during site operations. This profile would be used to document compliance with NRC radiological and safety standards and to adjust operational and monitoring programs as necessary to maintain compliance. The monitoring program is designed to be capable of evaluating ambient conditions as well as documenting any effects of site operations on the radiological environment.

The radiological monitoring program is described in Table 5.6. The disposal site layout and environmental monitoring station locations are provided in Figure 5.2.

Envirocare has operated a similar environmental monitoring and surveillance program since 1988 for the South Clive site designed to detect and quantify LARW radionuclides in concentrations greater than those occurring naturally. This program would be left intact and a separate complementary program would be performed, as necessary, to detect and quantify the presence of any radionuclides which might be disposed of at the 11e.(2) byproduct material site.

5.4.1 Radiological Monitoring

5.4.1.1 Airborne Particulate Monitoring

Airborne particulate samples would be collected by means of low-volume, constant-flow air samplers operated at 60 L/min (2.1 ft^3/min) under conditions of standard temperature and pressure [76 cm (29.92 in.) mercury pressure, 21.1°C (70° F)]. Samples would be collected on 5-cm (2-in.) diameter glass fiber filters. Samples would be changed weekly, or more often, and would be analyzed for gross alpha and gross beta concentrations.

Additionally, quarterly composite samples, consisting of all weekly samples taken from each specific station during the quarter, would be analyzed by gamma spectrometry for specific identification of gamma-emitting radionuclides, for total uranium, ^{226}Ra, ^{230}Th, ^{232}Th and ^{210}Pb. Analytical techniques chosen would provide minimum detectable concentrations of 25% or less of the applicable airborne concentrations in Table II of 10 CFR Part 20, Appendix B.

Of those radionuclides which might be accepted for disposal, the most restrictive limits in 10 CFR Part 20, Appendix B, Table II are, for alpha emitters, ^{230}Th at 3.0 X 10^{-6} Bq/L (0.08 pCi/m^3), and for beta emitters, ^{210}Pb at 1.5 X 10^{-4} Bq/L (4 pCi/m^3).

Samples with observed gross alpha concentrations of greater than 3.0 X 10^{-6} Bq/L (0.08 pCi/m^3) or gross beta concentrations of greater than 1.5 X 10^{-4} Bq/L (4 pCi/m^3) would be individually analyzed by gamma spectrometry to identify the nuclides present. If it is believed that non-gamma-emitting radionuclides might be present in samples above the described action levels, the samples would be analyzed for those nuclides at a contract laboratory.

5.4.1.2 Radon in Outdoor Air

Radon in outdoor air would be measured on a continuous basis using E-Perm Electret Ion Chambers. Radon detectors would be placed at the ten air sampling stations listed in Table 5.6.

Table 5.6 Radiological Monitoring Program

Type of Sample	Location	Collection Method	Collection Frequency	Sample Analysis
Air particulates (weekly	Stations A–2 A–5 A–6 A–7 A–10 A–11 A–12 A–13 A–14	Continuous low volume A–3	Weekly	Gross alpha on-site gamma scan
Air Particulates (quarterly)	Stations A–2 A–3 A–5 A–6 A–7 A–10 A–11 A–12 A–13 A–14	Continuous Low Volume	Quarterly	Total Uranium Ra–226 Th–230 Th–232 Pb–210
Radon Gas	Stations A–2 A–3 A–5 A–6 A–7 A–10 A–11 A–12 A–13 A–14 B–1 B–2	Passive	Continuous (exchanged quarterly)	Rn–222
Direct Gamma	Station A–2 A–3 A–5 A–6 A–7 A–10 A–11 A–12 A–13 A–14	TLD or Electret	Continuous (exchanged quarterly)	Gamma Exposure

Table 5.6 (Continued)

Type of Sample	Location	Collection Method	Collection Frequency	Sample Analysis
Soil	Stations A-2 A-3 A-5 to A-7 A-9 to A-12 B-1 B-2 Stations 11, 12 Stations 18 to 21 Stations 24 to 26 Stations 30 to 32 Stations 36 to 42 Station 44	Grab	Quarterly	Gamma Spectr.
Soil	Areas Vehicle Decon. Area Truck Staging Area by rollover-cell road	Grab	Quarterly Total U	Gamma Spectr. Th-230,232
Soil	Stations 5 32 37 43 45	Grab	Quarterly	Gamma Spectr. Th-230,232 Total U
Vegetation	Stations B-1 B-2 B-3 B-4 A-10 A-11 A-12 A-14 18	Grab	Twice annually during growing season	Gamma Spectr. Th-230, 232, Po-210, Pb-210, Total U
Wildlife	Stations A-3 A-11 A-12 A-14	Grab (field mice)	Annually	Gamma Spectr. Th-230, 232 Po-210 Pb-210 Total U
Ground Water	Wells GW-1 GW-1 GW-2 GW-17 GW-19 GW-22 I-2 I-3	Grab	Quarterly	Dissolved natural uranium Th-230, 232, Ra-226, 228, Gross alpha, Gross Beta, Spec. Cond., TDS, Cr, SO_4+

Source: EUI 1992b.

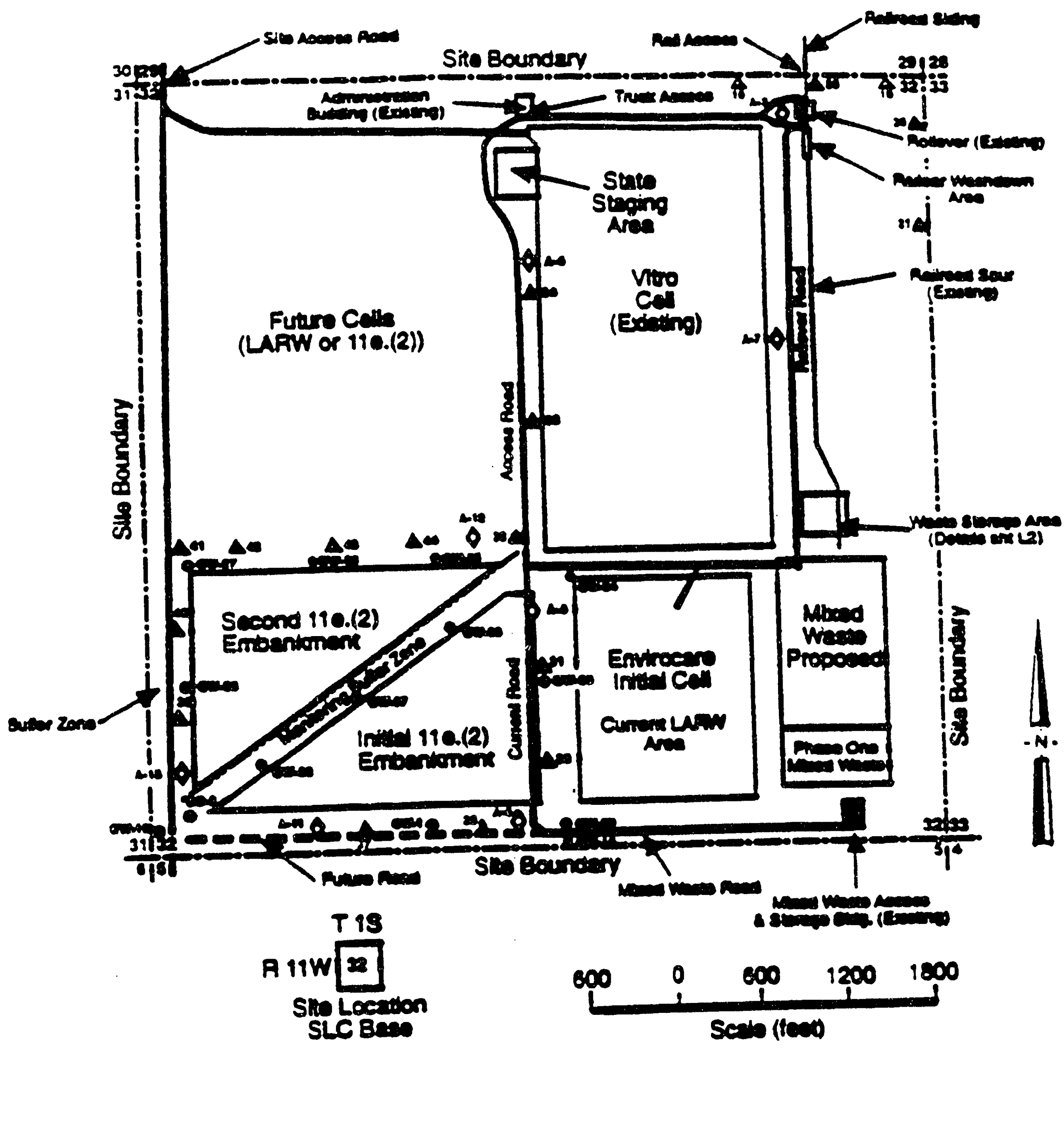

Figure 5.2 Environmental Monitoring Locations

Past experience at uranium mill sites indicates that radon from uncovered mill tailings is usually not significantly above background beyond about 1.6 km (1 mi). Two off-site stations would be used to monitor off-site radon levels during site operations.

Detectors would be collected quarterly, processed, and reported as the 3-month average concentration in pCi/L. Average radon concentrations for 1988, 1989 and 1990 have been reported in Envirocare's 1988, 1989 and 1990 Environmental Reports. Minimum detectable concentrations for ^{222}Rn in air are about 1.5 X 10^{-5} Bq/L (0.4 pCi/m^3), or about 0.01% of the limit in 10 CFR Part 20, Appendix B, Table II.

5.4.1.3 Gamma Radiation Exposure

Gamma ray exposures would be measured using E-Perm Electret Ion Chambers. These units would be placed at the 12 sites monitored for ^{222}Rn. The two off-site stations would be used to establish off-site background exposure during site operations. The detectors would be exchanged at quarterly intervals with the results averaged and reported in mrem/week $\pm$2 standard deviations.

5.4.1.4 Soil Sampling

Soil samples would be collected from a 15 X 15 X 2.5-cm (6 X 6 X 1-in.) deep area. After marking off the area with the sampling knife, a trench would be dug along one side of the area to permit using the collection knife to remove a 2.5-cm (1-in.) deep block of soil. Samples would be dried and pulverized before being submitted for laboratory analysis.

Soil samples would be collected quarterly. All samples would be analyzed by gamma spectrometry. Selected samples would also be analyzed for ^{230}Th and ^{232}Th and total uranium.

(1) Each quarter, soil samples taken from selected locations would be analyzed for gamma-emitting radionuclides by gamma spectrometry.

(2) Samples from the following sites would be analyzed by gamma spectrometry and also for ^{230}Th and ^{232}Th and total uranium:

- the vehicle decontamination area,
- the truck shipment staging area,
- the road from the rollover to the cell, and
- five other selected stations.

5.4.2 Groundwater Monitoring

Envirocare's groundwater monitoring program will be conducted in compliance with the requirements in 10 CFR Part 40, Appendix A.

Hydrogeological studies included as Appendices D, D-1, and D-2 in the Environmental Report (EUI 1992b) describe the results obtained from a system of monitoring wells which had been established to monitor potential contamination from both the DOE Vitro embankment and the Envirocare disposal cell(s). These studies have been completed to better define and characterize the aquifer underlying the disposal site.

The analysis parameters for Envirocare's groundwater monitoring program are described in Table 5.6. The locations of wells for the sampling are illustrated in Figure 5.2. Envirocare is performing accelerated background sampling of the monitor wells to develop background water quality data. Sampling and analyses are being performed monthly in 18 monitor wells for a 1-year period.

Water samples would be collected by means of dedicated bladder pumps permanently located in each well. Samples would be collected after purging three well volumes of water from the well. One gallon of water would be collected into a polyethylene container previously prepared with nitric acid to preserve the sample.

5.4.3 Meteorological Monitoring

A meteorology tower was installed on the Clive site in October 1989 by the U.S. Army, Dugway Proving Ground. By January 1990, data were being collected at least 95% of the time. Data are now made available to Envirocare, including hourly wind speed and direction averaged monthly, monthly wind speed frequency summaries, and wind rose data monthly or seasonally. Measurable precipitation is recorded daily by Envirocare.

Envirocare initiated a meteorological monitoring program in April 1992, with the installation of a full weather station. The weather station monitors and records wind speed, wind direction, temperature, Delta T, precipitation, and evaporation.

5.4.4 Ecological Monitoring

5.4.4.1 Vegetation Sampling

Since no commercial vegetation crops are grown near the site, vegetation samples would be obtained from the local native plants. Vegetation samples would be collected during the growing season and would consist of approximately 1 kg (2.2 lb) of available new growth. Each sample would require collecting the new growth from all plants within an area of approximately 9.3 m^2 (100 ft^2).

Vegetation samples are collected twice each year at nine locations. Four of the locations are 1.6 km (1 mi) east, west, north, and south of the site to serve as background sites. The other five stations are on or near the site. Samples would be analyzed by gamma spectrometry for gamma-emitting nuclides and for total uranium, ^{210}Pb, ^{210}Po, ^{226}Ra, ^{230}Th, and ^{232}Th.

5.4.4.2 Wildlife Sampling

Wildlife available for sampling near the South Clive site is limited, but field mice or other wildlife should be available. Mouse traps would be set at the selected locations and would be checked several times per week. As mice are collected, they will be stored in a freezer and segregated by sampling location until enough are collected from each location. This generally requires about two dozen mice and several months of collection time during the time of year when they are available for trapping.

Four stations would be designated for sampling wildlife with one off-site station sampled and analyzed as an upwind control. Samples would be analyzed by gamma spectrometry for total uranium, ^{226}Ra, ^{230}Th, ^{232}Th, ^{210}Po, and ^{210}Pb.

5.4.4.3 Related Environmental Measurement and Monitoring Programs

There are no environmental measurement or monitoring programs expected to be carried out by public agencies or other agencies not directly supported by Envirocare.

5.5 Mitigation Measures

5.5.1 Air Quality

In an effort to control air quality the applicant will develop and utilize programs designed to minimize fugitive dust emissions which conform to the following:

(1) Limit vehicle speeds on site to no more than 32 km/hr (20 mph),

(2) Achieve a high level of dust reduction through watering of the roads and application of chemical dust suppressants,

(3) Limit disturbed areas (where project activities are being conducted) to as small an area as possible,

(4) Limit dusting from stockpiled soil or overburden by applying a chemical dust suppressant where natural crusting does not occur,

(5) Utilize watering or chemical suppressant on all material being disposed until it is covered during the closure phase, and

(6) Monitor dust emissions and maintain a timely review of the results of such monitoring.

5.5.2 Radiological Environment

Mitigation measures for radiological considerations are essentially the same as those for air quality, except for special emphasis in the areas where disposal material is being placed.

To confirm that air quality mitigation measures are effective for the disposal areas, the staff will require that air monitors be operated continuously during disposal operations to detect off-site transport of radionuclides. If unexpectedly high values are observed, the licensee will be required to determine the cause and provide a plan for mitigation for NRC approval. This control program would contain documented inspections.

5.5.3 Water

5.5.3.1 Surface Water

There are no naturally occurring surface water bodies within the affected vicinity. Temporary surface waters resulting from natural precipitation will be collected and stored for use in dust control operations. No release from the site is contemplated for normal periods of precipitation.

Long term water control is provided by engineered erosion control drainage ditches which will carry runoff from the closed disposal embankment away from the site.

5.5.3.2 Groundwater

The disposal cell design is engineered to minimize water infiltration into the cell. The cell is underlain by a compacted clay liner to minimize water seepage into the underlying strata. The material being disposed will have a low moisture content and only water needed for dust control or to meet compaction specifications will be introduced.

5.5.4 Biota

There is no aquatic biota on the site. No effective short-term mitigation measures are available for terrestrial biota. Long-term impacts on terrestrial biota will be minimized by revegetation of disturbed areas and natural re-population.

5.6 Unavoidable Adverse Environmental Impacts

5.6.1 Air quality

The unavoidable impacts to air quality near the South Clive disposal site relate primarily to movement of both earth and contaminated disposal material. The area's air will be monitored during construction, operations, and closure to determine whether mitigative methods are adequate or if additional or modified procedures should be implemented. The staff expects the impact on regional air quality to be minimal.

5.6.2 Land Use

The site proposed for the disposal facility presently has a non-use status. It is located immediately adjacent to two large disposal sites where similar material is or has been disposed. During construction and operation, an area of approximately 40 ha (100 acres) will be disturbed. After closure of the site, it will be available for use only by small indigenous wildlife.

5.6.3 Water

There are no bodies of surface water in the area so there will be no impact.

No unavoidable adverse impacts on groundwater are expected as a result of operation of the proposed disposal facility. The existing groundwater under the proposed disposal site is saline and has no present use. The clay liner design restricts movement of water into or out of the disposal cell and the surface configuration of the final material pile and the clay cover restricts water inflow into the disposed material. In the unlikely event that water from the disposal cell moved into the underlying aquifer, the groundwater movement through the aquifer is very slow, and any contamination would stay within the saline groundwater.

5.6.4 Soils

Topsoil and subsoil will be segregated prior to construction for later use in closure of the site. Moving of the soils will disrupt existing physical, chemical, and biotic soil processes. Compaction by heavy machinery during closure will reduce water and air circulation needed for plant growth; this will be somewhat mitigated by fertilizing and using soil amendments.

5.6.5 Mineral Resources

No known commercially valuable mineral resources will be affected by this project.

5.6.6 Ecological—Terrestrial

Vegetation will be removed from all areas utilized in the disposal project. Plant species composition and diversity will be altered because of this disruption of the natural vegetation and subsequent revegetation. Loss of habitat will occur for most wildlife populations on disturbed areas. It is likely that many less mobile forms will be destroyed. Habitat removal will be temporary, but the natural diversity of plant species may not recover.

5.6.7 Radiological

There will be a short-term increase in radon emanation during movement and placement of the waste in the disposal pits. These releases will be temporary and will be offset by the cessation of radon releases at the sites previously occupied by the waste. After closure, this short-term increase in radon emanations will cease due to the radon control measures designed into the closure plans.

5.6.8 Socioeconomic

Because of the size of the regional employment force and the relatively small number of workers to be utilized on the project, there are not expected to be any adverse socioeconomic impacts from the project.

5.7 Relationship Between Short-Term Uses of the Environment and Long-Term Productivity

5.7.1 The Environment—Surface Element

The short-term increases in suspended particulates and radiological emissions associated with construction, operation, and closure of the waste disposal facility are more than offset by the removal from other areas and disposal of low-level radiological contamination. The short-term loss of wildlife habitat is temporary. The affected areas will be revegetated and returned to current use by wildlife.

5.7.2 Society

Any short-term socioeconomic problems encountered by local governmental sources will be offset by the long-term disposal of low-level radiological materials from multiple locations in a single stable permanent site. Social stresses on employees and families are short term and will not extend into the future.

5.8 Irreversible and Irretrievable Commitments of Resources

5.8.1 Land and Mineral Resources

If, over time, the 11e.(2) byproduct material disposal site is made available for grazing, there will be no long-term commitment of land. It should be noted, however, given the present UMTRCA legislation and NRC's regulatory authority over activities to provide long-term custodial monitoring and maintenance of the site, there is little likelihood that such grazing would ever be permitted on the 11e.(2) byproduct material disposal site. If grazing is not allowed, the site will still be available to small indigenous wildlife.

No known commercially valuable mineral resources are expected to be affected by the project with the possible exception of sand and gravel deposits which are widespread in the area.

5.8.2 Water and Air Resources

Water used during the project is recycled to the atmosphere for distribution elsewhere. Water used from aquifers will eventually be recharged. The air is self-cleaning of pollutants at the concentrations expected.

5.8.3 Vegetation and Wildlife

These resources are renewable, and although some irreversible and irretrievable commitment is required, the commitment is relatively minor.

5.8.4 Material Resources

Construction, operation, and closure of the site will require a commitment of human and financial resources. Commitments of machinery, vehicles, and fossil fuels are required during the project. None of the resources are in short supply relative to the size and desirability of the disposal project.

5.9 Cumulative Impacts

The applicant has addressed cumulative impacts in the Environmental Report (EUI 1992b). The discussion below summarizes the findings relevant to cumulative impacts of the proposed action in combination with other activities in the vicinity of the South Clive site.

Five nearby waste facilities that may contribute to the cumulative impacts of the proposed action have been identified. The five waste facilities, in terms of their relative proximity to the South Clive site, are (1) Envirocare's existing low-activity and mixed-waste disposal facility, (2) uranium mill tailings from the DOE Vitro remediation project, (3) USPCI's hazardous waste incinerator, presently under construction, (4) USPCI's Grassy Mountain hazardous waste landfill, and (5) Aptus, Inc.'s hazardous waste incinerator. The location of these facilities is shown in Figure 3.3.

The proposed action would have no cumulative impact with the hazardous waste incinerators and landfill facilities. The design of Envirocare's and Vitro's radioactive disposal facilities will minimize any cumulative impacts. The radon exposure from Envirocare's existing facilities and the Vitro facility will be similar to the proposed action. The leaching time prior to any groundwater impact will be similar to the proposed action, even though the proposed action incorporates a thicker clay liner.

Cumulative radiological impacts at the proposed site on workers and members of the public will be minimal. The site of the proposed action is located within Tooele County's Hazardous Industries Zone. There are no residential areas within this zone; therefore, the location of the site reduces the exposure to the public and to employees of other facilities located within the general area, as well as to occasional visitors.

6.0 NRC BENEFIT-COST SUMMARY

6.1 General

There are large quantities of uranium and thorium mill tailings [11e.(2) byproduct material] that exist throughout the United States. These mill tailings are located at sites that are neither licensed by the U.S. Nuclear Regulatory Commission (NRC) or Agreement States nor are one of the 24 abandoned mill tailings sites being remediated by the U.S. Department of Energy (DOE) under Title I of UMTRCA. The State of Utah has granted the applicant licenses to dispose of both Naturally-Occurring Radioactive Material (NORM) and Low-Level Waste (LLW) at the South Clive site. The benefits to the general public of having a safe, remotely-located disposal site for 11e.(2) byproduct material appear to be significant. However, because these costs and benefits are not localized, it is appropriate to review the specific site-related benefits and costs for the Envirocare facility.

6.2 Quantifiable Socioeconomic Impacts

The socioeconomic impacts of the proposed 11e.(2) byproduct material disposal site will be minimal because the proposed facility is an expansion of Envirocare's existing LLW and NORM facility. Since Envirocare proposes to use existing personnel, the impact on the labor force, housing, schools, local economy will be minimal as well. Tax revenue from the disposal operations, however, may provide some additional public funds.

6.3 The Benefit-Cost Summary

The proposed disposal project is beneficial because it fills a public need in that it provides a location for the safe disposal of 11e.(2) byproduct material and consolidates numerous sources of waste at one location, where other types of wastes [i.e., low-level radioactive, NORM, and Resource Conservation and Recovery Act (RCRA) wastes] are currently being consolidated. In addition, the waste would be consolidated in an area specifically zoned for handling of hazardous waste remote from populated areas.

The cost of the project is limited to a slight increase, during operations, in radiation exposure to the nearby public and along transportation corridors, over and above that which currently exists due to the LLW, NORM, and RCRA operations. However, the monitoring and mitigating measures will keep such potential exposure well below permissible guidelines for the protection of the health and safety of the public. After project completion and license termination, the site will be turned over for long-term care to the DOE, to another Federal Agency designated by the President, or to the State of Utah at its option.

6.4 Staff Assessment

The staff has concluded that the adverse environmental impacts and costs are such that use of the mitigative measures suggested by the applicant and the regulatory requirements of NRC would reduce to acceptable levels the short- and long-term adverse environmental impacts and costs associated with the Envirocare 11e.(2) byproduct material project.

In considering the need for additional disposal capacity for 11e.(2) byproduct material for the United States, minimal radiological impacts, minimal long-term disturbance of land, and mitigable nature of the impacts of any growth on the local communities, the staff has concluded that the overall benefit-cost balance for the Envirocare license application is favorable, and the indicated action is that of licensing.

7.0 LIST OF PREPARERS

7.1 Draft Environmental Impact Statement

The following individuals were responsible for independent evaluation of the information provided by the applicant in the Environmental Report and were primarily responsible for preparing the Draft Environmental Impact Statement:

Elaine S. Brummett
U.S. Nuclear Regulatory Commission
Washington D.C.

Elaine Brummett is a Project Manager/Health Physicist in the Uranium Recovery Branch. She is responsible for reviewing technical documents, primarily for the UMTRA Program (UMTRCA Title I). She has more than 14 years experience with the radiation protection programs of uranium mill tailings remedial action projects.

Education:

- B.S. in biology from the University of Western Michigan in 1964
- M.S. in zoology from the University of Arizona in 1966
- Ph.D. in medical science from the University of Florida's College of Medicine in 1971

Rateb (Boby) Abu Eid
U.S. Nuclear Regulatory Commission
Washington D.C.

Rateb (Boby) Eid is an environmental scientist for the Decommissioning and Regulatory Issues Branch of the Division of Low-Level Waste Management and Decommissioning. Dr. Eid's original education and experience are in the areas of geochemistry and radiological and environmental impacts studies. Dr. Eid was Professor of geochemistry at Pahlavi University in Iran during 1975 and then worked for the University of Bonn (Senior Research Associate) for two years. He then worked for 13 years for Kuwait Institute for Scientific Research (KISR) in the areas of waste treatment and remediation, materials characterization, radiological analysis, and radiation safety and health physics. He was the radiation safety officer for KISR and was on the Board of the High National Committee for Radiation Protection in Kuwait. Dr. Eid has been working with NRC for two years in the areas of dose assessment, site characterization, health physics and radiological impacts, residual contamination, and remediation technologies. He has been involved in the review of the Envirocare license application with respect to aspects of radiation safety and health physics, radiological monitoring and decommissioning. Lately, he became involved in the radiological impacts assessments and review of the Envirocare draft EIS.

Education:

- B.Sc. (with honors) in chemistry and geology from Alexandria University in 1968
- Ph.D. in geochemistry (with nuclear chemistry) from Massachusetts Institute of Technology (M.I.T.) in 1975

Allan T. Mullins
U.S. Nuclear Regulatory Commission
Washington, D.C.

Allan Mullins is a project manager for the uranium recovery program where he is responsible for reviewing and assessing activities of the Department of Energy on UMTRCA Title I remedial action sites. His original experience with environmental studies began in 1971 and continued until 1984 while employed with the Tennessee Valley Authority (TVA) in the fuels area where he worked on environmental assessments under NEPA including the management of programs for various coal prospecting, mining, and utilization projects for TVA's coal supply program and for uranium exploration, mining, and milling activities in support of TVA's uranium mineral rights program.

Education:

- B.S. in geology from Florida State University in 1957
- M.S. in geology from Florida State University in 1959

Latif S. Hamdan
U.S. Nuclear Regulatory Commission
Washington D.C.

Latif Hamdan is a Project Manager in NRC's Uranium Recovery Branch. He is responsible for reviewing technical documents related to groundwater protection at uranium mills and mill tailings disposal sites regulated under UMTRCA, and for development and review of regulations and regulatory guides for water resource protection at such sites. He has more than ten year's experience in environmental and related groundwater studies, and has participated in environmental impact assessments on several projects during his employment in the private sector from 1973 through 1983.

Education:

- B.S. in geology from Damascus University in 1964
- M.S. in geology (hydrogeology) from the University of Illinois at Urbana/Champaign in 1970
- Ph.D. in civil engineering (water resources) from the University of Illinois at Urbana/Champaign in 1974

Terry L. Johnson
U.S. Nuclear Regulatory Commission
Washington, D.C.

Terry Johnson is a senior surface water hydrologist/hydraulic engineer for the uranium recovery program where he is responsible for reviewing and assessing surface water hydrology and erosion protection aspects of waste disposal facilities. He has over 23 years of experience in hydraulic design and has participated in numerous safety and environmental reviews for nuclear power plants, low-level waste sites, and uranium mill tailings sites.

Education:

- B.S. in civil engineering from West Virginia University in 1968

John J. Surmeier
U.S. Nuclear Regulatory Commission
Washington, D.C.

John Surmeier is Chief of the Uranium Recovery Branch where he is responsible for oversight and programmatic direction of the NRC's uranium recovery licensing activities as well as NRC's concurrence responsibilities over DOE's UMTRCA Title I remedial action activities. His original experience with environmental studies was in the mid-1970's when he participated in the preparation of a major NRC Environmental Impact Statement for the proposed mixed-oxide fuel cycle. Prior to joining the NRC in 1975, Mr. Surmeier worked for the National Science Foundation, Georgetown University, the Research Analysis Corporation and the Rand Corporation.

Education:

- B.A. in economics from University of Southern California in 1959
- M.A. in economics from University of California, Berkeley in 1962.

Sandra L. Wastler
U.S. Nuclear Regulatory Commission
Washington, D. C.

Sandra Wastler is a project manager for the Envirocare licensing action where she is responsible for the management and coordination of safety and environmental review of Envirocare of Utah, Inc.'s application for a license to receive, store, and dispose of 11e.(2) byproduct material. In addition, she participates as a reviewer in her technical area of expertise. Her original experience with environmental studies was in NRC reactor projects and she has most recently been involved in the development of Environmental Assessments for Uranium In-situ facilities.

Education:

- B.S. in geology from Wright State University in 1971
- M.S. in structural geology from Wright State University in 1973

Michael F. Weber
U.S. Nuclear Regulatory Commission
Washington, D.C.

Michael Weber is the Section Leader of the Regulatory Issues Section in the Decommissioning and Regulatory Issues Branch of the Division of Low-level Waste Management and Decommissioning. He is responsible for managing the technical interfaces with the Environmental Protection Agency and the Department of Energy on issues related to environmental protection, decommissioning, and waste management. Mike is also responsible for NRC's efforts to resolve technical and policy issues related to radioactive waste management and decommissioning and for managing regulatory oversight of decommissioning projects at several nuclear facilities. He began working for NRC in 1982 as a performance assessment analyst and hydrogeologist in the high-level radioactive waste program. Since the mid-1980's, Mike has worked on waste management, safety assessment, groundwater protection, and environmental protection aspects at uranium recovery sites, low-level and high-level waste disposal sites, nuclear materials facilities, and decommissioning projects. From 1989 to 1991, he was a technical assistant to the Chairman of the NRC in the areas of radiation protection, nuclear materials safety, waste management, environmental protection, decommissioning, and nuclear materials transportation. He assumed his present supervisory position in 1991.

Education:

- B.S. in geosciences from Pennsylvania State University in 1982
- Graduate coursework in hydrogeology, computer modeling, management, and health physics, including Oak Ridge Associated University's Applied Health Physics Course

Emmett B. Moore
Senior Research Scientist
Technology Planning and Analysis Center
Pacific Northwest Laboratory
Richland, Washington

Dr. Moore's experience in environmental affairs dates back to 1973 when he became director of the Minnesota Power Plant Siting Program for the State of Minnesota Environmental Quality Board. At the present time he is a staff member of PNL and an adjunct professor of environmental science at Washington State University. His experience includes environmental impact statements, environmental permits, air pollution studies, hazardous waste cleanup studies, endangered species studies, and teaching of physics, chemistry, and environmental science.

Education:

- B.S. in chemistry from Washington State University in 1951
- Ph.D. in physical chemistry from University of Minnesota in 1956

Mark L. Murphy
Senior Research Scientist
Geophysics Section
Geosciences Department
Pacific Northwest Laboratory
Richland, Washington

Dr. Murphy joined PNL in the early part of 1990 as a Research Scientist in the Geophysics Section of the Geosciences Department. In late 1990, Dr. Murphy became involved in Battelle/PNL's Environmental Management Operations, contributing both technical and project management skills. Now a Senior Research Scientist, Dr. Murphy conducts and manages basic and applied research in the earth sciences. Dr. Murphy's 15 years of professional employment in geology and geological engineering have included surface- mining reclamation, hydrogeologic planning and development of municipal water supply, field geological investigations of slope stability and failure, foundation engineering, water supply and aggregate exploration, studies in Rb/Sr geochronology, uranium geochemistry, radioactive waste isolation, and various geothermal and uranium resource projects.

Education:

- B.S. in earth science from University of California in 1977
- M.S. in geology from University of New Mexico in 1985
- Ph.D. in geology from Johns Hopkins University in 1989

Iral C. Nelson
Staff Scientist
Life Sciences Center
Pacific Northwest Laboratory
Richland, Washington

Mr. Nelson has been at Hanford since 1955 and has over 35 years experience in the radiation and environmental protection field with 20 years of that in NEPA related activities. He lead PNL support to AEC Regulatory Staff in preparation of EISs supporting licensing for 6 commercial nuclear power reactors. He contributed to preparation of the Generic EIS on Management of Commercially Generated Radioactive Wastes, an EIS on Disposal of Hanford High Level, Transuranic, and Tank Wastes, and DOE's New Production Reactor. He also prepared EAs on food irradiators in Iowa and Florida, and prepared draft EAs on a Tritium Extraction Demonstration Task, Interim Storage of Plutonium Components at the Pantex Plant, and a Walk-in Radon/Thoron Experimental Chamber.

Education:

- B.S. in mathematics from University of Oregon in 1951
- M.A. in physics from University of Oregon in 1955
- Diplomate of American Board of Health Physics in 1962

Kathleen Rhoads
Senior Research Scientist
Health Physics Department
Life Sciences Center
Pacific Northwest Laboratory
Richland, Washington

Ms. Rhoads has been employed at PNL since 1975 in the Biology and Chemistry Department (1975–1985), Materials Sciences Department (1985–1988), and Health Physics Department (1988 to present). Her current responsibilities include risk assessment and estimation of radiation doses following routine or accidental release of radionuclides to the environment from nuclear facilities, and evaluation of health effects from energy production. Ms. Rhoads is a member of the Health Physics Society, the National Association of Corrosion Engineers, and is certified by American Board of Health Physics.

Education:

- B.S. in microbiology from University of Washington in 1972

- M.S. in radiological sciences from University of Washington in 1979

Richard W. Wallace
Research Scientist
Hydrology Section
Geosciences Department
Pacific Northwest Laboratory
Richland, Washington

Dr. Wallace has worked with proposed radioactive-waste disposal techniques, methods, and systems for the past 9 years. His work has included description and characterization of various geologic media and settings, development of release scenarios (both from natural events and from human activity), and analysis of scenarios for waste released as source terms for dose and consequences analyses.

Education:

- B.S. in geology from Iowa State University in 1959
- M.S. in geology from Iowa State University in 1961
- Ph.D. in hydrogeology from University of Idaho in 1972

7.2 Final Environmental Impact Statement

After the issuance of the Draft Environmental Impact Statement, the following individuals from the Oak Ridge National Laboratory (ORNL) provided limited, additional input to the NRC and assisted the NRC personnel listed in Section 7.1 with the preparation of this Final Environmental Impact Statement:

Gregory P. Zimmerman
NEPA Program Manager
Environmental Analysis and Assessment Section
Energy Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Mr. Zimmerman is the leader of the Environmental Risk Group at ORNL where he has been employed since 1977. His involvement with environmental assessments and environmental impact statements dates back to 1987. In his capacity as a NEPA Program Manager, Mr. Zimmerman is responsible for coordinating and supervising the technical progress of a multidisciplinary team of individual specialists—including scientists, engineers, ecologists, and social scientists—in the preparation of environmental impact statements. Most recently, Mr. Zimmerman has served as the program manager and technical coordinator for eight site-specific environmental impact statements being prepared for the U.S. Army's Chemical Stockpile Disposal Program. In his involvement with that program, Mr. Zimmerman has made contributions in the area of probabilistic risk assessments and accident analyses.

Education:

- B.S. in mechanical engineering from University of Tennessee in 1975
- M.S. in mechanical engineering from University of Tennessee in 1977

T.J. Blasing
Research Staff Member
Environmental Analysis and Assessment Section
Energy Division
Oak Ridge National Laboratory
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Dr. Blasing is a member of the Atmospheric Sciences Group at ORNL where he has been employed since 1977. He conducts research in characterizing climatic change and investigates interactions between the atmosphere and other aspects of the environment, particularly ecosystems. He performs air quality studies, including air dispersion modeling, for a variety of applications. Dr. Blasing is also currently an Adjunct Associate Professor with the Department of Geography at the University of Tennessee where he conducts courses in meteorology and climatology. He is a member of the American Geophysical Union and the American Meteorological Society.

Education:

- B.S. in meteorology from University of Wisconsin in 1966
- M.S. in meteorology from University of Wisconsin in 1968
- Ph.D. in meteorology from University of Wisconsin in 1975

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Biological and Radiation Physics Section
Health and Safety Research Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Dr. Easterly is the leader of the Health Effects Group at ORNL where he has been employed since 1973. His formal training in physics has allowed him to work in diverse fields which require identification and conceptualization of problems and development of their solutions. Dr. Easterly's degree is in physics with a minor in health physics. Essentially all of his work experience has been involved in some way with effects on human health. His current work is directed toward the understanding of human health response to energy and environmental factors and requires the integration of numerous specialty areas. It involves identification and quantification of potential hazards, the development of risk models, and application of those models for specific purposes. Dr. Easterly was active in the area now known as "health risk assessment" for more than a decade before the phrase became popular.

Education:

- B.S. in physics from Mississippi State University in 1966
- Ph.D. in physics from University of Tennessee in 1972

David L. Feldman
Research Staff Member
Environmental Analysis and Assessment Section
Energy Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Dr. Feldman is a member of the Human Systems and Technology Group at ORNL where he has been employed since 1988. He has participated in the development of socioeconomic analyses for use in a variety of environmental impact statements. Dr. Feldman's expertise is in environmental ethics, waste management, water resources management, and international energy and environmental policy. He currently serves as the senior editor of the *Forum for Applied Research and Public Policy*, a journal published quarterly by the University of Tennessee. Dr. Feldman is the author of *Water Resources Management: In Search of an Environmental Ethic*, a book published by John Hopkins University Press in 1991.

Education:

- B.A. in political science from Kent State University in 1973
- M.A. in political science from University of Missouri in 1975
- Ph.D. in political science from University of Missouri in 1979

Roger L. Kroodsma
Research Staff Member
Environmental Analyses Section
Environmental Sciences Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Dr. Kroodsma is a member of the Environmental Assessment Group at ORNL where he has been employed since 1974. His involvement with environmental assessments dates back to 1973 when he conducted ecology studies under E.P. Odum at the University of Georgia. Dr. Kroodsma's specialties include plant and animal ecology, as well as forest, wetland, and grassland ecosystems. Dr. Kroodsma has served as team leader for fourteen environmental impact statements or environmental assessments; he has participated in the development of 44 other such documents.

Education:

- B.A. in biology from Hope College (Holland, Michigan) in 1966
- M.S. in zoology from North Dakota State University in 1968
- Ph.D. in zoology from North Dakota State University in 1970

Richard R. Lee
Research Staff Member
Environmental Analysis and Assessment Section
Energy Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Mr. Lee is a member of the Applied Physical Sciences Group at ORNL where he has been employed since 1986. Prior to that time, he was employed with the NRC as a geologist. His technical specialties include both geology and geohydrology. Mr. Lee currently conducts research for proposed and existing waste sites—both for hazardous and low-level wastes. Mr. Lee is a registered professional geologist in the state of Tennessee.

Education:

- B.S. in geology from Temple University in 1979
- M.S. in geology from Temple University in 1982

8.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS RECEIVING COPIES OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

The following agencies, organizations and persons have been sent copies of and asked to comment on the Draft Environmental Impact Statement:

Advisory Committee on Historical Preservation
Old Post Office Building, Suite 809
1100 Pennsylvania Avenue, NW
Washington, DC 20004

Office of Senator Robert Bennett
Salt Lake City, Utah 84138

Council of Environmental Quality
General Counsel
722 Jackson Place NW
Washington, DC 20006

Ken Alkema, Director
Environmental Health
288 N 1460 W
PO Box 16690
Salt Lake City, Utah 84115-0690

Larry Anderson, Director
Bureau of Radiation Control
288 N 1460 W
Salt Lake City, Utah 84116-0690

Linda Armington, Director
Tooele County Health Department
Tooele County Courthouse
Tooele, Utah 84074

Brent Bradford, Director
Bureau of Hazardous Waste Management
Division of Environmental Health
288 N 1460 W
Salt Lake City, Utah 84116-0690

Bureau of Solid and Hazardous Waste
Tooele Office
Tooele County Courthouse
Tooele, Utah 84074

Tom Christensen
Energy, Natural Resources and Agriculture
State Capital
Salt Lake City, Utah 84114

B. Cordner, Director
State of Utah
Bureau of Air Quality
Salt Lake City, Utah

Robert Fairweather
U.S. Office of Management and Budget
New Executive Office Building
726 Jackson Place NW
Washington, DC 20503

Fred W. Finlinson
Energy, Natural Resources and Agriculture
State Capital
Salt Lake City, Utah

Senator Orrin Hatch
Federal Building Room 5430
Salt Lake City, Utah

Mr. David Hiller, Esq.
1737 Gaylord Street
Denver, Colorado 80206

Frank Khattat
U.S. Bureau of Indian Affairs
1951 Constitution Ave.
Rm 4518
Washington, DC 20515

Kenneth Kirkman, Chief
Environmental Office
Dugway Proving Ground
Dugway, Utah 84022

Connie S. Nakahara
Bureau of Solid and Hazardous Waste
288 N 1460 W
Salt Lake City, Utah 84116-0690

Don Ostler, Director
Bureau of WPC
288 N 1460 W
Salt Lake City, Utah 84116-0696

Tom Pauling
U.S. Environmental Protection Agency
Division of Air and Toxic Management
999 18th Street, Suite 500
Denver, Colorado 80202-2405

Khosrow B. Semnani, President
215 S. State Street, Suite 1160
Envirocare of Utah, Inc. Salt Lake City, Utah 84101

Gayle Smith, Director
Department of Health
Drinking Water/Sanitation
288 N 1460 W
Salt Lake City, Utah 84116–0690

Tom Turner
Environmental Office
Tooele Army Depot
Tooele, Utah 84704–500

Bill Wagner, Chief
U.S. Bureau of Land Management
Waste Management Division
324 S. State Street
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Larry Wapensky
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Denver, Colorado 80202–2405

Deane Zeller
U.S. Bureau of Land Management
Salt Lake District
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Salt Lake City, Utah 84119

William Cochran, Chief
Intermountain Field Operations Cent.
Bureau of Mines
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Denver, Colorado 80225

Robert R. DeSpain, Chief
Environmental Assessment Branch
U.S. EPA, Region VIII
999 18th Street, Suite 500
Denver, Colorado 80202–2405

Clark D. Johnson
Assistant Field Supervisor
Fish and Wildlife Services – Utah Office
2078 Administration Building
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Salt Lake City, Utah 84104–5110

Cindy King, Technical Advisor
Utah Chapter of the Sierra Club
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Suite 102
Salt Lake City, Utah 84111

Counselor at Law
Anthony J. Thompson
Perkins Coie
607 Fourteenth Street
Washington, D. C. 20005

Richard Wallace
Pacific Northwest Laboratory
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Richland, WA 99352

U.S. Army Corps of Engineers
4735 E Marginal Way S
Seattle, Washington 98134

U.S. Office of Management and Budget
ATTN: Budget Examiner
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Washington, DC 20503

U.S. Department of Commerce
Assistant Secretary for Legislative
and Intergovernmental Affairs
Herbert Clark Hoover Building
Mail Stop 460
Washington, DC 20230

U.S. Department of Defense
Environmental Planning
206 N Washington, Suite 100
Alexandria, Virginia 22314–2528

U.S. Environmental Protection Agency
Region VIII
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Denver, Colorado 80202–2405

U.S. Government Accounting Office
Jackson Federal Building
915 2nd Avenue
Seattle, Washington 98173

U.S. Department of Health and Human Services
Director of Environmental Affairs
200 Independence Avenue SW
Washington, DC 20201

U.S. Dept of Interior
Director (18 copies)
Office of Environmental Affairs
1849 C Street NW
Washington, DC 20204

U.S. Department of Transportation
Assistance Secretary for Policy and Internal Affairs
400 7th Street SW
Washington, DC 20590

9.0 REFERENCES

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Appendix A

COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND THE RESPONSES TO THOSE COMMENTS

A.1 Introduction

This appendix provides copies of all letters received from agencies and the public commenting on the Draft Environmental Impact Statement (DEIS); see Table A.1. The letters are separately displayed on the left-hand side of the following pages. Individual comments from each agency or person were assigned numbers as shown in the left margins of each letter. The notation for comments is as follows: C3–2 means comment number 2 in letter number 3. The response to each numbered comment appears on the right-hand side of the page, beside the comment letter; the notation for responses is similar to that of the comments: R3–2 means response to comment number 2 in letter number 3.

The last set of comments in Table A.1 represents seventeen individual letters from members of a "Thorium Action Group" located in the vicinity of West Chicago, Illinois. The seventeen letters unanimously urge that favorable consideration be given to the license application for the proposed Envirocare 11e.(2) disposal facility. Because of the similarity of the comments contained in those letters, they are not reproduced verbatim in this appendix, but rather are paraphrased and responded to collectively.

It should be noted that many comments on the DEIS are concerned with safety or technical issues that are beyond the scope of an environmental review; however, as noted in the individual responses, the issues are of concern to the U.S. Nuclear Regulatory Commission (NRC) and are being addressed in an on-going Safety Review as a separate part of the licensing process. The Safety Review will result in the preparation of a Safety Evaluation Report (SER). When completed, the SER can be found with other related documents at the locations indicated on the inside front cover of this Final Environmental Impact Statement.

Table A.1. Comments Received on the Draft Environmental Impact Statement

Letter Number	Agency/Person Commenting	Comment Numbers	Pages in This Appendix
1	U.S. Environmental Protection Agency	C1–1 and C1–2	A.2
2	U.S. Department of Health and Human Services	C2–1 to C2–5	A.3 to A.5
3	Perkins Coie (Counsel for U.S. Ecology, Inc.)	C3–1 to C3–28	A.6 to A.20
4	U.S. Department of the Interior	C4–1 to C4–12	A.21 to A.23
5	Members of the "Thorium Action Group"	C5–1	A.24

Sandra Wastler
58FR11642
2/24/93

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

DS09

USNRC
OFFICE OF ADMINISTRATION

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APR 26 1993

Ref: 8WM-EA

Michael Lesar, Acting Chief
Rules Review and Directives Branch
Division of Freedom of Information
and Publication Services
Mail Stop P-223
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

RE: Draft Environmental Impact Statement to Construct and Operate a Facility to Receive, Store, and Dispose of 11E.(2) Byproduct Material near Clive, Utah

Dear Mr. Lesar:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, the Region VIII office of the Environmental Protection Agency (EPA) has reviewed the subject draft environmental impact statement (DEIS) submitted by the Nuclear Regulatory Commission (NRC). The EPA commends the NRC for presenting a thorough evaluation of the project and related environmental effects. The NRC has sufficiently addressed scoping comments sent by the EPA (letter in response to the notice of intent to prepare the DEIS (letter from Robert R. DeSpain to Sandra L. Wastler, 7/12/91). **C1-1**

Based on the procedures EPA uses to evaluate the environmental impacts of the proposed action and alternatives and the adequacy of information provided in EISs, the EPA Region VIII rates the DEIS as category LO (lack of objections). **C1-2**

If you may have any questions, please contact Larry Kimmel of my staff at (303) 293-1697.

Sincerely,

Robert R. DeSpain

Robert R. DeSpain, Chief
Environmental Assessment Branch
Water Management Division

Printed on Recycled Paper

R1-1. The comment is noted.

R1-2. The comment is noted.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Sandra Wallace

Public Health Service

58FR11642

2/26/93

Centers for Disease Control
Atlanta GA 30333

April 21, 1993

(18)

USNRC
OFFICE ...

'93 APR 26 P1:20

Chief
Rules Review and Directives Branch
Division of Freedom of Information and Publication Services
Mail Stop P-223
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Sir or Madam:

We have completed our review of the Draft Environmental Impact Statement (DEIS) to Construct and Operate a Facility to Receive, Store, and Dispose of 11E.(2) Byproduct Material Near Clive, Utah. We are responding on behalf of the U.S. Public Health Service. Technical assistance for this review was provided by the Radiation Studies Branch (RSB), Division of Environmental Hazards and Health Effects, National Center for Environmental Health, Centers for Disease Control and Prevention.

The RSB reviewed the Draft EIS for potential radiological health impacts. The following comments are offered for your consideration.

The DEIS section 5.2.8 discusses potential radiological health impacts (workers and offsite public) resulting from the construction of the radioactive waste disposal facility near Clive, Utah, managed and operated by Envirocare of Utah.

Paragraph 5.2.8.1 states 'the potential radiation doses can, in a statistical sense, increase the potential for individual and population health effects (excess fatal cancers) above those expected from normal causes. It is assumed that environmental systems will be adequately protected against any adverse radiological impacts if workers and members of the public are adequately protected against the same impacts.'

C2-1 Page 4.7 of the DEIS presents a wind rose out to greater than 5 kilometers (km) or 2.5 miles from the proposed facility, showing nearest residences (Tab.e 4.3). This Table suggest that there are a considerable number of residents that live outside 2.5 miles of the proposed facility. The DEIS does not discuss emergency warning systems for members of the public or how the public will be protected in the event of a large waste-product release.

C2-2 The assumption in section 5.2.8.1, paragraph one, as stated above, needs to be explained.

R2-1. Section 4.6 states that in 1990, the closest residents ". . . lived 24 to 32 km (15 to 20 miles) to the northeast of the site." The release of a large quantity of waste-product is not a credible event, and an emergency warning system is therefore not needed for on-site releases. However, because a spill of 11e.(2) byproduct material is possible, clean-up procedures will be in effect to limit potential exposures. In addition, emergency plans will be prepared in accordance with Department of Transportation requirements for potential accidents along off-site transportation corridors.

In regard to the data in Table 4.3, the table simply shows that no people live within 5 km (3.1 miles) of the site, but it contains no information regarding the number or location of people living outside that zone.

R2-2. No regulatory guidelines have been established concerning the acceptable limits of radiation exposure for the protection of species other than humans. It is, however, generally recognized that the limits for humans are also conservatively protective for those species.

The NRC staff agrees with the assumption that by providing measures to adequately protect human health against any adverse radiological impacts, environmental systems will also be adequately protected.

Page 2 - Chief, RRDB

C2-3 Furthermore, on page 5.25 of the DEIS, the statement is made that the presence of ^{232}Th and decay products in the airborne pathway will contribute significantly to the offsite dose via inhalation (932 mrem/year to 3 rem/year). The DEIS should show how these high inhalation doses are calculated, i.e., distance from the facility and dose conversion factors used. As stated on page 5.26, 'Envirocare will need to consider potential radiation doses from particulate inhalation of ^{232}Th in demonstrating compliance with the public dose limit in 10 CFR part 20.1301'.

C2-4 Most of the land within a 10 mile radius of the South Clive site is public domain administered by the U.S. Bureau of Land Management (BLM) (Section 5.1.1 Land Use). 5.1.1 states clearly that this land is used for sheep grazing, transportation, hunting, and recreational activities. Are the sheep part of a potential food chain pathway for human exposure? If so, what are the potential doses to humans from consumption of sheep?

C2-5 For public health purposes, the DEIS should address the potential for offsite radionuclide exposures to the public through air pathways, food chain path ways, accidents, and recreational activities within the BLM public domain which surrounds the proposed facility. The fact that 'the Department of Energy (DOE) did not calculate potential population doses because no residents live within 30 km of the site' (pages 5.17, 5.19) does not exclude potential health risks to the hunter, camper, or visitor to the area.

Thank you for the opportunity to review and comment on this document. Please ensure that we are included on your mailing list to receive a copy of the Final EIS, and future EIS's which may indicate potential public health impact and are developed under the National Environmental Policy Act (NEPA).

Sincerely yours,

Kenneth W. Holt

Kenneth W. Holt, M.S.E.H.
Special Programs Group (F29)
National Center for Environmental
Health and Injury Control

cc:
Felix Rogers, RSB

R2-3. Text has been added to the end of Sect. 5.2.8.4 in response to the comment. The dose values of 9.72 mSv/yr (972 mrem/yr) and 0.03 Sv/yr (3 rem/yr), as reported in Sect. 5.2.8.4, were estimates for off-site individuals and on-site workers, respectively. These values were based on approximation and analogy with the gross-alpha activity values reported for the Vitro disposal site. Because thorium-232 was not a major constituent in the Vitro material, the doses for thorium-232 and its decay products were calculated by ratio and proportion from the Allowable Limit on Intake in Appendix B of 10 CFR Part 20. The location for off-site doses was taken as the site boundary.

The Safety Evaluation Report addresses radiation doses in detail. The applicant will be required by license condition to be in compliance with 10 CFR Part 20.

R2-4. Text has been added to the end of Sect. 5.2.8.4 in response to the comment. As stated in Sect. 4.1, historically the immediate area around the South Clive site has not been heavily utilized for grazing; it is a very dry desert area. The BLM areas are open for use by the public. While sheep and cattle grazing does occur on BLM land, it represents an infrequent activity as it is allowed only three months out of the year (during the winter). As shown in Table 4.1, no grazing animals were located within 8 km (5 miles) of the site.

The issue of potential food chain pathway for human exposure from sheep grazing in the area is not considered significant because of the low level of potential contamination and the scarcity of vegetation.

R2-5. As stated in Sect. 5.2.8.4, doses to off-site individuals are expected to be negligible. Potential radiation doses to casual visitors to the area (such as hunters, campers, and recreational vehicle users) would also be negligible due to the combination of the small doses beyond the site boundary and to the small exposure time, if any, for such individuals.

D509 6647 S. Washer 57FR11642 2/24/93

PERKINS COIE

A Law Partnership Including Professional Corporations
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USNRC
OFFICE OF ADMINISTRATION
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May 28, 1993

VIA CERTIFIED MAIL

Chief, Rules Review and Directives Branch
Division of Freedom of Information
and Publication Services
Mail Stop P-223
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Re: **Revised**
Comments of US Ecology, Inc. on the Nuclear Regulatory Commission's Draft Environmental Impact Statement Regarding Envirocare of Utah, Inc.'s License Application to Dispose of 11e.(2) Byproduct Materials

Dear Sir:

Please find enclosed a further revised version of the Comments of US Ecology, Inc. on the Nuclear Regulatory Commission's Draft Environmental Impact Statement Regarding Envirocare of Utah, Inc.'s License Application to Dispose of 11e.(2) Byproduct Materials. Previous versions of this document were supplied to you on April 30 and May 4, 1993.

I apologize for any inconvenience this may have caused you. In order to avoid confusion, I suggest you discard all previous versions of our comments supplied to you.

As always, please call if you have any questions or comments regarding these materials.

Very truly yours,

Anthony J. Thompson

AJT:clc
Enclosure

[09901-0001/DA931240.004]

Anchorage • Bellevue • Los Angeles • Portland • Seattle • Spokane • Taipei • Washington, D.C.

COMMENTS OF US ECOLOGY, INC. ON THE

NUCLEAR REGULATORY COMMISSION'S

DRAFT ENVIRONMENTAL IMPACT STATEMENT

REGARDING ENVIROCARE OF UTAH, INC.'s LICENSE

APPLICATION TO DISPOSE OF 11e.(2) BYPRODUCT MATERIAL

General Comments.

C3-1 1. US Ecology regrets that its comments on the Draft Environmental Impact Statement (DEIS) regarding Envirocare of Utah, Inc.'s application to dispose of high volume, low-activity, 11e.(2) by-product material are filed after the date comments were due (April 26, 1993). The notice of availability of the DEIS published by the Nuclear Regulatory Commission (NRC) (58 Fed. Reg. 11642, February 26, 1993), contained no date by which comments would be due. The notice of the due date for comments was published by the Environmental Protection Agency (EPA) (58 Fed. Reg. 13597, March 12, 1993) in a tiny blurb that provided a difficult to find and confusing vehicle for public notice of the time frame for filing comments. In any event, US Ecology appreciates NRC's stated willingness to consider these comments.

C3-2 2. US Ecology observes that in evaluating Alternative 1 (an above-ground embankment) and Alternative 2 (a below-

(13813-0006/DA931180.049) 5/28/93

R3-1. The schedule allowed the comments of Perkins Coie to be included in the FEIS.

R3-2. As stated in Criterion 3 of Appendix A to 10 CFR Part 40, ". . . below grade disposal may not be the most environmentally sound approach, such as might be the case if a groundwater formation is relatively close to the surface." As discussed in Sect. 3.6.1, the depth to groundwater was the major concern with all of the alternatives evaluated. Conformance with Criterion 3 is addressed in the Safety Evaluation Report.

ground embankment) for disposal at the South Clive, Utah site, the DEIS makes no reference to the fact that under Criterion 3 in 10 C.F.R. Part 40, Appendix A, the "prime option" for disposal of tailings is below grade disposal. (DEIS 2.4-.5). The DEIS merely indicates that Alternative 2, while viable, is not preferred because the design places the waste closer to the water table (i.e., within five feet) and would require a greater amount of acreage to dispose of the same volume of waste, increasing unit costs and land requirements.

C3-3 The alternatives that are addressed are rather cut and dried and the solution to the "questions" presented seems to be a forgone conclusion. For example, the DEIS also indicates that no "detailed design" was even made for Alternative 2. This hardly constitutes a rigorous explanation of why the "prime option" (or some modification thereof) is so cavalierly brushed aside.

3. Placing the tailings below grade at the proposed site could be important because it is located within a few

C3-4 hundred meters of a major U.S. Interstate Highway (I-80). A high-profile site reclaimed with rock rip-rap not otherwise available in the area might prove to be an attractive nuisance which would lure inadvertent intruders who could access an unpatrolled and unguarded site and remove the rock for personal use.

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R3-3. Consideration of the "prime option" of below grade disposal in Criterion 3 is not a NEPA requirement and does not preclude another option from being identified as the "preferred alternative." The EIS does consider and evaluate other alternatives to the proposed action, as required by NEPA. The level of detailed and/or conceptual designs for each alternative were adequate for the purpose of determining the extent and magnitude of potential environmental impacts, as well as for comparing impacts among and between alternatives. See also the response to Comment C3-2.

R3-4. Text has been added to Sect. 4.8.2 in response to the comment. The proposed Envirocare facility and the completed Vitro facility are remote from travelled roads and will both eventually be fenced and under the control of the Department of Energy, another Federal agency designated by the President, or the state of Utah, in accordance with 10 CFR Part 40.28. The fences will be clearly labeled with signs indicating that radioactive material is present; this will provide a deterrent for any casual visitors to the site.

The Interstate is about 3 km (2 miles) to the north of the proposed disposal area. The South Clive site is about 1300 m (4270 ft) above sea level, but elevations of 1370 to 1670 m (4500 to 5500 ft) can be found nearby to the south, southwest and southeast of the site. This local topographical relief provides a visual backdrop for the site when viewed from the Interstate. The existing Vitro site—which is mostly an above-grade mound—is not easily noticeable from the Interstate. Although the proposed Envirocare disposal mound would be about 3 m (10 ft) higher, it would have the same general visual impact as the Vitro site.

C3-5

4. There should at least be an in-depth discussion of the trade-off between placing the bottom of the facility within five feet of the groundwater, which is of notably poor quality (DEIS at 4.32), and the erosion potential associated with a mound that is 44 feet above the surface. Additionally, there is no discussion of whether or not a modified, shallower below-grade disposal alternative that would result in more of a buffer between the facility liner and the groundwater, and that would accordingly result in a lower profile surface mound, would be a preferable option.

C3-6

For example, the cell could be designed using a balanced cut-and-fill to ensure that a significant portion of the tailings will be placed below grade. The additional excavated soil materials could be used to construct protective containment berms around the cell that would provide some degree of wind protection (and thus reduce dusting potential) and prevent the release of tailings should the site experience a large-magnitude precipitation event (e.g., the PMP).

C3-7

5. It is unclear from an evaluation of the diagrams included in the DEIS whether the proposed disposal areas would comply with the requirements of 40 C.F.R. Section 61.252(b)(1) or (2) which requires (1) phased disposal of tailings in lined impoundments that are no more than 40

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R3-5. As discussed in Sect. 3.6.1, the provision of a large buffer distance between the bottom of the facility and groundwater was an important factor in distinguishing between Alternatives 1, 2, and 3. Section 2.3.3.3 discusses wind and water erosion of the proposed embankment; because of the arid nature of the South Clive site, erosion of the cover mound—especially a mound protected by rock armor—is not expected to be significant.

R3-6. The proposal in the comment would reduce the amount of material which can be disposed in the cell without providing a corresponding increase in the stability of the material to be disposed. The design of Alternative 1 does provide such a balance.

Cut-and-fill placement of the disposal material is planned.

R3-7. The proposed disposal facility is not a "surface impoundment" as defined in Appendix A of 10 CFR Part 40 because it will not receive liquid wastes or wastes containing free liquids. Therefore, compliance with 10 CFR Part 40, Appendix A, Criterion 5A, is not required. However, Envirocare has chosen to put in a liner and as a result, is required to meet Criterion 5E. The disposal cell will use phased disposal techniques, as discussed more fully in the Safety Evaluation Report.

In regard to the size of the active disposal area, see the response to Comment C-3-22.

acres in area at operational tailings disposal facilities, or (2) continuous disposal and dewatering with no more than 10 acres of tailings exposed at any time. The DEIS indicates that the disposal cell will be 1776 x 1809 feet (EIS at 5.15) which is substantially larger than 40 acres. This is clearly an issue that the EIS should address.

C3-8

6. The proposal includes a significant buffer zone (300 feet between the closest edge of any embankment and the outside site boundary or property line), as well as a buffer zone of 100 feet between the closest edge of any embankment and the Vitro site fence. (EIS 2.9). The EIS also indicates that the perimeter berm during construction would be replaced by a perimeter ditch, four feet deep and forty feet wide around the tailings impoundment. US Ecology wonders whether there has been a written affirmation by DOE that it will take title to the berm and/or the buffer zones at the time of final closure. The DEIS merely assumes that site ownership will be transferred to DOE and that DOE will accept it. (DEIS at 5.34). The question is: what constitutes the "site?"

This issue does not appear to be discussed in the DEIS although it is a question of some significance, considering the fact that there are multiple sites at the

R3-8. Section 83 of the Atomic Energy Act of 1954, as amended, and Criterion 11C of Appendix A to 10 CFR Part 40 requires Federal or state ownership and custody of a site after closure. The Department of Energy (DOE) is presently the designated Federal agency for this role; although, the President can designate another Federal agency, or the State can assume the custodial role at its option. It is clear that DOE understands its responsibilities to take the site for long-term custodial care, if the state of Utah does not. The DEIS only discusses the 11e.(2) site. Long-term responsibility for the other separate adjacent disposal sites (NORM and LLW) is not an appropriate part of the environmental assessment made in the DEIS.

The perimeter ditch around the site would be part of the erosion protection system and as such, would be included in the area to be taken into custodial care. A perimeter road and fencing, if constructed, would also fall into this category. Any larger buffer zone can be used by Envirocare to show compliance with standards (primarily 10 CFR Part 20) during the life of the facility; however, post-closure compliance does not require the use of this buffer zone.

South Clive facility. The sites include the DOE Vitro site, the proposed 11e.(2) site, a NORM/Low-Level Radioactive Waste (LLRW) disposal site (which is not owned nor committed to be owned by either the State of Utah or the Federal Government) and a mixed waste disposal facility (which also has no commitments regarding long-term federal or state ownership, although it will contain LLRW). As a result of the potentially conflicting regulatory requirements, and the potential difficulties that may stem therefrom (e.g., such as determining the source and responsibility for any releases outside various cell boundaries whether within the site boundary or not), it would appear that the DEIS is flawed in not discussing what portion of this site DOE has formally agreed to accept.

Additionally, the most recent draft version of the NRC's Staff Technical Position (STP) entitled "Alternate Concentration Limits for Title II Uranium Mills" (December 1992), would require written concurrence from DOE if a licensee proposes to include lands beyond the tailings or impoundment boundary(ies) as part of the land to be transferred for long-term care. It would appear that this requirement would apply equally to the buffer zone and diversion channels if they are to become part of the final landform.

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C3-9

7. The discussion of Alternative 1, while describing the proposed stabilization plan in very general terms, nowhere mentions whether it would comply with NRC's recently "Final Staff Technical Position, Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites (August, 1990)." All current Title II licensees all were recently required to revise their proposed reclamation plans in light of NRC's Final Staff Technical Position, and a discussion of how the Envirocare proposal would comply with NRC's current stabilization criteria would appear to be appropriate in an NRC DEIS.

Specific Comments.

C3-10

1. The DEIS contains scant discussion of the proposed seven-foot thick clay cover. To be acceptable, the cover should both reduce radon emanation to acceptable levels and retard the infiltration of moisture from precipitation. The second point is important because Envirocare proposes to use a rock armor as the final cover. The rock armor will act as a mulch and will trap and hold moisture from snow and rainfall that would otherwise blow away or evaporate. It is therefore likely that the cover would quickly saturate, even under the low amount of estimated precipitation for the area. Once

R3-9. In regard to long-term erosion protection, the reclamation design meets the criteria provided in the Staff Technical Position (STP). A discussion of compliance with the STP can be found in the Safety Evaluation Report.

R3-10. Section 2.3.3 describes the use of a 15-cm (6-inch) filter zone beneath the rock armor; this filter zone is intended to drain much of the accumulated precipitation. In addition, Sect. 2.3.3.3 describes the top of the embankment to be convex with a gentle (2% or less) slope to promote drainage. These design features are discussed further in Sect. 5.3.4. Because of these design features—and the high evaporation and the low annual precipitation rates in the vicinity of the site—there is little basis to assume that the cover will saturate quickly.

In regard to long-term seepage, It is acknowledged that a small amount of water is likely to collect on the cell bottom and partially saturate the liner. However, compared to the degree of saturation and driving heads available in a surface impoundment, the potential for this water to enter groundwater is small. Furthermore, in the arid environment, partial saturation of the liner is likely to reduce or eliminate cracking of the liner and enhance its performance. It is unlikely that the tailings would become a long-term source of seepage, since the cover is designed to limit infiltration of water.

The applicant has a plan to divert and control entry of runoff water into the cell by constructing a berm around the facility during operation and a drainage ditch after the cover has been completed. Any contaminants reaching the water table will be detected at the point of compliance (POC), and corrective action will be undertaken by the applicant in the event a standard for a particular constituent is exceeded.

saturated, moisture would infiltrate through the cover and recharge the tailings. The saturated tailings would then become a long-term source of seepage and ground-water radionuclide contamination.

2. Section 2.3.2.3 Support Facilities.

C3-11 Gray water from showers, etc., will likely be contaminated with 11e.(2) material and should therefore be considered byproduct material for the purposes of treatment and disposal. That is, it should be used only for dust control on the disposed tailings or evaporated in lined ponds specifically constructed for that purpose. The byproduct sludge from these ponds should also be placed in the final cell at the end of operations.

3. Section 2.3.2.6 Support Facilities.

C3-12 Decontamination Areas: No mention is made of radiological surveys of decontaminated equipment which should be conducted prior to releasing any trucks or rail cars that transport 11e.(2) materials to the site for unrestricted use. NRC should address this issue.

C3-13 Excavated Materials Area: Native vegetation should be used to stabilize the overburden and topsoil

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R3-11. Text has been added to Sect. 2.3.2.3 in response to the comment. The NRC concurs with the comment; Sect. 2.3.2.3 of the EIS now states "Gray water from showers, . . . will be collected and piped to tanks. This water will be applied as dust suppressant to the disposed 11e.(2) byproduct material or to the adjacent LARW cell or will be placed in the evaporative tanks. Any sludge in the evaporative tanks will be properly disposed of."

R3-12. Text has been added to Sect. 2.3.2.6 in response to the comment. The Department of Transportation (DOT) regulations for removable contamination and gamma doses for transportation containers are codified in 49 CFR Part 173. The state of Utah also has decontamination requirements that are, in some cases, more stringent than DOT's. Prior to exiting the site, trucks and rail cars used in transportation of disposal material will be radiologically surveyed and decontaminated to satisfy the applicable regulations.

R3-13. Text has been added to Sect. 2.3.2.6 in response to the comment. The NRC concurs with the comment; overburden and topsoil stockpiles will be protected from erosion by chemical suppressants if required.

stockpiles. If vegetable growth cannot be sustained, the facility should use a commercial dust palliativa to prevent particulation and excessive dust emissions.

4. Section 2.3.3 Principal Design Features.

C3-14

Excavating to a depth of 8 feet will not provide adequate berm material to construct cells of adequate size to contain the tailings. It appears that a significant portion of the waste is to be placed above grade - without protection from wind and water erosion - and covered later. Without wind protection, or continuous wetting, or the continuous application of a dust control agent, the tailings could blow and contaminate a large area outside the designated disposal cell(s). Further, in the event of a large rainfall occurrence, such as the PMP, berms that exceed the height of the tailings would both protect the tailings from the wind and would contain the full volume of tailings should an extreme precipitation event occur. It is likely that NRC would find a similar design (without berms) for a conventional tailings disposal cell inadequate, even for dewatered tailings, since byproduct material could be released under an

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R3-14. Protection is provided against the Probable Maximum Precipitation (PMP) during the operational period by a berm configured and designed to contain the entire runoff from a local 6-hour PMP event. This is in accordance with the operational criteria contained in the NRC Staff Technical Position, WM-8201, *Hydrologic Design Criteria for Tailings Retention Systems* (January 1983). All rainfall occurring inside the berms will be contained, and no off-site releases of rainfall runoff will occur. If erosion of tailings occurs, it will occur inside the berms; no tailings will be released off-site. Additional discussion of the design of the berms can be found in the Safety Evaluation Report. Wind erosion will be controlled by the use of water or chemical suppressants and soil covers as appropriate.

Detailed consideration of these issues is being conducted as part of the Safety Review; further information can be found in the Safety Evaluation Report.

extreme runoff event such as the PMP. The DEIS does not fully address these issues.

5. Section 2.3.3.1 Water.

C3-15

The DEIS dismisses the potential for significant recharge of the tailings due to infiltration. However, U.S. Ecology is aware that DOE sites reclaimed with rock covers in arid areas of the west have experienced significant recharge, thought to be caused by the rock protection used to stabilize the piles for the long term. Further, experience using the EPA HELP model at DOE sites indicates around 1/2 inch of infiltration (recharge) would occur each year at the Clive area, assuming a vegetated surface. However, the Clive site will be protected with rock which may enhance recharge. Nonetheless, if one nonconservatively assumes 1/2-inch of recharge per year, the tailings would resaturate after relatively few years because of the relatively low tailings porosity. The resaturated tailings would then begin to seep and eventually saturate the liner. Further, if the processed clay liner proposed for the cell bottom is significantly less permeable than the cover, the cells will become "bathtubs" and exacerbate seepage by creating a significant driving head. Hence, NRC's arguments

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R3-15. See the response to Comment C3-10 in regard to the infiltration of moisture from precipitation and in regard to long-term seepage.

The bottom liner is designed to have a hydraulic conductivity that is at least equal to the hydraulic conductivity of the cover. The applicant will be required to address the bathtubbing effects and demonstrate, prior to NRC's issuance of a license, that an unacceptable head build-up will not take place in the disposal cell.

Detailed consideration of this issue is being conducted as part of the Safety Review; further information can be found in the Safety Evaluation Report.

are not very convincing, especially given its own overriding concerns with infiltration at Title II sites.

6. 2.3.3.2 Radon Barrier.

C3-16 As noted previously, the rock cover that will ostensibly reduce potential drying of the recompacted clay will actually act as a water conserving mulch and thus promote moisture infiltration.

C3-17 Placing clay materials in 12 inch loose lifts has generally been frowned on by NRC at Title II sites. NRC usually prefers to see covers placed in loose lifts that do not exceed nine-inches and compact to 6 inches. Further, placing the clay material in thicker layers may require that the licensee test more frequently to assure that they attain 95 percent of maximum dry density. It is not clear whether NRC finds these proposed construction specifications acceptable for this site or why. This issue should be clarified in the DEIS.

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R3-16. See the response to Comment C3-10.

R3-17. Construction via 30-cm (12-inch) thick loose layers of clay material will be satisfactory when the required degree of compaction is attained (not less than 95 percent of maximum dry density, as discussed in Sect. 2.3.3.2).

Detailed consideration of this issue is being conducted as part of the Safety Review; further information can be found in the Safety Evaluation Report.

7. **2.3.3.3 Erosion Barrier**

C3-18 Again, the rock armor will serve as an infiltration-promoting mulch which will enhance tailings recharge and exacerbate potential long-term seepage.

R3-18. See the response to Comment C3-10.

8. **2.3.3.9 Construction Considerations**

C3-19 NRC historically has not approved placement or compaction of soil materials in tailings embankments at less than 95 percent of maximum density and should explain why compaction at 90 percent of maximum density is acceptable in this instance.

R3-19. NRC has historically accepted 90 percent compaction levels for contaminated fill at Title I sites. As discussed in Sect. 2.3.3.2, higher degrees of compaction (95 percent) have been used for structural berms, covers, etc.

C3-20 Also, NRC does not say whether the proposed site will have sufficient runoff storage to contain and evaporate the contaminated water that would accumulate if a significant precipitation event (e.g., 100 year return interval or greater) were to occur.

R3-20. The site will have sufficient storage to contain the water from a significant precipitation event. See the response to Comment C3-14.

9. **Section 4.4.1.3 Synthetic Flood Analyses**

C3-21 The PMP analysis says nothing about the ability of the site to contain and/or evaporate the contaminated water that would accumulate if the PMP were to occur during operations. Also, NRC has not analyzed runoff velocities across the site, the tailings or the cell berms during operations. NRC

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R3-21. In regard to the ability of the design to contain and/or evaporate water, see the response to Comment C3-14.

As stated in Sect. 2.3.2.8, a discussion of runoff velocities and flow rates from severe rainfall and flooding was included in the analyses contained in the applicant's Environmental Report.

should correct this deficiency. Further, if berms are not constructed to the full height required to contain the disposed tailings and PMP rainfall, the resulting runoff could erode and release a significant quantity of tailings.

10. C3-22 US Ecology notes that the DEIS does not contain any assessment of whether or not the facility will comply during operations with the radon emission limit (20 pCi/m²/s) contained in 40 C.F.R. Section 61.252(a). C3-23 In addition, the DEIS states that, in general, "site specific assessments of potential radiological impacts from the proposed Envirocare 11e.(2) by-product material disposal facility are not sufficiently advanced to estimate occupational and public doses with confidence." (DEIS at 5.14). Indeed, the estimated radiological impacts appear to rely entirely upon the analysis prepared by DOE for the Vitro facility (DEIS at 5.16-.17). The discussion of DOE's evaluation appears to rely primarily on potential radiological impacts at the Vitro facility after closure as the flux rate from uncovered tailings at Vitro was assumed to be on the order of 560 pCi/m²/s. This number would greatly exceed EPA's operational flux limit of 20 and the DEIS assumes that final cover will begin to be

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R3-22. 40 CFR Part 61.252(a), as referenced in the comment, applies to existing tailings piles. 40 CFR Part 61.252(b)(2) addresses new disposal areas at mills and allows continuous disposal of dewatered tails with no more than 4 ha (10 acres) uncovered at any one time. Although it is unclear whether this regulation applies to it, the proposed facility will meet the 4-ha (10-acre) restriction.

R3-23. The estimated radiological impacts evaluated in the DEIS for the proposed disposal facility were based on actual environmental and occupational monitoring data for the Vitro facility reported during the period of disposal activity before the tailings were covered. The DEIS impact assessment took into consideration the anticipated source terms of the 11e.(2) material; however, it is not possible to predict with precision the exact radionuclide mix of the material that will eventually be disposed. For this reason, the DEIS approach relied on the Vitro experience and modified it as appropriate for the anticipated 11e.(2) byproduct material.

The applicant is required to be in compliance with 10 CFR Part 20. Compliance will be demonstrated by either measurement (monitoring) or calculations.

applied about 4 or 5 years after facility operations begin.

C3-24

Further, it is evident that the radiological impact assessment appears substantially deficient when compared to similar assessments performed by applicants for uranium milling licenses. Since the site is essentially a uranium mill tailings disposal site, it should be held to an equivalent level of analysis and be judged on that basis on its own merits. Therefore, the DEIS' evaluation of this issue appears to be wholly insufficient.

C3-25

It is also likely that at 560 pCi/gm, Radium-226, the designed unit will not comply with the Subpart W 20 pCi/m^2-sec radon emanation standard without concurrent covering or wetting of the tailings. Wetting at a level sufficient to control radon emanation could likely saturate the tailings and cause contaminated seepage to accumulate on the impoundment "liner." Again, there is no cogent plan to control potential seepage releases.

C3-26

11. It is also worth noting that with respect to occupational exposures from radon, DOE made assumptions during closure at the Vitro site that were never validated because the State of Utah

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R3-24. The radiological assessment and analysis in the DEIS was presented to assess potential environmental impacts, not to address compliance with radiological dose regulations. The NRC staff considers the analyses in the DEIS to be adequate; see also Comments C1-1 and C1-2.

R3-25. Compliance with Subpart W is beyond the scope of this environmental evaluation. However, the facility will be required to maintain compliance with all applicable regulations. Under the operating design, the proposed disposal area will always have less than 4 ha (10 acres) of active disposal open at any time which will comply with 10 CFR Part 61.252(b)(2). In regard to long-term seepage, see the response to Comment R3-10.

R3-26. The comment is noted; validation of DOE assumptions is not essential to the radiological assessment presented in the DEIS.

failed to measure radon concentrations during closure. (DEIS at 5.18).

12. The DEIS does not appear to discuss in any great detail how the Envirocare proposal will differ from the Vitro site and whether or not differences in the likely characteristics of the waste are significant in light of the recent revisions to 10 C.F.R. Part 20. For example, the limits for release of thorium in 10 C.F.R. Part 20 have been reduced almost 300 times and would have potential compliance impacts with respect to both worker and environmental exposure.[1]

C3-27

C3-28

The relatively high thorium-230 concentration in the tailings and an assumed release rate of 440 tons per year of particulate are further indications that the site may not meet the proposed thorium standard at the site boundary.

[1]It should be noted that EPA regulations for control and stabilization of uranium mill tailings (40 C.F.R. 192.41 et seq.) apply to both thorium and uranium mill tailings. Id. See also, 10 C.F.R. Part 40, Appendix A, Introduction.

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R3-27. Section 5.2.8.2 of the DEIS related and contrasted the characteristics of the 11e.(2) material to those of the Vitro site. As discussed in Sect. 5.2.8.4, the analyses in the DEIS accounted for differences in waste characteristics between the Vitro site and the proposed Envirocare site.

Details of each candidate 11e.(2) material stream can be provided only in a general manner because of the great diversity in make-up and origin of such material. The weighted average radionuclide concentrations for 11e.(2) material were presented in Table 5.3; such concentrations were used in the radiological impact assessment.

Furthermore, Sect. 11e.(2) of the Atomic Energy Act of 1954, as amended, contains a definition of "byproduct material;" both the Vitro tailings and the material to be disposed in the proposed facility are "byproduct material" as defined.

R3-28. Section 5.2.8.4 of the DEIS discussed the issue of compliance with 10 CFR Part 20 in regard to release limits and monitoring activities; the applicant will be required to comply with 10 CFR Part 20 dose criteria at all times to obtain and keep a license.

The radiological assessment for compliance with 10 CFR Part 20 is contained in the Safety Evaluation Report.

DS04

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

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JUN 1 1993

Chief, Rules Review and Directives Branch
Division of Freedom of Information
and Publication Services, Mail Stop P-223
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Sir:

The Department of the Interior has reviewed the draft environmental impact statement for the licensing of Envirocare of Utah, Incorporated to construct and operate a facility to receive, store, and dispose of 11.E.(2) byproduct material near Clive, Tooele County, Utah and has the following comments.

General

C4-1 It seems redundant to have the same information in Chapter 2.0 Alternatives Including the Proposed Action and in Chapter 3.0 Description and Evaluation of Alternatives. The description of Alternative 2.2.3, pages 2.5-2.6, is practically identical to the description contained at 3.3, pages 3.5-3.6. The same is true with the discussions about the No Action Alternative.

Disposal

C4-2 Some portions of the description of the alternatives and the subsequent analysis are based on information that is lacking but should be presented or incorporated by reference. For example, the analysis assumes that a clay barrier will contain stored material. It is unclear whether a reaction might occur over time between the lined surfaces of the pits and the material being stored and weaken the barrier. The possibility of deterioration of the barrier over the long term should be addressed in the final statement.

C4-3 The design of the cap should account for potential runoff and erosion. All runoff should be trapped by the cap. The cap may require material other than rock to absorb water. Information should be presented or incorporated by reference to show that 7 feet of compacted overburden are sufficient as a radon barrier. The proximity of the site to ground water and subsequent potential for contamination should also be analysed and presented in the final statement.

C4-4 The project should be designed to incorporate vegetative cover species that are ecologically adapted to the site.

R4-1. The redundancy in the document is acknowledged. Similar text is included for completeness and ease of reference.

R4-2. The applicant is required to provide an analysis of the effect of material to be stored on the clay barrier. This analysis is incorporated into the Safety Evaluation Report. The license will not be issued until a satisfactory analysis is presented.

R4-3. See the response to Comment C3-10. The cap is designed to provide gradients to allow surface water to run off. It is not designed to trap water. The rock cover is provided for erosion protection.

The analysis of the sufficiency of the radon barrier to meet release criteria is contained in the Safety Evaluation Report.

The potential for groundwater contamination is addressed in Sects. 5.1.4, 5.1.12, and 5.3.4.

R4-4. Vegetative covers are not contemplated for the facility. If they are later found desirable, species which are ecologically adaptable to the site will be used.

<u>Alternative 1 - Disposal at the South Clive Site in an Above-Ground Embankment</u>

C4-5 On pages 2.4 and 3.1, it would be informative to indicate that the site occupies 540 acres of private land.

<u>Alternative 3 - Disposal at the Skunk Ridge Site</u>

C4-6 On page 2.5, section 2.2.3 Alternative 3, identifies a parcel of
public land near Skunk Ridge at the northern end of Skull Valley.
Apparently, this site was one of 29 identified in 1984 when a
site was selected for the Vitro tailings. However, those sites,
at least in the Salt Lake District, are no longer available for
hazardous waste disposal. <u>The U.S. Nuclear Regulatory Commission</u>
<u>did not contact the BLM Salt Lake District Office to determine</u>
<u>the availability of this site, which is not available for</u>
<u>consideration</u>. The Pony Express Resource Management Plan,
approved January 12, 1990, established an area of hazardous waste
disposal which does not include Skunk Ridge.

C4-7 On page 3.10, section 3.6.2 Benefit/Cost Evaluation, there is no
indication that Alternative 3, Skunk Ridge Site, or Alternative
4, No Action, are being dropped from further consideration even
though there is no further discussion of these alternatives in
the document. The final statement should resolve this issue.

<u>Endangered and Threatened Species</u>

C4-8 On page 4.36, section 4.5.4 should be retitled "Endangered, Threatened or Other Special Status Species." As presently discussed, the wild horses appear to be endangered species which is not the case.

C4-9 Also, the reference to <u>Sclerocactus pubispinus</u> is apparently an error as this species occurs in Uintah County, Utah, far to the east of the proposed site. A clearance of Special Status Plants and Animals, not just officially listed Endangered or Threatened Species, is needed. We suggest that informal consultation be initiated with the U.S. Fish and Wildlife Service and that the results be incorporated into the final statement.

<u>Truck Turnover or Collision</u>

C4-10 On page 5.28, section 5.2.8.2, the cumulative impacts of transporting 100,000 tons per year of material in 20-ton trucks (approximately 14 trucks per day, 7 days per week, 52 weeks per year) through Utah, along with additional transportation for the APTUS and USPCI Hazardous Waste (HW) incinerators and the USPCI HW landfill, should be analyzed. Otherwise, we believe the estimates presented in the draft statement minimize the potential for accidents.

R4-5. As suggested in the comment, text has been added to Sects. 2.2.1 and 3.1 to indicate that the applicant already owns 219 ha (540 acres) of the 259-ha (640-acre) section on which the proposed disposal facility would be located.

R4-6. The proposed action in this EIS is for the licensing of a facility on private land already owned by the applicant. The decision to be made by the NRC is whether or not to grant a license. It is beyond the scope of that decision to evaluate facility locations (such as Skunk Ridge) outside the control of the applicant or to explore the issue of site selection. A detailed analysis of the Skunk Ridge site was not made as it was included by the applicant for illustrative purposes.

R4-7. As suggested in the comment, Sect. 3.6.3 has been added to clarify that certain alternatives were eliminated from further consideration.

R4-8. Sect. 4.5.4 has been retitled as suggested in the comment.

R4-9. The reference to *Sclerocactus pubispinus* in Sect. 4.5.4 has been deleted. Since the issuance of the Draft EIS, consultation with the U.S. Fish and Wildlife Service has been completed and, as suggested in the comment, new text has been added to Sect. 4.5.4.

R4-10. The estimate of 90.7×10^6 kg/yr (100,000 tons/yr) for truck haulage of disposal material to the site is an upper bound, a conservative number. The effects of material being transported to other locations in the vicinity of the Envirocare site were not considered to be pertinent to the assessment of transportation risks at the proposed disposal site.

References

C4-11 Some of the references mentioned in Chapter 9.0 are outdated. Specifically, 1) Bureau of Land Management (BLM), 1983, "Tooele Grazing Draft Environmental Impact Statement," Salt Lake District Office, Salt Lake City, UT, U.S. Department of the Interior. That EIS was finalized in September 1983. 2) Bureau of Land Management (BLM), 1988, "Proposed Pony Express Resource Management Plan and Environmental Impact Statement," Salt Lake District Office, Salt Lake City, UT, U.S. Department of Interior, (May 1988). This plan and associated EIS was finalized in January 1990.

C4-12 The U.S. Nuclear Regulatory Commission should contact the BLM Salt Lake District Office, 2370 South 2300 West, Salt Lake City, Utah 84119 to obtain the latest planning documents in order to identify appropriate alternative locations for the proposed project.

We hope these comments will be helpful to you in the preparation of a final statement. If you have any questions concerning these comments, you may contact Lillian K. Stone, Chief, Energy Facilities Division at 202-208-6128.

Sincerely,

for Willie R. Taylor

Jonathan P. Deason
Director
Office of Environmental Affairs

R4-11. The comment on outdated references is acknowledged.

R4-12. Additional alternative locations for the proposed project are not needed. Envirocare owns the current site, has waste disposal facilities licensed by the state of Utah already active on parts of the site, and has infrastructure already constructed which can service all of the on-site facilities. The alternatives considered made it evident that the present site at South Clive is an acceptable location for the proposed disposal facility.

LETTERS FROM THE "THORIUM ACTION GROUP"

Seventeen letters were received from members of a "Thorium Action Group" in West Chicago; Warrenville; and Winfield, Illinois. The seventeen letters unanimously urge that favorable consideration be given to the license application for the proposed Envirocare 11e.(2) disposal facility. Because of the similarity of the comments contained in those letters, they are not reproduced verbatim in this appendix, but rather are paraphrased below.

C5-1 *Please license the Envirocare site in Utah.*
Please expedite the license of Envirocare at Clive, Utah.
I urge you to grant the license to Envirocare of Utah as soon as possible.
Please ensure a speedy approval of the Envirocare license.

R5-1. The comments are noted.

Appendix B

RESULTS OF THE SCOPING PROCESS

B.1 Introduction

The U.S. Nuclear Regulatory Commission (NRC) published a notice of intent (NOI) in the *Federal Register* (56 FR 25142, June 3, 1991) to prepare an environmental impact statement (EIS) on the construction and operation of a facility to receive, store, and dispose of uranium and thorium byproduct material (as defined by Section 11e.(2) of the Atomic Energy Act) to be received from other persons, at a site near Clive, Tooele County, Utah. This proposed facility is the subject of a license application, environmental report, and safety analysis report received by the NRC from Envirocare of Utah, Inc. (Envirocare).

Comments on the scope of the EIS were solicited by the NRC in the NOI and were received through July 1991. No scoping meetings were held.

B.2 Summary of Scoping Comments

B.2.1 Agencies and Organizations Responding

The NRC received five letters commenting on the scope of the EIS from the following interested agencies and organizations:

1) U.S. Department of the Interior
Bureau of Mines
Denver, Colorado

2) Sierra Club
Salt Lake City, Utah

3) U.S. Environmental Protection Agency
Region VIII
Denver, Colorado

4) Perkins Coie
(Counsel for U.S. Ecology, Inc.)
Washington, D.C.

5) U.S. Department of the Interior
Fish and Wildlife Service
Salt Lake City, Utah

B.2.2 Summary and Responses to Comments

These comment letters were reviewed for their contributions to the scope of the EIS, particularly to "the range of actions, alternatives, and impacts to be considered" in the EIS (40 CFR 1508.25). The comments are either quoted or paraphrased below followed by the NRC responses. The notation C4-2 means comment number 2 in letter number 4.

C1-1. Concern was expressed that the impact of the proposed action on mineral resources or mineral production facilities be addressed. The comment letter also noted that existing documentation appeared adequate with regard to minerals.

R1-1. The EIS will list known, nearby mineral resources and will discuss both the potential impacts of the facility on these resources and the impacts of production of sand, gravel, and bedrock needed for construction and operation of the facility.

C2-1. "Is this EIS only for the determination of '11E2', or could the waste contain a mixture of waste which has '11E2' as one of the materials? What will be the percentage of '11E2' to be allowed in this dump?"

R2-1. The NRC license will be only for Section 11e.(2) byproduct material and the license will state the total amount of Section 11e.(2) byproduct material to be disposed of in the facility. The EIS will cover the short-term and long-term impacts of the total amount of waste. Long-term cumulative impacts of the Section 11e.(2) byproduct material and other wastes known to be disposed of nearby will be covered in the EIS.

C2-2. "What would be the percentage of waste coming from Utah compared to that of other States?"

R2-2. This comment is not relevant to the scope of the EIS. The proposed action is the licensing of a commercial facility; therefore, waste which meets the licensing requirements can be taken from any source.

C2-3. "What will the impacts be on adjacent public lands?"

R2-3. Short-term, long-term, and cumulative impacts on adjacent public lands will be covered in the EIS.

C2-4. "What would be the lands that Envirocare is asking for in exchange and what are the lands that BLM would be receiving after the exchange?"

R2-4. The NRC is not aware of any proposed exchange of land between the BLM and Envirocare. Therefore, the amount is not relevant to the scope of the EIS. However, if there is such an exchange, BLM would perform any environmental review.

C2-5. "What are the long-term effects of the dump on the adjacent public lands, right-of-ways, and adjacent lands to right-of-ways?"

R2-5. See R2-3.

C2-6. "What are the post-closure plans?"

R2-6. Post-closure plans will be covered in the EIS.

C2-7. "Who will be responsible for radioactive contamination after post closure?"

R2-7. This issue is considered in the licensing (safety) review, not in the environmental review or the EIS.

C2-8. "What will be the effects of small amounts of radioactive contamination on the public lands which have accrued over the lifetime of the facility?"

R2-8. See R2-3.

C2-9. "How will the change in the permit affect the States that have prevention programs, and would this be a part of prevention?"

R2-9. This comment is not relevant to the scope of the EIS. Licensing will be by the NRC under 10 CFR 40, not by the State of Utah.

C2-10. "In the Utah Code 1990 edition, 26-14-9 subsection (11) paragraph (a) 'the probable beneficial environmental effect of the facility to the state outweighs the probable adverse environment [sic] effect; and (b) there is a need for the facility to serve industry within the state.'; how will this apply to Utah's industries compared to out-of-state waste?"

R2-10. See R2-9.

C2-11. "What is the compliance record of Envirocare, and how will this permit assure that compliance will occur?"

R2-11. This issue is outside the scope of the EIS, but will be considered in the safety review.

C2-12. "What are the transportation risks to the general public along [the] Envirocare transportation route[s]?"

R2-12. See R2-3.

C3-1. The Vitro EIS may serve as a useful reference.

R3-1. NRC will use the Vitro EIS as a reference document to the extent that information in the Vitro EIS is either applicable or current.

C3-2. "Radiological effects on local population and the on-site work force. The EIS should consider the potential radiological exposure [to the local population and on-site work force] during all phases of operation, including potential accidents that may occur during transportation of waste material to the site. Additionally, the cumulative impacts of all local radioactive waste disposal operations, both ongoing and discontinued, should be included in the assessment."

R3-2. The EIS will cover potential radiological exposures to the on-site work force and to members of the public, as well as potential transportation accidents. Cumulative impacts will be covered.

C3-3. "Groundwater impacts. Although the Vitro EIS noted that the Clive site's groundwater quality is considerably below drinking water standards, the proposed EIS should reassess potential aquifer uses, water treatment costs inclusive, given current economic conditions. In addition, the previous EIS noted a lack of geologic data to accurately assess formation units for the Clive region. If recent seismic or well data is available, this information should be useful in better defining aquifer viability and the need for groundwater protection measures."

R3-3. The EIS will reassess existing groundwater quality and will assess both short-term and long-term impacts of the facility on groundwater.

C3-4. "Air quality impacts. The estimated impacts of fugitive dust emission generated during material transport and site operations are of concern for the Salt Lake regional air quality. The EIS should specify planned measures that may be used to mitigate the impacts."

R3-4. Air quality impacts from facility construction, operation, and closure will be covered in the EIS. Mitigation measures will be discussed.

C4-1. This comment requested that the EIS address incompatibilities between hazardous waste disposal regulations promulgated under the Resource Conservation and Recovery Act (RCRA) and radioactive waste disposal regulations promulgated under the Atomic Energy Act (AEA).

R4-1. The purpose of the EIS is to examine the environmental consequences of disposal of only Section 11e.(2) byproduct material at the Envirocare site. Cumulative impacts from the disposal of different kinds of wastes at the Envirocare site will be evaluated in the EIS. Regulatory differences have no bearing on these impacts and will not be discussed. Envirocare's proposed 11e.(2) byproduct material disposal site will be licensed in accordance with 10 CFR 40 by Commission (NRC) order.

C4-2. This comment requested that the EIS discuss the impact of different owners of different portions of the Envirocare disposal site.

R4-2. The issue of government ownership is covered in 10 CFR 40. Therefore, the NRC staff will consider this issue in the licensing proceedings rather than in the EIS.

C4-3. This comment requested that the EIS address different regulatory long-term control requirements and different regulatory long-term time horizons associated with disposal of different kinds of radioactive wastes and with disposal of RCRA hazardous wastes.

R4-3. As stated in R4-1. Envirocare's proposed Section 11e.(2) byproduct material disposal site will be licensed under 10 CFR 40. Therefore, the only "long-term control horizon" for the disposal of 11e.(2) byproduct material will be 200-1000 years as defined in 10 CFR 40. Other regulations have no bearing on the environmental impact of the proposed action. However, cumulative impacts of the disposal of other wastes at the site will be considered in the EIS.

C4-4. This comment requested that the EIS discuss differing regulatory requirements in 10 CFR 40 and 10 CFR 61.

R4-4. NRC has determined that the proposed facility will be licensed under 10 CFR 40 and that only Subpart G of 10 CFR 61 will apply. Thus, there is no need to discuss differences between these regulations in the EIS.

C4-5. This comment requested that the EIS address differences between surety requirements under RCRA and the AEA, including the difference between NRC's surety requirements for 11e.(2) byproduct material and the State of Utah's (Agreement State) requirements for low-level radioactive wastes.

R4-5. Assuming that financial surety is meant, surety requirements will be addressed as part of the licensing proceedings. The Envirocare application for Section 11e.(2) byproduct material disposal has been modified and will not include mixed waste. Therefore, the only requirements regarding surety are the NRC's. Utah's low-level waste licensing authority has no bearing on the NRC's licensing process for 11e.(2) byproduct material.

C4-6. This comment was directed at the relationship between Envirocare's proposed action and interstate low-level waste compacts [under the Low-Level Radioactive Waste Policy Act].

R4-6. Envirocare's proposed Section 11e.(2) byproduct material disposal facility will be licensed under 10 CFR 40, not 10 CFR 61. Section 11e.(2) byproduct material is generally excluded from compact coverage, therefore the status of interstate compacts has no bearing on the proposed action.

C4-7. This comment was directed at a broad need to address regulatory, political, legal, and economic issues in the EIS.

R4-7. Most of the issues addressed in comment C4-7 and in comment letter No. 4 are related to differences among regulations, policies and/or the implementing agencies. These differences are not related to the environmental impact of the proposed action, except for cumulative impacts of different kinds of wastes disposed of at the site. With the exception of cumulative impacts of the wastes, these differences are not within the scope of the EIS.

C5-1. This comment deals with NRC's responsibilities under the Endangered Species Act.

R5-1. NRC will conduct the required consultations with the U.S. Fish and Wildlife Service and will carry out any necessary biological assessments.

Appendix C

ALTERNATIVE SITES

Excerpts from

U.S. Department of Energy
Final Environmental Impact Statement
DOE/EIS-0099F
(Appendices B and C)
Remedial Actions At the Former
Vitro Chemicalk Company Site
South Salt Lake, Salt Lake County, Utah
July 1984

Exhibit C.1

DOE's Appendix B — The Selection of An Off-Site Disposal Site

Appendix B

THE SELECTION OF AN OFF-SITE DISPOSAL SITE

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Appendix B (DOE)

LIST OF TABLES

Appendix B

THE SELECTION OF AN OFF-SITE DISPOSAL SITE

The impacts of transporting the Vitro tailings and other contaminated material to an off-site location are described in this document in terms of a new disposal site approximately 1 mile south of Clive, Utah. This appendix provides a background for and history of the events that led to the choice of the South Clive site as the off-site alternative.

B.1 BACKGROUND

On March 12, 1974, the subcommittee on Raw Materials of the Joint Committee on Atomic Energy (JCAE), Congress of the United States, held hearings on two identical bills submitted by Senator Frank E. Moss and Representative Wayne Owens of Utah. The bills, S. 2566 and H.R. 11378, provided for the assessment of an appropriate remedial action to limit the exposure of individuals to radiation from uranium mill tailings at the Vitro site in Salt Lake City, Utah. These bills also provided for a cooperative arrangement between the Atomic Energy Commission (AEC) and the State of Utah in making the assessment.

During the JCAE hearings, Dr. William D. Rowe of the U.S. Environmental Protection Agency (EPA) pointed out that there were other inactive uranium mill sites that shared the problems of the Vitro site; he recommended a generic approach to the problem of abandoned uranium mill tailings, with first priority being given to addressing the most critical tailings sites. Similar recommendations were made by Dr. James L. Liverman who testified for the AEC: he proposed that a comprehensive study should be made of all abandoned tailings piles, rather than treating potential problems on a piece-meal basis. This comprehensive study would be a cooperative two-phase undertaking by the concerned states and appropriate Federal agencies such as the AEC and EPA. Phase I of this undertaking would involve identifications of sites that might require remedial action, and determination of the need for corrective action through observations of each site's condition, ownership, proximity to populated areas, and prospects for increased population near the site. A preliminary report of Phase-I work would serve as a basis for determining if a detailed engineering assessment (Phase-II) was necessary for each mill site. The Phase-II engineering, if necessary, would include evaluation of the problems, examination of alternative solutions, preparation of cost estimates and of detailed plans, and specifications for alternative remedial-action measures.

The Phase-I assessment began in May 1974, with teams consisting of representatives of the AEC, the EPA, and the affected states visiting 21 of the known inactive millsites. A Phase-I report was presented to the JCAE in October 1974 (AEC, 1974). Based on the findings of that report, a decision was made by the AEC to proceed with the Phase-II engineering assessments at 17 sites, including the Vitro site at Salt Lake City.

B.2 HISTORY

B.2.1 The FBDU engineering assessments

An active search for alternate disposal sites for the Vitro mill tailings began in 1975. On May 5, 1975, the U.S. Energy Research and Development Administration (ERDA), formed by the Energy Reorganization Act of 1974 which abolished the AEC, selected Ford, Bacon & Davis Utah Inc. (FBDU) of Salt Lake City to provide architect-engineering services for Phase-II assessments of the 17 mill sites mentioned in the Phase-I report (AEC, 1974). FBDU began work on June 23, 1975, giving first consideration to the Vitro site. The architect-engineering services contract specified, among other things, that FBDU would determine the adequacy and the environmental suitability of sites at which mill tailings could be disposed.

The original Phase-II report on the Vitro site in Salt Lake City was published in April 1976 (FBDU, 1976). Altogether 29 potential disposal sites or areas were mentioned in this report; these sites are listed in Table B-1. The 29 sites were either nominated by state agencies, Federal agencies, private individuals, or were chosen by FBDU on the basis of their knowledge of suitable areas in the vicinity of Salt Lake City. Because of transportation costs, only those locations within 150 miles of Salt Lake City were initially considered.

Very early in their work on the engineering assessments, FBDU developed 29 criteria for determining the suitability of sites proposed for storage of mill tailings (personal communication, Mr. Robert Overmyer, FBDU, October 5, 1981). These 29 criteria, listed in Table B-2 in their original form as a field "score sheet," were logically developed from general principles of radiation protection that had been adopted by ERDA. It should be emphasized that in 1975 there were no Federal standards or guidelines specifically directed towards the cleanup of uranium mill sites or disposal of uranium mill tailings. Some guidelines for cleanup of habitable structures contaminated with tailings had been published by the U.S. Surgeon General for use in the Grand Junction, Colorado remedial program (10 CFR 12), but these guidelines did not directly apply to the problems of mill tailings disposal. Consequently, ERDA and FBDU had to create their own guidelines in order to proceed with the engineering assessments. In brief, these ad-hoc guidelines had three objectives: (1) to reduce residual gamma radiation to levels which would be as low as practicable; (2) where cleanup was necessary, to reduce the radium content of the soil to no more than twice the radium background in the area; (3) to meet applicable state and Federal standards for the radium-226 content of ground or surface waters. Other desirable goals, such as preservation of local ecosystems, the minimization of project costs, and making best use of lands, were factored into the development of the 29 site-selection criteria.

The site-selection criteria were used to score and rank the 29 sites shown in Table B-1; the highest-scoring site was ranked first, the next-highest-scoring site was ranked second, and so on. In obtaining a total score for each site, the scores for each criterion (a number in the range 1 to 10) were simply added, and equal weights were given to the 29 criteria. The results of this ranking are specified in Table B-1 for the top-ranking 15

Table B-1. Twenty-nine sites evaluated as repositories for the Vitro tailings in Phase II-Title I Engineering Assessment

Salt Lake Valley sites	FBDU site identification number	FBDU rank[a]
Salt Lake International Airport Fill for proposed runway expansion Township 1 North, Range 1 West	4[c]	7[b]
Freeway Interchange (I-80:40th W) South of Salt Lake International Airport #1 Township 1 South, Range 2 West	5[c]	8[b]
Kennecott Tailings Area 2 miles north of Magna, Utah Township 1 South, Range 2 West	6	-
Butterfield Canyon 5 miles south, southwest of Lark, Utah Township 1/2 South, Range 1 West	14	14
Magna Lake Bed North and east of Kennecott Tailings Pond Township 1 South, Range 2 West	28[c]	-
Magna Area State Land 2 miles east of Magna, Utah Township 1 South, Range 2 WEst	24[c]	12
Lark Copper Tailings Site 1/2 mile east of Lark, Utah Township 3 South, Range 2 West	25	15
Oquirrh Foothills 12 miles west of Midvale, Utah Township 3 South, Range 2 West	29[c]	-
Great Salt Lake Desert sites		
1 mile south of Clive, Utah Township 1-1/2 South, Range 11 West	1[c]	2
Natural Depression 8 miles north of Clive, Utah Township 1/2 North, Range 12 West	2[c]	1
Natural Depression Township 1 North, Range 15 West	11	-
Newfoundland Range Basin Township 5-1/2 North, Range 14 West	12	-

Table B-1 (continued)

Great Salt Lake Desert sites	FBDU site identification number	FBDU rank[a]
Dugway Proving Grounds 5 miles west of Camels Back Ridge Township 8 South, Range 11 West	17	-
6 miles northwest of Knolls, Utah Salt Lake Baseline, Range 12 West	22	-
12 miles northwest of Knolls, Utah Township 1 North, Range 13 West	23	-
1 mile south of Low, Utah	27	-
Other locations		
North Skull Valley 3 miles west of Delle, Utah Salt Lake Baseline, Range 9 West	3[c]	3
Rush Valley 20 miles south of Tooele Army Depot Township 7 South, Range 5 West	7	6
Ripple Valley 5 miles southeast of Porter Well, Utah Salt Lake Baseline, Range 10 West	8	-
Cedar Mountain Foothills 10 miles east of Clive, Utah Township 1-1/2 South, Range 10 West	9	-
Cedar Mountain Foothills 10 miles west of Delle, Utah Salt Lake Baseline, Range 9 West	10	5
Black Mountain Lakeside Mining District 7 miles north of Delle, Utah Township 1/2 North, Range 8 West	20	10
Point of the Mountain 3 miles north of Lehi, Utah Township 2 North, Range 10 West	26	13
Puddle Valley 5 miles east of Grassy Mountain Well Township 2 North, Range 10 West	13	-

Table B-1 (continued)

Other locations	FBDU site identification number	FBDU rank[a]
Puddle Valley Northwest of Delle, Utah Township 1 North, Range 9 West	21	9
Hell's Kitchen Ranch 40 acre natural basin Township 17 South, Range 1/2 West	16	-
Rush Valley 4 miles south of Tooele Army Depot Township 7 South, Range 4 West	18	4
Camp Williams State Military Reservation Tickville Gulch, 8 miles west of Lehi Township 3 South, Range 3 West	19	11
Ripple Valley 7 miles southwest of Porter Well, Utah Township 1/2 South, Range 11 West	15	-

[a]Ranks are specified for only the top-ranking 15 sites.
[b]No longer available as of 1981, since developments are already underway or are completed.
[c]Alternative disposal sites selected for cost studies (FBDU, 1976).

Table B-2. FBDU site selection criteria

Criteria	Point values 1	2	3	4	5	6	7	8	9	10
					HYDROLOGY & GEOLOGICAL CONSIDERATIONS					
Rainfall	More than 30"ann.	<27"ann.	<24"ann.	<21"ann.	<18"ann.	<15"ann.	<12"ann.	<9"ann.	<6"ann.	Less than 3"ann.
Evidence of flooding	Common occur.				50% Chance					Negli-gible
Run-off characteristics	Gully erosion		Sheet erosion			Rills evident				No ero-sional features
Drainage distance from site to rivers, lakes & lower elev.	Within 1 mile	>2	>3	>4	>5	>6	>7	>8	>9	Over 10 miles
Wells or springs in area	Within 1 mile	>2	>3	>4	>5	>6	>7	>8	>9	Over 10 miles
Water table location	Water table >20'	>40'	>60'	>80'	>100'	>120'	>140'	>160'	>180'	Water table over 200'
Possibility of mud or rock slides, faults, avalanches	Common occur.									Negli-gible
Potential for agri-culture & grazing, soil charc.	Good topsoil									No top-soil, rocky
Density of vegetative cover	100%	90%	70%	50%	30%	20%	15%	10%	5%	No vege-tation
Type of underlying unconsolid. strata	Sand & gravel									Heavy clay
Wind erosion	Flat and windy									Protected from wind
Ability to isolate the site	Impos-sible				Good					Presently isolated

Table B-2 (continued)

Criteria	Point values 1	2	3	4	5	6	7	8	9	10
Stabilization potential	Impossible				Good					Excellent
Dip of underlying strata	Folded	20°	10°	8°	6°	4°	3°	2°	1°	Flat
Extent of faulting	Evident offsets			Evident Fracturing			Occasional joints			Undisturbed
Type of bedrock	Limestone			Sandstone			Shales			Granite
Ground water quality	Potable		Suitable for livestock		Suitable for industry					Very poor quality
ECOLOGICAL CONSIDERATIONS										
Wildlife population	Yearlong habitat		Seasonal use		Shelter area					Negligible
Proximity to population	>2 miles	>4	>6	>8	>10	>12	>14	>16	>18	Over 20 miles
Current use of land	Rangeland									Wasteland
Aesthetic consideration	Naturally beaut.									Nondescript
Probable future land use	Human habitat				Agricultural					None
ECONOMIC CONSIDERATIONS										
Natural resources in area	Abundant									Negligible
Highway accessibility	Less than 10 mi	>9 miles	>8 miles	>7 miles	>6 miles	>5 miles	>4 miles	>3 miles	>2 miles	>1 mile

Table B-2 (continued)

Criteria	Point values 1	2	3	4	5	6	7	8	9	10
Proximity to railroad	Less than 20 mi	>18 miles	>16 miles	>14 miles	>12 miles	>10 miles	>8 miles	>6 miles	>4 miles	>2 miles
Miles from tailings site	Over 150 miles	<135	<120	<105	<90	<75	<60	<45	<30	30 miles
Estimated current value/acre	$360	$360	$320	$280	$240	$200	$160	$120	$80	Less than $40
Maintenance required for tailings in this area	Semi-annual	Annual	Every 2 years	Every 3 years	4	5	6	7	8	None
Source of fill for SLC site	None									Unlimited

sites. It is seen that areas in the Great Salt Lake Desert, or in the series of valleys west of the Salt Lake Valley, rank the highest. The highest-ranking sites in the Salt Lake Valley, such as the runway expansion at Salt Lake Airport and the Interstate-80 Exchange, would also be acceptable; but the latter are no longer at a stage of development where joint utilization for tailings disposal is practicable
(FBDU, 1981).

B.2.2 Site selection by the State of Utah

In November of 1978, Congress passed PL95-604, "The Uranium Mill Tailings Radiation Control Act of 1978" (UMTRCA). Title I of PL95-604 authorized the U.S. Department of Energy (DOE), successor to ERDA, to enter into cooperative agreements with affected states and Indian tribes in order to establish assessment and remedial action programs at inactive uranium mill tailings sites; the Federal government would pay 90 percent of remedial-action costs and the affected state would pay the remainder. The UMTRCA also stipulated that the affected state would acquire mill tailings disposal sites during remedial-action operations, but that ownership of these sites would revert to the Federal government after completion of the remedial action.

In November 1979, 25 former uranium-milling sites including the Vitro site in Salt Lake City, Utah, were designated for remedial action under PL95-604. In early 1980, Utah's governor directed the State Division of Environmental Health to recommend a final disposal site for the Vitro tailings. A committee of eight members, representing all pertinent Bureaus in the Division of Environmental Health and the Utah Geological and Mineral Office, was established to make the requisite studies and recommendations. The committee, called the "Vitro Tailings Site Selection Committee" (VTSSC) began work with the consideration of sites proposed in previous studies. The 29 sites mentioned in the 1976 engineering assessment (FBDU, 1976, and Table B-1) were studied, and all but the 3 top-ranking candidates were eliminated. Eight new candidates were added to obtain the 11 sites listed on Table B-3. All of the sites in the Salt Lake Valley were eliminated in this first round of site screening.

The VTSSC adopted the following rules for conducting its second and final round of screening: (1) each committee member would evaluate only those aspects of the site representative of his particular expertise; (2) the technical criteria used by FBDU (see Table B-2) would be used with possible changes in relative weighting of these criteria; (3) each committee member would submit a report to the Chairman who would summarize the committee recommendations; (4) only physical acceptability of the sites would be evaluated on the basis of direct observations and a review of information from reports of previous investigations; and (5) each committee member was to consider three separate options. The three options were: Option-I sites, the use of which was judged to entail no economic or political complications; Option-II sites, those sites requiring further evaluations to determine if transport of the tailings to them would be economical; and Option-III sites at which reprocessing of the tailings might be possible, subject to favorable outcomes of evaluations of the political and economic factors involved with reprocessing. The VTSSC eventually declined evaluation of Option-II and Option-III sites (VTSSC, 1980), pending an economic evaluation by the DOE (see Section C.2, Appendix C).

Table B-3. Sites considered by Vitro tailings site selection committee (VTSSC)

VTSSC site no.	Location	FBDU site no.[a]
Option-I sites[b]		
1	One mile south of Clive, Tooele County	1
2	Eight miles north of Clive, (Natural Depression), Tooele County	2
3	Three miles west of Delle, Tooele County	3
4	Boulder Creek, Tooele County	
Option-II sites[b]		
5	Three miles north of Woodside, Carbon County	
6	Nine miles south of Crescent Junction, Grand County	
Option-III sites[b]		
A	North of Crescent Junction, Grand County	
B	Sager's Flat, Grand County	
C	Northwest of Whitehouse, Grand County	
D	West of Cisco, Grand County	
E	North of Cisco, Grand County	

[a]See Table B-1.

[b]Option-I sites: Use of these would entail no economic or political complications.

Option-II sites: Use of these might require economic evaluations to determine if costs are competitive with Option-I sites.

Option-III sites: Use of these might include reprocessing to recover the uranium and other mineral values. In addition to economic evaluations, agreements with the DOE, the State of Utah, and property owners would be required.

A report by the VTSSC was submitted to the Governor of Utah on June 20, 1980 (VTSSC, 1980). The Committee recommended the FBDU site No. 2, a natural depression 8 miles north of Clive in Tooele County, as a primary site for final disposal of the tailings at the Vitro site. As secondary sites, the committee recommended FBDU site No. 1, one mile south of Clive, Tooele County, and FBDU site No. 3, 3 miles west of Delle, Tooele County. The Governor of Utah endorsed these recommendations in a letter to the DOE on January 6, 1981.

After the VTSSC report had been submitted, the Utah Department of Health recommended consideration of a fourth area not previously included in the State's site-selection process. In a letter to the DOE dated July 23, 1981, the Utah Department of Health requested that DOE evaluate an area on the extreme northeast corner of the Wendover Bombing and Gunnery Range, about 3 miles south of FBDU site No. 1. The DOE notified the U.S. Department of Defense (DOD) that it would consider part of the Wendover Bombing Range as a location for disposal of uranium mill tailings, and requested permission to perform studies and tests on the land in question. Officials of the DOD declined approving use of the Wendover Bombing Range lands on September 4, 1981, stating that the lands would be needed to support operational requirements and that they believed the lands would in any case be environmentally unsuited for the proposed use.

B.2.3 Site evaluations by the DOE

In April 1981, a DOE contractor made an independent analysis of the three Option-I sites recommended by the State of Utah. At the conclusion of this evaluation, the DOE determined that the area 1 mile south of Clive, Tooele County (FBDU site No. 1) was the superior of the three areas proposed by the State. The relative rankings of the three sites according to 7 environmental and geotechnical disciplines are shown in Table B-4.

Table B-4. Relative rankings of state-nominated areas

Discipline	FBDU Site No. 1	FBDU Site No. 2	FBDU Site No. 3
Vegetation	2	1	3
Wildlife	1	2	3
Soils & reclamation	2	3	1
Hydrology & water quality	1	2	3
Meteorology & air quality	1	2	3
Human resources	1	3	2
Geotechnical engineering	1	3	2
Composite score	9	16	17

A summary of the evaluation of the three state-nominated areas, and reasons for rejecting FBDU sites Nos. 2 and 3, are provided in Appendix C where considered-but-rejected alternatives are discussed.

The Option-II and Option-III sites proposed by the State's site-selection committee were evaluated by the DOE and then rejected because of their distance being at least 150 miles by road or rail from the Vitro site; evaluations of these options and reasons for rejecting them are also contained in Appendix C.

The possibility that there are technically suitable disposal areas nearer to the Vitro site than the three state-nominated areas was also considered. At the request of the DOE, Sandia National Laboratories (SNL) reviewed all the sites that had so far been proposed as alternative disposal sites, and in September 1981 the DOE determined that (1) there are presently no more-isolated locations for disposal of the Vitro tailings within 17 road-miles of the Vitro site other than the former Vitro site itself, and (2) there may be technically suitable disposal areas west of the Salt Lake Valley other than the three state-nominated areas, but the use of such areas would offer little or no environmental or economic advantages beyond the advantages to be realized in the use of one of the state-nominated areas. Therefore, the DOE determined that it was not reasonable to examine these Salt Lake Valley areas further. The bases for these conclusions are outlined in Appendix C.

B.3 CONCLUSIONS

The DOE has chosen the area approximately one mile south of Clive, Utah as the candidate for use as an alternative disposal site for the Vitro tailings and other contaminated material. This choice is in accord with site nominations made by the State of Utah, and can be justified by the results of over 7 years of study directed towards finding suitable alternate areas for long-term storage of the Vitro site wastes. The impacts of a remedial action at the Vitro site that would include the transportation of mill tailings and wastes to the area south of Clive, Utah, are assessed in the body of this document.

REFERENCES FOR APPENDIX B

AEC (U.S. Atomic Energy Commission), 1974. Phase-I Summary Report, October 1974.

FBDU (Ford, Bacon & Davis Utah Inc.), 1976. Phase-II - Title I Engineering Assessment of Inactive Uranium Mill Tailings, Vitro Site, Salt Lake City, Utah, GJT-1, prepared for U.S. Energy Research and Development Administration, Grand Junction, Colorado.

FBDU (Ford, Bacon & Davis Utah Inc.), 1981. Engineering Assessment of Inactive Uranium Mill Tailinga, Vitro Site, Salt Lake City, Utah, DOE/UMT-0102, prepared for U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico.

VTSSC (Vitro Tailings Site Selection Committee), 1980. "Vitro Tailings Site Selection Committee Report," dated June 20; signed by Blaine N. Howard (Chairman), Earl Peirce, Fitzhugh Davis, Dan Blake, Robert Cunliffe, and Dane Finerfrock; copies available on request to Uranium Mill Tailings Remedial Actions Project Office, DOE Albuquerque Operations Office, Albuquerque, New Mexico.

Exhibit C.2

DOE's Appendix C — Alternatives that Were Considered But Rejected

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Appendix C (DOE)

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Appendix C

ALTERNATIVES THAT WERE CONSIDERED BUT REJECTED

The alternatives for remedial actions at the Vitro site that were considered during the development of this EIS but were determined to be unreasonable are described in this appendix, and reasons given for their rejection. The considered-but-rejected alternatives can be divided into four classes: (1) alternatives involving disposal of the Vitro wastes at other locations considered by the State of Utah (excluding the South Clive site); (2) alternatives involving disposal at sites in Carbon County; (3) alternatives involving disposal of the Vitro wastes at locations within or near the Salt Lake Valley; (4) alternatives that would involve the reprocessing of the Vitro mill tailings to extract residual mineral values.

C.1 STATE-RECOMMENDED ALTERNATE DISPOSAL AREAS

The State of Utah found three areas acceptable for long-term disposal of the mill tailings and other residues from the Vitro site (see Section B.2.2, Appendix B). They are named and located as follows.

- The Prime Area is the so-called great depression located approximately 8 miles north of Clive, Tooele County, Utah. This area consists of three sections of public domain: Sections 8, 17, and 20 of T1N, R12W.

- The First Alternate Area is a parcel of state land located approximately one mile south of Clive, Tooele County, Utah within Section 32 of T1S, R11W. This area is referred to throughout this EIS as the "South Clive site."

- The Second Alternate Area is a section of state land located approximately 3 miles west of Delle, Tooele County, Utah: Section 2 of T1S, R9W.

The firm of Dames & Moore was contracted by the DOE to perform an independent evaluation of the suitability of the three areas for disposal of uranium mill tailings; the evaluation was made in April of 1981 by specialists in geohydrology, surface-water hydrology, soils and reclamation, plant ecology, wildlife ecology, meteorology and air quality, human resources, and geotechnical engineering. Evaluations were based on available literature, knowledge of the region, site reconnaissance, and professional judgement. It was assumed that the disposal of the mill tailings would be, according to current practice, subgrade in lined trenches or cells. Factors considered by the specialists were oriented toward achieving the standards then proposed by the EPA for disposal of mill tailings under Title I of UMTRCA (46 FR 2556-2563). Specific factors considered included the following:

- Potential for geologic hazards, erosion potential, or subsidence.

- Economics of the transport and stabilization of contaminated materials, including transportation distance, access to existing rail and highway systems, construction of the retention system, and availability of cover materials.

- Geohydrology, including general depth to ground water and potential for impacts on ground-water quality.

- Surface-water hydrology, including proximity to and potential for impacts on intermittent and perennial drainages, drainage basin characteristics, and flood potential.

- Local meteorological conditions and potential for impacts on air quality.

- Topography as related to transportation, engineering, and long-term stabilization (erosional versus depositional environment).

- Present and potential land use, general productivity.
- Existing and potential vegetation, value as wildlife habitat and/or rangeland.
- Importance of area to plant and wildlife species of concern (endangered, threatened, ecologically important).
- Potential for reclamation.
- Proximity and potential for visual impacts to human residences and public use areas.
- Engineering restrictions and construction problems imposed by geotechnical conditions.

The evaluation led to the elimination by the DOE of two of the three areas that the State had found to be acceptable--the Prime Area and the Second Alternate Area. The DOE found that these are not reasonable alternative areas (see Appendix B). A description of each of these areas and reasons for their elimination are given below.

C.1.1 The Prime Area

The Prime Area is an elongated natural depression in the Great Salt Lake desert. The depression is up to about 10 feet in depth, approximately 1 mile in width, and extends both north and south beyond the three sections of concern. The depression is bounded to the east and west by what appear to be old sand dune ridges that are sparsely covered with shadscale, winterfat, nuttall saltbush, koschia, and other salt-tolerant species of plants.

Geohydrology and surface waters. During the site reconnaissance, (April 1981), the ground-water table was within 3 feet of the depression's floor, which is a mud flat composed of salt-encrusted silt and clay underlain by Lake Bonneville lakebed depositions. Periodically there is standing water in the depression and there would thus be a very high potential for impact on ground-water quality if the disposal site were located there. Otherwise, this depression has no clear-cut disadvantages from a surface hydrology standpoint. It would not be subject to erosion from runoff and would have a very low potential for flood damage.

Soils and reclamation. The general lack of an on-site source of rock and gravel to protect the reclaimed surface from wind erosion coupled with an anticipated difficulty in establishing a vegetative cover would increase the cost of reclamation; the latter would make reclamation success questionable. The depression is a depositional environment since it receives run-in from the adjacent ridge slopes. Upon drying, however, the deposition of material carried in by water would be countered by wind erosion. The net effect of these two opposing actions would be most influenced by moisture conditions which, in turn, will reflect precipitation patterns and fluctuations in Great Salt Lake water levels.

Wildlife and plants. The depression floor is nearly devoid of vegetation. As evidenced by the presence of several desiccated individuals on the depression floor the day after heavy precipitation, the mud flat contains a population of Great Basin Spadefoot Toads; otherwise, very limited wildlife habitat exists on this area. No endangered or threatened species are known from this vicinity.

Meteorology and air quality. The depression is the farthest from Interstate 80 of the three areas (about 5 miles). Since about 40 percent of all winds greater than 12 mph are from the south, emissions would be blown away from the highway. However, soil erosion and drifting in the vicinity of the depression indicate that blow dust and wind erosion could be serious local problems; use of the area would involve about 10 miles of unpaved haul roads (compared to approximately 2.5 and 0.8 miles at the other two areas).

The railroad line lies 0.5 mile south of I-80. If contaminated material were transported by rail, a transfer point for transport to the depression would be required which could produce emissions that would impact highway traffic.

The nearest Class I air quality area (Capital Reef National Park) is approximately 200 miles south of the area.

Human resources. The issues that are of consequence to the choice of the best among the three nominated areas are transportation costs (construction of new rail or roads, total cost of transportation) and visual impacts to travelers on I-80 and/or nearby residents. The Prime Area would involve the longest (rail or highway) distance from Salt Lake City and the greatest transportation cost for haulage from the rail or highway to the disposal area. Visual impacts would be concentrated near Clive where material would be transloaded from the existing rail or highway to the connecting rail spur or haul road. The depression is sufficiently far from the existing railroad and I-80 (8-10 miles) to prevent on-site activities being visible to travelers. Of historical interest, the Donner Trail passes to the north of this depression.

Geotechnical engineering. Use of the depression would present major construction problems relative to excavation of pits or trenches in the soft silty clays and transport of contaminated materials from the adjacent alluvial ridges onto the mud flat. Periodic inundation of the site and the shallow water table would further complicate engineering design and construction. Excavated clay from the depression would be suitable for use as an impermeable cover over the disposal trenches or pits. A bottom liner would be unnecessary to control vertical seepage. The nearest gravels for cover are about 5 miles away in the Grayback Hills to the east.

Reasons for elimination. The Prime Area was ranked second after the South Clive Area owing mainly to its disadvantages in terms of reclamation, transportation, and geotechnical engineering, all of which would lead to increased costs of implementation with no increase in environmental benefits over those offered by use of the South Clive Area. Another major problem with use of the Prime Area would be the necessity for transporting the tailings from a railhead near Clive, across Interstate 80, and into the Prime Area. The most economical means of carrying the material over this path would be truck transport. A direct truck route that crossed Interstate 80 would lead to serious and frequent traffic interruptions; on the other hand, use of an existing overpass west of Clive would necessitate the upgrading or construction of frontage roads and an extra transport distance of about 15 miles.

For these reasons, and the fact that an alternative involving the Prime Area would be too close on the spectrum of alternatives to one involving the South Clive site, the DOE has determined that the Prime Area alternative is unreasonable.

C.1.2 The Second Alternate Area

This area, about 3 miles west of Delle, is in the Skull Valley portion of the old lakebed deposits of Lake Bonneville. The topsoil is poorly developed and varies from sandy to clayey silt. There is some topographic relief in the area and defined runoff channels are present, particularly on the eastern portion of the section. The area is used for recreation (hunting and target shooting, motorcycle riding) and is traversed by an access road to the Cedar Mountains, which are also used for recreation.

Geohydrology and surface waters. Based upon the literature, the upper water table is approximately 150 feet beneath the ground surface. However, the area is clearly the worst from the viewpoint of surface hydrology. Because of its location relative to surrounding terrain and the size of the drainage basin, it is susceptible to sufficient velocity and volume of runoff to be hazardous to a disposal system. This is evidenced by the existence of defined drainage channels. A relatively large depression in the eastern part of this area is not enclosed but, rather, is a portion of a major drainage system through Skull Valley. Thus, there would be a serious potential for contamination of down-gradient water quality.

Soils and reclamation. Because of its proximity to the Cedar Mountains, this area is exposed to lower wind velocities than the other two areas. There is consequently less potential for wind erosion. As on the other areas, the soils are highly alkaline; the soil texture is less than 18 percent clay. Of the three areas, soils on this area offer the greatest potential for development of winter sheep range through proper management. As elsewhere, rock and gravel would have to be imported for cover material. Because of the relatively favorable soils and availability of suitable plant materials for revegetation, this area would be the easiest to reclaim of the three evaluated.

Wildlife and plants. Because ecological conditions on this area are the most diverse of those evaluated, it is rated as being the most valuable as wild-life habitat. In addition, the presence of prairie dogs is not only academically of interest (since they were not known to occur in this vicinity) but represents potential habitat for endangered species. (However, no endangered or threatened species are known from this vicinity.) The area is used for recreational hunting more than are the other two. No wetlands are present.

Vegetation on the area varies from what is essentially a greasewood flat on the northwestern portion of the section to a sparse grassland to the east; the existing vegetation is similar to that on the South Clive site but is more diverse and includes less of the noxious weed Halogeton.

Meteorology and air quality. Assuming transportation emissions would be proportional to distance, this area is most favorable in being the closest to the Vitro site. However, the nearest residences are within 2 miles of the area and would potentially be impacted by fugitive emissions. In addition, the access road to the Cedar Mountains passes along and through this area; travelers on this would be impacted by fugitive emissions. Finally, the area is both south of and the closest to I-80 (less than 1 mile); because about 40 percent of the winds stronger than 12 mph blow from southerly directions, fugitive emissions would be carried across the highway.

Human resources. Because the existing railroad is on the opposite side (north) of I-80, transloading material from the railroad would require a crossing, increasing transportation costs. This would be partially offset by the fact that this area is about 25 miles closer to the Vitro site than the others. The overall cost advantage of the Delle area would be minimal. Because of its proximity to I-80 and to Delle, the use of this area would be more visible than at the other two areas.

Geotechnical engineering. From an engineering viewpoint, this area is similar to the South Clive site except for access problems imposed by the railroad being north of I-80; the latter problem is common to this area and the Prime Area.

Based upon the literature, the upper water table is deeper than at the First Alternate Area but the difference is not that significant relative to construction and operation of a disposal site. Construction problems would be minimal. Clay capping material could be obtained through excavation of trenches; a bottom liner would not be necessary. A gravel source is less than 1 mile from the area.

Reasons for elimination. The Second Alternate Area was ranked only slightly below the Prime Area, and, hence, third after the South Clive site, owing mainly to its value as wildlife habitat, its proximity to the highway and the settlement of Delle, and its unfavorable surface hydrology. As stated above, the Second Alternate Area shares the same kind of access problem with the Prime Area--the tailings would have to be transported from the rail head across I-80 to reach the disposal site. Thus, the DOE has concluded that an alternative involving the Second Alternative Area would be unreasonable for the same reasons that an alternative involving the Prime Area was determined to be unreasonable.

C.2 ALTERNATE DISPOSAL AREAS IN CARBON AND GRAND COUNTIES, UTAH

The State of Utah's site-selection team considered two disposal areas in Carbon and Grand Counties, respectively, but declined to evaluate them in detail (VTSSC, 1980). These areas were (1) an area 3 miles north of Woodside, Carbon County, Utah, and (2) an area 9 miles south of Crescent Junction, Grand County, Utah. The following is a brief discussion of these alternate disposal areas and the major environmental and economic factors that caused them to be rejected as reasonable alternate areas for the disposal of Vitro mill tailings and residues.

C.2.1 Stabilization north of Woodside

The Woodside site that was considered is located approximately 156 road miles southeast of Salt Lake City in Emery County, Utah, as shown on Figure C-1. Consideration was given to this area in response to a proposal submitted to the State of Utah that recommended the use of an existing fleet of trucks that were currently (1980) hauling coal from the Emery and Carbon County areas to the Kennecott copper mill near Salt Lake City. After the State of Utah had suggested this site, a preliminary analysis was made by DOE contractors of environmental and economic factors affecting its suitability. From this evaluation, it was concluded by the DOE that the Woodside site could not be considered a reasonable alternative disposal site.

General description of the area. The Woodside site, approximately 6.5 square miles in size, is located on a level, sparsely vegetated pediment near the base of the Book Cliffs. The site area itself appears to be suitable for the deposition of the Vitro tailings according to preliminary evaluations in which the geologic, hydrologic, and environmental setting of the site were considered (FBDU, 1981). The site is isolated from major population centers and is easily accessible by highway. It is public domain administered by the U.S. Bureau of Land Management. The stabilization alternatives proposed in the conceptual plan and engineering evaluation for the South Clive site (see Section 3.2.4 and Appendix A) would be suitable for the Woodside site.

Reasons for rejection. Although the Woodside site appears to be physically suitable for the stabilization of tailings, the primary concern associated with using this site involves the transportation of materials. One transportation proposal presented to the State consisted of using coal hauling trucks to transport the Vitro tailings to the Woodside site (VTSSC, 1980). The trucks currently haul coal from mines in Carbon and Emery Counties to the Kennecott mill near Salt Lake City. It was recommended in the proposal that, once unloaded, the trucks would be diverted to the Vitro site and loaded with tailings for their return trip. After discussions with local trucking contractors, a preliminary cost estimate was prepared. The estimate was prepared assuming a 9-year transporting period (250 working days per year) requiring an average of 39 truckloads per day. The estimated cost of transportation for this period was $14.09 per ton which included the cost of fitting trucks with the required seals and covers. This cost is well in excess of the $8.50 per ton ($0.10 per ton mile) estimated for truck transportation to the South Clive site and, thus, from the economic standpoint alone does not represent a reasonable alternative. Furthermore, the

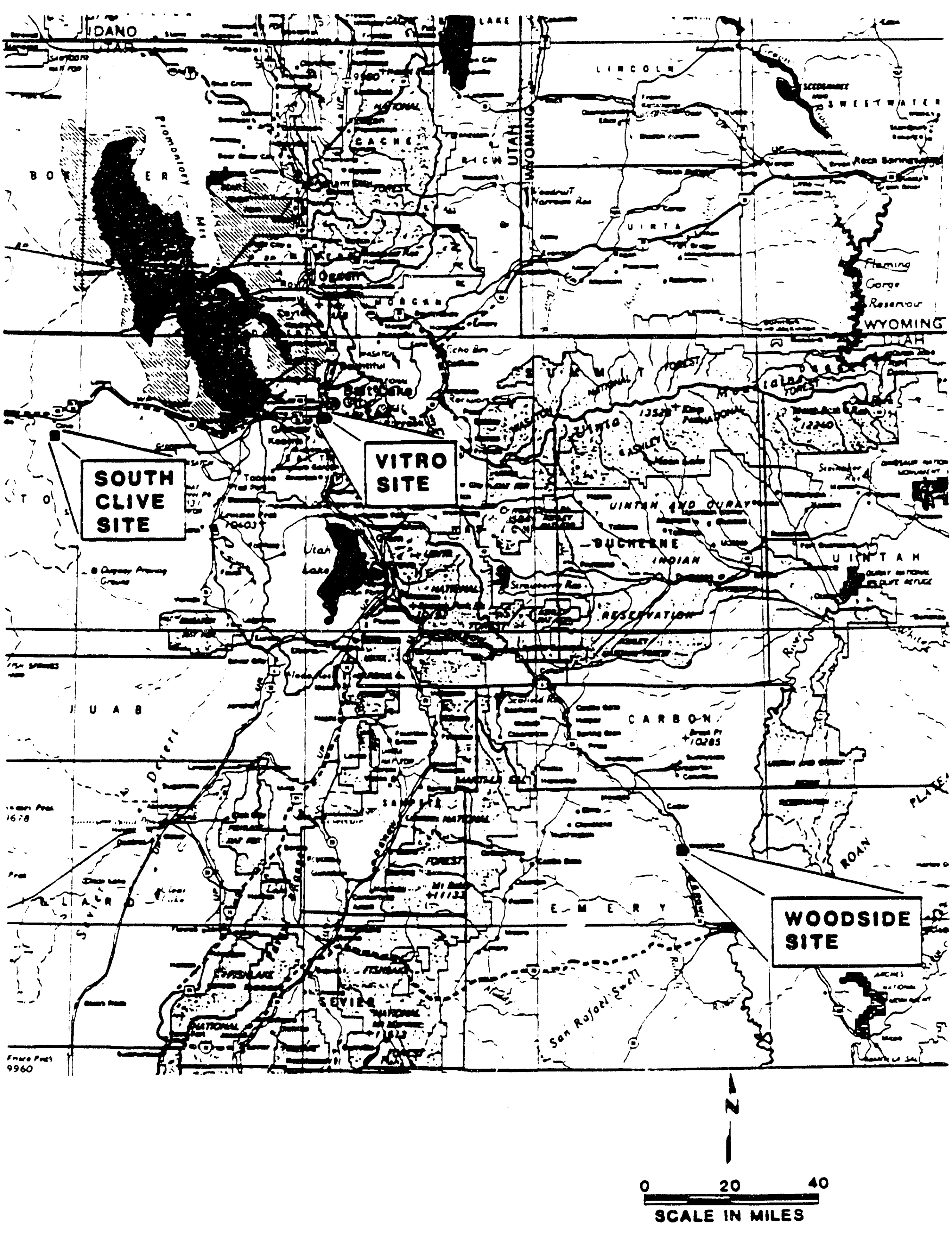

FIGURE C-1
VICINITY MAP, WOODSIDE AREA

9-year transporting period would exceed the 7 years (after publication of final EPA standards) allowed for remedial actions by PL95-604, Title I.

An additional concern that decreases the practicality of this alternative is the increased transport distance and the consequent increased potential for the occurrence of a traffic accident involving a truck filled with contaminated tailings. The transport distance estimated for the Woodside site is approximately 156 miles compared to a distance of about 85 miles for the South Clive site. Further, as shown on Figure C-1, the shortest route between the Vitro site and Woodside is via Highway 6, which crosses the Wasatch Mountain Range at Soldier Pass. During the winter months this pass is periodically snow packed and slippery, thus significantly increasing general trucking hazards.

C.2.2 Stabilization south of Crescent Junction

The Crescent Junction area is 9 miles south of Crescent Junction, Grand County, Utah. It is about 11 square miles of pediment near the base of the Booker Cliffs, and is similar to the Woodside area except that it lies approximately 215 road miles from Salt Lake City. Though the State ranked the Crescent Junction area higher than the Woodside area in terms of technical suitability for uranium mill tailings disposal, the State also disqualified the area. Apparently, use of the area for uranium mill tailings disposal would conflict with a proposed land exchange between the Division of State Lands and the Bureau of Land Management (VTSSC, 1980).

The DOE did not perform cost estimates for transportation to the Crescent Junction area, but since the area is some 60 miles farther from Salt Lake City than the Woodside area the reasons for rejecting the Woodside area would also apply with increased force to the rejection of the Crescent Junction area. Therefore, transport of the tailings and other contaminated material to the Crescent Junction area would not be a reasonable alternative.

C.3 ALTERNATIVE DISPOSAL AREAS IN THE SALT LAKE VALLEY

The State of Utah did not recommend any areas within the Salt Lake Valley for alternative disposal sites for the Vitro mill tailings and other residues. The possibility that suitable areas exist in the Salt Lake Valley or on its periphery was briefly studied in September 1981 by the DOE's contractor, Sandia National Laboratories, and based on results of that study, the DOE concluded that (1) there are presently no suitable locations for disposal of the Vitro tailings within the Salt Lake Valley more isolated than the Vitro site itself, and (2) there may be technically suitable disposal areas west of the Salt Lake Valley other than the three state-nominated areas, but use of such areas would offer little or no environmental or economic benefit beyond the benefits to be realized in the use of one of the state-nominated areas. This section briefly documents the bases for these two conclusions.

C.3.1 Lack of isolated areas within the Salt Lake Valley

The Salt Lake Valley is assumed to be that region bounded on the east by the foothills of the Wasatch Mountains, on the north by the Great Salt Lake, on the west by the Great Salt Lake and the foothills of the Oquirrh Mountains, and on the south by the foothills of the Traverse Mountains. The Vitro site is located in the northwest quadrant of this valley, and straight-line distances from it to other points in the valley vary up to about 17 miles; road mileage between any two points is usually larger than the straight-line mileage. Railroads connecting to the Vitro site are limited to a narrow north-to-south corridor that roughly bisects the region and lies on the western side of its most urbanized parts. An east-to-west railroad corridor joins the north-to-south corridor at a point just north of metropolitan Salt Lake City and runs westward along the southern margin of the Great Salt Lake. No railroads cross the Wasatch mountains east of the Salt Lake Valley; I-80 is the main route crossing the Wasatch range east of the city.

The lands east of the north-south railroad corridor are, in general, heavily populated and privately owned; no areas there could be construed as being isolated or would be acceptable to the Salt Lake Valley residents as a site for the disposal of uranium mill tailings. The lands west of the north-south railroad corridor are less densely populated, although most of these are in various stages of development. The immediate vicinity of the Vitro site is fairly typical of the type and degree of development of this western half of the region: land is used for businesses (retail, manufacturing, light industry) and residences or, in the extreme west of the region, for agriculture and mining (gravel pits, copper mine facilities). It is thus possible that locations as isolated and as technically suitable for tailings disposal as the Vitro site could be found in this western half of the valley. From the standpoint of the major physical factors that determine disposal site suitability (topography, geology, hydrology, and climate) all locations in the western half would be roughly equivalent.

The equivalence of the physical factors that determine site suitability, however, suggests that there would be no environmental benefit in moving the tailings from their present location to a new one in the western half of the valley unless the new location afforded unique opportunities for stabilization of the tailings at reasonable costs and with minimum interference with planned land use. A few such locations have been considered in the past in connection with public construction projects such as interstate highway exchanges or airport runway extensions; but as of September 1981 these projects were no longer available and further projects of this kind are not foreseen to occur within the time span allowed for completion of remedial actions under the UMTRCA. For these reasons, the DOE determined that an alternative involving disposal at a location in the Salt Lake Valley other than the Vitro site would be unreasonable.

C.3.2 Lack of technically suitable areas in the mountains

Suitably isolated sites for disposal of the Vitro tailings might be found in the Wasatch Mountains bordering the Salt Lake Valley on the east or in the Oquirrh Mountains to the west. However, these mountains are of high relief, and there are few roads leading into them that could support a safe and efficient transport of the large amounts of material that would be moved during remedial action at the Vitro site. Railroad access to locations within the Wasatch Range is possible only by a long and roundabout route through Provo, Utah. Rail access to the Oquirrhs is apparently limited to routes owned by the Kennecott Corporation.

It would be difficult and expensive to construct an engineered waste containment in these mountains that would meet the EPA disposal standards. The large relief combined with relatively high precipitation make erosion a problem; there is also the risk of long-term contamination of useful ground waters, since both mountain ranges are recharge areas for the deeper ground waters of the Salt Lake Valley. Thus, the cost of placing the Vitro tailings in these mountains would probably be excessive because of the additional engineering required to build a waste depository under these adverse conditions. In short, the DOE sees neither environmental nor economic advantages in placing an alternative disposal site within the Wasatch or Oquirrh Mountains, and has determined that such alternatives are not reasonable.

C.4 ALTERNATIVES INVOLVING REPROCESSING OF THE VITRO MILL TAILINGS

In alternatives of this kind, the higher-grade tailings at the Vitro site would first be reprocessed to recover residual minerals of economic value; then the residues (still retaining most of the original radioactive elements) would be placed in an engineered structure for long-term disposal. In principle, at least two basic alternatives are practicable: (A) on-site reprocessing of the Vitro tailings followed by on-site stabilization of the residues; (B) transfer of the wastes to a new site and decontamination of the Vitro site, followed by the reprocessing of the wastes and stabilization of the residues at the new site.

These alternatives involving reprocessing cannot be entirely rejected until all procedures for determining the practicability of reprocessing have been completed. By law (PL95-604, Title I, Section 108(b)), the DOE must solicit expressions of interest regarding the remilling of residual radioactive materials at designated inactive processing sites and, upon receipt of any expressions of interest, must determine whether the proposals are practicable. The determination of practicability includes an assay of the tailings to determine their residual mineral contents. The DOE has complied with these requirements by publishing a request for expressions of interest in the Federal Register, "Commerce and Business Daily," and in local newspapers. Several expressions of general interest were received; and an assay program was begun in 1981. The Vitro tailings pile was sampled for assay in May 1981. The results of the assay program are available in DOE (1982).

<u>Summary of investigations at Vitro site, Salt Lake City, Utah</u>

Project Description:

The primary objectives of these investigations were to:

- Determine the total quantity of uranium bearing material at the site.
- Determine the total quantity of uranium, vanadium, and molybdenum present in the material at the site.
- Determine the extractability of uranium, vanadium, and molybdenum by leaching methods.
- Evaluate the economics of reprocessing the tailings for recovery of any or all of these three metals.
- Obtain data on the concentration of various trace metals normally associated with uranium mill tailings, including Ra-226.

In order to accomplish these objectives it was necessary to drill and sample the entire tailings deposit at the site. A sufficient number of samples was required to assure a statistical accuracy of 90 percent with a minimum 12 percent confidence interval. A total of 104 holes (samples) were taken at the site. Samples of each 2.5-foot interval were taken to provide moisture determinations throughout the pile. Where possible, each hole was drilled a minimum of 5 feet into the subbase material to investigate the amount of uranium migration into the substrate.

All samples were transported to the Tucson laboratories of Mountain States Research and Development (MSRD) where they were dried, analyzed, and prepared into composite charges for leach testing. Approximately 10 percent of the samples were taken with Shelby tube samplers so that bulk density determinations could be made on the tailings.

Using survey data for the drill holes, hole depths, moisture data, bulk density data, and chemical analyses, the volume, tonnage, and metal content of the tailings and subbase material were calculated.

Laboratory leach testing was conducted on composite test charges to determine optimum conditions and methods for leaching of the uranium, vanadium, and molybdenum. These data were then used to develop process flowsheets and major equipment lists, from which the capital cost could be estimated for a treatment plant.

Based upon total recoverable value of the three metals, the capital cost of the plant, and the estimated cost of operating the plant, a final evaluation as to the profitability of reprocessing the tails was made.

Site Description:

The Vitro site is located in the Salt Lake City Metropolitan area and is bordered on the south by 33rd South Street and on the west by 9th West. The immediate vicinity is zoned for light industry.

The tailings were deposited in five separate and distinct areas covering approximately 75 acres. Section A, located in the northwest portion of the area is surrounded by berms and during recent years has been used for discard and storage of sewage plant effluent. A major part of the section is extremely soft and has a high water content.

Section E is located on the eastern portion of the site and is low-lying with no distinct boundaries. This section had some of the highest grade material found, probably due to its proximity to the mill and discharges of higher grade material during emergency situations as well as use for ore storage.

The other three sections are easily distinguishable and, with the exception of the heavy rubble cover on Section C, present no particular handling problem.

The tailings are typical of beneficiated ore, being sandy in nature and relatively fine. Screen analyses indicate they are 100 percent minus 10 mesh and over 50 percent minus 200-mesh.

A drilling and sampling program was conducted at the site to provide the physical and analytical data required to determine the total quantity of tailings and uranium-bearing subbase material at the site and the total content of uranium, vanadium, and molybdenum. From these data the following statistics were developed:

Tailings, wet tons	2,755,711
Water, %	20.21
Tailings, dry tons	2,198,668
U_3O_8, %	.0150
pounds	659,452
V_2O_5, %	.0955
pounds	4,198,565
Mo, %	.0173
pounds	62,458
Subbase, wet tons	739,047
Water, %	3.39
Subbase, dry tons	566,157
U_3O_8, %	.0116
pounds	131,440
Total material, wet tons	3,494,758
Water, %	20.89
Total material, dry tons	2,764,825
U_3O_8, %	.0143
pounds	790,892

Amenability Testing:

Laboratory testing was conducted at MSRD's laboratories on composited samples from the site. Testing was conducted on samples representing each section and for the entire site. Testing procedures included:

- Agitation leach with sulfuric acid.
- Agitation leach with carbonate solution.
- Extended acid agitation leach.
- Column leach with acid.

The tailings were generally unresponsive to alkaline leaching with low extractions of uranium and vanadium.

Agitation leaching with acid indicated uranium extractions in the 55 percent range could be expected. Hence, column leach testing was conducted with acid only. The best overall results were obtained with the column acid leach process, which is indicative of what can be attained in the heap leach process. Analysis of the test results indicated that extraction for uranium, vanadium, and molybdenum, respectively, of 75 percent, 30 percent, and 55 percent could be expected in a heap leach operation on this material.

Accordingly, flowsheets were developed for a process plant to treat the pregnant leach solutions from heap leaching to recover uranium, vanadium, and molybdenum as marketable products.

Economic Evaluation:

Although a total of 2,764,825 dry short tons (DST) of uranium-bearing material was identified at the site, only 1,192,940 DST were considered to be acceptable feed for processing by reason of its grade and/or response to treatment. The material considered not acceptable is located such that it could be either left in place or bypass the plant during mining operations.

The process plant was sized to treat the 1,992,940 DST of tailings plus subbase material at a rate of 750,000 dry short tons per year with a project life of apporoximately 2.7 years. During this period the production would be as tabulated below:

Product	Total lbs	Unit Price	Total
U_3O_8	567,968	$23.00	$13,063,264
V_2O_5	1,168,831	3.00	3,506,493
Mo	390,161	8.50	3,316,369
TOTAL VALUE			$19,886,126

Evidently, reprocessing of the Vitro site tailings is not economic at present-day prices (unit prices given above) as shown by the following estimates:

Plant Capital Cost	$16,060,000
Operating Cost	27,419,000
Total Project Cost	$43,479,000
Less Salvage Value	782,000
Total Direct Cost	$42,697,000
Marketable Production	$19,886,126
Profit or (Loss)	($22,810,900)

The $23 million loss would be added to the costs of stabilizing the residue that remain after reprocessing is completed. Therefore, reprocessing does not represent a reasonable alternative at this time.

REFERENCES FOR APPENDIX C

DOE (U.S. Department of Energy), 1982. Economic Evaluation of Inactive Uranium Mill Tailings, Vitro Site, Salt Lake City, Utah. UMTRA-DOE/ALO-171.

FBDU (Ford, Bacon and Davis Utah Inc.), 1981. Engineering Assessment of Inactive Uranium Mill Tailings, Vitro Site, Salt Lake City, Utah, DOE/UMT-0102, prepared for U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico.

VTSSC (Vitro Tailings Site Selection Committee), 1980. "Vitro Tailings Site Selection Committee Report," dated June 20; signed by Blaine N. Howard (Chairman), Earl Peirce, Fitzhugh Davis, Dan Blake, Robert Cunliffe, and Dane Finerfrock; copies available on request to Uranium Mill Tailings Remedial Action Project Office, DOE Albuquerque Operations Office, Albuquerque, New Mexico 87185.

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