FEASIBILITY STUDY FOR SOILS AND BUILDINGS AT THE FUSRAP MAYWOOD SUPERFUND SITE

MAYWOOD, NEW JERSEY

August 2002

US Army Corps
of Engineers®
New York District

Formerly Utilized Sites Remedial Action Program

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August 2002

prepared by
U.S. Army Corps of Engineers, New York District Office, Formerly Utilized Sites Remedial Action Program

with technical assistance from
Stone & Webster, Inc.
Under Contract No. DACW41-99-D-9001

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
AQUIRE	Aquatic Information Retrieval
ARAR	applicable or relevant and appropriate requirement
ART	Alternative Remedial Technologies, Inc.
ATSDR	Agency for Toxic Substances and Disease Registry
BNA	base neutral/acid extractable
BNI	Bechtel National, Incorporated
BRA	Baseline Risk Assessment
CAA	Clean Air Act
CCM	Concerned Citizens of Maywood
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGG	Cooperative Guidance Group
COC	constituent of concern
COPEC	chemicals of potential ecological concern
Cr	chromium
CWA	Clean Water Act
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
dpm	disintegrations per minute
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
EQ	ecological quotient
ERA	ecological risk assessment
ºF	degrees Fahrenheit
FACA	Federal Advisory Committee Act
FFA	Federal Facilities Agreement
FS	Feasibility Study
ft	foot
ft/sec	feet per second
ft/yr	feet per year
FUSRAP	Formerly Utilized Sites Remedial Action Program
g	gram
GAO	Government Accounting Office
gpm	gallons per minute
GRA	general response action
HI	hazard index
HQ	hazard quotient
hr	hour(s)
ICIP	Institutional Controls Implementation Plan
in.	inch(es)
L	liter(s)
Li	lithium
M	million(s)

m	meter(s)
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MCW	Maywood Chemical Works
MED	Manhattan Engineer District
Mg/kg	milligram per kilogram
mi.	mile(s)
MISS	Maywood Interim Storage Site
mL	milliliter
$\mu g/m^3$	micrograms/cubic meter
mrem/yr	millirem per year
NaI	sodium iodide
NCP	National Contingency Plan
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
O&M	operations and maintenance
ORNL	Oak Ridge National Laboratory
OSWER	EPA's office of Solid Waste and Emergency Response
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi	picoCurie
pCi/g	picoCurie per gram
pCi/L	picoCurie per liter
PP	Proposed Plan
PRG	Preliminary Remediation Goal
QA/QC	quality assurance/quality control
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RESRAD	RESidual RADiation computer modeling system
RfD	reference dose
RI	Remedial Investigation
RME	reasonable maximum exposure
Rn	radon
ROD	Record of Decision
s	second
SARA	Superfund Amendments and Reauthorization Act
SGS	Segmented Gate System
SVOC	semivolatile organic compound

ABBREVIATIONS, ACRONYMS, AND SYMBOLS (continued)

TBC	to-be-considered
TCLP	toxicity characteristic leaching procedure
UMTRCA	Uranium Mill Tailings Radiation Control Act
UMTRAP	Uranium Mill Tailings Remedial Action Program
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USACE	United States Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VOCs	volatile organic compounds
WL	working limit
XQ	exposure quotient
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)
%	percent

ES. EXECUTIVE SUMMARY

This Feasibility Study (FS) was prepared to address the commercial and government properties (including the Maywood Interim Storage Site [MISS] and the Stepan Company) portion of the Soils/Buildings Operable Unit (OU) consisting of contaminated soil, contaminated buried debris, and contaminated building materials that meet the definition of Formerly Utilized Sites Remedial Action Program (FUSRAP) waste at the Maywood Chemical Company site. The Maywood Chemical Company site in Bergen County, New Jersey, is being addressed under three separate Remedial Investigation (RI)/FS processes, all coordinated by the U.S. Environmental Protection Agency (EPA). The U.S. Army Corps of Engineers (USACE) is responsible for two of the RI/FSs. One RI/FS addresses soil/building contamination and the second addresses potential groundwater contamination. The Stepan Company is responsible for the third RI/FS that addresses chemical contamination.

The USACE was delegated authority for the cleanup of FUSRAP waste associated with thorium processing activities at Maywood Chemical Works (MCW) by the Energy and Water Development Appropriations Act of 1998, and subsequent reauthorizations of that act; other chemical contamination is being addressed under a separate investigation by the Stepan Company. FUSRAP waste is defined by the Federal Facility Agreement (FFA) signed by EPA and the U.S. Department of Energy (DOE) to address each party's responsibilities at the FUSRAP Maywood Superfund Site. DOE was USACE's predecessor as lead agency on the FUSRAP Maywood Superfund Site. The FUSRAP portion of the Maywood Chemical Superfund Site will be referred to as the "FUSRAP Maywood Superfund Site" for the remainder of this document.

This document has been prepared by the USACE to address FUSRAP waste only; this document does not address other chemical contamination present at the Maywood Chemical Company site that does not meet the definition of FUSRAP waste. The FUSRAP Maywood Superfund Site, as defined by this FS, is comprised of properties in the Boroughs of Maywood and Lodi and the Township of Rochelle Park, New Jersey that were contaminated by thorium processing at the MCW from the early 1900s through 1959. The three municipalities adjoin each other and are located in a densely populated area of Bergen County in northeastern New Jersey.

Soils located on the FUSRAP Maywood Superfund Site contain thorium and radium, and to a lesser degree uranium, above the site-specific cleanup levels established for the FUSRAP Maywood Superfund Site. Deposition of radionuclides was either by soil and sediment transport along the former Lodi Brook and Westerly Brook channels, by emplacement of fill containing radionuclides, or by past waste disposal practices. Properties with FUSRAP waste include 88 designated commercial, government, and residential tracts. Sixty-four of these properties have previously been remediated by removal actions as authorized under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This FS addresses soil and building contamination meeting the definition of FUSRAP waste at the remaining 24 properties (including the MISS and the Stepan Company) of the FUSRAP Maywood Superfund Site. The MISS, previously used for interim storage of excavated soils and demolition debris from early vicinity property removal actions, is located on a portion of the original MCW facility and is now owned by the Federal government. The MISS will be used to stage soils removed from vicinity properties and for railcar loading prior to offsite shipment. The 87 properties are referred to as Vicinity Properties of the government-owned MISS in many of the documents that have been prepared for the FUSRAP Maywood Superfund Site.

Remedial action will be taken under the USACE's FUSRAP. FUSRAP was established by the DOE to identify and remediate sites where residual radioactivity remains from the early years of the nation's atomic energy program, or from similar commercial operations that resulted in radiological contamination that Congress authorized DOE to remedy. Although originally a commercial operation, the FUSRAP Maywood Superfund Site was assigned to DOE by Congress in the 1984 Energy and Water Development Appropriations Act, as a decontamination and decommissioning research project. Internally, DOE assigned the FUSRAP Maywood Superfund Site to its FUSRAP. Responsibility for executing and administering FUSRAP was transferred to the USACE by the 1998 Energy and Water Development Appropriations Act.

The Maywood Chemical Company Site is listed by the EPA on the National Priorities List (NPL). USACE is executing cleanup at the FUSRAP Maywood Superfund Site in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), and as regulated under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at 40 CFR Part 300. Activities at the FUSRAP Maywood Superfund Site are coordinated between EPA Region 2 and USACE by a site-specific FFA that was developed by DOE and EPA to outline responsibilities for the lead agency (now USACE) and the supporting regulatory agency (EPA).

Under the terms of the FFA, FUSRAP waste is defined as:

- All contamination, both radiological and chemical, whether commingled or not, on the MISS;
- All radiological contamination above cleanup levels related to past thorium processing from the MCW occurring on any of the Vicinity Properties; and
- Any chemical or non-radiological contamination on Vicinity Properties that would satisfy either of the following requirements:
    1. The chemical or non-radiological contaminants which are mixed or commingled with radiological contamination above cleanup levels; or,
    2. The chemical or non-radiological contaminants which originated at the MISS or were associated with the specific thorium manufacturing or processing activities at the MCW which resulted in the radiological contamination.

The Maywood Chemical Company Site is being addressed through three separate RI/FSs. The RI/FS process evaluates the conditions at a site and evaluates possible cleanup alternatives. The DOE and the USACE have prepared an RI/FS that primarily addresses the radioactive constituents at the FUSRAP Maywood Superfund Site. The Stepan Company, which is situated on a portion of the former MCW property, performed an RI/FS focusing on chemicals under both an EPA administrative order on consent and an EPA administrative order. The Maywood Chemical Company Site consists of both the FUSRAP Maywood Superfund Site and the Stepan Company chemical contamination responsibilities. Although the USACE and Stepan RI/FS activities are being conducted independently, EPA oversight of both actions will ensure that sufficient coordination occurs between the USACE and the Stepan Company to fully address the Maywood Chemical Company Site.

The goal of remedial action at the FUSRAP Maywood Superfund Site is to minimize or eliminate the potential for human exposure to FUSRAP waste at the Soils/Buildings OU properties (MISS, Stepan, and 22 commercial/government vicinity properties), and to meet the requirements of CERCLA. The purpose of this study is to provide the information necessary to select the most appropriate method(s) to remediate the FUSRAP waste at the Soils/Buildings OU properties at the FUSRAP Maywood Superfund Site.

As part of the RI/FS process, the USACE will propose a preferred remedy in a Proposed Plan (PP), and after regulatory agency and public review, will conclude the evaluation with the issuance of a Record of Decision (ROD). The ROD will document the remedy selected for the commercial and government properties portion of the Soils/Buildings OU for the FUSRAP Maywood Superfund Site. The primary evaluation documents prepared by DOE and the USACE to summarize the findings of the integrated RI/FS process are the RI, Baseline Risk Assessment (BRA), FS, and PP. The RI report summarizes the nature, extent and potential for migration of the radioactive and associated chemical contaminants. The BRA evaluates potential health and ecological risks posed by the presence of radioactive and chemical contaminants. The FS evaluation is based on historical data and the results of the RI report. The FS evaluates and compares the alternatives for cleanup of the FUSRAP Maywood Superfund Site. The PP highlights information from the FS and identifies the lead agency's preferred remedy proposed for the site. The PP is released for public and regulatory comment. At the completion of the public comment period, the lead agency (USACE) and the supporting regulatory agency (EPA) will consider all comments received and select the remedial action alternative to be implemented at the site in a ROD.

It should be noted that many interim cleanup activities for portions of the FUSRAP Maywood Superfund Site (residential properties, municipal properties, and the interim storage pile) have already been completed. Of the 88 designated properties comprising the FUSRAP Maywood Superfund Site, 64 have been addressed through previously approved cleanup documentation (Phase I Cleanup). This FS focuses only on a portion of the Soils/Buildings OU for the FUSRAP soil and building contamination at the remaining 24 properties at the FUSRAP Maywood Superfund Site (Phase II Cleanup), consisting of MISS, Stepan (including the three Nuclear Regulatory Commission [NRC] licensed burial pits), and 22 commercial/government properties.

Groundwater is not directly addressed in this FS. Groundwater will be addressed following completion of the USACE's groundwater investigation. The outcome of the groundwater investigation and the need for remedial action will be addressed in separate decision documents. The groundwater contamination has been separated from the soil and building contamination as a groundwater OU and will be addressed on a separate timetable. The USACE's responsibility with respect to any remediation of groundwater will be consistent with the FFA.

Extent of Radiological and Chemical Contamination

The overall results of site investigations and removal actions taken to date regarding the nature and extent of contamination reveal the following:

- Eighty-eight properties in the Boroughs of Maywood and Lodi and in the Township of Rochelle Park were identified and designated as contaminated by thorium processing from operations of the MCW. Sixty-four of these properties (Phase I) have been remediated by earlier CERCLA removal actions. During these cleanup actions, additional properties were remediated if the contamination extended onto an adjacent undesignated property.

- Of the 64 Phase I properties, twenty-four residential properties, and a portion of one commercial property (96 Park Way), were addressed by the DOE during a removal action taken in 1985; the materials removed from these Vicinity Properties were transported to the MISS and formed the interim storage pile at the MISS. The storage pile was removed for permanent offsite disposal during 1995 and 1996.

- All of the remaining Phase I residential properties, the rest of the Phase I commercial property in Rochelle Park (96 Park Way), and four Phase I municipal properties in Lodi, have been addressed by a CERCLA removal action that was initiated in 1995 by the DOE and completed in 2000 by the USACE (DOE 1995).

- Twenty-four commercial and government-owned vicinity properties (Phase II) in Maywood and Lodi, including the MISS and Stepan properties, are addressed under this FS.

- The primary radioactive constituents of concern (COCs) at the FUSRAP Maywood Superfund Site are thorium-232, radium-226, uranium-238, and their decay products. The media of concern for this FS are source media (soil and bulk waste) and buildings/structures. Sediments in wetland areas and the brook channels are combined with the soil source media.

- Unacceptable risks from exposure to radionuclides are estimated to currently exist at the FUSRAP Maywood Superfund Site. The risks associated with exposure to the levels of radioactivity at the FUSRAP Maywood Superfund Site are greater than the risks associated with chemical exposures by one to two orders of magnitude. No unacceptable risks to human health from FUSRAP chemical waste constituents in soil were projected by DOE's risk assessment.

- The DOE's chemical investigation of onsite soils at MISS did not reveal the presence of hazardous waste, as defined by the Resource Conservation and Recovery Act (RCRA). Additional characterization by USACE has also not revealed any chemical contamination that would indicate the presence of RCRA characteristic waste. Soils were analyzed by the Toxicity Characteristic Leaching Procedure (TCLP) for the characteristics of hazardous waste specified in 40 CFR 261.20. The thorium extraction process is not a listed process under 40 CFR 261.32, nor are there records of any other listed processes occurring on the MISS. There are also no records of listed chemicals being spilled or discarded at the MISS. Pesticide and polychlorinated biphenyl (PCB) concentrations were below detection limits. The USACE recognizes that the presence of characteristic RCRA wastes at the FUSRAP Maywood Superfund Site is a possibility based on the history of operations in the area (chemical manufacturing and other commercial activities); design activities and disposal facility waste characterization during remedial action will take this possibility into account.

- The USACE's responsibility for the cleanup of chemical contamination at the FUSRAP Maywood Superfund Site is limited by the definition of FUSRAP waste. Based on this definition, and the results of the site investigation, USACE responsibility for the cleanup of chemical contamination at the FUSRAP Maywood Superfund Site is limited to chemicals that are located on, or originated from, the MISS or that are commingled with radioactive materials. Based on analysis of the site investigation results, no additional chemicals of concern present in soils at the FUSRAP Maywood Superfund Site were determined to be the result of thorium processing operations or to have originated on the MISS.

Maywood-Specific Cleanup Criteria for Commercial/Government Properties

For the FUSRAP Maywood Superfund Site, the EPA and the DOE (See the EPA-DOE Dispute Resolution in Appendix C) established site-specific criteria for acceptable levels of radium-226 and radium-228 in soils dependent on land use. USACE has determined that attainment of these cleanup levels will assure compliance with the relevant and substantive requirements of the State of New Jersey radiation dose standards for the remediation of radioactive contaminated properties. For the FUSRAP Maywood Superfund Site contamination, the presence of thorium-232 is estimated by the measurement of radium-228 (see Section 3.2.1.1 for additional explanation). For the Phase I residential properties, the cleanup criterion for soil, regardless of depth, was established at an average of 5 picoCuries per gram (pCi/g) radium-226 and thorium-232 combined, above background. For the commercial/government properties, the cleanup criterion for soil, regardless of depth, was established at an average concentration of 15 pCi/g of radium-226 plus thorium-232 combined, above background.

The cleanup numbers established above were developed by the EPA and agreed to by the DOE (predecessor to USACE in the implementation of FUSRAP). These criteria were determined by EPA to be protective of human health and not result in excess risk above the NCP protective range of cancer risks. Following the remedial action, exposure to humans would be less than 15 millirem per year (mrem/yr) above background and would satisfy the radiation dose standards as a substantive requirement of the New Jersey Administrative Code (NJAC) 7:28-12.8. In addition, the cleanup criterion would assure that radon-222 (Rn-222) would not exceed 3.0 picoCuries per liter (pCi/L) above background of indoor radon gas, also a substantive requirement of the New Jersey regulation. The radiation dose standard established by the State of New Jersey Remediation Standards for Radioactive Materials is considered the applicable or relevant and appropriate requirement (ARAR) for soils at the FUSRAP Maywood Superfund Site.

For uranium, a site-specific cleanup level for release of properties without radiological restrictions was also developed for the FUSRAP Maywood Superfund Site (See Appendix C). The cleanup level for uranium-238 is an average of 50 pCi/g above background (which is essentially 100 pCi/g total uranium above background).

On the Stepan Company property, buildings would be decontaminated, demolished, or partially demolished to meet the substantive requirements of NJAC 7:28-12.8. If necessary, buildings overlying contamination will be demolished or partially demolished to access underlying soils. Contaminated buildings will either be decontaminated or demolished, as necessary, to meet ARARs and to prevent future releases into the environment. The NRC-licensed burial pits on Stepan would be decommissioned (excavation with off-site disposal) to meet the requirements of 10 CFR 20.1402 and the substantive requirements (dose of 15 mrem/yr above background and 3.0 pCi/L Rn-222 above background in indoor air) of NJAC, Section 7:28-12.8(a).

Surveys consistent with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) would be used in the implementation and assessment of this remedial action. Table ES-1 summarizes the in situ volumes of soil for each property at the FUSRAP Maywood Superfund Site, as estimated for the proposed cleanup criteria.

Reasonably Foreseeable Future Land Use and Selection of Cleanup Criteria by Property

The USACE has performed an evaluation of the reasonably foreseeable future land use of the properties being addressed, and determined that the most reasonably foreseeable land use is continued commercial or light industrial. However, due to the proximity of residential neighborhoods to some of the properties, the potential for future residential land use of some of these properties cannot be dismissed. For the restricted use[1] cleanup criterion, restricting land use with the use of institutional controls is a discretionary measure USACE is adding as a component of the remedial alternatives to assure long-term effectiveness of the remedy. Therefore, measures will be incorporated to either prevent an unanticipated change in land use that could result in unacceptable exposures to residual contamination or to monitor for any changes in use and alert the government when land use has changed.

Controls recommended by EPA were incorporated into the terms of the EPA/DOE site-specific agreement on cleanup criteria with the requirement of government notification of changing land use by communities notifications and 5-year reviews for properties cleaned to the restricted use criterion. In order to prevent unacceptable future uses of properties cleaned to the restricted use criterion, USACE is electing to expand on the use of institutional controls for properties which are not cleaned up to the unrestricted cleanup criteria of 5 pCi/g combined radium-226 and thorium-232 average concentration and 50 pCi/g for uranium-238, above background.

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[1] This FS uses the terms "restricted" and "unrestricted use" differently than the NRC, whose requirements are also discussed in this FS. NRC regulations require provisions for legally enforceable institutional controls that provide reasonable assurance that the total effective dose equivalent from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 millirem (mrem) per year.

Table ES-1. Maywood Contaminated Soil Volume Estimates

Property	In Situ Soil Volume to Restricted Use Criteria[1] (yd^3)		In Situ Soil Volume to Unrestricted Use Criteria [2] (yd^3)		Comments
	Accessible	Inaccessible	Accessible	Inaccessible	
Lodi Properties					
8 Mill St.	N/A	N/A	2,357	0	
I-80 (west right-of-way and underneath roadway)	107	3,000	N/A	N/A	Volume of inaccessible soils under I-80 was identified in a March 29, 1996 letter from Susan Cange, DOE FUSRAP Maywood Superfund Site Manager, to Angela Carpenter, EPA RPM.
160 &174 Essex St.	N/A	N/A	1,845	254	See note 5
170 Gregg St.	N/A	N/A	14	0	
80 Industrial Rd.	N/A	N/A	690	916	See note 5
80 Hancock St.	N/A	N/A	868	3,440	See note 5
100 Hancock St.	N/A	N/A	954	866	See note 5
72 Sidney St. (a.k.a. 88 Money St.)	N/A	N/A	58	0	
Maywood Properties					
NJ State Rt. 17	0	20,000	N/A	N/A	See note 5
23 Howcroft Rd.	N/A	N/A	4552	338	See note 5
149–151 Maywood Ave.	74,741	20,485	N/A	N/A	See note 5
205 Maywood Ave., 50 and 61 West Hunter Ave.	N/A	N/A	59	0	
137 NJ State Rt. 17	N/A	N/A	965	0	
Lodi Industrial RR	1,317	185	N/A	N/A	
167 NJ State Rt. 17	N/A	N/A	8,001	400	See note 5
200 NJ State Rt. 17	N/A	N/A	375	0	
239 NJ State Rt. 17	N/A	N/A	3,393	156	See note 5
85, 87, 99–101 NJ State Rt. 17	N/A	N/A	2,066	0	
99 Essex St.	N/A	N/A	423	0	
111 Essex St.	N/A	N/A	3,617	0	
113 Essex St.	N/A	N/A	514	0	
New York, Susquehanna & Western Railway	2,900	3,100	N/A	N/A	Contaminated soil directly under railroad tracks considered inaccessible.
Stepan 100 West Hunter Ave. [3]	44,125	974	N/A	N/A	
MISS Maywood Interim Storage Site (100 West Hunter Ave.)	73,233	0	N/A	N/A	
Subtotal [4]	196,423	47,744	30,751	6,370	
Subtotal [4]	244,167		37,121		
Total [4]	281,288				

1) Restricted Use Criteria: 15 pCi/g of radium-226 and thorium-232 combined average concentration.
2) Unrestricted Use Criteria: 5 pCi/g of radium-226 and thorium-232 combined average concentration.
3) Stepan soil volume includes contaminated material in NRC-licensed Burial Pits 1, 2, and 3. (Approximately 19,100 yd^3.) Burial Pit #3 is not considered inaccessible because the Stepan warehouse over Burial Pit #3 will be demolished to access the burial pit.
4) Total in situ volume (i.e.: volume of soil in the ground without accounting for volume growth due to swell and overexcavation) of contaminated media includes waste volume from the properties that are addressed by this FS. Volumes associated with other past cleanup actions are not included in this total. An additional 12,500 yd^3 of inaccessible soils are estimated to be present under streets adjacent to Phase I residential properties and have been included with the inaccessible soils at the Phase II properties. These soils will be addressed with the inaccessible soils at the commercial/government properties.
5) Due to limited data, the volume of inaccessible soil was estimated.

N/A = Indicates that the proposed cleanup criteria would not be applied to this property.

Sources: BNI 1997. Volume Register, Revision 11; S&W 2001. Volume Register, Revision 0

The USACE has performed an analysis for determining the cleanup criteria to be used at each property giving consideration to:

- Current land use
- Reasonable foreseeable future land use
- Comprehensive community master plans
- Population growth patterns and projections (e.g., Bureau of Census projections)
- Institutional controls currently in place
- Site location in relation to urban, residential, commercial, industrial, agricultural and recreational areas
- Federal/State/local land use designation
- Historical development patterns

This analysis indicated that the majority of the properties should remain in commercial or light industrial use far into the future, however based on the above criteria an unrestricted use, cleanup criteria is established for all properties located within the Borough of Lodi, except the I-80 (west right-of-way). An unrestricted use cleanup criteria, is also established for all properties located in the Borough of Maywood, except the MISS, Stepan, 149-151 Maywood Avenue, and the transportation corridors. USACE will use institutional controls as necessary to restrict future land use on commercial and government properties where the restricted use cleanup criterion is used (details of institutional controls are conceptually presented later in this document and will be fully developed during the Remedial Design and Remedial Action). Institutional controls would be utilized to restrict future land use and to notify the government when inaccessible contaminated soil becomes accessible. Inaccessible soils are defined as soils that are located under permanent structures, such as buildings and active roadways. Soils near buildings and roadways would be considered inaccessible if their removal could compromise the structural integrity of the building or roadway. Utility corridors will be addressed on a case-by-case basis to determine if contaminated soils beneath a utility corridor can be safely excavated. Accessible soils are defined as soils that do not meet the definition of inaccessible soils. Accessible soils would include contaminated soils located under sidewalks, parking lots, and other non-permanent cover, unless their removal would compromise the integrity of a permanent structure, such as a building foundation, roadway, or utility corridor. Accessible soils include the three licensed NRC-burial pits (the warehouse over Burial Pit 3 would be demolished). USACE anticipates that institutional controls can be emplaced to minimize the social and economic impacts to businesses and the area. USACE will establish institutional controls (with monitoring) as necessary to restrict future land use to commercial activities and establish notification procedures when inaccessible soils become accessible.

The application of the restricted use criterion will include the use of institutional controls (e.g., easements, zoning controls, covenants, and other tools, see Section 2.3 of this FS for the discussion of institutional controls) to restrict future uses and future exposure.

Summary of Remedial Alternatives

A total of four cleanup options (Remedial Alternatives) were developed and evaluated in this FS for the FUSRAP Maywood Superfund Site, using the evaluation criteria established under the NCP at 40 CFR 300.430(e)(9)(iii). A no action alternative was evaluated to provide a baseline for comparison. Per EPA FS guidance, the cost estimates assumed a 30-year performance period for ongoing actions, such as monitoring and maintenance. A summary of these alternatives is provided below.

Alternative 1: *No Action* was developed and evaluated to provide a baseline for comparison and to provide an appropriate alternative in the event that no significant health or environmental risk was found to exist at the FUSRAP Maywood Superfund Site. Under this alternative, there would be no further action taken at the FUSRAP Maywood Superfund Site, and existing access restrictions, maintenance, and monitoring activities would be discontinued. 5-year reviews in accordance with 40 CFR 300.430(f)(4)(ii) would be performed. The purpose of a 5-year review is to assure that human health and the environment are being protected by the remedial action. The costs associated with this activity for 30 years is estimated to be $439,000.

Alternative 2: *Monitoring and Institutional Controls* would involve maintaining the current status at some of the properties and reducing uses and exposures at other properties and, would include periodic monitoring to detect any changes in the nature or extent of contamination at the FUSRAP Maywood Superfund Site. Institutional controls would include continuing the existing access restrictions at MISS and Stepan; maintaining existing cover materials including grass, building foundations, and asphalt; periodic inspection of all the properties to determine any changes in land use; and institutional controls (e.g., easements, covenants, zoning controls, deed notices, and other tools restricting land use) to prohibit changes in land use or construction in contaminated soils on some land at the FUSRAP Maywood Superfund Site and to reduce uses and exposure on other land at the Site. These institutional controls would effectively limit unacceptable exposure for human health to the contaminants by removing or limiting the exposure pathways of concern (direct gamma, inhalation, and ingestion). This alternative would also include 5-year reviews to monitor the protectiveness of the remedy. The cost of this alternative is estimated to be $20 million for a 30-year period.

Alternative 3: *Excavation and Offsite Disposal* would involve removing contaminated accessible and inaccessible soils above the appropriate cleanup criteria. Soils above the identified cleanup criteria would be excavated for offsite disposal. Clean soil will be used as backfill up to grade. Inaccessible soils currently located under buildings and roadways would be excavated and disposed offsite when they are made accessible by the property owners (e.g., due to renovation or demolition activities).

Physical separation of a portion of the excavated material would be done at MISS to sort boulders and rocks, materials potentially requiring disposal as mixed wastes, and bulk waste, such as building rubble, from soils requiring disposal as radioactive waste. Boulders, rocks, and bulk waste would be decontaminated if necessary. This decontaminated material could be used onsite as treated backfill, as appropriate or shipped offsite to an appropriate disposal facility.

Contaminated structures on Stepan would be surveyed and decontaminated as necessary to achieve cleanup. There is a slight possibility that partial demolition will be required in some of these buildings depending on the cost to decontaminate, and the effectiveness of decontamination. However, there is no indication at this time that demolition would be necessary. No contaminated structures are located on other FUSRAP Maywood Superfund Site properties, but non-operating structures on the MISS may be demolished to access contaminated soils beneath them. Material resulting from the demolition of buildings will be shipped offsite to an appropriate disposal facility.

Alternative 3 would comply with the substantive requirements of NJAC, Section 7:28.8(a) as an ARAR for soil. The USACE, in coordination with State and local governmental authorities, would obtain institutional controls as necessary (e.g., easements, covenants, zoning controls, and other tools to restrict future land use) on properties (including properties with inaccessible soils) where the restricted use criteria is applied and where combined levels of radium-226 and thorium-232 remain above an average of 5 pCi/g, above background. Unrestricted use cleanup levels are an average of 5 pCi/g of radium-226 and thorium-232 combined and an average of 50 pCi/g of uranium-238 (essentially an average of 100 pCi/g total uranium) above background, would be used on properties where appropriate. The EPA would review the land uses at the FUSRAP Maywood Superfund Site areas where radioactive materials are left above the appropriate criteria at least every five years.

On the Stepan Company property, buildings would be decontaminated, demolished, or partially demolished to meet the substantive requirements of NJAC 7:28-12.8. If necessary, buildings overlying contamination will be demolished or partially demolished to access underlying soils. Contaminated buildings will either be decontaminated or demolished, as necessary, to meet ARARs and to prevent future releases into the environment. The NRC-licensed burial pits on Stepan would be decommissioned (excavation with off-site disposal) to meet the requirements of 10 CFR 20.1402 and the substantive requirements (dose of 15 mrem/yr above background and 3.0 pCi/L radon-222 above background in indoor air) of NJAC, Section 7:28-12.8(a).

The offsite disposal option that was evaluated for this alternative is a disposal facility permitted or licensed to receive the specific materials being shipped, although the details of the offsite disposal will be evaluated and finalized during the implementation phase of this alternative during remedial design after the ROD is signed. In a letter addressed to Envirocare of Utah, Inc., dated September 20, 2001 (September 2001 NRC Letter), the NRC changed its position on the status of the radioactively contaminated soils located at the FUSRAP Maywood Superfund site. In response to the change, USACE evaluated whether to add 10 CFR Part 40 as an ARAR, and determined that a cleanup in accordance with the EPA/DOE Dispute Resolution cleanup criteria, 10 CFR 20.1402 (for the Stepan NRC-licensed burial pits), and the substantive standard of NJAC § 7:28-12.8(a), would provide a level of health and safety protection equivalent to the substantive requirements of 10 CFR Part 40, Appendix A, Criterion 6(6). As a result, a corresponding change to the ARARs was not necessary. Radiologically contaminated soil sent offsite for disposal will be treated as 11(e)(2) byproduct material. The contaminated soils would be shipped by rail from MISS to the disposal facility. The cost of this alternative is estimated to be $254 million. Costs include the excavation and off-site disposal of accessible soil contamination, and the excavation and off-site disposal of inaccessible soil contamination under operating buildings and transportation corridors when they become accessible. Costs have been estimated for these inaccessible soils based on a current understanding of contaminated soil volumes and the related costs of excavation, transportation, and disposal. The remedial action is estimated to require five years to complete the accessible portions of contaminated buildings and soils. Time to complete the inaccessible portions of this alternative depends on when landowners make the inaccessible soils accessible.

Alternative 4: ***Excavation, Treatment, and Offsite Disposal*** is similar to Alternative 3 regarding contaminated buildings and excavation of soils on the various properties (including the NRC-licensed burial pits). CERCLA and the NCP establish a preference for remedial alternatives using treatment to reduce the toxicity, mobility or volume of the "principal threat" at CERCLA sites. The principal threat at this site is considered to be the highest levels of contaminated soil and buried debris. This alternative evaluates the use of treatment to address this principal threat. However, this alternative also incorporates treatment to reduce the volume of contaminated materials requiring disposal as radioactive waste. Because the effectiveness, implementability, and cost of treatment are uncertain, a treatment demonstration was conducted at the MISS to evaluate the technology. If the evaluation of the demonstration proves a technology is effective, implementable, and cost-effective, the USACE will treat the excavated soils prior to disposal; otherwise, the USACE will dispose of the excavated soils without treatment (similar to Alternative 3). The public will be informed of the results of the treatment demonstration prior to implementation of the treatment portion of this alternative.

The following constraints would apply to treated soils:

- ***Contaminated Stream*** **–** Soils greater than 15 pCi/g combined radium-226 and thorium-232 average concentration above background from the treatment process would be disposed at an offsite disposal facility.

- ***Residual Stream*** **–** Soils less than an average of 15 pCi/g combined radium-226 and thorium-232 above background will either be backfilled at the MISS or disposed offsite at an appropriate landfill. If the treated soil is backfilled at the MISS, all backfilled areas would then be covered by at least one foot of clean backfill material to meet the criteria of 15 mrem/yr above background.

The evaluation of treatment processes to be used in conjunction with this alternative has not yet been completed. A limited number of treatment options are available for the radioactive materials present at the FUSRAP Maywood Superfund Site. The most suitable treatment options are physical techniques to reduce the volume of contaminated materials. These techniques physically separate the contaminated materials from uncontaminated materials present in the soil matrix. Soil washing tests were previously performed on FUSRAP Maywood Superfund Site soils. These tests are documented in treatment reports. The feasibility of soil washing, along with gravel separation and radiological sorting, were investigated during the Engineering Test Pit Program performed by the USACE in the fall of 1999. The results of the Engineering Test Pit Program, documented in Volume 5 of the Pilot Demonstration Work Plan (PDWP), indicated that gravel separation and radiological sorting showed the most promise for volume reduction on the FUSRAP Maywood Superfund Site. Soil washing was removed from consideration due to the soil conditions present at the FUSRAP Maywood Superfund Site. Because treatment results will vary by contamination levels and soil types (i.e., amount of clay, fine versus coarse material ratios, etc.), there was uncertainty regarding the actual volume reduction and cost of treatment for the remaining soils at the FUSRAP Maywood Superfund Site.

Due to the uncertainty regarding the effectiveness of treatment, a treatment demonstration was conducted on the FUSRAP Maywood Superfund Site soils to determine if full-scale treatment could be accomplished. Gravel separation and radiological sorting were evaluated during the treatment demonstration. If the evaluation of the demonstration proves a technology is effective, implementable, and cost effective, the USACE will treat the excavated soils. The public will be informed of the results of the treatment demonstration prior to implementation of the treatment portion of this alternative. Treatment effectiveness will be evaluated in terms of volume reduction potential. Implementability will be evaluated by such factors as the availability of equipment and trained labor, the room to stockpile, stage and handle material, and the ability to address current community and regulator concerns (regarding such issues as noise, safety, schedule impact, equipment accuracy, stockpiling of soils, and waste management). Cost effectiveness will be evaluated relative to excavation and disposal without treatment.

At the property subject to potential backfilling with treated soils (MISS), subsurface soil concentrations would be expected to range anywhere from naturally-occurring background levels to an average of 15 pCi/g of radium-226 and thorium-232 combined above background concentrations. The concentration would depend on the effectiveness of the soil treatment. Soils not meeting these requirements would be disposed off-site at an authorized disposal facility.

The following elements of Alternative 4 would be the same as in Alternative 3: cleanup criteria for the various properties; placement of institutional controls; subsequent long-term management of soils remaining above 5 pCi/g of thorium-232 and radium-226 combined average concentration above background, and an average of 50 pCi/g uranium-238, and an average of 100 pCi/g total uranium above background; building cleanup; and ARARs (including 10 CFR 20.1402 and NJAC 7:28-12.8(a)).

The offsite disposal option that was evaluated for Alternative 4 uses a disposal facility permitted or licensed to receive the specific materials being shipped, although the details of the offsite disposal will be evaluated and finalized during the implementation phase of this alternative. Per the September 2001 NRC Letter, USACE will dispose of radiologically contaminated soil offsite as 11(e)(2) byproduct materials. The contaminated soils would be shipped from MISS to the disposal facility. If treatment proves to be effective, and is implemented, the remaining soil containing lower amounts of radiological materials below criteria (i.e., 15 pCi/g combined radium-226 and thorium-232) would be either backfilled at the MISS or disposed offsite at a suitable landfill. The decision to utilize the treated material onsite vs. offsite disposal will be made by the USACE and EPA, in consultation with the NJDEP, and will take into consideration the residual condition of the MISS property under each scenario.

The public would be notified of both determinations- i.e., whether to employ treatment at the MISS, and, if so, the disposition of the treated soil. Public notification would occur prior to any physical activity associated with onsite treatment and any disposal of treated soil if treatment is found to be appropriate.

Inaccessible soils currently located under buildings and roadways would be excavated and disposed offsite as they become accessible in the future (e.g., due to renovation or demolition activities). Radon would be monitored in buildings with inaccesible soils remaining beneath them to ensure compliance with the radon limit of NJAC 7:28-12.8(a)2. If radon levels exceed 3 pCi/L above background at some point in the future, mitigation (e.g., sealing foundation cracks, supplementing existing ventilation systems, etc.) would be performed to return radon levels to below 3 pCi/L above background.

The total volume of accessible soil above criteria on the respective properties is an estimated 227,174 yd^3 (in situ) including the NRC-licensed burial pits on the Stepan property. The total volume of estimated inaccessible soil above criteria on the respective properties is 66,614 yd^3 *in situ*. All soil volumes presented in this FS are *in situ* unless otherwise specified. *In situ* soil volume numbers are for contaminated undisturbed (in the ground) soil prior to excavation. Excavation of the undisturbed soil will increase the volume of *ex situ* (or out of the ground) soil volumes because of overexcavation (the excavation of clean soils to completely remove contaminated soils) and swell (expansion of the compacted soil as it becomes loose soil upon excavation). To be conservative in the cost estimate, it was assumed that the burial pit material and the contaminated material in the retention ponds on MISS would not be amenable to treatment. It was also assumed that remobilization of the treatment system would not be cost effective in the future as inaccessible soils became accessible. So, inaccessible soils were excluded from the volume of material that would be treated for cost estimating purposes. These untreated materials (approximately 160,000 yd^3) would be disposed directly offsite. Twenty percent of all the accessible material to be remediated is estimated to be oversized materials (16,645 yd^3), such as concrete, rocks and boulders, and would also be screened out prior to treatment. This material would be used as backfill if appropriate, or disposed off-site at an appropriate location. The cost estimate assumes that treatment is applied to the remaining excavated soils. For soils subjected to treatment, the process is assumed to be effective at achieving up to a 60 percent volume reduction in the amount of soil requiring offsite disposal as radioactive contaminated material. The actual effectiveness of treatment will not be known until after the treatment demonstration data have been reviewed.

The effectiveness of the systems demonstrated at the MISS are being evaluated based on the following:

- Ability of the processes to separate non-contaminated site materials from materials that have been contaminated with radiological residuals from the thorium extraction process.

- Ability of the gravel separation system to extract coarse material (+3/8 in, -6 in) from the soil mass and demonstrate by sampling and laboratory analyses that the separated gravel meets the cleanup levels.

- Quantification of the influence of excavation and material handling on the mixing of radioactively contaminated and non-contaminated excavated material by tracking the material mass and activity from in situ to the output processed stockpiles.

- Ability of the radiological sorting system to assay the material and accurately sort it into "above criteria" and "below criteria" stockpiles. It must be demonstrated through rigorous sampling and laboratory analysis that "below criteria" material meets the cleanup levels.

- Demonstration, by means of monitoring and observing dust and noise levels during the demonstration that the processing units do not create a public nuisance or public health hazard.

- Time required to process material and any impacts to remediation schedule.

- Cost effectiveness of system operation compared to full disposal option.

Costs are based on excavation, treatment, and disposal of accessible soil contamination. Costs are also based on the excavation, and disposal of inaccessible soils under operating buildings and transportation corridors (treatment will not be used for the future excavation of currently inaccessible soils). Costs estimated for the inaccessible soils are based on the current understanding of existing volumes, and costs related to the excavation, transportation and disposal of contaminated soil. The cost to implement this alternative is estimated to be $244 million. The time to implement this alternative is estimated at approximately five years for the accessible contaminated soils and buildings. The time to remediate the inaccessible soils depends on when the landowners make these soils accessible.

ANALYSIS OF ALTERNATIVES

The USACE will propose a preferred alternative following an evaluation of all of the alternatives in accordance with the nine criteria established by the EPA under 40 CFR 300.430(e)(9)(iii) of the NCP in a PP. The PP will be released for public review and comment. After consideration of regulatory and public comments, USACE and EPA, in consultation with the NJDEP, will select the remedial alternative to be implemented in a ROD. The nine criteria used to evaluate alternatives are described below.

CERCLA Evaluation Criteria

Threshold Criteria (must be met)

- ***Overall Protection of Human Health and the Environment -*** addresses whether an alternative provides adequate protection and describes how risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- ***Compliance with Applicable or Relevant and Appropriate Requirements -*** addresses if a remedy would meet all of the applicable or relevant and appropriate requirements (ARARs). ARARs are Federal and State environmental laws and promulgated regulations identified for the FUSRAP Maywood Superfund Site cleanup.

Primary Balancing Criteria (identifies major trade-offs among alternatives)

- ***Long-Term Effectiveness and Permanence -*** addresses the remaining risk and the ability of an alternative to protect human health and the environment over time, once cleanup levels have been met.

- ***Short-Term Effectiveness and Environmental Impacts* -** addresses the impacts to the community and site workers during cleanup, including the amount of time it takes to complete the action.

- ***Reduction in Toxicity, Mobility, or Volume through Treatment* -** addresses the anticipated performance of treatment that permanently and significantly reduces toxicity, mobility, or volume of waste of a principal threat(s) at the site.

- ***Implementability* -** addresses the technical and administrative feasibility of an alternative, including the availability of materials and services required for cleanup.

- ***Cost* -** compares the differences in cost, including capital, operation, and maintenance costs.

Modifying Criteria (formally evaluated after the comment period)

- ***State Acceptance* -** evaluates whether the State agrees with, opposes, or has no comment on the preferred alternative. This criterion is evaluated formally when comments on the FS, PP and other documents on the Administrative Record for this decision are reviewed.

- ***Community Acceptance* -** addresses the issues and concerns the public may have regarding each of the alternatives. This criterion is evaluated formally when comments on the FS, PP and other documents in the Administrative Record for this decision are reviewed.

ALTERNATIVE COMPARISON

The advantages and disadvantages of each of the alternatives were compared using the nine evaluation criteria established by EPA in 40 CFR 300.430(e)(9)(iii) of the NCP. Some of these comparisons are summarized below. The detailed comparative analysis of all the alternatives is in Chapter 5 of the FS.

Threshold Criteria

Alternative 1, No Action, is not considered protective because the BRA predicted unacceptable risks to human health in both current and future use scenarios. The baseline risk assessment predicted risks above the CERCLA lifetime cancer risk threshold of 10^{-4} (1 in 10,000 chance a resident living on the site would develop cancer) when the existing controls are not maintained and additional actions are not taken at the FUSRAP Maywood Superfund Site. Alternatives 1 and Alternative 2 (Institutional Controls and Monitoring) might not be protective of the environment because flora and fauna exposure to FUSRAP contamination could not be controlled and site contaminants remain in place in these alternatives. A more detailed analysis of ecological risk than that completed in the DOE BRA would be required to make a more definitive determination of ecological protectiveness. Alternatives that include the excavation and offsite disposal of contamination above the cleanup criteria, Alternatives 3 and 4, are protective of human health and the environment, because materials above safe levels are excavated from the FUSRAP Maywood Superfund Site and shipped for offsite disposal. Properties where residual concentrations are below an average of 5 pCi/g radium-226 and thorium-232 combined and an average of 50 pCi/g uranium-238 (essentially 100 pCi/g total uranium) above background would be released for unrestricted use. In order to assure overall protectiveness, USACE will supplement the remedy with institutional controls where contamination remains above these criteria.

Alternatives 3 and 4 comply with ARARs, which is a NCP threshold criterion for remedy selection, and which is discussed in detail in Section 3 and Appendix A of this document. Alternative 2 would not comply with ARARs. The properties would not be released for unrestricted use under this alternative. Alternative 2 requires institutional controls to prohibit changes in the use of some land at the Site, and reduce the use of other land at the Site, and prohibit land use or construction in contaminated soils and notification of the government when land uses change. Alternatives 3 and 4 would achieve compliance with contaminant-specific ARARs by the removal and offsite disposal of contaminated materials greater than the cleanup criteria established for the FUSRAP Maywood Superfund Site and would release more properties without restrictions than Alternative 2.

Primary Balancing Criteria

For the excavation alternatives (Alternatives 3 and 4), DOE and EPA developed site-specific cleanup criteria for radium-226 and radium-228 combined average concentration above background. Thorium-232 at the FUSRAP Maywood Superfund Site is commonly estimated by analysis of radium-228, which is a decay product of thorium-232. If residual concentrations at any of these properties are above 5 pCi/g combined radium-226 and thorium-232 average concentration, above background, institutional controls (e.g., easements, covenants, zoning controls, utility notification [such as the toll free call-before-you-dig telephone number], 5-year reviews, municipal notifications, and/or other tools) will be emplaced as necessary at that property to preclude future residential development. For uranium, DOE developed a site-specific guideline for uranium-238 (50 pCi/g average concentration above background, which is essentially100 pCi/g total uranium above background). Residual concentrations of uranium expected after cleanup are much lower than these guidelines because of the minor uranium contamination at the FUSRAP Maywood Superfund Site. Existing disposal facilities will be used and are considered to be protective of human health as well as compliant with pertinent environmental requirements. Institutional controls on properties that are not remediated to the unrestricted use criterion are included in Alternatives 2, 3, and 4.

The excavation alternatives (3 and 4) provide long-term effectiveness because they would remove for permanent disposal all accessible and inaccessible soil (when it is made accessible) above cleanup criteria for either safe commercial or unrestricted residential use from the FUSRAP Maywood Superfund Site. Alternative 2 has questionable long-term effectiveness in protecting human health when compared to Alternatives 3 or 4 because it relies more heavily on institutional controls. Alternative 2 might not be protective of the environment because exposure to flora and fauna cannot be controlled through institutional controls and the BRA predicts the potential for ecological risks if the contamination remains in place. More detailed analysis would be required to make a more definitive determination of ecological protectiveness than was completed in the DOE BRA. Under the treatment option of Alternative 4, where the cleaned portion of treated soil is replaced on MISS, overall protectiveness for these properties is ensured by the placement of clean cover material over the treated backfill and continued commercial use of the properties. Overall protection is further ensured by requesting municipalities to inform the USACE and EPA of any land use changes that may affect properties where radioactivity remains above 5 pCi/g of radium-226 and thorium-232 combined average concentration above background.

Only Alternative 4 (assuming the treatment option proves effective) meets the CERCLA preference for remedies that use treatment to reduce the toxicity, mobility, or volume of principal threats at the site. Full-scale treatment performance information is under evaluation.

Alternatives 2, 3, and 4 are implementable. Alternative 3 would be easier to implement than Alternative 4, which includes a treatment option. Note that actions taken under Alternative 4, if the treatment option were not implemented, are the same as Alternative 3.

The costs to implement the different alternatives have been calculated in terms of the cost in 2001 dollars (FY01$) without escalation or discounting. Capital, operation, and maintenance costs are included in Table ES-2.

Table ES-2. Estimated Cost of Cleanup Alternatives

Alternative	Description	Estimated Costs (FY01$)
1	No Action	$439,000
2	Monitoring and Institutional Controls	$20,000,000
3	Excavation and Disposal	$254,000,000
4	Excavation, Treatment, and Disposal	$244,000,000

Modifying Criteria

State and community acceptance will be evaluated formally after the public comment period on the PP. A community relations program and a community relations plan for the FUSRAP Maywood Superfund Site have been established and are maintained. Input from community groups and the general public have been incorporated into the remedy selection process. In general, the community has expressed a preference for removal and offsite disposal of the contaminated materials.

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1. INTRODUCTION AND NEED FOR ACTION

The National Priorities List (NPL) site known as the Maywood Chemical Company Site is being addressed by two separate parties. The U.S. Army Corps of Engineers (USACE) is responsible for addressing radioactive and chemical contamination defined as Formerly Utilized Sites Remedial Action Program (FUSRAP) waste by the Federal Facility Agreement (FFA). USACE's responsibilities will be referred to as the "FUSRAP Maywood Superfund Site" for the remainder of the document. The Stepan Company is investigating non-radioactive, chemical contamination on Stepan Company property, and on adjoining properties, under both an administrative order on consent and an administrative order. Although the USACE and Stepan Remedial Investigation/Feasibility Study (RI/FS) activities are being conducted independently, the U.S. Environmental Protection Agency (EPA) is overseeing both actions. Combined, both actions comprise the investigations into contamination at the "Maywood Chemical Company Site."

This FS documents the comprehensive review and analysis of remedial action alternatives being considered for FUSRAP contaminated soils and buildings at the Maywood Interim Storage Site (MISS), Stepan, and commercial/government properties in Maywood, Lodi, and Rochelle Park, New Jersey (or FUSRAP Maywood Superfund Site). The FUSRAP Maywood Superfund Site is a set of properties contaminated by past thorium processing and other chemical processing activities at the Maywood Chemical Works (MCW) (Figures 1-1 and 1-2). The objective of remedial action at the FUSRAP Maywood Superfund Site is to ensure that risks to human health or the environment from potential exposure to contaminated materials are either eliminated or reduced to prescribed, protective levels. Remedial action to address FUSRAP waste at the FUSRAP Maywood Superfund Site will be taken under the USACE's FUSRAP, in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300.

The FUSRAP Maywood Superfund Site is composed of the MISS and various Vicinity Properties, including the Stepan Company property and numerous residential, commercial, and government properties in Maywood, Rochelle Park, and Lodi, New Jersey (Figure 1-2). Many of these properties have been remediated or are scheduled for remediation under an ongoing CERCLA non-time critical removal action. The remaining properties contain soils with thorium-232, radium-226, uranium-238, and their associated decay products as a result of previous thorium processing at the MCW. Chemical contamination also exists on some of these properties. MISS, Stepan, and other Vicinity Properties were once part of the former MCW property. MISS is a Federally-owned property that has been used for interim storage of material removed from previously remediated properties. It borders on the northern and western boundaries of the Stepan property. Past thorium processing at MCW resulted in dumping of some process residues on MISS and surrounding properties. The MISS property was acquired by the Federal government from Stepan in 1985.

The U.S. Atomic Energy Commission (AEC), a predecessor agency to the U.S. Department of Energy (DOE), under authorities granted by the Atomic Energy Act of 1954, as amended, created FUSRAP, as a program, in 1974. FUSRAP was created to identify and clean up or otherwise control sites where radioactivity remained from activities carried out under

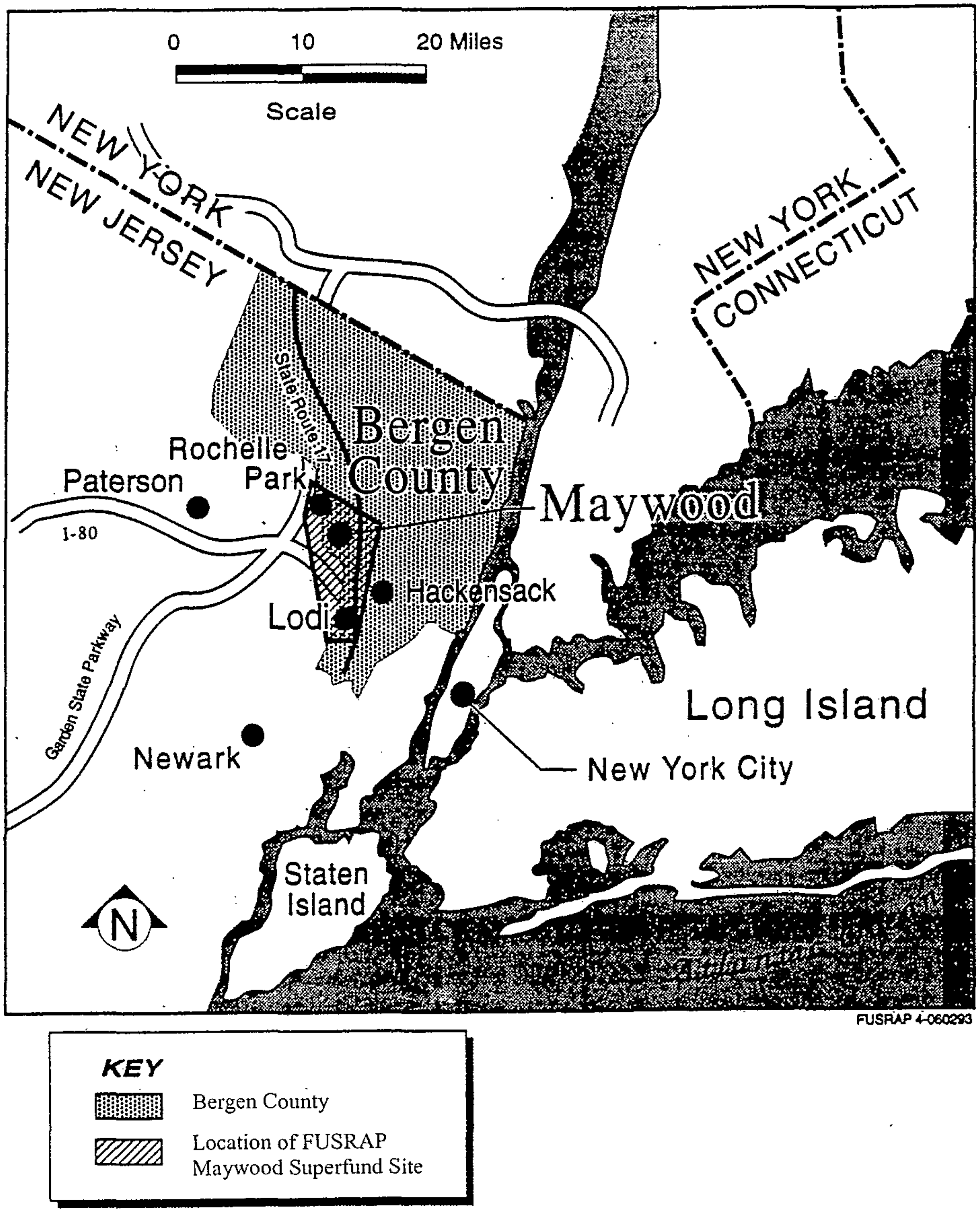

Figure 1-1. Location of Maywood, New Jersey

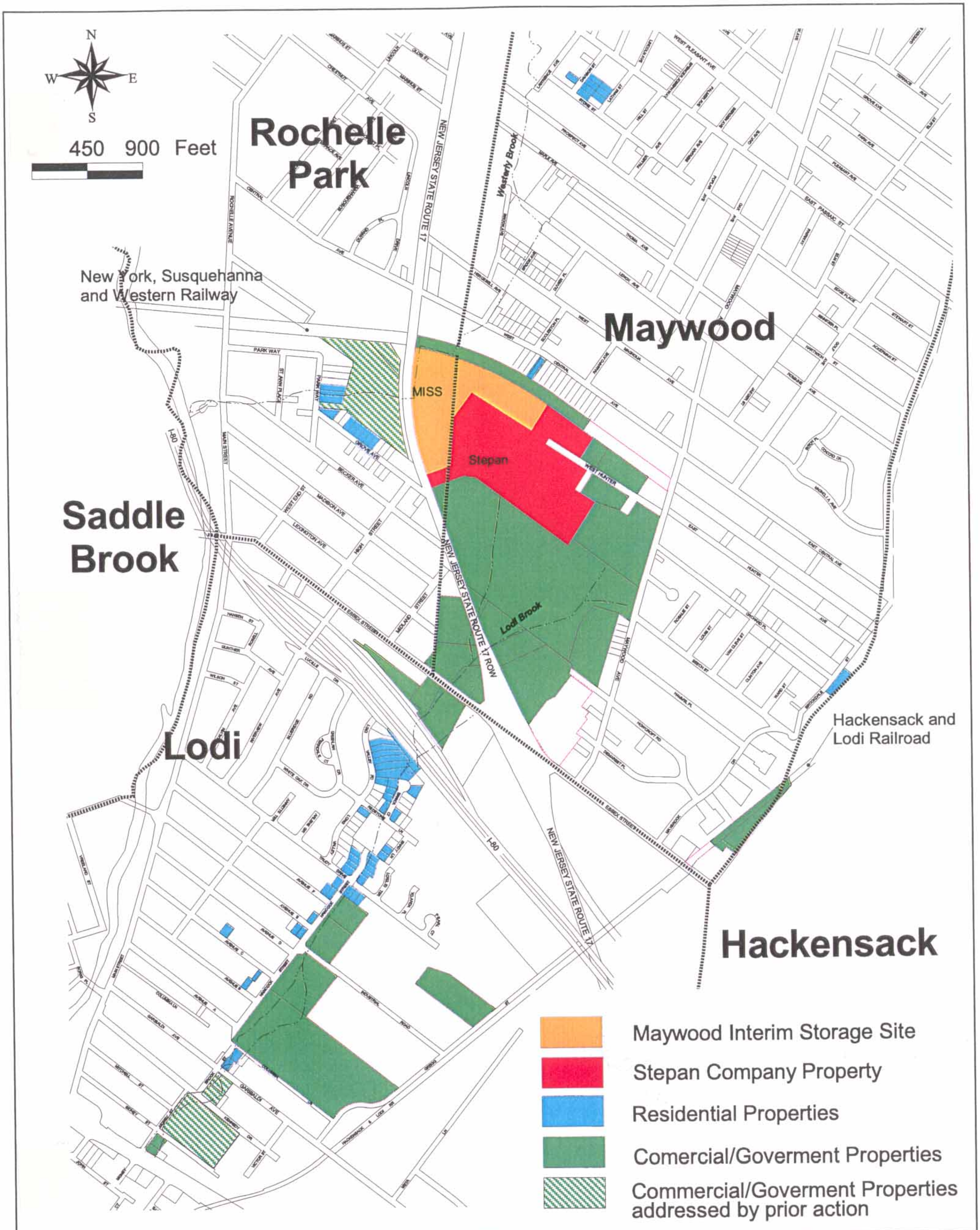

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Figure 1-2. Location of Properties Comprising the FUSRAP Maywood Superfund Site

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contract to the Manhattan Engineer District (MED) and AEC. Although radioactivity present at the FUSRAP Maywood Superfund Site is the result of commercial processing (the MCW was not operated by or for the MED), responsibility for the Site was assigned to DOE in late 1983, as a decontamination research and development project. Congress assigned responsibility for the Site through the fiscal year 1984 Energy and Water Development Appropriations Act. Because environmental concerns at the Site were similar to those of DOE's FUSRAP sites, DOE assigned this Site to FUSRAP. FUSRAP was then transferred from DOE to the USACE by the 1998 Federal Energy and Water Development Appropriations Act.

The limits of the DOE's responsibilities for the FUSRAP Maywood Superfund Site were defined under an FFA, negotiated between DOE and EPA Region 2 that became effective April 22, 1991. Under the terms of the FFA, FUSRAP waste was defined as:

- All contamination, both radiological and chemical, whether commingled or not, on the MISS;

- All radiological contamination above cleanup levels related to past thorium processing at the MCW occurring on any Vicinity Properties; and

- Any chemical or non-radiological contamination on Vicinity Properties that would satisfy either of the following requirements:

    1. The chemical or non-radiological contaminants which are mixed or commingled with radiological contamination above cleanup levels ; or
    2. The chemical or non-radiological contaminants which originated at the MISS or were associated with the specific thorium manufacturing or processing activities at the MCW which resulted in the radiological contamination.

On September 8, 1983, the EPA placed the Maywood Chemical Company Site on the NPL. All remedial activities at the Maywood Chemical Company Site are conducted under CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA). NPL sites must undergo a detailed, two-part study called an RI/FS. The RI describes the nature and extent of contamination. That information is then used in the FS to evaluate cleanup, or remedial action, alternatives. The RI report for the FUSRAP Maywood Superfund Site (DOE 1992a) was prepared by DOE and placed in the administrative record for public review in January 1993, and is used by this FS in evaluating potentially applicable remedial alternatives.

A Baseline Risk Assessment (BRA) was prepared by DOE to evaluate the resulting risk to human health and the environment if the FUSRAP Maywood Superfund Site is not cleaned up. The BRA is used to identify a need for remedial action, and is considered part of the RI for a site. The BRA for the FUSRAP Maywood Superfund Site (DOE 1993a) was placed in the administrative record for public review in April 1993, and is considered part of the RI.

The BRA evaluated the potential present and future excess cancer and non-cancer risks to employees, residents, and transients, resulting from exposure to the chemicals and radioactivity present at the FUSRAP Maywood Superfund Site. The calculated reasonable maximum exposure (RME) cancer risk, for those receptors under the various scenarios, ranges from 5×10^{-2} to 6×10^{-4} from exposure to radionuclides. This means that exposed individuals would have an increased risk of developing cancer of 5 in 100 to 6 in 10,000. For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} to 10^{-6}. Therefore, the BRA clearly establishes the need for action.

The FUSRAP Maywood Superfund Site consists of 88 designated properties: the Stepan property, which includes all of the contaminated buildings and three burial pits licensed by the Nuclear Regulatory Commission (NRC); the MISS; 59 residential properties; 3 properties owned by the State or Federal government; 4 municipal properties; and 20 commercial properties. Of the 88 designated properties, 64 (including all residential and municipal properties) were included in interim removal actions initiated by DOE and completed by USACE in 2000. During cleanup actions on these properties, additional properties were remediated if the contamination extended onto an adjacent undesignated property. The MISS, the Stepan property, and 22 other commercial and government properties remain to be addressed at the FUSRAP Maywood Superfund Site. This FS addresses the portion of the FUSRAP Maywood Superfund Site known as the Soils/Buildings Operable Unit (OU) containing the contaminated buildings and the soil contamination at the MISS, Stepan, and the remaining 22 commercial and government properties (including the Stepan burial pits licensed by the NRC).

Status of Prior Cleanups

Sixty-four residential and municipal vicinity properties have been cleaned up by DOE and the USACE. Although the initial 26 residential properties were cleaned under a less restrictive cleanup standard by DOE during the mid-1980's, actual concentrations remaining at the properties after cleanup generally meet the current cleanup criteria for unrestricted use, based on review by DOE and EPA. For the initial 26 residential properties remediated at the FUSRAP Maywood Superfund Site, measured concentrations of thorium-232 following remediation were below 5 picoCuries per gram (pCi/g) above background in over 95 % of the samples, and radium-226 and uranium concentrations were generally at or near background levels (see 1994 EPA/DOE dispute resolution in Appendix C). Thirty-eight properties have been remediated under an interim removal action as proposed by the 1995 *Engineering Evaluation/Cost Analysis (EE/CA) for the Cleanup of Residential and Municipal Vicinity Properties at the Maywood Site, Bergen County, New Jersey* and as selected in the associated Action Memorandum. The cleanup level for these 38 properties was an average of 5 pCi/g combined radium-226 and thorium-232 above background as agreed between EPA and DOE in the 1994 dispute resolution (see Section 3.2.11). DOE and EPA referred to these 38 properties addressed under the 1995 EE/CA as Phase I. Contaminated soils at the 24 remaining commercial and government properties, and the contaminated buildings addressed by this FS, have been referred to as Phase II of the Soils/Buildings OU.

Groundwater

Due to continuing investigations at the Maywood Chemical Company Site by the USACE and the Stepan Company, groundwater contamination is not directly addressed in the FS. Groundwater will be addressed under separate CERCLA documentation. The USACE has prepared an RI Workplan to investigate potential groundwater contamination from FUSRAP waste. The USACE is in the process of implementing that plan. Groundwater at the FUSRAP Maywood Superfund Site will be addressed in the future as a separate OU.

Inaccessible soils

Inaccessible soils are defined as soils under permanent structures, such as buildings and roadways. Soils near permanent structures, under parking lots, sidewalks, and other nonpermanent cover (e.g., grass, gravel, dirt, debris, etc.) are considered accessible, unless their removal would compromise the integrity of a permanent structure, such as a building foundation, roadway, or utility corridor. Utility corridors will be addressed on a case-by-case basis to determine if contaminated soil is accessible. Inaccessible soils do not present a potentially significant threat in their current configuration, because the structures provide a barrier to human or ecological exposure to the contaminants. These soils will be addressed at such time when property owners make the soils accessible. As shown in Table 1-1, thirteen of the remaining Soils/Buildings OU properties are assumed to have contaminated soils under existing structures. In addition, inaccessible soils with FUSRAP contamination above the soil cleanup criteria specified in this FS are expected to be present under residential streets adjacent to the FUSRAP Maywood Superfund Site properties. The Phase I extent of contamination under residential streets and utility corridors is estimated to be 12,500 yd^3.

For Phase II of the Soils/Buildings OU, the extent of contamination under transportation corridors and structures is estimated to be 54,114 yd^3. For Phase II of the Soils/Buildings OU, two properties encompass 80% of the total volume of inaccessible soils - New Jersey State Route 17 and a warehouse located at 149-151 Maywood Avenue. For several properties, the assumption that a property contains inaccessible soils is based on limited data. To determine the presence and extent of inaccessible soils, additional sampling may be done during remediation of the accessible soils, or when property owners make these soils accessible. Figure 1-3 provides a map of known or suspected inaccessible soils under buildings, roads, railroads, and inaccessible soils remaining in place under utility corridors in the Phase I residential property cleanups. Areas of contamination and volumes provided are based on the best information available at the time of publication of this FS. Inaccessible soils will be remediated to the restricted use cleanup criteria unless the rest of the property has already been remediated to the unrestricted use cleanup criteria.

These inaccessible soils do not pose a current risk because they are isolated by their location under building foundations, utility corridors, roadways, railroad tracks, and other similar locations. Radon monitoring and walkover gamma surveys were performed at the affected properties to evaluate potential exposures; in all cases, measurements were well within acceptable limits. The inaccessible soils will be remediated as they become accessible.

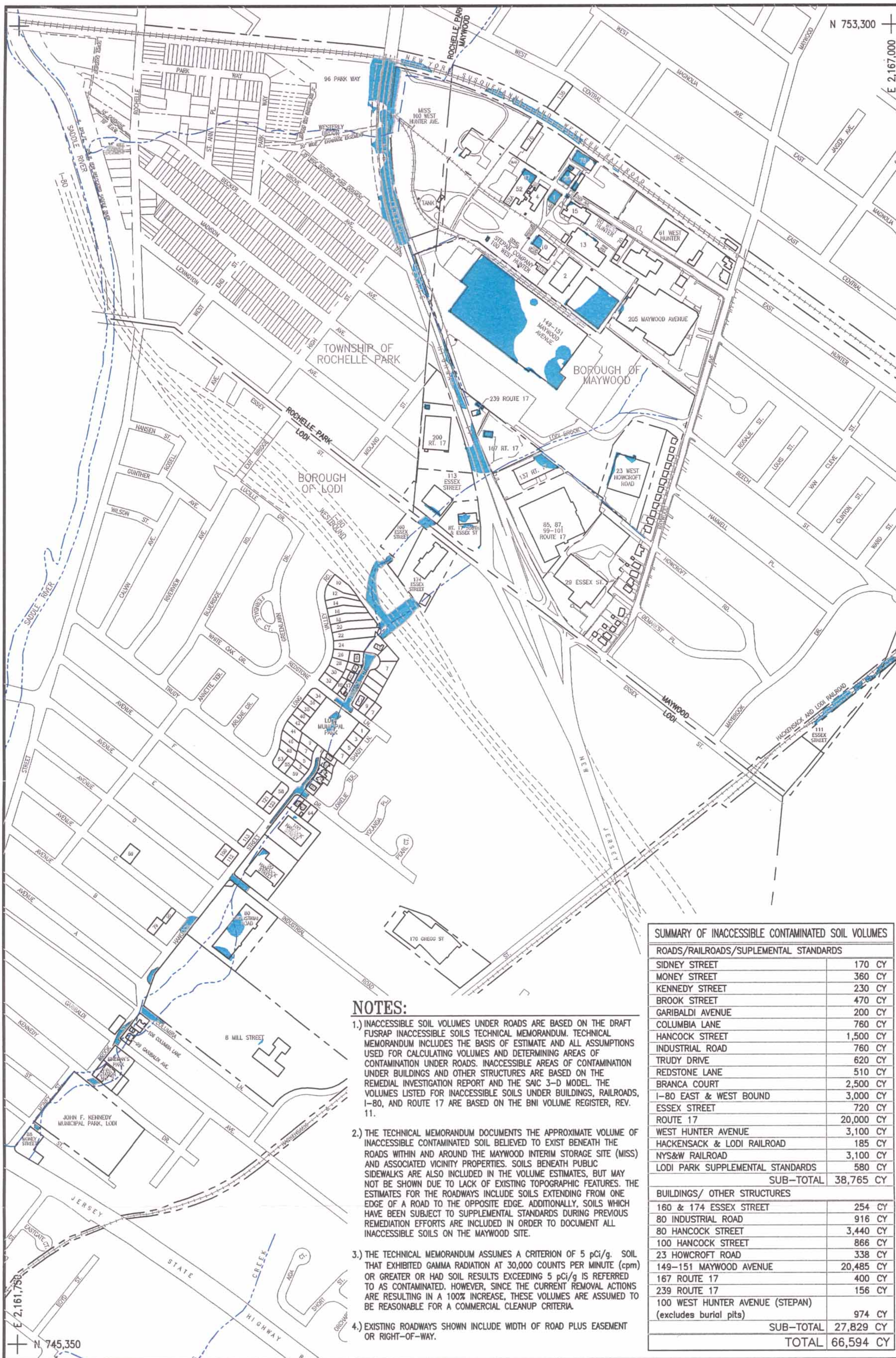
Table 1-1. FUSRAP Maywood Superfund Site Contaminated Soil Volume Estimates

Property	In Situ Soil Volume to Restricted Use Criteria[1] (yd^3)		In Situ Soil Volume to Unrestricted Use Criteria [2] (yd^3)		Comments
	Accessible	Inaccessible	Accessible	Inaccessible	
Lodi Properties					
8 Mill St.	N/A	N/A	2,357	0	
I-80 (west right-of-way and underneath roadway)	107	3,000	N/A	N/A	Volume of inaccessible soils under I-80 was identified in a March 29, 1996 letter from Susan Cange, DOE FUSRAP Maywood Superfund Site Manager, to Angela Carpenter, EPA Maywood Manager.
160 &174 Essex St.	N/A	N/A	1,845	254	See note 5
170 Gregg St.	N/A	N/A	14	0	
80 Industrial Rd.	N/A	N/A	690	916	See note 5
80 Hancock St.	N/A	N/A	868	3,440	See note 5
100 Hancock St.	N/A	N/A	954	866	See note 5
72 Sidney St. (a.k.a. 88 Money St.)	N/A	N/A	58	0	
Maywood Properties					
NJ State Rt. 17	0	20,000	N/A	N/A	See note 5
23 Howcroft Rd.	N/A	N/A	4,552	338	See note 5
149–151 Maywood Ave.	74,741	20,485	N/A	N/A	See note 5
205 Maywood Ave., 50 and 61 West Hunter St.	N/A	N/A	59	0	
137 NJ State Rt. 17	N/A	N/A	965	0	
Lodi Industrial RR	1,317	185	N/A	N/A	
167 NJ State Rt. 17	N/A	N/A	8,001	400	See note 5
200 NJ State Rt. 17	N/A	N/A	375	0	
239 NJ State Rt. 17	N/A	N/A	3,393	156	See note 5
85, 87, 99–101 NJ State Rt. 17	N/A	N/A	2,066	0	
99 Essex St.	N/A	N/A	423	0	
111 Essex St.	N/A	N/A	3,617	0	
113 Essex St.	N/A	N/A	514	0	
New York, Susquehanna & Western Railway	2,900	3,100	N/A	N/A	Contaminated soil directly under railroad tracks considered inaccessible.
Stepan 100 West Hunter Ave.[3]	44,125	974	N/A	N/A	
MISS Maywood Interim Storage Site (100 West Hunter Ave.)	73,233	0	N/A	N/A	
Subtotal [4]	196,423	47,744	30,751	6,370	
Subtotal [4]	244,167		37,121		
Total [4]	281,288				

1) Restricted Use Criteria: 15 pCi/g of radium-226 and thorium-232 combined average concentration above background.
2) Unrestricted Use Criteria: 5 pCi/g of radium-226 and thorium-232 combined average concentration above background.
3) Stepan soil volume includes contaminated material in NRC-licensed Burial Pits 1, 2, and 3. (Approximately 19,100 yd^3.) Burial Pit #3 is not considered inaccessible because the Stepan Warehouse over Burial Pit #3 will be demolished to access the Burial Pit.
4) Total in situ volume (i.e.: volume of soil in the ground without accounting for volume growth due to swell and overexcavation) of contaminated media includes waste volume from the properties that are addressed by this FS. Volumes associated with other past or ongoing cleanup actions are not included in this total. An additional 12,500 yd^3 of inaccessible soils are estimated to be present under streets adjacent to Phase I residential properties and have been included with the inaccessible soils at the Phase II properties. These soils will be addressed with the inaccessible soils at the commercial/government properties.
5) Due to limited data, the volume of inaccessible soil was estimated.

N/A = Indicates that the proposed cleanup criteria would not be applied to this property.

Sources: BNI 1997. Volume Register, revision 11; S&W 2001. Volume Register, Revision 0.



NOTES:

1.) INACCESSIBLE SOIL VOLUMES UNDER ROADS ARE BASED ON THE DRAFT FUSRAP INACCESSIBLE SOILS TECHNICAL MEMORANDUM. TECHNICAL MEMORANDUM INCLUDES THE BASIS OF ESTIMATE AND ALL ASSUMPTIONS USED FOR CALCULATING VOLUMES AND DETERMINING AREAS OF CONTAMINATION UNDER ROADS. INACCESSIBLE AREAS OF CONTAMINATION UNDER BUILDINGS AND OTHER STRUCTURES ARE BASED ON THE REMEDIAL INVESTIGATION REPORT AND THE SAIC 3-D MODEL. THE VOLUMES LISTED FOR INACCESSIBLE SOILS UNDER BUILDINGS, RAILROADS, I-80, AND ROUTE 17 ARE BASED ON THE BNI VOLUME REGISTER, REV. 11.

2.) THE TECHNICAL MEMORANDUM DOCUMENTS THE APPROXIMATE VOLUME OF INACCESSIBLE CONTAMINATED SOIL BELIEVED TO EXIST BENEATH THE ROADS WITHIN AND AROUND THE MAYWOOD INTERIM STORAGE SITE (MISS) AND ASSOCIATED VICINITY PROPERTIES. SOILS BENEATH PUBLIC SIDEWALKS ARE ALSO INCLUDED IN THE VOLUME ESTIMATES, BUT MAY NOT BE SHOWN DUE TO LACK OF EXISTING TOPOGRAPHIC FEATURES. THE ESTIMATES FOR THE ROADWAYS INCLUDE SOILS EXTENDING FROM ONE EDGE OF A ROAD TO THE OPPOSITE EDGE. ADDITIONALLY, SOILS WHICH HAVE BEEN SUBJECT TO SUPPLEMENTAL STANDARDS DURING PREVIOUS REMEDIATION EFFORTS ARE INCLUDED IN ORDER TO DOCUMENT ALL INACCESSIBLE SOILS ON THE MAYWOOD SITE.

3.) THE TECHNICAL MEMORANDUM ASSUMES A CRITERION OF 5 pCi/g. SOIL THAT EXHIBITED GAMMA RADIATION AT 30,000 COUNTS PER MINUTE (cpm) OR GREATER OR HAD SOIL RESULTS EXCEEDING 5 pCi/g IS REFERRED TO AS CONTAMINATED. HOWEVER, SINCE THE CURRENT REMOVAL ACTIONS ARE RESULTING IN A 100% INCREASE, THESE VOLUMES ARE ASSUMED TO BE REASONABLE FOR A COMMERCIAL CLEANUP CRITERIA.

4.) EXISTING ROADWAYS SHOWN INCLUDE WIDTH OF ROAD PLUS EASEMENT OR RIGHT-OF-WAY.

SUMMARY OF INACCESSIBLE CONTAMINATED SOIL VOLUMES	
ROADS/RAILROADS/SUPLEMENTAL STANDARDS	
SIDNEY STREET	170 CY
MONEY STREET	360 CY
KENNEDY STREET	230 CY
BROOK STREET	470 CY
GARIBALDI AVENUE	200 CY
COLUMBIA LANE	760 CY
HANCOCK STREET	1,500 CY
INDUSTRIAL ROAD	760 CY
TRUDY DRIVE	620 CY
REDSTONE LANE	510 CY
BRANCA COURT	2,500 CY
I-80 EAST & WEST BOUND	3,000 CY
ESSEX STREET	720 CY
ROUTE 17	20,000 CY
WEST HUNTER AVENUE	3,100 CY
HACKENSACK & LODI RAILROAD	185 CY
NYS&W RAILROAD	3,100 CY
LODI PARK SUPPLEMENTAL STANDARDS	580 CY
SUB-TOTAL	38,765 CY
BUILDINGS/ OTHER STRUCTURES	
160 & 174 ESSEX STREET	254 CY
80 INDUSTRIAL ROAD	916 CY
80 HANCOCK STREET	3,440 CY
100 HANCOCK STREET	866 CY
23 HOWCROFT ROAD	338 CY
149-151 MAYWOOD AVENUE	20,485 CY
167 ROUTE 17	400 CY
239 ROUTE 17	156 CY
100 WEST HUNTER AVENUE (STEPAN) (excludes burial pits)	974 CY
SUB-TOTAL	27,829 CY
TOTAL	66,594 CY

LEGEND:

- BUILDING
- ROAD OR ROAD R.O.W.
- RAILROAD TRACKS
- FENCE LINE
- STREAM
- PROPERTY BOUNDARY
- AREAS OF INACCESSIBLE CONTAMINATED SOIL

N. J. STATE PLANE

0 300 600

SCALE: 1" = 600'

REVISION	DRAWN BY:	CHKD. BY:	DATE:
0	R. BEELER	M. POLIGONE	05-05-99
1	S. KITCHINGS	M. POLIGONE	10-05-99

CAD FILE # [BOSFS01\MAYWOOD] \Maywood\Task0256\drawings\esk\b\02\E38sorg2.dwg

FUSRAP

INACCESSIBLE CONTAMINATED SOILS MAYWOOD, NEW JERSEY

Figure 1-3. Inaccessible Contaminated Soils at the FUSRAP Maywood Superfund Site

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1.1 PURPOSE, SCOPE, AND ORGANIZATION OF THE REPORT

This FS report identifies and evaluates remedial action alternatives for this OU, soils and contaminated building surfaces at the FUSRAP Maywood Superfund Site, based on the nature and extent of contamination documented in the Maywood RI (DOE 1992a). This FS addresses building contamination on the Stepan property and the soil contamination at the MISS, Stepan, and the remaining 22 commercial/government properties (including the Stepan Company burial pits licensed by the NRC). A minor amount of contaminated sediments in the Lodi Brook channel are included with soils. Figure 1-4 shows the location of properties addressed by this FS. Groundwater is not specifically addressed by the scope of this FS; potentially contaminated groundwater at the FUSRAP Maywood Superfund Site will be evaluated as a separate OU. Table 1-1 provides the volumes of contaminated accessible and inaccessible soil associated with each of the 24 properties.

CERCLA requires preparation of the Proposed Plan (PP) as part of the site remediation process. After the RI/FS study process is completed, the PP will be prepared and made available with the FS for public comment. The PP highlights key aspects of the RI/FS process, provides a brief analysis of remedial alternatives under consideration, identifies the recommended alternative, and provides members of the public with information on how they can participate in the remedy selection process and provide comments on remedy selection to USACE.

The public review process for the FS and PP is illustrated in Figure 1-5. A public meeting will be held to allow the community an opportunity to provide verbal and written comments. The public comment period begins when the USACE publishes a notice of the availability, in a major local newspaper of general circulation, to inform the public that the FS and Proposed Plan documents are available for review and comment. A CERCLA Record of Decision (ROD) will follow the public comment period, in which the USACE and EPA, in consultation with the State of New Jersey, will select a remedial action for this OU at the FUSRAP Maywood Superfund Site. The ROD will include a summary of responses to all significant comments received on the remedial alternatives evaluated in the FS and the PP.

This FS is organized using guidance provided by EPA for remedial actions. The need for action, scope, description of related Federal actions, and summary of information obtained through consultations with other agencies is detailed in Section 1. Section 2 of this report describes the FUSRAP Maywood Superfund Site, its history, and its environmental setting. This section also summarizes the nature and extent of contamination from radiological and chemical materials, the transport of these materials, and results of the BRA. In Section 3, remedial action goals are defined and remedial action technologies are identified and screened for their effectiveness in meeting those goals. The development and screening of remedial action alternatives are presented in Section 4, followed by a detailed analysis of alternatives in Section 5. Section 6 lists references used in this report. Appendix A lists the applicable or relevant and appropriate requirements (ARARs) for the FUSRAP Maywood Superfund Site. In Appendix B, the cost for all the remedial action alternatives is detailed. Appendix C contains documentation regarding DOE's site-specific uranium guideline derivation, the agreement between EPA and DOE regarding site-specific cleanup criteria for the FUSRAP Maywood Superfund Site, a qualitative assessment of worker risk, and an estimate of potential exposure to the general public during remedial action.

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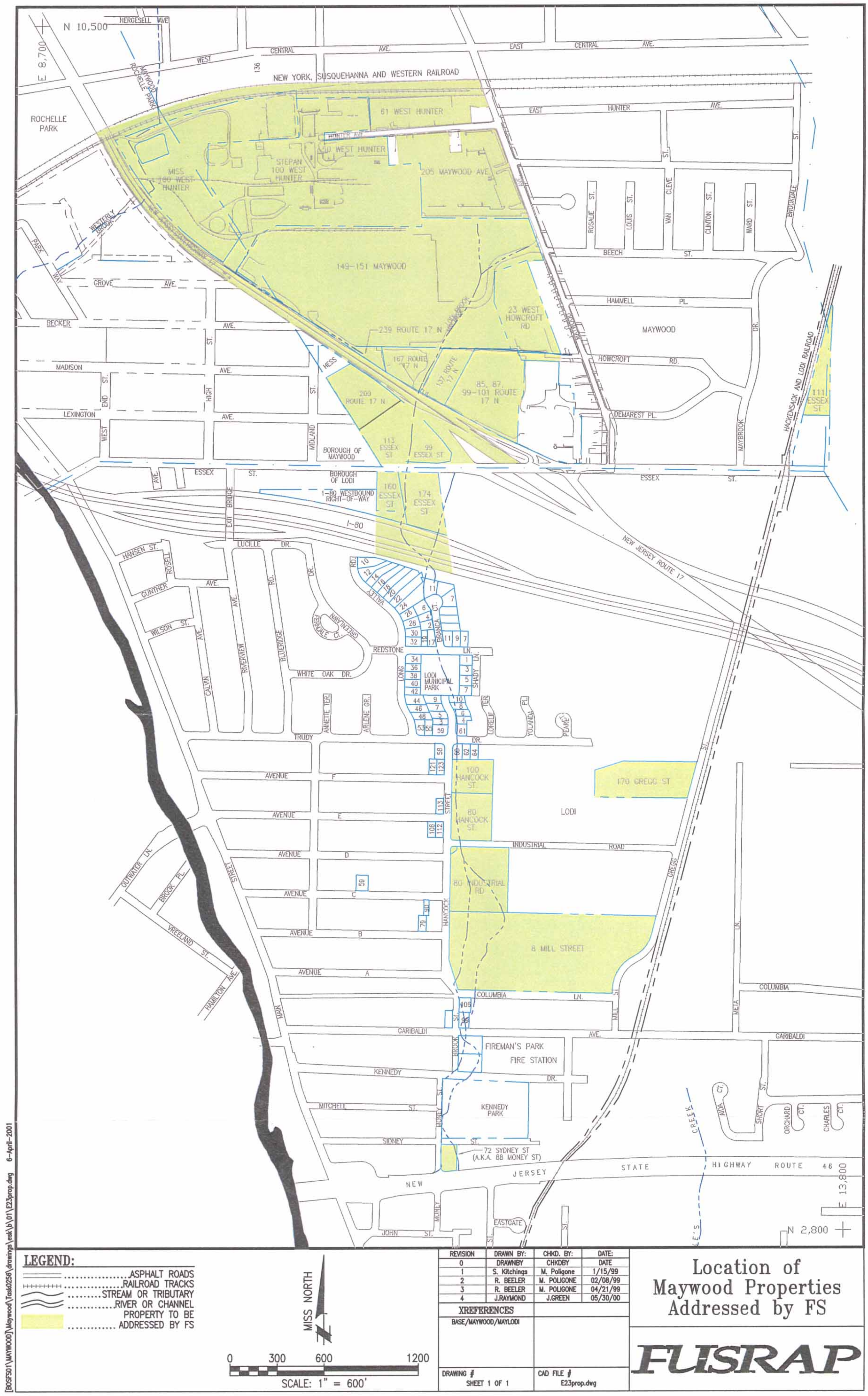

Figure 1-4. Location of Remaining Properties to be Addressed by the FS

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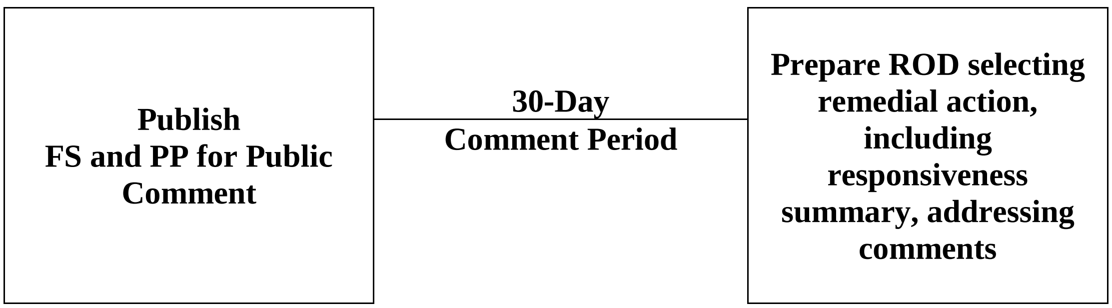

CERCLA requires a 30-day comment period; a 30-day extension may be granted upon request.

Figure 1-5. Public Review Process for the Feasibility Study and Proposed Plan

Correspondence regarding threatened and endangered species and historic preservation at the FUSRAP Maywood Superfund Site is in Appendix D. Appendix E contains a description of the thorium process used at MCW.

1.2 SCOPING

Scoping meetings help determine the range of issues to be addressed during the CERCLA process by identifying potential actions and significant issues to be addressed, the range of alternatives to be evaluated, the relevance of existing information, and areas where more information is needed.

DOE received comments on the scoping process for the FUSRAP Maywood Superfund Site at a public meeting held at the Fairmount Elementary School in Hackensack, New Jersey, on December 6, 1990. Written comments were also received within the formal comment period, which ended December 17, 1990. DOE prepared a Responsiveness Summary to address comments, questions, and public concerns mentioned during the scoping process, and integrated it with the Work Plan for the FUSRAP Maywood Superfund Site. The resulting document, placed in the administrative record in January 1993, is titled *Work Plan/Implementation Plan for the Maywood Site* (DOE 1992b). This document identified the following significant issues to be addressed in the FS: radioactive and chemical contamination; engineering and technical issues; issues related to mitigative measures and monitoring; institutional controls; socioeconomic issues; cumulative impacts associated with issues for proposed actions at the New Jersey FUSRAP sites at Maywood, Wayne, Middlesex, Deepwater, and New Brunswick (other sites with similar contamination. See Section 1.3); and issues related to the evaluation criteria to be used for selection of a remedial action (see Section 5 for a description of those criteria). Secondary issues for consideration included the precise definition of FUSRAP Maywood Superfund Site radioactive material and the extent to which disposal options were restricted. (At the time of scoping, limited commercial disposal facilities were available for radioactive waste). Assessment of the community concerns caused the USACE to reassess the remedial alternatives evaluated for the FUSRAP Maywood Superfund Site. Consideration of those concerns is reflected in the alternatives presented in this FS.

A community relations plan has been prepared and implemented to keep the public informed of activities onsite and invite community input (USACE 2001a). As part of the community relations plan, DOE established the Maywood Public Information Center, located in the Borough of Maywood, to provide information locally about activities at the FUSRAP Maywood Superfund Site. Additionally, USACE has established a website for the FUSRAP Maywood Superfund Site at www.fusrapmaywood.com. Through the community relations program, the Federal government interacts with the public through news releases, public meetings, informal meetings with local interest groups, availability sessions, reading materials, the internet website, and receiving and responding to public comments. A copy of the Maywood administrative record is maintained by the USACE at the Public Information Center, located at 75A West Pleasant Street, Maywood, NJ, and is also available on the website.

1.3 RELATED FEDERAL PROJECTS

The FUSRAP Maywood Superfund Site is one of four active New Jersey sites managed by USACE under FUSRAP. The other sites are in Wayne, Deepwater, and Middlesex. Wayne and Middlesex have environmental concerns similar to those at the FUSRAP Maywood Superfund Site. However, DOE established separate response actions, primarily because of the distances between sites [Wayne is approximately 13 miles (mi.) west, and Middlesex is approximately 32 mi. south of the FUSRAP Maywood Superfund Site] and differences in site conditions, such as geologic and hydrogeologic settings.

In addition to the CERCLA investigation conducted by the Stepan Company, EPA Region 2 conducted a CERCLA investigation at a municipal well field in Lodi. Monitoring results from the wells indicated detectable quantities of volatile organic compounds (VOCs); one well had elevated levels of radioactivity, mainly from uranium (DOE 1992b). An EPA study indicates the radioactivity was produced by a pocket of naturally-occurring uranium. EPA has issued a ROD for the Lodi well-field site which States that no further remedial action is necessary at the site.

Montclair, West Orange, and Glen Ridge in suburban Essex County in northeastern New Jersey, contain three separate radium-contaminated sites approximately 15 mi. southeast of the FUSRAP Maywood Superfund Site. The Montclair, West Orange, and Glen Ridge sites were contaminated by wastes from a radium-processing facility in Orange, New Jersey that ceased operation in the 1920s. EPA conducted a CERCLA investigation at the sites, issued a ROD, and remedial actions are being conducted by the USACE on behalf of EPA.

1.4 CONSULTATION AND COORDINATION WITH OTHER AGENCIES

Pursuant to the 1998 Energy and Water Development Appropriations Act, the USACE has assumed responsibilities from DOE as lead agency for remedial action at the FUSRAP Maywood Superfund Site. EPA Region 2 has oversight responsibilities for the Maywood Chemical Company Site, which includes both the FUSRAP Maywood Superfund Site and contamination addressed by the Stepan RI/FS. An FFA was negotiated between DOE and EPA under CERCLA Section 120 to clarify responsibilities. Coordination has also occurred with the NRC due to the NRC-licensed burial pits on Stepan Company's property. Plans and activities are also being coordinated with the appropriate New Jersey State agencies, including the New Jersey Department of Environmental Protection (NJDEP). The identification of Federal and State regulations (ARARs) that may affect site remediation is being coordinated with EPA Region 2 and NJDEP, respectively. Through community relation activities for the FUSRAP Maywood Superfund Site, the USACE also enables Federal and State legislators, local and county officials, and the general public to participate in the decision-making process for site remediation.

Federal and State agencies responsible for natural or cultural resources addressed in the FS have been consulted. These agencies include the U.S. Fish and Wildlife Service (USFWS), the New Jersey Office of Natural Land Management, and the Office of New Jersey Heritage. A copy of Federally listed and candidate species in New Jersey was provided by the USFWS and rare species information was provided by the State. No threatened or endangered species have been identified at the FUSRAP Maywood Superfund Site that would be impacted by remedial actions. Letters of consultation are provided in Appendix D.

2. THE SITE AND AFFECTED ENVIRONMENT

2.1 DESCRIPTION OF SITE

The FUSRAP Maywood Superfund Site is in a highly developed area of northeastern New Jersey in the Boroughs of Maywood and Lodi and the Township of Rochelle Park. It is located approximately 12 mi. north-northwest of New York City and 13 mi. northeast of Newark, New Jersey. The population density of this area is approximately 7,000 people/mi^2. For the purpose of developing and evaluating remedial action alternatives in this FS, the remaining properties requiring remediation at the FUSRAP Maywood Superfund Site have been divided into four property units based on land use and media of concern: MISS, FUSRAP contaminated soil on Stepan Company (including the three NRC-licensed burial pits), FUSRAP contaminated soil on the 22 commercial and government vicinity properties, and contaminated buildings/structures. Figure 1-2 shows the location of the properties comprising the FUSRAP Maywood Superfund Site. Figure 1-4 shows the remaining properties to be addressed by this FS. All FUSRAP Maywood Superfund Site properties are in Bergen County. The property units are the same as defined in the RI except for the addition of the buildings/structures property unit, and the deletion of the residential property unit [all remaining residential properties have been addressed under a recent CERCLA removal action (DOE 1995)]. Table 2-1 lists all 88 designated properties included in the FUSRAP Maywood Superfund Site grouped by property unit (including residential properties) and indicates which have been remediated by previous actions.

The FUSRAP Maywood Superfund Site consists of two OUs. This FS only addresses the remaining 24 commercial and government properties known as the Soils/Buildings OU. The second OU is the groundwater OU. Groundwater contaminated by FUSRAP waste at the FUSRAP Maywood Superfund Site is not addressed by this FS. The Soils/Buildings OU contains all soils and structures contaminated by FUSRAP waste at the FUSRAP Maywood Superfund Site. During cleanup actions on the residential properties, additional (undesignated) properties were also remediated if the contamination extended from a designated property to an undesignated property. These undesignated property cleanups are also listed in Table 2-1.

2.1.1 MISS

MISS is a 11.7-acre fenced lot that was previously part of a 30-acre property owned by the Stepan Company. The Federal government acquired MISS from the Stepan Company in 1985. MISS contains two buildings (Building 76 and a Pump House), temporary office trailers, a water reservoir, and two railroad spurs. The water reservoir and Pump House are still in use by Stepan Company. It is bounded on the west by NJ State Route 17; on the north by a New York, Susquehanna, and Western Railway line; and on the south and east by the Stepan Company property. Residential properties are located north of the railroad line and within 300 yards (yd) to the north of MISS. The topography of MISS ranges in elevation from approximately 51 to 67 feet (ft) above mean sea level. The highest elevations are in the northeastern portion of the property. Small mounds and ditches are the result of process waste that was stored by the MCW. A chain-link fence encloses the property. Access is restricted within the fenced area.

Table 2-1. Status of the FUSRAP Maywood Superfund Site Properties
(Grouped by Property Unit)

Property Unit	Property Address	Type of Property	Status
MISS	100 W. Hunter, Maywood and Rochelle Park	Federal	A
Stepan	100 W. Hunter, Maywood	Commercial	A
Commercial/ Government	149-151 Maywood Avenue, Maywood	Commercial	A
	InterState 80, Lodi: (1) east right-of-way (2) beneath road and west right-of-way	State	B A
	New Jersey State Route 17, Maywood and Rochelle Park	State	A
	167 State Rt. 17, Maywood	Commercial	A
	239 State Rt. 17, Maywood	Commercial	A
	111 Essex Street, Maywood	Commercial	A
	Lodi Industrial Railroad, Maywood	Commercial	A
	88 Money Street, Lodi	Commercial	A
	8 Mill St., Lodi	State	A
	80 Industrial Road, Lodi	Commercial	A
	80 Hancock Street, Lodi	Commercial	A
	100 Hancock Street, Lodi	Commercial	A
	170 Gregg St., Lodi	Commercial	A
	160/174 Essex Street, Lodi	Commercial	A
	99 Essex Street, Maywood	Commercial	A
	113 Essex Street, Maywood	Commercial	A
	200 State Rt. 17, Maywood	Commercial	A
	New York, Susquehanna, & Western Railway	Commercial	A
	85, 87, 99-101 State Rt. 17, Maywood	Commercial	A
	137 State Rt. 17, Maywood	Commercial	A
	23 W. Howcroft, Maywood	Commercial	A
	205 Maywood Avenue, Maywood	Commercial	A
Commercial/ Government (continued)	96 Park Way, Rochelle Park	Commercial	B
	Lodi Municipal Park, Lodi	Municipal	B
	Fire Station No. 2, Lodi	Municipal	B
	Fireman's Memorial Park, Lodi	Municipal	B
	John F. Kennedy Municipal Park, Lodi	Municipal	B
Residential	136, 142* W. Central Avenue, Maywood	Residential	B
	200 Brookdale SE, Maywood	Residential	B
	454, 459, 460, 464, 468 Davison Avenue, Maywood	Residential	B
	459, 461, 467 Latham Street, Maywood	Residential	B
	10, 22, 26, 30, 34, 38, 42 Grove Avenue, Rochelle Park	Residential	B
	86, 90 Park Way, Rochelle Park	Residential	B
	59 Avenue C, Lodi	Residential	B
	58, 59, 61, 64 Trudy Drive, Lodi	Residential	B
	60, 62 Trudy Drive, Lodi	Residential	B
	121, 123 Avenue F, Lodi	Residential	B
	3, 4, 5, 6, 7, 8, 9*, 10 Hancock Street, Lodi	Residential	B
	2, 4, 6, 7, 11 Branca Court, Lodi	Residential	B
	14, 28*, 46* Long Valley Road, Lodi	Residential	B
	16, 18, 20, 22, 24, 26, 34 Long Valley Road, Lodi	Residential	B
	11 Redstone Lane, Lodi	Residential	B
	17, 19* Redstone Lane, Lodi	Residential	B
	106 Columbia Lane, Lodi	Residential	B
	99 Garibaldi Avenue, Lodi	Residential	B
	90 Avenue C, Lodi	Residential	B
	108, 112, 113 Avenue E, Lodi	Residential	B
	79 Avenue B, Lodi	Residential	B
	5, 7 Shady Lane	Residential	B

A = Property addressed by this FS.
B = Removal action completed on property.
* = Identifies property addresses that were not originally designated, but where contamination was remediated during other cleanup activities. These properties are in addition to the 88 originally designated properties at the FUSRAP Maywood Superfund Site.

2.1.2 Stepan Company Property

The Stepan Company, a pharmaceutical and chemical manufacturer that purchased the former MCW property in 1959, is located at 100 West Hunter Avenue in the Borough of Maywood. The property covers 18.2 acres. The topography of the property has been modified into a series of terraces to accommodate construction of the operating facility. Topographic relief from the highest terrace at the north side to the lowest terrace at the south side of the property is about 25 ft. Approximately two-thirds of the property contain buildings, some in or near locations where the MCW thorium processing operations occurred. A chain-link fence encloses the property (excluding the main office and parking area) and access is restricted within the fenced area.

Land use in the vicinity of the Stepan Company property is industrial, commercial, and residential. West Hunter Avenue is lined with small businesses, as is a portion of nearby Maywood Avenue. The area east of Maywood Avenue from the Stepan property is predominantly residential. To the north and northeast, a New York, Susquehanna, and Western Railway line and numerous residential properties border the property. Various commercial properties border the Stepan Company property to the south and southwest. MISS adjoins the Stepan property on the west and northwest.

The Stepan property contains the three NRC-licensed burial pits and contains inaccessible soils underneath operating facilities. Inaccessible soils would be remediated when the landowner makes these soils accessible.

2.1.3 Commercial/Government Vicinity Properties

Twenty-seven properties comprise the commercial/government property unit (see Table 2-1). Twenty commercial properties are included in this property unit, as are four municipal properties (three parks and a fire station). State and Federally owned properties included in this property unit are rights-of-way and an embankment for InterState 80, a NJ State Route 17 embankment, and the New Jersey Vehicle Inspection Station. Two of the commercial properties (96 Park Way and 149-151 Maywood Avenue) and one government property (NJ State Route 17) were originally part of the MCW and were used for waste storage and burial. The remaining commercial and government properties were contaminated by transport of soil by surface water runoff along former stream channels or by use of contaminated material as fill and mulch. The majority of the contaminated material is soil; however, there are isolated areas where stream or wetlands sediments may be contaminated.

Five of the 27 commercial/government properties (96 Park Way and the four municipal properties) have been addressed by the recent CERCLA removal action (DOE 1995); the 22 remaining commercial/government properties are addressed by this FS. As shown on Figure 1-3, some of these 22 properties are known or suspected to have contaminated soils under permanent structures such as buildings. These soils are considered inaccessible and are also addressed in this FS; however, excavation will occur at such time when property owners make the soils accessible.

2.1.4 Residential Vicinity Properties

There are 59 designated residential vicinity properties at the FUSRAP Maywood Superfund Site, located in the Boroughs of Maywood and Lodi, and the Township of Rochelle Park (see Table 2-1). DOE identified these properties through surveys performed by Oak Ridge National Laboratory (ORNL). The residential properties were contaminated by transport of soil by surface water runoff along former stream channels or by use of contaminated material as fill and mulch. Nine Rochelle Park residential properties on Grove Avenue and Park Way, and eight Maywood residential properties on Davison Avenue and Latham Street, were remediated by DOE between 1984 and 1986, and verified for use without radiological restriction. Eight residential properties in Lodi were also remediated and independently verified during this time. In 1995, DOE published an Engineering Evaluation/Cost Analysis (EE/CA) for the Cleanup of Residential and Municipal Vicinity Properties at the FUSRAP Maywood Superfund Site (DOE 1995). Cleanup of these properties was initiated in 1995 and completed during 2000. No residential vicinity properties are included in the scope of this FS; all have been addressed by prior removal actions (DOE 1995). However, residential streets, assumed to be underlain by contaminated soil, are included with other inaccessible soils in the commercial/government property unit of this FS.

2.1.5 Buildings/Structures on Stepan

Based on radiological survey data, the buildings/structures property unit includes contaminated buildings on the Stepan property (Buildings 4, 10, 13, 15, 20, 67, 78, and the guard house). Additional surveys will be conducted prior to remedial action to further define the extent of decontamination necessary to achieve building cleanup levels. In all contaminated buildings, the radioactivity detected is fixed in place, and is not transferable.

Transferable radiation on a building surface poses more risk than fixed contamination of the same concentration. This is because transferable radiation can be readily removed from a surface by casual contact, and thus provides more routes for human exposure than fixed contamination (i.e., ingestion, dermal contact, inhalation, and direct gamma). Fixed contamination is defined as radioactive contamination that cannot be removed by casual contact, rubbing, air movement or vacuuming. Fixed contamination is typically located under painted surfaces and can only be removed through abrasive decontamination techniques (i.e., wire brushing, sanding, scabbling, etc.). The primary route of exposure for fixed contamination is direct exposure to gamma radiation.

The contaminated buildings on Stepan, which existed during the time that MCW was processing thorium, are currently part of an active industrial complex utilized by Stepan. No buildings on other vicinity properties were found to be contaminated, other than a residence in Lodi that contained building materials taken from MCW. The residence was cleaned up and reconstructed in 1991 as part of a DOE time-critical removal action. Contaminated soils are known or suspected to be located beneath many of the non-contaminated permanent buildings and structures located on MISS, Stepan, and the commercial/government properties. Depending on the conditions and use of the structures, some of the buildings may be demolished to access the underlying contaminated soils.

2.2 SITE HISTORY

The original plant, which became known as the MCW after incorporation on December 24, 1918 under the laws of the State of New Jersey, was constructed in 1895. The principal products manufactured by MCW were chemicals used in the pharmaceutical, food, glass, soap, and metals industries (Barnum 1942). Starting in 1916, the plant was used to extract thorium and rare earth metals from monazite sands for use in manufacturing industrial products, such as mantles for gas lanterns. Thorium and rare earth metals were extracted from the monazite sands using an acidic separation process. The wastes from this process were pumped as slurry to holding ponds. Wastes from these ponds were later transferred into burial pits 1 and 2. The liquid portions of the ponds containing the thorium and rare earth metals were separated from the tailings, and thorium was separated from the rare earth metals. Some concentrated thorium residues were pumped into a holding pond where the thorium portion of the residues was precipitated as a phosphate. Wastes from this holding pond were later transferred into burial pit 3 (Figure 2-1).

Process wastes from the thorium extraction operations were pumped into two areas surrounded by earthen dikes on property west of the plant (Cole et al. 1981). In 1932, the disposal areas were partially covered by the construction of NJ State Route 17 (Figure 2-2). Waste retention ponds existed on portions of MCW that now comprise 96 Park Way, MISS, and 149-151 Maywood Avenue.

MCW also produced detergents, alkaloids, essential oils, and lithiated compounds, including lithium chloride and lithium hydroxide. MCW owned and operated mining properties in the vicinity of Keystone, South Dakota, which produced lithium ore that was transported to the MCW and processed (Bradford 1942). Lithium wastes were believed to have been disposed in diked areas on the MCW. Protein extraction from leather digestion was also performed on the MCW. Leather wastes are believed to have been buried in two primary shallow disposal areas on Stepan, just east of the MISS property boundary (CH2MHill 1994b).

According to a 1942 memorandum (Bradford 1942), the products manufactured by MCW could be broken down into six major groups as described below: aromatics, flavorings, lithium metal and salts, pharmaceuticals, rare earth salts, and miscellaneous products.

- The principal products of the aromatic group are Ionone and Iraldiene (methylated Ionone) and were used mainly in the soap industry. The raw material, for the most part, consisted of lemongrass oil imported from India.

- The principal products of the flavorings group were Coumarin (manufactured by MCW as a coal tar derivative), and Vanillin, which is a synthetic vanilla made from cloves imported by MCW from Zanzibar. Vanillin was also synthesized from ortho-anisidene and para-phenetidene.

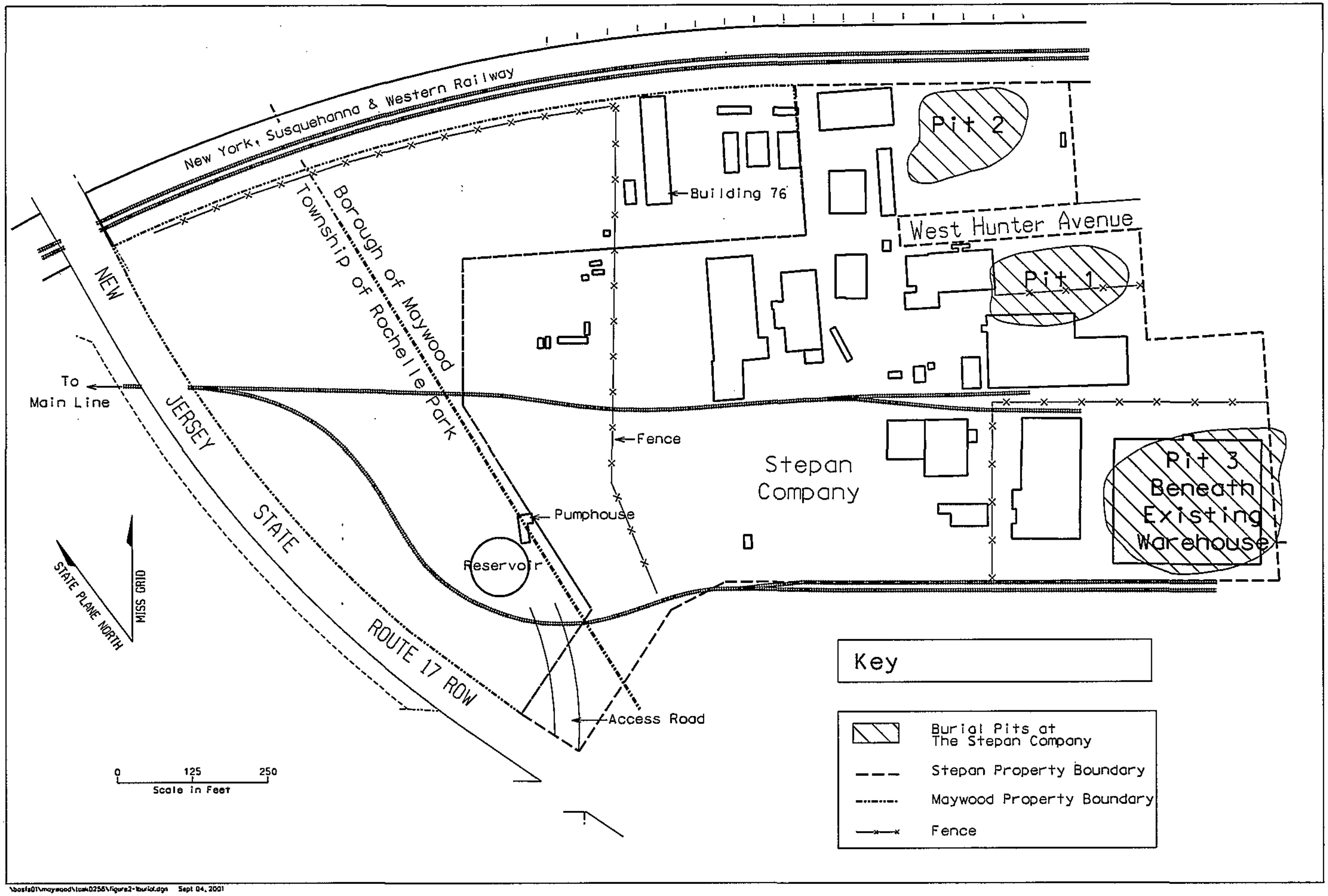

Figure 2-1. Location of the Stepan Company Property and MISS Showing Burial Pits on the Stepan Company Property

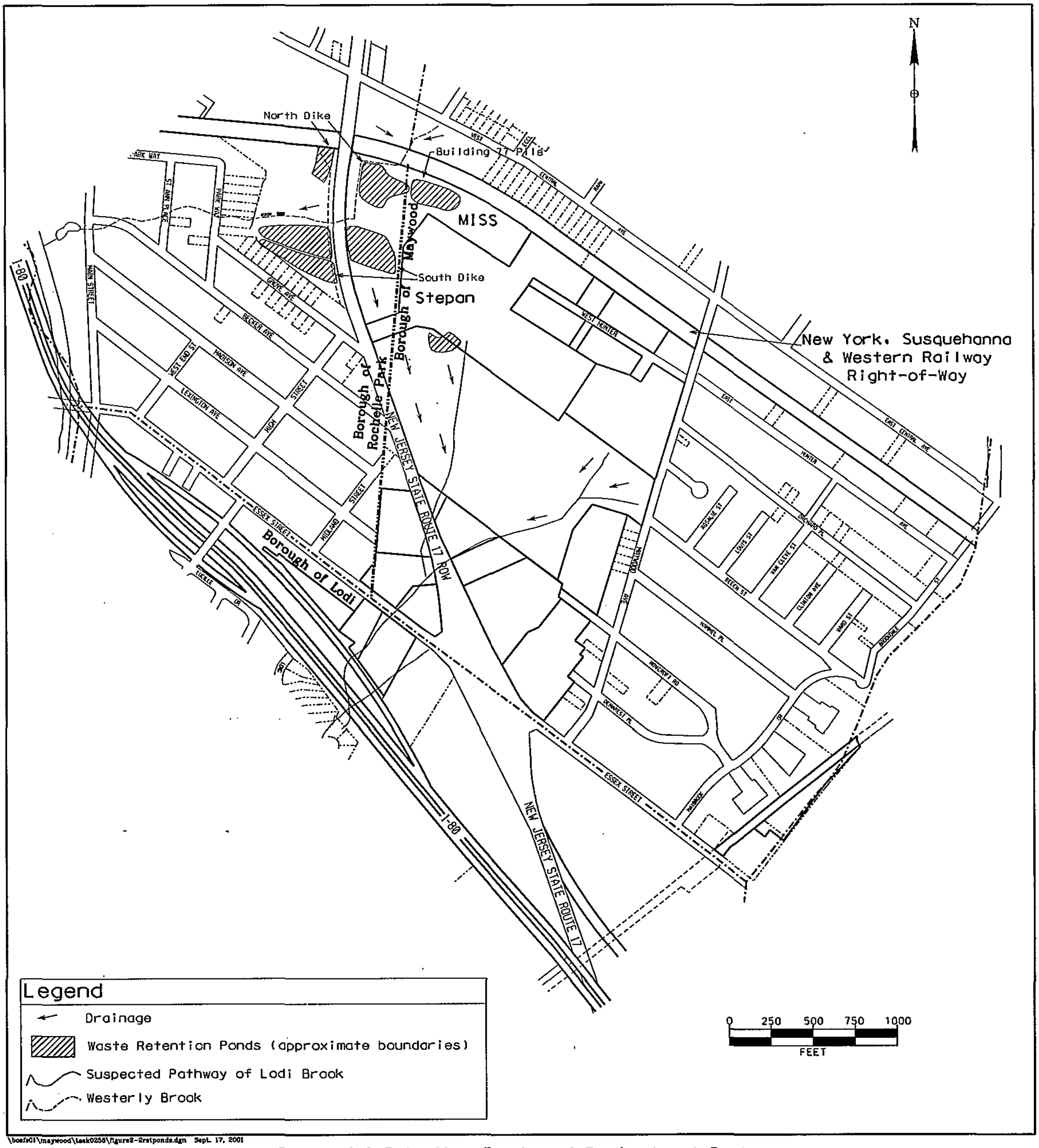

Figure 2-2. Retention Ponds and Predominant Drainage Pathways at the FUSRAP Maywood Superfund Site

- Lithium was manufactured by MCW in at least thirty forms. Spodumene ore was brought from mines owned and operated by the company in South Dakota; lithium was then extracted from the ore at MCW. Lithium was used for the purification of other metals, for the manufacture of storage batteries, and for military purposes.

- The principal pharmaceuticals manufactured by MCW were quinine, cocaine, theobromine, acetanilid, and caffeine.

- Rare earth salts were derived from monazite sands that MCW imported, primarily from India. The most important rare earths manufactured by MCW were cerium, lanthanum and neodymium. These products were used, for the most part, by the glass industry. Thorium was also derived from the monazite sands, and sold for use in the manufacturing of thorium mantles for lanterns.

Process wastes from these manufacturing processes were generally stored in open piles and retention ponds on the MCW property. Some of the process wastes were removed for use as mulch and fill on nearby properties, thereby contaminating those properties with radioactive thorium (Mata 1984). Although the fill consisted primarily of tea and coca leaves from other MCW processes, these materials were apparently contaminated with the thorium-processing wastes.

Additional waste migrated off the property via natural drainage associated with the former Lodi Brook (Figure 2-2). Historical photographs and maps indicate that the former course of the brook, which originated on the MCW property in the area that is now 149-151 Maywood Avenue, generally coincides with the distribution of contaminated properties in the Borough of Lodi. Most of the open stream channel in Lodi was replaced by a storm-drain system in the 1960s.

MCW stopped extracting thorium in 1956, after approximately 40 years of production. The property was subsequently sold to the Stepan Company in 1959.

In 1961, the Stepan Company was issued an AEC (The AEC was a predecessor agency to the NRC; licensing activities of the AEC were transferred to the NRC when the NRC was created by the Energy Reorganization Act of 1974, Public Law 93-438 [1974]) radioactive-materials storage license based on AEC inspections and information related to the property on the west side of NJ State Route 17 (known as the 96 Park Way property). Stepan began to clean up residual thorium wastes. From 1966 through 1968, Stepan removed residues and tailings from the area east of NJ State Route 17 and in the 96 Park Way property, and reburied them on the Stepan property in burial pits 1, 2, and 3 (Figure 2-1). In 1968, AEC conducted a survey of the area west of NJ State Route 17 and certified it for use without radioactive restrictions. At the time of the survey, AEC apparently was not aware of waste materials still present on the property. The Stepan property west of NJ State Route 17 was sold in the same year to a private citizen who later sold it to Ballod Associates in the 1970s (Cole et al. 1981).

The presence of radioactive materials in the northeast corner of the 96 Park Way property was discovered in 1980, after a private citizen reported the presence of radioactivity near NJ State Route 17 to the NJDEP. A survey of the area (NJ State Route 17, 96 Park Way property, and Stepan property) conducted by the NJDEP found thorium-232 and radium-226. The NRC was notified of the results and undertook additional surveys from November 1980, to January 1981. These surveys confirmed high concentrations of thorium-232 in soil samples collected from both the Stepan and 96 Park Way properties (NRC 1981). Accordingly, the NRC requested a comprehensive survey of the area. The NRC was notified because of their involvement with Stepan's licensed thorium activities and the AEC's previous release of the area west of NJ State Route 17 for use without radiological restrictions.

In January of 1981, NRC had an aerial radiological survey performed (Figure 2-3) for the Stepan property and surrounding properties (EG&G 1981). The survey, which covered a 3.9-mi^2 area, indicated the presence of radioactivity not only on the Stepan and 96 Park Way properties, but also in areas to the north and south of the 96 Park Way property. During February of 1981, the NRC also performed a separate radiological ground survey of the 96 Park Way property (Cole et al. 1981), the results of which eventually led to its designation for remedial action under FUSRAP (Coffman 1983). An additional radiological survey of the Stepan and 96 Park Way properties, commissioned by the Stepan Company, produced similar findings (Morton 1982).

By enacting a provision of the fiscal year 1984 Energy and Water Development Appropriations Act, Congress authorized DOE to undertake a decontamination research and development project at the FUSRAP Maywood Superfund Site in late 1983. Accordingly, the site was assigned to the FUSRAP, and the DOE obtained access to a 11.7-acre portion of the Stepan property for use as an interim storage facility for materials that were to be removed from vicinity properties. This area is now known as MISS. In late 1983, DOE began surveys of properties in the vicinity of the former MCW plant.

In 1984 and 1985, DOE conducted removal actions on 25 properties and placed the waste in a temporary storage pile on the MISS. At that time, commercial disposal facilities were not available for the volume of radioactive waste generated by the cleanup. In September of 1985, ownership of the MISS was transferred to the Federal government. By September 1994, commercial disposal facilities became available, and DOE published an EE/CA evaluating several potential removal alternatives. DOE then selected a non-time critical removal action in an Action Memorandum for the removal of the interim waste storage pile to such a facility. This removal was initiated in 1994, and completed in 1996. In September 1995, DOE published an EE/CA evaluating removal alternatives for all residential, one commercial, and four municipal properties. This action was initiated in 1995, and was completed in 2000.

The following provides a chronology of the MCW and the Stepan Chemical radioactive license history. This information was obtained from documents provided in the NRC license docket; the majority of the information is from Report No. 40-8610/80-01.

3/9/54 MCW applies to AEC for a license to process thorium.

4/1/54 License R-103 issued; scope includes possession, processing, and re-sale.

9/56 Processing of monazite sands for rare earths and thorium ceases.

12/1/57 License R-103 expires.

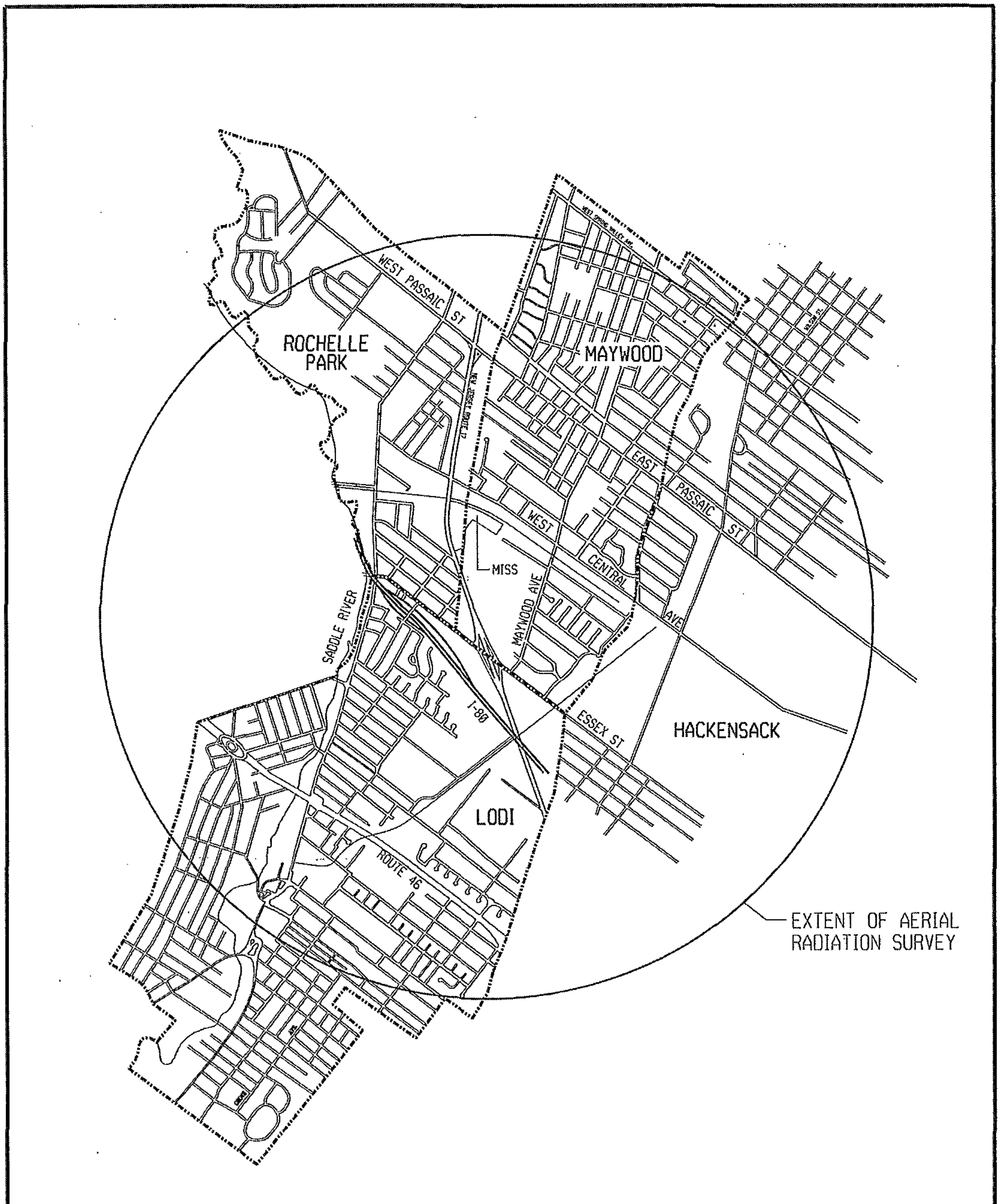

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Figure 2-3 DOE Aerial Radiological Survey at Maywood

1959	Stepan Chemical Company buys MCW.
12/23/59	Stepan submits Application Form AEC-2 for license "to cover our operations as processors and exporters of source material," States "active manufacturing in the Thorium Plant is at a stand still."
2/28/61	Stepan Chemical Company applies for renewal of license R-103.
3/7/61	License STC-130 issued to Stepan Chemical Company for possession and sale of existing thorium inventory only.
8/30/63	AEC inspection identifies residues and tailings behind dikes as "slurry piles."
1963	Sale of inventory of remaining thorium products to Davidson Chemical, Pompton Plains, NJ.
11–12/66	Waste moved from area east of NJ State Route 17 ("Building 77 Pile") to Burial Pit #1 (located in Stepan's front lawn and containing 8,358 yd^3) without prior notification to the AEC.
7–8/67	Waste moved from area east of NJ State Route 17 to Burial Pit #2 (located in parking lot and containing 2,053 yd^3) without prior notification to the AEC.
10/18/67	AEC inspection – licensee cited for unauthorized burials in Burial Pits #1 and #2.
2/28/68	Licensee requests permission to relocate additional wastes.
3/19/68	AEC grants permission to relocate wastes.
6–7/68	Waste moved from South Dike (west of NJ State Route 17) to Burial Pit #3 (8,600 yd^3 located under the current Stepan Building #3).
8/15/68	Licensee requests release for unrestricted use of certain areas where wastes were removed to burial areas.
9/4/68	AEC conducts closeout survey of the area west of NJ State Route 17.
9/9/68	AEC releases two areas, including the South Dike, for unrestricted use.
1972	License STC-130 expired; Stepan did not renew it.
1974	Warehouse (Building #3) constructed over Burial Pit #3 after a minimum of 1 foot of additional cover was added to make the area level.

1976	AEC, prompted by a Government Accounting Office (GAO) investigation of old AEC records, contacted Stepan about its lapsed source material license, and inspected the first two burial pits in late 1976. Burial Pit #3 was inadvertently left out of NRC's inspection. Note that this investigation was initiated by AEC, but then completed by NRC, the successor agency to AEC.
1977–78	Stepan applied for a new license at the AEC's request. Only the material in the first two burial pits was mentioned in the application. The AEC issued License No. STC-1333, which required Stepan to comply with all the representations made in its application.
9/29/80	NJDEP receives a letter from a private citizen reporting radioactive contamination in an area near NJ State Route 17 in Rochelle Park, New Jersey.
10/8/80-	Surveys and soil sample analysis by the NJDEP identified the presence of radioactive material in the form of thorium-232 and radium-226.
11/5/80	NRC was notified of these findings by NJDEP by telephone.
11/80	In response to the reported contamination, NRC Region I inspectors conducted a series of surveys both on the licensee's facility and in the immediate vicinity. The surveys confirmed the report by the private citizen and the surveys by the State of New Jersey. The inspectors found offsite contamination on property formerly owned by the licensee, and onsite contamination in areas outside the licensed burial pits. The radioactive materials, both onsite and offsite, appeared to be either a white or yellow clay-like material, quite different from the local brown sandy dirt. The presence of Burial Pit #3 was re-discovered by NRC.
12/80	NRC presents radiation survey information to mayors of Maywood and Rochelle Park and the local press, and holds public meetings in Rochelle Park and Maywood.
12/80-1/81	Additional inspections of Stepan and offsite properties conducted by NRC.
4/29/1981	NRC issues Notice of Violation (NOV) to Stepan Chemical Company. Two Severity Level IV violations were identified: the presence of additional licensed material in Burial Pit #3, and contamination at other locations, both on and offsite, resulted in a license violation. The second violation was issued because contaminant levels in unrestricted areas were exceeded.
8/14/81	Stepan submits application for an amendment to Source Material License, No. STC-1333, to cover burial of material at Burial Pit #3.

10/26/81 $20,000 civil penalty imposed by NRC on Stepan Chemical Company for knowingly withholding information regarding Burial Pit #3.

1/7/82 Amendment No. 1 to License No. STC-1333 authorizing the storage of thorium residues in Burial Pit #3 is issued to Stepan Chemical Company.

3/12/82 Amendment No. 2 to License No. STC-1333. Letter authorizes amendment of Stepan Source Material License No. STC-1333 "to authorize storage of approximately 4000 yd^3 of thorium residues as described in the application and supplements (dated November 10, 1981, and January 8 and 14, 1982) subject to certain conditions. This would have formed the fourth burial pit, however, the material was not moved.

2/1/83 Stepan applies for renewal of License No. STC-1333.

1983 EPA lists Maywood Chemical Company Site on the Superfund NPL; Congress assigns DOE responsibility for cleaning up the radioactive-related wastes at the FUSRAP Maywood Superfund Site (via the FY84 Energy and Water Development Appropriations Act).

1984 DOE was authorized to conduct a remedial research and development demonstration at the "Maywood Site" (Stepan Chemical Company and vicinity properties) through the FY84 Energy and Water Development Appropriations Act.

1985 DOE and Stepan enter into a cooperative agreement to decontaminate the Stepan property. Under the cooperative agreement, Stepan maintains the existing NRC license for the storage of radioactive material in three burial pits. The NRC license will be terminated subject to approval by the NRC.

11/5/87 Amendment No. 3 to License No. STC-1333 issued to Stepan Company. Amendment No. 3 extended the expiration date of License No. STC-1333 to April 30, 1992. A current license amendment or renewal application requesting extension of License No. STC-1333 from 1992 onward could not be found in the docket records.

The requirements of the license include:

1. Monitoring groundwater semi-annually at each burial pit,
2. Performing surface radiation measurements annually at each burial pit, and
3. Performing an annual cap inspection.

This amendment specifically references the cooperative agreement and Phase II activities being conducted by DOE in the mid-1990s.

4/5/95 NRC issues a NOV to Stepan for groundwater monitoring violation under License No. STC-1333.

4/25/95 Stepan responds to groundwater monitoring violation with a corrective action and the NOV is closed.

11/20/96 Letter to NRC from Stepan requesting postponement of decommissioning activities. Stepan's justification for postponement:

1. The material presents no risk in its present circumstance,
2. The removal of the material at this time would not provide the lowest reasonably achievable exposure potential, and
3. The DOE has responsibility under FUSRAP to remove thorium residue from the FUSRAP Maywood Superfund Site.

2/10/97 Letter to Stepan from NRC. NRC grants approval for postponement of the three burial pits decommissioning activities authorized under license. Postponement of Stepan performing decommissioning activities was granted until DOE initiates decommissioning of burials.

12/28/98 Letter from John O'Brien (Stepan) to John Hickey (NRC). Letter indicates Stepan's position in regard to license renewal and decommissioning. Pending USACE decommissioning of its FUSRAP Maywood Superfund Site, Stepan's understanding is that its radioactive materials license does not currently require renewal. At publication of this document, USACE has not seen an NRC response to Stepan's letter.

4/12/01 Consultations between USACE and NRC regarding NRC's classification of radiologically contaminated soil pertaining to acceptable offsite disposal options and facilities.

9/20/01 Letter from Martin Virgilio (Director Office of Nuclear Materials Safety and Safeguards) to Jonathan P. Carter, Esq. (Envirocare of Utah, Inc.).

2.3 ENVIRONMENTAL SETTING

2.3.1 Institutional Environment

The FUSRAP Maywood Superfund Site is located in three communities: the Borough of Maywood, the Borough of Lodi, and the Township of Rochelle Park. The Borough of Maywood is governed by a Mayor and council, as is the Borough of Lodi. The Township of Rochelle Park is managed by a Township committee, which includes the Mayor as one of its members.

DOE was assigned authority for the FUSRAP Maywood Superfund Site by the Energy and Water Appropriations Act of 1984, following the addition of the Maywood Chemical

Company Site to the EPA's NPL. Representatives of DOE subsequently met with local officials to obtain background information about the site and community concerns, and to discuss planned cleanup actions.

A memorandum of understanding between DOE and the Borough of Maywood was executed in August 1984. This agreement addressed properties scheduled for cleanup, establishment and monitoring of the MISS (where the excavated soils from cleanups would be stored), and efforts to locate a permanent disposal site within the State of New Jersey. State officials were also asked to assist in the location of a permanent disposal site, but indicated that no such disposal site existed and no community could be identified as willing to host such a site.

During 1984 and 1985, approximately 35,000 yd^3 of soil were removed from contaminated properties in Rochelle Park and Maywood. These materials were stored within a protective geotextile membrane and covering at MISS. During this time, citizens and officials at Maywood became concerned that the storage site would become permanent. A group of Maywood residents formed the Concerned Citizens of Maywood (CCM), which later became an advisory group to the Mayor and Council of Maywood. CCM was also awarded a $25,000 EPA Technical Assistance Grant that they used to fund a consultant to assist with understanding technical issues.

In December 1990, the DOE held a public meeting regarding the environmental cleanup process. Residents and public officials had an opportunity to express opinions and to make recommendations about the cleanup and disposal of the radioactive soils at MISS and the vicinity properties. Also during 1990, a FFA was negotiated between EPA and DOE which outlined the regulatory and procedural requirements for investigation and cleanup of the FUSRAP Maywood Superfund Site, with EPA oversight under CERCLA (Superfund).

Because of community concerns, the Agency for Toxic Substances and Disease Registry (ATSDR), in cooperation with the New Jersey Department of Health and Senior Services, conducted a health assessment in the Maywood area in 1990. The assessment cited a need for a more thorough study, as characterization-sampling data became available for the FUSRAP Maywood Superfund Site properties. In 1992, the ATSDR began an update to the earlier study that concluded the FUSRAP Maywood Superfund Site posed no increased health risks to the community under the current conditions. The ATSDR performed a health consultation and issued a report in 1993. The report Stated no adverse health effects could be attributed to exposure to contamination from the FUSRAP Maywood Superfund site. Another ATSDR health consultation was conducted in 1995, and could draw no conclusions associating an increased incidence of adverse health effects in populations which may have been exposed at the FUSRAP Maywood Superfund site.

During 1993, EPA and DOE disagreed about the cleanup criteria that should be applied to the radioactive materials still at the FUSRAP Maywood Superfund Site. DOE and EPA primarily disagreed on the criteria that should be applied to the soils. The dispute was resolved in 1994 in a document known as the "Dispute Resolution" with site-specific cleanup criteria set at an average of 5 pCi/g combined radium-226 and radium-228, above background, for residential properties. For commercial properties, a higher cleanup criteria of an average of 15 pCi/g combined radium-226 and radium-228, above background, was established. USACE has determined that attainment of these cleanup levels will assure compliance with the relevant and substantive requirements of the State of New Jersey radiation dose standards for the remediation of radioactive contaminated properties. Note that the quantity of thorium-232, the principal contaminant at the FUSRAP Maywood Superfund Site, is estimated by measuring radium-228, which is in the thorium-232 decay chain. Please see Section 3.2.1.1 for more details on using radium-228 data to estimate quantities of thorium-232. The terms of the EPA-DOE Dispute Resolution regarding cleanup criteria for the FUSRAP Maywood Superfund Site are provided in Appendix C.

Also in 1994, the DOE initiated discussions about a radioactive soil treatment technology called soil washing with EPA, NJDEP, and the local community. Soil washing is a technique that separates radioactive soil particles from clean soil particles. At the time, the community strongly opposed soil washing, and specifically onsite use of soil washing. DOE had planned to conduct pilot-scale treatment studies at the FUSRAP Maywood Superfund Site in 1994, but agreed not to do so in response to the strong community opposition. Pilot-scale treatment tests were subsequently conducted at a DOE facility in Oak Ridge, Tennessee, in October 1995, using soils from the interim storage pile.

During 1996 and 1997, DOE and a steering committee of local community officials established a community group called the Cooperative Guidance Group (CGG). This group was established to involve a diverse cross section of the community in the cleanup decisions for the remaining commercial/government properties at the FUSRAP Maywood Superfund Site. While currently inactive, this group met monthly during 1997 and 1998, with DOE, the USACE, regulators, and the interested public also participating.

2.3.2 Current Land Use

Land use planning is guided principally by Municipal Land Use Law (Chapter 291, Laws of New Jersey, 1976) which requires that every six years, municipalities will re-examine and update their Master Plan and development regulations. It establishes rules, regulations, and procedures for creating municipal planning and zoning boards. It also provides these boards with guidelines for creating zoning ordinances, master plans, and other planning tools. The Borough of Maywood Master Plan was last revised in 1995, and the Borough of Lodi Master Plan was last revised in 1994.

2.3.2.1 Borough of Maywood

Land use at MISS, Stepan, and the 14 vicinity properties located in the Borough of Maywood is currently zoned for limited light industrial activities, except for a small strip of land adjacent to Maywood Avenue, which is zoned for residential use (Figure 2-4). Industrial land uses comprise about nine percent (%) of the total land area of the Borough of Maywood, and includes four districts zoned limited light industrial. This classification permits light manufacturing operations, as well as the related functions of processing, wholesaling, warehousing, and storage of goods.

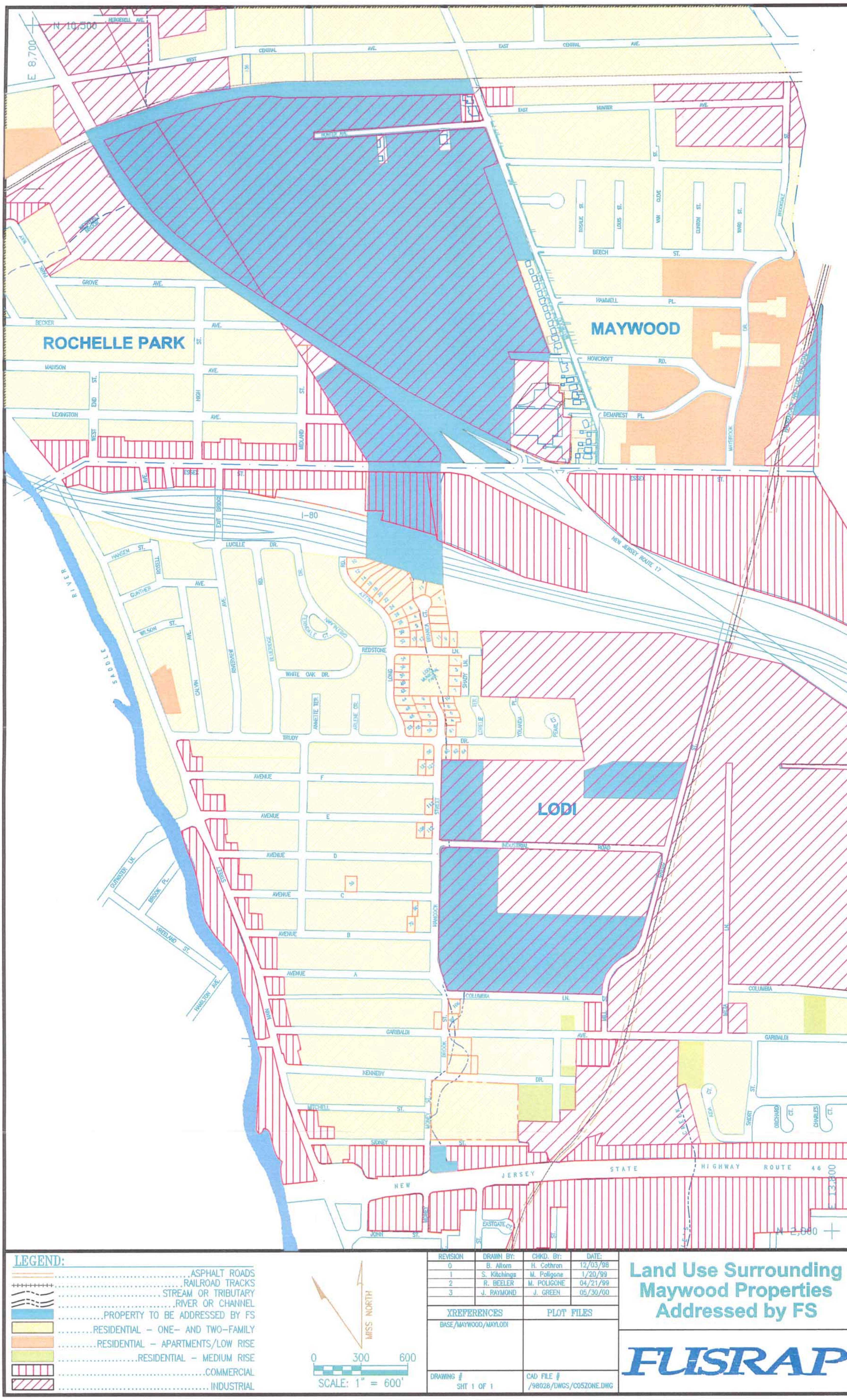

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Figure 2-4. Zoning Boundaries for the Northern and Southern Properties

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2.3.2.2 Borough of Lodi

Land use on the eight vicinity properties located in the Borough of Lodi is currently zoned for commercial and industrial use (Figure 2-4). Commercial and industrial land uses comprise about 15 and 13 %, respectively, of the total area of the Borough of Lodi. These vicinity properties are contained within defined commercial and industrial land use areas, however, many properties are located immediately adjacent to residential or recreational use areas. The commercial use classification in Lodi permits smaller commercial buildings, convenience stations, planned shopping centers, auto-related establishments, retail stores, and restaurants. The industrial use classification permits food processing and manufacturing, automotive-related uses, communications, and a variety of light manufacturing, office, and warehouse use.

2.3.3 Future Land Use and Institutional Controls

Reasonably anticipated future use of the land at the FUSRAP Maywood Superfund Site is an important consideration in determining the appropriate extent of remediation. Future land use will affect the types and the frequency of exposures that may occur from any residual contamination remaining on the FUSRAP Maywood Superfund Site, which in turn affects the nature of the remedy chosen. Conversely, the alternatives selected through the CERCLA remedy selection process determine the extent to which hazardous constituents remain at the site, and therefore affect subsequent available land uses. The factors used to determine the reasonably anticipated future land use were as follows:

- Current land use
- Reasonable foreseeable future land use
- Comprehensive community master plans
- Population growth patterns and projections (e.g., Bureau of Census projections)
- Institutional controls currently in place
- Site location in relation to urban, residential, commercial, industrial, agricultural and recreational areas
- Federal/State/local land use designation
- Historical development patterns

These criteria were used to evaluate the Soils/Buildings OU properties addressed by this FS in the Boroughs of Maywood and Lodi as discussed below.

2.3.3.1 Borough of Maywood

Historically, the southern area of Maywood has been zoned for light industrial use, and continues to experience an increase in population. The Maywood Master Plan has a well-defined industrial development area and the properties addressed by this FS are all located inside that zone. This light industrial area is separated from a mixture of residential, commercial, and light industrial properties by the New York, Susquehanna, and Western Railway to the north; InterState 80 to the west; Essex Street to the south; and Maywood Avenue to the east. The Maywood Master Plan recommends maintaining the light industrial zoning classification for all properties except for MISS, where a commercial, high rise zoning designation has been recommended.

From 1970 to 1990, the total population of Maywood, and Bergen County as a whole, declined, and then experienced a slight population increase from 1990 to 2000. This 20-year period of population loss has been attributed to a decrease in household size rather than emigration. Maywood is a community that is 98% developed, with very little vacant or unused land. However, there is vacant land in other parts of Bergen County, allowing for some growth in the county. A review of population characteristics and development projects within the area has indicated a generally stable Borough population through 2000. The July 1998 Census Bureau population estimate for Bergen county is 858,529, a 4% increase since 1990. This same report estimates the population for the Borough of Maywood at 9,694, a 1.7% increase since 1990. Because of this, no major increase in demand for additional housing is anticipated.

No cultural resources, environmental justice issues, wetlands, floodplains, or critical habitats of endangered or threatened species have been identified that would impact the current limited light industrial zoning.

2.3.3.2 Borough of Lodi

The remaining Lodi contaminated vicinity properties have historically been zoned commercial and industrial. The Lodi Master Plan has well-defined commercial and industrial development areas. The Master Plan recommends maintaining the current land uses for all properties.

From 1970 to 1990, the total population in Lodi and Bergen County as a whole, declined, and then experienced a slight population increase from 1990 to 2000. As of July 1998, the Census Bureau population estimate for the Borough of Lodi is 22,917, a 2.5% increase since 1990. Because the population of much of the surrounding area is expected to remain stable, no major increase in demand for additional housing is anticipated.

No cultural resources, environmental justice issues, wetlands, floodplains, or critical habitats of endangered or threatened species have been identified that would impact the current commercial or industrial zoning.

2.3.3.3 Reasonably Anticipated Future Land Use and Selection of Cleanup Criteria

Even though EPA and DOE’s dispute resolution set cleanup levels at the current land use (i.e., all commercial for Phase II), USACE and EPA have agreed that the reasonably anticipated future land use should be considered in determining the cleanup criteria for a particular property. USACE evaluated a number of factors in determining what cleanup criteria would be appropriate for Phase II properties. These factors include:

- Current land use,
- Reasonable foreseeable future land use,
- Comprehensive community master plans,
- Population growth patterns and projections (e.g., Bureau of Census projections),

- Institutional controls currently in place,
- Site location in relation to urban, residential, commercial, industrial, agricultural and recreational areas,
- Federal/State/local land use designation, and
- Historical development patterns.

While varying at individual properties, the volume of soils requiring removal at a particular property to cleanup to the unrestricted use criteria is expected to be approximately double the volume required to be removed under a restricted use cleanup criteria. This assumption is based on USACE's experience with remediation at the Phase I properties, and a detailed analysis of Phase II subsurface investigation data. Impacts to individual property owners during remediation would likely also be more extensive under the unrestricted criteria, as the duration and extent of excavation would increase. The additional cost and impact to the community of a more extensive cleanup is not warranted for those properties which are unlikely to be converted to residential use in the future, such as the well defined commercial triangle in Maywood (containing the MISS, 149-151 Maywood Avenue, and Stepan Company), and the transportation corridors (highways, streets, and railroad tracks). Therefore, USACE believes that institutional controls can be used to restrict the future use of these properties as necessary, so that cleanup to a restricted standard is effective in the long term.

The area currently occupied by MISS, Stepan Company, and 149-151 Maywood Avenue has been under industrial use for more than 100 years. The limitations on available industrial property in the area are likely to result in continued industrial use of these properties.

The selection of the cleanup criteria to be used on an individual property will be based upon an assessment of the factors listed earlier in this section. For those property owners who intend to retain future restricted use of their properties, implementation of the restricted use criteria is likely to provide benefits by reducing impacts such as loss of business during remediation. Reasonably anticipated future land use, and recommended cleanup criteria for individual properties are listed on Table 2-2. Remedial action objectives (RAOs) will be identified in Chapter 3 in order to develop alternatives that would achieve the appropriate cleanup criteria associated with the reasonably anticipated future land use. Because residential use of seven Phase II properties is unlikely in the future, USACE is proposing restricted use cleanup criteria for these properties with the placement of institutional controls (e.g., easements, covenants, notification procedures, zoning controls, etc.) as necessary on the properties, assuring that future land use will remain commercial. USACE plans to remediate the remaining 17 commercially zoned properties to the unrestricted use criteria used on the Phase I properties because these properties are in close proximity to residential land use and/or have the greatest potential in the future to be residentially developed.

2.3.3.4 Institutional Controls

Institutional controls are used to limit exposure and assure long-term effectiveness and permanence of a chosen remedy when it is determined that an unrestricted use remedy/criteria is either cost prohibitive or not feasible for a site. Institutional controls may include "proprietary" controls such as easements, and "governmental" or "regulatory" controls such as covenants, zoning ordinances, permit requirements, and notification advisories (to make the Federal

Table 2-2. Reasonably Anticipated Future Land Use and Recommended Cleanup Criteria

Property	Reasonably Anticipated Future Land Use	Recommended Cleanup Criteria	Factors to Consider during Remedial Design when Selecting Appropriate Controls
Borough of Maywood			
MISS	Limited light industrial	Restricted use	Property is Federally-owned; former MCW waste burial location; significant volumes of contamination present; industrial use for over 100 years
Stepan	Limited light industrial	Restricted use	Property is the site of former MCW and current chemical manufacturing company; significant volumes of contamination present; industrial use for over 100 years; presence of inaccessible soils
23 Howcroft Rd.	Limited light industrial	Unrestricted use	Significant volumes of contamination present; although industrial use for over 40 years, because of location, future residential use is possible; proximity to residential properties; presence of inaccessible soils
149-151 Maywood Ave.	Limited light industrial	Restricted use	Property is site of former MCW and current distribution warehouse; significant volumes of contamination present; industrial use for over 100 years; presence of inaccessible soils
205 Maywood Ave., 50 and 61 West Hunter	Limited light industrial	Unrestricted use	Minimal volume of contamination present; no inaccessible soils. Neighbors Stepan Company and is part of well-defined Maywood commercial/light industry district.
137 NJ State Route 17	Limited light industrial	Unrestricted use	Moderate volume of contamination present; no inaccessible soils. Fronts NJ State Route 17 and neighbors 149-151 Maywood Avenue. Property is part of well-defined Maywood commercial/light industry district.
Lodi Industrial Railroad	Limited light industrial	Restricted use	Current use of property as transportation (railroad) corridor; size of property prohibits residential development; presence of inaccessible soils
167 NJ State Route 17	Limited light industrial	Unrestricted use	Current use of property as a gas station; significant volumes of contamination present; presence of inaccessible soils. Fronts NJ State Route 17 and neighbors 149-151 Maywood Avenue. Property is part of well-defined Maywood commercial/light industry district.
200 NJ State Route 17	Limited light industrial	Unrestricted use	Minimal volume of contamination present; no inaccessible soils. Fronts NJ State Route 17 and is part of well-defined commercial district along NJ State Route 17 and Essex Street.
239 NJ State Route 17	Limited light industrial	Unrestricted use	Current use of property as a gas station; significant volumes of contamination present; presence of inaccessible soils. Fronts NJ State Route 17 and neighbors149-151 Maywood Avenue. Property is part of well-defined Maywood commercial/light industry district.
85,87,99-101 State Route 17	Limited light industrial	Unrestricted use	Minimal volume of contamination present; no inaccessible soils. Fronts NJ State Route 17 and neighbors 149-151 Maywood Avenue. Property is part of well-defined Maywood commercial/light industry district.

Table 2-2. Reasonably Anticipated Future Land Use and Recommended Cleanup Criteria (continued)

Property	Reasonably Anticipated Future Land Use	Recommended Cleanup Criteria	Factors to Consider during Remedial Design when Selecting Appropriate Controls
99 Essex St.	Limited light industrial	Unrestricted use	Minimal volume of contamination present; no inaccessible soils. At the corner of NJ State Route 17 and Essex Street. Part of well-defined commercial district along NJ State Route 17 and Essex Street.
111 Essex St.	Limited light industrial	Unrestricted use	Property location between railroad corridor and creek; significant volumes of contamination present;
113 Essex St.	Limited light industrial	Unrestricted use	Moderate volume of contamination present; no inaccessible soils. Fronts Essex Street and is part of well defined commercial district on Essex Street.
New York, Susquehanna, & Western Railway	Limited light industrial	Restricted use	Current use of property as transportation (railroad) corridor; size of property prohibits residential development; presence of inaccessible soils
NJ State Route 17	Right-of way	Restricted use	Current use of property as transportation (State highway) corridor; all soils inaccessible
Borough of Lodi			
8 Mill St.	Limited light industrial	Unrestricted use	Moderate volume of contamination present; no inaccessible soils; property bounded by residential properties on west and south sides
InterState 80	Right-of way	Restricted use	Current use of property as transportation (interState) corridor; substantial volume of inaccessible soils relative to accessible soil volume
160 & 174 Essex St.	Commercial	Unrestricted use	Moderate volume of contamination present; no inaccessible soils. Fronts Essex Street and is part of well-defined commercial district along Essex Street.
170 Gregg St	Industrial	Unrestricted use	Minimal volume of contamination present; no inaccessible soils. Part of well defined light industry district in Lodi.
80 Industrial Rd.	Industrial	Unrestricted use	Proximity of property to existing large residential neighborhoods and recreational parks; property bounded by residential property on west side
80 Hancock St.	Industrial	Unrestricted use	Proximity of property to existing large residential neighborhoods and recreational parks; property bounded by residential property on west side
100 Hancock St.	Industrial	Unrestricted use	Proximity of property to existing large residential neighborhoods and recreational parks; property bounded by residential property on north and west side
72 Sidney St. (a.k.a. 88 Money St.)	Commercial	Unrestricted use	Minimal volume of contamination present; no inaccessible soils. Fronts NJ State Route 46 and part of well-defined commercial district along Route 46.

government aware of changing land use or the accessibility of previously inaccessible soils); and methods to keep owners/occupants/community aware of the residual contamination that may remain on a property.

An Institutional Controls Implementation Plan (ICIP) will be developed and implemented as part of the Remedial Action to describe how institutional controls will be implemented, how they will be monitored and maintained, who will assure their effectiveness, and what corrective actions will be required if an institutional control should fail. Any institutional controls necessary will be tailored to the particular property. USACE will develop the ICIP in close coordination with the owners, occupants, local municipalities, and other interested parties to establish a tiered approached for establishing and enforcing institutional controls on a property. Monitoring will be a key component to determine when the next tier requires implementation to assure effectiveness of the remedy. The EPA will review the effectiveness of the institutional controls no less than every five years, but more frequent monitoring would be considered in the development of the ICIP.

2.3.4 Topography, Drainage, and Surface Water

The FUSRAP Maywood Superfund Site is located in the glaciated section of the Piedmont Plateau of north-central New Jersey. The terrain is generally level, with highs and lows created by occasional shallow ditches and low mounds. Elevations range from 51 to 67 ft above mean sea level. The surface slopes gently to the west and is poorly drained (Cole et al. 1981).

The FUSRAP Maywood Superfund Site lies primarily within the Saddle River drainage basin. MISS is located about 0.5 mi. east of the Saddle River, which is a tributary of the Passaic River, and about 1 mi. west of the drainage divide of the Hackensack River basin. Drainage characteristics at the FUSRAP Maywood Superfund Site are shown in Figure 2-5. Rainwater runoff from most of MISS empties into the Saddle River through Westerly Brook, which flows under the property and under NJ State Route 17 through a concrete culvert. It eventually empties into the Saddle River (DOE 1992a, Section 3.3). Neither the Saddle River nor Westerly Brook is used as a source of potable water (Jacobson 1982).

Another perennial stream on the FUSRAP Maywood Superfund Site, Lodi Brook, originates as two branches on the 149-151 Maywood Avenue property. Because of construction, most of the original stream channel has been replaced by a storm drain system beneath the surface. The original stream channel has been determined from old photographs and maps. The former channel pathways match the distribution of contaminated materials in the Borough of Lodi (DOE 1987). A structure and parking lot at 149-151 Maywood Avenue currently cover the western branch of Lodi Brook. The easternmost branch drains the surface area outside the fence on this property and then flows underground for most of its route to the Saddle River. Some surface runoff from MISS (Figure 2-5) moves parallel to NJ State Route 17 and drains into Lodi Brook. Lodi Brook empties into the Saddle River downstream of Westerly Brook's confluence with the Saddle River. The 111 Essex Street property lies adjacent to Coles Brook. Coles Brook flows north-northeast and is part of the Hackensack River basin. Additional information on topography, drainage, and surface water at the FUSRAP Maywood Superfund Site is presented in Sections 3.1 and 3.3 of the RI (DOE 1992a).

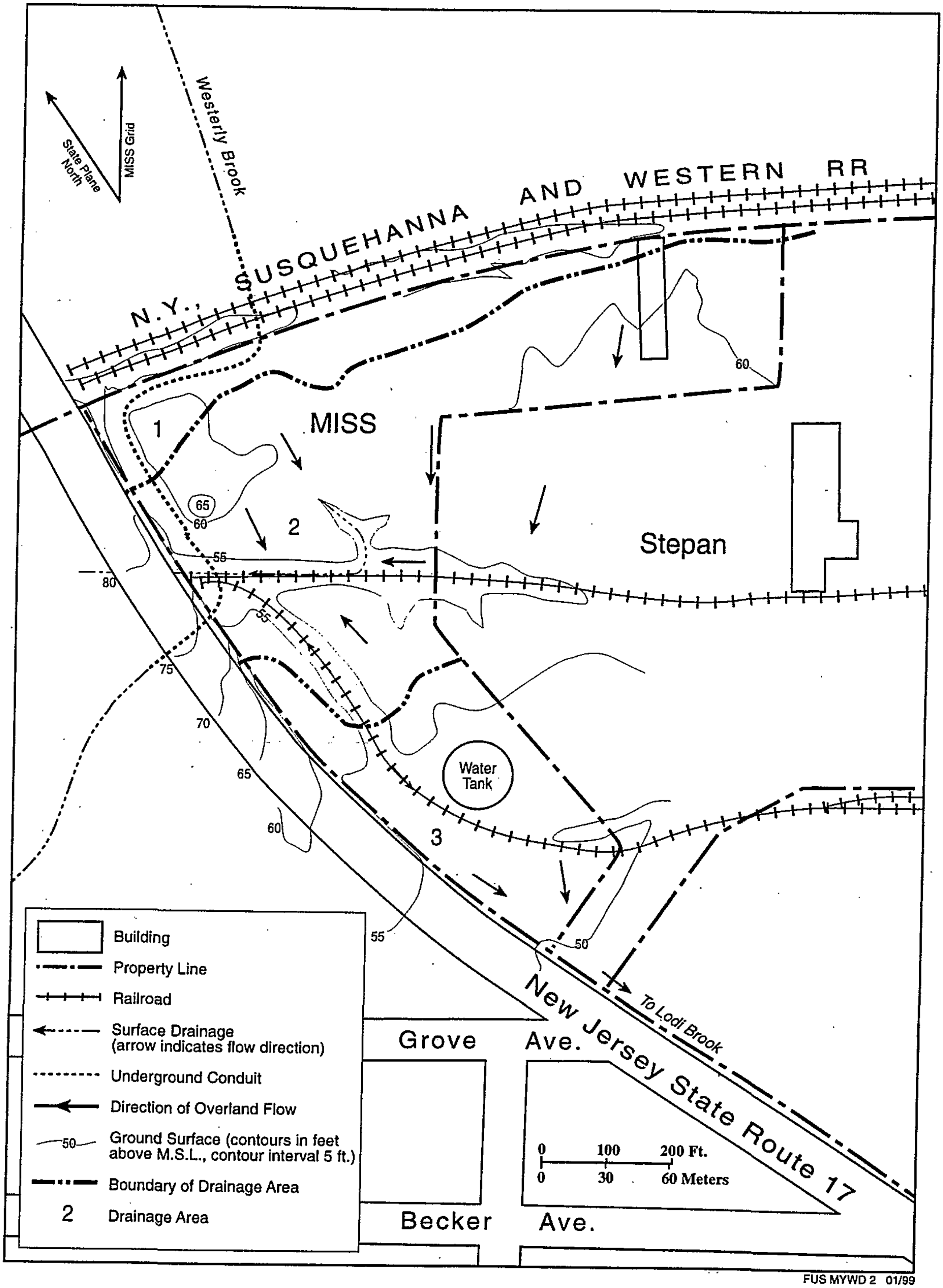


Figure 2-5. On-site Surface Water Features at MISS

2.3.5 Geology/Soils

The bedrock underlying the FUSRAP Maywood Superfund Site is divided into two distinct units: bedrock composed of the Triassic- to Jurassic-age Passaic Formation, and overburden of unconsolidated glacial till. The Passaic Formation, which reaches a maximum thickness in excess of 8,000 ft, is part of a 33,800 ft sequence of sediments deposited in the Newark Basin during the Triassic and Jurassic time periods. The Formation consists of interlayered dark to moderate red-brown, fine-grained sandstones and siltstones. Beds exhibit a monoclinal dip of 10 to 15 degrees northwest and contain shallow open folds (Carswell and Rooney 1976).

The northeast-trending Ramapo Fault that marks the westerly margin of the Newark Basin bound minor north-trending faults in the Triassic formations to the northwest. The Ramapo Fault at its nearest location is about 13 mi. west-northwest of the FUSRAP Maywood Superfund Site. Minor faults, fractures, and joints are prevalent throughout the Newark Group. A prominent set of joints parallels the strike of beds and dips steeply; another less prominent set parallels the northwest direction of dip. Bedrock topographic lows at the FUSRAP Maywood Superfund Site show alignment to northwest and northeasterly trends that are probably the result of bedrock weakness caused by joining in the Triassic Formations. At the FUSRAP Maywood Superfund Site, beds of the Passaic Formation also exhibit extensive weathering, and horizontal jointing in this formation is probably related to weathering (DOE 1992a).

Unconsolidated material overlying the weathered bedrock consists of sands, silts, and clays deposited as a result of glaciating during the Pleistocene time period. The thickness of unconsolidated sediments varies over the FUSRAP Maywood Superfund Site. Bedrock is within 6 inches (in.) of the surface near the northern end of the Stepan Property where there is a pronounced bedrock high. The overburden reaches a maximum thickness of over 25-ft in a downcut channel on the MISS property (DOE 1992a).

Unconsolidated deposits are loosely divided into three groups at the FUSRAP Maywood Superfund Site: a lower unit of fine grained sands and silts with occasional coarse gravels and sands, a middle unit of clays and silts with occasional organic-rich soil horizons, and an upper unit of undifferentiated sands and silts, which is much disturbed by urban development. Erosional lows that downcut into bedrock contain sands and gravels are probably of fluvial origin. This sequence of deposits is interpreted as being deposited from streams and lakes that originated from glaciers to the north. Periodically, during the advance and retreat of glaciers, the environments of deposition would change, and this has resulted in the glacial sediments exhibiting a high degree of lithologic variability, both vertically and horizontally. In some cases streams originating from glaciers cut valleys into existing sediments. The location and orientation of these valleys was probably controlled by weaknesses in the bedrock geology.

Historically, the glacial deposits of the Maywood area were capped with a well-developed deciduous forest soil. Extensive agricultural and urban development has destroyed or disturbed much of the original soil and most of the current soil cover is classified as urban fill. The geology and soils of the area are described more fully in Section 3.4 of the RI (DOE 1992a).

2.3.6 Hydrogeology/Groundwater

Note: Groundwater is outside the scope of this FS and is not explicitly addressed by any of the alternatives evaluated in this document. The following information is provided as a summary of the RI report only.

Groundwater in the Maywood area occurs in both the bedrock Passaic Formation and the unconsolidated glacial deposits. The Passaic Formation, classified as Class II-2, is a productive aquifer that is a major source of water for public and industrial use (Carswell and Rooney 1976; Morton 1982; ANL 1984). Groundwater occurs under confined and unconfined conditions in the unconsolidated deposits and in joints, fractures, and partings in bedding planes in the consolidated Passaic Formation. The predominantly unfractured rock underlying the region has negligible capacity to store and transmit groundwater and as depth increases, the fractures and joints typically decrease in size and number as is suggested by the bore-hole geophysical data obtained during Phase I Groundwater Remedial Investigation activities (USACE 2000).

The bedrock groundwater system typically consists of a series of alternating aquifers and aquitards several tens of feet thick. The water-bearing fractures of each aquifer are more or less continuous, but hydraulic connection between individual aquifers is poor (BNI 1992 citing Carswell 1976). These aquifers generally dip downward for a few hundred feet and are continuous along the strike for thousands of feet. Regional strike and dip are reported as being NNE-SSW with dip direction and angle NNW between 6 to 20 degrees.

Virtually all groundwater in the Passaic Formation occurs in interconnecting fractures and joints (Vecchioli and Miller 1973). The permeability and storativity of bedrock formations in the Newark Basin are fracture-controlled, with the exception of some sandstone facies (Michalski and Britton 1997). The prevailing groundwater flow direction within individual aquifer units tends to be near parallel to the strike of the beds.

The shallow groundwater flow system in the FMSS is in the unconsolidated material and the shallow bedrock. Previous studies (DOE 1992) and the Phase I (USACE 2000) at the FMSS revealed that groundwater in the shallow bedrock generally appears under confined conditions toward the northeastern portions of the site. Unconfined conditions have been reported to exist toward the west and southwest portion of the Site.

The variability of fracturing and weathering within the bedrock results in differences in permeabilities in different zones in the bedrock. Groundwater flowing in water-bearing fractures at different depths below ground surface will display a range of hydraulic heads. Potentiometric head differences also occur between the unconsolidated material and the bedrock.

Water level measurements are obtained quarterly from 35 monitoring wells as part of the Environmental Monitoring Program. Similarly, a synoptic gauging round was conducted as part of Groundwater Remedial Investigation activities in March 2000. Water levels fluctuate in response to short and long term seasonal changes in precipitation and evapo-transpiration. The minimum water level fluctuation in bedrock in year 2000 was noted in B38W14D (0.32 ft), and the maximum water level fluctuation in bedrock was noted in B38W05D, where the water level was noted to fluctuate by 5.38 feet.

Shallow groundwater flow at the MISS is strongly influenced by the morphology of the bedrock surface. The bedrock slopes westward across the site. Bedrock topographic highs exist in the middle and eastern portion of the site and are expressed as ridges that rise within the Stepan property to the east. These bedrock highs form a local groundwater divide, and influence the direction of groundwater flow in the bedrock aquifer as seen in the bedrock potentiometric surface map for March 27, 2000 (Figure 2-6). The direction of bedrock groundwater flow as depicted by the figure is dictated by the presence of a groundwater high, which strongly coincides with a bedrock high located in the northeast corner of the site in the vicinity of the Stepan property. The divide shows one component of groundwater flowing predominantly to the west-southwest, and a second component of groundwater flow to the northwest. This is supported by the presence of the gently plunging bedrock ridge trending east-west through the MISS.

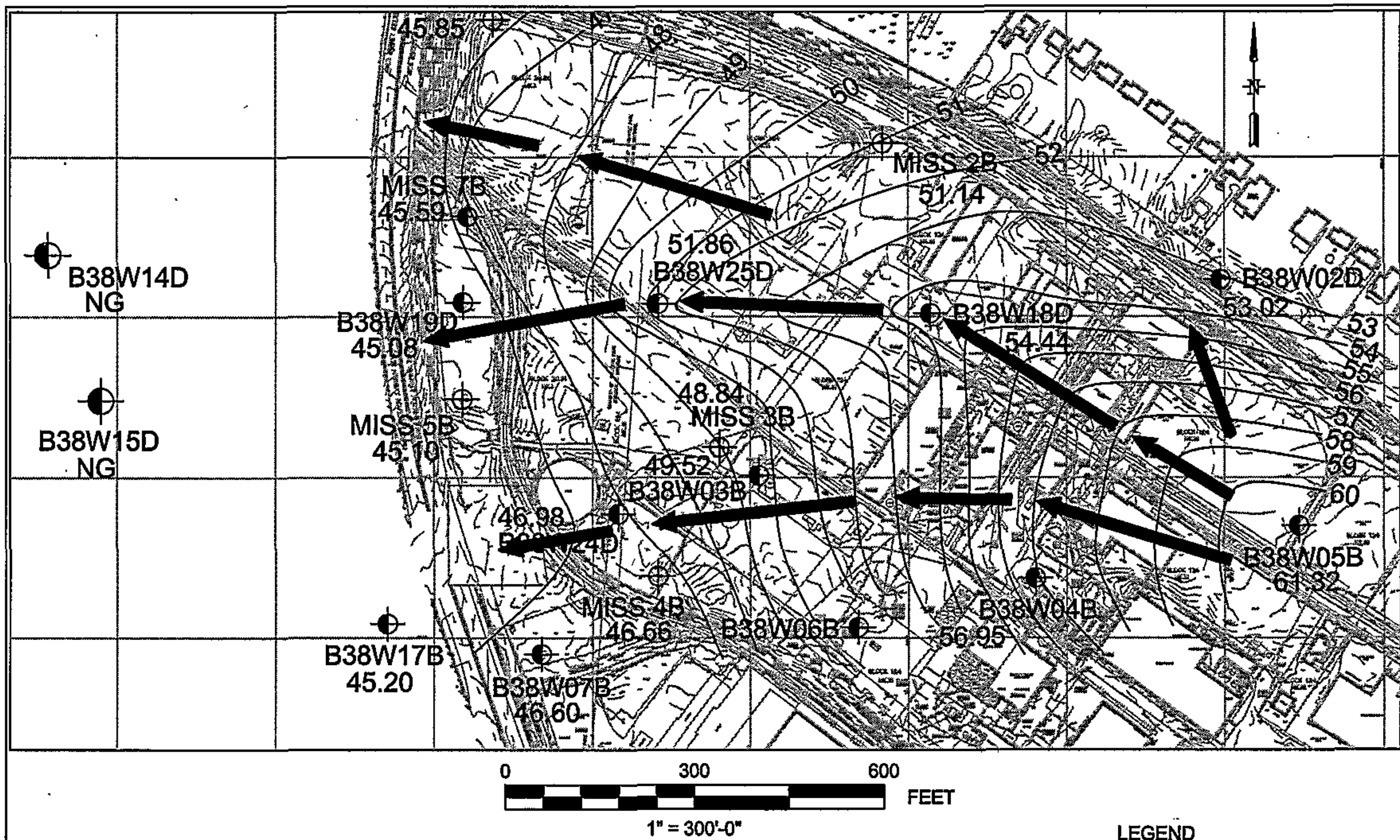
The horizontal hydraulic gradient measured in the shallow bedrock aquifer, ranged between 0.005 to 0.020 ft/ft. The hydraulic conductivity of the bedrock was estimated during Phase I GWRI activities to be between $2.0x10^{-4}$ cm/s (0.57 ft/day) and $4.6x10^{-4}$ cm/s (1.30 ft/day). These values exhibit hydraulic conductivity values that are cited in Freeze and Cherry (1979) in similar consolidated material, i.e., sandstone and shale. As part of on-going (Phase II) GWRI activities, pressure packer tests performed in bedrock boreholes have been initiated and preliminary results from seven bedrock borings indicate that hydraulic conductivity ranges from $3.9x10^{-4}$ cm/s (1.1 ft/day) to $1.1x10^{-3}$ cm/s (3.2 ft/day). These results are representative of both matrix and fractured bedrock media.

The average linear groundwater velocity in the bedrock was estimated to range from 0.017 ft/day to 0.4 ft/day. The average linear groundwater velocity of the bedrock has previously been estimated to range between 0.3 to 2 ft/day (DOE 1992).

The saturated thickness in the unconsolidated material at the MISS ranges from five feet to 15 feet. Overburden thickness generally increases to the west and thins to the east on the bedrock high in the vicinity of the Stepan property. The minimum water level fluctuation in the overburden aquifer was noted in B38W14S (0.44 ft), and the maximum water level fluctuation was noted in MISS-4A, where the water level was noted to fluctuate by 3.65 feet over the course of the synoptic gauging year.

A water table contour map based on water levels collected on March 27, 2000 is presented as Figure 2-7. The direction of groundwater flow in the overburden aquifer is predominantly to the west-southwest towards the Saddle River.

In the unconsolidated material, the horizontal hydraulic gradient varies spatially from approximately 0.007 ft/ft to 0.012 ft/ft. Permeability test data indicated that the hydraulic conductivity of the overburden materials ranged between $8.8x10^{-5}$ cm/s (0.25 ft/day) to $1.4x10^{-4}$ cm/s (0.4 ft/day). These values exhibit hydraulic conductivity values found in Freeze and Cherry in similar unconsolidated material, i.e. ranging from silt to silty sands. Similarly, results reported



SYNOPTIC GROUNDWATER LEVEL MEASUREMENTS (DEEP AND SHALLOW BEDROCK) MARCH 27, 2000

Well ID	G.W. Elev. FT MSL
B38W02D	53.02
B38W03B	49.52
B38W04B	56.95
B38W05B	61.32
B38W07B	46.60
B38W12B	44.96 *
B38W14D	NG
B38W15D	NG
B38W17B	45.20
B38W18D	54.44
B38W19D	45.08
B38W24D	46.98
B38W25D	51.86
MISS 1B	45.85
MISS 2B	51.14
MISS 3B	48.84
MISS 4B	46.66
MISS 5B	45.10
MISS 7B	45.59

NOTES:

1. THIS SURVEY SHOWS CONDITIONS AS OF OCTOBER 1999 BASED ON AERIAL MAPPING PREPARED BY GEOD CORP. AND GROUND SURVEY BY GARDEN STATE ENGINEERING SURVEYING AND PLANNING.
2. VERTICAL DATUM IS REFERENCED TO NGVD 1929.
3. HORIZONTAL DATUM IS REFERENCED TO NEW JERSEY STATE PLANE COORDINATE SYSTEM NAD 1927.
4. LOCATION OF HISTORIC LODI BROOK SHOWN ON THIS MAP IS APPROXIMATE ONLY. IT HAS BEEN TRANSFERRED FROM HISTORIC RECORDS THAT UTILIZED BASE MAPPING THAT DOES NOT CORRELATE WELL WITH BASE MAPPING SHOWN ON THIS SHEET.

LEGEND

- 50 — GROUNDWATER CONTOUR
- BEDROCK WELL
- OPEN HOLE WELL
- GROUNDWATER FLOW DIRECTION
- NG — NOT GAUGED
- * — NOT CONTOURED DUE TO LACK OF CONTROL

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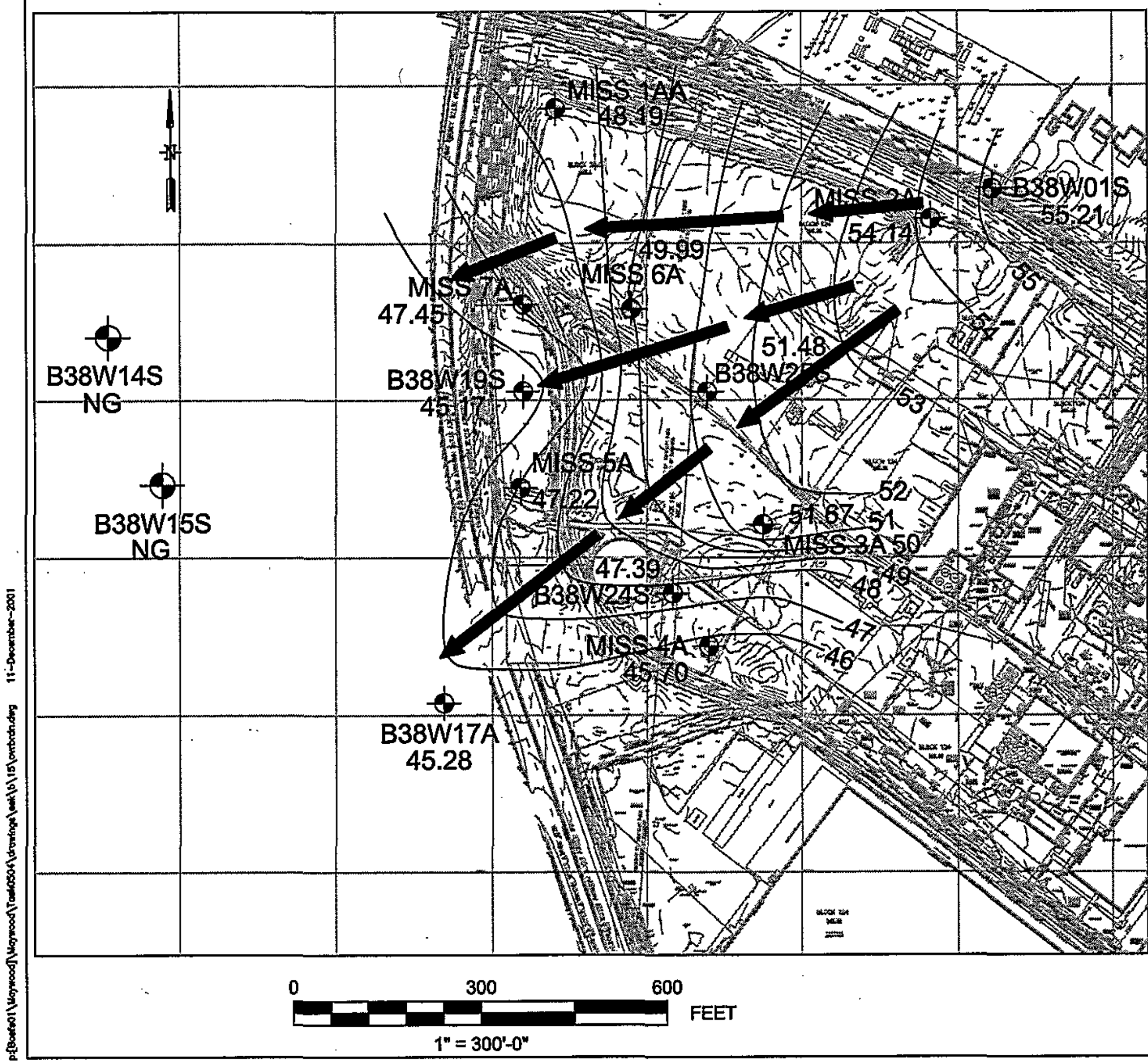
Figure 2-6 Groundwater Contour Map - Bedrock 03/27/00 Feasibility Study



SYNOPTIC GROUNDWATER LEVEL MEASUREMENTS (OVERBURDEN) MARCH 27, 2000

Well ID	G.W. Elev.
	FT MSL
B38W01S	55.21
B38W12A	44.77*
B38W14S	NG
B38W15S	NG
B38W17A	45.28
B38W19S	45.17
B38W24S	47.39
B38W25S	51.48
MISS 1AA	48.19
MISS 2A	54.14
MISS 3A	51.67
MISS 4A	45.70
MISS 5A	47.22
MISS 6A	49.99
MISS 7A	47.45

LEGEND

- 50~ GROUNDWATER CONTOUR
- ⊕ OVERBURDEN WELL
- ⬅ GROUNDWATER FLOW DIRECTION
- NG NOT GAUGED
- * NOT CONTOURED DUE TO LACK OF CONTROL

NOTES:

1. THIS SURVEY SHOWS CONDITIONS AS OF OCTOBER 1999 BASED ON AERIAL MAPPING PREPARED BY GEOD CORP. AND GROUND SURVEY BY GARDEN STATE ENGINEERING SURVEYING AND PLANNING.
2. VERTICAL DATUM IS REFERENCED TO NGVD 1929.
3. HORIZONTAL DATUM IS REFERENCED TO NEW JERSEY STATE PLANE COORDINATE SYSTEM NAD 1927.
4. LOCATION OF HISTORIC LODI BROOK SHOWN ON THIS MAP IS APPROXIMATE ONLY. IT HAS BEEN TRANSFERRED FROM HISTORIC RECORDS THAT UTILIZED BASE MAPPING THAT DOES NOT CORRELATE WELL WITH BASE MAPPING SHOWN ON THIS SHEET.

Figure 2-7 Groundwater Contour Map - Overburden 03/27/00 Feasibility Study from previous hydraulic conductivity tests conducted on Stepan monitoring wells in 1994 (Stepan 1994) yielded similar results.

The average linear groundwater velocity in the overburden was estimated to range from 0.0125 ft/day to 0.02 ft/day. The average linear groundwater velocity of 0.05 ft/day has previously been estimated for the unconsolidated sediments (DOE 1992).

Based on the year 2000 synoptic gauging rounds, information regarding the vertical component of groundwater flow was inferred (USACE 2001b). Of nine well clusters located within the MISS/Stepan Company property, the overburden well had a greater hydraulic head than the well completed in bedrock at seven clusters. The data indicates that the MISS/Stepan Company property represents a recharge area for the unconsolidated/overburden aquifer except for well clusters B38W24S/24D and B38W25S/25D. At these two well clusters, 3 of the 5 gauging rounds, and 4 of 5 gauging rounds indicated a vertically upward component of groundwater flow, respectively.

As indicated in the Remedial Investigation report (DOE 1992), in the vicinity of B38W25S/25D, fracture zones orientated approximately 90 degrees apart have resulted in the gouging of the bedrock surface. The bedrock surface in this area has been gouged and filled with unconsolidated material. Based on hydraulic heads measured in March 1992 (DOE 1992), the presence of sand, silt, and clay overlying the weathered bedrock surface may act as a confining layer. Therefore, the hydraulic head in the vicinity of this well cluster and that in the vicinity of B38W24S/24D may be under confining conditions, and thereby result in an upward gradient during varying times of the year.

With respect to off-site well clusters gauged in the synoptic year 2000, B38W12A/12B, B38W14S/14D, and B38W15S/15D, the hydraulic heads in the bedrock aquifer are greater than that in the overburden aquifer, resulting in an upward component of groundwater flow from the bedrock to the overburden. These wells are located in proximity to a drainage swale/Lodi Brook (B38W12A/12B), and the Saddle River (B38W14S/14D and B38W15S/15D). The other off-site well cluster, B38W17A/17B, predominantly displayed a horizontal component of groundwater flow, whereby the groundwater flow system is in transition between a recharge and discharge regime.

2.3.7 Ecology

2.3.7.1 Terrestrial Ecosystems

The FUSRAP Maywood Superfund Site is located within the glaciated portion of the Appalachian Oak Forest Section of the Eastern Deciduous Forest Province (BNI 1992 citing Bailey 1978). However, past agricultural and urban development has destroyed the forest habitat in the area. Before removal actions on the 96 Park Way property and development of MISS in the 1980s, these areas supported an early successional community dominated by grasses and forbs (herbs) with scattered shrubs and trees (e.g., aspen, elm, and oak).

The 96 Park Way property is now partially developed as an assisted living complex and covered by lawn, some trees, buildings, and pavement; MISS is currently covered by grasses and forbs. Residential properties contain plant species common to landscaped yards, such as grasses (fescue and blue grass), garden vegetables, and/or flowers, evergreen shrubs, and trees (ANL 1984).

Lack of suitable local habitat related to urban development limits animal life. Commonly occurring species are those adapted to suburban and urban environments. Bird species include house sparrow, red-winged blackbird, common crow, common grackle, starling, mourning dove, robin, and wood thrush. Mammalian species include Norway rat, house mouse, meadow vole, raccoon, eastern cottontail rabbit, opossum, and eastern gray squirrel. Woodchuck burrows have been observed at MISS. A small number of reptile and amphibian species (e.g., eastern garter snake and American toad) probably inhabit the area (ANL 1984).

2.3.7.2 Aquatic Ecosystems

Aquatic habitats are limited to drainage-ways, small temporary ponds, Westerly Brook, Lodi Brook, and the Saddle River. Westerly Brook traverses MISS but does not actually constitute an aquatic habitat, because it is encased in concrete pipe beneath the site. Similarly, much of Lodi Brook has been incorporated into a storm drain system. The upper reaches of Lodi Brook, on the 149-151 Maywood Avenue property, are not enclosed in a culvert. Surface-feeding ducks (e.g., mallard and black duck) are commonly observed on the Saddle River and accessible portions of Westerly Brook and Lodi Brook. Mosquito larvae, beetles, bugs, snails, isopods, midges, aquatic worms, and other invertebrates typically occur in these habitats and in stream and temporary pond habitats (ANL 1987).

2.3.7.3 Threatened and Endangered Species and Wetlands

No endangered or threatened plant or animal species have been identified at the FUSRAP Maywood Superfund Site (Day 1992, Williams 1991, ANL 1984). Letters of consultation are contained in Appendix D. Other than in the wetland area on the 149-151 Maywood Avenue property, no natural habitat remains at the site. Hydrophytic vegetation is apparent along the upper portions of Lodi Brook on the 149-151 Maywood Avenue property. Wetland delineation has been performed as part of the RI that the Stepan Company conducted on the 149-151 Maywood Avenue property (CH2MHill 1992). DOE performed a floodplain and wetland assessment for the FUSRAP Maywood Superfund Site. Wetlands encompass approximately 4.3 acres on the site; the majority of the wetlands are classified as palustrine emergent and palustrine forested. The USACE will use information in the wetland report to plan activities and comply with wetlands review requirements specified at 33 CFR 320–330.

2.3.8 Climate, Meteorology, and Air Quality

Information presented in this section is summarized from Section 3.2 of the RI (DOE 1992a).

2.3.8.1 Climate and Meteorology

The regional climate is humid, with a normal annual precipitation of about 42.3-in. and about 120 days of precipitation per year. August is the wettest month, with an average of 4.2 in. of rain. The area receives about 30 in. of snow per year. About 25 to 30 thunderstorms and an average of less than one tornado (Statewide) occur annually. Floods sometimes accompany heavy rains associated with storms of tropical origin. A small portion of the FUSRAP Maywood Superfund Site (properties at the south end of Lodi Brook and the 111 Essex Street commercial property on the eastern edge of the FUSRAP Maywood Superfund Site) is located within the 100-year floodplain of the Saddle River. Prolonged droughts are rare, typically occurring only once every 15 years. Average monthly temperatures range from a January low of 31.3 degree Fahrenheit (°F) to a July high of 76.8°F. The prevailing winds are from the northwest from October to April and from the southwest during the remainder of the year (Gale Research Company 1980).

2.3.8.2 Air Quality

Bergen County is designated a nonattainment area for carbon monoxide and ozone for failing to meet EPA's National Ambient Air Quality Standards guidelines. Ambient air quality monitoring stations in Bergen County are located in Cliffside Park, Fort Lee, and Hackensack.

During the fall and winter of 1986–1987, the NJDEP conducted a statistical sampling in which New Jersey homes were screened for radon-222 (Rn-222). The Statewide average for the screened homes was 5.2 picoCurie per liter (pCi/L), ranging from 0.1 to 246 pCi/L. In Bergen County, the average was 1.81 pCi/L, with a range of 0.3 to 19.1 pCi/L (BNI 1992 citing Camp, Dresser, and McKee 1989). DOE also conducted building surveys during the RI, and these are discussed in Section 2.4.5.

2.4 NATURE AND EXTENT OF FUSRAP CONTAMINATION

This summary of the nature and extent of (FUSRAP) contaminated material by property unit is based on Section 4 of the RI and on previous characterization reports referenced in Table 1-2 of the RI (DOE 1992a). Note that the RI was performed by DOE to focus on the nature and extent of FUSRAP waste present at the FUSRAP Maywood Superfund Site; the following summaries of the results of the RI are not intended to provide a complete discussion of other potential contamination at the Maywood Chemical Company Site. The Stepan Company is conducting a separate RI/FS, which focuses on other chemical contamination known to be present at the Maywood Chemical Company Site.

Figures 2-8 and 2-9 depict radiological contamination at the FUSRAP Maywood Superfund Site based on computer modeled radiological sample data. Figures 2-8 and 2-9 present the expected extent of contamination for the northern portion of the FUSRAP Maywood Superfund Site at the restricted and unrestricted use criteria, respectively. Figures 2-10 and 2-11 present this information for the southern portion of the FUSRAP Maywood Superfund Site. The BRA is also used (DOE 1993a) to determine contaminants at the FUSRAP Maywood

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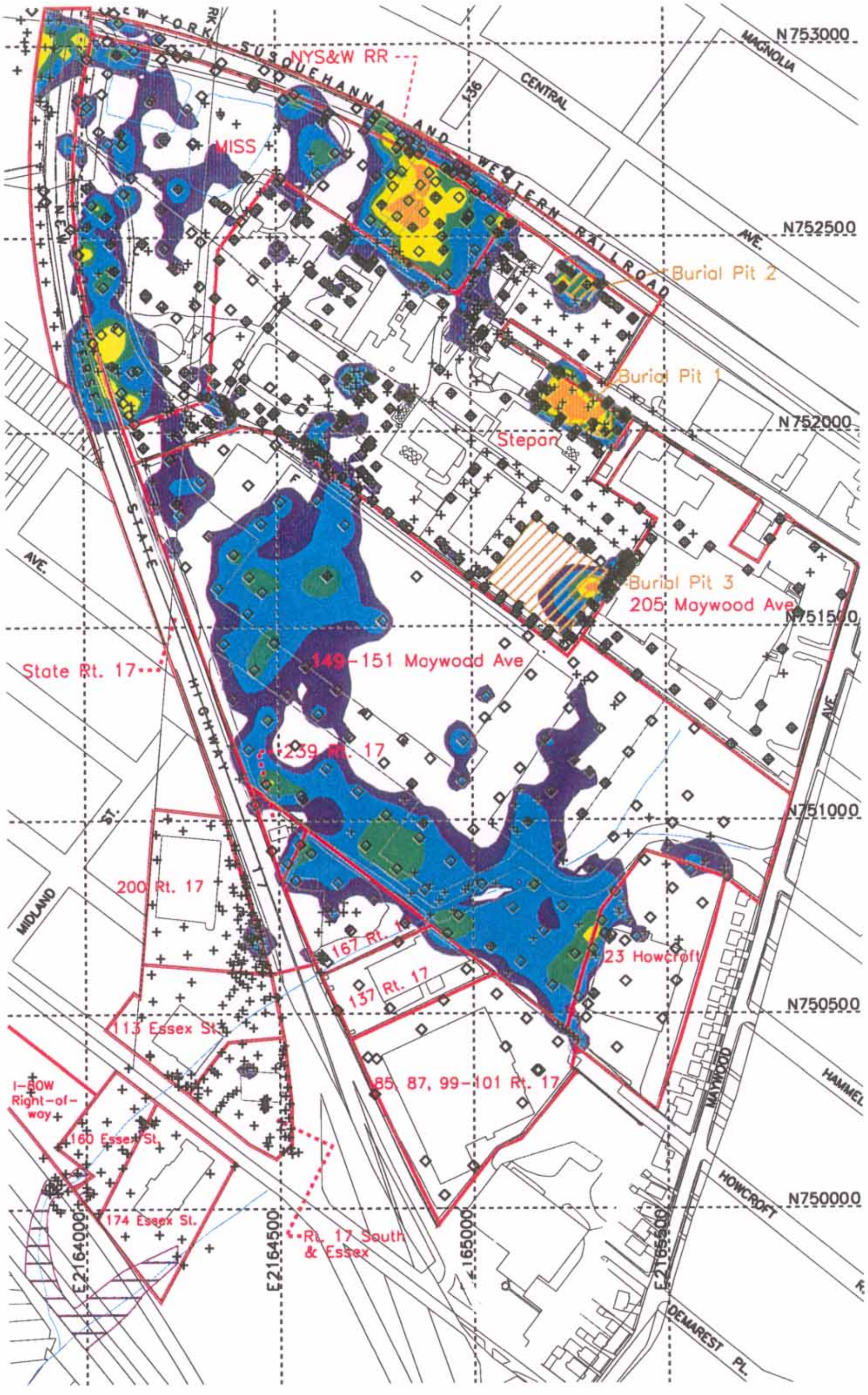


Notes:

Displayed Sum of Ratios (SOR) distribution is based upon 3D modeling of data using the equation:

SOR= (Ra226–background)/(cleanup criterion) + (Th232–background)/(cleanup criterion).

Isotopic data used include both analytic data and predicted isotopic data for a subset of the gamma log locations. In areas where the gamma logs locations were generally coincident with the analytic locations, the gamma data were not used. The cleanup criterion is 15 pCi/g for Ra226 and Th232 at all depths.

An SOR of 1 indicates exceedance of the combined cleanup criteria.

Maximum modeled values in the Z-direction in the 3D model were projected onto a 2D plane to generate the displayed distribution. As such, this distribution does not necessarily occur at the ground surface.

SOR (unitless)

1 3 10 30 100 300

Assumed Extent of Contamination along Lodi Brook Under I-80

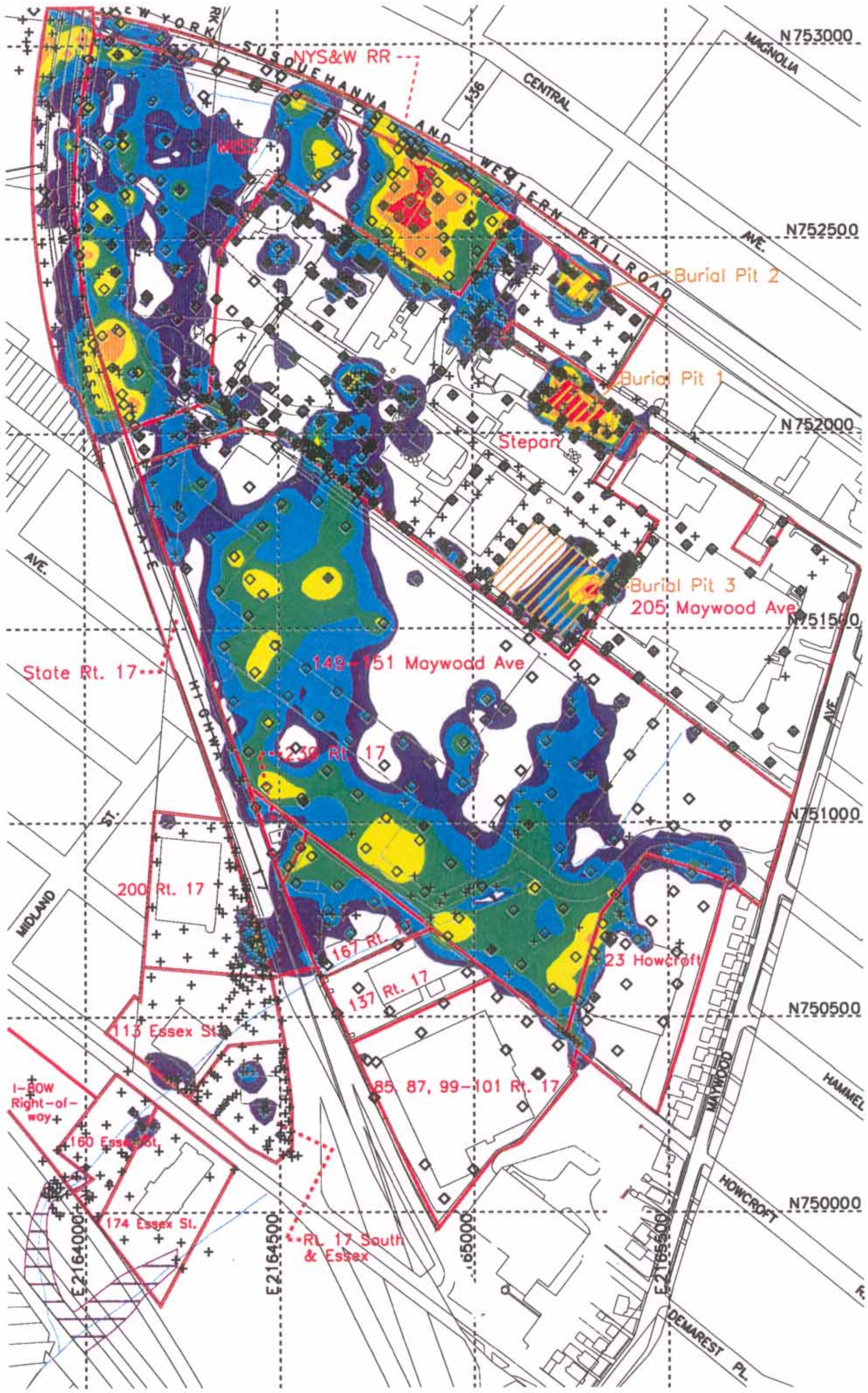
N

0 200 400
FEET
NJ State Plane, NAD27

Data Used to Develop 3D Model
+ Analytical Data Location
◇ Gamma Data Location

Figure 2-8
Northern Areas of Contamination
at the FUSRAP Maywood Superfund Site
(Restricted Criteria)

NAME: /usr/data3/maywood/mayv3/show/MAYRad10TriWGamma_Ratio015x015Max.sho



Notes:
Displayed Sum of Ratios (SOR) distribution is based upon 3D modeling of data using the equation:
SOR= (Ra226-background)/(cleanup criterion) + (Th232-background)/(cleanup criterion).
Isotopic data used include both analytic data and predicted isotopic data for a subset of the gamma log locations. In areas where the gamma logs locations were generally coincident with the analytic locations, the gamma data were not used. The cleanup criterion is 5 pCi/g for Ra226 and Th232 at all depths.
An SOR of 1 indicates exceedance of the combined cleanup criteria.
Maximum modeled values in the Z-direction in the 3D model were projected onto a 2D plane to generate the displayed distribution. As such, this distribution does not necessarily occur at the ground surface.

SOR (unitless)

1 3 10 30 100 300

Assumed Extent of Contamination along Lodi Brook Under I-80

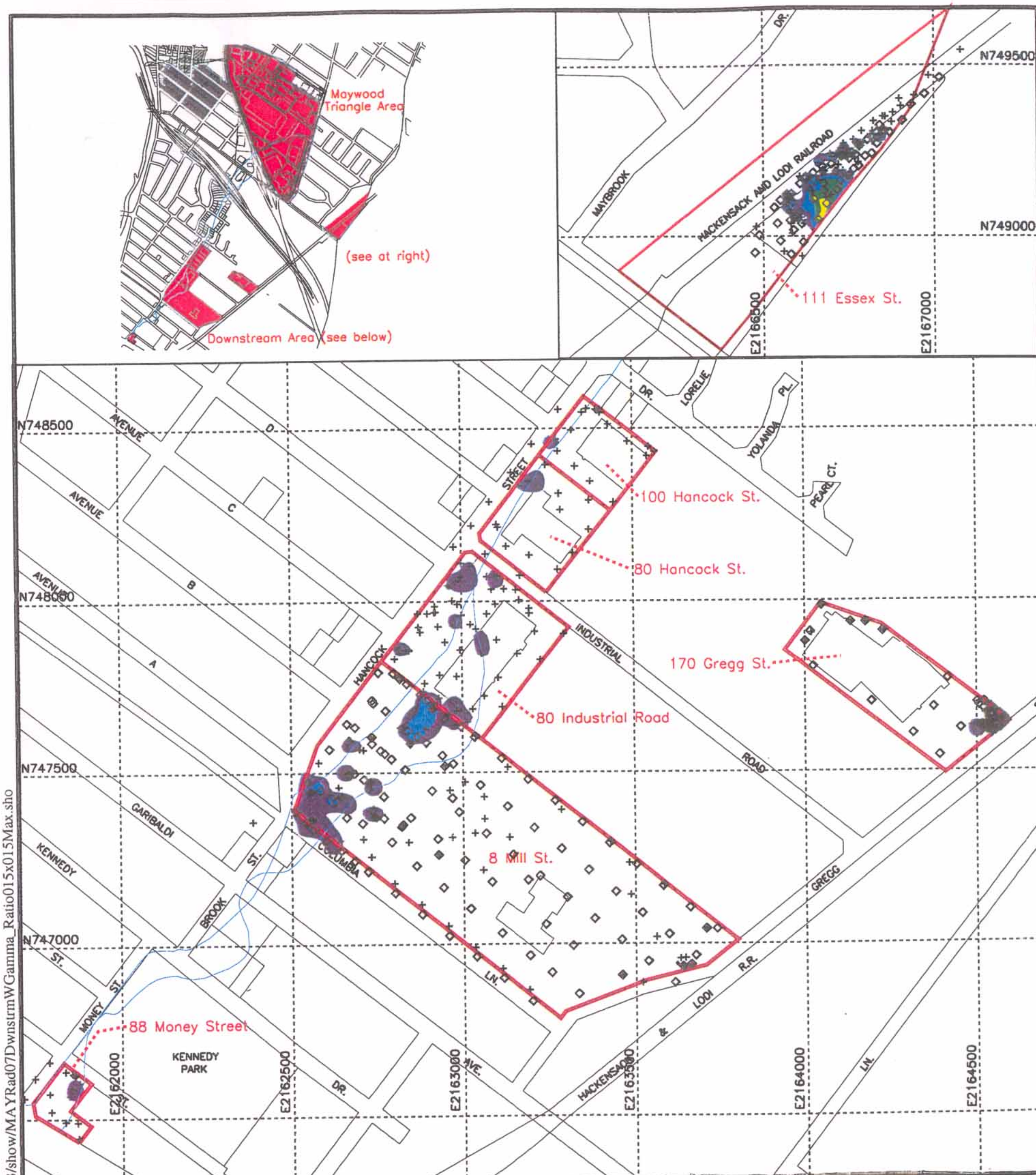
N

0 200 400
FEET
NJ State Plane, NAD27

Data Used to Develop 3D Model
+ Analytical Data Location
◇ Gamma Data Location

Figure 2-9
Northern Areas of Contamination
at the FUSRAP Maywood Superfund Site
(Unrestricted Criteria)

NAME: /usr/data3/maywood/mayv3/show/MAYRad10TriWGamma_Ratio005x005Max.sho



Notes:
Displayed Sum of Ratios (SOR) distribution is based upon 3D modeling of data using the equation:
SOR= (Ra226–background)/(cleanup criterion) + (Th232–background)/(cleanup criterion).
Isotopic data used include both analytic data and predicted isotopic data for a subset of the gamma log locations. In areas where the gamma logs locations were generally coincident with the analytic locations, the gamma data were not used. The cleanup criterion is 15 pCi/g for Ra226 and Th232 at all depths.
An SOR of 1 indicates exceedance of the combined cleanup criteria.
Maximum modeled values in the Z–direction in the 3D model were projected onto a 2D plane to generate the displayed distribution. As such, this distribution does not necessarily occur at the ground surface.

SOR (unitless)
1 3 10 30 100 300

Data Used to Develop 3D Model
+ Analytical Data Location
◇ Gamma Data Location

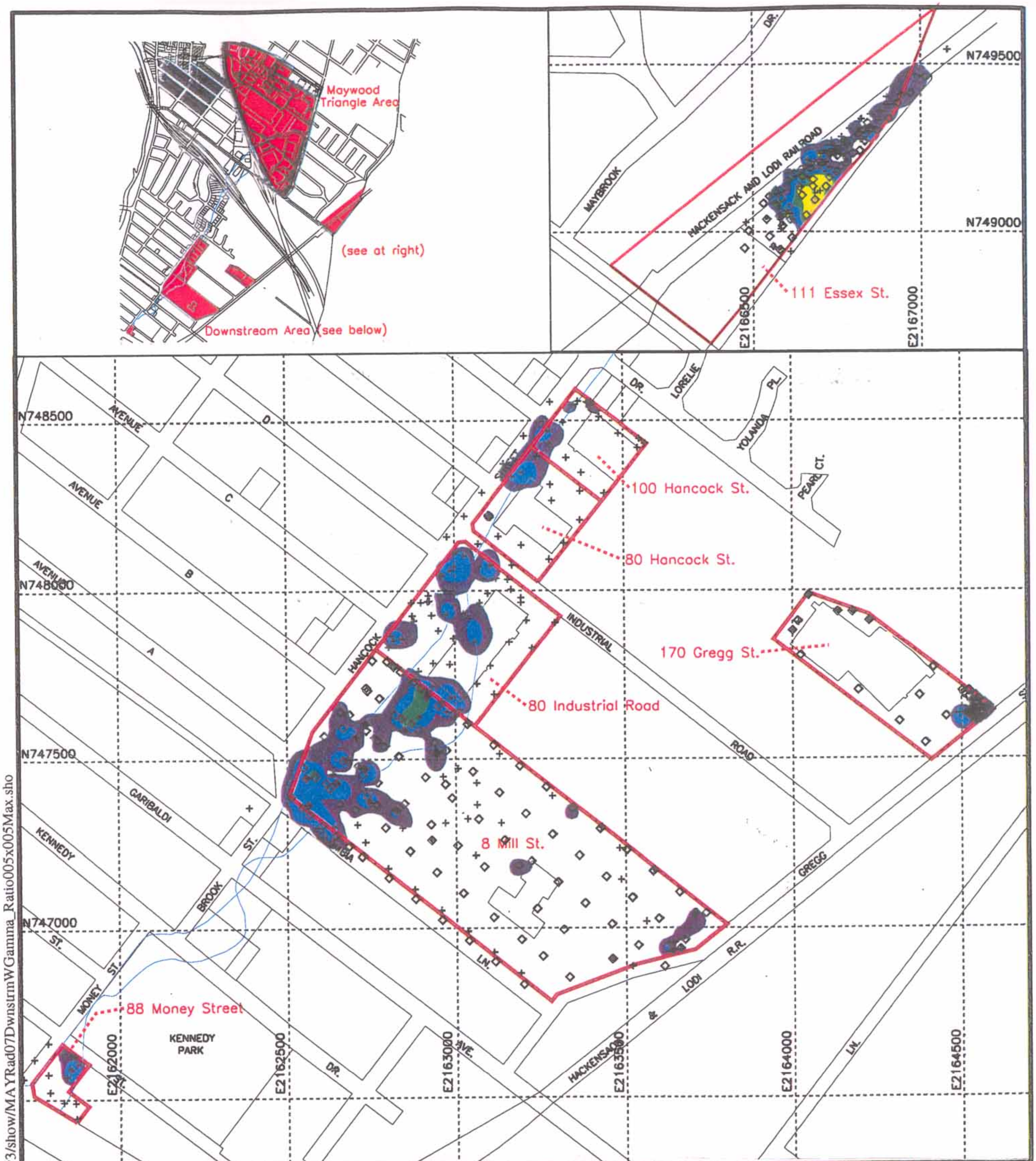
N

0 200 400
FEET
NJ State Plane, NAD27

Figure 2-10
Southern Areas of Contamination
at the FUSRAP Maywood Superfund Site
(Restricted Criteria)

REVISION NO.	DATE:	DRAWN BY:
01	06/07/99	NRV

NAME: /usr/data3/maywood/mayv3/show/MAYRad07DwnstrmWGamma_Ratio015x015Max.sho



Notes:
Displayed Sum of Ratios (SOR) distribution is based upon 3D modeling of data using the equation:
SOR= (Ra226–background)/(cleanup criterion) + (Th232–background)/(cleanup criterion).
Isotopic data used include both analytic data and predicted isotopic data for a subset of the gamma log locations. In areas where the gamma logs locations were generally coincident with the analytic locations, the gamma data were not used. The cleanup criterion is 5 pCi/g for Ra226 and Th232 at all depths.
An SOR of 1 indicates exceedance of the combined cleanup criteria.
Maximum modeled values in the Z–direction in the 3D model were projected onto a 2D plane to generate the displayed distribution. As such, this distribution does not necessarily occur at the ground surface.

SOR (unitless)
1 3 10 30 100 300

Data Used to Develop 3D Model
+ Analytical Data Location
◇ Gamma Data Location

N

0 200 400
FEET
NJ State Plane, NAD27

Figure 2-11
Southern Areas of Contamination
at the FUSRAP Maywood Superfund Site
(Unrestricted Criteria)

REVISION NO.	DATE:	DRAWN BY:
01	06/07/99	NRV

NAME: /usr/data3/maywood/mayv3/show/MAYRad07DwnstrmWGamma_Ratio005x005Max.sho

Superfund Site that may pose a risk. Some constituents of concern (COCs) identified in the RI, based on a comparison to background, may be screened out for the FS if the BRA determines they are not a risk to human health or the environment. Conversely, an element or substance that was not identified as a COC in the RI may be brought forward into the FS if the BRA identifies a risk.

Groundwater contamination is not addressed in this FS. Therefore, a discussion of contaminants in groundwater is not included in the following sections. Groundwater contamination will be addressed in separate CERCLA documentation following the completion of scheduled groundwater investigations at the FUSRAP Maywood Superfund Site.

2.4.1 FUSRAP Waste

2.4.1.1 Federal Facility Agreement Definition

Under the terms of the FFA between DOE and EPA, DOE's responsibility was limited to FUSRAP waste. Under the terms of the FFA, FUSRAP waste is defined as:

- All contamination, both radiological and chemical, whether commingled or not, on the MISS;
- All radiological contamination above cleanup levels related to past thorium processing at the MCW occurring on any Vicinity Properties; and
- Any chemical or non-radiological contamination on Vicinity Properties that would satisfy either of the following requirements:

  1. The chemical or non-radiological contaminants which are mixed or commingled with radiological contamination above cleanup levels; or

  2. The chemical or non-radiological contaminants which originated at the MISS or were associated with the specific thorium manufacturing or processing activities at the MCW which resulted in the radiological contamination.

2.4.1.2 Chemical or Non-Radiological Contaminants Associated with the Thorium Manufacturing or Processing Activities

The terms of the FFA clearly assign responsibility for all radioactive contamination at the FUSRAP Maywood Superfund Site, and all radioactive and chemical contamination at the MISS, to DOE. However, the FFA limited DOE's responsibility for chemical contaminants unless commingled with radioactive contamination above the criteria. DOE's responsibility for chemical contamination outside the areas of radioactive contamination (on properties other than MISS) was limited to the following definition:

- Chemicals which are determined to have originated from MISS, or are associated with the specific thorium manufacturing or processing activities at the MCW which resulted in the radiological contamination.

In order to determine the chemicals for which DOE had cleanup responsibility under the FFA, both the chemicals associated with the source materials and the source material processing must be evaluated.

Chemicals Associated with Monazite Sands

The source material for thorium processing activities at the MCW was monazite sand. Monazite is the only thorium-bearing mineral that has been an important commercial source of thorium. Monazite is processed principally to recover cerium and other rare earths; the thorium is recovered as a by-product of this processing (Cuthbert 1958).

Monazite is essentially a phosphate of the rare earths cerium and lanthanum, in which thorium and the yttrium earths substitute in part for cerium and lanthanum. Monazite usually contains 30 to 35 % of the oxides of lanthanum, yttrium, neodymium and praseodymium, and a small amount of europium (Brady 1991). All of the Lanthanide series of rare earths can be represented. The Lanthanide series of rare earths includes lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium. Note that these rare earth elements are not CERCLA hazardous substances and do not have verified toxicity values ("reference doses" or "slope factors"). Therefore, rare earth elements are not targeted by or considered the focus of the remedial alternatives being evaluated in this FS. In addition, most analyses reveal the presence of small to moderate amounts of ferric iron, aluminum, calcium, magnesium, silicon, titanium and zirconium (Cuthbert 1958). Table 2-3 provides the typical analyses of monazite sands. Based on NRC inspection reports, the MCW procured its monazite from India and Brazil, in addition to domestic sources in the Carolinas.

Table 2-3. Typical Analyses of Monazite

Compound	**Source of Monazite**		
	Brazil (wt. %)[1]	**India (wt%)[1]**	**USA (wt%)[1]**
Thorium oxide	6.8	9.9	3.4
cerium oxide	25.9	27.5	19.5
Phosphorous pentoxide	25.5	29.5	20.5
silicon dioxide	2.51	1.5	8.5
Zirconium	3.5	1.0 – 3.0	0.1 – 1.0
Titanium oxide	1.10	0.40	2.1
Iron (III) oxide	0.50	0.90	4.5
Aluminum oxide	—	—	12.5
RE_2O_3 [2]	60.5	59.8	40.1
uranium oxide	0.18	0.27	0.15
Molybdenum oxide	0.01	0.01	—

NOTES:

(1) It is recognized that the weight percents add up to >100%. The result for each compound represents the average of a range.

(2) RE indicates an oxide of yttrium, scandium, or (most commonly) an element from the Lanthanide Series. The Lanthanide Series includes lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium.

Source: Cuthbert 1958.

Chemicals Associated with Thorium Processing

The thorium process used at the MCW is described in a Stepan Company internal memorandum dated July 26, 1963. Stepan provided this memorandum to the NRC, and is now a part of the NRC docket (Docket No. 40-8610) for the Stepan Chemical Company. This memorandum describes the thorium process that obtained thorium nitrate and thorium oxide from monazite sands. A summary of this process, as described in the memorandum, is provided in Appendix E. Based on this process description, the following chemicals were used in thorium processing in addition to the thorium ores: sulfuric acid, oxalic acid, soda ash, caustic soda, hydrogen chloride, hydrogen sulfide, hydrogen sulfite, ammonia, and nitric acid. Sulfuric acid, hydrogen chloride, hydrogen sulfide, ammonia, and nitric acid are considered hazardous substances under CERCLA. However, after 40 years of exposure to the environment, they would have been neutralized to their basic elemental compounds and would no longer be expected to be present in the environment from thorium processing activities that ceased in 1956. Table 2-4 provides a summary of the chemicals associated with either monazite sands or thorium production at MCW.

Table 2-4. Summary of Chemicals Associated with the Manufacturing or Processing Activities Which Resulted in the Radiological Contamination

Chemical	Source of Chemical
Aluminum	Monazite Sands
Calcium	Monazite Sands
Cerium (rare earth)	Monazite Sands
Ferric Iron	Monazite Sands
Lanthanum (rare earth)	Monazite Sands
Magnesium	Monazite Sands
Neodymium (rare earth)	Monazite Sands
Silicon	Monazite Sands
Thorium	Monazite Sands
Titanium	Monazite Sands
Uranium	Monazite Sands
Yttrium	Monazite Sands
Zirconium	Monazite Sands
Sulfuric Acid	Thorium Processing
Soda Ash	Thorium Processing
Ammonia	Thorium Processing
Hydrogen Sulfite	Thorium Processing
Hydrogen Sulfide	Thorium Processing
Oxalic Acid	Thorium Processing
Hydrogen Chloride	Thorium Processing
Nitric Acid	Thorium Processing
Caustic Soda	Thorium Processing

Source: Cuthbert 1958; NRC Docket 40-8610

Correction to the Remedial Investigation Report

The RI report for the FUSRAP Maywood Superfund Site (DOE 1992a) reported that seven metals detected at the FUSRAP Maywood Superfund Site (arsenic, cobalt, copper, lead, nickel, selenium, and vanadium) were metals identified as meeting the criteria of FUSRAP waste because of their association with monazite sands or uranium ores. All of the metals listed are associated with uranium ores but are not associated with monazite sands. There is no known history of uranium processing at MCW, and the USACE is only responsible for chemical contaminants associated with thorium processing at MCW or chemical contamination on or originating at the MISS. Based on a review of multiple sources (Cuthbert 1956, Brady 1991, Dreesen 1982, Lutze 1988, Meldrum 1997, Weast 1983), these metals are not known to be associated with the monazite sands or other chemicals used in the thorium processing. These metals do not appear to be associated with lithium ore processing operations conducted by MCW either. These metals are probably associated with MCW's long term burning of coal at the site as an energy source. Thus, these metals only meet the definition of FUSRAP waste contaminants if they are:

- commingled with radioactive contamination above DOE's action levels (15 pCi/g Ra-226 and Ra-228 combined above background on commercial properties and 5 pCi/g Ra-226 and Ra-228 combined above background on residential properties;

- present above contaminant specific cleanup criteria at the MISS; or

- present on a FUSRAP Maywood Superfund Site property and proven to have originated at the MISS.

Of the seven metals incorrectly identified by the RI as meeting the criteria of FUSRAP waste, only two (arsenic and lead) had maximum reported concentrations that exceeded the proposed New Jersey Soil Cleanup Criteria – Non-Residential. The MISS does not appear to be the source of contamination on the adjoining properties with respect to these metals. The metals are not anticipated byproducts of the thorium processing operations, nor does the existing data suggest the MISS is currently acting or has acted as a source for offsite transport into the other areas where these metals have been identified.

Although the maximum arsenic concentration has been detected at MISS (1,060 milligrams per kilograms [mg/kg]), this result was from soils in the 10 to 12 ft depth interval, and no radiological contamination was detected in the same interval in this area. (The soil boring log indicates this interval is fill material). Of the 69 samples from MISS analyzed for arsenic, only 32 samples were above the site-specific background of 3.3 mg/kg, and only 10 of those 32 samples are commingled with radiological contamination (22 of the detections above background are in areas unaffected by radiological contamination). Similar results were obtained at Stepan, where no samples within the radiologically impacted areas exceeded the proposed New Jersey Soil Non-Residential Direct Contact Soil Cleanup Criteria, but 20% of the samples collected outside the areas of radiological contamination exceeded this level. Thus, there is no strong correlation between arsenic contamination and radiological contamination that would indicate this metal is associated with the sources of radiological contamination.

As with arsenic, the percentage of samples of lead above the proposed New Jersey Soil Cleanup Criteria – Non-Residential in the radiologically impacted areas at MISS (23%) were lower than the percentage of samples above NJDEP's draft cleanup levels in samples collected outside the areas of radiological impact (28%). Similar results were obtained at Stepan, where

28% of the samples taken in radiological areas exceeded the draft cleanup levels, and 36% of the samples taken in non-radiological areas exceeded the draft level. Thus, there is no strong correlation between lead contamination and radiological contamination, which would indicate this metal is probably not associated with the sources of radiological contamination.

2.4.2 Representative Background/Baseline Concentration

To evaluate the extent of contamination resulting from activities associated with the former MCW and its impact on the surrounding environment, soil samples were taken during the RI to determine background (or uninfluenced, undisturbed) conditions. Background concentrations of radionuclides in soil were determined from several locations (Table 2-5). Representative background soil samples were also analyzed to determine background concentrations of metals and rare earth elements (Table 2-6). The FUSRAP Maywood Superfund Site selected sampling locations on the basis of proximity to the FUSRAP Maywood Superfund Site, but with relative independence from potential impact.

Table 2-5. Analytical Results for Background Radionuclide Concentrations in Soil (pCi/g)

Location	U-238	Ra-226	Th-232
Foschini Park	<3.5	<0.8	<1.1
Rochelle Park	<2.4	<0.5	<0.9
Borough Park-Maywood	<2.9	<0.7	<0.9
Average	<2.9	<0.7	<1.0

Source: Remedial Investigation Report for the FUSRAP Maywood Superfund Site (DOE 1992).

2.4.3 MISS

2.4.3.1 Radioactive Constituents

Radioactive constituents are present in the majority of surface soils at MISS. Radionuclide concentrations in surface soils (from 0 to 6 in. below ground surface) range from 0.5 to 7.9 pCi/g for radium-226, and from 0.9 to 95.2 pCi/g for thorium-232. [Note that this and all subsequent references to radionuclide contamination (radium-226, thorium-232 and uranium) of soil are "above background". However, references to chemical contamination (such as lead or arsenic), include background.] Concentrations of uranium-238 were all below analytical detection limits, which ranged from 5.5 to 46.7 pCi/g for these samples. Subsurface (below a depth of 6 in) radiological contaminants are present over approximately 85 % of MISS. Subsurface analyses showed thorium-232 concentrations ranging from 1.2 to 1,699 pCi/g, radium-226 ranging from 1.0 to 447 pCi/g, and uranium-238 concentration from 4 to 304 pCi/g. These concentrations are substantially above naturally occurring background levels for the Maywood area. Further information on radioactive constituents in soil on MISS can be found in Sections 4.4.1 and 4.5.1 of the RI.

Table 2-6. Representative Background Metal and Rare Earth Concentrations in Soil, FUSRAP Maywood Superfund Site

Constituent	Minimum Concentration (mg/kg)		Maximum Concentration (mg/kg)		Mean Concentration (mg/kg)
Aluminum	4,690	J	10,500	J	7,448
Arsenic	1.5	B	7.1		3.3
Boron	22.6	U	24.6	U	23.6
Barium	31.5	B	56.2	U	44.6
Beryllium	0.41	B	0.69	B	0.56
Calcium	888		1,510		1,210
Cadmium	0.68	U	0.74	U	0.71
Cerium	45.3		49.5		47.3
Cobalt	3.3	B	9.9	B	7.6
Chromium	5.3		18.8		12.8
Copper	8.1		28.2		17.9
Dysprosium	45.3	U	49.1	U	47.2
Erbium	206		785		506
Europium	4.53	U	49.1	U	47.2
Iron	5,590	J	21,200	J	14,448
Gadonlinium	45.3	U	49.1	U	47.2
Holmium	45.3	U	49.1	U	47.2
Potassium	288	B	726	B	405
Lanthanum	45.3	U	49.1	U	47.2
Lithium	22.6	U	24.6	U	23.6
Lutetium	45.3	U	49.1	U	47.2
Magnesium	724	B	2,610	J	1,841
Manganese	237	J	725	J	466
Molybdenum	22.6	U	24.6	U	23.6
Sodium	46	B	75.8	B	62.2
Neodymium	45.3	U	49.1	U	47.2
Nickel	5.6	B	10.2		8.8
Lead	10.7	U	89.8	J	39
Praseodymium	45.3	U	49.1	UJ	4.7
Antimony	4.53	U	4.91	UJ	4.7
Selenium	0.41	UJ	0.49	UJ	0.45
Samarium	4.53	U	4.91	UJ	47.2
Terbium	56.6	U	61.4	U	59
Tellurium	45.3	U	49.1	U	47.2
Thallium	0.41		0.49	U	0.45
Thulium	201		750		482.8
Vanadium	7.2	B	31.3		20.2
Yttrium	45.3	U	49.1	U	47.2
Ytterbium	45.3	U	49.1	U	47.2
Zinc	25.7		102	J	50.5
Zirconium	45.3	U	49.1	U	47.2

J – Analyte present; reported as an estimated value.

B – Reported value was less than the Contract Required Detection Limit but greater than or equal to the Instrument Detection Limit.

U – The analyte was not detected. The minimum detection limit for the sample is reported.

UJ – Associated value was analyzed for and was not detected but must be estimated due to quality control considerations.

Note: Where a constituent was identified as nondetectable (U) and therefore the minimum detection limit reported, this value was factored into the determination of the mean.

Source: Remedial Investigation Report for the FUSRAP Maywood Superfund Site (DOE 1992).

Results from quarterly surface water monitoring of Westerly Brook for total uranium, radium-226, and thorium-232 were similar at upstream and downstream sampling locations; most concentrations were below analytical detection limits. Further analysis for decay products showed that thorium-232, thorium-228, and thorium-230 levels of radionuclides were not above detection limits and above background (upstream) in Westerly Brook (DOE 1992a). Therefore, there is no indication that radioactive constituents present on MISS are currently migrating offsite via surface water. Section 4.9.1 of the RI presents additional information on surface water.

As part of the RI, sediment samples were collected from the surface water sampling locations and analyzed for total uranium, radium-226, and thorium-232. No sediment sample result exceeds guidelines for residual radioactivity in soil. Additional characterization during recent environmental monitoring indicated low concentrations of thorium-232, thorium-228, and thorium-230 comparable to levels of total uranium, radium-226, and thorium-232. Additional information on radiological contamination in sediments at the FUSRAP Maywood Superfund Site is presented in Section 4.10.1 of the RI.

Monitoring of surrounding air for radon, both onsite and offsite, shows that none of the annual average concentrations exceeded DOE's derived concentration guides or NJDEP standards. Radon flux monitoring was performed at 192 locations on MISS. The average flux rate for the FUSRAP Maywood Superfund Site was 1.29 pCi/m^2-s. This can be compared to the maximum flux rate of 20 pCi/m^2-s allowed by 40 CFR 61.192 (National Emission Standards for Radon Emissions).

The annual average external gamma exposure dose to the maximally exposed individual at MISS for 1992 was 0.6 millirem per year (mrem/yr). These exposure rates are in addition to the average background exposure of 74 mrem/yr. The gamma exposure rates at MISS are only slightly elevated above background levels. Restricted access to MISS limits current exposure to the public via other pathways (DOE 1993b).

During the spring of 1996 an interim action was taken at MISS to mitigate radon levels in a grassy area adjacent to the eastern side of Building 76. Although the radon concentrations posed no health risks to the surrounding offsite properties, the action was taken to decrease any possible inadvertent exposure on the MISS. The area was covered with a low permeability cover (hypalon) forming a protective barrier that greatly reduced the release of radon to the atmosphere. The hypalon barrier was then covered with 6 in. of crushed stone to provide additional protection. This area has since been paved and serves as a trailer area and parking lot, which also greatly reduces potential radon releases.

Additional information on radon levels on MISS is presented in Section 4.11.1 and 4.11.2 in the RI, and additional information on gamma exposure is in Section 4.11.3 of the RI.

2.4.3.2 Chemical Constituents

DOE's RI soil sample analyses at MISS did not reveal the presence of hazardous waste, as defined by the Resource Conservation and Recovery Act (RCRA) at the FUSRAP Maywood Superfund Site. Soils were analyzed by the Toxicity Characteristic Leaching Procedure (TCLP) for the characteristics of hazardous waste specified in 40 CFR 261.20. (The thorium extraction process is not a listed process under 40 CFR 261.32, and there are no records of listed chemicals being spilled or discarded at the FUSRAP Maywood Superfund Site.) The concentrations of pesticides and polychlorinated biphenyls (PCBs), which are not regulated by RCRA, were below detection limits.

In addition to the radiological contaminants thorium-232, radium-226, and uranium-238, chemical contaminants have been detected above natural background in soil on MISS, including arsenic, beryllium, chromium, antimony, barium, cadmium, cobalt, copper, lead, lithium, nickel, selenium, and vanadium. The New Jersey Non-Residential Direct Contact Cleanup Criteria for soil was exceeded for arsenic, beryllium, copper, lead, mercury, thallium, benzene, toluene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-chloroethyl)ether, dibenz(a,h)anthracene, gamma-BHC (Lindane), and dieldrin. The New Jersey Impact to Groundwater Soil Cleanup Criteria for soil was exceeded for gamma-BHC (Lindane), methylene chloride, and toluene.

Stepan's RI/FS investigation, which was overseen by EPA, included a 1994 focused investigation to characterize chromium (Cr) contamination in soil and waste leather material buried at the Maywood Chemical Company Site. The leather material is believed to be residuals from a protein extraction process used on tanned hides. Two of the test pits containing leather material were excavated on the MISS. This investigation indicated that the leather processing material contains relatively high concentrations of chromium, ranging from 20,100 mg/kg to 117,000 mg/kg on both MISS and Stepan. Chromium occurs in the environment, including soil, principally in one of two valence States: the more toxic hexavalent, and the less toxic trivalent. Chromium detected in the adjacent soils (i.e., within 3 feet of the leather material) was typically ten times lower, with a maximum concentration of 2,500 mg/kg. For soils at least 3 feet distant from the leather processing materials, the maximum concentration of chromium was measured at 1,690 mg/kg (CH2MHill 1994b). While the hexavalent chromium data was rejected by EPA Region 2 due to their stringent CLP requirements, the data indicates that the chromium is present nearly exclusively in its trivalent form. Additionally, the material did not exhibit the characteristic of TCLP toxicity for any other constituent besides chromium.

If the leather material is scrap tanned hides used at the site, it is exempt from RCRA hazardous waste requirements based on a specific exemption at 40 CFR 261.4(b)(6)(i) and (ii). However, Stepan's investigation also refers to potential filtercake material. Based upon process knowledge and the provided analytical results, it appears that this material (if actually filtercake) could be a hazardous waste when generated through excavation, and be fully subject to RCRA requirements. Stepan's report indicates that this material may be decayed leather product instead of filtercake. Analytical results also indicate that scrap leather and sludge, attributed to decayed leather or filtercake material, are not commingled with radioactive material at levels of concern. Therefore, this material, if present at the Maywood Chemical Company Site, should not require excavation by the USACE because they would be associated with the portion of the Maywood Chemical Company Site under the responsibility of the Stepan Company. If commingled with FUSRAP waste, the sludges buried on the FUSRAP Maywood Superfund Site would require separate characterization for the purposes of making a hazardous waste determination, and, depending upon the characterization, potential management as a RCRA hazardous waste.

The chromium waste at the site appears to qualify for exclusion under RCRA due to the process and type of chromium waste generated. Therefore, the chromium waste at Maywood would not be considered a hazardous waste (as defined under RCRA) and would not be subject to the hazardous waste regulations in 40 CFR Subtitle C (RCRA). However, the chromium wastes would be defined as a hazardous substance under CERCLA (40 CFR 302.4), and, if it meets the definition of FUSRAP waste, would be subject to evaluation for inclusion as a FUSRAP Maywood Superfund Site COC.

Eleven rare earth elements were identified at levels above method detection limits; three (cerium, lanthanum, and neodymium) were identified at greater concentrations and frequencies. These three rare earths were the principal rare earth elements processed at MCW. One other rare earth element (samarium) and the element tellurium were also detected at concentrations above mean representative background in radioactively contaminated areas. As previously noted, rare earth elements are not CERCLA hazardous substances. Rare earth metals are constituents of the monazite sands processed at MCW. Monazite sands are the primary source for rare earths. “Rare earths” refers to the oxides of yttrium, scandium, and a series of metallic elements known as the Lanthanide series (atomic numbers 58–71). The Lanthanide series includes lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium (Cuthbert 1958).

Trace concentrations of VOCs were detected in onsite borehole locations across the site. A limited number of samples detected semivolatile organic compounds (SVOCs) in soils at MISS. More information on chemical constituents in soil on MISS is presented in Section 4.5.2 of the RI; additional information on groundwater, surface water, and sediments is presented in Sections 4.8.2, 4.9.2, and 4.10.2, respectively, in the RI.

Surface water samples collected at locations upstream and downstream from MISS were analyzed for a group of indicator parameters, metals, rare earth metals, mobile ions, SVOCs and VOCs. Results of these analyses indicated the presence of several metals, VOCs, and mobile ions. Of these, arsenic, zinc, trichloroethylene, 1,2,-dichloroethene, and 1,1,2,2,-tetrachloroethane were present at downstream sampling locations. The RI determined the likely source(s) of the VOCs lie(s) somewhere within the MISS/Stepan watershed. Recent information provided by the State of New Jersey indicates that the VOCs may be related to an offsite source. The USACE has developed work plans as part of the groundwater investigations to perform additional characterization activities, confirm information provided by NJDEP, attempt to verify if the source of this contamination is upgradient, and determine if it is a FUSRAP waste. Groundwater and surface water contaminated by FUSRAP waste will be addressed in future CERCLA documentation following the completion of USACE’s groundwater investigation. Groundwater and surface water are not addressed in this FS.

Sediment samples were collected from upstream and downstream locations and analyzed for metals to determine whether chemical constituents were migrating via sediment transport. The findings indicate that MISS is not currently contributing metal COCs to sediment transported from the Maywood Chemical Company Site (See RI Section 4.5.2).

2.4.4 Stepan Property

2.4.4.1 Radioactive Constituents

Radioactivity on the Stepan property is present in both surface and subsurface soils. Radionuclide concentrations in surface soils ranged from 0.3 to 130 pCi/g for radium-226 and from 0.4 to 380 pCi/g for thorium-232. Concentrations of uranium-238 were all below analytical detection limits, which ranged from 1.6 to 21 pCi/g. The largest area of surface contamination is in the northeastern portion of the property. This area is near or adjacent to a grassy area on which the MCW thorium-processing building was formerly located.

In subsurface soils, radionuclide concentrations ranged from 2.0 to 170 pCi/g for uranium-238, from 0.2 to 333 pCi/g for radium-226, and from 0.2 to 1,592 pCi/g for thorium-232. The highest concentration of thorium-232 (1,592 pCi/g) was found in a sample from burial pit 1. Areas of radioactively contaminated subsurface soils are primarily burial pits 1, 2, and 3 but also include areas of the property where thorium processing operations were conducted, areas near those locations, and low-lying areas of the property where residues may have been placed as fill material.

Soil sampling in burial pits 1 and 2 indicated that process residues that were removed from the diked areas or retention ponds and reburied in these locations lie atop bedrock. Samples of bedrock in these locations were analyzed for the radionuclides of concern, and analytical results indicate that radioactive constituents have not migrated into the bedrock surface. Sampling within burial pit 3 could not be accomplished because the pit is beneath an operating warehouse, Building 3 (Figure 2-12), which is supported by several hundred wooden pilings. Information on radioactive constituents on Stepan is found in Section 4.4.1 of the RI.

Radiological surveys of the buildings, performed to confirm data from past surveys, indicated that alpha and beta-gamma surface levels were above guidelines in effect at the time in Buildings 4, 10, 13, 15, 20, 67, 78, and the guard shack (Figure 2-12). The radioactivity was identified to be fixed in place (nontransferable) on structural surfaces. Transferable radiation provides more risk than fixed contamination of the same concentration. This is because transferable radiation can be readily removed from a surface by casual contact and, thus, provides more routes of exposure than fixed contamination (i.e., ingestion, dermal contact, inhalation, and direct gamma). Fixed contamination is defined as radioactive contaminants that cannot be removed by casual contact, rubbing, air movement, or vacuuming. Fixed contamination is typically located under painted surfaces and can be removed only through abrasive decontamination techniques (i.e., wire brushing, sanding, scabbling). The primary route of exposure for fixed contamination is direct gamma. Table 4-8 in the RI provides more information on radiological contamination in buildings on the Stepan property unit (DOE 1992a). NRC's Regulatory Guide 1.86 was superceded by the Standard Review Plan, NUREG 1727. Contamination in the buildings at Stepan will need to be re-evaluated based on this new guidance. Insufficient building survey information is available to perform this evaluation; therefore, additional surveys will need to be performed in the future to define the extent of decontamination necessary to achieve cleanup criteria.

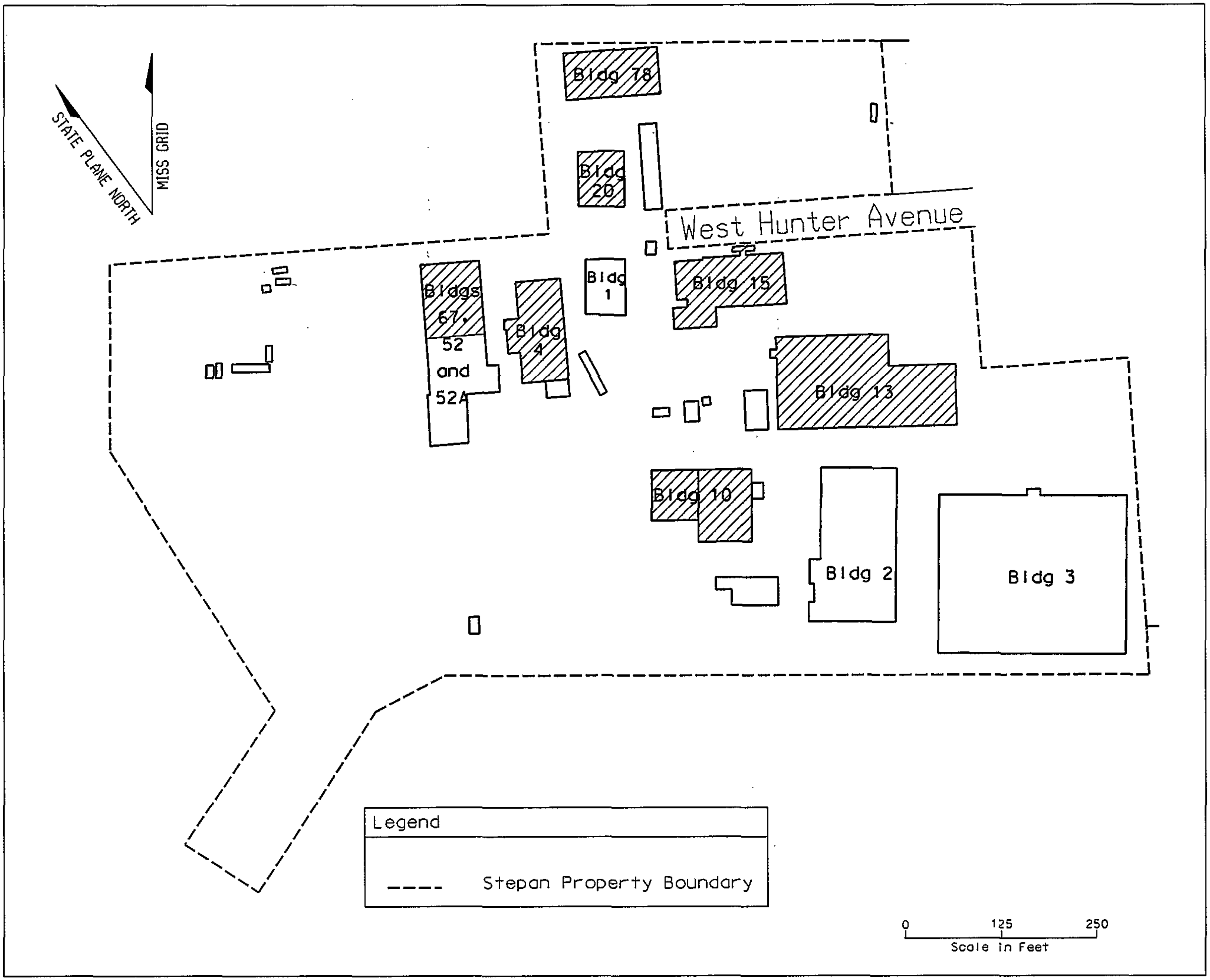


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Figure 2-12. Buildings with Elevated Alpha and Beta-Gamma Surface Levels (Shaded) on the Stepan Property

2.4.4.2 Chemical Constituents

A limited chemical assessment of soils on the Stepan property was undertaken to attempt to identify any chemical contamination associated with the thorium processing operations and to determine whether hazardous wastes, as defined by RCRA, are mixed with radioactive contamination. Soil samples subjected to analysis for TCLP evaluation produced no results that would classify the soil as a RCRA hazardous waste according to 40 CFR 261, Subpart C. Additionally, testing for corrosivity and reactivity produced no result that would identify the soil as a characteristic RCRA hazardous waste. No PCBs, which are not regulated by RCRA, or pesticides were detected.

Additional sampling on the Stepan property was conducted for analysis of metals, VOCs, and SVOCs. Metals present in soils on the Stepan property include arsenic, beryllium, and chromium. The identified metals are not associated with the processing of thorium (monazite sands) at MCW. Organic compounds were detected infrequently and at low concentrations. VOCs detected include toluene, trichloroethylene, and tetrachloroethylene. Organic compounds characterized as SVOCs were detected in soil at Stepan. Neither historical information nor the chemical investigation conducted in the RI uniquely associates organic constituents with the thorium processing operations. Rare earth elements known to be associated with monazite sands (e.g., cerium, lanthanum, and neodymium) were found to be commingled with radioactivity. There are no ARARs for these constituents. These constituents are not CERCLA hazardous substances. Section 4.4.2 of the RI presents more information on chemical COCs on the Stepan property unit (DOE 1992a).

As mentioned in the MISS chemical constituents discussion, a focused investigation was conducted by the Stepan in 1994 on the MISS and Stepan properties. The results of the investigation indicate a maximum of 117,000 mg/kg of chromium in the leather processing material samples, a maximum of 2,500 mg/kg in adjacent soil (within 3 ft of leather processing material), and a maximum of 1,690 mg/kg in soils at least 3 ft distant of leather processing material. No TCLP data are given in the EPA report (CH2MHill 1994b). See Section 2.4.3.2 for additional discussion regarding these wastes.

The scope of this chemical investigation on the Stepan Company property was limited by design. A full-scale and separate investigative study to identify and characterize existing sources of nonradioactive constituents on Stepan and area properties has been conducted by the Stepan Company under an Administrative Order and an Order on Consent with EPA (CH2M Hill 1994a).

2.4.5 Commercial/Government Vicinity Properties

A brief summary of the results of the RI follows for these properties. Further information on radioactive and chemical constituents detected at the commercial/government properties can be found in Sections 4.7.1 and 4.7.2, respectively, in the RI (DOE 1992a).

2.4.5.1 Radioactive Constituents

On commercial/government vicinity properties (excluding the 96 Park Way property) concentrations of uranium-238, radium-226, and thorium-232 in surface soils ranged from 1.1 to 80 pCi/g, 0.3 to 12.9 pCi/g, and 0.4 to 238.4 pCi/g, respectively. In subsurface soils, concentrations ranged from 0.5 to 42.7 pCi/g for uranium-238, from 0.2 to 37 pCi/g for radium-226, and from 0.2 to 180 pCi/g for thorium-232.

Results of radon testing on commercial/government properties are presented in the Buildings/Structures property unit (Section 2.4.6)

2.4.5.2 Chemical Constituents

Organic chemicals and metals were found above site background concentrations in soils on the 149-151 Maywood Avenue and 23 West Howcroft Road properties. The 149-151 Maywood Avenue property was part of the original MCW property, and was used in part for waste disposal. None of the soils on the commercial/government properties analyzed to date has exhibited characteristics of RCRA hazardous waste, and no PCBs were detected.

2.4.6 Buildings/Structures

Building surveys were conducted during the RI for direct and transferable (removable) radioactivity. The only building contamination detected during the RI was on the Stepan property. No transferable radioactivity above guidelines was detected; all radioactivity was fixed in place. Characterization was limited due to Stepan Company's ongoing operations, and the RI indicates that additional testing must be made before the buildings undergo remediation.

The building data collected during the RI were collected in accordance with internal DOE policies and procedures relative to acceptable limits for surface contamination. The DOE procedures and limits were compared to those found in NRC Regulatory Guide 1.86. This data indicated the presence of fixed surface contamination above DOE standards in Buildings 4, 15, 20, and 78, and the potential presence of contamination above DOE standards in Buildings 67, 10, 13, and the guardhouse. After the data was collected, Congress transferred FUSRAP from the DOE to the USACE. Unlike DOE, the USACE is not self-regulating for radioactivity; the USACE follows the regulations, policies, and procedures of the NRC where appropriate. While the NRC's policy at the time of the surveys was similar to DOE's regarding building surface contamination (Regulatory Guide 1.86), this policy was superceded by the Standard Review Plan, NUREG 1727.

Some of the buildings on Stepan property are located above contaminated soils. As a result, as part of the soils remedial action, the buildings will be demolished as necessary to access underlying contaminated soils. Other buildings on Stepan property contain contaminated components that, if not addressed in this remedial action, could be inadvertently released to the environment when improvements to the property are made subsequent to completion of the remedial action. Therefore, these buildings will be addressed as part of this remedial action.

In order to meet State of New Jersey standards for remediation of radioactive contamination of real property, additional data collection and evaluation will be needed to define the extent of decontamination necessary to meet these standards. Further discussion of these standards can be found in Chapter 3. The data gathered to date on the buildings at Stepan is not useful to determine compliance with the pertinent standards. Existing data demonstrates the need for remedial action, and the data will be used to help guide further characterization efforts. For this reason, the level of decontamination efforts required for the buildings at Stepan has yet to be determined. Additional surveys will be performed during future remedial actions; actions to be taken on the buildings are evaluated in this FS.

In March of 1994, radon measurements were made of 19 commercial and government properties. Note that two of these properties, Fire Station #2 and John F. Kennedy Park in Lodi, have been addressed by removal actions. Interior and exterior gamma exposure measurements were collected at each of the 19 properties included in the investigation. The highest measurements, both interior and exterior, were located on the Stepan Company property in areas that are not occupied full-time by Stepan employees. Data for radon indicate that radon concentrations at the properties do not exceed the New Jersey Administrative Code (NJAC) 7:28-12.8(a)2 action level of 3.0 pCi/L above background. Unprotective concentrations of radon-222 have not been found at the Site. The highest concentration of radon (3.4 pCi/L, including background) was measured inside Building 3 at the Stepan Company property. Building 3 was constructed above a known burial area containing thorium process wastes and residues; this building is not occupied full-time.

Ten percent of the radon canisters deployed on properties where contamination is known or suspected to be present beneath the building were analyzed for thoron (Radon-220). None of the thoron measurements exceeded guidelines.

The measurements of radon for the 19 commercial and government properties are identified below:

Commercial Properties

- 160/174 Essex Street - 0.2 pCi/L to 0.3 pCi/L
- 113 Essex Street - 0.2 pCi/L to 0.6 pCi/L
- 85 N. NJ State Route 17 - 0.2 pCi/L to 0.3 pCi/L
- 87 N. NJ State Route 17 - 0.2 pCi/L to 0.4 pCi/L
- 99 N. NJ State Route 17 - 0.2 pCi/L to 0.4 pCi/L
- 239 State Rt. 17 (office) - 1.3 pCi/L
(storage) - 1.0 pCi/L
- 100 W. Hunter Ave. Maywood (Stepan Company) - 0.2 pCi/L to 3.4 pCi/L

- 167 State Rt. 17 - 0.2 pCi/L to less than 0.3 pCi/L
- 137 State Rt. 17 - 0.2 pCi/L to 0.3 pCi/L
- 80 Industrial Road - 0.3 pCi/L to 0.5 pCi/L
- 170 Gregg Street - 0.2 pCi/L to 0.4 pCi/L
- 80 Hancock Street - 0.2 pCi/L to 0.4 pCi/L
- 100 Hancock Street - 0.4 pCi/L to 0.5 pCi/L
- 23 West Howcroft Road - 0.2 pCi/L to 0.4 pCi/L
- 72 Sidney Street (a.k.a. 88 Money Street) - 0.3 pCi/L to 0.4 pCi/L
- 200 State Rt. 17 - 0.3 pCi/L to 0.4 pCi/L
- 149-151 Maywood Avenue - 0.4 pCi/L or less
- 205 Maywood Avenue - 0.4 pCi/L to 1.7 pCi/L

Government Properties

- 8 Mill Street, Lodi NJ Vehicle Inspection Station - 0.3 pCi/L to 0.6 pCi/L
- Lodi Fire Station No. 2 - 0.4 pCi/L to 0.8 pCi/L
- John F. Kennedy Park - 0.6 pCi/L to 1.1 pCi/L

2.5 FUSRAP CONTAMINANT FATE AND TRANSPORT

Constituents identified as FUSRAP waste at the FUSRAP Maywood Superfund Site include radionuclides (thorium-232, uranium-238, and radium-226), metals, and rare earth metals. The primary sources identified include: the burial pits on Stepan; former retention ponds on MISS, 149-151 Maywood Avenue, and 96 Park Way; and the former location of the thorium processing building on the northeast corner of MISS. The principal migration pathways are groundwater, surface water, and air. Figure 2-13 presents a conceptual model of release mechanisms and transport in the environment; Figure 2-14 illustrates transport between different media. Metals and radionuclides in the unsaturated soil zone may migrate in the groundwater when they reach the water table.

Although sediment transport was historically a principal migration pathway, results of the environmental monitoring program indicate this is no longer a migration pathway; Lodi Brook is now almost entirely encased in culvert.

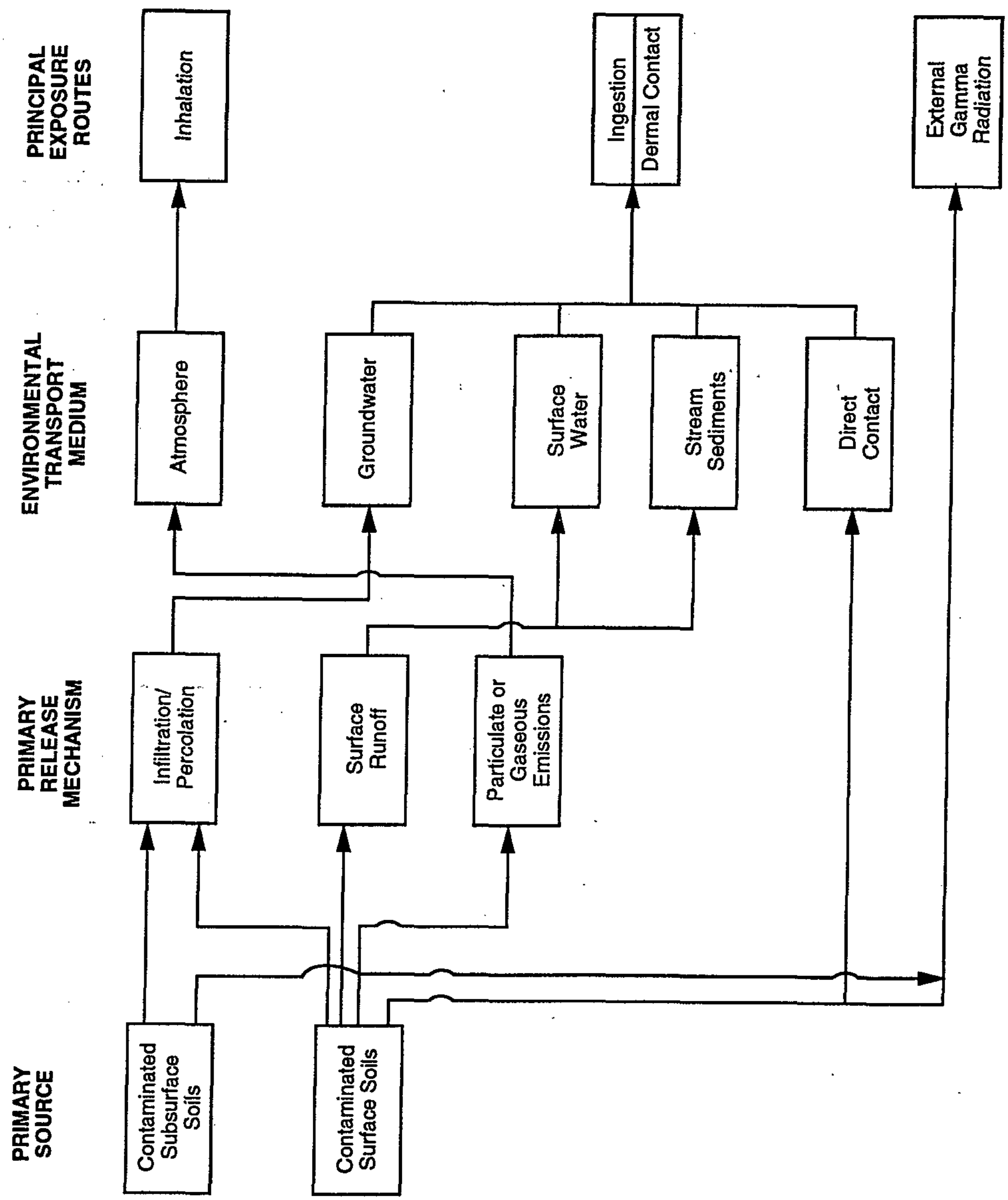

Figure 2-13. Conceptual Site Model

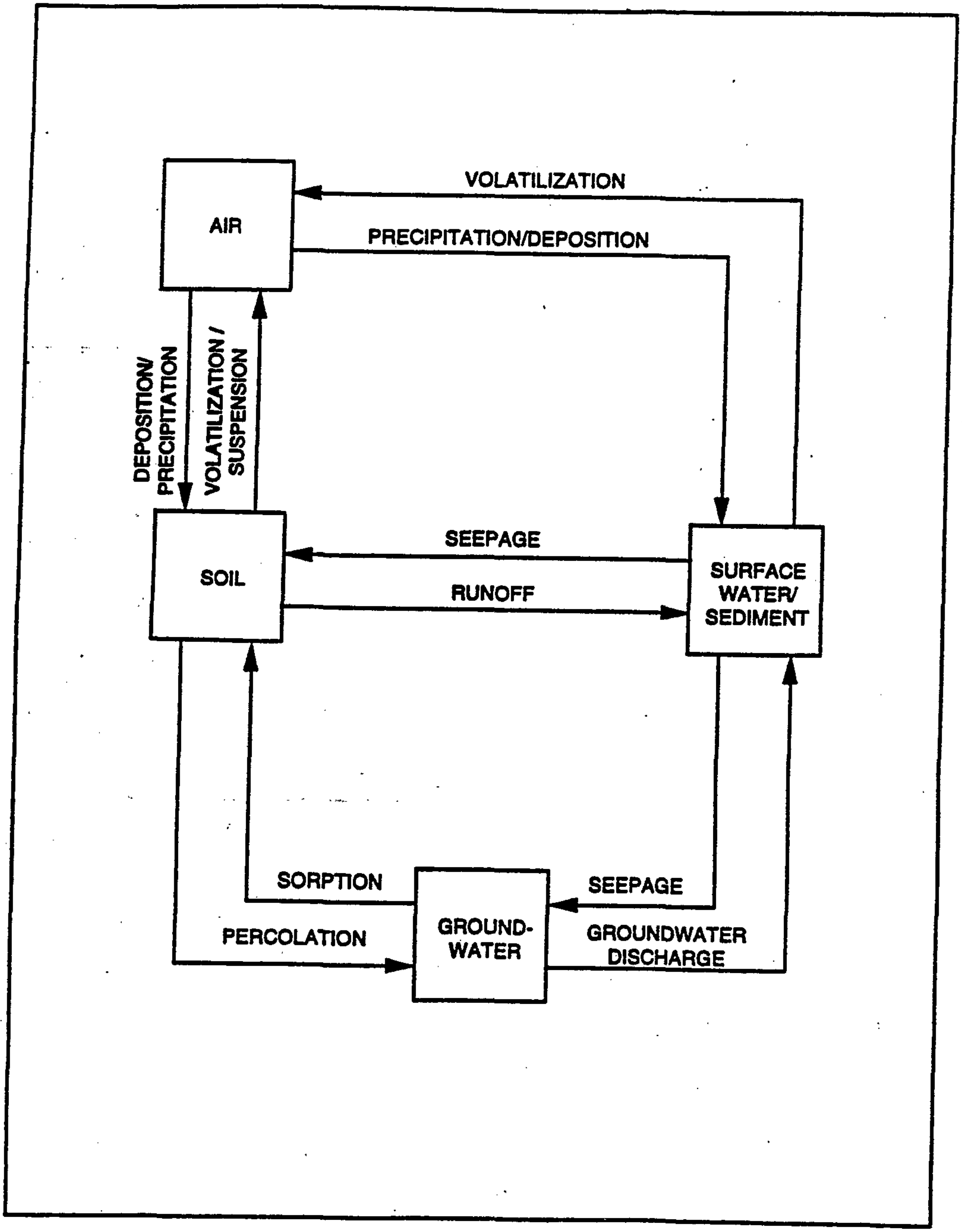

Figure 2-14. Intermedia Transfer Processes

Grass, other thick vegetation, or asphalt covers the properties investigated. Therefore, surface water transport and air resuspension are not identified as likely pathways for migration for radioactive constituents unless these covers are disturbed. Chemical constituents are present in groundwater and surface water. Section 5 of the RI provides a complete discussion of COC fate and transport at the FUSRAP Maywood Superfund Site (DOE 1992a).

2.6 BASELINE RISK ASSESSMENT

As part of the ongoing analysis at the FUSRAP Maywood Superfund Site, a BRA (DOE 1993a) was prepared to evaluate risk to human health and the environment from the radioactive and chemical constituents at the FUSRAP Maywood Superfund Site. This section summarizes the information presented in that document. Note that the BRA was prepared to address the entire FUSRAP Maywood Superfund Site and, therefore, calculated risks from data that included groundwater, inaccessible soils, and the burial pits. Groundwater is excluded from the evaluation of alternatives for remedial action in this FS, and will be addressed later outside the scope of this FS.

The BRA examines both radioactive and chemical contamination and includes the determination of projected central tendency (mean) and RME (upper 95% confidence limits) individual and population risks. The Maywood BRA used EPA's *Risk Assessment Guidance for Superfund* (RAGS) (EPA 1989a).

Some volume estimates and other data have been refined using additional monitoring data and further analysis. The BRA was not revised because it still accomplishes the principal purpose of a BRA, establishing that human health risks for portions of the site may exceed the CERCLA protective risk range, thereby warranting consideration of remedial action.

Information on the sampling and analyses performed for the FUSRAP Maywood Superfund Site is presented in the RI (DOE 1992a). These data and those drawn from historical reports were used to select chemicals and radionuclides of potential concern for detailed evaluation, primarily on the basis of a comparison of FUSRAP Maywood Superfund Site concentration with mean representative background and the known or suspected toxicological or radiological properties of the compounds.

2.6.1 Human Health Risk Assessment

The principal radionuclide COCs on the FUSRAP Maywood Superfund Site properties are thorium-232, radium-226, uranium-238, and their associated decay products. Potential chemical COCs evaluated in the BRA include metals (including uranium), VOCs, SVOCs, and one pesticide. These are presented in Table 2-7. Chemicals were selected as potential COCs if detected average concentrations exceeded twice the average background concentrations (background for organic chemicals is zero) and frequency of detection warranted inclusion under the COC screening criteria. The final list of potential COCs for the risk assessment is comprised of those chemicals that remained after application of the screening criteria and for which appropriate toxicity factors were available.

Table 2-7. Summary of Potential COCs Evaluated in the Baseline Risk Assessment

Risk		Constituents of Concern	Soil						Groundwater		Surface Water		Sediment	
			MISS		Stepan		Commercial/ Government		Alluvium	Bedrock	Westerly Brook	Lodi Brook	Westerly Brook	Lodi Brook
Metals and Rare Earths			**S**	**AH**	**S**	**AH**	**S**	**AH**						
	NC	Aluminum							•					
C	NC	Arsenic[a]		•	•	•			•[b]		•			
	NC	Barium[a]					•	•	•					
C	NC	Beryllium[a]							•[b]					
	NC	Boron							•	•				
C	NC	Chromium	•	•		•		•	•[b]					•
	NC	Copper[a]	•	•			•	•	•					
	NC	Lithium	•	•					•	•	•			
	NC	Manganese							•					•
C	NC	Nickel[a]							•[b]					
	NC	Selenium[s]				•			•[b]					
	NC	Vanadium[a]							•					
C	NC	Uranium	•	•	•	•	•	•						
Volatile Organics														
C		Benzene[a]								•[b]				
	NC	2-butanone[a]		•										
	NC	Carbon disulfide		•					•	•				
C	NC	Chloroform								•[b]				
C	NC	1,1-dichloroethene							•	•				
	NC	1,2-dichloroethene							•	•	•			
	NC	Ethylbenzene								•[b]				
C	NC	Methylene chloride							•[b]	•[b]				
C		1,1,2,2-tetrachloroethane								•	•			
C	NC	Tetrachloroethylene[a]				•			•[b]	•[b]				
	NC	Toluene[a]	•	•		•			•[b]	•[b]				
	NC	1,1,1-trichloroethane												
C	NC	Trichloroethylene[a]				•			•[b]	•[b]	•			
C		Vinyl chloride[a]							•[b]	•[b]				
	NC	Xylenes (total)[a]		•				•		•[b]				
Semi-VolatileOrganic Compounds														
C		1,2-diphenylhydrazine		•										
C	NC	Acenaphthene[a]		•										
C		Acenaphthylene		•										
C	NC	Anthracene[a]	•	•	•	•								
C		Benz(a)anthracene[a]	•	•	•	•	•	•						

Table 2-7. Summary of Potential COCs Evaluated in the Baseline Risk Assessment (continued)

Risk		Constituents of Concern	Soil						Groundwater		Surface Water		Sediment	
			MISS		Stepan		Commercial/ Government		Alluvium	Bedrock	Westerly Brook	Lodi Brook	Westerly Brook	Lodi Brook
C		Benzo(a)pyrene[a]	•	•	•	•								
C		Benzo(b)fluoranthene[a]	•	•	•	•								
C		Benzo(g,h,i)perylene[a]	•	•	•	•								
	NC	Benzoic acid		•										
C		Benzo(k)fluoranthene[a]	•	•		•								
C		Bis(2-chloroethyl)ether[a]							•[b]	•[b]				
C	NC	Bis(2-ethylhexyl)phthalat[e]	•	•		•		•	•[b]	•[b]				
	NC	Butylbenzylphthalate[a]	•	•			•	•						
C		Chrysene	•	•		•	•	•						
C		Dibenz(a,h)anthracene	•	•										
	NC	Di-n-butylphthalate	•	•	•	•	•	•						
C	NC	Fluoranthene	•	•		•	•	•						
C	NC	Fluorene		•	•	•								
C		Indeno(1,2,3-cd)pyrene	•	•	•	•								
	NC	Naphthalene		•						•				
C	NC	N-nitrosodiphenylamine		•						•				
C	NC	Pentachlorophenol		•										
	NC	Phenol		•					•					
C	NC	Pyrene	•	•		•	•	•						
		Pesticides/PCBs												
C	NC	Dieldrin								•				
		Radionuclides	S	AH*	S	AH*	S	AH*						
C		U-238	•	•	•	•	•	•					AS	AS
C		Th-232	•	•	•	•	•	•					AS	AS
C		Ra-226	•	•	•	•	•	•					AS	AS

[a]New Jersey soil standard available (proposed rule at time of BRA evaluation)
[b]New Jersey groundwater standards

Notes:

C	=	Carcinogenic effects
NC	=	Noncarcinogenic effects
S	=	Surficial soil horizon
AH	=	All soil horizons
*	=	Subsurface soil horizon only
AS	=	Aggregated with surficial soil

Rare earth elements, such as cerium, lanthanum and neodymium, identified in the RI as meeting the definition of FUSRAP waste were not included in the quantitative risk assessment. As previously noted, they are not CERCLA hazardous substances, they lack EPA toxicity values, and are not considered toxic. These constituents were found in elevated concentrations but were not evaluated quantitatively in the risk assessment because there is no toxicity data available. A qualitative assessment was performed in the DOE BRA.

Radiological exposure rates and doses were calculated using the RESidual RADiation computer modeling system (RESRAD) computer code (Yu et al. 1993). Inhalation of radon progeny was estimated using the methodology of United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 1988). Doses from measured radon and gamma levels were substituted for modeled doses where available.

Chemical intake estimates are based on EPA methodology presented in RAGS (EPA 1989a) and related guidance (EPA 1991a). Appendix E of the BRA (DOE 1993a) summarizes all estimated intakes and risks. Inhalation exposure estimates included inhalation of airborne particulates and radon, where appropriate.

Surface soil statistical data were used as the exposure point concentration for all scenarios. All current land-use scenarios assumed an adult receptor.

Risk estimates are presented for current-use and future-use scenarios for human receptors at the FUSRAP Maywood Superfund Site. Human receptors include residents, employees, and transients (e.g., visitors, customers, trespassers, and commuters). Radiological and chemical cancer risks are estimated separately. The principal potential adverse health effect from human exposure to radioactivity is an increased lifetime risk of developing cancer. Radionuclides are not believed to present significant noncancer toxicity except for uranium, which has toxicity similar to heavy metals like lead. Some chemicals are toxic, as well as carcinogenic. As a result, any noncancer risk calculated in the DOE BRA related solely to chemical contamination.

Cancer risk is defined as the lifetime probability of cancer morbidity. Cancer risk does not include genetic or noncarcinogenic effects. Cancer risk estimates are presented for the chemical COCs where toxicity values are available. Cancer risks are estimated as the incremental probability of an individual developing cancer over a lifetime caused by pathway-specific exposure to carcinogenic constituents. The potential for noncarcinogenic effects is evaluated by summing the ratios of intake to chronic reference dose values. This ratio of exposure is called a hazard quotient (HQ). HQs for each COC are then summed to obtain a hazard index (HI) for the specific pathway. If the HI exceeds one, adverse health effects might occur, at the types and levels of exposure assumed.

2.6.1.1 Radiological Cancer Risk

Refer to Table 2-8a and 2-8b and Figures 2-15 through 2-18 in this FS for the following discussion of radiological cancer risks.

Table 2-8a Radiological Risk Summary
Current Use Scenario

LOCATION	PROPERTY UNIT*	PROPERTIES ADDRESSED IN FS	Employee		Resident		Transient	
			Mean	RME	Mean	RME	Mean	RME
Residential	Unit 1**				3E-04	4E-03		
	Unit 2**				3E-05	2E-04		
Stepan	Unit 3	100 W. Hunter Ave.	9E-05	6E-04			2E-07	9E-05
	Unit 3H	100 W. Hunter Ave.	2E-04	1E-03				
	Unit 7	100 W. Hunter Ave.	4E-05	4E-04				
Municipal Parks	Unit 4**						2E-06	9E-05
Commercial/ Government	Unit 3	205 Maywood Ave.	9E-05	6E-04			2E-07	9E-05
	Unit 3H	61 W. Hunter Ave.	2E-04	1E-03				
		NYS&W Railway	2E-04	1E-03				
		100 W. Hunter Ave.	2E-04	1E-03				
	Unit 5	160/174 Essex St.	4E-05	2E-04				
		I-80 Westbound ROW	4E-05	2E-04				
		99 Essex St.	4E-05	2E-04				
		113 Essex St.	4E-05	2E-04				
		200 Rt. 17 South	4E-05	2E-04				
		170 Gregg St.	4E-05	2E-04				
		100 Hancock St.	4E-05	2E-04				
		80 Hancock St.	4E-05	2E-04				
		80 Industrial Rd.	4E-05	2E-04				
		8 Mill St.	4E-05	2E-04				
		72 Sidney St.	4E-05	2E-04				
	Unit 6	100 W. Hunter Ave. (MISS)	5E-04	2E-03			2E-05	4E-04
		NYS&W Railway	5E-04	2E-03			2E-05	4E-04
		NJ Rt. 17 North	5E-04	2E-03			2E-05	4E-04
	Unit 6H	100 W. Hunter Ave. (MISS)	7E-04	3E-03			9E-05	3E-03
		NYS&W Railway	7E-04	3E-03			9E-05	3E-03
	Unit 6B**	96 Park Way					1E-05	2E-04
	Unit 7	85-101 Rt. 17 North	4E-05	4E-04				
		137 Rt. 17 North	4E-05	4E-04				
		167 Rt. 17 North	4E-05	4E-04				
		239 Rt. 17 North	4E-05	4E-04				
		29 Essex St.	4E-05	4E-04				
		23 W. Howcroft St.	4E-05	4E-04				
		149-151 Maywood Ave.	4E-05	4E-04				
	Unit 7H	23 W. Howcroft St.	6E-04	4E-03				
		149-151 Maywood Ave.	6E-04	4E-03				
	Unit 8	Hackensack and Lodi Railroad					2E-05	3E-04
		111 Essex St.					2E-05	3E-04

RME = Reasonable Maximum Exposure
*Because of the number of properties and range of contaminant concentrations present at the FUSRAP Maywood Superfund Site, the BRA broke the FUSRAP Maywood Superfund Site into a number of different property units for risk evaluation. See Figures 2-15 through 2-18 for more information on property unit designations.
**Properties not addressed by this FS because previously addressed by CERCLA interim removal actions.

Table 2-8b Radiological Risk Summary
Future Use Scenario

LOCATION	PROPERTY UNIT*	PROPERTIES ADRESSED BY FS	Employee		Resident		Transient	
			Mean	RME	Mean	RME	Mean	RME
Residential	Unit 1**				3E-04	4E-03		
	Unit 2**				3E-05	2E-04		
Stepan	Unit 3	100 W. Hunter Ave.	9E-05	6E-04				
	Unit 3H	100 W. Hunter Ave.	2E-04	1E-03				
	Unit 7	100 W. Hunter Ave.			2E-04	2E-03		
Municipal Parks	Unit 4**				2E-04	1E-03		
Commercial/ Government	Unit 3	205 Maywood Ave.	9E-05	6E-04				
	Unit 3H	61 W. Hunter Ave.	2E-04	1E-03				
		NYS&W Railway	2E-04	1E-03				
		100 W. Hunter Ave.	2E-04	1E-03				
	Unit 5	160/174 Essex St.			2E-04	8E-04		
		I-80 Westbound ROW			2E-04	8E-04		
		99 Essex St.			2E-04	8E-04		
		113 Essex St.			2E-04	8E-04		
		200 Rt. 17 South			2E-04	8E-04		
		170 Gregg St.			2E-04	8E-04		
		100 Hancock St.			2E-04	8E-04		
		80 Hancock St.			2E-04	8E-04		
		80 Industrial Rd.			2E-04	8E-04		
		8 Mill St.			2E-04	8E-04		
		72 Sidney St.			2E-04	8E-04		
	Unit 6	100 W. Hunter Ave. (MISS)	5E-04	2E-03			2E-05	9E-05
		NYS&W Railway	5E-04	2E-03			2E-05	9E-05
		NJ Rt. 17 North	5E-04	2E-03			2E-05	9E-05
	Unit 6H	100 W. Hunter Ave. (MISS)	9E-04	5E-03			9E-05	3E-03
		NYS&W Railway	9E-04	5E-03			9E-05	3E-03
	Unit 6B**	96 Park Way			6E-03	5E-02		
	Unit 7	85-101 Rt. 17 North			2E-04	2E-03		
		137 Rt. 17 North			2E-04	2E-03		
		167 Rt. 17 North			2E-04	2E-03		
		239 Rt. 17 North			2E-04	2E-03		
		29 Essex St.			2E-04	2E-03		
		23 W. Howcroft St.			2E-04	2E-03		
		149-151 Maywood Ave.			2E-04	2E-03		
	Unit 7H	23 W. Howcroft St.			3E-03	2E-02		
		149-151 Maywood Ave.			3E-03	2E-02		
	Unit 8	Hackensack and Lodi Railroad	8E-04	7E-03				
		111 Essex St.	8E-04	7E-03				

RME = Reasonable Maximum Exposure
*Because of the number of properties and range of contaminant concentrations present at the FUSRAP Maywood Superfund Site, the BRA broke the FUSRAP Maywood Superfund Site into a number of different property units for risk evaluation. See Figures 2-15 through 2-18 for more information on property unit designations.
**Properties not addressed by this FS because previously addressed by a CERCLA interim removal action.

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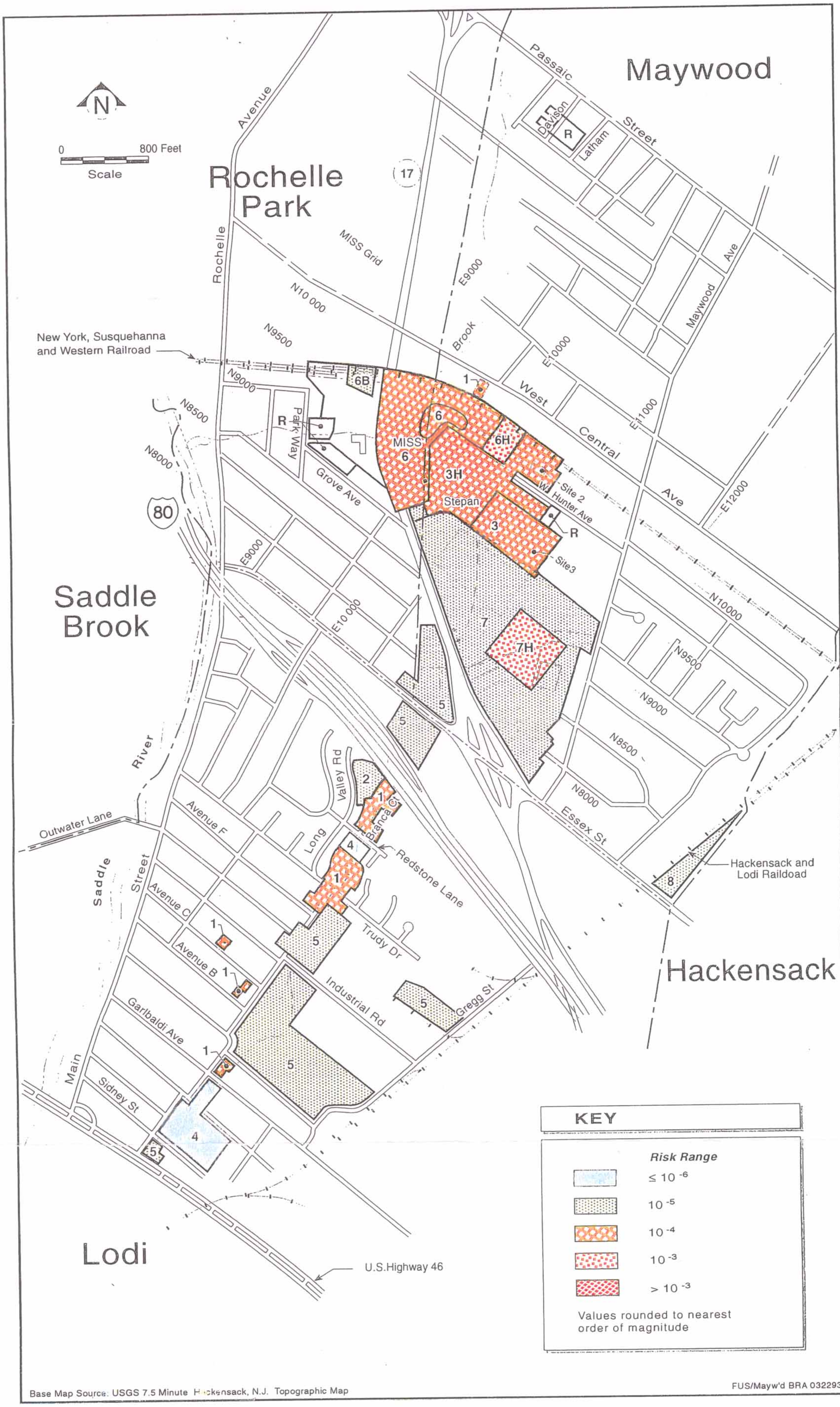


Figure 2-15. Excess Radiological Cancer Risk for the Current Use Scenario (Mean)

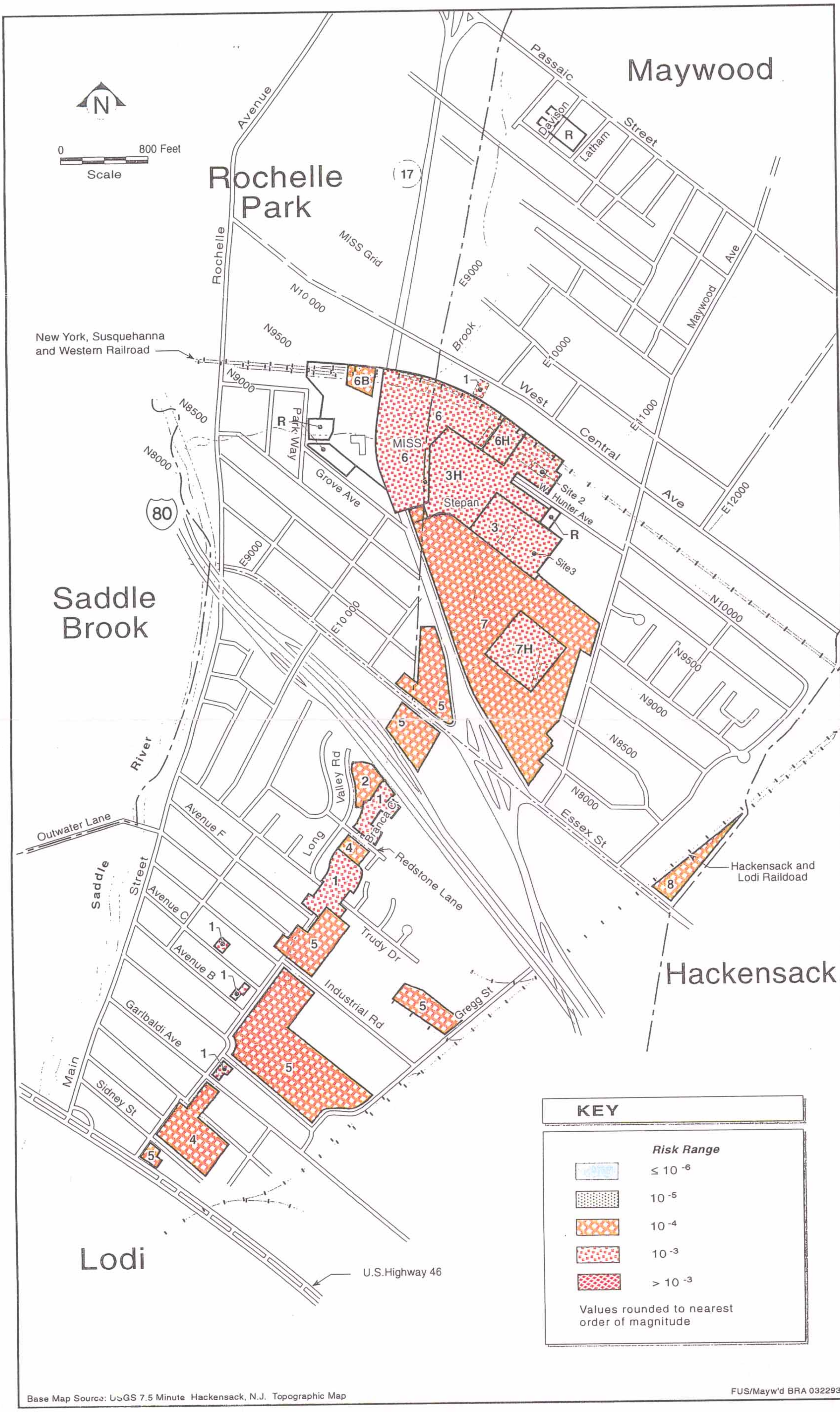


Figure 2-16. Excess Radiological Cancer Risk for the Current Use Scenario (RME)

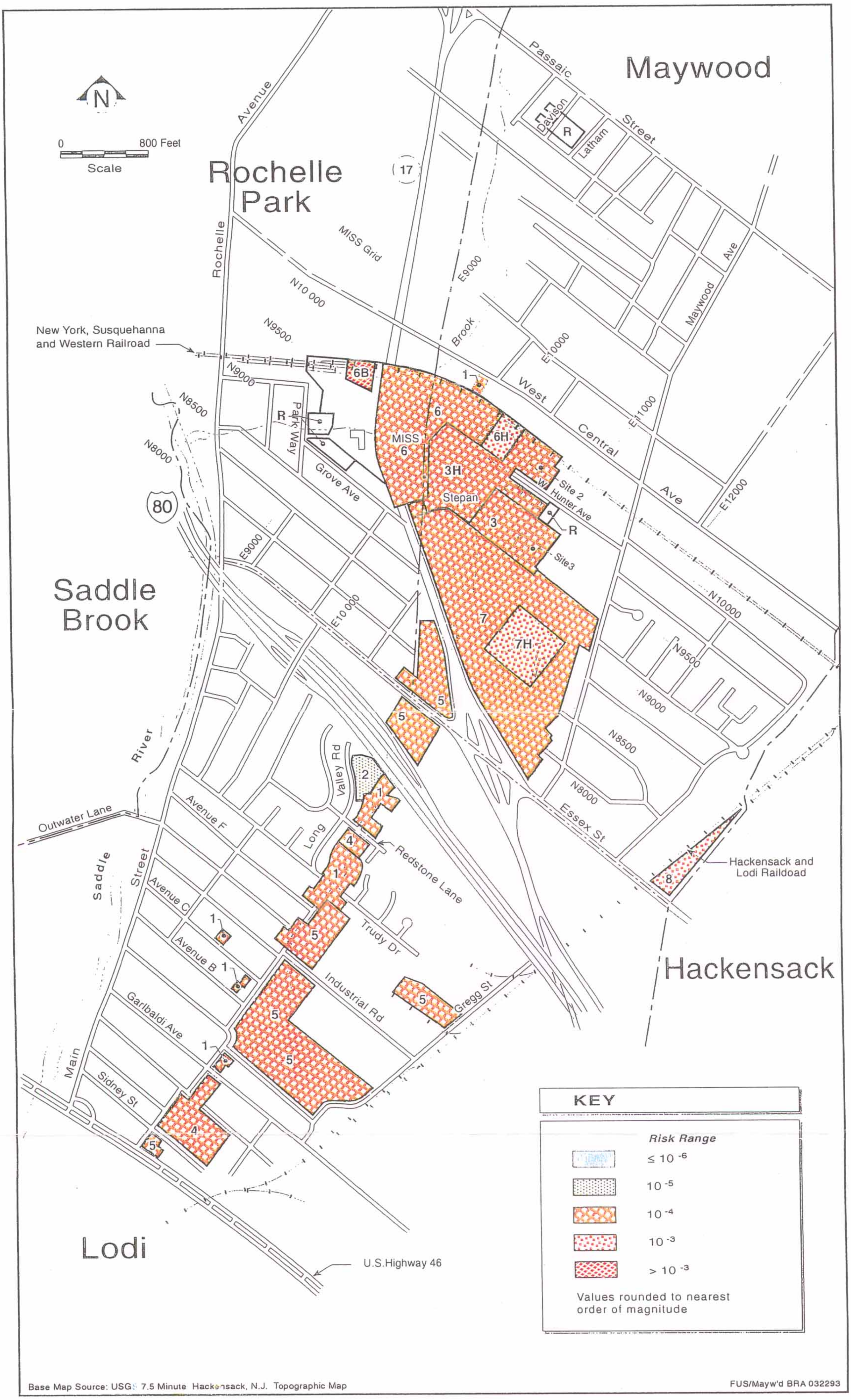


Figure 2-17. Excess Radiological Cancer Risk for the Future Use Scenario (Mean)

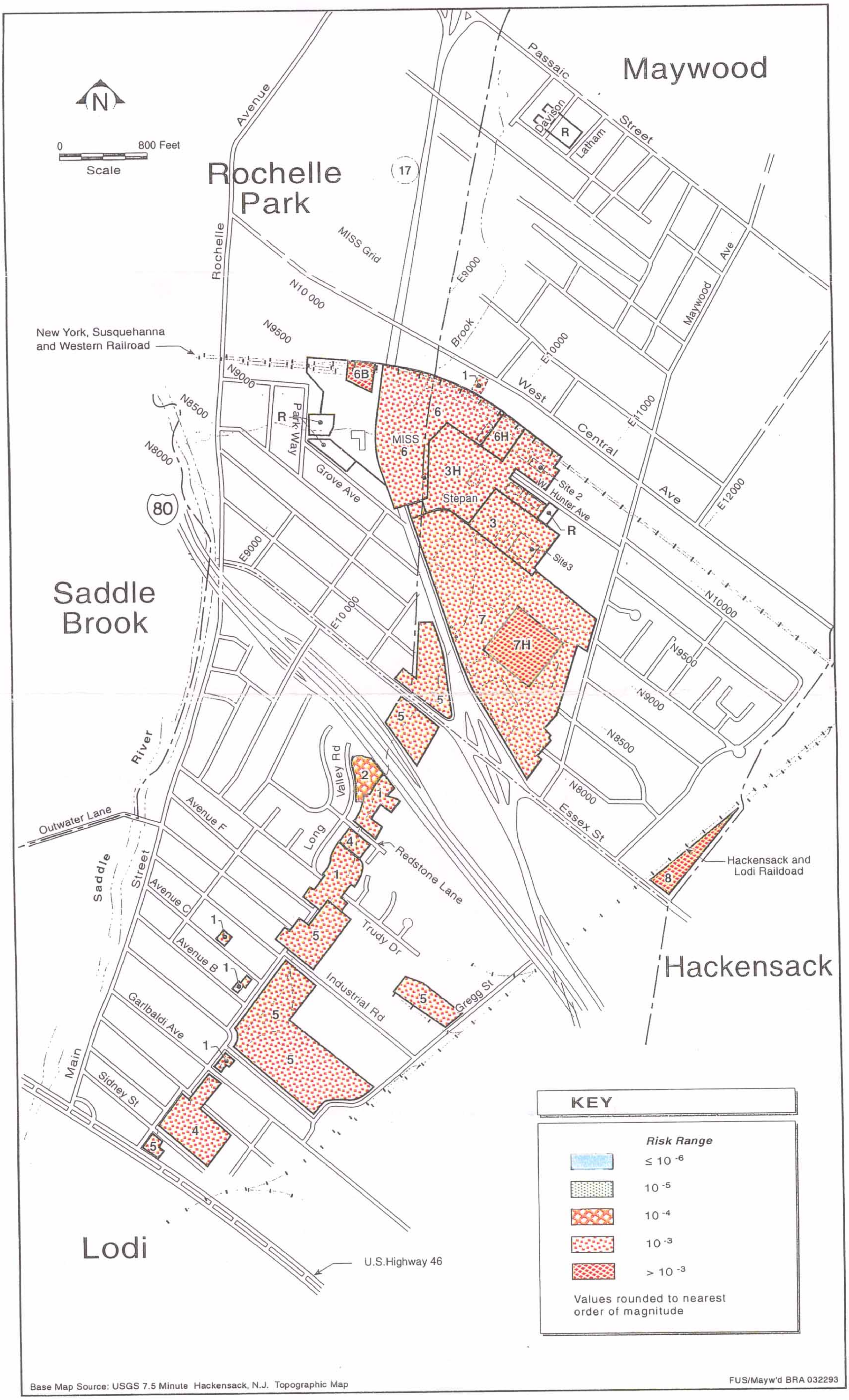


Figure 2-18. Excess Radiological Cancer Risk for the Future Use Scenario (RME)

Current Land Uses

The current use scenario assesses risk for current land uses, but assumes somewhat more exposure than actually occurs at the site for this land use. This is a conservative procedure to minimize the potential that risks will be underStated or underestimated. None of the properties addressed in this FS are currently used for residential uses. Existing land uses are commercial or industrial, and the populations for these current land use scenarios are employee and transient. Some properties at the site have both employee and transient populations, in which case only the population having the greater risk is discussed.

In assessing human health risks at this site, DOE's BRA addressed both central tendency (mean) and RME risks. These risks were quantified for each property and for each exposure scenario. The estimation of the central tendency risks used mean or 50th percentile values for the levels of environmental contamination and the amount of exposure assumed (i.e. how much soil might be ingested on a daily basis). RME risks are based upon conservative estimates of environmental contamination, and exposure for each scenario and population (generally 90-95th percentile). As a result, RME risks are greater than central tendency or mean risks.

For current land uses, the highest cancer risks from radiological contaminants was estimated for Units 6H and 8, where the estimated mean employee risks were up to 7E-04 and where the RME employee risks for radiological contaminants were up to 4E-03. Still for current land uses, the lowest cancer risks for radiological contaminants were estimated for Unit 8, where the mean risk was 2E-06, and the RME risk was 3E-04, for both the transient population, and Unit 5, where the employee RME risk was estimated at 2E-04.

Future Land Uses

Three different populations, relating to the land use scenarios, were considered for some properties addressed in this FS: employee, resident and transient. Both employee and transient populations were evaluated for Units 6 and 6H (which is the MISS). As for the current land use scenarios, both mean ("central tendency") and RME risks were assessed.

The greatest cancer risks for radiological contamination, for future land uses, were estimated for Unit 7H, where the mean and RME risks for a resident were estimated at 3E-03 and 5E-02. The smallest radiological cancer risks were estimated for Unit 3, with mean and RME risks for an employee estimated at 9E-05 and 6E-04.

2.6.1.2 Chemical Risk

Under the reasonable current-use scenario, all estimated cancer risks were within or below the CERCLA risk range for all receptors evaluated (employees and transients) at MISS or Stepan (see Table 2-9). The principal chemical contributors to risk from soil ingestion were arsenic and polynuclear aromatic hydrocarbons (PAHs) at both properties. For airborne particulate inhalation, chromium was the sole contributor to risk at MISS, as was arsenic at Stepan; however, risks could not be calculated for PAHs because no inhalation slope factors were available for PAHs. The HIs for current employees and transients at MISS and Stepan were all much less than one, indicating no concern for potential adverse noncancer health effects (see Table 2-10).

In the future-use scenario, both employees and transients experience the same conditions as the current scenario. Residents are assumed to live on contaminated property adjacent to the MISS (assumed to remain a commercial property) and consume groundwater containing contaminants leached from the FUSRAP Maywood Superfund Site. In addition, children are assumed to wade in contaminated water in Westerly Brook. For the hypothetical future-use scenario, none of the estimated cancer risk exceeded the EPA target range (excluding groundwater ingestion) for the future employee at MISS. The highest risk (excluding groundwater ingestion) was 2×10^{-5} for the future employees at the FUSRAP Maywood Superfund Site, based on RME concentrations.

The cancer risk from soil ingestion and particulate inhalation for future employees and transients at MISS and Stepan is the same as the current-use scenario and does not exceed the CERCLA risk range. The estimated mean cancer risk for a future resident child ingesting surface water while playing in Westerly Brook was 2×10^{-7}, the estimated RME risk was 4×10^{-7}. (There were no COCs in Westerly Brook sediment or Lodi Brook surface water.) Sediment ingestion from Lodi Brook was not evaluated due to the lack of toxicity factors for estimating exposure.

Groundwater risks were evaluated in the BRA and are presented for information purposes only (groundwater remediation is not addressed in this FS); therefore, risks were calculated based on proximity to the source materials. The risk attributable to ingestion of shallow (alluvium) groundwater was approximately three to four times greater than that projected for the bedrock groundwater.

The highest cancer risk (RME) was to the future resident consuming contaminated groundwater and living adjacent to MISS (1×10^{-2}). Most of the risk was attributed to vinyl chloride and arsenic that is assumed to leach from the soils into the shallow groundwater.

No pathways (excluding groundwater ingestion) for which HIs were calculated exceeded the threshold of one, indicating little or no potential for adverse noncancer health effects to occur for the types and levels of exposure assumed. The principal noncancer health hazard under the hypothetical future scenario is groundwater ingestion by future employees and residents. In shallow (alluvium) groundwater, arsenic, chromium, lithium, and manganese were the most significant contributors to the HI, while manganese accounted for approximately 90% of the HI in bedrock groundwater. Chromium was assumed to be in its more toxic hexavalent form. Current information collected by Stepan Company indicates the chromium is present in its less toxic trivalent form. Consequently, the calculations involving chromium in the BRA are very conservative. A summary of the chemical cancer risks and hazard indices are presented in Tables 2-9 and 2-10.

Table 2-9. Summary of Chemical Risk-Carcinogens

Location/Pathway	Employee		Resident		Transient	
Current Use Scenario						
	Mean	**RME**	**Mean**	**RME**	**Mean**	**RME**
MISS						
Soil Ingestion	5E-07	6E-06			3E-07	2E-06
Particulate Inhalation	3E-07	2E-05			3E-08	1E-05
Stepan						
Soil Ingestion	4E-06	2E-05			2E-06	1E-05
Particulate Inhalation	3E-08	4E-07			2E-09	3E-07
Westerly Brook						
Soil Ingestion						
Particulate Inhalation						
Lodi Brook						
Soil Ingestion						
Particulate Inhalation						
Future Use Scenario						
Location/Pathway	**Employee**		**Resident**		**Transient**	
	Mean	**RME**	**Mean**	**RME**	**Mean**	**RME**
MISS						
Soil Ingestion	5E-07	6E-06			3E-07	6E-06
Particulate Inhalation	3E-07	2E-05			3E-08	1E-05
Stepan						
Soil Ingestion	4E-06	2E-05			2E-06	1E-05
Particulate Inhalation	3E-08	4E-07			2E-09	3E-07
Westerly Brook						
Surface Water Inhalation			2E-07	4E-07		
Lodi Brook						
Sediment Inhalation			a	a		
Alluvium Groundwater						
Near Sources	3E-04	4E-03	1E-03	1E-02		
500 ft away			1E-05	1E-04		
1000 ft away			1E-07	1E-06		

a = Risk value was not calculated due to the absence of EPA slope factors.
RME = reasonable maximum exposure

Table 2-10. Summary of Noncarcinogenic Hazard Indices

Location/Pathway	Employee		Resident		Transient	
Current Use Scenario						
	Mean	**RME**	**Mean**	**RME**	**Mean**	**RME**
MISS Soil Ingestion Particulate Inhalation	0.02	0.2			0.006	0.06
Stepan Soil Ingestion Particulate Inhalation	0.01	0.04			0.004	0.01
Westerly Brook Soil Ingestion Particulate Inhalation						
Lodi Brook Soil Ingestion Particulate Inhalation						
Future Use Scenario						
Location/Pathway	**Employee**		**Resident**		**Transient**	
	Mean	**RME**	**Mean**	**RME**	**Mean**	**RME**
MISS Soil Ingestion Particulate Inhalation	0.02	0.2			0.006	0.06
Stepan Soil Ingestion Particulate Inhalation	0.01	0.04			0.004	0.01
Westerly Brook Surface Water Inhalation			0.004	0.009		
Lodi Brook Sediment Inhalation			0.006	0.02		
Alluvium Groundwater Near Sources 500 ft away 1000 ft away	7.0	30	20 0.2 0.002	90 0.9 0.009		

2.6.1.3 Overall Health Risk

To lend perspective to the FUSRAP Maywood Superfund Site risk, radiological and chemical carcinogenic risks for current and hypothetical future receptor scenarios were combined (summed). Because insufficient data are available to calculate chemical risks for all property units, the summation encompasses only the MISS and Stepan properties. Aggregate cancer risk ranged from 2×10^{-3} (for employee RME exposure at MISS) to 2×10^{-6} (for transient average exposure at Stepan). For current and future scenarios, potential radiological risks are generally ten to a thousand times higher than chemical cancer risks. No unprotective human health risks, as defined by the NCP, were calculated from chemical contaminants in soil for either cancer or noncancer effects.

2.6.1.4 Uncertainties Related to Human Health Risk Estimates

Uncertainties attributable to the numerous assumptions incorporated in the risk estimations are inherent in each step of the risk assessment process. These uncertainties are discussed in detail below. However, most of the assumptions listed in the BRA were deliberately selected to provide conservative estimates of risk (i.e., they tend to overestimate rather than underestimate potential risks). Therefore, actual risks are expected to be lower than those presented in the assessment.

Uncertainties in Radiological Risk Estimates

Constituents of Concern. The identification of COCs for a human health evaluation relies on information from FUSRAP Maywood Superfund Site characterization activities and the application of a selection process.

Analytical data were not available for all of the individual properties and not all radionuclides were reported for each sample location. In addition, the majority of the properties were bias sampled in areas likely to contain higher levels of contamination. For those properties where data was available, the data was aggregated to establish representative property units. However, the predominant radiological risk associated with contaminated soil is from external gamma irradiation. Measured gamma exposure rates were used where available in this assessment. Therefore, the uncertainty in the estimates of the radiological risk from soil as a result of lack of location-specific radionuclide concentrations and undetected subsurface deposits is expected to be low. However, the assumption that radionuclides are heterogeneously distributed throughout the soils leads to uncertainty that may be the most important component of total uncertainty in exposure assessment. Uncertainty associated with sample laboratory analysis and data evaluation is also considered low because an extensive, site-specific quality assurance program was in place.

Some contaminants, primarily rare earth elements, were found on the site in concentrations above background, but lack EPA toxicity values (references doses for noncancer toxicity and slope factors for cancer risk). Therefore, no risk was calculated on such contamination. A comparison of the highest concentrations of rare earth elements found in soil on the site indicates that even these concentrations would not be toxic using an unapproved or provisional reference dose. Nonetheless, the lack of toxicity values for rare earth elements tends to underestimate the actual noncancer risk of soil contamination at the site.

The limited characterization of airborne contamination could potentially affect the risk estimates. Except for radon, the uncertainty is not expected to significantly affect the results of this assessment since the particulate inhalation pathway is typically a minor contributor to the projected radiation exposure. However, radon exposure is an important contributor to total risk. Radon was not identified directly as a COC by the screening process because the limited available data indicated that average measured concentrations did not exceed twice background levels (screening criteria). Radon was included in the analysis because it is a progeny of radium, which was a COC in soil. However, there is much uncertainty associated with the potential for radon in contaminated soil to migrate through the soil and through the floors or walls (below ground) of buildings into indoor air. The uncertainty relates, in part, to soil compaction and how much air there is in soil, and to the porosity of a building's floors and walls (below ground).

The contaminant selection screening may also introduce uncertainty. The estimated health effects could be higher if all compounds were included in the baseline assessment. To address this uncertainty, the selection process for radionuclides is designed to include all components of the measure radioactive decay series by assuming secular equilibrium. Hence, the uncertainty associated with the screening step for radiological COCs is considered low.

Exposure Assessment. An exposure assessment is constructed from a number of site-specific considerations, including exposure point concentrations, scenario assumptions and intake parameters, and primary exposure pathways. Factors that can contribute to uncertainty in exposure point concentrations include data availability and data heterogeneity. For example, limited data are available for air, including radioactive particulates and radon, and no site-specific measurements of uptake by plants are available. These exposure pathways were modeled which, based on the assumption used to identify the scenarios, could result in overestimation or underestimation of the actual doses. Land-use assumptions, intake parameters, exposure durations, etc., were chosen based on site-specific conditions. However, there is still substantial uncertainty associated with the modeling. For the case of modeled air particulates and radon, the uncertainty would be low because these pathways are typically a minor contributor to radiological risk at the FUSRAP Maywood Superfund Site.

The exposure pathways quantified in this BRA were determined on the basis of the FUSRAP Maywood Superfund Site conceptual model and related characterization data. The uncertainty associated with selected pathways for the current use scenarios is low because FUSRAP Maywood Superfund Site conditions support the conceptual model. However, the exposure pathways identified for future use scenarios are more uncertain, especially the conservative assumptions concerning onsite groundwater consumption where municipal water supplies exist.

Toxicity Assessment. Standard dose conversion factors and risk estimates were used to estimate the carcinogenic hazards associated with radioactive contaminants. The health effects associated with radiation exposure have been studied for many years and are well known. The risk estimators used in this assessment are generally accepted by the scientific community as representing reasonable projections of the hazards associated with radiation exposure.

Human epidemiological data on carcinogenesis from exposure to ionizing radiation is more extensive than that for most chemical carcinogens. However, these data are based primarily upon studies of populations exposed to radiation doses and dose rates that are orders of magnitude higher than the levels of concern at the FUSRAP Maywood Superfund Site (e.g., atomic bomb survivors, uranium mine workers, radium dial painters, thorotrast painters). Use of these data to predict excess cancer risk from low-level radiation exposure requires extrapolation based upon very uncertain dose-response assumptions. This uncertainty is evidenced by the revision in cancer risk estimates presented in the BEIR V report prepared by the National Research Council (NRC 1990) by a factor of 3-4 over those presented only 10 years earlier in the BEIR III report (NRC 1980), due primarily to additional study of the atomic bomb survivors and reassessment of the atomic bomb dosimetry. Whereas this revision would indicate higher radiological risks than previously predicted, the BEIR V report also States that "...epidemiological data cannot rigorously exclude the existence of a threshold in the millisievert dose range. Thus, the possibility that there may be no risks from exposures comparable to the external natural background radiation cannot be ruled out. At such low doses and dose rates, it must be acknowledged that the lower limit of the range of uncertainty in the risk estimates extends to zero" (NRC 1990).

Risk Characterization. Some of the procedures used and uncertainties inherent in the human health assessment process may tend to underestimate potential risks, including the use of standard dose conversion factors for estimating radiation doses that are based on adult exposures. However, most of the other assumptions used in the Maywood BRA tend to overestimate rather than underestimate potential risks.

The radiological dose conversion factors used in this assessment are based on the ICRP "reference man." The reference man is an adult male weighing 70 kg. The ICRP selected such a standardized individual for their dosimetry models because their main concern is associated with worker protection; the majority of radiation workers are adult males. Although children are more susceptible to radiation exposure, such effects are significant only for young children. The uncertainty associated with using dose conversion factors developed for adults, and used for an adolescent, is low and does not significantly impact the radiological risks presented in this document. The estimation of health effects associated with radiation doses was based on lifetime-average risk estimators for all routes of exposure. These lifetime-average risk estimators are appropriate because they reflect the likely conditions of exposure, i.e., any given age group could be exposed to the radioactive contaminants. Therefore, the uncertainty associated with the risk estimates used to assess radiation toxicity is considered low.

Uncertainties in Chemical Risk Estimates

Constituents of Concern. Thorium processing conducted from 1916 to 1957 is not likely to have generated the metals and organic chemicals detected at the MISS, Stepan, and 96 Park Way properties. Other chemical operations conducted during this time are not documented. Chemical waste was disposed onsite, but not all suspected waste areas have been sampled. The independent RI/FS study in progress on the Stepan property may provide more insight into chemical contamination sources in the area.

Limitations in the available chemical data create uncertainty in the selection of COCs, in the statistical analysis of FUSRAP Maywood Superfund Site contamination, and in the resulting intake and risk determinations. The soil concentration measurements may not completely represent the true distribution of soil contamination at the individual properties that could overestimate or underestimate chemical risk. Uncertainty in FUSRAP Maywood Superfund Site sampling data is considered low because the sampling plans generally targeted appropriate analytes based on historical information and guidance. Reasonable certainty also is assumed because of the sample data validation and quality assessment/quality control (QA/QC) procedures applied to sample analysis and data evaluation.

Lack of speciation data for chemicals, such as chromium, requires conservative assumptions concerning the species present at the site (i.e., all chromium is hexavalent). While no valent specific soil analysis was performed during the course of the RI, valent specific analyses were performed during a Stepan investigation (CH2MHill 1994b). The Stepan analyses indicate that only a small fraction of the total chromium detected is hexavalent chromium. While this data was rejected by EPA Region 2 due to their stringent laboratory protocol requirements for hexavalent chromium, it does provide strong evidence that the risk from chromium has been overestimated at the site.

Exposure Assessment. Factors that can contribute to uncertainty in the exposure assessment include derivation of exposure point concentrations, assumptions for scenario development and intake parameters, and exposure pathways. The risk estimate from groundwater exposure was limited to consideration of the MISS and Stepan properties because of data availability. Limited surface water and sediment sampling was conducted in Westerly and Lodi Brooks; therefore, this data may not be representative of actual exposure concentrations.

Values assumed for exposure parameters (e.g., inhalation rate and exposure frequency) used in calculations for intakes were based primarily on EPA guidance (EPA 1990 and 1991b). Depending on the accuracy of the assumptions relative to actual site conditions and uses, the intakes could be overestimated or underestimated. For example, a 50 milliliter (mL)/event water ingestion rate and a 200 mg/day sediment ingestion rate were used for the child wading in Westerly and Lodi Brooks. The water ingestion rate is the EPA recommended value for incidental ingestion while swimming, and the sediment ingestion rate is the default value for child soil ingestion. Both of these assumptions probably overestimate intake, and thus risk, for the wading scenario.

Two potential pathways for the scenarios in this assessment, the dermal pathway and the ingestion of homegrown produce pathway, were not evaluated. Uncertainties in the values (i.e., dermal adsorption coefficients and soil-to-plant uptake factors) necessary to calculate or estimate these pathways are considered high. The omission of these potential exposure pathways may result in underestimation of the chemical risks, however the omission is not expected to significantly affect the assessment.

The exposure pathways quantified in this BRA were determined based on the FUSRAP Maywood Superfund Site conceptual model and related characterization data. The uncertainty associated with selected pathways for the current use scenarios is low because FUSRAP Maywood Superfund Site conditions support the conceptual model. However, the exposure pathways identified for future use scenarios are more uncertain, especially the conservative assumptions concerning onsite groundwater consumption where municipal water supplies exist.

Toxicity Assessment. Uncertainty is also inherent in the toxicity values utilized in characterizing the carcinogenic and non-carcinogenic risks. Such uncertainty is chemical-specific and is incorporated into the toxicity value during its development. A number of identified COCs are currently under EPA review for possible changes to reference doses (RfDs), slope factors, or carcinogenic weight of evidence. Interim and provisional toxicity values were used, where available, when values could not be obtained from risk databases (IRIS or HEAST). Uncertainty in risk estimates is introduced when some contaminants do not have valid toxicity factors for use in quantitative estimates. Toxicity values could not be obtained for some contaminants, thereby precluding their inclusion in the quantitative risk estimates. This would underestimate risk, although the magnitude of this underestimation is not quantifiable.

The lack of chemical speciation data for chromium and assumption that all chromium is chromium (VI) overestimates the contribution to risk from this metal. In addition, a single factor was used to estimate the risk for all PAHs present, another potentially conservative assumption.

Arsenic, tetrachloroethylene, and vinyl chloride were the principle contributors to carcinogenic risk from groundwater ingestion. Arsenic and vinyl chloride are known human carcinogens (Class A) that accounted for approximately 30 % of the risk, whereas tetrachloroethylene, which is only a probable to possible human carcinogen (Class C), contributed approximately 70 % of the risk.

Risk Characterization. Assumptions built into the Maywood BRA tend to overestimate rather than underestimate potential risks, including conservative assumptions for the exposure scenarios. For example, much of the FUSRAP Maywood Superfund Site characterization data was based upon biased sampling in areas of known contamination. This data collection method tends to result in an average detected concentration that is biased high over the actual FUSRAP Maywood Superfund Site average concentration. The future use of the FUSRAP Maywood Superfund Site is assumed to change, providing longer exposure durations than are currently present; additionally, surface soils that provide cover are assumed to erode, providing exposure to higher concentration subsurface soils.

Oral RfDs were available for most of the toxicologically important chemicals, but few inhalation RfDs were available, limiting estimation of this pathway's contribution to health hazard. In addition, toxicity factors are not available for any of the rare earth element COCs. Although lead exposure causes significant toxic effects, and lead may be carcinogenic, toxicity factors were not available at the time the baseline risk assessment was conducted. However, draft guidance from EPA (1992e) suggested a quantitative method for estimating detrimental environmental lead levels (uptake/biokinetic model). This model was used in the BRA and has since been approved by EPA.

For this assessment, it was assumed that the toxic and carcinogenic effects of the chemical COCs are additive. This assumption could result in underestimation or overestimation of risks. Concurrent exposure to several contaminants might have synergistic toxic effects (i.e., exposure to two of the metals concurrently might induce a greater toxic effect than that expected if the separate effects were simply added) or conversely, concurrent exposure to some of the metals might also mitigate the toxic effects of exposure to individual metals. However, synergistic effects generally occur only at much higher levels of contamination than were found at this site. The assumption that the effects of multiple contaminants are additive is generally considered to be conservative. Many chemical contaminants actually affect different organs or body systems. Assuming additive toxicity is therefore conservative.

Finally, it should be noted that potentially sensitive populations (children) were addressed using a wading scenario in a brook near the site. However, nursing home residents located near the MISS were not included in the assessment, thus excluding this potentially sensitive subpopulation.

Because of the inherent uncertainties in the risk-assessment process, the results of the human-health assessment presented in the BRA should not be taken to represent absolute risk.

Rather, estimated risks should be considered to represent the most important sources of potential risk at the FUSRAP Maywood Superfund Site that, once identified, might be evaluated in more detail and remedied, as appropriate, during the remedial action process. These sources of uncertainty are common for a Superfund site, and sufficient information is available to allow a remedial action to be selected for the FUSRAP Maywood Superfund Site.

2.6.2 Ecological Risk Assessment

The ecological risk assessment (ERA) for the FUSRAP Maywood Superfund Site is structured according to the general framework for ecological assessments in the Superfund Program (EPA 1989b, EPA 1992). Because of the qualitative nature of the characterization of ecological resources at risk and the screening of constituents, the assessment of potential impacts to ecological resources from exposure to contaminated materials was based largely on toxicological effects reported in the literature for the chemicals of potential ecological concern (COPECs), expected exposure pathways, and biological uptake. Where possible, a semi-quantitative characterization of the risk to ecological resources from exposure to ecological COPECs was based on the ratio of known environmental concentrations to reported threshold concentrations (Barnthouse et al. 1986).

Portions of the FUSRAP Maywood Superfund Site, although generally located in an urban/industrial area, also contain areas with ecological resources that include aquatic, terrestrial, and wetland ecosystems. Habitats and biota occurring at the FUSRAP Maywood Superfund Site are typical of urban/industrial areas and are not viewed as sensitive, unique or unusual. The significance of the FUSRAP Maywood Superfund Site with regard to local ecological resources is considered minimal. Intensive field studies for potential impacts to biota from FUSRAP Maywood Superfund Site COPECs were not considered to be warranted when literature findings were sufficient. No threatened or endangered species listed by the USFWS or the State of New Jersey are known to inhabit the FUSRAP Maywood Superfund Site. Consultation regarding threatened or endangered species is provided in Appendix E. No habitat necessary for the continued propagation of any key species is known to be present at the site.

Ecological COPECs are those substances detected at the FUSRAP Maywood Superfund Site with the potential to pose a hazard to the biota. Factors in determining whether a COPEC qualifies as an ecological COC include environmental concentration, frequency of occurrence, background level, bioavailability, physical and chemical properties, potential for bioaccumulation, toxicity, and effects. Sixty-two chemicals were recognized as potential ecological COPECs. Most of these chemicals were found above background levels in the surface soils at MISS, Stepan, and commercial/government vicinity properties, alluvial groundwater at the MISS/Stepan/96 Park Way property, and surface water and sediments in Westerly and Lodi brooks. Calcium, potassium, and sodium were eliminated from the risk characterization because they are essential biological minerals. There were no readily available terrestrial wildlife toxicity data for radium, thorium, and uranium or their isotopes at the FUSRAP Maywood Superfund Site. The risk assessment for metals and other elements and volatile and semivolatile organic chemicals relied on aquatic and oral toxicity data for laboratory animals that were gathered from compendia of published studies (e.g., Long and Morgan 1991, EPA AQUIRE database). When the observed environmental concentrations and physical-chemical parameters of the initial list of

COPECs were compared to toxicity, mobility, and persistence thresholds, 40 constituents emerged as ecological COPECs warranting further evaluation (Table 2-9).

Risk characterization compares exposures to effect (EPA 1991b). Evaluation of the relative risks of the COPECs at Maywood formed the basis of this risk characterization (EPA 1992). An ecological quotient (EQ) or ratio method compares a constituent's environmental concentration to its toxicity threshold concentration. Any EQ greater than or equal to one indicates the potential for adverse ecological effects. Ecological quotients were used to characterize the relative risks of COPECs at the FUSRAP Maywood Superfund Site. The quotients are summarized in Table 2-11. Additionally, the relative risks of COPECs to ecological receptors were assessed using exposure quotients (XQs), the ratio of exposure concentration (environmental concentration corrected for various exposure modes and pathways) to toxicity threshold concentration. The EQs for those constituents exceeding their toxicity thresholds ranged from 2.1 to 98 (mean) and from 2.1 to 15,053 (RME), where any ratio of 1 or greater is a concern or might warrant further assessment. The potential COPECs consist of radium, thorium, and uranium (and their isotopes), 14 elements (metals and rare earths), and 23 volatile and SVOC organic chemicals (Table 2-12).

Lead, hexavalent chromium, and copper had the highest EQs at Maywood property units. Chromium was assumed to be in its more toxic hexavalent form. Current information collected by Stepan indicates the chromium is present in its less toxic trivalent form. Consequently, the EQs involving chromium are very conservative and, therefore, overestimate risk.

When hypothetical exposure is considered for land uses which do not currently exist, the heavy metals present the greatest ecological risk to both onsite and offsite terrestrial receptors. Terrestrial organisms exposed onsite via direct contact with contaminated media or through tropic pathways are subject to the greatest risk from arsenic and chromium in groundwater, lead in soils at all property units, and chromium in MISS soil. Terrestrial organisms are exposed to an unknown degree of risk from the organic compounds. All COPECs pose a lower relative risk to offsite terrestrial predators.

Table 2-11. Summary of Ecological Quotients (EQs) for COCs at the FUSRAP Maywood Superfund Site[a]

EQs	SOIL		
	MISS	**Stepan**	**Commercial/Government**
EQ ≥ 10,000	Chromium (VI)		
1,000 ≤ EQ < 10,000			Barium, Lead
100 ≤ EQ ≤ 1000	Copper, Lead	Lead	Chromium (VI), Copper
10 ≤ EQ < 100		Chromium (VI)	
1 ≤ EQ < 10		Phenanthrene, Zinc	

[a] Based upon the 95 % upper confidence limit concentration. Values reported are for "surface soil" or "soil-all horizons," whichever is larger for a given location.

Table 2-12. Potential Ecological COCs for the FUSRAP Maywood Superfund Site

Radionuclides[a]		
• Radium	• Thorium	• Uranium
Metals		
• Aluminum	• Arsenic	• Barium
• Cerium	• Chromium	• Copper
• Gadolinium	• Iron	• Lanthanum
• Lead	• Lithium	• Manganese
• Vanadium	• Zinc	
Organics		
• Acenaphthylene	• Benzo(b)fluoranthene	• Benzo(k)fluoranthene
• Benzo(g,h,I)perylene	• Bis(2-chloroethyl)ether	• 2-butanone
• n-butylbenzylphthalate	• Carbon disulfide	• Chlordane
• Dibenzofuran	• 1,1-dichloroethene	• 1,2-dichloroethene
• 1,2-diphenylhydrazine	• Indeno(1,2,3-cd)pyrene	• Nitrobenzene
• n-nitrosodiphenylamine	• Phenanthrene	• 1,1,2,2-tetrachloroethane
• Tetrachloroethylene	• Toluene	• Trichloroethylene
• Vinyl chloride	• Xylene	

[a] This assumes associated decay products in secular equilibrium.

Uncertainties in the Ecological Risk Assessment

The results of the ecological assessment indicate that both onsite and offsite terrestrial organisms and populations at Maywood are at theoretical risk of adverse ecological effects, or at least warrant additional assessment, based on conservative risk assumptions. However, there were a number of potentially significant sources of uncertainty, including the following:

-Biased concentrations of contaminants in soil and water were used to assess the ecological effects to receptors, which are apt to be somewhat higher in levels of contamination than would be samples collected randomly across the site. Environmental concentrations of contaminants at the FUSRAP Maywood Superfund Site, which are used to calculate EQs and XQs, are based on a limited number of nonrandomly located samples. Given that assumptions on the distribution of the data are correct, there is a quantifiable degree of uncertainty about the actual spatial distribution of contaminants. Also, because the estimated upper limit of the 95th percentile concentrations were used to calculate EQs and XQs, the estimates of risk from ecological COCs were conservative with a likelihood of overestimating the risk.

-Uncertainties occur in each of the four interrelated steps of the assessment ERA process. The major uncertainties in the ERA center around the estimates of the contaminant concentrations to which ecological receptors are actually exposed (exposure concentrations) and the concentrations that present an acceptable level of risk of adverse effects to the site organisms, their populations, and the ecosystems that comprise them (toxicity thresholds). These uncertainties arise from many sources, especially the lack of site-specific information concerning the ecosystem effect of FUSRAP Maywood Superfund Site contaminants.

-The structure of the biotic community comprising the ecological receptors at the FUSRAP Maywood Superfund Site (i.e., the distribution and abundance of organisms) was not characterized for the ERA. In addition, no data was compared to a reference area. The lack of quantitative data introduces uncertainties concerning whether, and to what extent, the risk characterization based on proxy organisms underestimates or overestimates the risk to the remainder of the ecological community. It is possible that one or more unobserved species of organism at Maywood are more sensitive than those species for which toxicity data were available for use in setting toxicity thresholds. It does not necessarily follow that these organisms are at significantly greater risk of adverse ecological effects than that estimated in the ERA, because exposure concentrations could be overestimated.

-The identified ecological COCs may have deleterious effects at concentrations above the threshold concentrations used to screen contaminants as ecological COCs. Toxicity thresholds were either based on concentrations reported not to have an effect on the study organism, including Federal water quality criteria, or were estimated conservatively. These thresholds would underestimate the risks only to organisms at Maywood that are considerably more sensitive than the study organisms, and overestimate the risk to organisms equally or less sensitive than the study organisms. There remains the possibility that some thresholds were set at levels at or below which some harm would occur to the study organism or similar organisms at the FUSRAP Maywood Superfund Site.

-The pertinence of toxicity to individual organisms for characterizing the risk to populations and ecosystems should be considered. It is possible that populations may compensate for the loss of large numbers of juveniles or adults with increased survival or fecundity, and ecosystems may possess functionally redundant species that are less sensitive to contaminants. The great uncertainty as to whether ecosystems at the FUSRAP Maywood Superfund Site (e.g., Westerly and Lodi Brooks) possess these buffering mechanisms justifies a conservative approach to risk assessment based on organismal toxicity.

-The ERA estimates the risk to ecological receptors from individual contaminants. Generally, the methods used were sufficiently conservative such that individual risks are overestimated. Nevertheless, synergistic effects are possible, perhaps likely, when toxicants interact in biological systems. Deleterious effects in ecosystems (and organisms) may cascade throughout the system and have indirect effects on the ability of a population to persist in the area even though individual organisms are not sensitive to the given contaminants in isolation. Therefore, the ecological risk characterization for the FUSRAP Maywood Superfund Site may underestimate actual risks to biotic receptors from chemical mixtures.

-Another area of uncertainty in the ecological risk characterization is the future risk to the environment from contamination at the FUSRAP Maywood Superfund Site. The ERA characterizes the current risk based on chronic exposure to low concentrations of toxicants with the potential to persist in the environment for an extended period of time. Nevertheless, possible mechanisms exist that could significantly increase (e.g., erosion, leaching to surface or groundwater) or decrease (e.g., enhanced microbial degradation) the risk to future nonhuman inhabitants of the FUSRAP Maywood Superfund Site.

In spite of the above-noted sources of uncertainty, a new ecological assessment of this site is not required at this time. The available information is sufficient to allow for the selection of a remedial action that would be protective of the environment. Excavation alternatives would remove the contamination causing potentially significant ecological risk because of human health risk. If alternatives were selected that left contamination posing potential ecological risk in place, then additional assessment of ecological risk would be warranted at that time to make a more definitive assessment of ecological protectiveness. In summary, although ECs above one were calculated for the site in the BRA, this may not be significant. This is because there are no unusual or ecologically sensitive habitats considered critical or important for the survival of any ecologically important species, due to the urbanized setting of the site.

3. IDENTIFICATION AND SCREENING OF REMEDIAL ACTION TECHNOLOGIES

This section describes the identification and screening of remedial action technologies for the FUSRAP Maywood Superfund Site. Identifying and screening technologies establishes a range of suitable remedial action technologies to consider further in the detailed analysis.

3.1 INTRODUCTION

The purpose of this identification and screening process is to produce a range of suitable remedial action technologies that can be assembled into remedial alternatives capable of mitigating the existing contamination at the FUSRAP Maywood Superfund Site. EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988) has established a structured process for identifying and screening relevant technologies for site remediation.

Selection of a response action proceeds in a series of steps designed to reduce the universe of potential alternatives to a smaller group of viable alternatives from which a final remedy may be selected. The selection of the site remedial action alternatives involves:

- identifying ARARs (Section 3.2);
- identifying preliminary RAOs specific to the contaminated environmental media (Section 3.2);
- identifying general response actions (GRAs) required to attain the RAOs for the site (Section 3.3);
- identifying technologies and process options applicable to GRAs and performing an initial screening to reduce the number of technologies that require detailed evaluation (Section 3.4); and
- evaluating the screened process options for effectiveness, implementability, and cost (Section 3.5).

3.2 IDENTIFICATION OF ARARS AND REMEDIAL ACTION OBJECTIVES

The purpose of the RI/FS process is to assess site conditions and evaluate alternatives to the extent necessary to select a remedy. The FUSRAP Maywood Superfund Site RI and BRA were placed in the administrative record in January 1993 and April 1993, respectively. This FS uses information from these documents to determine the COCs and possible types of receptors and routes of exposure. This FS satisfies the primary objective under CERCLA to ensure that appropriate remedial alternatives are developed and evaluated, and that relevant information concerning the RAOs can be presented to decision-makers for selection of an appropriate remedy.

RAOs, as developed in this FS, provide the basis for developing proposed remedial actions for contaminated soils at the FUSRAP Maywood Superfund Site. They are based on the nature and extent of the site's radiological and chemical contamination, threatened resources, and the potential for human and environmental exposure.

3.2.1 Development of ARARs

EPA specifies two threshold criteria for evaluating potential remedial action alternatives (EPA 1988):

- overall protection of human health and the environment, and
- compliance with ARARs.

A requirement under Federal and State environmental laws may be classified as applicable or relevant and appropriate, but not both. Identifying ARARs is a two-step process that determines whether the requirement is applicable and, if not, whether it is both relevant and appropriate. Site-specific factors used to identify ARARs include the physical circumstances of the site, COCs present, and characteristics of the remedial action. These factors are compared to the requirement under evaluation to determine whether it is directly applicable, or relevant and appropriate. The terms are defined in the NCP (40 CFR 300.5) as follows:

"*Applicable* requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site….

…*Relevant and appropriate* requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is suited to the particular site."

State statutes may be applicable, or relevant and appropriate, if they are: (1) promulgated so that they are of general applicability and legally enforceable, (2) identified by a State in a timely manner (and are consistently applied in similar circumstances at other remedial actions within the State), and (3) are more stringent than Federal requirements. Where State environmental standards have been promulgated to enact more stringent standards than those required by Federal regulations, including EPA, those State standards may be ARARs (42 USC §9621(d)(2)(A)(ii) 1992, as amended). A determination that a requirement is relevant and appropriate will result in an ARAR that must be achieved to the same degree as if it were applicable. Even though a requirement may not be directly applicable to the site, contaminant, or action; the following comparisons [40 CFR 300.400(g)(2)] between the requirement and the site, contaminant, or action need to be evaluated to determine if a requirement is relevant and appropriate:

1. The purpose of the requirement and the purpose of the CERCLA action
2. The medium (e.g., soil, building, water, groundwater, etc.) regulated by the requirement and the medium contaminated or affected at the CERCLA site.
3. The substances regulated by the requirement and the substances found at the CERCLA site.
4. The actions regulated by the requirement and the actions being considered at the CERCLA site.
5. Any variances, waivers, or exemptions of the requirement and their availability for the situation present at the CERCLA site.
6. The type of place regulated by the requirement and the type of place undergoing the CERCLA action.
7. The type and size of structure or facility regulated by the requirement and the type and size of the structure or facility undergoing the CERCLA action.
8. Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resource at the CERCLA site.

Onsite actions must comply with the substantive requirements of ARARs, but not with related administrative and procedural requirements. Offsite activities, such as treatment of liquid waste at an offsite facility, are directly subject to both substantive and administrative requirements of the pertinent environmental regulations, including the permit requirements of those facilities. The management of CERCLA waste offsite must be in accordance with the offsite rule 58 FR 49200, Sept. 12, 1993, as codified at 40 CFR 300.440.

A third classification is "to be considered" (TBC) criteria, which are non-promulgated advisories or guidance issued by Federal or State governments that are not legally binding and do not have the status of a potential ARAR. However, TBCs may be used in the absence of ARARs at the discretion of the lead agency if they are reliable and useful to the development of remedial alternatives for the site.

Regardless of classification, CERCLA §121 stipulates compliance with all ARARs established by Federal law and, where they are more stringent, State laws, unless an ARAR is waived. Section 121(d)(4) of CERCLA identifies six circumstances under which ARARs may be waived:

- The alternative is an interim measure and will become part of a total remedial action that will attain the applicable, or relevant and appropriate, Federal or State requirement.

- Compliance with a requirement will result in greater risk to human health and the environment than other alternatives.

- Compliance with a requirement is technically impracticable from an engineering perspective.

- The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach.

- The ARAR is a State requirement that the State has neither consistently applied, nor demonstrated the intention to consistently apply in similar circumstances.

- An alternative that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of fund (CERCLA Environmental Trust Fund) monies to respond to other sites that may present a threat to human health and the environment. This requirement does not apply to the FUSRAP Maywood Superfund Site because it is not a "fund-financed" cleanup.

ARARs are also classified as chemical-specific, location-specific, or action-specific standards. Appendix A provides table listings of the chemical-, location-, and action-specific ARARs for the FUSRAP Maywood Superfund Site. The following sections describe some of the more significant ARARs that will impact the selection of a remedy.

3.2.1.1 Contaminant-Specific ARARs

Chemical-specific ARARs are health- or risk-based numerical values that, when applied to site-specific conditions, can be used to formulate remedial action objectives. These values reflect the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment without harm to human health or the environment.

Soils

The primary Federal agencies with regulatory authority for the cleanup of radioactively contaminated sites are EPA and NRC. In general, the determination of an ARAR for a site contaminated with radioactive materials requires consideration of the radioactive constituents present, the functional operations that occur at the site, the regulatory jurisdiction over the site and the more protective of Federal and State regulations (EPA 1989a).

EPA’s regulatory authority for radioactively contaminated sites is derived from several statutes, including the Clean Air Act (CAA), the Uranium Mill Tailings Radiation Control Act (UMTRCA) and CERCLA.

The primary soil contaminants at the FUSRAP Maywood Superfund Site are the radioactive elements thorium-232 (as measured by radium-228, see the subsection titled *Substitution of Thorium-232 for Radium-228 in the Cleanup Criteria* later in this section) and radium-226. Standards for these contaminants in soils can be found in regulations promulgated by both the EPA (40 CFR 192) and the NRC (10 CFR 20 and 10 CFR 40), but are not directly applicable to the majority of the FUSRAP Maywood Superfund Site (the exception is the Stepan company NRC-licensed burial pits). The UMTRCA standards at 40 CFR 192 are not applicable because they apply only to licensed uranium mill sites and inactive mill sites specified by Congress. The FUSRAP Maywood Superfund Site is not a licensed uranium mill site and is not on the list of inactive mills specified by Congress pursuant to UMTRCA. NRC standards found at 10 CFR 40 are discussed later in this section.

The NRC has promulgated standards for decommissioning properties of NRC licensees and terminating NRC licenses at 10 CFR 20, Subpart E. These standards are generally applicable only to persons who hold NRC licenses that regulate source, special nuclear, and byproduct materials. In these standards, NRC has established criteria for release of property that had been regulated by NRC for unrestricted use, as well as criteria for release of property for restricted use would be allowed in cases where achieving unrestricted use would be unreasonable.

The NRC regulations at 10 CFR 20 are not applicable to the majority of the FUSRAP Maywood Superfund Site because the USACE is not conducting decommissioning under an NRC license; rather, the USACE is conducting CERCLA remediation activities at the site. The NRC regulation at 10 CFR 20.1402 is applicable only for the cleanup of the NRC-licensed burial pits. In a Memorandum of Understanding between USACE and the NRC, effective July 5, 2001, USACE agreed to remediate NRC-licensed portions of FUSRAP sites to meet 10 CFR 20.1402 or a more stringent requirement. USACE compared the substantive standards of 10 CFR 20.1402 (25 mrem/yr and as low as reasonably achievable (ALARA)) to the substantive standard applicable to all soils at the site, NJAC § 7:28-12.8(a)1 (15 mrem/yr), which is discussed in more detail later in this section. USACE determined that cleanup of the NCR-licensed burial pits in accordance with NJAC § 7:28-12.8(a)1 would likely be comparable to a cleanup conducted in accordance with 10 CFR 20.1402. Therefore, at this time, USACE determined it would be appropriate to identify both NJAC § 7:28-12.8(a)1 and 10 CFR 20.1402 as ARARs for the licensed burial pits.

In the early 1990s, DOE (as a predecessor agency to USACE on the FUSRAP Maywood Superfund site) sought to identify UMTRCA as a relevant and appropriate requirement for the FUSRAP Maywood Superfund Site to establish cleanup levels for the site-specific contaminants. EPA disagreed with the use of UMTRCA as a relevant and appropriate requirement on a number of grounds. Primarily, EPA argued that UMTRCA Sites, although contaminated with the same radiological contaminants, were not sufficiently similar to the FUSRAP Maywood Superfund Site to make UMTRCA well suited in establishing cleanup criteria for the FUSRAP Maywood Superfund Site. EPA and DOE went through a formal dispute process which was resolved in 1994, in a document known as the "Dispute Resolution", which established cleanup standards for radium-226 and radium-228 at the FUSRAP Maywood Superfund Site. Radium-228 is a decay product of the primary site contaminant, thorium-232. Thorium-232 and radium-228 are assumed to be in secular equilibrium at the FUSRAP Maywood Superfund Site. So, establishing cleanup criteria for Ra-228 establishes the same cleanup criteria for thorium-232. If radium-228 and thorium-232 are not in secular equilibrium at the FUSRAP Maywood Superfund Site, the cleanup will be more conservative because the actual cleanup value for thorium-232 would be lower than its daughter product, radium-228. This substitution is discussed in more detail later in this section. DOE also developed a site-specific cleanup level for total uranium. Both the dispute resolution document and the uranium cleanup derivation can be found in Appendix C and are discussed later in this section. USACE has determined that attainment of these cleanup levels will assure compliance with the relevant and substantive requirements of the State of New Jersey radiation dose standards for the remediation of radioactive contaminated properties.

In the absence of applicable requirements, the DOE and USACE had relied on the terms of the 1994 Dispute Resolution between EPA and DOE regarding cleanup criteria for the various Phase I property units at the FUSRAP Maywood Superfund Site. This site-specific agreement established criteria for both unrestricted use and restricted use property cleanups. The Dispute Resolution's cleanup criteria for soil are discussed in more detail later in this section.

Since the establishment of the Dispute Resolution cleanup criteria between the EPA and DOE, the State of New Jersey promulgated NJAC 7:28-12 *Remediation Standards for Radioactive Materials*. Promulgated in August 2000, this regulation establishes minimum standards for the remediation of real property located within the State of New Jersey contaminated by radioactive materials. The USACE and EPA have evaluated this regulation and have determined that the substantive requirements of these regulations, namely a maximum dose of 15 mrem/yr above background and indoor air Rn-222 concentrations of 3 pCi/L above background in indoor air are an ARAR. These substantive requirements are an ARAR under an unrestricted use remedial action, a limited restricted use remedial action, or a restricted use remedial action. USACE will confirm that a remedial action for the Site complies with these ARARs, or establishes the basis for waiving an ARAR, pursuant to the procedures of the NCP at 40 CFR 300.430(f)(1)(ii)(C) for ARAR waivers. USACE has determined that attainment of these cleanup levels will assure compliance with the relevant and substantive requirements of the State of New Jersey radiation dose standards for the remediation of radioactive contaminated properties.

In a letter addressed to Envirocare of Utah, Inc., dated September 20, 2001 (September 2001 NRC Letter), the NRC changed its position on the status of the radioactively contaminated soils located at the FUSRAP Maywood Superfund site. In response to the change, USACE evaluated whether to add 10 CFR Part 40 as an ARAR, and determined that a cleanup in accordance with the EPA/DOE Dispute Resolution cleanup criteria, 10 CFR 20.1402 (for the Stepan NRC-licensed burial pits), and the substantive standards of NJAC § 7:28-12.8(a)1 and 2, would provide a level of health and safety protection equivalent to the substantive requirements of 10 CFR Part 40, Appendix A, Criterion 6(6). As a result, a corresponding change to the ARARs was not necessary. Radiologically contaminated soil sent offsite for disposal will be treated as 11(e)(2) byproduct materials.

RCRA

DOE’s chemical investigation of soils at the FUSRAP Maywood Superfund Site did not reveal the presence of hazardous waste, as defined by RCRA. Additional investigations by USACE have also not revealed the presence of hazardous waste at the FUSRAP Maywood Superfund Site. However, a focused investigation conducted by Stepan as part of their RI provided indications that chromium wastes have been disposed at the Maywood Chemical

Company Site in the form of scrap leather wastes, and possibly water treatment sludges or filtercake. Stepan's analyses of these wastes revealed that the chromium was present almost exclusively in its less toxic, trivalent form. Stepan's analyses also showed that these wastes did not fail the TCLP test for any constituent besides chromium and the wastes did not show any other characteristic which would qualify it as a hazardous waste (reactivity, flammability, corrosivity). Scrap leather wastes are exempt from classification as a hazardous waste under RCRA [40 CFR 261.4(b)(6)(i)], as long as the scrap leather contains exclusively trivalent chromium, does not exhibit the RCRA hazardous waste characteristic of toxicity for constituents other than chromium, and does not exhibit any other hazardous waste characteristics of reactivity, ignitability and corrosivity. Based on available information, it is most likely that the scrap leather is a solid, nonhazardous, waste under 40 CFR 261.2 and 40 CFR 261.4.

However, other wastes with the potential to meet the classification of RCRA wastes may be present at the site. For example, while records indicate that Stepan's filter cake from the leather extraction processes was disposed offsite at a hazardous waste disposal facility, there is the potential for these wastes to be encountered at the site. Several of the FUSRAP Maywood Superfund Site vicinity properties were initially part of the original MCW; a variety of wastes were historically stored or disposed onsite at these areas on the outlying property boundaries. The companies that merged to form the MCW began operations in the 1890s; over one hundred years of various chemical production operations have occurred at the Maywood Chemical Company Site, and production and waste disposal practices over that timeframe are not well-documented. Based on the known history of the processes at the MCW, there are no known listed processes that were performed at the MCW, and there are no known listed chemicals that were discarded or spilled at the MCW.

Based on the known history of chemical manufacturers in the area, the USACE believes there is a potential for wastes that meet the classification of RCRA characteristic hazardous wastes to be encountered on the FUSRAP Maywood Superfund Site. Radioactively contaminated soils were used as fill material throughout the MCW property. Thus, the potential exists for radioactive contaminants to be commingled with RCRA hazardous wastes in some areas of the FUSRAP Maywood Superfund Site, or for RCRA hazardous wastes to require excavation in order to access radioactively contaminated soils beneath them. Therefore, USACE will be prepared to test soils during the remedial action for RCRA characteristic hazardous waste in order to assure proper management. Accordingly, the initial USACE responsibility for soils at the FUSRAP Maywood Superfund Site is to determine if any soil to be excavated by USACE in this remedial action would be a RCRA hazardous waste (40 CFR 262.11). Under 40 CFR 262.11, solid waste must be evaluated to determine if it is a hazardous waste as follows:

- whether it meets any of the 40 CFR 261.4 exclusions;
- whether it meets the listing criteria of 40 CFR 261 Subpart D; or
- whether it exhibits one of the 40 CFR 261 Subpart C characteristics.

If the above evaluation reveals that hazardous waste would be removed by USACE's remedial action, then such wastes would have to be managed in compliance with the substantive requirements of the RCRA regulations. All applicable RCRA requirements would be complied with when the hazardous and non-hazardous solid waste are sent off-site for disposal, including the requirement that any shipments of hazardous waste comply with the RCRA manifest requirements.

Buildings

Certain standards under 10 CFR Part 20 and 10 CFR Part 40 related to the decontamination and decommissioning of facilities licensed by the NRC were evaluated as potential action-specific ARARs. In addition, the State of New Jersey regulation, NJAC § 7:28-12.8(a)1, related to remediation of radioactive contamination of real property, was also evaluated as a potential action-specific ARAR. The substantive standards of NJAC § 7:28-12.8(a) were compared to the substantive standards of 10 CFR Part 20 and 10 CFR Part 40. It was determined that the substantive standards of NJAC § 7:28-12.8(a) exceeded the substantive requirements of 10 CFR Part 20 and 10 CFR Part 40, as they relate to decontamination of buildings. As a result, NJAC § 7:28-12.8(a) was determined to be the action-specific ARAR for remediation of buildings on Stepan property.

Although not specifically identified as a COC, radon is a gaseous decay product of radium, one of the COCs at the FUSRAP Maywood Superfund Site. Because of the relatively short half-life, radon would only be of interest in a building or structure where the radon could accumulate. Because structures at multiple properties at the FUSRAP Maywood Superfund Site have been constructed above contaminated soils, it is possible that radon from FUSRAP wastes at the site might have been released into indoor air in buildings located over the most heavily contaminated soil.

State of New Jersey standards exist for radon that are considered substantive standards of NJAC 7:28-12.8 as an ARAR. Sites shall be remediated so that Rn-222 shall not exceed 3.0 pCi/L above background of indoor radon gas.

Site-Specific Cleanup Criteria

DOE and EPA developed site-specific cleanup criteria in 1994, pursuant to the procedures of the DOE-EPA dispute resolution process (see Appendix C). Site-specific cleanup levels were established for both residential and commercial use of properties. To be considered eligible for residential or unrestricted use, surface and subsurface soils must be remediated to an average of 5 pCi/g combined radium-226 and thorium-232 above background, and clean backfill must be placed in excavated areas. To be eligible for commercial or restricted use, subsurface soils at the FUSRAP Maywood Superfund Site must be remediated to an average of 15 pCi/g, combined, above background. If treatment is implemented and treated soil is used as treated backfill onsite, the average concentration of radium-226 and thorium-232 in the treated soil must be less than 15 pCi/g above background. Additionally, areas backfilled with treated soils must be covered with at least one foot of clean backfill “to grade”.

Per the terms of the Dispute Resolution, following successful remediation, properties at the FUSRAP Maywood Superfund Site which are not remediated to the unrestricted cleanup levels will be subject to 5-year reviews to assure that human health and the environment remain protected by the remedial action being implemented. In addition, the USACE and EPA will request that the

Boroughs of Maywood and Lodi and the Township of Rochelle Park during and after the proposed action inform the USACE (or DOE) and the EPA of any land use or zoning changes affecting any portion of the commercial/government areas of the FUSRAP Maywood Superfund Site and of any permit, building, construction, excavation or demolition activity that might affect unremediated portions of the FUSRAP Maywood Superfund Site.

Given some of the surrounding land uses, the USACE has determined that, dependent on the site-specific circumstances of each property, more durable institutional controls may be necessary to assure long-term effectiveness of the remedy for those properties which are not remediated to the unrestricted use criteria. USACE will obtain institutional controls as necessary to ensure long-term effectiveness. For properties that are not owned by the Federal government, negotiations with current (non-Federal) property owners will determine the appropriate institutional controls necessary for the property. For Federally owned properties cleaned up to the restricted use criteria, restrictions shall be placed upon the deed of the property which shall restrict such property's future use to commercial. USACE and DOE (who still owns the MISS) have a Memorandum of Understanding (MOU, dated March 17, 1999), which defines each agency's responsibilities for FUSRAP sites. Institutional controls will be obtained on those properties not remediated to the unrestricted cleanup levels. USACE will include an example covenant/restriction for the Federally owned property not remediated to the unrestricted criteria in an Institutional Controls Implementation Plan which will be developed during the Remedial Design, and an example of restrictions for properties not owned by the Federal government which are not remediated to the unrestricted use criteria, such as an easement.

Because of the previous absence of an ARAR to set the cleanup level for uranium at the FUSRAP Maywood Superfund Site, DOE performed a site-specific analysis to establish the guidelines for both uranium-238 (50 pCi/g) and total uranium (100 pCi/g) (both as averages, and both above background). The guideline derivation document is provided in Appendix C. The uranium guidelines apply on an average basis across a 100 m^2 area and 6 in. depth intervals. Remediation to the uranium guideline has been determined protective for both the radioactive and toxic effects of uranium. However, a much lower residual concentration of uranium is expected at the FUSRAP Maywood Superfund Site following cleanup to the radium guidelines discussed above. This is because the uranium is commingled with the thorium and radium contamination at the FUSRAP Maywood Superfund Site. Based on the relative concentrations of uranium, thorium, and radium at the FUSRAP Maywood Superfund Site, it is expected that cleanup to the radium guideline will result in near-background concentrations of uranium.

The site-specific cleanup levels for radioactive contamination are based upon site-specific derivations (by DOE and EPA in the dispute resolution for radium and thorium; and by DOE for uranium). USACE has determined that attainment of these cleanup levels will assure compliance with the relevant and substantive requirements of the State of New Jersey radiation dose standards for the remediation of radioactive contaminated properties.

Substitution of Thorium-232 for Radium-228 in the Cleanup Criteria

While the final site surveys (post-remediation) will require the explicit measurement of both radium-226 and radium-228, characterization activities to date have reported data on the radionuclides radium-226, thorium-232 and uranium-238. However, the thorium-232 measurements in the site database are estimated based on radium-228 concentrations, which are less costly to measure. Radium-228 is in the decay chain of thorium-232, and as long as secular equilibrium (when a long-lived radionuclide decays into a short-lived daughter, and the activity of the daughter radionuclide approached that of the parent, reaching equilibrium) can be assumed, a measurement of radium-228 can be substituted for thorium-232. This assumption regarding secular equilibrium is considered valid based on the following assessment.

It is known that thorium extraction activities ceased in 1959, more than 40 years ago. This extraction process altered the equilibrium conditions. That is, in a natural State all the radionuclides in the thorium-232 decay series are in equilibrium (present at the same activity). When thorium was removed, equilibrium conditions were altered from natural conditions. The likely State of processed material was that the thorium isotopes were left at relatively low concentrations and the radium-228 concentration, left unaltered by the thorium extraction process, remained at a relatively elevated concentration.

Fortunately, radium-228 has a relatively short half-life at approximately 5.8 years. Because radium-228 is the direct decay product of thorium-232, the relationship between isotopes may easily be approximated using the following approach:

(1) The first step is to break the radium-228 into two categories, 1) the “old” radium-228 that remained in process residuals dating back to 1959 and 2) “new” radium-228 created from the decay of thoriun-232 since 1959;

(2) As a rule of thumb, less than 1 % of a radionuclide remains after 7 half-lives. Because 7 half-lives for radium-228 is 40 years, it can be assumed that more than 99 % of the original radium-228 is gone; and

(3) When a long-lived radionuclide has a relatively short-lived decay product (as with thorium-232 and radium-228), secular equilibrium conditions are reached after about 7 of the decay product’s half-lives. Therefore, there has been sufficient time for the “new” radium-228 to reestablish equilibrium conditions with thorium-232.

Using this logic, it is assumed that the “old” radium-228 has decayed away and the “new” radium-228 has reached equilibrium with thorium-232. As Stated previously, the current thorium-232 measurements reported for the site are actually radium-228 measurements. If thorium-232 and radium-228 are in secular equilibrium, the radium-228 measurements are an accurate substitute for thorium-232. Even if they are not yet in secular equilibrium (i.e., there is still “old” radium-228 left), then the reported measurements for thorium-232 are conservatively high (actual thorium-232 measurements would be lower).

3.2.1.2 Action-Specific ARARs

Action-specific ARARs are usually technology- or activity-based limitations controlling action conducted at hazardous waste sites. As remedial alternatives are developed, action-specific ARARs provide a basis for assessing feasibility and effectiveness. The applicability or relevance and appropriateness of potential action-specific ARARs is dependent upon the nature of the overall action and any supporting work elements necessary for its implementation.

Air

Subpart H of the National Emissions Standards for Hazardous Air Pollutants (NESHAP) addresses radiation doses resulting from radionuclide emissions, other than Rn-222 and Rn-220, into the air from DOE facilities. The provisions of Subpart H require emissions to the air to be limited such that the effective dose to any member of the public does not exceed 10 mrem/yr. This regulation is inapplicable to the remedial activities undertaken by the USACE at the MISS. Notwithstanding the inapplicability of this regulation to the USACE activities, the USACE has been meeting the substantive requirements of this regulation in the spirit of the final Memorandum of Understanding, April 4, 1995, between the DOE and the EPA, in which DOE committed to complying with the requirements of this regulation at DOE-owned facilities.

Water

Under 40 CFR 122, Subpart B, stormwater and point-source discharges associated with industrial activity are required to meet the requirements of the National Pollutant Discharge Elimination System (NPDES). Among the activities included in the term "industrial activity" are solid waste management facilities, disposal facilities, and construction activities involving more than five acres. Remediation activities involving stormwater and point source discharges should be limited to managing accumulations of stormwater, surface water, and groundwater in excavation pits. Currently, the plan is to pump the accumulated water to an on-site treatment plant for treatment. After treatment, the current plan is to discharge contaminated water to the Bergen County Utilities Authority Treatment Works in accordance with an existing Treated Groundwater Discharge Permit. This Permit includes specific discharge limitations in accordance with the USEPA Prevailing Safe Drinking Water Act Regulations and the New Jersey Groundwater Quality Standards at NJAC 7:9.6. The specific discharge limitations contained in the Permit for COCs at the FUSRAP Maywood Superfund Site are listed in the following table and are considered ARARs.

Parameter	Limitation
Gross Alpha (excluding Uranium and Radon)	15 pCi/L
Gross Beta	50 pCi/L
Radium 226 plus Radium 228	5 pCi/L
Uranium	30 ug/L

Although not anticipated, if additional point source discharges resulting from remediation activities become necessary, USACE will comply with specific discharge limitations for COCs set forth in NJAC 7:14A-12 Appendix B (FW-2 surface water) and 7:9-6 Appendix, Table 1 (Class II-A ground waters). Point source discharges to surface water or groundwater would comply with specific discharge limitations for radionuclide COCs set forth in NJAC 7:9-6 Appendix, Table 1 (Class II-A ground waters).

Wetlands

Wetlands located on several of the Vicinity Properties contain radiological contamination in the sediment above the radiological cleanup criteria for soil. Sediments exceeding the cleanup criteria would be removed as part of the remedial action under any excavation alternative. Removal of sediments exceeding the cleanup criteria is considered sufficient to reverse the temporary disturbance of the wetland and to assure protection of human health and the environment, and comply with the substantive relevant and appropriate standards contained in the New Jersey Freshwater Wetlands Mitigation Requirements (NJAC 7:7A-Subchapter 15). Wetlands containing sediments exceeding the cleanup criteria are the only wetlands addressed by this remedial action.

3.2.2 Identification of COCs and Proposed Cleanup Levels

The radioactive COCs identified by the BRA include thorium-232, radium-226, and uranium-238 (and their respective decay products). Potential chemical COCs in soil initially included metals, VOCs, and SVOCs. The human health risk assessment did not calculate any risks above the thresholds considered by the NCP to be protective for human health given the pathways, receptors and exposures evaluated in the BRA for the FUSRAP Maywood Superfund Site. Therefore, no chemical soil COCs were identified which would need to be remediated in a remedial action for the FUSRAP Maywood Superfund Site. Constituents in surface water and groundwater are present at levels of potential concern for future ingestion by humans or for toxic effects on aquatic biota. However, remediation of soils is expected to substantially reduce the potential for offsite migration of contaminants to surface and groundwater. Groundwater and surface water contamination are not addressed by this FS and will be addressed in the decision documents for the groundwater OU. However, the remediation of soil under the Soils/Buildings OU will eliminate source areas of contaminants for the surface water and groundwater and should be consistent with any remedy that may subsequently be selected for the groundwater OU.

Based on the risks calculated in the BRA, cancer risks from radiological exposures are far more significant (by two orders of magnitude) than the chemical risks. Table 3-1 lists all COCs and proposed cleanup levels. Remediation of the FUSRAP Maywood Superfund Site will ensure that all COCs will meet cleanup guidelines and ARARs.

Very little ecological habitat exists at the FUSRAP Maywood Superfund Site; the majority of the FUSRAP Maywood Superfund Site is mowed lawn or paved and graveled area. However, there are small strip areas of hydrophilic (associated with wetlands) vegetation on the MISS, 149-151 Maywood Avenue and along open portions of the Lodi Brook drainage basin (areas which are not culverted), which may serve as travel corridors for such animals as muskrats. Additionally, narrow strips of trees, shrubs, and ground cover border many of the properties. Surface and subsurface radioactive contamination is extensive at the MISS and 149-151 Maywood Avenue properties, and remediation will require extensive excavation of existing surface and subsurface soils, including the above travel corridors. Where treated soil is used as treated backfill, a minimum of one foot of clean backfill material will be used. The application of one foot of clean backfill material at the MISS will remove any remaining exposure pathway to ecological receptors of concern. Thus, no specific cleanup criteria were developed for the contaminants that showed the potential for ecological risk in the BRA. This is based on the absence of significant habitat and ecological receptors of concern at MISS, combined with the knowledge that any cleanup of radioactively contaminated areas will result in removal of soils to depths affecting ecological receptors.

Table 3-1. COCs and Proposed Cleanup Levels

FUSRAP Maywood Superfund Site Contaminant of Concern		**Proposed Cleanup Level**	**Source of Cleanup Level**
Radionuclides in Soil	Thorium-232 Radium-226	**Restricted Use:** average 15 pCi/g combined radium-226 and thorium-232 above background **Unrestricted Use:** average 5 pCi/g combined radium-226 and thorium-232 above background	EPA/DOE Dispute Resolution on Site-Specific Cleanup Criteria for the FUSRAP Maywood Superfund Site (see Appendix C for complete terms of this agreement). The proposed cleanup levels will meet the ARARs.
	Uranium-238	average of 50 pCi/g of uranium-238 above background (which is essentially 100 pCi/g of total uranium)	Site-specific uranium guideline (DOE 1994b) (See Appendix C).
Buildings and Building Surface Contamination	Radionuclides	Compliance with the dose limit specified in NJAC 7:28-12.8(a)1	NJAC 7:28-12.8(a)1 (will require building-specific dose assessment)
Radon in Structures	Radon	Rn-222 concentration in buildings shall not exceed 3.0 pCi/L above background.	NJAC 7:28-12.8(a)2.

3.2.3 Remedial Action Objectives for the FUSRAP Maywood Superfund Site

The general RAOs for the FUSRAP Maywood Superfund Site are to prevent or mitigate further release of FUSRAP waste to the surrounding environment and to meet the established cleanup criteria and comply with ARARs. The sources of contamination (source media) identified by the RI at the FUSRAP Maywood Superfund Site that are addressed by this FS include both soil and bulk waste (e.g., buried demolition debris). The BRA identifies direct radiation, inhalation, dermal contact, and ingestion of plants, drinking water, and soil as the pathways of exposure. A number of buildings at the Stepan property are radiologically contaminated. The radioactivity detected during surveys is nontransferable, and the pathway of exposure is direct radiation.

Development of Remedial Action Objectives

The FUSRAP Maywood Superfund Site RAOs were developed by considering the COCs, associated media, potential exposure pathways and receptors, ARARs, and other preliminary remediation goals. Media-specific RAOs for the FUSRAP Maywood Superfund Site were developed considering the probable pathways for impact on public health and the environment. In addition to reducing the radioactive COCs to the remediation cleanup levels, RAOs include various other objectives, such as the elimination or minimization of the potential for humans to ingest, come into dermal contact with, or inhale particulates of radioactivity. In general, mitigation of the exposure pathways of concern identified in the BRA is the framework for media-specific RAOs, which are identified in Table 3-2.

Table 3-2. FUSRAP Maywood Superfund Site Remedial Action Objectives

Environmental Media	Remedial Action Objectives
Source Media (soil and bulk waste)	To eliminate or minimize the potential for humans to ingest, come into dermal contact with, or inhale particulates of radioactive constituents, or to be exposed to external gamma radiation.
	To reduce radium and thorium concentrations in soil including the NRC licensed burial pits to levels in accordance with EPA/DOE dispute resolution cleanup criterion. For restricted use, the cleanup criterion is 15 pCi/g of thorium-232 and radium-226 combined above background; institutional controls to prohibit future residential use will be used. For unrestricted use, the cleanup criterion is 5 pCi/g of thorium-232 and radium-226 above background.
	To reduce FUSRAP Maywood Superfund Site concentrations of uranium-238 to 50 pCi/g (which is essentially 100 pCi/g total uranium) above background. These levels are considered protective for unrestricted use.
	To comply with exposure dose limits of 15 mrem/yr as specified in NJAC 7:28-12.8(a)1.
	To reduce the potential for environmental impacts and reverse the temporary disturbance of existing wetland habitats.
	To eliminate or minimize toxicity, mobility, and/or volume of contaminated soils.
	To eliminate or minimize the potential migration of COCs into stream and storm drain sediments by surface water runoff.
	To eliminate or minimize the potential migration of COCs by infiltration or percolation that would result in contamination of the groundwater.
	To comply with ARARs.
Buildings/Structures	To comply with exposure dose limits of 15 mrem/yr as specified in NJAC 7:28-12.8(a)1.
	To prevent radon concentrations in buildings from exceeding 3 pCi/L above background as specified in NJAC 7:28-12.8(a)2.
	To eliminate or minimize toxicity or mobility, and/or volume of COCs.

pCi/g = picoCuries per gram
COC = constituent of concern
pCi/L = picoCuries per liter
ARARs = applicable or relevant and appropriate requirements
NJAC = New Jersey Administrative Code

In establishing RAOs for radionuclides in soil and the NRC-licensed burial pits on Stepan Company property, it was determined that, at a minimum, the objective must meet the requirements of the site-specific criteria established by DOE and EPA in the 1994 dispute resolution agreement as well as the standards of NJAC 7:28-12.8(a)1. In establishing RAOs for contaminated buildings, the requirements of NJAC 7:28-12.8(a)1 must also be met. This will require additional data collection and a site-specific exposure assessment.

3.3 GENERAL RESPONSE ACTIONS

This section describes the GRAs and remedial technologies potentially applicable to the FUSRAP Maywood Superfund Site. GRAs for the FUSRAP Maywood Superfund Site were based on media of concern and were determined by defining actions that satisfy the RAOs. The universe of potential actions is described in Section 3.3. Section 3.4 performs an initial screening of these actions for their technical implementability at the FUSRAP Maywood Superfund Site. Those actions that pass this initial screening are then evaluated for effectiveness, implementability, and cost in Section 3.5. Actions that pass this final screening are then used to develop remedial action alternatives for the FUSRAP Maywood Superfund Site in Section 4.

Contaminated soil, bulk waste, and possible sediments at the FUSRAP Maywood Superfund Site are addressed under the general category of source media. The contaminated buildings and structures are addressed under the category of buildings/structures. The GRAs involve activities that directly impact the source of materials at the FUSRAP Maywood Superfund Site to minimize the potential hazard to human health and the environment. Each GRA may include several technology options. GRAs for the FUSRAP Maywood Superfund Site include no action; institutional controls; containment; and soil and source removal, treatment, and disposal actions.

3.3.1 No Action

In this response, no action would be taken to reduce the hazard to potential human or ecological receptors. The consideration of this action complies with CERCLA guidance to provide an appropriate alternative in the absence of unacceptable risk and to provide a baseline against which other alternatives can be compared. Included in this option is the assumption that 5-year reviews would be conducted. The 5-year reviews are required by CERCLA regulations whenever a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use of the property and unrestricted exposure. The purpose of the 5-year review is to assure that human health and the environment are being protected. Maintenance activities would be discontinued under this alternative.

3.3.2 Institutional Control Actions

Institutional controls can be an effective means of eliminating possible pathways of exposure and restricting access or use of contaminated media. Environmental monitoring is included with institutional control actions; however, monitoring itself does not prevent or minimize exposure. Monitoring does allow assessment of migration and thus is an important part of preventing unacceptable exposures.

The primary goal of institutional controls is to prevent access to contaminated areas. The primary pathways of exposure to be controlled by institutional controls are direct gamma radiation and radon inhalation. Human health risks for current land uses are protective except for one area on the MISS and one area on 149-151 Maywood Avenue that have higher levels of contamination (although these areas are currently covered and unprotectiveness for the current use scenario only arises over time as cover erodes). Unacceptable risks are more likely if current land use conditions change from commercial to residential use, if employees or residents are placed on current vacant areas of the site that contain relatively high concentrations of contaminants, or if contaminants currently covered by clean soils or structures are made accessible to human exposure. The NCP allows the use of institutional controls to supplement engineering controls (also referred to as "land use controls" by the State of New Jersey) for short- and long-term management of hazardous substances, pollutants, or COCs [(40 CFR, 300.430(a)(*iii*)(D)]. Some possible controls include posting signs, implementing land-use or access restrictions, deed restrictions, resource restrictions (such as well-drilling prohibitions), well-use advisories for existing wells, and building permit restrictions. Implementation of institutional controls by USACE might be appropriate to achieve the protection of human health and the environment for inaccessible soils.

NJAC 7:26-6.4(e), (g), and (h) describes NJDEP's required deed notification process. These regulations describe procedures for recording deed notices, documenting monitoring activities, and notification requirements for use when a person relinquishes their obligation for maintaining and inspecting the institutional controls. USACE will use these regulations as procedural guidelines in the deed notification process.

3.3.3 Containment Actions

Containment actions protect receptors from exposure to the COCs. Containment actions considered for the FUSRAP Maywood Superfund Site include caps for containment of the soils, vertical and horizontal barriers for groundwater, and sealant for buildings/structures. Capping would involve covering an area with a low-permeability material to reduce migration to the atmosphere, adjacent soils, or groundwater. Capping would reduce the infiltration of surface water through contaminated soils to the groundwater. Capping would not reduce the toxicity of the soil contaminants, but it could reduce mobility or migration, as well as exposure. Capping also would minimize the release of contaminated surface soil into the atmosphere as dust particles, which could potentially be inhaled or redeposited onto another area.

The containment actions related to buildings/structures involve the surface sealing or covering of contaminated surfaces with appropriate sealants to prevent direct contact and to reduce potential mobility. The applicable options for surface sealing include painting (applying paints to masonry and wooden surfaces); applying resins or liquid plastic (spraying on resins or plastic materials to form a barrier or applying foam); and using other impermeable materials (using plastic sheeting or wooden structures to provide a barrier).

3.3.4 Excavation and Removal

The bulk removal of contaminated soil and material would reduce the long-term potential for human exposure. Excavation would help minimize direct human contact with and migration of contaminated material. Source material (soils, bulk waste, and sediments) would be excavated using conventional earth-moving equipment; manual excavation techniques would be required in areas with limited access. Removal of soil by excavation would require the use of dust control and surface runoff control measures to ensure worker safety and to protect the general-public. These measures have been successfully used in interim actions at the FUSRAP Maywood Superfund Site and at other sites around the country. Excavation of accessible soils would remove soils that are not located near or under permanent structures such as buildings and active roadways. Soils under sidewalks, parking lots, and other non-permanent structures are also considered accessible, unless their removal would compromise the integrity of a permanent structure, such as a building foundation, roadway, or utility corridor. Excavation of inaccessible soils would remove soils that would require the removal of a permanent structure such as a building foundation, roadway, or utility corridor. Inaccessible soils will be removed at the time soils are made accessible by the property owners.

Removal actions for buildings/structures could include partial demolition or complete demolition. Partial demolition involves the blasting, wrecking, drilling, or sawing of appropriate portions or sections of the buildings. This results in a reduced volume of waste materials requiring disposal in comparison to complete demolition, which is often used when an entire building is contaminated.

3.3.5 Treatment Actions

The treatment actions evaluated for the FUSRAP Maywood Superfund Site include physical, chemical, biological, and thermal technologies to be used for contaminated soil constituting the principal threat (or source of contamination) at the site.

Ex situ physical treatment considered for the COCs includes size reduction, radiological sorting, stabilization/solidification, encapsulation, soil washing and gravel separation. These technologies are described below:

- Waste material size reduction involves physically reducing the size and, potentially, the volume of a waste material through use of shredders, mills, and compactors. Generally this option would be used as a pretreatment for a primary treatment process and is most applicable to construction debris. This option is not required for the FUSRAP Maywood Superfund Site soils, but is applicable for use in the buildings/structures demolition, and could be useful for other bulk waste that may be located in soils, such as buried drums and building debris.

- Radiological sorting would involve sending the soil through an automated radiological sorting system. The soil passes below a series of radiological detectors that distinguish soil below and above certain radiological criterion and separates it into two piles based upon that criterion.

- Stabilization/solidification is a process in which contaminants are physically bound within an impervious matrix, such as concrete or glass, to reduce their mobility.

- Encapsulation would coat or seal waste with asphalt, polyethylene, or thermo-setting resins to form a solid matrix.

- Soil washing would involve pretreating soils to remove large objects and then washing the soils with water (with or without additives to improve contaminant extraction) to remove constituents. Some constituents would be dissolved in water, while others are washed free of the soil particles. Physical separation techniques would then be used to separate the soil by particle size from the water/soil slurry into clean and dirty fractions.

- Gravel separation describes the process of removing the coarse fraction from the soil volume by mechanical means, typically a vibrating screen. The coarse fraction is generally below criteria, since the contaminants are most closely associated with the fines.

The in situ physical processes considered include stabilization/solidification, vitrification, and soil flushing. These technologies are described below:

- Stabilization/solidification techniques would solidify the soil matrix through in situ injection of grouting material. Vitrification involves applying electricity to electrodes to melt the soil, producing a glass-like material with a crystalline structure with low leaching characteristics.

- Soil flushing would involve the flushing of contaminants from the soil through injection of water and removal of the flushing solution by pumping through an extraction well.

The chemical treatment processes considered included chemical stabilization and fixation techniques that use chemicals to cause reactions between the stabilizing agent and the COCs to reduce their mobility. Additional chemical processes include a variety of potential operations such as chemical oxidation, neutralization, chelation, and solvent flushing. These processes involve a form of chemical addition for removal of the COCs, and they can be performed in situ or ex situ.

Biological treatment involves using microbes to degrade the contaminants. These techniques are used mainly for organically contaminated media and would not be effective in treating the radioactive constituents at the FUSRAP Maywood Superfund Site.

Thermal treatment includes using high temperatures to volatilize, decompose, or melt the contaminated soil. Incineration and vitrification are the primary thermal treatment processes. Incineration processes are generally used for the destruction of organic compounds. Incineration would not be effective in treating the radioactive contaminants at the FUSRAP Maywood Superfund Site. Vitrification processes use high temperatures to melt soils to form a glasslike matrix with very low leaching characteristics.

Decontamination actions for buildings/structures include physical and chemical decontamination procedures. Physical procedures include scrubbing, scraping, sanding, grinding, scabbling, using pelletized carbon dioxide, or sandblasting. These methods use physical force to mechanically separate contaminants from the surface of the material. Chemical procedures involve the use of chemicals (water, solvents, complexing agents, acids, and bases) to dissolve or suspend the contaminants in the decontamination fluid to facilitate their removal from the surface of the material.

3.3.6 Disposal Actions

Disposal would involve the permanent and final placement of the waste materials in a manner that protects human health and the environment. Contaminated soils and bulk waste above cleanup criteria would be disposed of on-site or offsite in accordance with local, State, and Federal regulations. On-site disposal would require the creation of a disposal cell in accordance with State regulations. Off-site disposal would use existing permitted/licensed disposal facilities (i.e., a regulated landfill) with the approval of the facility's regulator(s). Concentrated wastes, resulting from treatment processes, would be disposed of offsite in an approved disposal facility. Sampling of the FUSRAP Maywood Superfund Site soils has not identified any RCRA-hazardous wastes. Treatment testing conducted to date on the FUSRAP Maywood Superfund Site soils has shown that no RCRA-hazardous wastes are present in the concentrated waste stream. TCLP testing would be conducted prior to disposal to verify that these materials are not RCRA hazardous waste. If RCRA hazardous wastes are identified, such wastes would be managed in compliance with the RCRA regulations. Additional disposal considerations include creation of an on-site disposal cell, ocean disposal, use of an underground mine, landspreading, and use of a permitted treatment/disposal facility.

Interim storage would reduce the mobility of the waste materials by isolating the contaminants from further transport and minimizing the potential for short-term exposure. Interim storage could be accomplished with a newly constructed engineered structure to contain the excavated waste materials. This option is considered only as an interim action, prior to disposal in a licensed disposal facility.

It is the intent in the excavation and treatment alternatives to use uncontaminated soils from treatment, over-excavation, and overburden removal for beneficial reuse as on the MISS at the FUSRAP Maywood Superfund Site. If unsuitable for use as backfill, the confirmed-clean material would be disposed at an approved RCRA Subtitle D, solid waste or industrial waste landfill. Additional clean backfill material would be purchased from a vendor.

3.4 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section describes the identification and initial screening of potential technologies to meet the RAOs defined in Section 3.2. Subsection 3.4.1 describes the potential remedial technologies and identifies the related process options. Subsection 3.4.2 summarizes the results of the initial screening of the process options. The criterion used to identify and initially screen the process options is technical implementability. These criteria include an evaluation of the process options applicable to the COCs and the technical feasibility of the options to accomplish the RAOs.

3.4.1 Identification of Remedial Technologies and Process Options

Remedial technologies and process options were selected based on their applicability to the contaminated environmental media at the FUSRAP Maywood Superfund Site. The media considered include soil, bulk waste, and buildings/structures. Technologies that would not be effective in a reasonable amount of time, that are not applicable to the COCs, or that were demonstrated to be ineffective were eliminated from further consideration. Table 3-3 provides a media-specific summary of the FUSRAP Maywood Superfund Site GRAs, remedial technologies, and process options identified for the COCs prior to screening.

Table 3-3. FUSRAP Maywood Superfund Site General Response Actions, Remedial Technologies, and Process Options Considered Prior to Screening

Environmental Media	General Response Actions	Remedial Technologies	Process Options
Source Media (soil and solid waste)	Institutional Actions	Access Restrictions	Fencing, guards, and institutional controls
		Monitoring	Environmental sampling
	Containment Actions	Capping	Clay, concrete, asphalt, synthetic, multimedia
	Removal Actions	Excavation	Soil excavation
		Dredging	Sediment excavation
	Treatment Actions	Physical	Radiological sorting, stabilization/encapsulation, solidification, soil washing, gravel separation
		Chemical	Chemical stabilization, oxidation/ neutralization/chelation, etc.
		Thermal	Incineration, vitrification
		In Situ	Stabilization/solidification, vitrification, soil flushing
	Disposal Actions	Onsite Disposal	Disposal cell, backfill
		Offsite Disposal	Disposal cell, landfill, special waste repository, beneficial reuse, ocean disposal, underground mine
Buildings/ Structures	Institutional Actions	Access Restrictions	Fencing, guards, and institutional controls
		Monitoring	Environmental sampling
	Containment Actions	Surface Sealing	Paint, plastics, resins, impermeable barriers
	Removal Actions	Demolition	Complete and/or partial
	Treatment Actions	Decontamination	Physical procedures, chemical procedures
	Disposal Actions	Onsite Disposal	Same as for soil
		Offsite Disposal	Same as for soil (although some disposal facilities may classify soil differently from building debris)

3.4.2 Initial Screening of Process Options

Process options for soil and solid waste (which are together termed “source media”) and buildings/structures are evaluated for each response action identified earlier. The rationale for either retaining or eliminating certain options is summarized in Tables 3-4 and 3-5, respectively, and explained in more detail in the following section.

Table 3-4. Initial Screening of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Source Media[1]

Source Media Response Action	Remedial Technology	Process Options	Description	Screening Comments
No Action	No Action			Carried through the CERCLA analysis as a baseline.
Institutional Control	Access Restrictions	Site Security/ Isolation	Fences, berms, and signs surrounding sites. Guards for authorized access control.	Potentially applicable (fences and berms already in place at some portions of the FUSRAP Maywood Superfund Site).
		Deed Restrictions (easements & covenants)	Deeds for property in the area could include restrictions on digging and drilling.	Potentially applicable.
	Monitoring	Sampling	Ongoing environmental monitoring.	Potentially applicable.
Containment	Capping	Synthetic	Synthetic liner installed over impacted areas.	Potentially applicable.
		Multilayered Caps	Multiple layers of different media over impacted areas.	Potentially applicable.
		Native Soils	Soil spread over impacted areas.	Potentially applicable.
		Asphalt	Layer of asphalt applied over impacted areas.	Potentially applicable for minimizing or eliminating direct human contact; high potential of cracking due to freeze/thaw. Cracking can be mitigated with maintenance.
		Concrete	Concrete placed over impacted areas.	See comment for asphalt.
		Clay	Compacted clay covered with soil over impacted areas.	Potentially applicable; potential for cracking of cap due to freeze/thaw if not properly maintained.

[1] Source media includes soil, solid waste, and sediments.

Table 3-4. Initial Screening of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Source Media (continued)

Source Media Response Action	Remedial Technology	Process Options	Description	Screening Comments
Removal/ Extraction	Bulk Removal	Lifting & Moving Equipment	Cherry pickers, forklifts, pallet jacks, etc., are used to remove bulk solid waste.	Potentially applicable.
	Excavation	Physical or Mechanical Excavation	Excavation of large amounts of soil using large mechanical equipment such as front-end loaders or excavation from discrete areas using smaller mechanical equipment and hand tools.	Potentially applicable.
	Dredging	Mechanical, Physical, or Hydraulic Dredging	Physically removing sediments from brooks, rivers, or wetland areas.	Not applicable due to suspected location of sediments (culverts and isolated areas of open stream channel) and small estimated volume of sediments.
Treatment addressing the more heavily contaminated soil & building debris as "principal threats"	Ex situ Physical	Encapsulation	Physical encapsulation of wastes in an organic binder or resin.	Not applicable due to high costs and technical implementability concerns.
		Thermoplastic Solidification	Waste sealed in asphalt bitumen, paraffin, or polyethylene matrix.	Not applicable due to high costs and technical implementability concerns.

[hatched box] Indicates technologies determined to be not applicable.

Table 3-4. Initial Screening of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Source Media (continued)

Source Media Response Action	Remedial Technology	Process Options	Description	Screening Comments
Treatment (continued)	Ex situ Physical (continued)	Soil Washing	Physical separation of impacted material in an aqueous base, concentrating COCs.	Potentially applicable.
		Gravel Separation	Physical separation of large diameter soil material (i.e., gravel) using mechanical screens or sieves.	Potentially applicable.
		Radiological Sorting	Physical separation of impacted materials based on radionuclide concentrations. Constituents associated with a specific particle size are physically separated out.	Potentially applicable.
		Solidification/ Stabilization	Excavated soil solidified using various cements and silicate-based mixtures as solidifying agents. The resulting solids are resistant to leaching.	Potentially applicable.
	Ex situ Thermal	Vitrification	Soil and constituents fused to a glass-like form.	Potentially applicable for volume reduction and immobilization.
	Ex situ Chemical	Chemical Processes	Addition of strong acids or bases to extract metals from the solid matrix. Can include a variety of processes such as chemical oxidation, reduction, neutralization, precipitation, chelation, soil flushings, etc. All processes involve adding chemicals to mitigate the constituents in the soil.	Large amounts of chemical waste products that required additional treatment would be generated. Potentially applicable as enhancement to soil washing process.

Table 3-4. Initial Screening of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Source Media (continued)

Source Media Response Action	Remedial Technology	Process Options	Description	Screening Comments
Treatment (continued)	In situ Treatment	Stabilization/ Solidification	Soil matrix solidified through pressure injection grouting.	Not applicable due to the location of the various properties and high groundwater at MISS and Stepan.
		Vitrification	Soil and constituents fused into a glass-like form.	Not applicable due to the location of the various properties and high groundwater at MISS and Stepan.
		Soil Flushing	Constituents washed from soils by injection of water in area of concern and removed by pumping.	Not applicable to COCs.
		Chemical Stabilization Chemical Fixation	Stabilization/fixation of hazardous substances through the use of chemicals which form an organic polymer with the waste.	Not applicable due to high groundwater table and difficulty in evaluating performance of treatment.
		Chemical Process	Can include a variety of processes such as chemical oxidation, reduction, neutralization, precipitation, chelation, and solvent flushing, etc. All processes involve a form of chemical addition to mitigate the constituents in the soil.	Not applicable as a stand-alone process for COCs.

[hatched box] Indicates technologies determined to be not applicable.

Table 3-4. Initial Screening of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Source Media (continued)

Source Media Response Action	Remedial Technology	Process Options	Description	Screening Comments
Disposal Actions	Onsite Disposal	Construct a Disposal Facility	Design and construct a disposal facility onsite at MISS.	Potentially applicable for a limited volume of materials.
	Offsite Disposal	Existing Facility	Transport materials to an existing offsite disposal facility.	Potentially applicable.
		New Facility	Design and construct a disposal facility at an offsite location.	Not applicable due to time and expense to site a new facility.
		Beneficial Reuse	Reuse of impacted media for roadbed disposal, landfill cover, or construction fill.	Not applicable. No applications for beneficial reuse of the soils could be identified in the vicinity of the site.
		Ocean Disposal	Disposal of materials with trace quantities of constituents.	Not applicable. Presence of long-lived radiological constituents would preclude this option, because material will remain radioactive beyond the expected life of a disposal container or matrix.
		Underground Mine	Disposal in an underground mine.	Not applicable for low activity constituents.
		Land Spreading	Disposal of impacted media through dispersal over a large area.	Not applicable.
	Offsite Treatment/ Disposal	Permitted/ Approved Treatment Disposal Facility	Transportation of impacted materials to offsite treatment/disposal facility.	Potentially applicable.

(Hatched box) Indicates technologies determined to be not applicable.

Table 3-5. Initial Screening of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Buildings/Structures

Buildings/Structures Response Action	Remedial Technology	Process Options	Description	Screening Comments
No Action	No Action			Carried through the analysis as a baseline.
Institutional Control	Access Restrictions	Site Security/ Isolation	Fences, berms, and signs surrounding FUSRAP Maywood Superfund Sites. Guards for authorized access control.	Potentially applicable.
		Deed Restrictions (easements & covenants)	Deeds for property in the area could include restrictions on demolition.	Potentially applicable.
	Monitoring	Sampling	Ongoing environmental monitoring at MISS.	Potentially applicable.
Containment	Surface Sealing	Paints, Resins, or Plastics; Other Impermeable Barriers	Surface sealing with paint, resins/ plastics, or other sealants or placement of impermeable barriers (plastic sheeting on wood structures) to prevent direct contact and reduce mobility.	Potentially applicable.
Removal/ Extraction	Demolition	Partial	Blasting, wrecking, sawing, or crushing specified sections of buildings and structures.	Potentially applicable. Most effective if only portion of building or structure is impacted.
		Complete	Complete demolition of buildings and structures.	Potentially applicable.

Table 3-5. Initial Screening of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Buildings/Structures (continued)

Buildings/Structures Response Action	Remedial Technology	Process Options	Description	Screening Comments
Treatment	Decontamination	Physical	Physical force is used to achieve removal from the surface of the material.	Potentially applicable.
		Chemical	Chemicals are applied to the surface of the material for removal by suspension or dissolution.	Potentially applicable.

Table 3-5. Initial Screening of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Buildings/Structures (continued)

Buildings/Structures Response Action	Remedial Technology	Process Options	Description	Screening Comments
Disposal	Onsite Disposal	Construct a Disposal Facility	Design and construct a disposal facility onsite at MISS.	Potentially applicable for a limited volume of contaminated materials.
	Offsite Disposal	Existing Facility	Transport contaminated materials to an existing offsite disposal facility.	Potentially applicable.
		New Facility	Design and construct a disposal facility at an offsite location.	Not applicable due to time and expense required to site a new facility.
		Beneficial Reuse	Reuse of impacted media for roadbed disposal, landfill cover, or construction fill.	Not applicable due to time and expense required to locate an acceptable beneficial reuse location for the volume of Maywood soils.
		Ocean Disposal	Disposal of materials with trace quantities of constituents.	Not applicable. Presence of radiological constituents would preclude this option.
		Underground Mine	Disposal in an underground mine.	Not applicable due to expense; generally reserved for high-concentration radioactive wastes.
		Land Spreading	Disposal of impacted media through dispersal over a large area.	Not applicable due to long-lived nature of radionuclides.
	Offsite Treatment/ Disposal	Permitted/ Approved Treatment Disposal Facility	Transportation of impacted media to offsite treatment/disposal facility.	Potentially applicable.

(hatched box) Indicates technologies determined to be not applicable.

3.4.2.1 Source Media

Institutional Control

The remedial technology identified for institutional control of source material is access restriction. This includes denial of entry to a site or restriction of access to residual contaminated media. Process options include site security/isolation, zoning controls, covenants for Federally owned property not cleaned to the unrestricted use criteria, and easements for property not owned by the Federal government and not cleaned up to unrestricted use criteria.

Site security/isolation use fences, berms, and signs surround the FUSRAP Maywood Superfund Site and help prevent unauthorized access. Security personnel can be employed to allow only authorized access to the FUSRAP Maywood Superfund Site.

This process option minimizes the potential for direct human contact and/or inhalation of contaminated soil and sediments; therefore, it is potentially applicable. Fences and berms are already in place on some portions of the FUSRAP Maywood Superfund Site.

Easements (for property not owned by the Federal government) and covenants (for property owned by the Federal government) can be obtained to prevent digging, building, or any activity that can disturb the soils. Such restrictions can minimize the potential for direct human contact and/or inhalation of contaminated soil; therefore, they are potentially applicable.

Barriers and warning signs could be placed around the perimeter of Federal government-owned property. Security personnel could be employed, and the deed to the property could be modified to ensure that future owners know about the residual COCs and what activities are not allowed (e.g., excavating soil, residential development, etc). Agreements with local utility companies could be put in place to address emergency-situations requiring contact with contaminated soils.

If the Federal government does not own the property, then the Federal government could acquire it or enter into an agreement with the current landowner (i.e. obtain an easement) to place restrictions on current and future activities on the property and to modify the property deed to reflect these restrictions. Other options are for a municipality to place restrictions on land use within the municipal boundary that contains residual COCs, or for the State to establish deed advisories to notify potential new owners of the contamination.

Monitoring and reevaluation are required by CERCLA 121(c) at least every 5 years on sites containing residual contamination above levels that would not be protective for unlimited use and unrestricted exposure. Environmental monitoring is included with institutional control actions; however, monitoring itself does not prevent or minimize exposure. It does allow assessment of migration and is, thus, an important part of preventing unacceptable exposures. Therefore, institutional controls and environmental monitoring are retained for further consideration.

Containment

The process options screened for containment of source media included the following types of caps: synthetic, multi-layered, native soil, asphalt, concrete, and clay.

Capping techniques could be applied over contaminated soil or debris to prevent the escape of contamination (including radon) into the atmosphere, infiltration of surface water, and direct human contact. Synthetic liners or multi-layered caps of different media over the areas of contamination would not be as susceptible to cracking and, therefore, are potentially applicable. Asphalt and concrete caps are susceptible to cracking if not properly maintained. Existing building slabs and paved surfaces can be effective in reducing direct human contact and wind and water erosion. Native soil may be used in areas of relatively low radioactivity to provide an exposure barrier against direct human contact and, in conjunction with surface controls, could reduce COC migration by wind and water erosion. Clay caps over the contaminated areas are also potentially applicable. Therefore, native soil, asphalt, clay, and concrete cover are also retained for further consideration.

Removal/Extraction

The process options screened for removal/extraction of source media included bulk removal and excavation for soil. Because of the suspected locations (culverts and isolated open channel areas) and limited estimated volume, sediments would be included with the soil and bulk waste. The techniques utilized to remove material under the excavation process would depend on the areas and locations to be excavated. Large mechanical excavators would be used for the most easily accessible areas. In areas where space is limited, smaller mechanical excavation devices or hand tools may be required. These options were retained for further consideration.

Treatment

The process options screened for treatment included both *in situ* and *ex situ* physical, chemical, and thermal options. Biological processes were previously identified as not applicable to the FUSRAP contamination.

Several *ex situ* physical process options were evaluated, including encapsulation, thermoplastic solidification, soil washing, radiological sorting, gravel separation and solidification. Encapsulation, the physical sealing of wastes in an organic binder of resin, was eliminated due to its high cost and difficulty in implementation. Thermoplastic solidification seals wastes in an asphalt bitumen, paraffin, or polyethylene matrix. This process was also eliminated from further consideration due to high cost and difficulty in implementation.

Soil washing is a water-based process for mechanically scrubbing excavated soil to remove contaminants in two ways: by dissolving or suspending them in the wash solution or by concentrating them into a smaller volume of soil through particle size separation techniques. Soil washing systems that incorporate both techniques achieve the greatest success with soils contaminated with radioactive constituents. Soils containing a large amount of clay and silt are typically not effectively treated by soil washing alone. However, soil washing can be used in combination with other physical or chemical treatment options. Laboratory characterization and technology screening testing of the FUSRAP Maywood Superfund Site sub-surface soils indicate that they may be suitable for volume reduction by soil washing (EPA 1993 and SC&A 1997). This technology will, therefore, be retained for future evaluation.

Radiological sorting is a process in which soils are mechanically sorted based on radionuclide concentrations to separate contaminated soils from clean soils. This technology offers many advantages as it does not produce any secondary waste and requires no process additives. This technology has been retained for further evaluation.

Gravel separation is a mechanical process in which coarse particles are removed from the soil, typically by a vibrating screen. The coarse fraction is generally below criteria, since the contaminants are most closely associated with the fines. This technology has been retained for further evaluation.

Stabilization/solidification technologies employ the use of various cement- and silicate-based mixtures to act as physical solidifying agents. Stabilization has been used effectively to stabilize soils contaminated with inorganic constituents. These technologies may significantly increase the volume of waste for disposal. The resulting solids resist leaching and erosion, thereby minimizing migration. Therefore, this physical process option is potentially applicable and will be retained for further evaluation.

Ex situ chemical process options include a variety of processes such as chemical leaching, chemical oxidation, reduction, neutralization, precipitation, chelation, and solvent flushing. In general, all these processes involve adding chemicals to reduce or remove the constituents in the soil. The potential exists for generating large volumes of hazardous constituents and hazardous by-products in waste streams that would require additional treatment. Ex situ chemical processes are not retained for further consideration as stand-alone treatment processes. However, chemical processes are potentially applicable as an enhancement to the soil washing technology.

Incineration processes are generally used for the destruction of organic compounds. Incineration would not be effective in treating the radioactive contaminants at the FUSRAP Maywood Superfund Site and was therefore eliminated.

Vitrification involves the immobilization of COCs in a glasslike matrix. Vitrification is a high-temperature process (2,012°F to 2,552°F); therefore, small quantities of inorganics may be volatilized during the process. Afterburners may be required on the exhaust stream to convert the partially burned organics to carbon dioxide. The vitrification process includes blending glassmaking constituents and the waste and feeding into a high-temperature furnace. The waste materials are melted in the molten glass; upon cooling, a solid mass forms that contains the immobilized waste. A pretreatment step may be required to reduce the moisture content or reduce the size of the feed material.

Vitrification has been shown to reduce the gamma dose rate for gamma-emitting radionuclides due to the increase in density of the vitrified matrix. Further, both alpha and beta emitters could be sealed in the glass matrix (EPA 1991c). For these reasons, ex situ vitrification has been determined to be potentially applicable and will be retained for further evaluation.

Physical and chemical in situ processes were eliminated from further consideration due to the location of the contaminated material on the properties. Furthermore, these processes were not considered for implementation at MISS or Stepan because of the high groundwater table (BNI 1992). The high groundwater table would adversely impact the implementation and effectiveness of any in situ process.

Disposal

Both onsite and offsite disposal options were considered for source material.

Onsite disposal of soils in a land encapsulation facility has been included for further evaluation. Land encapsulation is a proven and well-demonstrated technology. A disposal facility, similar to the DOE design developed for the Uranium Mill Tailings Remedial Action Program (UMTRAP), has been constructed at the Canonsburg, Pennsylvania site and is considered protective of public health with erosion-proof barriers designed to ensure long-term control of radionuclides (Camp, Dresser, & McKee 1985). It is feasible that such a design could be used at the FUSRAP Maywood Superfund Site, in combination with volume reduction options. An onsite disposal facility would have to be designed and constructed to contain all the excavated materials or the residuals after treatment. Limited land space is available onsite for a disposal facility at the 11.7-acre MISS. This option could be considered if additional space is made available or treatment significantly reduces volume. There is a possibility that concentrated materials from the soil treatment process or other materials yet to be identified, could be identified as mixed or hazardous waste. If this occurs, that soil determined to be RCRA hazardous waste would have to be disposed or treated in a RCRA-approved offsite facility, or any treatment or disposal of such wastes would have to comply with the substantive requirements of RCRA.

Among the offsite disposal options to be considered are ocean disposal, disposal in geologic repositories (abandoned underground mines), and land spreading. Also included is disposal at a new specially designed facility at a location within New Jersey, an existing Federal facility, an existing commercially-licensed facility, and beneficial reuse.

The disposal of materials in the ocean is regulated under 40 CFR 220–225 and 227–229, and is controlled via a permit system. Regulation 40 CFR 227.6(b) authorizes disposal of materials with trace quantities (near background) of radionuclides if the material will not cause significant undesirable effects, as tested according to 40 CFR 227.6(c). Although the FUSRAP wastes should easily pass any immediate hazard test criteria, the radionuclides are probably present in more than “trace” quantities. Radioactive materials must be contained as directed by 40 CFR 227.11 to prevent their direct dispersion or dilution in ocean waters. 40 CFR 227.11(b)(1) requires that the materials decay to environmentally innocuous materials within the life expectancy of the container and/or the matrix. This requirement precludes the disposal of materials with long half-lives. In addition, the U.S. has not used ocean disposal for radioactive waste since 1970. Therefore, ocean disposal will not be considered further.

Disposal in deep abandoned mines is typically considered for high-activity wastes and may not be appropriate for low-activity soils found at the FUSRAP Maywood Superfund Site. The use of an abandoned mine would involve the cost of reconstruction and consequently may pose safety hazards. Due to these concerns, mine disposal would be expected to be the most expensive of the disposal options. Disposal in geologic repositories, therefore, will not be considered further.

Per the September 2001 NRC Letter, USACE will dispose of the radiologically contaminated soil offsite as 11(e)(2) byproduct materials.

The types of materials that are disposed via land spreading fall within a narrow range of physical and chemical characteristics. Soils contaminated with radionuclides do not fall within this category because of their long half-lives. In addition, land spreading of the Maywood soils may present problems associated with emissions of soil particles containing low activity levels. This option does not fully protect human health and the environment and is inconsistent with regulatory requirements. Land spreading, therefore, will not be considered further.

A newly constructed offsite disposal facility in New Jersey would be designed to reduce potential exposure and minimize the migration of contaminated material. Due to the time and expense that would be required to site and permit a new disposal facility in New Jersey, this disposal option will not be considered further.

An existing disposal cell for similar wastes at another Federal facility could be used for disposal, such as the DOE Hanford Reservation near Richland, Washington. Due to the time and expense (relative to commercial disposal) that would be required for approval and the cost to ship and dispose of the waste at the Hanford Reservation facility, this disposal option will not be considered further.

Land disposal facilities are now available for the types of contaminated soil at the FUSRAP Maywood Superfund site. Either the NRC or the State in which such facilities are located regulates such facilities. Some of these facilities may also accept soil that is regulated by RCRA. Disposal facilities will, therefore, be considered further.

Beneficial reuse through roadbed dispersal involves excavating the contaminated soils and using it as fill material during construction of roads and highways. Newly constructed interState highways or airport runways would be appropriate for such dispersal. To use the material as construction fill, it must be demonstrated that groundwater is not contaminated and that the soil meets the specifications for fill. Another option used at other CERCLA sites involves using the soil as interim landfill cover material. No specific applications for the beneficial reuse of the material generated during this action could be identified in the vicinity of the site. Therefore, beneficial reuse will not be considered further. However, if treatment is used, the cleaned stream from treatment could be beneficially used as treated backfill onsite.

Finally, transportation of contaminated material to a permitted/licensed treatment and disposal facility is considered potentially applicable. MISS will be used for staging or temporary storage during remedial action. If offsite treatment and disposal is selected, the material would be shipped offsite with a minimal accumulation of contaminated materials onsite.

It is intended in the excavation alternatives that clean soil from over-excavation and overburden removal be replaced as clean backfill at the FUSRAP Maywood Superfund Site. In addition, the clean soils from treatment could also be used as treated backfill on the MISS. If determined to be unsuitable for treated backfill, the clean soils would be disposed offsite in an approved Subtitle C RCRA disposal cell or Subtitle D industrial landfill, as appropriate.

3.4.2.2 Buildings/Structures

Based on surveys, several buildings on the Stepan property have contaminated building surfaces (Buildings 4, 10, 13, 15, 20, 67, 78, and the guard shack). A more thorough survey of the buildings on Stepan will be conducted to determine the extent of remedial action necessary to meet the cleanup criteria. In addition, access to contaminated soil beneath some buildings may require building demolition. The demolition activities for buildings would be considered in determining future actions for the removal of inaccessible soils. Containment, treatment, or other action(s) on the structures may be necessary prior to demolition to prevent the release of any existing contaminants.

Institutional Control of Buildings/Structures

The options of implementing site security with appropriate posting of signs and monitoring of the ambient air for radioactivity levels are retained for further consideration. Building surfaces where radioactive contamination has been detected are located on the Stepan Company property. Stepan enforces its own security through access restrictions. The option of having either Stepan Company or the Borough of Maywood place deed restrictions, to prevent the public from coming into contact with the contaminated buildings sometime in the future, is potentially applicable. Environmental monitoring is retained as applicable. Reevaluation is required by CERCLA 121(c) at least every five years on sites if the residual levels of contamination do not allow for unlimited use and unrestricted exposure. Monitoring would be required to evaluate continued protectiveness.

Containment of Radionuclides on Buildings and Structures

The applicable options for surface sealing include painting (applying paints on masonry and wooden surfaces); applying resin or liquid plastics; and using other impermeable barriers (employing plastic sheeting or wooden structures). The principal objectives of surface sealing are to reduce the mobility of the contaminants and reduce the potential for human absorption. This option would not reduce gamma levels associated with the radiological COCs and their decay chains. Surface sealing options are considered applicable and will be retained for further evaluation.

Demolition of Buildings and Structures

Demolition involves the blasting, wrecking, drilling, or sawing of appropriate portions or sections of the contaminated buildings. Partial demolition could be implemented where portions or sections of a building are contaminated or are located over contaminated soils. Complete demolition could be implemented where partial demolition is not considered effective. Partial and complete demolition are both considered applicable.

Decontamination

All available physical decontamination options such as scrubbing, scraping, scabbling, sanding, grinding, and sand/grit or carbon dioxide blasting are considered applicable.

Chemical decontamination procedures would include the use of water, solvents, acids and bases, and complexing agents. The choice of chemical to be used would be site- and material-specific and would depend on the contaminants to be removed, the surface that needs to be decontaminated, and the physical location of the building or structure surface (i.e., whether it is located at a point where it could impact public health or the environment). Chemical decontamination is considered applicable.

Disposal

The potential disposal options are the same as those described in Section 3.4.2.1.

3.5 EVALUATION OF PROCESS OPTIONS

3.5.1 Evaluation Criteria

This section presents an evaluation of the remaining process options based on their effectiveness, implementability, and cost in relation to site-specific conditions. A description of the criteria for evaluation is presented in Sections 3.5.1.1 through 3.5.1.3. The evaluation of options follows in Section 3.5.2.

3.5.1.1 Effectiveness Evaluation Criteria

The identified technology process options are evaluated to ensure that they effectively protect human health and the environment and satisfy the RAOs defined for the media of concern. The effectiveness of each process option to reduce the concentrations or exposure levels or to sufficiently recover media for subsequent treatment is evaluated. In addition, the protection each option affords to human health and the environment is considered. Also included in the evaluation is a technical assessment of the ability of the process option to achieve the RAOs, as well as the useful life of the process option (i.e., the length of time that it performs its intended function). The effectiveness and reliability of the process options are evaluated with respect to the COCs and conditions at the site. Reliability is an important concern because of the significant operation and maintenance (O&M) requirements associated with most technology process options and the importance of protecting public health and the environment. Long-term management of residual constituents and/or untreated wastes reduces the effectiveness of a technology; therefore, the duration of long-term management required for each process option is also evaluated.

3.5.1.2 Implementability Evaluation Criteria

The implementability criterion encompasses both the technical and administrative feasibility and the availability of services and materials. Two aspects of technical feasibility are (1) availability and constructability of the process option and (2) construction and implementation timeframe. Constructability addresses both onsite and offsite conditions. Implementation time and the period for beneficial results to be realized are critical factors in protecting public health and the environment.

The administrative aspects of implementability are also important. For each process option, the ability to obtain necessary approval from government agencies; availability of approved treatment, storage, and disposal facilities and their capacities; and availability of necessary equipment and skilled workers to implement the technology are considered.

3.5.1.3 Cost Evaluation Criterion

The cost criterion played a lesser role than other criteria in the initial screening of process options for the development of alternatives. Relative capital costs and O&M costs are used rather than detailed estimates. During this phase, the cost analysis was based on engineering judgment, and each process option was evaluated on its cost relative to other process options within the same remedial technology.

3.5.2 Evaluation of Technologies

The process options that passed the screening process were evaluated in greater detail to determine which could be selected to develop remedial alternatives. Process options were evaluated using the criteria of effectiveness, implementability, and cost. Tables 3-6 and 3-7 summarize the evaluation of process options for source media and buildings/structures, respectively, at the FUSRAP Maywood Superfund Site. The no-action alternative is retained through the FS, as per CERCLA guidance.

3.5.2.1 Source Media

Institutional Controls

This response action includes methods to control exposure (e.g., site security, access restrictions, etc.) and tools to restrict future land use (e.g., easements, zoning restrictions, etc.). MISS and the Stepan Company already have site security in the form of protective fences and locked gates that permit only authorized personnel to enter. In addition to the security measures already in place at MISS and Stepan, warning signs could be posted around the FUSRAP Maywood Superfund Site, and cooperative agreements could be put in place with utility companies who may contact these soils during emergency repairs. Institutional controls are considered effective in limiting exposure.

Restrictions on future development at Federal government-owned property could be incorporated into the property deed to limit land use (e.g., a covenant), should contaminants above unrestricted release guidelines remain on the property. Tools to restrict future land use (e.g., easements, covenants, zoning controls, etc.) would also be emplaced as necessary on non-government owned property. Also, municipalities, State, or other Federal agencies may implement restrictions on land use and permissible activities on contaminated property within their boundaries. Even though the capital cost to implement institutional controls should not be prohibitive, labor costs and the time to implement institutional controls as necessary on properties with commercial cleanup standards and/or inaccessible soils will not be minimal.

Soils would be monitored to ensure that constituents are not dispersing offsite, where they could impact public health and the environment. These options have low capital and O&M costs.

Institutional controls are considered applicable alone or as a component of other alternatives and will be retained for further evaluation.

Containment

Containment at the FUSRAP Maywood Superfund Site can be provided by a cap made of many materials including native soil, clay, asphalt, concrete, synthetic liners or a combination of more than one media (multimedia) cap. Clean native soil, existing concrete floors, and existing asphalt pavement are effective in restricting direct human contact and minimizing wind and water erosion of the contaminated soil under these features. Due to the binding of the radiological COCs in the soil, these options have been determined to be adequate for interim containment. Synthetic liner, concrete, and asphalt would be considered adequate as an interim containment barrier, while native soil, clay, and multimedia materials, if maintained, would be suitable for long-term containment. In addition, these options are easily implemented and have low capital and O&M costs.

The native soil, clay cap, and multimedia cap are effective and implementable as a permanent measure. The capital and O&M costs are expected to be low. However, due to the persistence of the contaminants, the presence of contaminants on multiple properties, the dense population in the vicinity of the FUSRAP Maywood Superfund Site, and community opposition to onsite disposal, containment will not be considered further for the accessible soils at the FUSRAP Maywood Superfund Site.

Table 3-6. Evaluation of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Source Media

Source Media Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
No Action	None	Not Applicable	Does not satisfy NCP threshold criteria.	Easily implemented.	Negligible cost.
Institutional Controls	Access & Land Use Restrictions	Site Security/ Isolation	Effective for controlling site access and reducing public exposure. No constituent reduction.	Easily implemented on some properties; already implemented at some portions of the site.	Low capital, low O&M.
		Deed Restrictions (e.g., covenants)	Effectiveness depends on continued future implementation. Does not reduce toxicity, mobility, or volume.	Potentially difficult to implement on privately-owned property.	Minimal cost.
	Monitoring	Sampling	Useful for documenting conditions. Does not reduce risk by itself.	Easily implementable.	Low capital, low O&M.
Containment	Capping	Synthetic	Not effective over long term when used alone. Would require maintenance/replacement.	Eliminated due to long-lived nature of radionuclides and presence of contamination on multiple properties.	Moderate capital, low O&M.
		Multilayered Caps	Effective, least susceptible to cracking. Would require maintenance/ replacement over long term.	Eliminated due to long-lived nature of radionuclides and presence of contamination on multiple properties.	Moderate capital, low O&M.
		Native Soils	Effective in restricting direct human contact and minimizing migration caused by wind or surface-water erosion.	Eliminated due to long-lived nature of radionuclides and presence of contamination on multiple properties.	Low capital, low O&M.
		Asphalt	Effective in restricting direct human contact and minimizing migration caused by wind or surface-water erosion. Requires maintenance.	Eliminated due to long-lived nature of radionuclides and presence of contamination on multiple properties.	Low capital, low O&M.
		Concrete	Effective in restricting direct human contact and minimizing migration caused by wind or surface-water erosion. Requires maintenance.	Eliminated due to long-lived nature of radionuclides and presence of contamination on multiple properties.	Low capital, low O&M.
		Clay	Effective in restricting direct human contact and minimizing migration caused by wind or surface-water erosion. Requires maintenance.	Eliminated due to long-lived nature of radionuclides and presence of contamination on multiple properties.	Low capital, low O&M.

(hatched) Individual options not retained.

Table 3-6. Evaluation of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Source Media (continued)

Source Media Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
Removal/ Excavation	Bulk Removal	Lifting and Moving Equipment	Effective for safely removing containerized material and debris. Requires disposal.	Easily implemented; equipment is readily accessible.	Low capital, low O&M.
	Excavation	Physical or Mechanical Excavation	Conventional earth-moving equipment is effective for excavation of impacted soil; can excavate to specific criteria (i.e., specific target levels, all accessible locations, etc.). Requires disposal.	Implementable; conventional dust controls and runoff control techniques would be necessary.	Moderate to high capital, low O&M.
Treatment	Physical	Soil Washing	Effective for concentrating contaminants in soil fractions, but may generate liquid wastes that may need further treatment.	Easily implemented; commercial vendor units available.	Moderate capital, moderate O&M.
		Radiological Sorting	May be effective in reducing volume of soil requiring offsite disposal as low level radioactive waste. Limited site-specific data is currently available to judge its effectiveness.	Easily implemented; commercial vendor units available.	Moderate capital, low O&M.
		Gravel Separation	Effective in removing larger diameter soil fractions from smaller diameter soil fractions. Associated gravel rinse system generates low volumes of liquid wastes requiring disposal	Easily implemented; commercial vendor units available.	Low capital, low O&M.
		Solidification	Effective but increases volumes of waste.	Easily implemented.	Low capital, moderate O&M.
	Ex situ Thermal	Vitrification	Effective immobilization and some volume reduction.	Not easily implemented; requires specialized equipment and highly-skilled personnel.	High capital, high O&M.

Individual options not retained.

Table 3-6. Evaluation of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Source Media (continued)

Source Media Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
Disposal	Onsite Disposal	New Facility	Effective and reliable, however a site suitability study would be required to assess site conditions (i.e., seismic activity, foundation soils, geologic conditions, etc.).	Implementable only if additional land could be acquired. Necessary approvals, siting, and acquisition of additional property would impact implementation timeframe. Questionable administrative feasibility.	High capital, moderate O&M.
	Offsite Disposal	Existing Facility	Effective and reliable. Requires transportation.	Implementable.	High capital, low O&M.

Individual options not retained.

Table 3-7. Evaluation of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Buildings/Structures

Buildings/Structures Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
No Action	None	Not Applicable	Does not satisfy NCP threshold criteria	Easily implemented.	Negligible cost.
Institutional Controls	Access & Land Use Restrictions	Site Security/ Isolation	Effective for controlling site access and reducing public exposure. No constituent reduction. Protective of current occupants based on measurements collected to date.	Already implemented at some portions of MISS and Stepan.	Low capital, low O&M.
		Easements & covenants	Effectiveness depends on continued future implementation. Protective of current occupants based on measurements collected to date.	Difficult to implement on privately owned property.	Minimal cost.
	Monitoring	Sampling	Useful for documenting conditions. Does not reduce risk by itself.	Not acceptable as a stand-alone option.	Low capital, low O&M.
Containment	Surface Sealing	Paints, resins, or plastics; other impermeable barriers	Not effective over long term. Limits dermal inhalation exposure over limited time.	Implementable but would require maintenance of sealants.	Low capital, low O&M.
Removal/ Extraction	Demolition	Partial	Effective where impacts are limited.	Implementable with appropriate equipment. Potentially difficult to implement on privately owned property or active building.	Moderate capital, low O&M.
		Complete	Effective. May be required to access contaminated soils beneath structures.	Implementable with appropriate equipment. Potentially difficult to implement on privately owned property or active building.	Moderate capital, low O&M.

Individual options not retained. (hatched: Surface Sealing; Paints, resins, or plastics; other impermeable barriers)

Table 3-7. Evaluation of Remedial Technologies and Process Options for the FUSRAP Maywood Superfund Site Buildings/Structures (continued)

Buildings/Structures Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
Treatment	Decontamination	Physical	Effective for wood and masonry surfaces.	Implementable; commercial vendor availability. Isolation and collection of airborne particulates required.	Moderate to low capital, moderate O&M.
		Chemical	Effective for waste that can be dissolved or suspended with chemicals. Poor for porous materials.	Implementable; collection and treatment/disposal of fluids required.	Moderate to high capital, low O&M.
Disposal	Onsite Disposal	New Facility	Effective and reliable, however a site suitability study would be required to assess site conditions (i.e., seismic activity, foundation soils, geologic conditions, etc.).	Implementable but additional land required. Questionable administrative feasibility due to siting a new cell in New Jersey (no precedence). Necessary approvals, siting, and acquisition of additional property would impact implementation timeframe.	High capital, moderate O&M.
	Offsite Disposal	Existing Facility	Effective and reliable. Requires transportation.	Implementable disposal facilities are currently in operation.	High capital, low O&M.

Removal

Source media at the FUSRAP Maywood Superfund Site can be removed by excavation using a variety of equipment, including backhoes, bulldozers, and front-end loaders, in addition to manual techniques. Excavation can involve removal of large areas of soils, or it can involve selective excavation based on localized conditions. It is expected that during excavation of soils using the conventional equipment described above, strictly enforced dust and runoff control techniques would effectively protect workers and the public.

Excavation would be highly effective in addressing the contaminated soils at the FUSRAP Maywood Superfund Site. At the Stepan Company and commercial/government properties, excavation would have to be coordinated with the owners to ensure minimal disruption of ongoing activities that may affect implementability. Site-specific considerations concerning mitigation techniques of surface water runoff and run-on, and potential groundwater impacts on excavation actions would be implemented. Excavation costs are expected to be moderate to high.

Treatment

Volume-reduction methods (e.g., soil washing, radiological sorting) and ex situ immobilization technologies (e.g., solidification, vitrification) were retained for further evaluation.

Treatability test results (see Section 5.2.1.2) indicate volume reduction by soil washing is a potentially feasible option (EPA 1993 and SC&A 1997). However, the results of the Engineering Test Pits Program at MISS indicated that there were several conditions at the FUSRAP Maywood Superfund Site that would limit the effectiveness of soil washing. These conditions include a high fines content in soils throughout the FUSRAP Maywood Superfund Site and radiological contamination in the sand fractions (Stone & Webster 2000). These conditions, coupled with the lower throughput and higher unit cost for soil washing than for gravel separation and radiological sorting, led to the elimination of soil washing from further consideration. Limited site-specific data is currently available to evaluate the effectiveness of radiological sorting in reducing the volume of radioactive material requiring offsite disposal. The Engineering Test Pits Program at MISS showed a degree of heterogeneity in the FUSRAP Maywood Superfund Site radiological levels, which is promising for the success of radiological sorting. Therefore, radiological sorting is retained as a potential volume reduction technology. The Engineering Test Pits Program at MISS also showed that there was a substantial coarse fraction (greater than 3/8 in. diameter) and that this fraction was consistently below the proposed cleanup criteria. Therefore, gravel separation will be retained as a potential volume reduction technology.

Effectiveness and implementation concerns for treatment options include the ability of the process to meet cleanup criteria, logistical and technical problems for treatment demonstrations and scale-up to full-scale operations, community opposition to onsite treatment, demonstrating acceptable risk related to backfilling treatment residuals, and the long-term institutional controls that may result from this approach. A full-scale treatment demonstration was conducted on the Maywood soils to determine if these technologies could be cost effectively applied to the FUSRAP Maywood Superfund Site.

The immobilization technologies retained for further evaluation, solidification and vitrification, would reduce the leachability of the radioactive materials and limit the spread of constituents. Solidification involves adding an appropriate binding matrix that produces a monolithic block of waste with high structural integrity. The contaminants do not chemically interact with the solidification agents, but they are physically bonded. This process option has low capital and moderate O&M costs. Due to the increased volume, this option will not be considered further.

The vitrification process (EPA 1991c) described in Section 3.4 is energy intensive and requires specialized equipment. This treatment option could potentially be used for immobilization of COCs; however, the uncertainties associated with implementability are high. The capital and O&M costs for this option are also considered high; therefore, this option will not be considered further.

Disposal

Interim storage would be considered in combination with the new onsite disposal facilities. Such storage options could include construction of covered waste piles, outdoor storage of containerized soil, and indoor storage. Interim storage is not considered as a stand-alone option.

The disposal options considered for further evaluation are onsite and offsite disposal. The potential options include onsite disposal and out-of-State disposal.

Onsite disposal – This option involves the design and construction of a new encapsulated disposal facility onsite. Onsite disposal is feasible if treatment is used to reduce the volume of soils requiring disposal as radioactive waste. For this option, property near MISS may need to be acquired. Per the September 2001 NRC Letter, USACE will dispose of the radiologically contaminated soil offsite as 11(e)(2) byproduct materials.

A new onsite disposal cell has high capital costs. O&M costs would be low compared to the capital costs, but would be higher than other alternatives, such as offsite disposal. There would be no disposal fees with a dedicated onsite facility.

Effectiveness concerns for onsite disposal include the ability of the site to meet the engineering design criteria (i.e., geologic conditions, foundation soils, groundwater, seismic activity) for siting and licensing a disposal cell in the State of New Jersey.

The implementation time required to acquire additional land adjacent to MISS, perform site suitability studies, obtain approvals, and address opposition from local stakeholders would be significant and not allow for a timely remedy to protect public health and the environment. Therefore, onsite disposal will not be considered further.

Off-site disposal – This option involves use of an existing disposal facility. Per the September 2001 NRC Letter, USACE will dispose of the radiologically contaminated soil offsite as 11(e)(2) byproduct materials. Several existing disposal facilities possess an NRC license to accept radioactive wastes.

Depending on the characteristics of the waste, a RCRA Subtitle C facility for hazardous waste disposal or a Subtitle D facility for solid waste disposal may be appropriate for a portion of the material generated at the FUSRAP Maywood Superfund Site. The disposal criteria for these facilities vary widely; therefore, individual facilities are not identified in this FS.

3.5.2.2 Buildings/Structures

Institutional Control

This response action includes site security and restrictions on land use (e.g., covenants and deed restrictions for Federally owned property not remediated to the unrestricted use criteria, and the use of easements, zoning controls, and other institutional controls for other properties not remediated to the unrestricted use criteria). MISS and the Stepan Company already have site security in the form of protective fences and locked gates that permit only authorized personnel to enter. In addition to the security measures already in place at MISS and Stepan, warning signs would be posted around the FUSRAP Maywood Superfund Site. Institutional controls are considered effective in limiting exposure.

Restrictions on future construction or demolition of buildings would be incorporated into the property deed to limit land use, should constituents above unrestricted release guidelines remain on the property. Negotiations with owners of property not owned by the Federal government would be required in order to obtain easements on property not remediated to the unrestricted criteria. In order for institutional controls to be effective and implementable, the property may either have to be purchased by the Federal government or the Federal government may have to enter into an agreement with the property owner to implement the easement. Also, municipalities, State, or other Federal agencies may implement restrictions on land use and permissible activities on contaminated property within their boundaries. Even though the capital cost to implement deed restrictions should not be cost prohibitive, labor costs and the time to implement institutional controls for building contamination will not be minimal.

Building/structures would be monitored to ensure that constituents are not dispersing offsite, where they could impact public health and the environment. These options have low capital and O&M costs.

Institutional controls are considered applicable alone or as a component of other alternatives and will be retained for further evaluation.

Containment

Surface sealing is effective in the short-term but not in the long-term, due to potential degradation of the applied sealant or barrier. Surface sealing is implementable upon selection of the preferred type of sealant and application method, but may be difficult to implement at non-Federally-owned properties due to inaccessibility and difficulty in monitoring for effectiveness. The capital and O&M costs are considered low. This action was eliminated from further consideration because it is not effective in the long-term.

Removal/Extraction

The removal/extraction option of complete and partial demolition is effective in protecting human health and the environment, when appropriately applied to the defined extent of contaminated material. Implementation of complete or partial demolition of buildings on the Stepan property would require coordination with Stepan. Both options were retained for further consideration.

Treatment

Decontamination of the contaminated buildings and structures is effective in treating certain types of contamination, depending on the contaminated surface material. This option may not be capable of complete removal of contamination. Specific chemical or physical methods would be applied where considered effective for the type of surface material. This option is considered implementable due to commercially available equipment. Capital and O&M costs are considered low to moderate and moderate, respectively. Both physical and chemical methods were retained for further consideration.

Disposal

The disposal options retained for further consideration are the same as those described for source media.

3.6 RESULTS OF SCREENING OF REMEDIAL ACTION TECHNOLOGIES

The results of the screening of remedial action technologies for the FUSRAP Maywood Superfund Site are illustrated in Tables 3-6 and 3-7. This information was used to develop remedial action alternatives for each of the property units. These alternatives and the results of their screening, for the purpose of developing and evaluating site-wide alternatives, are presented in Section 4.

4. DEVELOPMENT AND SCREENING OF ALTERNATIVES

4.1 INTRODUCTION

In this section, the remedial action technologies that passed initial screening in Section 3 are combined into alternatives that represent a range of institutional control, treatment, removal, and disposal options. Section 4.2 provides a description of the property units used for evaluating remedial actions at the FUSRAP Maywood Superfund Site. The development of alternatives for each property unit is then discussed in Section 4.3, and the initial screening of the alternatives is provided in Section 4.4. Section 4.5 describes the development of the site-wide alternatives.

The remedial actions considered applicable to the FUSRAP Maywood Superfund Site include:

- No Action;
- Institutional Controls;
- Excavation/Bulk Removal;
- Treatment (soils);
- Decontamination (buildings);
- Demolition of Buildings/Structures (complete and partial demolition); and
- Disposal.

4.2 DESCRIPTION OF FUSRAP MAYWOOD SUPERFUND SITE PROPERTY UNITS

The remaining properties to be addressed at the FUSRAP Maywood Superfund Site are partitioned into three property groups, primarily based on historical use and current ownership. For the FS evaluation, the three property units are the Federally-owned MISS, which encompasses the former thorium processing area and the waste retention ponds; Stepan Company, which purchased the MCW in 1959 and contains contaminated buildings and the three NRC-licensed burial pits; and the remaining 22 commercial/government vicinity properties.

The media of concern for the FUSRAP Maywood Superfund Site are source media (soils, sediments, and bulk waste) and buildings/structures. The remaining properties to be addressed at the FUSRAP Maywood Superfund Site are composed of commercial, industrial, and government properties. All properties contain radioactively contaminated soil; MISS also contains radioactively contaminated bulk waste, such as drums and other debris. Several buildings on the Stepan property are also contaminated. The Stepan property and other commercial/government properties (including streets and highways) contain inaccessible soils where structures have been built on top of contaminated soils. Inaccessible soils will be removed when made accessible by the property owner (e.g., through renovation or demolition activities). There is considerable uncertainty associated with estimating the volumes of material involved and the costs associated with remediating these inaccessible soils. Costs have been estimated for these inaccessible soils based on the current understanding of existing soil volumes and costs related to the excavation, transportation and disposal of contaminated soil. The evaluation of alternatives provides costs associated with the estimated volume of accessible and inaccessible contaminated soils.

The in situ volumes of contaminated material on the remaining properties using the restricted use criteria are shown in Table 4-1; this volume is expected to increase by 100 % if the unrestricted use criteria is applied. This assumption is based on USACE's experience with the excavation of contamination on the Phase I residential properties and an analysis of the subsurface investigative data on the Phase II commercial properties. However, there is significant uncertainty in the increase in volume that will be realized by using the restricted use criteria to unrestricted use criteria. The uncertainty in the volume estimate under the unrestricted use criteria is based primarily on the fact that all remedial investigations were performed assuming the restricted use criteria would apply. Therefore, limited data is available to perform an accurate estimate of potential volume growth. Table 4-1 presents the estimated in situ volumes of affected media at the various property units.

4.2.1 MISS

The MISS property unit is a 11.7-acre fenced area that contains contaminated soils, Building 76, and miscellaneous features (water reservoir and Pump House, decontamination station, railroad spurs). The accessible contaminated in situ soils on MISS are estimated to be 73,233 yd^3) (Stone & Webster 2001) based on application of the restricted use criteria. This includes soils located under Building 76, the water reservoir, and Pump House, all of which are currently in use. All MISS soils are considered accessible, because the property is owned by the Federal government and the structures can be removed or relocated.

4.2.2 Stepan

The Stepan Company property includes radiologically contaminated soils that are considered FUSRAP wastes. Some of the soils are considered inaccessible due to their locations under buildings. The estimated volume of soil beneath the affected buildings (Buildings 1, 4, 13, 15, 20, 52, 67, 78, and the guard house) is approximately 974 yd^3. The estimated volume of contaminated material in burial pits 1, 2, and 3 at Stepan is estimated to be 19,100 yd^3. The total in situ volume of accessible radioactively contaminated soils and wastes for the Stepan property unit, including burial pits 1, 2, and 3, is estimated to be 44,125 yd^3, based on the application of the restricted use cleanup criteria. Also, chemicals have been identified in soils and groundwater on the Stepan property as described in the Maywood RI report and in Section 2 of this report. Separate RI/FS activities conducted by Stepan were directed toward identifying and quantifying the nature and extent of chemicals in soils and groundwater. Chemicals in soil on the Stepan property that are not defined as FUSRAP waste are not the responsibility of the USACE.

The buildings/structures unit consists of radiologically contaminated buildings (4, 10, 13, 15, 20, 67, 78, and the guard shack) on the Stepan property as defined in Section 2.4.6 and buildings that may have to be demolished to access underlying contaminated soils. The radioactivity found in the buildings is fixed and not transferable. Most of the buildings are currently in use by the Stepan Company. The options potentially applicable to the buildings warranted development and evaluation of separate alternatives for the buildings.

Table 4-1. Volumes of In Situ Contaminated Media at the Various Property Units

Property Units	In Situ Soil Volume to Restricted Use Criteria[a,b] (yd^3)		In Situ Soil Volume to Unrestricted Use Criteria[a,c] (yd^3)	
	Accessible	Inaccessible[f]	Accessible	Inaccessible[f]
MISS	73,233	0	N/A	N/A
Stepan	44,125	974	N/A	N/A
Commercial/Government	79,065	46,770	30,751	6,370
Buildings/Structures	(e)	(e)	(e)	(e)
TOTAL[d]	196,423	47,744	30,751	6,370

a. Primary radionuclides include thorium-232, radium-226, and uranium-238 and their decay products.
b. Based on cleanup to 15 pCi/g (combined radium-226 and thorium-232 above background) in the soils.
c. Based on cleanup to 5 pCi/g (combined radium-226 and thorium-232 above background) at all soil depths.
d. Total volume of contaminated media for the FUSRAP Maywood Superfund Site includes waste volume from the remaining properties that are addressed by this FS. Volumes associated with past or current cleanup actions are not included here. The contaminated volume is the estimated amount of material in place that is above guidelines. Stepan accessible soil volume includes 19,100 cubic yards of contaminated material in Burial Pit 1, 2, and 3.
e. Volumes not calculated because the extent of remediation required to meet cleanup levels has yet to be defined. Contamination limited to isolated building surface areas. Additional characterization needed to determine extent; however, volume expected to be minimal compared to total volume.
f. Inaccessible soil volume from Phase I activities is 12,500 yd^3 which will be addressed with the inaccessible soils at the commercial/government properties.

Source: BNI 1997. *Volume Register*, Revision 11; March 29, 1996, letter from Susan Cange, DOE, to Angela Carpenter, EPA; and S&W 2001. *Volume Register*, Revision 0.

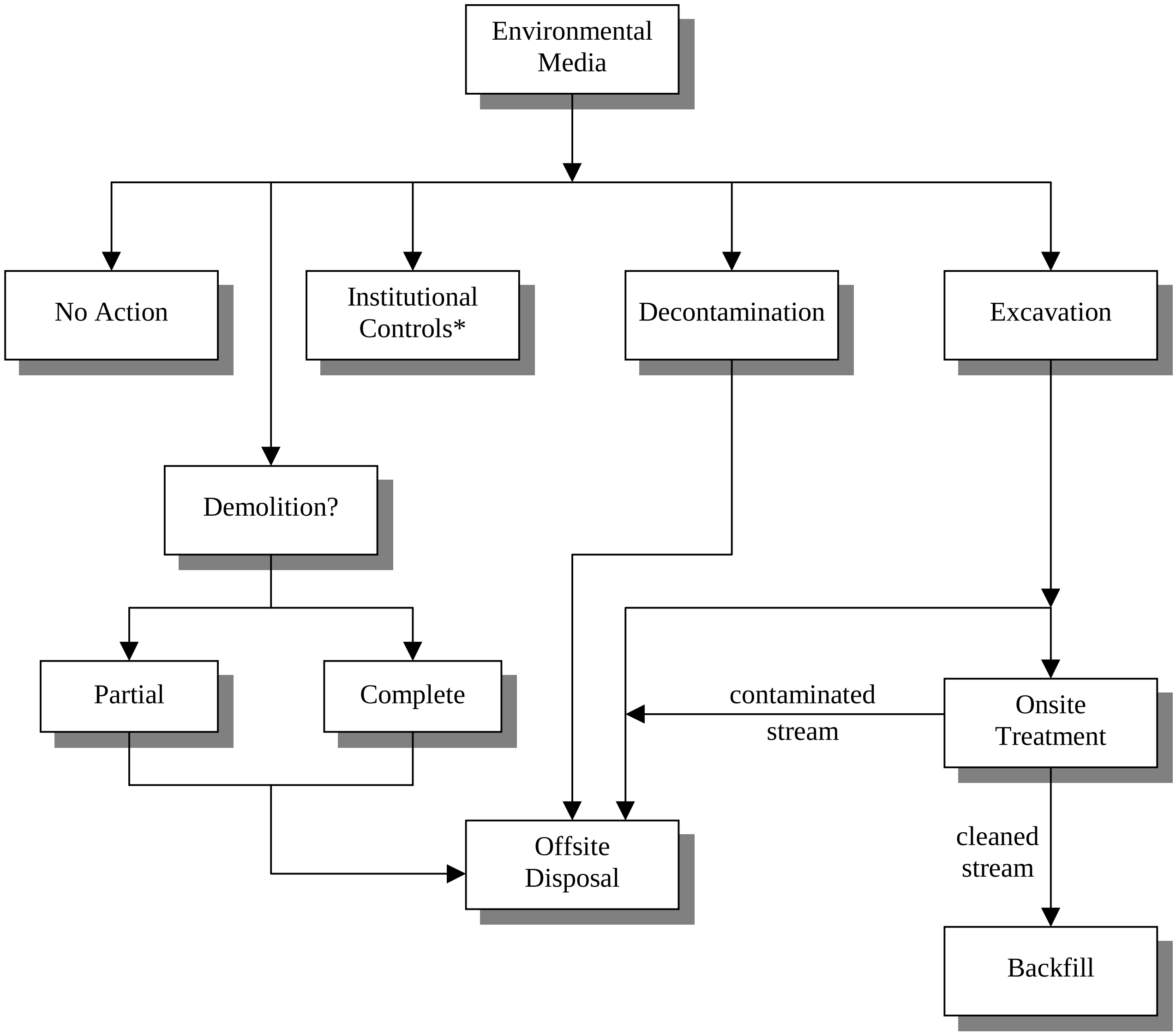
Additional surveys will be performed prior to or during remedial design to determine the extent of remediation required.

4.2.3 Commercial/Government Properties

The FUSRAP Maywood Superfund Site properties included within the commercial and government property unit are listed in Table 2-1. The total in situ volume of accessible contaminated soil for the restricted and unrestricted use cleanup levels is approximately 79,065 yd^3 and 30,751 yd^3,respectively. The commercial and government properties contain both accessible and inaccessible contaminated soils. Table 1-1 provides a listing of estimated inaccessible and accessible soil volumes by property.

4.3 DEVELOPMENT OF ALTERNATIVES

Based on the general response actions identified to meet RAOs (Section 3), preliminary remedial action alternatives have been developed for each of the property units. The process for identifying remedial action alternatives is shown on Figure 4-1. The remedial action alternatives have been developed in accordance with NCP and EPA guidance.



* Institutional Controls are a component of all alternatives except no action.

Figure 4-1. Process Model for Identification of Alternatives

4.3.1 Uncertainties and Assumptions

The estimated volume of soils to be excavated from the properties comprising the FUSRAP Maywood Superfund Site is based on previous removal action activities and characterization data. Volumes were estimated using the downhole gamma log data reported in the Maywood RI (DOE 1992a). The level of uncertainty increases with soil depth and the application of the unrestricted use criteria.

4.3.2 Alternatives for Property Units

A list of the remedial actions considered appropriate for the FUSRAP Maywood Superfund Site property units can be found in Section 4.1.

4.3.2.1 Source Media (Soils and Bulk Waste)

The alternatives developed for source media for the FUSRAP Maywood Superfund Site include:

A. No Action
B. Institutional Controls and Environmental Monitoring
C. Excavation of Accessible Soils and Disposal
D. Excavation of Accessible Soils, Treatment, and Disposal

Preliminary information on the effectiveness, implementability, and cost of each of the developed property unit alternatives is given in the following sections.

Alternative A – No Action

The no-action alternative is included for evaluation as a baseline in accordance with EPA CERCLA guidance. This alternative includes 5-year reviews in accordance with 40 CFR 300.430(f)(4)(ii), which requires reviews at least every five years for CERCLA sites where contamination remains above levels acceptable for unlimited use and unrestricted exposure. Actions taken to reduce the potential for exposure (e.g., site fencing, security) are not included as a component of the no-action alternative. The no-action alternative is not effective in protecting human health and the environment in areas where COCs are considered above acceptable levels, but it is considered to be easy to implement and involves costs associated with 5-year reviews only.

Alternative B – Institutional Controls and Environmental Monitoring

This alternative involves maintaining the current land uses for some properties and reducing uses and exposures at other properties at the FUSRAP Maywood Superfund Site. Based on the results of the BRA, this alternative is protective to human health as long as current property uses, the nature of the exposures and configurations do not change. The BRA calculated some preliminary ecological risks for the site that might not be considered protective. However, in view of the lack of significant ecological habitat at the site, this might not be that significant.

Additional analysis of potential ecological risk would be required if the institutional controls and environmental monitoring alternative were selected as the remedial action for this OU. The BRA estimated a potential for risks to ecological receptors if current conditions remained. Additional land use controls may be necessary to protect ecological receptors under this alternative. The primary pathways of exposure to be controlled by institutional controls are direct gamma radiation and radon inhalation. Unprotective risks are possible if current land use conditions change from commercial to uses that could increase human exposure. Human exposure could potentially increase if employees or residents are placed on current vacant areas of the FUSRAP Maywood Superfund Site which contain relatively high concentrations of contaminants, or if contaminants currently covered by clean soils or structures are made accessible, or if land use changes to a residential scenario.

Institutional controls may be implemented to prevent intrusion into the controlled areas; these could consist of several options described in Section 3.4. Environmental monitoring and 5-year reviews to determine whether the remedy was still protective of human health and the environment would be implemented. This alternative is effective in eliminating some pathways of exposure, and to some extent, the mobility of contaminants and, therefore, is protective of human health and the environment. Overall, institutional controls (e.g., covenants and easements) are implementable and relatively low in capital costs on Federal government-owned property. Implementing institutional controls on other properties may be more difficult, and would involve negotiations with those property owners. Obtaining and maintaining institutional controls on property not owned by the Federal government are considered implementable, but will require extensive time and labor to accomplish.

Alternative C – Excavation of and Disposal of Accessible and Inaccessible Soils

Excavation of accessible and inaccessible soils would involve removal of accessible contaminated soils, and, in the future, the excavation of inaccessible soils as these soils are made accessible by the property owner. Accessible soils are defined as soils that are not located under or near permanent structures, such as buildings and active roadways. Soils under sidewalks, parking lots, and other non-permanent structures are considered accessible, unless their removal would compromise the integrity of a permanent structure, such as a building foundation, roadway, or utility corridor.

Per the September 2001 NRC Letter, USACE will dispose of the radiologically contaminated soil offsite as 11(e)(2) byproduct materials.

Excavation of accessible and inaccessible soils is considered protective of human health and the environment. Environmental monitoring and 5-year reviews would be required for those locations where contamination is left above levels for unlimited use and unrestricted exposure. The capital cost of removal actions would be relatively high and O&M costs would be expected to be low.

Alternative D – Excavation, Treatment and Disposal of Accessible Soils; and Excavation and Disposal of Inaccessible Soils

This alternative is similar to Alternative C but would include treatment of accessible contaminated soils to reduce the volume requiring disposal. Treatment would probably only be used on accessible soils because the volume of inaccessible soils becoming available at any given time would be too small to make treatment cost-effective for inaccessible soils. If some inaccessible soils become available while accessible soils are still being treated, then treatment might be used on those inaccessible soils. Treatment would be performed onsite at the MISS. The clean soils from the treatment process would be used as backfill on the MISS. The concentrated radioactive soils would be shipped offsite for disposal. Soil reuse potential will be addressed in property remedial design documentation in full coordination with NJDEP and EPA.

Per the September 2001 NRC Letter, USACE will dispose of the radiologically contaminated soil offsite as 11(e)(2) byproduct materials.

The effectiveness of gravel separation was evaluated as part of the Engineering Test Pits Program at the MISS. This program indicated that at least 15 % of the non-retention pond material could be removed as below criteria by a gravel separation system. Gravel separation is reliable and relatively low-cost. Preliminary evaluation of radiological sorting information indicates that this technology could also be effective. A site-specific treatment demonstration has been conducted on the use of this process, although the data review is not yet complete, and the treatment demonstration report has not yet been completed. The cost of this alternative is expected to be lower than that for Alternative C, based on the treatment efficiency assumptions used. The lower cost is primarily due to the lower volume of soil requiring offsite disposal.

4.3.2.2 Buildings/Structures Alternatives

The alternatives developed for Buildings/Structures for the FUSRAP Maywood Superfund Site include:

A. No Action
B. Institutional Controls and Environmental Monitoring
C. Partial Demolition and Disposal
D. Complete Demolition and Disposal
E. Decontamination
F. Decontamination, Partial Demolition, and Disposal

Alternative A – No Action

This alternative is included for consideration in accordance with EPA guidance and includes monitoring every five years in accordance with 40 CFR 300.430(f)(4)(ii). This alternative does not meet either of the NCP threshold criteria of protectiveness or ARAR compliance, but it is considered easy to implement, and the only costs would be for the 5-year reviews.

Alternative B – Institutional Controls and Environmental Monitoring

Institutional controls could be effective in limiting exposure. Environmental monitoring and 5-year reviews to determine whether the remedy was still protective of human health and the environment would be implemented. This alternative is relatively easy to implement and has low capital and moderate O&M costs for Federally owned property. Implementation would be somewhat more difficult on property not owned by the Federal government, and would involve negotiations with those property owners.

Alternative C – Partial Demolition and Disposal

Partial demolition is effective in protecting human health and the environment by reducing direct contact and the mobility of the contaminants for the areas or portions of the buildings and structures demolished and disposed. This alternative would involve the removal of only the parts of buildings and structures with contaminant levels above criteria. This alternative is moderate to high in capital and low in O&M costs. Implementation of this alternative would require coordination with ongoing Stepan operations.

Alternative D – Complete Demolition and Disposal

This alternative is effective in reducing direct contact and the mobility of the contaminants by complete demolition and removal of the entire building and structure. This alternative would involve the complete demolition of buildings associated with active chemical plant operations at the Stepan property with levels of contaminants above guidelines. This alternative is high in capital and low in O&M cost. Implementation of this alternative would require coordination with ongoing Stepan operations.

Alternative E – Decontamination

Decontamination procedures remove the contaminants from the surface of the material through physical and chemical procedures. This alternative is effective in protecting human health and the environment by reducing direct contact and the mobility of the COCs. Depending on the method of decontamination and the type of surface material, all of the constituents may not be removed from the surface. This alternative is moderate in capital and low in O&M cost. Implementation of this alternative would require coordination with ongoing Stepan operations.

Alternative F – Decontamination, Partial Demolition, and Disposal

This alternative is effective in reducing direct contact and the mobility of the contaminants by removal of contaminants present on the surface of materials by decontamination, and partial demolition of buildings and structures where decontamination is impractical or not completely successful. This alternative is moderate in capital and low in O&M cost. Implementation of this alternative would require coordination with ongoing Stepan Company operations.

4.4 SCREENING OF ALTERNATIVES

In this section, alternatives for source media and buildings/structures are screened for applicability to the FUSRAP Maywood Superfund Site property units. An alternative may be screened out for a property unit based on effectiveness, implementability, or cost. The screening is usually performed on a general basis because the information required to fully evaluate the alternatives is not complete at this point in the process. The desired result of screening is to provide a range of alternatives, consistent with the NCP, to be evaluated in more detail. The screening of alternatives follows in Sections 4.4.1 through 4.4.5.

4.4.1 MISS

The excavation alternatives, including the alternative that employs treatment, are retained for consideration for MISS. The excavation of accessible and inaccessible soils would be implementable and effective in providing overall protection of human health and the environment through removal of all potential sources of COCs. (See Table 4-2 for the initial screening of MISS property units alternatives.) The institutional controls alternative allows all sources of contaminants to remain in place and provides effectiveness as long as controls remain in place. Long-term protectiveness would be evaluated in 5-year reviews using site-specific exposure assumptions consistent with then-current land uses. The treatment of soils is considered implementable based on laboratory- and pilot-scale studies, provides volume reduction of the waste stream, and is consistent with the CERCLA preference for treatment. No action, institutional controls and environmental monitoring, and the excavation alternatives (including those that employ treatment), are therefore retained.

4.4.2 Stepan

The excavation alternatives are retained for consideration for the Stepan property. The excavation of accessible soils would be implementable and effective in providing overall protection of human health and the environment. (See Table 4-2 for the initial screening of Stepan property unit alternatives.) The excavation of inaccessible soils would be implementable and effective as contaminated soils become accessible by action of the property owner (e.g., through renovation or demolition activities). The institutional controls and environmental monitoring alternative allows all of the accessible and inaccessible contaminants to remain in place and provides effectiveness as long as the control systems remain in place. Long-term protectiveness would be evaluated in 5-year reviews. The treatment of accessible soils is considered implementable, provides volume reduction of the waste stream, and is consistent with the CERCLA preference for treatment. Institutional controls, environmental monitoring and the excavation alternatives (including those that employ treatment), are therefore retained. No-action is retained as a baseline against which other alternatives are compared.

Table 4-2. Initial Screening of MISS, Stepan, and Commercial/Government Property Unit Alternatives for FUSRAP-Contaminated Source Media (i.e. Soil, Debris)

Alternative	Retained	Effectiveness	Implementability	Cost
A. No Action	Yes	Does not achieve remedial action objectives.	Easily implemented.	Negligible cost; monitoring only.
B. Institutional Controls and Environmental Monitoring	Yes	Can be effective as long as controls remain in place.	Implementable.	Low capital; moderate O&M.
C. Excavation and Disposal of Accessible and Inaccessible Soils	Yes	Effective due to removal of accessible soils.	Implementable.	High capital; low O&M.
D. Excavation, Treatment and Disposal of Accessible Soils; and Excavation and Disposal of Inaccessible Soils	Yes	Effective due to removal of accessible soils.	Implementable; treatment process performance could impact implementability.	High capital; low O&M.

Alternatives involving complete demolition are screened out for the buildings/structures property unit. (See Table 4-3 for initial screening of buildings/structures of Stepan property unit alternatives.) The extent of contamination documented at present indicates that complete demolition of buildings currently in use is not warranted (BNI 1992). Building Alternative F, decontamination and partial demolition, provides for the removal of the COCs in the most cost-effective and complete manner in comparison to the other alternatives for the buildings/structures property unit. Building Alternative C, partial demolition, and Building Alternative E, decontamination, address only portions of the buildings and, therefore, would not be retained as individual alternatives. Building Alternative B, institutional controls and environmental monitoring, does not eliminate the COC contamination but does provide for short-term effectiveness and was thus retained for the detailed analysis. Therefore, the no-action, containment and institutional controls, and decontamination and partial demolition building alternatives are retained for the detailed analysis.

4.4.3 Commercial/Government Properties

The institutional controls and environmental monitoring alternative allows accessible and inaccessible soils to remain in place and provides for some effectiveness as long as the control systems remain intact. Long-term protectiveness would be evaluated using 5-year reviews. (See Table 4-2 for initial screening of commercial/government property unit alternatives.) The excavation of accessible soils is implementable and would be effective in providing overall protection of human health and the environment. Additionally, the excavation of inaccessible soils would be effective and implementable as contaminated soils become accessible by action of the property owner (e.g., through renovation or demolition activities). The treatment of accessible soils is considered implementable, provides volume reduction of the waste stream, and is consistent with the CERCLA preference for treatment. Therefore, no action, institutional controls and environmental monitoring, the excavation alternatives (including those that employ treatment) are retained for detailed analysis.

Table 4-3. Initial Screening of Buildings/Structures Portion of the Stepan Company Property Unit Alternatives

Alternative	Retained	Effectiveness	Implementability	Cost
A. No Action	Yes	Does not achieve remedial action objectives.	Easily implemented.	Negligible cost; monitoring only.
B. Institutional Controls and Environmental Monitoring	Yes	Can be effective as long as controls remain in place.	Implementable.	Low capital; moderate O&M.
C. Partial Demolition and Disposal	No	Effective due to removal of source of COCs. (Combined with Alternative E to form Alternative F.)	Implementable; access to buildings due to operating facility may be difficult.	High capital; low O&M.
D. Complete Demolition and Disposal	No	Effective in removing source of COCs	Difficult to implement due to demolition of operating facility.	High capital; low O&M.
E. Decontamination and Disposal	No	Effective in removing source of COCs. (Combined with Alternative C to form Alternative F.)	Implementable; access to buildings due to operating facility may be difficult.	Moderate capital; low O&M.
F. Decontamination, Partial Demolition and Disposal	Yes	Effective in removing source of COCs.	Implementable.	Moderate capital; low O&M.

4.4.4 Disposal Options

The only disposal option retained after initial screening in Section 3 is disposal in an existing offsite commercial facility. A description of this option is provided in Section 3.5.2.1.

4.5 DEVELOPMENT OF SITE-WIDE ALTERNATIVES

In this section, alternatives to address the soils impacted with FUSRAP wastes are developed based on the screening of alternatives for property units. The potential combinations of alternatives for the FUSRAP Maywood Superfund Site are provided in Table 4-4. Disposal under soil alternatives C and D and building alternatives C, D, E, and F include offsite disposal at a permitted disposal facility. For the treatment alternative, offsite disposal would be used for the contaminated waste stream. Cleaned soils from treatment would be beneficially used as backfill at MISS. A minimum of one foot of clean (untreated) fill would be placed over remediated areas.

Table 4-4. Summary of Alternatives for Property Units at the FUSRAP Maywood Superfund Site

MISS/Stepan/Commercial/Government Properties – Source Media (soils, sediments, and bulk waste)	
Alternative A.	No Action
Alternative B.	Institutional Controls and Environmental Monitoring
Alternative C.	Excavation and Disposal of Accessible and Inaccessible Soils
Alternative D.	Excavation, Treatment and Disposal of Accessible Soils; and Excavation and Disposal of Inaccessible Soils
Buildings/Structures	
Alternative A.	No Action
Alternative B.	Institutional Controls and Environmental Monitoring
Alternative C.	Partial Demolition and Disposal
Alternative D.	Complete Demolition and Disposal
Alternative E.	Decontamination
Alternative F.	Decontamination, Partial Demolition, and Disposal

In addition to the no-action alternative, three site-wide alternatives were developed in this FS from the possible combinations identified in Tables 4-2 and 4-3. Site-wide alternatives were assembled to cover a range of options that address the source media of concern for the FUSRAP Maywood Superfund Site and provide for the overall protection of human health and the environment. Table 4-5 presents a brief summary of each of the site-wide alternatives combined with the disposal options. The detailed analysis of these four alternatives is presented in Section 5. The origin of the site-wide alternatives is presented below.

- Building Alternative A (no-action) for soil is combined with soil Alternative A (no-action) to form Site-wide Alternative 1 (no-action).

- Site-wide Alternative 2 is a combination of building Alternative A (institutional controls and monitoring) with soil Alternative B (institutional controls and monitoring).

- Site-wide Alternative 3 is a combination of soil Alternative C (excavation and disposal of accessible and inaccessible soils) and building Alternative F (decontamination, partial demolition and disposal).

- Site-wide Alternative 4 is a combination of soil Alternative D (excavation, treatment, and disposal of accessible soils, and excavation and disposal of inaccessible soils) and building Alternative F (decontamination, partial demolition and disposal).

Table 4-5. Summary of Site-wide Alternatives

Alternative 1 – No Action This alternative would provide no further remedial action at the FUSRAP Maywood Superfund Site and is included as a baseline against which other alternatives can be compared. Although some institutional controls are in place at the site, these would not be maintained under this alternative. 5-year reviews would be conducted.
Alternative 2 – Monitoring and Institutional Controls This alternative would involve maintaining the current status of some of the properties and reducing the uses of and exposures at other properties at the Site, including periodic monitoring to detect any changes in the nature or extent of contamination at the FUSRAP Maywood Superfund Site. Institutional controls would include monitoring the use and condition of buildings at the site, including building surfaces containing nontransferable contamination. Institutional controls would include continuing the existing access restrictions at MISS and Stepan; maintaining existing cover materials including grass, building foundations, and asphalt; periodic inspection of all the properties to determine any changes in land use; institutional controls (e.g., zoning restrictions, covenants, easements) as necessary to prohibit potentially unprotective land uses or construction in contaminated soils; and 5-year reviews.
Alternative 3 – Excavation and Disposal of Accessible and Inaccessible Soils This alternative would involve removing contaminated accessible and inaccessible soils (including burial pits 1,2 and 3) above the appropriate cleanup criteria for offsite disposal. Inaccessible soils would be removed by the government as they become accessible by action of the property owner (e.g., through renovation or demolition activities). Properties that are reasonably likely to become residential in the future will be remediated to the dispute resolution residential (unrestricted) use criteria. Other commercial and government properties will be remediated to the dispute resolution commercial (restricted use) cleanup standard and institutional controls would be established as necessary to assure continued commercial use of properties not remediated to the unrestricted use criteria. Clean soil would be purchased and used for backfill. A minimum of one foot of clean fill would be placed over remediated areas. The USACE would obtain institutional controls as necessary, and as described for Alternative 2, where the restricted use criterion is applied and where combined levels of radium-226 and thorium-232 remain above an average of 5 pCi/g (above background). Institutional controls (e.g., zoning restrictions, covenants) will be placed on Federal property not remediated to the unrestricted use criteria; 5-year reviews would also be conducted on the properties not remediated to the unrestricted use criteria. The uranium cleanup criteria would be 50 pCi/g average concentration above background of uranium-238 (which is essentially 100 pCi/g total uranium). Contaminated building surfaces would be remediated in accordance with NJAC 7:28-12.8(a) and properly disposed at an authorized off-site disposal facility. Indoor air at buildings with inaccessible material temporarily remaining beneath them would be monitored for radon to show compliance with the 3.0 pCi/L, above background, level. Mitigation (e.g., sealing foundation cracks, supplementing existing ventilation systems) would be performed if monitoring revealed radon levels in excess of the 3.0 pCi/L, above background, level.
Alternative 4 – Excavation, Treatment and Disposal of Accessible Soils; and Excavation and Disposal of Inaccessible Soils This alternative is similar to Alternative 3 regarding excavation of accessible and inaccessible soils (including burial pits 1, 2, and 3) on the various properties, the cleanup criteria to be applied, building decontamination/demolition/disposal, radon monitoring and mitigation, disposal of contaminated soils, institutional controls, and the need for 5-year reviews. However, this alternative also incorporates treatment to reduce the volume of contaminated materials, requiring disposal as radioactive waste. Because the effectiveness, implementability, and cost of treatment are uncertain, a treatment demonstration was conducted on the MISS to evaluate the technology. If the treatment demonstration proves a technology is effective, implementable, and cost-effective, the USACE will treat the excavated soils prior to disposal; otherwise, the USACE will dispose of the excavated soils without treatment. This evaluation will not delay implementation of the remedy however. While the evaluation continues, the USACE will begin excavation and offsite disposal of contaminated soils. The public will be informed of the results of the treatment demonstration prior to implementation of the treatment portion of this alternative. Below criteria processed soil could be reused as backfill on the MISS. Soil reuse potential will be addressed in property remedial design documentation in full coordination with NJDEP and EPA.

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5. DETAILED ANALYSIS OF ALTERNATIVES

5.1 INTRODUCTION

In this section, alternatives capable of addressing the FUSRAP waste at the Soils/Buildings OU properties at the FUSRAP Maywood Superfund Site are described (Section 5.2) and evaluated using CERCLA criteria.

In the statutory requirements (CERCLA Section 121, 42 U.S.C. 9621) that guide the evaluation of alternatives in a FS, a remedial action must:

- Protect human health and the environment;
- Attain ARARs or define criteria for invoking a waiver;
- Be cost effective;
- Use permanent solutions and alternative treatment technologies to the maximum extent feasible; and
- Satisfy the preference for treatment that reduces mobility, toxicity, or volume as a principal element (or explain why this is not feasible).

EPA has established nine evaluation criteria in the NCP to evaluate remedial alternatives. Section 5.3 and 5.4 present an evaluation of each potential remedial action alternative based on the nine CERCLA criteria [NCP 300.430(e)(9)(iii)]:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Short-term effectiveness;
- Reduction of mobility, toxicity, or volume through treatment;
- Implementability;
- Cost;
- State acceptance; and
- Community acceptance.

The first two criteria are threshold criteria that must be met. The next five criteria are considered balancing criteria and are used to evaluate the trade-offs between the alternatives. The last two criteria are modifying criteria that are evaluated formally following the public comment period.

The analysis of each alternative with respect to overall protection of human health and the environment evaluates how the alternative reduces the risk from potential exposure pathways through treatment, engineering, or institutional controls. It also examines whether alternatives pose any unacceptable short-term or cross-media contamination.

The Federal environmental laws that are determined to be ARARs to each alternative are identified. Likewise, applicable or relevant and appropriate State requirements that are more stringent than the Federal requirements are also identified as ARARs. The ability of each alternative to meet all of its respective ARARs, or to establish the basis for a waiver, is noted for each. Regulations and guidance screened for relevance to the remedial actions are presented in Section 3.2. The resulting ARARs are provided in tabular form in Appendix A.

Long-term effectiveness and permanence are evaluated on the magnitude of residual risk and the adequacy and reliability of controls used to manage remaining waste (untreated waste and treatment residuals) over the long term (e.g., after remedial objectives are met). Alternatives that afford the highest degree of long-term effectiveness and permanence leave little or no waste at a site. Long-term maintenance, monitoring, and institutional controls are unnecessary when the site contaminants are completely treated or disposed offsite.

Evaluation of alternatives for short-term effectiveness considers the ability to protect workers and the community during the remedial action, and before RAOs are met. In this document, environmental impacts from implementing the action are also considered, as well as the time required to achieve cleanup levels.

CERCLA indicates a preference for selection of a remedial action(s) that employs treatment to reduce the mobility, toxicity, or volume to reduce the principal threats posed by the site. Such an evaluation would address the anticipated performance of technologies that may be employed to achieve treatment goals. Criteria included in the evaluation would include the amount of waste treated or destroyed; the reduction in mobility, toxicity, or volume; the irreversibility of the treatment process (i.e., will the treatment be less effective over time?); and the type and quantity of residuals resulting from the treatment process.

The analysis of implementability deals with the technical and administrative feasibility of implementing the alternatives, as well as the availability of necessary goods and services. This criteria includes consideration of such items as the ability to construct and operate components of the alternatives; the ability to obtain services, capacities, equipment, and specialists; the ability to monitor the performance and effectiveness of technologies; and the ability to obtain necessary approvals from other agencies.

Appendix B presents backup information for the costs given in this report. Costs are based on a variety of information including quotes from suppliers, generic unit costs, vendor information, conventional cost estimating guides, and prior experience. For the purposes of this document, capital costs include: construction activities, site preparation, obtaining temporary buildings and services, transportation, disposal, and indirect costs such as engineering and design studies. O&M costs include: site environmental monitoring, institutional controls, and program support. Total costs include capital costs and O&M costs.

The FS-level cost estimates shown are prepared from the information available at the time of the estimate, and are used for guidance in project evaluation and implementation. The actual costs of the project will depend on true labor and material costs, actual site conditions, competitive market conditions, final project scope and design, the implementation schedule, and other variables. An example of an uncertainty that may affect the cost is the actual volume of soil excavated and disposed. Most of these uncertainties would affect all of the costs similarly. The cost estimate presents the total 30-year cost in 2001 dollars for the site-wide alternatives and includes no escalation or discount factors. The 30-year period for O&M costs is based on guidance included in the *EPA Remedial Action Costing Procedures Manual* (EPA 1987). This document addresses the preparation of CERCLA detailed feasibility cost estimates of remedial action alternatives. These estimates should provide a measure of the total resource costs over a consistent time period for each remedial action alternative being evaluated.

The NCP's modifying criteria of State and community acceptance of the various remedial action alternatives being evaluated is factored into this analysis, to the extent possible, based on information to date and are described in Section 5.4. These two criteria will be reevaluated following public comment on the FS and the PP. Comments obtained during the public comment period will be addressed in a Responsiveness Summary that will be included in the ROD selecting the remedial action.

5.2 DETAILED DESCRIPTIONS OF REMEDIAL ACTION AND DISPOSAL OPTIONS

This section describes in detail the site-wide remedial action alternatives developed from the initial screening. Actions that are a component of one or more alternatives (e.g., excavation, treatment, demolition, transportation, institutional controls, monitoring, and disposal), are described in Sections 5.2.1 through 5.2.7.

5.2.1 Excavation

Soil is excavated with conventional earth moving equipment, e.g., backhoes and front-end loaders. The type of equipment to be used is determined by the size of the area to be remediated, the area available to set up the equipment, the required bucket size for efficient removal of the soil, and the capability for moving the soil to a facility for treatment or disposal. Manual excavation techniques will be employed where conventional equipment is infeasible due to lack of sufficient space or size of the areas to be excavated. Conventional construction techniques would be employed to mitigate groundwater impacts to excavation activities. Standard dewatering techniques may be required during excavation or before loading the waste material for transport.

The excavated soils and bulk waste would be temporarily stockpiled for initial screening after transport to MISS. The intent of this initial screening would be to segregate materials such as boulders and cobbles and other non-soil materials. The extent of contamination of various soils would be determined to select the appropriate disposal location. (Some soils may be suitable for disposal at a RCRA Subtitle C or D facility, others will require disposal at facilities that are authorized to receive radioactive waste with higher levels of contamination. RCRA Subtitle C facilities are permitted hazardous waste treatment and/or disposal facilities; RCRA Subtitle D facilities are permitted for disposal of non-hazardous solid waste). Due to the likelihood of overexcavation, some clean soils may also be segregated during this screening stage; if present, these soils would be used as clean backfill in the excavations on properties as needed. The size and locations of the segregated piles will be determined in the remedial design phase. Contaminated staged materials will either be removed from the MISS before the close of each construction season (i.e., no long-term staging will occur), or winter shutdowns would not occur, and staged contaminated soils on the MISS would be continually shipped offsite.

Inaccessible soils would be excavated in the future as the property owners make them accessible (e.g., through renovation or demolition activities). All inaccessible soils would be remediated to the restricted use cleanup levels under the dispute resolution unless the remainder of the property had already been remediated to the unrestricted use cleanup level. There is considerable uncertainty associated with estimating the volume of inaccessible material involved, and with the future costs associated with remediating these inaccessible soils. Costs have been estimated for inaccessible soils based on the current understanding of existing volumes, and costs related to the excavation, treatment, transportation and disposal. The evaluation of alternatives provides costs associated with the estimated volume of both accessible and inaccessible contaminated source material (soil, bulk waste, and sediments). The alternatives described are intended to be applicable to all remaining radiologically contaminated soils, debris, and building surfaces on the Soils/Buildings OU properties at the FUSRAP Maywood Superfund Site (including the NRC-licensed burial pits 1, 2 and 3 on the Stepan Company property).

5.2.2 Treatment

Soils

The objective of the treatment process option is to separate the radioactive COCs from the remaining soil (following removal of any bulk waste). The decontaminated soil would potentially be suitable for use as treated backfill on the MISS, while the soil with the concentrated radioactivity, would be sent to an appropriate offsite disposal facility. Identification of the disposal options is an important step before implementing treatment because the disposal facility may impose limitations on waste characteristics that they will accept. To further evaluate the potential applicability of certain treatment processes for the site, USACE has completed an onsite treatment demonstration using radiological sorting and gravel separation. Although the fieldwork for this treatment demonstration has been completed, the data review continues, and the report has not yet been completed. Figure 5-1 shows a conceptual model of the application of soil treatment technologies.

Earlier studies indicated that physical separation could be effective in reducing the volume of contaminated soil. Radiological and geotechnical analyses conducted during an engineering test pit program conducted in 1999 showed that radiological contamination, above the selected criteria, resided primarily in material that is less than 3/8-in diameter. This finding provided one of the underlying premises of the treatment demonstration: the separation of material less than 3/8-in diameter from the FUSRAP Maywood Superfund Site soils would remove material that is above the selected criteria for radiological contamination. The “selected criteria” may be established based upon different criteria sources, i.e., the criteria may be selected from a reuse requirement or from a waste acceptance requirement established by a likely disposal facility. The second underlying premise was that the heterogeneous (uneven) distribution of the radiological contamination, which was demonstrated in the test pit program, will make soil separation a viable process.

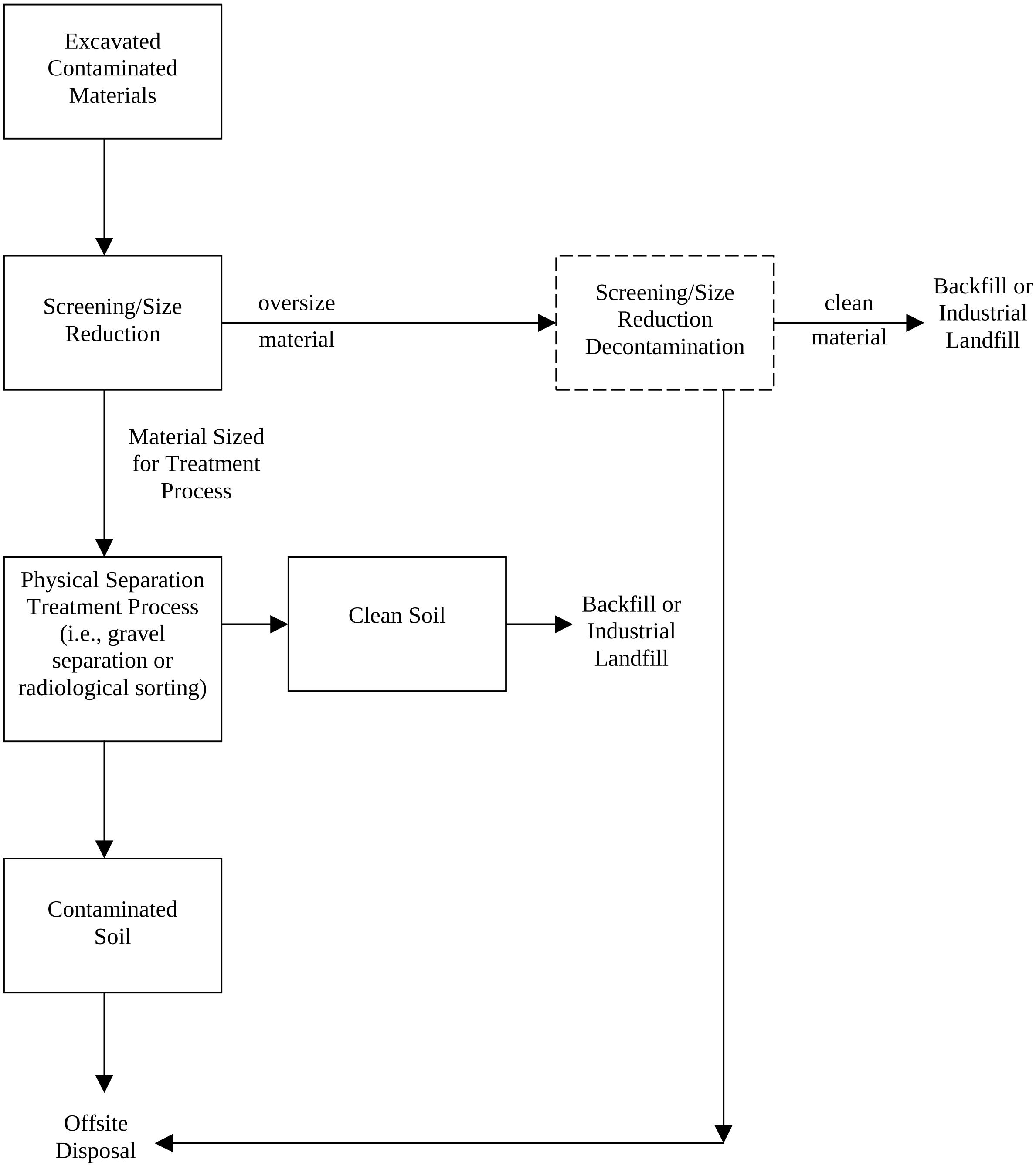

Figure 5-1. Conceptual Model for Soil Treatment

The technology selected for the treatment demonstration consists of a multi-stage process that includes gravel separation of material greater than 3/8-in nominal diameter, and radiological sorting of the soil finer than 3/8-in nominal diameter.

Gravel Separation

The gravel separation process separates the smaller radiologically contaminated particles of soil from the larger non-radiologically contaminated particles of soil. The larger particle size material, with radiological concentrations below criteria, can be reused on the MISS as clean backfill or, if necessary, disposed in a landfill. The smaller particle size materials can be further processed (using the radiological sorting system) to separate soil with radiological COCs above criteria from that with radiological COCs below criteria. The gravel separation process includes a stage where the gravel is rinsed. This stage operates in a closed system so that the rinse water is contained and recycled, and very little liquid waste is generated. This technology is based on common gravel plant operations and utilizes proven components.

Earlier treatability studies performed on Maywood soils (EPA 1993, SC&A 1997) indicated that physical separation processes are effective in isolating the contaminated material. Data on the Engineering Test Pits at the MISS revealed that approximately 15% of material surrounding the retention ponds, including the overburden above retention ponds, is greater than 3/8-in. nominal diameter. The greater than 3/8-in. nominal diameter material was found to be below the radiological cleanup criteria.

The gravel separation process is expected to concentrate the radiological and the metal contaminants into the smaller particle-sized material. Limited testing of the contaminated fraction indicates the metal constituents remain below RCRA (hazardous waste) levels.

Commercial treatment equipment is available for this technology. The equipment will either be assembled onsite at the MISS or brought to the MISS by commercial suppliers. The specific design parameters for the process are addressed in the detailed analysis of alternatives. The treatment equipment may be constructed and operated via a contract with one of the commercial suppliers of the technology.

Developing physical treatment capabilities onsite at MISS would begin by establishing a specific location at the MISS to install the treatment process. For purposes of the analysis, electricity and water are available onsite.

The treatment demonstration plant was located in the northwest corner of the MISS. The total area required for the plant was approximately 250 ft x 250 ft. The pad consisted of a 6-in. thick gravel base laid over a geotextile fabric. Steel bearing plates were used to support the heavy components of the gravel separation system. The bearing plates provided a stable, level support for the vibrating components of the equipment.

The design of the treatment demonstration equipment and pad reflects the mobile nature of the systems. The equipment may be readily moved to other portions of the MISS, as required. Use of the metal bearing plates allows for ease in decontamination of the equipment, and eliminates the need for disposing of potentially contaminated foundation materials, such as concrete, after the plant is relocated.

Figure 5-2 shows the components associated with a gravel separation system. Soils must be transported from the excavations to the treatment site. Considerations that are evaluated when deciding upon transportation methods include the required throughput of the treatment system (i.e., quantity of soil that can be treated per unit time), the distance from the excavation site to the treatment facility, and the safety precautions necessary to move the soils (e.g., movement across unrestricted access areas such as public roads requires greater precautions than movement within a restricted access areas such as the MISS).

In the first treatment step shown in Figure 5-2, excavated soils are put through a coarse separation unit to remove any debris or large objects. Once removed, the debris and large objects may be disposed as construction debris or placed onsite as backfill. The remaining soil enters the separation system. During processing the soils are agitated vigorously to break up colloidal material.

The gravel separation system consists of two main groups of components: the gravel separation system and the gravel rinse system. The gravel separation operation is a coarse screening system to remove material greater than six inches in nominal diameter, followed by a vibrating screen that removes soil particles larger than 3/8-in. nominal diameter. The removed material (i.e., gravel) is then rinsed to remove finer materials that may adhere to the coarse materials. The rinse water is filtered to remove the fines and recycled back through the system. This should not be confused with soil washing. Soil washing is an aqueous-based form of treatment. Water is added to the soil to form a slurry, and then it is sent through a series of processes designed to separate the soil into its various size fractions. The gravel separation system introduces water only to the greater than 3/8-in. gravel fraction to rinse adhered fines from an already separated stream. The less than 3/8-in. stream is maintained in a dry State and is directed, via a conveyor, to a feed hopper for the radiological sorting system or to a bypass stockpile.

At the end of the project, when all the soils intended for treatment have been processed by the treatment system, the equipment can be removed from the FUSRAP Maywood Superfund Site. Before transporting the processing equipment, the surfaces of the trailer and equipment must be decontaminated.

The location occupied by the processing equipment must be surveyed after the equipment is removed. If concentrations of radioactivity are found to be above cleanup guidelines, the area must be decontaminated.

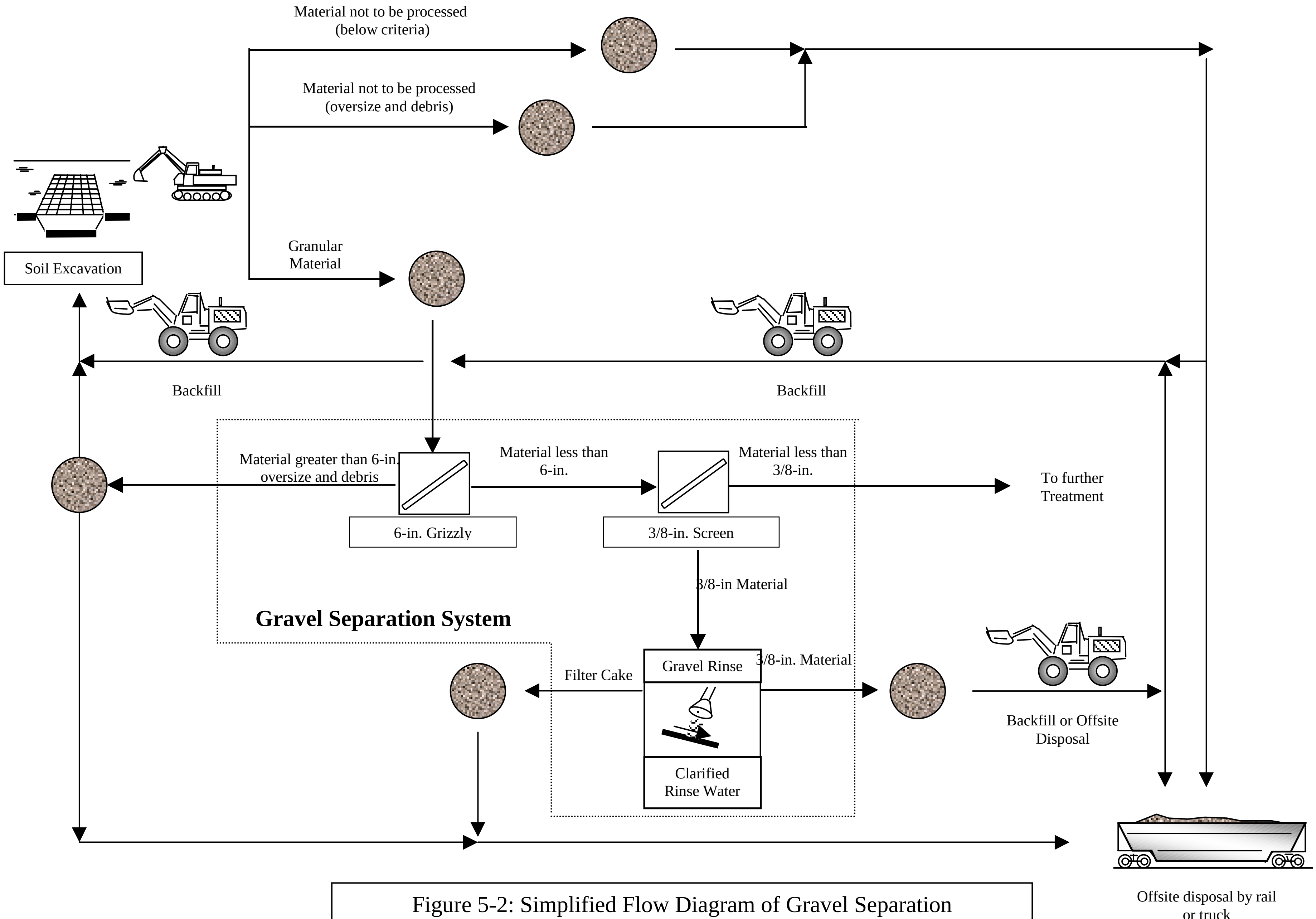

Figure 5-2: Simplified Flow Diagram of Gravel Separation

Radiological Sorting

Radiological sorting can be used as a stand-alone treatment alternative or as a component in a treatment train. The system proposed for the FUSRAP Maywood Superfund Site has the radiological sorting system deployed downstream of the gravel separation system. The less than 3/8-in. nominal diameter material is conveyed to the radiological sorting system by the gravel separation system conveyors.

The radiological sorting technology uses radiation detectors to physically separate soils contaminated with radioactive COCs from clean soils (containing radioactive COCs below the cleanup level). The detection levels can be varied based upon the required cleanup criteria. The clean soil from the sorting process may be able to be disposed of in a conventional industrial landfill or reused on the MISS as treated backfill. The soil contaminated with radioactive COCs is managed as radioactive waste.

The radiological sorting process typically operates in a conveyor type system that has computer control automation, data logging, and real-time monitoring of the radioactive COCs. Key operating parameters include the soil's moisture content, the density of the soil, thickness of soil on the conveyor belt, and speed at which the soil traverses the conveyor belt. This process does not generate additional waste other than decontamination materials and personal protective equipment (e.g., protective coveralls, boot covers) from handling operations.

Commercial treatment equipment is available for this technology. The specific design, throughput, and operational capability for the process must be defined, and would be addressed further following a detailed analysis of treatment demonstration and full-scale results. The key to success for the radiological sorting system is the degree of radiological heterogeneity (i.e. a significant difference in the levels of radioactivity from location to location in the excavated soils) in the FUSRAP Maywood Superfund Site soils. Heterogeneity is required for the radiological sorting system to be able to separate out the above criteria soils from the below criteria soils. The Engineering Test Pits program at MISS demonstrated a promising degree of heterogeneity in the radiological contamination on the MISS.

Similar to the gravel separation technology, a specific location at the MISS would first need to be established to install the treatment process. Electricity and compressed air equipment are the only utilities that must be provided to operate the radiological sorting equipment. Water will also be used as necessary for dust suppression of the soils entering and exiting the radiological sorting equipment.

The radiological sorting equipment can be a transportable system, mounted on trailers, and need not be a permanent installation. Commercial suppliers and treatment equipment operators are available.

Figure 5-3 shows the simplified process flow diagram for operation of a radiological sorting system. In the first step, excavated soils are put through a separation sizing screen and/or hammermill to prepare the soil for the proper thickness on the conveyor. Oversize rocks and/or debris (bulk materials) are removed, decontaminated, if necessary and either sent to an industrial landfill or used onsite as treated backfill. The remaining soil is then placed into a hopper and is deposited on the conveyor belt using a screed to control the thickness and width of the soil layer.

The radiological sorting system separates the soils into those with radioactive COCs above a specified level (e.g., cleanup criteria, disposal criteria, etc.) and those with radioactive COCs below the specified level. Any soil exceeding the established cleanup criteria was diverted to the contaminated soil stockpile until soil with activity that no longer exceeds the specified detection level is encountered. This is accomplished by the use of detectors specifically targeted for the radioactive COCs and a computer control system with switching capabilities (e.g., similar to railroad switches). The soil with radioactive COCs below the cleanup level are shipped offsite for disposal as industrial waste or used onsite as treated backfill on the MISS. The soil with radioactive COCs at, or above the cleanup level, are shipped offsite to a radiological disposal facility.

When all soils have been processed by the treatment system, the equipment would be removed from the FUSRAP Maywood Superfund Site. Before transporting the radiological sorting equipment, the surfaces of the trailer and equipment would be decontaminated. The location occupied by the radiological sorting equipment would be surveyed after the equipment is removed. If a concentration of radioactivity is found above cleanup guidelines, the area would be decontaminated.

Buildings

The treatment of buildings and structures involves chemical and/or physical decontamination by removal of COCs from the material surface. Walls, floors, and ceilings of surveyed buildings and structures were identified during the RI as being radioactively contaminated. Additional characterization of these buildings will be required during the remedial design activities to define the extent of decontamination necessary to meet the cleanup criteria. Therefore, the detailed analysis of alternatives for buildings/structures will consider physical and chemical decontamination options.

5.2.3 Transportation

Either bulk waste or containerized waste may be transported. Bulk soil may be shipped by rail car or by truck. Some disposal facilities are known to have rail access and facilities for offloading rail cars.

Flatbed and enclosed semi-trailer trucks are commonly used to transport containerized waste, and their use would be appropriate for excavated soils. If the receiving facility can accept bulk soil, transportation by covered dump truck could be used instead. If the excavated soils must be transported across the country, rail transportation for either the bulk or containerized soil is a viable option.

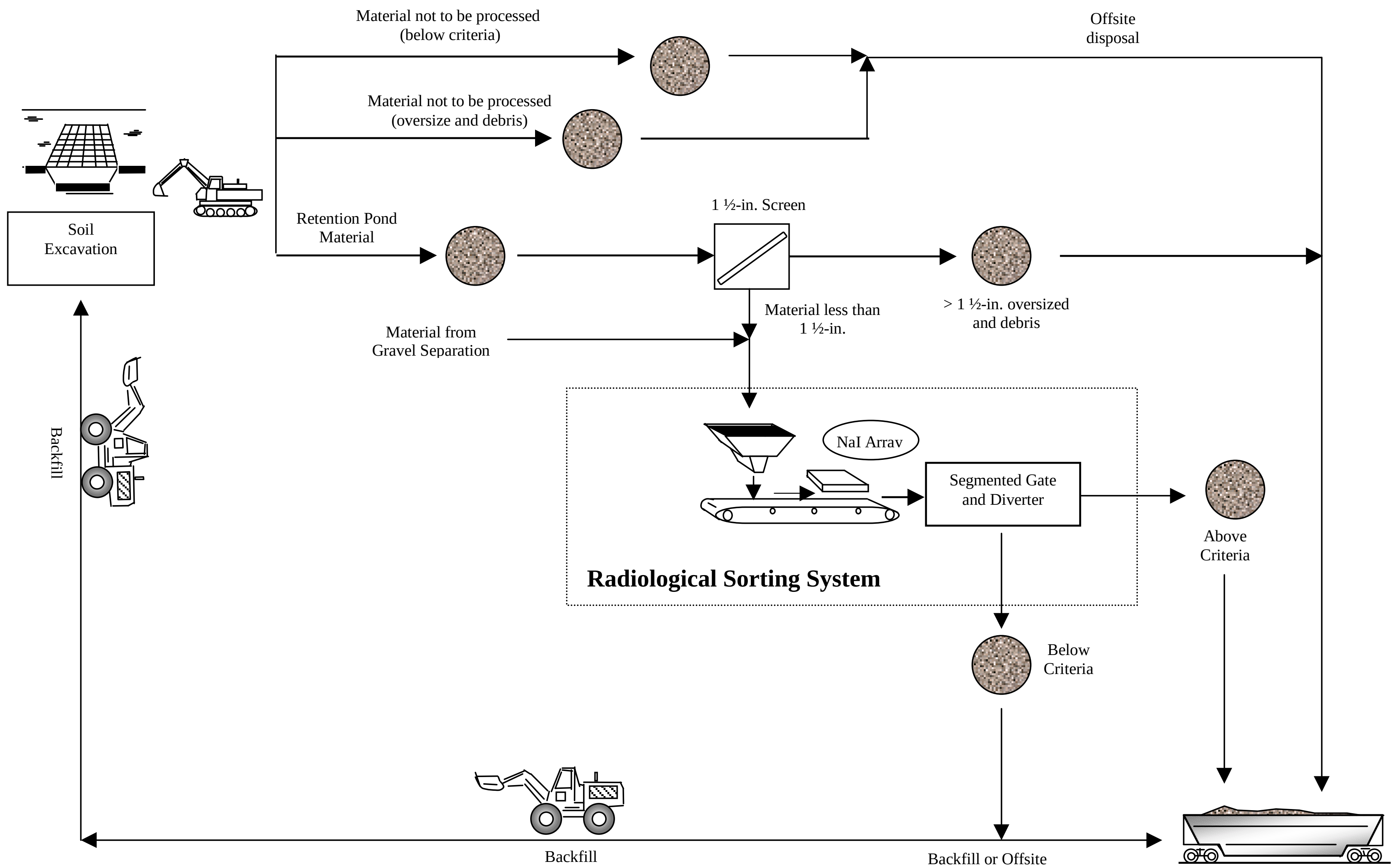

Figure 5-3: Simplified Flow Diagram of Radiological Sorting

The containers would be manifested according to applicable requirements for shipment of radioactive waste materials. As required, an emergency response program would be developed for accidents. The emergency response program will ensure that the appropriate government officials are contacted immediately to coordinate necessary response actions in the event of a spill of FUSRAP material. Upon arriving at the disposal facility, the containers or bulk soils would be removed from the truck or rail car for disposal. The transportation of FUSRAP materials will be in accordance with U.S. Department of Transportation (DOT) regulations.

Material that does not exceed 2,000 pCi/g of total radioactivity, including the contribution of all daughter products, or contain a reportable quantity of a radionuclide in a single container (e.g., rail gondola car), is exempt from the DOT regulations pertaining to the shipment of radioactive materials. Therefore, DOT radioactive material regulations may not apply to soils shipped from the FUSRAP Maywood Superfund Site.

Work plans and procedures will be established for inspecting and surveying the containers and transport vehicles in compliance with applicable laws and regulations. Decontamination would be performed as appropriate.

There are short-term risks associated with the transportation of waste during remedial activities. Accidental injury and death can occur during the transport of excavated materials. The transportation risks increase with the distance and amount of materials (increasing the number of loads) transported. In general, risks are greater for vehicular transportation than rail transportation. Other potential short-term transportation-related risks to offsite populations would be the potential exposure to transported wastes during a catastrophic event (e.g., vehicular accidents, rail accidents, and spills). These short-term risks should be qualitatively considered during remedial alternative selection as part of the evaluation of short-term effectiveness of the alternative.

5.2.4 Demolition

Demolition of buildings and structures can be accomplished by selectively or completely wrecking, sawing, drilling, crushing, and dismantling the structure or equipment. The appropriate demolition method to be used would be evaluated during the remedial design stage. For this evaluation, any of the many potential demolition methods could be used.

Shredders, impact crushers, and hammer mills can reduce the volume of debris after the demolition of buildings and structures. This equipment will be considered as part of any demolition activities.

5.2.5 Institutional Controls

The following paragraphs describe some of the tools being considered that may be implemented by USACE as necessary to control future land use and future exposures wherever contaminated soil above an average of 5 pCi/g combined radium-226 and thorium-232 above background remain in place at the FUSRAP Maywood Superfund Site.

Easements

Easements are a legal instrument whereby the use of properties at the site not owned by the Federal government, which are not remediated to the unrestricted use criterion, would be restricted. Obtaining easements would include, but not necessarily be limited to, negotiations between the Federal government and the owners of such property.

Covenants

Covenants are a legal instrument whereby the use of property owned by the Federal government at the site, which are not remediated to the unrestricted use criterion, would be restricted.

Notifications

Other types of institutional controls for property at the site not remediated to the unrestricted criterion might be warranted to supplement or replace the legal controls mentioned above. These might include coordination with utilities (including the potential provision of radiation safety support) so that their employees would be aware of potential contamination when excavating into or working in contaminated soil. Appropriate measures could then be taken to protect such workers. Similar methods would be used to keep landowners, occupants, and local governments aware of remaining FUSRAP wastes at the FUSRAP Maywood Superfund Site.

5.2.6 Monitoring

Monitoring activities of several types might be warranted, including periodically visiting the site to confirm that land uses have not changed to the extent that unprotective levels of exposure might occur (for property not remediated to the unrestricted use criterion). Monitoring for radon gas might also be considered, as would periodic surveys for excess gamma radiation.

5.2.7 Offsite Disposal

Offsite disposal of wastes from the FUSRAP Maywood Superfund Site is the only disposal option carried through the screening process. Contaminated wastes will be disposed in an appropriately licensed or permitted disposal facility. Both radioactive waste disposal facilities and RCRA Subtitle C facilities will be considered for the contaminated wastes; RCRA Subtitle D facilities will be considered for other wastes. Reference the September 2001 NRC Letter, USACE will dispose of radiologically contaminated soil offsite as 11(e)(2) byproduct materials. The USACE will evaluate specific facilities based on the characteristics of the waste materials during remedial design after the ROD is signed. Consistent with the requirements of Section 300.440 of the NCP (regarding off-site response actions) the USACE may use the most cost-effective disposal facility available at the time of remedial action. There are no significant delays expected with the use of disposal facilities.

5.3 DETAILED ANALYSIS OF SITE-WIDE ALTERNATIVES

In this section, alternatives capable of addressing the Soils/Buildings OU properties at the FUSRAP Maywood Superfund Site are evaluated in detail within the framework of the CERCLA evaluation criteria outlined in the NCP (Table 5-1). Four alternatives were developed and evaluated. Each alternative is evaluated in detail in the following sections; a reference to previous general actions is included when appropriate. An individual evaluation of alternatives is presented in Table 5-2 for Alternatives 1 through 4. Details on the cost evaluation are provided in Appendix B.

Table 5-1. CERCLA Evaluation Criteria

THRESHOLD CRITERIA
Overall Protection of Human Health and the Environment Compliance with ARARs
PRIMARY BALANCING CRITERIA
Long-term Effectiveness and Permanence Short-term Effectiveness Reduction of Toxicity, Mobility, and Volume through Treatment Implementability Cost
MODIFYING CRITERIA
State Acceptance Community Acceptance

5.3.1 Alternative 1 – No Action

This alternative was developed and evaluated to provide a baseline for comparison of the other alternatives evaluated. Under this alternative, there would be no further action taken at the FUSRAP Maywood Superfund Site, and existing access restrictions, maintenance, and monitoring activities would be discontinued. 5-year reviews in accordance with the NCP (40 CFR 300.430(f)(4)(ii) would be performed.

5.3.1.1 Overall Protection of Human Health and the Environment

This alternative would not protect human health and the environment. Potential exposure pathways of direct contact with and ingestion and inhalation of contaminated soils would exist and would likely increase over time. Exposure to COCs and the size of the affected area could increase over time as a result of disturbances by humans and natural processes and the subsequent movement of COCs by erosion and surface water transport. Potential current radiological risk, estimated by the BRA (DOE 1993a) using RME values, ranges from 2×10^{-4} to 4×10^{-3} excess cancer risk for employees (note that no employees are currently working in the areas identified as a current risk by the BRA). Because the RME values are conservative, risk from mean exposure was also calculated for comparison. The mean excess cancer risk is estimated to be about 10 times less than the RME radiological cancer risks.

Table 5-2. Individual Evaluation of Site-wide Alternatives 1–4

Criteria	Alternative 1 No Action	Alternative 2 Monitoring and Institutional Controls	Alternative 3 Excavation and Disposal	Alternative 4 Excavation, Treatment, and Disposal
OVERALL PROTECTIVENESS				
Human Health Protection	Not protective of human health because risk from exposure exists. COC migration likely to occur.	Protective of human health due to use of institutional controls where soils above cleanup criteria remain in place.	Protective of human health due to removal of accessible soils and use of institutional controls as necessary to control exposure where soils above unrestricted use cleanup criteria remain in place.	See Alternative 3.
Environmental Protection	May not be protective of the environment due to contamination in wetlands and other habitats remaining in place.	May not be protective of the environment due to contamination in wetlands and other habitats remaining in place.	Protective of the environment due to removal of accessible soils and sediments presenting unacceptable ecological risks.	See Alternative 3.
COMPLIANCE WITH ARARs				
ARARs	No-action alternative does not comply with ARARs.	This alternative would comply with ARARs for buildings and soil and with the State substantive requirement for a dose of 15 mrem/yr above background. However, Alternative 2 would not allow for the unrestricted release of properties.	Complies.	See Alternative 3.
LONG-TERM EFFECTIVENESS AND PERMANENCE				
Magnitude of Residual Risk	Residual risk exceeds EPA risk range due to waste remaining in current configurations, thereby allowing for potential future exposure.	Residual risk would be within NCP protective range for current land uses. To be protective institutional controls would have to prevent land uses involving or allowing more human exposure than occurs currently on some properties, and would have to reduce exposures below what they are currently on other properties.	Residual risk would be within the NCP protective risk range. Residual risk due to excavation of soils on the commercial/ government properties, MISS, and Stepan to restricted use criteria is considered acceptable with the implementation of institutional controls (e.g., covenants and easements) as necessary and the use of 5-year reviews. Residual risk for excavation of soils on the commercial/ government properties to an average of 5 pCi/g combined radium-226 and thorium-232 above background allows unrestricted residential use.	See Alternative 3.
Adequacy and Reliability of Controls	No controls	Institutional controls considered adequate.	Institutional controls considered adequate.	See Alternative 3.

Table 5-2. Individual Evaluation of Site-wide Alternatives 1–4 (continued)

Criteria	Alternative 1 No Action	Alternative 2 Monitoring and Institutional Controls	Alternative 3 Excavation and Disposal	Alternative 4 Excavation, Treatment, and Disposal
Need for 5-year Review	Required.	Required since soils would remain in place.	Elected for properties where soils > 5 pCi/g combined radium-226 and thorium-232 average concentration above background remain in place.	See Alternative 3.
SHORT-TERM EFFECTIVENESS				
Community Protection	Risk to community not increased, but potential COC migration and increased exposure possible over time.	Risk to community not increased, but potential COC migration and increased exposure possible over time.	Slight potential for an increase in risk from construction activities. However, FUSRAP Maywood Superfund Site risks would be controlled by mitigative measures.	See Alternative 3. Slight potential increase in risk due to additional materials handling during treatment. However, mitigative measures would be taken to ensure risks are acceptable.
Worker Protection	No significant risks or hazards to workers.	Radiological risks and nonradiological hazards reduced by institutional controls.	Radiological risks and nonradiological hazards reduced by mitigative measures.	See Alternative 3. Potential for added risk to workers due to materials handling during treatment. Site safety measures would be implemented.
Environmental Impacts	Continued potential for impacts from existing conditions.	Continued potential for impacts from existing conditions.	Potential short-term environmental impacts minimized by mitigative measures.	See Alternative 3.
Geology and Soils	No additional impacts but wastes remain in place.	No additional impacts but wastes remain in place.	Potential localized changes to soil profile due to backfilling with clean soil.	Potential localized changes to soil profile due to backfilling with treated soil and clean soil.
Water Resources	No additional impacts.	No additional impacts.	Potential impacts minimized by erosion and runoff control measures.	See Alternative 3. Wastewater from treatment would meet discharge requirements or be disposed of offsite.
Air Quality	No additional impacts.	No additional impacts.	Modeling indicates no impacts to local air quality.	See Alternative 3.
Time Until Action is Completed (years)[1]	Not applicable.	2 years	5 years	5 years
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT				
Treatment Process Used	None.	None.	None.	Volume reduction (gravel separation/radiological sorting)
Amount Destroyed or Treated	Not applicable.	Not applicable.	Not applicable.	All excavated materials, except for pond material, would be considered for treatment.
Reduction of Toxicity, Mobility, or Volume	Not applicable.	Not applicable.	Not applicable.	Approximately 60% volume reduction for treated material (based upon very preliminary data which continues to be evaluated).

Table 5-2. Individual Evaluation of Site-wide Alternatives 1–4 (continued)

Criteria	Alternative 1 No Action	Alternative 2 Monitoring and Institutional Controls	Alternative 3 Excavation and Disposal	Alternative 4 Excavation, Treatment, and Disposal
Type and Quantity of Residuals Remaining After Treatment	Not applicable.	Not applicable.	Not applicable.	Contaminated soils from treatment would be disposed offsite. The cleaned stream from treatment (defined as less than 15 pCi/g combined radium-226 and thorium-232 above background) would be used as subsurface treated backfill on MISS.
IMPLEMENTABILITY				
Ability to Construct and Operate	Not applicable.	Relatively easy to implement.	Excavation of accessible soil fairly easy to implement. Building decontamination uses standard procedures.	See Alternative 3. Treatment unit available commercially. Treatment performance may impact feasibility.
Ease of Doing More Action if Needed	Not applicable.	Relatively easy to implement.	Relatively ease to implement.	Dependent upon treatment unit performance and availability.
Ability to Monitor Effectiveness	Not applicable.	Relatively easy to monitor effectiveness.	Relatively easy to monitor effectiveness.	See Alternative 3.
Ability to Obtain Approvals and Coordinate with Other Agencies	No approval necessary.	Coordination of deed restrictions moderately difficult to implement.	Coordination of easements moderately difficult to implement. Disposal facilities available.	See Alternative 3.
Availability of Services and Capacities	None required.	None required.	Excavation services and disposal facilities available.	See Alternative 3. Treatment units commercially available.
Availability of Equipment, Specialists, and Materials	None required.	Equipment available.	Equipment available.	See Alternative 3.
Availability of Technologies	None required.	Appropriate technologies available.	Appropriate technologies available.	See Alternative 3.
COST				
FY 01[2]	$ 439,000	$ 20,000,000	$ 254,000,000	$ 244,000,000

[1] Defines time to implement remedial action (after completion of remedial design). Actual time to implement may vary due to funding constraints. Funding may fluctuate because USACE funding is appropriated annually by Congress.
[2] FY 01 denotes total cost in fiscal year 2001 dollars with no escalation or discount.

5.3.1.2 Compliance with ARARs

ARARs are requirements that must be met (or waived) if remedial action is to be taken. The no-action alternative fails to satisfy the ARARs.

5.3.1.3 Long-term Effectiveness and Permanence

Alternative 1, no action, includes no control for exposure to COCs and no long-term management measures. All current and potential future risks remain. The human health risk associated with the no-action alternative results from COCs remaining in place at the FUSRAP Maywood Superfund Site. Annual monitoring and a five-year review would be necessary to assess risk to human health and the environment.

5.3.1.4 Short-term Effectiveness and Environmental Impacts

Community Protection. Baseline risk at the FUSRAP Maywood Superfund Site is presented in the BRA (DOE 1993a) and summarized in Section 2.6 of this FS. There are no transportation risks under this alternative.

Worker Protection. Baseline risk to workers at the FUSRAP Maywood Superfund Site is presented in the BRA (DOE 1993a) and summarized in Section 2.6 of this FS.

Environmental Impacts. Since no action would be taken, Alternative 1 would not directly cause adverse impacts on soils and geology, air quality, water resources, or biotic resources. However, no action allows waste soils to remain. Continued exposure to COCs remaining in place may adversely affect urban biota on the FUSRAP Maywood Superfund Site and any fauna feeding upon them. Baseline risk to ecological receptors is presented in Section 6 of the BRA (DOE 1993a) and summarized in Section 2.6.2 of this FS.

Institutional Issues

Transportation Impacts. Under the no-action alternative, traffic levels and patterns in the area of the FUSRAP Maywood Superfund Site would not change from present conditions. Thus, no impacts on local transportation infrastructure would occur.

Ambient Noise Impacts. Under the no-action alternative, ambient noise levels would not change from existing conditions. Thus, no noise impacts would occur.

5.3.1.5 Reduction in Mobility, Toxicity, or Volume through Treatment

There is no treatment to reduce mobility, toxicity, or volume of waste source materials.

5.3.1.6 Implementability

Implementability is not a concern since no action would be taken under Alternative 1.

5.3.1.7 Cost

There would be no capital cost for the FUSRAP Maywood Superfund Site under Alternative 1. Statutory-required 5-year reviews would be required. The total cost to complete 30 years of this action in FY 01 dollars is approximately $439,000 with no escalation or discount.

5.3.2 Alternative 2 – Monitoring and Institutional Controls

Alternative 2 would involve maintaining the current status of some of the properties, including periodic monitoring to detect any changes in the nature or extent of contamination at the FUSRAP Maywood Superfund Site. At other properties, where current uses and exposures may present a radiological dose greater than 15 mrem/yr above background, institutional controls would have to reduce the uses of those properties below what they are currently. Institutional controls would include continuing the existing access restrictions at MISS and Stepan; maintaining existing cover materials including grass, building foundations, and asphalt; limiting worker exposure; periodic inspection of all the properties to identify any potentially unsuitable land uses; and institutional controls (e.g., covenants, easements, zoning controls, etc.) and other tools to prohibit unsuitable land uses or construction in contaminated soils.

5.3.2.1 Overall Protection of Human Health and the Environment

Alternative 2, monitoring and institutional controls provide some incremental protection over the no action alternative. Institutional controls would restrict site access, and monitoring would provide information concerning potential contaminant migration. As evaluated by the BRA, potential future risk (assuming the loss of institutional controls) is the same as reported for the no-action alternative. 5-year reviews are considered adequate to ensure that any unplanned facility modifications at these properties are not resulting in unacceptable human exposures. Alternative 2 may not be protective of the environment because the BRA estimated the presence of unacceptable ecological risk if contamination remained in place. Institutional controls would not be effective in controlling exposure to flora and fauna, and additional evaluation of potential ecological risk would be needed if this alternative were to be selected..

5.3.2.2 Compliance with ARARs

Alternative 2 would attain ARARs for buildings, the NRC-licensed pits, and the State's substantive requirement for a dose of 15 mrem/yr above background. However, as the name of Alternative 2 implies, properties at the Site could not be released for unrestricted use under this Alternative. To ensure protectiveness, Alternative 2 would require deed restrictions (covenants or easements) to prohibit changes in land use on some properties or construction in contaminated soils, and allow property transfers to occur in compliance with State laws. On other properties, which may present a radiological dose greater than 15 mrem/yr above background, institutional controls would have to reduce the use of properties to achieve overall protectiveness.

5.3.2.3 Short-term Effectiveness and Environmental Impacts

Time Until Action is Completed

Estimated time to complete this action is two years. Actual time to complete Alternative 2 is dependent on funding, which is appropriated annually from Congress. Following completion of implementation of institutional controls (e.g., easements and covenants) as necessary for the FUSRAP Maywood Superfund Site properties, monitoring and 5-year reviews would be continued.

5.3.2.4 Implementability

As Alternative 2 continues an existing monitoring and control program, problems with implementation are expected to be limited to the acquisition of appropriate institutional controls.

5.3.2.5 Cost

There are low capital costs associated with Alternative 2, monitoring and institutional controls. O&M costs (for monitoring and institutional controls) are estimated for the 30-year costing period. Additionally, a 5-year periodic review is required throughout the costing period. Total cost in FY01 dollars is $20 million for the 30-year period; however, costs would continue to be incurred beyond this period, as monitoring and maintenance of institutional controls would continue indefinitely.

5.3.3 Alternative 3 – Excavation and Offsite Disposal

Alternative 3 would involve removing contaminated accessible and inaccessible source material above the appropriate cleanup criteria (including the NRC-licensed burial pits 1, 2 and 3). Accessible source materials are defined as soils that are not located under or near permanent structures, such as buildings and active roadways. Burial pit 3 under the Stepan Warehouse is considered accessible in evaluating this alternative (the building will be demolished to access the burial pit). Materials under sidewalks, parking lots, and other non-permanent structures are also considered accessible, unless their removal would compromise the integrity of a permanent structure, such as a building foundation, roadway, or utility corridor. These inaccessible contaminated materials would be removed when the property owner makes these materials accessible (e.g., through demolition of a structure, abandonment of roadway, etc.). Materials above the restricted use cleanup criteria would be excavated for offsite disposal. Per the September 2001 NRC Letter, USACE will dispose of radiologically contaminated soil offsite as 11(e)(2) byproduct materials. The unrestricted criteria would only be used on inaccessible soils (when made accessible) if the remainder of the property was remediated to the unrestricted criteria. Clean soil will be used for backfill to grade.

Physical separation of a portion of the excavated material would be done at MISS to sort boulders and rocks, materials potentially requiring disposal as mixed wastes (e.g., leather scraps), and other bulk waste such as building rubble from soils requiring disposal as radioactive waste. The boulders, rocks, and other construction debris would be used onsite as backfill or shipped offsite to an appropriate disposal facility.

Contaminated structures on Stepan would be surveyed and partially demolished and/or decontaminated as necessary to achieve cleanup. No contaminated structures are located on other Maywood properties, but non-operating structures on the MISS will be demolished to access contaminated soils beneath them. Waste resulting from decontamination or demolition of buildings would be shipped offsite for disposal at an appropriate disposal facility.

The USACE would use institutional controls (e.g., easements, covenants, zoning controls, etc.) as necessary on seven properties (including properties with inaccessible soils) where the restricted use criterion is applied and where combined levels of radium-226 and thorium-232 remain above 5 pCi/g average concentration above background. Unrestricted cleanup levels (5 pCi/g of radium-226 and thorium-232 combined, average above background) will be used on 17 properties where USACE's analysis has determined that future residential encroachment onto these properties is possible.

The EPA would review the FUSRAP Maywood Superfund Site areas where radioactive material is left above an average of 5 pCi/g of radium-226 and thorium-232 combined above background concentrations at least every five years, in accordance with 40 CFR 300.430(f)(4)(ii).

The offsite disposal option that was evaluated for Alternative 3, excavation and disposal, is an existing disposal facility. Per the September 2001 NRC Letter, USACE will dispose of radiologically contaminated soil offsite as 11(e)(2) byproduct materials.

Selection of Unrestricted or Restricted Use Cleanup Criteria

The recommendation by the USACE of the restricted or unrestricted cleanup criteria for an individual property is based on a number of factors, both quantitative and qualitative. These factors include:

- Current land use
- Reasonable foreseeable future land use
- Comprehensive community master plans
- Population growth patterns and projections (e.g., Bureau of Census projections)
- Institutional controls currently in place
- Site location in relation to urban, residential, commercial, industrial, agricultural and recreational areas
- Federal/State/local land use designation
- Historical development patterns

The additional costs and impacts to the community of a more extensive cleanup are not warranted for those properties which are unlikely to be converted to residential use in the future, such as the well-defined commercial/light industry areas in Maywood (MISS, Stepan, 149-151 Maywood Avenue, and the roadway and rail properties).

The area currently occupied by MISS, Stepan, and 149-151 Maywood Avenue has been under industrial use for over one hundred years; the limitations on available industrial property in the area are likely to result in continued industrial use of these properties. The railroad and roadway properties do not offer sufficient acreage to allow residential development.

The selection of which cleanup level would be used on an individual property was based upon the factors mentioned above. For property owners who intend to retain future commercial use of their properties, implementation of the restricted use criteria is likely to provide benefits by reducing impacts such as loss of business during remediation.

Table 5-3 provides a listing of the properties intended by USACE for application of the restricted use and unrestricted use criteria with the respective associated volumes of accessible contaminated soils. The estimated volume of inaccessible soils on each of the properties can be found in Table 1-1. The cost of remediating inaccessible soils has been estimated in this FS. These soils will not be remediated until such time that they become accessible through actions of the property owners (e.g., through demolition, renovation activities, etc.). The decision to recommend 17 of the Soils/Buildings OU properties for cleanup to the unrestricted use criterion is based on the proximity of residential properties and parks, and a less defined commercial/industrial zoning footprint in the Borough of Lodi. Seven of the Soils/Buildings OU properties are currently recommended by the USACE for application of the restricted use criteria. It is the intent of the USACE that the restricted use criteria be applied for these 7 properties and institutional controls (e.g., easements, zoning controls, etc.) be emplaced as necessary to restrict future residential development.

5.3.3.1 Overall Protection of Human Health and the Environment

Alternative 3, excavation and offsite disposal, is considered protective of human health and the environment for the FUSRAP Maywood Superfund Site. While residual concentrations of contaminants would remain at some properties above levels for unrestricted use, institutional controls would be put in place to restrict residential development. Additionally, the affected municipalities would be requested to inform the USACE and EPA of any land use or zoning changes that would affect these properties (including any permit, building, construction, excavation, or demolition activity that might affect these properties).

5.3.3.2 Compliance with ARARs

Federal and State environmental laws were evaluated with regard to their applicability or relevance and appropriateness to the COCs and circumstances at the FUSRAP Maywood Superfund Site under Alternative 3. A list of ARARs is presented in Appendix A, and those requirements considered applicable or relevant and appropriate to this remedial action alternative are summarized below.

Table 5-3. Inaccessible and Accessible Soil Volumes for Site-wide Alternatives

Property	In Situ Inaccessible Soil Volume (yd^3)[(c)]	In Situ Accessible Soil Volume (yd^3)[(a)]
Restricted Use Criteria		
Maywood Interim Storage Site (100 West Hunter Avenue)	0	73,233
Stepan (100 West Hunter Avenue) [(b)]	974	44,125
149-151 Maywood Avenue	20,485	74,741
I-80 (west right-of-way and underneath roadway)	3,000	107
NJ State Rt. 17 (all inaccessible)	20,000	0
Lodi Industrial RR	185	1,317
New York, Susquehanna &Western RR	3,100	2,900
Total Restricted Use Criteria	47,744	196,423
Unrestricted Use Criteria		
167 State Rt. 17	400	8,001
170 Gregg Street	0	14
160 &174 Essex Street	254	1,845
99 Essex Street	0	423
113 Essex Street	0	514
200 State Rt. 17	0	375
72 Sidney Street (a.k.a. 88 Money Street)	0	58
85, 87, 99–101 State Rt. 17	0	2,066
137 State Rt. 17	0	965
205 Maywood Avenue, 50 and 61 West Hunter Avenue	0	59
239 State Rt. 17	156	3,393
111 Essex St.	0	3,617
23 Howcroft Road	338	4,552
8 Mill St.	0	2,357
80 Industrial Rd.	916	690
80 Hancock Street	3,440	868
100 Hancock Street	866	954
Total Unrestricted Use Criteria	**6,370**	**30,751**
Total Unrestricted and Restricted Phase II	**54,114**	**227,174**

[a] Total in situ volume (i.e., volume of soil in the ground without accounting for volume growth due to swell and overexcavation) of contaminated media for the FUSRAP Maywood Superfund Site includes waste volume from the properties that are addressed by this FS. Volumes associated with other past or ongoing cleanup actions are not included in this total.

[b] Stepan volume includes contaminated material in Burial Pits 1, 2, and 3. Source: BNI 1997. Volume Register, Revision 11; S&W 2001

[c] Phase I inaccessible soils volume is estimated at an additional 12,500 yd^3 which will be addressed with the inaccessible soils at the commercial/government properties.

Alternative 3, excavation and disposal would achieve action- and chemical-specific ARARs. This alternative would comply with permissible levels of residual activity established in site-specific cleanup criteria for radium-226, thorium-232, uranium-238, and total uranium by excavation of soils exceeding acceptable site-specific guidelines established by EPA and DOE for commercial (restricted) or residential (unrestricted) use. Long-term effectiveness would be assured through the use of institutional controls (e.g., easements, covenants, zoning controls, etc.) as necessary on the properties cleaned to the restricted use criteria. This alternative would comply with ARARs by incorporating the pertinent requirements of the New Jersey Pollutant Discharge Elimination System (NJPDES), New Jersey Freshwater Wetlands Mitigation Requirements, NJAC 7:28-12, and NRC's 10 CFR 20.1402 (burial pits) in the remedial design. NJAC 7:28-12(a) *Remediation Standards for Radioactive Materials* would be used to establish a remedial objective for Rn-222. No Rn-222 levels above 3.0 pCi/L, above background, have been measured and buildings with inaccessible soils remaining beneath them would be monitored to show compliance with that standard. If the 3 pCi/L, above background, level were surpassed in the future, mitigation (e.g., sealing foundation cracks, supplementing existing ventilation systems, etc.) would be performed until radon levels returned to acceptable levels.

5.3.3.3 Long-term Effectiveness and Permanence

Alternative 3, excavation and disposal, is highly effective in the long term because soil above the restricted or unrestricted use criteria is excavated and transported offsite for disposal, thereby mitigating residual risk to human health and the environment. Based on the site-specific risk evaluation conducted by DOE and EPA (see Appendix C), the residual risk of this alternative meets the CERCLA risk range.

Institutional controls would be necessary to assure long-term protection for the remediated areas where soils remain above criteria for unrestricted use. Zoning would need to preclude residential development of current commercial/government properties where soils containing radionuclides greater than an average of 5 pCi/g combined radium-226 and thorium-232 above background remain in place. Local municipalities would be requested to inform USACE and EPA of any land use or zoning changes (including building, construction, excavation, or demolition activities) that might affect the unremediated portions (inaccessible soils) of the FUSRAP Maywood Superfund Site and those properties cleaned to the restricted use criteria. Five-year reviews by the Federal government would be necessary to confirm continued restricted use for those properties cleaned to the restricted use criteria.

5.3.3.4 Short-term Effectiveness and Environmental Impacts

Community Protection. Remedial actions under Alternative 3 will temporarily increase generation of fugitive dust and internal combustion engine emissions at the FUSRAP Maywood Superfund Site. Appropriate measures and land use controls will be used to mitigate the slight potential for an increase in risk to the community. Excavated soils will be transported by dump trucks to MISS. The soil will then be transferred to railcars and transported to the disposal facility. Risks will be mitigated during transport by inspecting the vehicles before and after use, decontaminating when needed, covering the transported waste, observing safety protocols, following pre-designated routes, and limiting the distance the waste is transported in vehicles. Transportation risks increase with distance and volume. The transport of FUSRAP wastes to an offsite disposal facility would comply with DOT regulations. An emergency response program would be developed to respond to any accidents.

Worker Protection. Potential occupational doses to workers involved in implementation of Alternative 3 would be due to direct exposure to gamma radiation from contaminated soil and from inhalation and ingestion of airborne particulates. Risk to workers would be reduced through implementation of a comprehensive health and safety program including the proper use of safety protocols, personal protective clothing and equipment, restrictions on access to contaminated areas, and rotation of worker assignments. In addition, all machinery and equipment would be inspected after use, surveyed for radioactivity and decontaminated, if necessary. No occupational or safety barriers that would prevent the implementation of this remedy are foreseen. In addition, all workers would be provided adequate protection by implementing the State and Federal health and safety requirements.

Environmental Impacts

Geology and Soils. Most of the soils at the FUSRAP Maywood Superfund Site have been modified by previous human activities, such as grading and addition of fill for construction of homes and businesses, construction of roadbeds and parking lots, and waste storage and disposal (on the former MCW property). The soil is classified as urban fill. Although the soil profile would be altered by the addition of clean fill soil, the impacts at the site are not considered significant since a natural profile no longer exists. On the FUSRAP Maywood Superfund Site, erosion of contaminated soil could occur during excavation. Backfilled areas would be susceptible to soil erosion until a new vegetative cover becomes established. Proper erosion control measures would limit the amount of material eroded during excavation. The soil cover would be of sufficient quality to allow prompt growth of a vegetative cover. Topography of the site would not be impacted by this alternative. Some contaminated soils would remain in place at the FUSRAP Maywood Superfund Site until they become accessible.

Water Quality. Impacts on water resources due to potential soil erosion and transport into receiving waterways could occur at the FUSRAP Maywood Superfund Site during the implementation of Alternative 3. However, properly implemented erosion and runoff control measures would minimize impacts. A slight increase in turbidity in Westerly Brook and Lodi Brook is probably unavoidable. Also, depending on the characteristics of the clean backfill soil and the amount of compaction during backfilling, the flow of water through soil pores could be impacted. Flow through soil could be increased or decreased relative to its current flow rate. The layer of soil covering the site would be graded so that surface runoff would be similar to that under existing conditions. Excavation of accessible contaminated soils would significantly reduce the potential for leaching of COCs into groundwater. This potential would not be eliminated, however, since inaccessible soils would remain in place.

Air Quality. Alternative 3 would result in releases of gaseous and particulate material to the atmosphere. These materials would be generated by the disturbance of soils from earth-moving activities and vehicular movement [fugitive (non-point source) emissions] and by internal combustion engines (controlled emissions). However, modeling shows that air quality should not be impacted by these activities at the FUSRAP Maywood Superfund Site and is discussed in Appendix C.

Fugitive dust would constitute the highest potential for atmospheric-emissions load. Under this alternative, fugitive dust could arise from disturbance and entrainment of soil material due to excavation and backfilling in contaminated areas, demolition of buildings and structures, wind-induced entrainment and erosion from exposed surfaces, and entrainment of particles due to vehicular activity on haul roads.

Wetting surface materials with water or dust control chemicals as necessary would mitigate fugitive dust impacts. Regular surface wetting can reduce the dust load from construction sites and storage piles by as much as 40 to 50 % (EPA 1977). Chemical wetting agents can increase the reduction significantly. In addition, storage piles and inactive areas can be covered to reduce wind erosion of soils.

Ecological Resources

(Note that ecological resources were not discussed for Alternatives 1 and 2 because those alternatives do not include excavation, which may be disruptive to the environment.)

Biota. Terrestrial biota would be impacted by disruption of existing habitat during implementation of remedial actions under Alternative 3, excavation and disposal. Mortality of some small mammals and soil invertebrates may result. These impacts would be temporary at the FUSRAP Maywood Superfund Site because the existing habitat would be reestablished and other biota similar to those originally present would be expected to rapidly recolonize after application of the final soil cover.

Offsite aquatic habitat in the downstream areas of Lodi Brook and Westerly Brook could be impacted by increased sediment loading of contributing surface runoff. Erosion control measures would minimize these impacts. Aquatic biota of the headwater region of Lodi Brook would be heavily impacted during excavation activities on the 149-151 Maywood Avenue property. These populations would be expected to quickly recolonize after remediation when aquatic habitats are reconstructed.

Threatened and Endangered Species. Initial consultation with USFWS and the NJDEP indicates that no protected species are known to be present on the FUSRAP Maywood Superfund Site (Day 1992; Williams 1991; provided in Appendix D). Two walk over surveys of most of the FUSRAP Maywood Superfund Site indicated that no protected species are present (ANL 1984; DOE 1993a). Almost the entire FUSRAP Maywood Superfund Site has been developed. The only natural habitat that remains on the FUSRAP Maywood Superfund Site is the wetland area on the 149-151 Maywood Avenue property. During a wetlands delineation performed by Stepan Company at the Maywood Chemical Company Site, no endangered or threatened species were identified (CH2M Hill 1992). See Appendix D for a list of threatened or endangered species in New Jersey.

Floodplains/Wetlands. A Floodplains and Wetlands Assessment has been prepared for the FUSRAP Maywood Superfund Site. Most of the FUSRAP Maywood Superfund Site is not located within the 100-year floodplain (DOE 1992a). The southern most portion of Lodi Brook is the exception.

Wetlands are present on the FUSRAP Maywood Superfund Site. Remedial actions to remove contaminated soil in the headwaters of Lodi Brook on the 149-151 Maywood Avenue property would affect approximately 4 acres of jurisdictional wetland (CH2MHill 1992). The excavation of soil in the wetland would be expected to result in the loss of the characteristics and functions of the wetland at least during the implementation phase of the remedial action. The wetland would be restored after remedial action is completed. Relevant and appropriate requirements of State freshwater wetland regulations would be followed.

Time Until Action is Completed

Estimated time to complete the accessible portions of this action is five years. Actual time to completion for Alternative 3 is dependent on the cleanup criteria used at each property and on funding, which is appropriated annually from Congress. Estimated time to complete the inaccessible portions of this remedy is unknown because the time frame is contingent on landowners making the inaccessible contaminated soils accessible.

5.3.3.5 Reduction of Mobility, Toxicity, or Volume Through Treatment

Under Alternative 3, excavation and disposal, there is no treatment to reduce mobility, toxicity, or volume of contaminated soil.

5.3.3.6 Implementability

Alternative 3 is an implementable option. Excavation, construction, decontamination, demolition, and transportation equipment are commercially available, but require trained personnel for operation. Borrow sites for clean backfill and soil cover material have not yet been identified, but are assumed to be procured as a commodity at the time of remedial action implementation. Decontamination and partial demolition actions at Stepan may be difficult to implement due to ongoing plant operations. Extensive coordination would be required.

The acceptability of Alternative 3 would also be affected by the administrative requirements for transport and disposal. The DOT regulates the transport of most radioactive and chemically hazardous material, and some States also have their own special requirements. The material being transported may not be subject to DOT requirements depending on the actual levels of radioactivity.

5.3.3.7 Cost

The total cost to complete Alternative 3 in 2001 dollars is approximately $254 million with no escalation or discount. Costs are based on excavation and disposal of accessible soil contamination; costs are also included for future excavation and disposal of inaccessible soils under operating buildings and transportation corridors. Costs have been estimated for these inaccessible soils based on the current understanding of existing volumes, and costs related to the excavation, transportation and disposal of contaminated soil. Costs to implement also assume that 7 properties are remediated to the restricted use criteria; the unrestricted use criteria would be applied to the remaining 17 properties.

5.3.4 Alternative 4 – Excavation, Treatment, and Offsite Disposal

This alternative is similar to Alternative 3 regarding contaminated buildings, excavation of soils on the various properties, cleanup criteria (radium-226, thorium-232, uranium-238, total uranium, and radon), and the remediation of the three Stepan NRC-licensed burial pits. However, this alternative also incorporates treatment to reduce the volume of contaminated materials requiring disposal as radioactive waste. Because the effectiveness, implementability and cost-effectiveness of treatment are uncertain, a site-specific treatment demonstration was completed on the use of treatment. Although the treatment demonstration is complete, data are still being reviewed. This treatment demonstration evaluated a technology (radiological sorting and gravel separation) with the potential for reducing the volume of soils requiring disposal as radioactive waste. If the review of the treatment demonstration data by USACE and EPA, in consultation with the NJDEP, demonstrates that these processes are effective, implementable, and cost-effective, the USACE will treat the excavated soils prior to disposal; otherwise, the USACE will dispose of the excavated soils without treatment. This evaluation will not delay implementation of the remedy however. While the evaluation continues, the USACE will begin excavation and offsite disposal of contaminated soils. The public will be informed of the results of the treatment demonstration prior to implementation of the treatment portion of this alternative.

The effectiveness of the systems demonstrated at the MISS are being evaluated based on the following:

- Ability of the processes to separate non-contaminated site materials from materials that have been contaminated with radiological residuals from the thorium extraction process.

- Ability of the gravel separation system to extract coarse material (+3/8 in., -6 in.) from the soil mass and demonstrate by sampling and laboratory analyses that the separated gravel meets the cleanup levels.

- Quantification of the influence of excavation and material handling on the mixing of radioactively contaminated and non-contaminated excavated material by tracking the material mass and activity from in situ to the output processed stockpiles.

- Ability of the radiological sorting system to sort the excavated material into “above criteria” and “below criteria” stockpiles and perform a 100 % assay of the sorted material. Demonstrate through rigorous sampling and laboratory analysis that “below criteria” material meets the cleanup levels.

- Demonstration, by means of monitoring and observing dust and noise levels during the demonstration that the processing units do not create a public nuisance or public health hazard.

- Time required to process material and any impacts to remediation schedule.

- Cost effectiveness of system operation compared to full disposal option.

The following constraints would apply to treated soils:

- *Contaminated Stream* – Soils greater than 15 pCi/g above background from the treatment process would be disposed at an offsite disposal facility.

- *Residual Stream* – Soils less than an average of 15 pCi/g combined radium-226 and thorium-232 above background will either be backfilled at the MISS or disposed offsite at an appropriate landfill. If the treated soil is backfilled at the MISS, all backfilled areas would then be covered by at least one foot of clean backfill material to meet the criteria of 15 mrem/yr above background.

The treatment demonstration was performed at the MISS during the summer of 2000. Although the data from this study are now available, their review continues. The technology selected for the treatment demonstration consists of a multi-stage process that includes gravel separation of material greater than 3/8-in. nominal diameter and radiological sorting of the soil finer than 3/8-in. nominal diameter.

The gravel separation system is a two-stage system. A soil pre-screening system removes boulders and debris greater than 6-in. This material will be used as backfill, or shipped off-site to an appropriate disposal facility. The second stage removes material that is greater than 3/8-in. in diameter. Material that falls within the range of 3/8- to 6-in. nominal diameter is sent through a water rinse system to remove fine particles that may have adhered to the gravel.

The radiological sorting system may be operated in two different configurations during the demonstration. The system may be operated on the back end of the gravel separation system when processing granular material, or it may be fed material directly. If used in the direct feed mode, the material must go through a screen to remove all material greater than 1-1/2-in. nominal diameter. Essentially, this system uses an in-line sodium iodide (NaI) array to detect radiologically contaminated soil and separates the soil into either a below or above criteria stockpile. The system set points can be varied based on project reuse levels or disposal site acceptance criteria.

Any materials that could not be treated or decontaminated would be shipped directly offsite for disposal. This demonstration is intended to evaluate technology with the potential for reducing the volume of soils requiring disposal as radioactive waste. If the demonstration proves a technology is effective, implementable, and cost-effective, the USACE would implement a full-scale treatment system. Treatment effectiveness will be evaluated in terms of volume reduction potential; implementability will be evaluated by such factors as the ability to address regulator questions (regarding issues such as noise, dust, schedule impact, stockpiling of soils, and waste management) and availability of equipment and trained labor. Cost will be evaluated relative to excavation and disposal without treatment.

At the property subject to backfilling with treated soils (MISS), subsurface soil concentrations would be expected to range anywhere from naturally-occurring background levels to an average of 15 pCi/g of radium-226 and thorium-232 combined above background concentrations. Potential soil reuse will be addressed in property remedial design documentation in full coordination with NJDEP and EPA. The implementation of this alternative would comply with New Jersey regulations for soil reuse, including permeability requirements.

Under Alternative 4, excavation, treatment, and disposal, cleanup criteria for the various properties and subsequent long-term management of soils remaining above an average of 5 pCi/g of radium-226 and thorium-232 combined above background would be the same as Alternative 3.

The disposal option evaluated with Alternative 4 was a disposal facility permitted or licensed to receive the specific materials being shipped, although the details of the offsite disposal will be evaluated and finalized during the implementation phase of this alternative. The contaminated soils would be shipped from MISS to the disposal facility permitted. If treatment proves to be effective, and is implemented, the remaining soil containing lower amounts of radiological materials below criteria (i.e., 15 pCi/g combined radium-226 and thorium-232) would be either backfilled at the MISS or disposed offsite at a suitable landfill. The decision to utilize the treated material onsite vs. offsite disposal will be made by the USACE and EPA, in consultation with the NJDEP, and will take into consideration the residual condition of the MISS property under each scenario.

This evaluation will not delay implementation of the remedy however. While the evaluation continues, the USACE will begin excavation and offsite disposal of contaminated soils. The public will be informed of the results of the treatment demonstration prior to implementation of the treatment portion of this alternative. The public would be notified of both determinations- i.e., whether to employ treatment at the MISS, and, if so, the disposition of the treated soil. Public notification would occur prior to any physical activity associated with onsite treatment and any disposal of treated soil if treatment is found to be appropriate.

Inaccessible soils currently located under buildings and roadways would be excavated and disposed offsite as they become accessible in the future (e.g., due to renovation or demolition activities). Radon would be monitored in buildings with inaccesible soils remaining beneath them to ensure compliance with the radon limit of NJAC 7:28-12.8(a)2. If radon levels exceed 3 pCi/L above background at some point in the future, mitigation (e.g., sealing foundation cracks, supplementing existing ventilation systems, etc.) would be performed to return radon levels to below 3 pCi/L above background.

5.3.4.1 Overall Protection of Human Health and the Environment

Alternative 4 is considered protective of human health and the environment. The overall risk from implementation of this alternative is slightly higher than for Alternative 3 because of the increased handling of wastes during treatment. The Protection of Human Health and the Environment discussion in Section 5.3.3.1 for Alternative 3 would also be applicable to Alternative 4.

5.3.4.2 Compliance with ARARs

Alternative 4 would comply with ARARs as described under Alternative 3 (See Section 5.3.3.2). Onsite treatment and bulk removal of solid waste are not expected to result in significant airborne emissions.

5.3.4.3 Long-term Effectiveness and Permanence

The long-term effectiveness and permanence of Alternative 4 is similar to Alternative 3 (See Section 5.3.3.3). The need for 5-year reviews and municipal notifications would be required on those properties where the clean stream from treatment is replaced as treated backfill, if the backfill concentrations exceed an average of 5 pCi/g of radium-226 and thorium-232 combined above background. The inaccessible soils that are protected by their location would not contribute to risk as long as institutional controls are in place, since there is no exposure pathway.

5.3.4.4 Short-term Effectiveness and Environmental Impacts

Community Protection and Worker Protection. Maximum short-term health risks to the public during implementation of Alternative 4 (excavation, treatment and, disposal) would be similar to Alternative 3 (excavation and disposal, see Section 5.3.3.4). Health risks to remediation workers would also be similar to Alternative 3. Risk to workers would be reduced through implementation of a comprehensive health and safety program. Transportation risks for Alternative 4 would be expected to be less than Alternative 3, since less material is transported for offsite disposal.

Risks to workers would be mitigated through the proper use of safety protocols, personal protective clothing and equipment, and restrictions on access to contaminated areas. In addition, all machinery and equipment would be inspected after use, surveyed for radioactivity and decontaminated, if necessary. Impacts would be mitigated through the proper use of safety procedures, personal protective equipment and clothing, and restrictions on access to contaminated areas.

Environmental Impacts. Adverse environmental impacts similar to those described for Alternative 3 may result from remedial activities performed under Alternative 4. Impacts would be mitigated by the use of proper drainage controls, silt fences and site restoration. Construction of a temporary onsite soil treatment facility would temporarily increase emissions of fugitive dust. Particulate emissions would be controlled using appropriate dust control methods. A lesser amount of clean fill would be required for this alternative since the cleaned soil from treatment would be used for treated backfill; therefore, less material would be disposed of at an offsite disposal facility. Impacts related to the borrow location for clean backfill would also be less.

Time Until Action is Completed. Estimated time to complete this action is five years. Actual time to completion is dependent on the cleanup criteria used at each property and on funding, which is appropriated annually from Congress.

5.3.4.5 Reduction in Mobility, Toxicity, or Volume Through Treatment

Alternative 4, excavation, treatment, and disposal, provides for a net reduction in the volume of contaminated material requiring disposal as radioactive waste. The proposed treatment technology does not reduce the mobility or toxicity of COCs. Note, there are no physical treatment methods that reduce the toxicity of radionuclides.

5.3.4.6 Implementability

This alternative is considered to be implementable if certain treatment performance criteria are met. Gravel separation and radiological sorting technologies are currently available commercially, although some refining for site-specific conditions will be required to optimize volume reduction. Implementation concerns for treatment include logistical problems for full-scale operations, regulator acceptance of onsite treatment, use of treatment residuals as treated backfill, and assurance of long-term institutional controls that may be recommended from this approach. The treatment demonstration is intended to address these concerns. The waste acceptance and capacity restrictions imposed by an offsite disposal facility would not be expected to impact implementability.

5.3.4.7 Cost

In estimating the cost of this alternative, the USACE has assumed that the unrestricted and restricted use criteria would be applied to the same subsets of properties discussed under Alternative 3. The total volume of accessible soil above these criteria on the respective properties is estimated to be 227,174 yd^3 (in-situ). Treatment will only be considered for the accessible portions of the cleanup because of the high cost of remobilizing the treatment unit as each parcel of inaccessible material becomes accessible in the future. The total volume of inaccessible soil above the cleanup criteria on the Soils/Buildings OU properties is 54,114 yd^3 (in-situ). The total volume of inaccessible soil above the cleanup criteria from Phase 1 residential properties is 12,500 yd^3 (in-situ). It was assumed that the inaccessible contaminated material, the contaminated material in the retention ponds on the MISS (approximately 75,000 yd^3), and the licensed material in the Stepan burial pits (19,100 yd^3) would not be amenable to treatment; these materials (approximately 160,000 yd^3) are assumed to be disposed directly offsite without treatment. Twenty percent of the remaining material is estimated to be oversized materials (16,645 yd^3), such as concrete, debris, rocks, and boulders, and would also be screened out prior to treatment. The estimate assumes that treatment is applied to the remainder of the excavated soils. Treatment is assumed to be effective at achieving a 60 % volume reduction; note that there is considerable uncertainty in the actual volume reduction to be achieved.

Based on these assumptions, the total cost to complete this action in FY 01 dollars is approximately $244 million. If treatment is not implemented after completion of the treatment demonstration, costs would be similar to those described for Alternative 3. Costs are based on excavation, treatment, and disposal of accessible soil contamination; costs are also included for future excavation, and disposal of inaccessible soils under operating buildings and transportation corridors. Costs have been estimated for these inaccessible soils based on the current understanding of existing volumes, and costs related to the excavation, transportation and disposal of contaminated soil.

5.4 COMMUNITY AND STATE OR SUPPORT AGENCY ACCEPTANCE

Acceptance of the proposed alternative by the community and State or support agencies must be considered under CERCLA. This is formally evaluated after public comment on the PP; however, it is appropriate to identify public preferences early in the process if those preferences are known. A community relations program for the FUSRAP Maywood Superfund Site is in place, and has acquired extensive comment from the local community.

Both the local community and the State have expressed a strong preference for prompt removal and out-of-State disposal of the waste material. After public comment on the PP, acceptance of the community and State regarding all components of the proposed action will be evaluated.

5.5 MONITORING AND MITIGATIVE MEASURES

The primary monitoring and mitigative measures that would be used at the FUSRAP Maywood Superfund Site in implementing any of the final action alternatives are summarized in Table 5-4. These measures would provide a high degree of effectiveness in minimizing the potential for adverse effects associated with implementation of the alternatives.

Following completion of all construction and excavation activities, disturbed areas onsite would be backfilled and revegetated, and disturbed areas outside the site boundary would be restored to natural conditions. Habitat restoration would be carried out in consultation with appropriate State and Federal agencies.

FUSRAP Maywood Superfund Site cleanup activities would be conducted in compliance with the FUSRAP Maywood Superfund Site safety and health plans, and USACE safety regulations. Radiation monitoring and protection in the workplace would be provided for all workers. Prior to implementing the selected remedy, detailed plans would be developed to address (1) safe work practices, land use controls, and worker protection equipment designed to reduce worker exposure and/or releases to the environment; (2) emergency response procedures; (3) monitoring techniques and frequencies; and (4) various contingencies and the anticipated responses to such contingencies.

5.6 SUMMARY OF UNAVOIDABLE IMPACTS

A number of unavoidable impacts would occur if Alternatives 2 through 4 were implemented. These impacts are summarized in Table 5-5. Many of these impacts would be temporary.

5.7 IMPACTS OF POTENTIAL LOSS OF INSTITUTIONAL CONTROLS

USACE or DOE would ensure that institutional controls at the FUSRAP Maywood Superfund Site are maintained for all alternatives and locations where residual concentrations above an average of 5 pCi/g combined radium-226 and thorium-232 above background are left in place. Institutional control measures might include easements and zoning controls. Local municipalities would also be requested to notify the USACE and EPA of any land use changes that would affect those properties where radioactive contamination is left above an average of 5 pCi/g radium-226 and thorium-232 combined above background. A minimum of one foot of clean backfill material would be placed over all remediated areas of the FUSRAP Maywood Superfund Site. Because long exposure durations are required before risks exceed acceptable limits for the soil concentrations present at the FUSRAP Maywood Superfund Site, five-year reviews are considered adequate to ensure that no unsuitable uses of properties remediated to the restricted use criteria occur.

Table 5-4. Major Monitoring and Mitigative Measures for the Action Alternatives 3 and 4

Factor	Potential Impact or Area of Concern	Mitigative Measure
Construction and excavation activities	Transport of clean soil to nearby surface water	Good construction practices would be implemented, including sediment barriers, dikes, siltation ponds, and drainage channels, to direct silt runoff to siltation ponds away from downstream or downgradient surface waters, with surface grading and revegetation upon completion of excavation.
	Transport of contaminated surface soil to nearby surface water and wetlands, runoff of contaminated surface water, and possible impacts of transport to groundwater	Runoff control will be especially important for any area draining to a wetland. Good construction practices would be implemented, as described above. In addition, groundwater, surface water, and sediment would continue to be monitored during implementation for chemicals and radioactive COCs so that transport could be controlled through appropriate management.
	Loss of aquatic and terrestrial habitats	Habitats would be restored , as appropriate. The final form of mitigation would be determined in consultation with the appropriate State and Federal agencies.
	Disturbance of local biota, area residents, and recreational visitors by noise and remedial action activities	Vehicle and equipment mufflers would be checked periodically and maintained in good condition.
	Disturbance of local biota, area residents, and recreational visitors and impacts to local air quality as a result of fugitive dust emissions	Dust would be controlled using wet methods and/or covers at the FUSRAP Maywood Superfund Site, along the haul roads, at storage and staging areas, and at offsite construction and excavation areas. Chemical dust suppressants would be used if needed. Work areas would be covered as needed, e.g., at night and during high winds.
	Radon and particulate emissions	Land use controls such as limiting the area of the working surface and using covers, water, or chemical agents would be applied, as needed, to reduce radon and particulate emissions. Air would be monitored through all phases of the action period.
Transport of contaminated material from vicinity properties at the FUSRAP Maywood Superfund Site	Accidental spill (release) of contaminated material as a result of equipment failure or vehicular accident	Waste would be transported in covered trucks traveling at low speeds. Contingency plans would be in place to address any spills that might occur during waste transport.
	Inadvertent transport of contaminated material on haul vehicle surfaces or tires leaving controlled areas	Haul vehicles would be decontaminated and inspected before leaving the FUSRAP Maywood Superfund Site or offsite excavation areas.
Transport of waste to an offsite disposal location	Accidental spill (release) of contaminated material as a result of equipment failure or vehicular accident	Waste would be covered during transport. Contingency plans would be in place to address any spills that might occur during waste transport.
	Inadvertent transport of contaminated material on haul vehicle surfaces or tires leaving controlled areas	Haul vehicles and containers would be decontaminated and inspected before leaving any contaminated area.

Table 5-4. Major Monitoring and Mitigative Measures for the Action Alternatives 3 and 4 (continued)

Factor	Potential Impact or Area of Concern	Mitigative Measure
All phases of active remedial activities	Protection of workers	All activities would be conducted in accordance with project health and safety plans and would include continuous monitoring of the work environment and the use of protective equipment, as needed.
	Protection of the general public	Air and water would be monitored at the FUSRAP Maywood Superfund Site and vicinity, and appropriate responses would be implemented if measured COC levels approached an exceedance of acceptable levels. Access to construction and excavation areas would be limited; public vehicle access would also be limited along some of the offsite haul routes. Land use controls would be applied to minimize dust, radon, noise, and erosion during remedial action activities. Decontamination methods would be employed to minimize vehicle tracking of COCs to surrounding areas. All traffic associated with the remedial action would be coordinated to minimize impacts on nearby facilities.
	Environmental monitoring	Environmental monitoring would continue to be conducted during the remedial action. Air quality (perimeter and indoor air), surface water, and groundwater would be monitored for chemical and radioactive COCs per the existing environmental monitoring program.
Completion of all construction and excavation activities	Environmental restoration	Regrading and revegetating with native and/or forage species would restore disturbed areas. Wetlands would be reconstructed and revegetated as necessary in consultation with the appropriate State and Federal agencies.

Table 5-5. Summary of Unavoidable Impacts

Affected Resource	Impact Type
Topography and soil	Much of the FUSRAP Maywood Superfund Site would be disrupted by construction and excavation activities. Many impacts would be temporary, pending completion of remedial action activities and restoration programs. A small portion of the 100-year floodplain of the Saddle River would be disturbed during remedial action activities. This area would be restored to its original contours upon completion of these activities.
Air quality	Slight temporary impacts to air quality at the FUSRAP Maywood Superfund Site could result from fugitive dust emissions associated with construction, excavation, loading, placement, grading, compacting, and transport activities. Lesser impacts would also be incurred from vehicle and equipment exhausts. Potential air impacts would be mitigated to the extent possible.
Water quality	Construction and excavation activities at the FUSRAP Maywood Superfund Site could impact local surface water as a result of increased sediment and soil erosion, subsequent runoff, and the possible transport of waste via runoff. Implementation of appropriate mitigative measures would limit the significance of these impacts. Any minor impacts to local waters from increased siltation and turbidity would be temporary and would cease following completion of remedial action activities.
Ecological resources	Construction and excavation activities at the FUSRAP Maywood Superfund Site would result in the disturbance of approximately 4 acres of wetland and 10 acres of grassland at the FUSRAP Maywood Superfund Site. The remaining area at the FUSRAP Maywood Superfund Site is developed and covered with buildings, pavement, or lawns with trees and shrubs. Excavation activities during remediation would destroy vegetation and some wildlife habitat associated with the FUSRAP Maywood Superfund Site. The impacts resulting from this habitat loss are not expected to significantly affect biotic resources in the area and would be temporary. Local biota could also be affected by impacts to air quality, noise levels, and water quality, but these impacts would be minor and temporary. Some impacts to area vegetation and wildlife would be incurred during construction, excavation, and transportation activities as a result of unavoidable impacts to air quality, noise levels, water quality, and increased vehicular activity. These impacts would be minor and temporary and would cease following completion of remedial action activities. Construction and excavation activities would result in some minor incremental increases over the current visual and aesthetic impacts of MISS. Following completion of remedial action activities, the existing vegetation will be reestablished.
Noise	Ambient noise levels would temporarily increase as a result of construction, excavation, treatment, and transportation activities. All noise impacts would be temporary and would cease following completion of remedial action activities.

5.8 COMPARATIVE ANALYSIS OF SITE-WIDE ALTERNATIVES

The purpose of the comparative analysis is to identify the advantages and disadvantages of the alternatives when compared with each other, based on the detailed analysis described in Sections 5.3 and 5.4. The comparative analysis allows for identification of items that can be evaluated by the decision-making party during the final selection of a preferred alternative. The results of this analysis are summarized in Table 5-6 for Alternatives 1 through 4.

5.8.1 Overall Protection of Human Health and the Environment

This criterion addresses whether an alternative provides adequate protection of human health and the environment, and describes how risks are eliminated, reduced, or controlled through treatment, land use controls, or institutional controls.

Except for Alternative 1, no action, all of the alternatives are protective of human health and the environment (although Alternative 2 may not be protective for ecological receptors, further assessment would be required if this alternative would be selected). Alternative 1 is not considered protective in the future because the BRA-predicted risks above the CERCLA risk range of 10^{-4} to 10^{-6} are possible if existing controls are not maintained, if the uses and exposures at some properties are not reduced by institutional controls, and if additional actions are not taken at the FUSRAP Maywood Superfund Site. The excavation and offsite disposal alternatives (Alternatives 3 and 4) rank highest in overall protection of human health and the environment, because materials above safe levels are excavated from the FUSRAP Maywood Superfund Site and shipped to offsite disposal facilities. Based on the site-specific risk evaluation conducted by DOE and EPA (see Appendix C), the residual risk after implementation of these site-specific guidelines would be within the risk range specified in the NCP (10^{-4} to 10^{-6}). For those properties where residual concentrations are below an average of 5 pCi/g combined radium-226 and thorium-232 above background, institutional controls would not be implemented to restrict future land use. Of the action alternatives, Alternative 2, monitoring and institutional controls, is the least protective because contaminated soils and buildings remain in place, and the alternative relies solely on institutional controls for protectiveness.

For the treatment alternative (Alternative 4), overall protection is similar to Alternative 3. However, short-term risks could be slightly higher due to the potential for increased handling of soils during treatment. Any potential risks would be mitigated by the use of land use controls. The action alternatives are similarly with respect to ecological risk. It is estimated that all alternatives, except for no-action, would reduce levels of site-related COCs below levels of ecological concern.

Under the treatment alternative (Alternative 4), where the cleaned waste stream from treatment is replaced on MISS, overall protectiveness is ensured by the placement of one foot of clean backfill cover and institutional controls. The local municipalities would be requested to notify the USACE and EPA of any land use changes that would affect these properties and any properties where residual concentrations exceed acceptable limits for unrestricted (residential) use.

For the excavation alternatives 3 and 4), a mitigation action plan would be developed during remedial design to specify measures that would be taken during implementation of the remedial action to minimize risk to human health and the environment (e.g., institutional controls, environmental controls, radon monitoring, and contingency response actions).

Table 5-6. Comparative Evaluation of Site-wide Alternatives 1–4

Criteria	Alternative 1 No Action	Alternative 2 Monitoring and Institutional Controls	Alternative 3 Excavation and Offsite Disposal	Alternative 4 Excavation, Treatment, and Offsite Disposal
Overall Protectiveness of Human Health and the Environment	Low	Low/Medium	Medium/High	Medium/High
Compliance with ARARs	Low	Medium	High[1]	High[1]
Long-term Effectiveness and Permanence	Low	Low	High[1]	High[1]
Short-term Effectiveness, Including Potential for Environmental Impacts Time to implement[2]	Low Not Applicable	Medium 2 years	High[1] 5 years	Medium 5 years
Reduction in Toxicity, Mobility, or Volume Through Treatment	Low	Low	Low	Medium
Implementability	Not applicable	High[1]	High[1]	High[1]
Cost in FY 01 dollars[3]	$439,000	$20,000,000	$254,000,000	$244,000,000
Preliminary Evaluation of Regulatory and Public Input				
State or Support Agency Acceptance	Low	Low	High[1]	Medium
Community Acceptance	Low	Low	High[1]	Medium

[1] Most favorable ranking
[2] Time to implement is dependent on USACE funding, which is appropriated annually from Congress.
[3] FY 01 dollars denotes 30-year cost for the alternative with no adjustment for inflation or discount factor. Note that all alternatives would require operation and maintenance activities such as environmental monitoring beyond the 30-year time period used in the cost estimate.

5.8.2 Compliance with ARARs

The alternatives must meet requirements of Federal and State environmental laws that are deemed ARARs for the cleanup, or provide justification for invoking a waiver from the requirements. Alternatives 2, 3 and 4 would meet pertinent ARARs as summarized in Section 3.2 and Appendix A. The no action alternative does not comply with the ARARs. Alternatives 2, 3, and 4 would comply with the site-specific permissible levels of residual activity established by EPA and DOE for restricted or unrestricted use, the radiation dose standards promulgated in NJAC 7:28-12.8, and NRC's criterion for the decommissioning of the burial pits.

Per the September 2001 NRC Letter, USACE will dispose of radiologically contaminated soil offsite as 11(e)(2) byproduct materials.

5.8.3 Long-term Effectiveness and Permanence

This criterion addresses the amount of risk remaining at the conclusion of remedial activities. It also addresses the adequacy and reliability of controls established to maintain protection of human health and the environment over time, once cleanup levels have been met.

Human health risks after remediation give an indication of the long-term effectiveness of an alternative. Human health risks due to exposure to contaminated materials are reduced from the existing risk by varying degrees, depending on the extent of remediation provided by the alternatives.

For the excavation alternatives, cleanup criteria for radium-226 and thorium-232 combined specified by site-specific risk analyses were established in the DOE and EPA dispute resolution according to EPA guidance. If residual concentrations at these properties are above 5 pCi/g combined radium-226 and thorium-232, institutional controls would be implemented to preclude future development, which could involve significantly greater levels of human exposure, such as residential land use. Existing disposal facilities will be used and are considered to be protective of human health and in compliance with pertinent environmental requirements.

The excavation alternatives (3 and 4) provide long-term effectiveness because they would remove for permanent offsite disposal all soil above cleanup criteria established for either safe commercial or unrestricted residential use of the FUSRAP Maywood Superfund Site. Alternative 2, which relies heavily on institutional controls to maintain long-term effectiveness, is less effective in the long-term than 3 or 4. Under the treatment option of Alternative 4, where the cleaned portion of treated soil is replaced on MISS, overall protectiveness for these properties is ensured by their continued commercial use. Overall long-term effectiveness is further ensured by requesting municipalities to inform USACE and EPA of any land use changes that may affect properties where radioactivity remains above an average of 5 pCi/g of radium-226 and thorium-232 combined above background.

Since some COCs above the unrestricted use cleanup criteria would remain onsite under all the alternatives, a review would be conducted at least every five years for properties where soils remain above the unrestricted use criteria. [Periodic 5-year reviews would be required by

40 CFR 300.430(f)(4)(ii) where contamination above the unrestricted use criteria remain.] In addition, municipal notification regarding land use changes would be requested.

5.8.4 Short-term Effectiveness and Environmental Impacts

This criterion addresses the effects of an alternative during the construction and implementation phase of a remedy. The speed with which the remedy achieves protectiveness and the potential to create adverse impacts on human health and the environment during construction and implementation are also considered.

Alternatives 1 and 2 have less potential for negative impacts to workers, the community and the environment during implementation, because the current status quo is maintained at the FUSRAP Maywood Superfund Site. Of the excavation alternatives (Alternatives 3 and 4), Alternative 3 has less potential for impacts to workers, because of the additional potential for exposure to contaminated material during treatment. Transportation risks for Alternative 4 would be expected to be less than for Alternative 3, since less material is transported for offsite disposal. Alternatives 3 and 4 both provide for minimal environmental impacts beyond the implementation phase.

Time to implement for each of the alternatives is as follows:

Alternative	Time to Implement (Years)
1	0
2	2
3	5
4	5

5.8.5 Reduction in Mobility, Toxicity, and Volume through Treatment

This criterion addresses the statutory preference (CERCLA Section 121) for selecting remedial actions that employ treatment to permanently and significantly reduce mobility, toxicity, or volume of waste at CERCLA sites. This evaluation addresses the amount of waste treated or destroyed; the reduction in mobility, toxicity, or volume; the irreversibility of the treatment process; and the type and quantity of residuals resulting from the treatment process.

Because of the nature of the primary COCs at the FUSRAP Maywood Superfund Site (i.e., radionuclides in soil and radiologically contaminated building surfaces), treatment for reduction of toxicity is not feasible. Therefore, only treatment to reduce mobility and/or volume may be considered.

Only Alternative 4 provides for a reduction in the volume of contaminated soils requiring disposal or long-term management and satisfies the statutory preference for treatment as a principal element. Alternatives 3 and 4 both include a treatment component for the contaminated buildings and structures by using decontamination for remediation.

5.8.6 Implementability

This criterion addresses the ability to technically accomplish the cleanup; the ability to obtain approvals and coordinate with other authorities (administrative feasibility); and the availability of services and materials required for the cleanup. This technical evaluation considers such items as the ability to construct and operate the cleanup equipment; the ease and reliability of the cleanup techniques used; the ability to obtain services, capacities, equipment, and personnel; and the ability to monitor the performance and effectiveness of technologies.

All alternatives are considered implementable on a technical and administrative basis. The engineering, design, and administrative requirements increase with the complexity of each alternative. Alternatives 3 and 4 involve excavation and offsite disposal, and use readily available technology and equipment. The treatment alternative (Alternative 4) is also considered to be implementable, although it involves greater uncertainties with respect to treatment performance. However, the proposed treatment process is available from commercial sources, and has been effectively demonstrated in similar applications and tests.

All excavation alternatives utilize standard equipment and procedures for decontamination or demolition of buildings and structures, and therefore compare equally with respect to implementability. Alternatives 3 and 4 involve offsite disposal at an existing facility, and are therefore considered easily implementable.

5.8.7 Cost

The comparative analysis of costs compares the differences in capital, O&M, and total 2001 dollars. Costs for each alternative, including itemization of individual components and the sensitivity analysis for each alternative are provided in detail in Appendix B. The alternatives are listed in Table 5-7 with the total 30-year cost in 2001 dollars without escalation or discount.

Table 5-7. Cost of Alternatives

Alternative	Description	Costs (FY01$)
1	No Action	$439,000
2	Monitoring and Institutional Controls	$20,000,000
3	Excavation of Accessible Soils and Disposal	$254,000,000
4	Excavation of Accessible Soils, Treatment, and Disposal	$244,000,000

5.8.8 State Acceptance

This criterion evaluates the State's position and key concerns the State may have about the preferred alternative, ARARs, and other related matters. This criterion is not evaluated formally until comments on the PP are received.

5.8.9 Community Acceptance

This criterion addresses the issues and concerns the public may have regarding each of the alternatives. This criterion is not evaluated formally until comments on the PP are received.

However, the USACE maintains a community relations program for the FUSRAP Maywood Superfund Site and has acquired extensive input from the local community. The community has expressed a strong preference for removal and out-of-State disposal of the contaminated materials. In addition, the community has opposed onsite treatment as an option for remediation at the FUSRAP Maywood Superfund Site in the past. This criterion will be more completely evaluated after public comments on the PP have been received.

5.9 CONCLUSION

The comparative analysis of alternatives for the Soils/Buildings OU properties at the FUSRAP Maywood Superfund Site provides the basis for selecting the preferred alternative. The preferred alternative, which will be described in the PP, will be selected from among these four alternatives.

In accordance with the NCP, the PP, this FS and other documents in the administrative record on this decision will be released to the public for review and comment. Public input on the alternatives is paramount in the selection process. The preferred remedy may be modified based on the comments received. The final remedy will be selected by USACE and EPA, in consultation with the NJDEP, and presented in a ROD.

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APPENDIX A

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE FUSRAP MAYWOOD SUPERFUND SITE

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Table A-1. Potential Chemical-, Location-, Action-specific ARARs for the Remediation of the FUSRAP Maywood Superfund Site

Potential Requirement	Citation	Description of Requirement	ARAR Status	Comment
Nuclear Regulatory Commission Regulations (1991)	10 CFR 20.1402	This rule provides standards for determining the extent to which lands and structures must be remediated before decommissioning of a site can be considered complete and the license terminated. Standards are based on dose from all pathways.	Yes	This rule is applicable to the license decommissioning (remediation and closeout) of the three NRC-licensed burial pits on the Stepan property.
Clean Air Act - National Emission Standards for Hazardous Air Pollutants	40 CFR 61, Subpart H	Applies to facilities owned or operated by the Department of Energy. Emissions of radionuclides to the ambient air shall not exceed levels that would result in an effective dose equivalent of 10 mrem/yr to a member of the public.	No	This regulation is inapplicable to the remedial activities of the US Army Corps of Engineers undertaken at the Maywood site. Notwithstanding the inapplicability of this regulation to the Corps' activities, the Corps has been meeting the substantive requirements of this regulation in the spirit of the final Memorandum of Understanding, April 4, 1995, between the Department of Energy and the Environmental Protection Agency, in which DOE committed to complying with the requirements of this regulation at DOE-owned facilities.
New Jersey Groundwater Quality Standards and NJDEP Effluent Standards for Site Remediation Projects	N.J.A.C. 7:9.6 Appendix, Table 1 (Class II-A Groundwaters); N.J.A.C. 7:14A-12 Appendix B (FW-2 surface waters)	These standards list point-source discharge limitations for specific contaminants.	Yes	Remedial actions involving point-source discharges of contaminants of concern into waters of the State, including POTWs, would comply with the specific relevant and appropriate discharge limitations listed in Section 3.2.1.2 of the Feasibility Study.
Resource Conservation and Recovery	40 CFR 262.11	Requires the generator of a solid waste to make a hazardous waste determination.	Yes (an ARAR for Alternatives 3 & 4)	Site characterization data indicates that the soils and waste material present at the site would not be classified as hazardous wastes under RCRA; however, any RCRA-regulated wastes that may be generated would be managed and disposed in accordance with all applicable requirements.

Table A-1. Potential Chemical-, Location-, Action-specific ARARs for the Remediation of the FUSRAP Maywood Superfund Site (continued)

Potential Requirement	Citation	Description of Requirement	ARAR Status	Comment
New Jersey Freshwater Wetlands Mitigation Requirements	N.J.A.C. 7:7A Subchapter 15	Generally requires mitigation of wetlands impacted by regulated activities in fresh water wetlands and State open waters.	Yes	Wetland areas classified as ordinary and/or of intermediate value (by State of New Jersey definitions) exist on more than half of the 24 properties addressed in this FS. Pursuant to the substantive relevant and appropriate standards of N.J.A.C. 7:7A Subchapter 15, sediments exceeding the cleanup criteria will be excavated and removed from the wetlands thereby reversing the temporary disturbance of the wetlands
New Jersey Remediation Standards for radioactive Materials	N.J.A.C 7:28-12.8(a)1 and 2	Sites shall be remediated so that the incremental radiation dose to any person from any residual radioactive contamination at the site above that due to natural background radionuclide concentration, under either an unrestricted use remedial action, limited restricted use remedial action, or a restricted use remedial action, shall have a sum of annual external gamma radiation dose and intake dose of 15 mrem/yr or less above background. In addition, Rn-222 shall not exceed 3 pCi/l above background.	Yes	NJAC 7:28-12.8(a)1 applies to soils and the NRC-licensed burial pits. NJAC 7:28-12.8(a)2 applies to buildings. Only the substantive requirements of this regulation would apply.

APPENDIX B

FUSRAP MAYWOOD SUPERFUND SITE FEASIBILITY STUDY COST ANALYSIS INFORMATION

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B.1 INTRODUCTION

This appendix provides information regarding the cost estimate for the detailed analysis of alternatives for the Maywood FS. These costs are not intended to provide a construction estimate for the remedial actions. The costs used in this analysis are based on Means Cost Data, vendor quotes, and engineering estimates. Productivity adjustments are incorporated to compensate for lost productivity due to construction delays and safety requirements imposed due to contaminated soil. These cost estimates are expected to provide an accuracy of -30 % to +50 % and are prepared using data available from the FS. The detail used to develop these costs should provide much more certainty (± 20 %) if the assumptions prove accurate.

The format for the cost estimate is based on guidance from the USACE Hazardous, Toxic, Radioactive Waste (HTRW) Interagency Cost Engineering Group. Section B.2 provides general cost information including the scope of the estimates, the HTRW Work Breakdown Structure (WBS), project schedules, estimating methodology, key parameters and general groundrules and assumptions. Section B.3 summarizes the total 2001 costs for each alternative. Section B.4 provides the scope of work, detailed assumptions and basis of estimate for each alternative.

B.2 GENERAL COST INFORMATION

B.2.1 ESTIMATE SCOPE

Scope is defined by the HTRW WBS elements for which costs have been estimated for each alternative. Costs are estimated for all WBS elements listed in Section B.4. Costs are estimated over a 30-year span for each alternative.

B.2.2 WORK BREAKDOWN STRUCTURE

The HTRW WBS, February 1996, was used as the basis for the Maywood cost estimate. The cost estimate consists of five hierarchical levels and uses a 2-digit number at each level. The 2-digit numbers for title levels 1, 2, and 3 are taken from the HTRW WBS. Detail items are at levels 4 and 5.

Level 0 – WBS Level 0 (Project) e.g., Maywood Alternative 3
Level 1 – WBS Level 1 (Account) e.g., HTRW RA
Level 2 – WBS Level 2 (System) e.g., Mobilization
Level 3 – WBS Level 3 (Subsystem) e.g., Soil Collection
Level 4 – User Defined (Assembly Category or Other) e.g., Excavation
Level 5 – User Defined (Assembly Category or Other) e.g., Loading

B.2.3 SCHEDULE

Major remediation activities are typically complete within 5 to 30 years. For this reason, and to make the task of estimating feasible, all estimates are based on a 30-year project life cycle. Schedules for major construction activities are assumed to be constant and do not change between alternatives. This assumption facilitates cost comparisons between alternatives. Specific schedules are calculated or based on engineering judgment.

B.2.4 ESTIMATING METHODOLOGY

The primary methodology used is of a quantity take-off nature whereby costs are calculated based on unit cost multiplied by quantity or other input parameters. Unit cost data used in the relationship is primarily drawn from the Means Cost Data.

Several WBS elements incorporate a productivity adjustment process as part of the estimating methodology. This process is accomplished through the use of factors which are applied to equipment performance measures in order to account for a degradation in the productivity, performance, or output levels of the equipment resulting from site-specific conditions. Productivity factors exist for three conditions: site, soil, and safety. Site adjustments are made to account for temporary work interruptions and delays resulting from poor weather, unsafe work conditions and other similar unforeseen events. Soil adjustments are made to account for varying levels of difficulty associated with excavating different types of soil or rubble. A safety adjustment is made to adjust productivity levels due to safety procedures associated with the radioactive nature of impacted materials. Productivity adjustments are part of the methodology used to estimate costs for WBS 33.08 – Solids Collection/Containment.

In general, estimating methodology is not site- or alternative-specific. Once a methodology has been established for a given WBS element, it becomes the common methodology which is employed for that given WBS element across the various alternatives.

B.2.5 KEY PARAMETERS, GROUNDRULES, AND ASSUMPTIONS

Key parameters are quantities, unit costs and assumptions which tend to drive the ultimate cost for a project. Key parameters for the FUSRAP Maywood Superfund Site are shown in Table B-1 in 2001 dollars. These parameters were used to generate the estimate.

Ground rules and assumptions are statements of guidance and/or logic which are established in order to bound or limit the cost estimate. They serve to define the estimate by clarifying the effort which the estimate addresses and how cost for that effort is derived. Listed below are general groundrules and assumptions which are common to all alternatives estimated for the soils/buildings operable unit containing the 24 remaining commercial and government properties at the FUSRAP Maywood Superfund Site. Assumptions used in the development of the costs for specific alternatives are presented in Section B.4.

Table B-1. FUSRAP Maywood Superfund Site Key Parameters
Feasibility Study Volumes and Unit Price Rates

Parameter	Alt. 1 No Action	Alt. 2 Monitoring & Institutional Controls	Alt. 3 Excavation[1] & Offsite Disposal	Alt. 4 Excavation[1], Treatment, & Offsite Disposal
Building 76 demolition volume for disposal (cy)	—	—	2,043	2,043
Stepan Building 3 demolition volume for disposal (cy)	—	—	7,379	7,379
Total Buildings Volume for Disposal at a Sanitary Landfill (cy)	—	—	**9,422**	**9,422**
In Situ Volume MISS (cy)	—	—	73,233	73,233
In Situ Volume Stepan (cy)	—	—	44,125	44,125
In Situ Volume Gov't/ Commercial (cy)	—	—	109,816	109,816
In Situ Volume Phase I			12,500	12,500
Total In Situ Soil Volume (cy)	—	—	**239,674**	**239,674**
Total Excavation Volume w/ 20% overexcavation (in situ cy)	—	—	**287,609**	**287,609**
Total Ex Situ Volume w/ 25% expansion (ex situ cy)	—	—	**359,511**	**359,511**
Soil Volume Unavailable for Treatment that Incurs Incremental Disposal Costs (ex situ cy)	—	—	**292,928**	**292,928**
Retention Ponds[4]	—	—	112,500	112,500
Special Waste[5]			90,919	90,919
Debris[6]	—	—	16,645	16,645
Inaccessible Soils[7]			72,864	72,864
Remaining soil volume available for treatment (cy)	—	—	N/A	66,583
Treated soil for disposal (40% of vol. Avail. for treatment)	—	—	N/A	26,633
Soil mass reduction due to treatment (%)[8]	—	—	N/A	60%
Total vol. of clean soil from treatment (cy)(60% of vol. avail. For treat.)[8]	—	—	N/A	39,950
Treatment Rate ($/ton)	—	—	N/A	$ 42.90
Special Waste Stabilization Material Volume to Incur Incremental Disposal Costs			**5,000**	**5,000**
Total Soil Disposal Volume of Soils Available for Treatment (ex situ cy)	—	—	**66,583**	**26,633**[9]
Total Soil Volume to Incur Incremental Disposal Costs (ex situ cy)	—	—	**292,928**	**292,928**
Total Sanitary Landfill Waste Disposal Volume (ex situ cy)	—	—	**9,422**	**9,422**
TOTAL DISPOSAL VOLUME (ex situ cy)	—	—	**368,933**	**328,983**
Disposal Fee, Commercial ($/ton)	—	—	$ 119.60	$ 119.60
Gondola Transportation Rate ($/ton)	—	—	$ 83.00	$ 83.00
Sanitary Landfill Waste Disposal Fee ($/cy)	—	—	$ 59.50	$ 59.50

NOTE: All costs for key parameters are in $FY2001.

1 Excavation of accessible and inaccessible soils .
2 In situ excavation volumes include a 20% increase to account for overexcavation.
3 Ex situ excavation volumes include a 25% increase to account for expansion of soil.
4 In situ volume of retention ponds on MISS = 74,987 cy (3D calc. package 1044.971114.002).
5 Special Waste includes unique materials such as asbestos, and mixed waste (radiological and chemical contamination) on the MISS, Stepan and 149-151 Maywood Avenue including burial pits 1, 2 and 3 (bulk and debris); and 2,000 drum removal.
6 Debris (i.e., oversize material and bulk waste) is approximately 20% of total ex situ volume (excluding retention ponds, special waste and inaccessible soils)
7 Ex Situ volume includes 18,750 yd^3 of inaccessible soils from Phase I
8 Based on studies by Sanford Cohen and Associates (SC&A 1997), 60% of the soils can be successfully treated to 15 pCi/g.
9 Total Soils Disposal Volume = treated soils >15 pCi/g.

- No sunk costs.
- All costs are reported in Base Year 2001 dollars in thousands unless otherwise noted.
- Indirect costs have been applied to prime contractor and all subcontractors.
- Subcontractor material costs include a 10 % material handling overhead (Means).
- Material cost includes a 6 % sales tax.
- Contingency factor of 25 % is applied to the Subtotal Project Cost (RA + O&M + Remedial Design) at the bottom line.
- Program Management is calculated using a 10 % factor based on Total Project Cost (Subtotal Project Cost + Contingency).
- Data sources for key parameters include the Volume Register, Rev. 11 (BNI 1997), Volume Register, Rev.0 (S&W 2001) this FS for the FUSRAP Maywood Superfund Site, and engineering judgment.
- Costs for treatment are based on soil washing treatment processes. This cost is conservative compared to the proposed gravel separation and radiological sorting.
- Source for equipment cost and output is Means unless otherwise cited.
- Productivity adjustments are used in many elements for weather and other delays.
- Twenty % increase in volume is added for expected overexcavation. An additional 25% increase in volume is assumed from expansion of the excavated in situ soils.
- Remedial action down time is calculated based on 3 months of down time for every 9 months of working time.
- Radiological waste disposal fees are based on existing USACE contract.

B.2.6 COST ESTIMATION

Federal construction programs have traditionally distinguished between the capital and operations and maintenance (O&M) costs. The remedial action alternatives for the Maywood FS consist of those activities required to prevent or mitigate the migration of waste into the environment. The remedial action may include activities considered to be O&M in situations where construction alone will not achieve the health and environmental protection criteria.

The remedial action will have a schedule with a defined completion date. The post-closure or O&M phase occurs after the completion of the remedial action and includes those activities necessary to confirm closure of the remedial action or the activities necessary to monitor and prevent migration of releases of hazardous waste into the environment for an indefinite period.

B.2.6.1 Capital Costs

Capital costs are those expenditures required to implement a remedial action and consist of both direct and indirect costs. Capital costs do not include the costs required to maintain or operate the action throughout its lifetime.

B.2.6.1.1 Direct Capital Costs

Direct capital costs include equipment, labor, and material necessary for implementing the remedial action. These typically include costs for:

- mobilization and demobilization;
- monitoring, sampling, and analysis during remedial action;
- surface water and groundwater collection/control during remedial action;
- solids (soil) collection (excavation)/containment;
- structure removal;
- decontamination and decommission;
- treatment;
- transportation and disposal; and
- site restoration.

B.2.6.1.2 Indirect Capital Costs

Indirect capital costs consist of engineering, supervision, management, administration, financial and other services necessary to implement a remedial action. These costs are not incurred as part of actual remedial actions but are ancillary to direct or construction costs. Indirect costs typically include:

- remedial design;
- project overhead and profit; and
- program management and technical support.

B.2.6.2 Operations and Maintenance (O&M) Costs

O&M costs are those post-remedial action costs necessary for monitoring and ensuring hazardous waste will not migrate into the environment. These costs typically include:

- monitoring, sampling and analysis;
- institutional controls;
- site management/engineering and technical support in support of O&M activities, and;
- program management and technical support in support of O&M activities.

B.3 REMEDIAL ACTION ALTERNATIVE COST SUMMARIES

Table B-2 provides a cost breakdown in fiscal year 2001 dollars by activity for each alternative.

Table B-2. Maywood Government and Commercial Properties FUSRAP Remediation Alternatives HTRW WBS Cost Summary

30-Year Cost in Thousands, $FY01

HTRW WBS Number	Activity	Alt. 1 No Action	Alt. 2 Monitoring & Institutional Controls	Alt. 3 Excavation & Offsite Disposal	Alt. 4 Excavation, Treatment & Offsite Disposal
33	**HTRW REMEDIAL ACTION**	**0**	**0**	**151,233**	**145,738**
33.01	Mobilization and Preparatory Work	0	0	1,220	1,220
33.02	RA Monitoring, Sampling, & Analysis	0	0	12,937	12,937
33.05	Surface Water Collection/Control	0	0	664	664
33.06	Groundwater Collection/Control	0	0	331	331
33.08	Solids Collection/Containment[1]	0	0	19,160	18,763
33.10	Drums/Tanks/Structures/Misc. Removal	0	0	201	201
33.13	Physical Treatment	0	0	0	3,856
33.15	Soil Stabilization	0	0	1,240	1,240
33.17	Decontamination and Decommission	0	0	993	993
33.19	Disposal (Commercial)	0	0	89,767	81,476
33.20	Site Restoration	0	0	8,968	8,304
33.21	Demobilization	0	0	148	148
33.22	General Requirements	0	0	15,606	15,606
34	**HTRW O&M**	**290**	**13,328**	**7,230**	**7,230**
34.02	Monitoring, Sampling, & Analysis	290	8,159	2,922	2,922
34.22	General Requirements	0	5,169	4,308	4,308
	TOTAL REMEDIAL ACTION AND O&M[2]	**290**	**13,328**	**158,463**	**152,968**
	Prime Contractor (12% Subtotal RA + O&M)			19,016	17,591
	Remedial Design [10% (Total Direct – Disposal)]	290	1,333	8,496	8,528
	SUBTOTAL PROJECT COST	**319**	**14,661**	**185,975**	**179,087**
	Construction Contingencies (25% Subtotal Project)	80	3,665	44,370	42,640
	TOTAL PROJECT COST	**399**	**18,326**	**230,345**	**221,727**
	Program Management (10% Total Project)	40	1,833	23,072	22,173
	TOTAL	**439**	**20,159**	**253,417**	**243,900**

[1] Includes burial pits 1, 2, and 3

[2] Includes project overhead and profit

B.4 BASIS OF COST ESTIMATE

WBS 33. HTRW REMEDIAL ACTION

WBS 33.01 Mobilization and Preparatory Work

Includes all preparatory work required during remedial action. This includes submittals; construction plans; mobilization of personnel, facilities, and equipment; construction of temporary facilities; temporary relocations; setup of decontamination facilities and institutional controls.

This item would not be applied to Alternatives 1 or 2. For Alternatives 3 and 4, it is assumed that there is an existing trailer and storage facilities onsite.

WBS 33.02 Remedial Action Monitoring, Sampling, and Analysis

Provides for all work during remedial action associated with air, water, sediment and soil sampling, monitoring, testing and analysis. Includes sample collection, shipment, and analysis by onsite and offsite laboratory facilities. This item would not be applied to Alternatives 1 or 2.

Periodic sampling of all media would be conducted during remedial action activities in Alternatives 3 and 4 to monitor levels of contamination. A duration of four years is estimated for the completion of actual excavation activities (five years total remedial action time). Sampling costs during remedial action activities are based on the annual costs of monitoring of all media. After all excavation activities have been completed, verification sampling of soil would be conducted prior to backfill of the properties to confirm that cleanup criteria have been met.

WBS 33.05 Surface Water Collection/Control

Provides for the collection and control of contaminated surface water through erosion control measures and civil engineering structures such as berms and dikes. Includes the collection of surface water through tanks and pump systems. Includes transport to treatment plant. This item would not be applied to Alternatives 1 or 2.

WBS 33.06 Groundwater Collection/Control

Provides for the remedial action collection and control of contaminated groundwater through the construction of piping, tanks, and pump systems. Includes transport to treatment plant. This item would not be applied to Alternatives 1 or 2.

WBS 33.08 Solids Collection/Containment

Provides for excavation of accessible and inaccessible solid hazardous, toxic, and radioactive waste (HTRW) (including burial pits 1, 2 and 3). This item would not be applied to Alternatives 1 or 2.

The total volume of accessible and inaccessible in situ soils to be excavated is 239,674 yds^3. An over excavation factor of 1.2 and an expansion factor of 1.25 are both applied to the in situ volume to calculate the ex situ volume of 359,511 yd^3. Soils would be excavated and transported either directly to the rail siding (Alternative 3) or to the soil treatment facility assumed to be located on MISS (Alternative 4). The contaminated soils from the FUSRAP Maywood Superfund Site would be excavated using a backhoe/excavator with an adjusted output of 416 yds^3 per eight-hour day and would be either loaded directly into 16 yd^3 dump trucks or stockpiled for loading. The excavation production rate has been adjusted to compensate for delays, equipment production, air drying of soils if necessary, rail car availability and job conditions. Other materials such as rocks and oversized debris would be crushed using general excavating equipment. The front-end loader would also be retained onsite to assist with loading and backfill operations. All equipment would be decontaminated by pressure washing prior to leaving the FUSRAP Maywood Superfund Site. The depth of excavation below the existing grade varies from 0 ft. to 20 ft. in some areas. The ground water table ranges from 3 ft. to 15 ft. below the existing surface. Any contact water encountered during excavation would be collected and sent to a wastewater treatment plant (33.06). Water trucks would be used as necessary for dust control.

WBS 33.10 Drums/Tanks/Structures/Miscellaneous Demolition and Removal

Includes the demolition and removal during remedial action of HTRW contaminated structures. This item would not be applied to Alternatives 1 or 2.

In Alternatives 3 and 4, Building 76, located at the MISS, would be completely demolished in order to access contaminated soils present beneath the building. Complete demolition of Building 76 would leave an estimated final building rubble volume of 2,043 yd^3, which would be disposed of offsite at a local landfill. In addition, the Stepan Building 3 on the Stepan Property would be demolished in order to access burial pit 3 contaminated materials. Removal includes 2,400 woodpiles and building rubble, which would be disposed as debris at a local landfill.

WBS 33.13 Physical Treatment

Treatment of soils applies to Alternative 4 only. The treatment facility would be located on the MISS. The treatment process would include screening, classification of soils, gravel separation, radiological sorting. and dewatering. The process operation is designed to prevent any spread of contaminants to the environment. Appropriate site improvements will be provided and existing utilities (electrical, plant, air, potable water, fire protection, sanitary sewer service, etc.) would be extended to the treatment facility. The unit cost for treatment is estimated at $42.90/ton, which includes all engineering design, plant facilities, process equipment, utility installations, materials and management to construct and dismantle the plant on the MISS. The unit cost also includes all costs for startup, testing, sampling, facility O&M, and the treatment and disposal of all wastewater generated.

For the Maywood FUSRAP Maywood Superfund Site, out of a total ex situ volume of 359,511 yd^3, the Retention Ponds ex situ volume of 112,500 yd^3 and the Special Waste ex situ volume of 90,919 yd^3 would be considered untreatable. In addition, 20% of the total ex situ yd^3 (excludes Retention Ponds and Special Waste) would be considered debris and not treatable. Inaccessible soils (72,864 yd^3) will not be treatable due to the timing of accessibility from property owners. With a remaining volume of 66,583 yd^3 ex situ available for treatment, the average soil mass reduction resulting from the soil treatment process to below an average concentration of 15 pCi/g would be 60% of the throughput (39,950 ex situ yd^3). The plant is designed to process 30 tons each hour. The process equipment would treat the contaminated soil and would discharge soils into two separate piles, a clean stream of treated soil and a concentrated waste stream. The clean stream would be used for treated backfill in accordance with the Processed Material Soil Reuse Evaluation Plan, while the concentrated waste stream would be disposed of off-site. Any wastewater generated during the gravel separation process would be recycled, re-circulated and re-used. The only water requiring actual disposal is the wastewater retained at the end of the treatment process. This water would be transported to a local water treatment facility for treatment and disposal by the vendor

As part of this alternative, a full-scale treatment demonstration has been conducted on the FUSRAP Maywood Superfund Site soils to determine the effectiveness, implementability, and cost-effectiveness of treatment prior to processing all the contaminated FUSRAP Maywood Superfund Site soils. Although the data from this study are now available, their review continues, and the treated study report has not yet been written.

WBS 33.15 Soil Stabilization

This item applies to Alternatives 3 and 4. Soil stabilization would include mixing the mixed waste with a 50% mixture of lime/portland cement and storing in 55-gallon drums for disposal. This process would take place at a designated area located near the rail spur. The total waste stabilization volume is 5,000 yd^3.

WBS 33.17 Decontamination

This item provides for all the work associated with the characterization, decontamination, and verification survey of the Stepan buildings. Stepan Buildings 1, 2, 4, 10, 10H, 13, 14, 15, 20, 52A/67/52, and 78 are included for characterization. The total area is estimated to be 110,446 ft^2 with 20 % of the area expected to be decontaminated (22,089 ft^2). This item would be applied to Alternatives 3 and 4.

WBS 33.19 Disposal (Commercial)

Commercial disposal during remedial action provides for the final placement of HTRW at third party commercial facilities that charge a fee to accept waste depending on a variety of waste acceptance criteria. This item would not be applied to Alternatives 1 or 2.

In Alternatives 3 and 4, soils to be disposed of would be transported to an existing rail spur (e.g. the rail spur located at the MISS) with an average distance of one mile from the excavation. Transportation from the individual properties to the rail spur would be via 16.5 yd^3 dump trucks having a transport capacity of 45,000 lbs. or 16 loose yd^3. The rail spur facility is assumed to be constructed to allow the dump trucks to dump the soils directly onto the containment pad for loading. Soils would be loaded into 75 yd^3 lined rail cars. Assume an availability of five rail cars per day from the rail-company. The soils would be transported to a disposal facility authorized to accept radioactive wastes.

The mixed waste would be stored in drums after stabilization and transported by flatbeds to a disposal facility authorized to accept these wastes. Building debris from Building 76 would be disposed of by dump truck at a sanitary landfill.

WBS 33.20 Site Restoration

Site restoration during remedial action includes topsoil, seeding, landscaping, restoration of roads and parking, and other hardscaping disturbed during site remediation. This item would not be applied to Alternatives 1 or 2.

Backfill and site restoration of the excavated properties would commence upon verification of the clean properties to their proper cleanup levels and would run concurrently with excavation activities. For Alternative 3, all of the fill material would be imported from off-site and would be placed in 6 in. lifts of loose soils. For Alternative 4, the soil treatment process is expected to generate 39,950 ex situ yd^3 of treated backfill at less than the restricted cleanup criteria. The remaining fill material would be imported from off-site. Compaction of 50% of the properties would be accomplished using conventional earth moving equipment. A compactor would be used for the remaining properties requiring additional compaction. Upon filling the excavated area to within one ft. of the final grade with clean offsite material, the properties would be covered with one foot of clean topsoil and restored to their existing conditions (seeding, landscaping, asphalt resurfacing, utilities, etc.).

WBS 33.21 Demobilization

Provides for all work associated with remedial action plant takedown and removal of temporary facilities, utilities, equipment, material, and personnel. This item would not be applied to Alternatives 1 or 2.

In Alternatives 3 and 4, following completion of the remedial action phase, all necessary verification and documentation needed for closing the project would be completed (e.g., Post-Remedial Action Report and Certification Dockets). All remediated properties would be reviewed with the appropriate cleanup requirements prior to any release of property restrictions. Those properties meeting the unrestricted use criteria would be released without any radiological restrictions. Institutional controls would be emplaced to control exposure and future land use as necessary for those properties meeting the restricted use criteria.

WBS 33.22 General Requirements

Consists of general remedial action requirements which are not specifically identifiable in the other systems such as indirect, overhead, profit, health and safety, and other general requirements.

WBS 34. HTRW O&M

WBS 34.02 Monitoring, Sampling, and Analysis

Provides for all work during post-construction O&M associated with air, water, sediment and soil sampling, monitoring testing, and analysis. Includes sample collection, shipping, and analysis by onsite and offsite laboratory facilities. Also includes report preparation and CERCLA 5-year reviews. Each 5-year review is estimated to have an overall duration of four months for draft report preparation, review, and final report preparation. All costs associated with these reviews consist of labor only.

In Alternatives 2, 3, and 4, an assumption is made that groundwater monitoring wells currently in place at the FUSRAP Maywood Superfund Site would be replaced once during the 30-year monitoring period. This would be accomplished in two phases of 12 wells and 11 wells, respectively. A depth of 30 ft. is assumed for the development of installation costs per well. Costs are based on the assumptions that the well installations would be permanent and that stainless steel materials would be used to ensure longevity of the wells. Any investigative derived waste (IDW) generated would be disposed of offsite.

Alternative 1 – No Action: No long-term sampling or monitoring data would be collected. Six 5-year reviews would be conducted during the 30-year performance period to assure that human health and the environment are being protected due to the presence of contaminants remaining at the FUSRAP Maywood Superfund Site.

Alternative 2 – Monitoring and Institutional Controls: A long-term environmental monitoring program would be implemented at the FUSRAP Maywood Superfund Site for a period of thirty years. Air, soil, and water media would be addressed. The current network of groundwater monitoring wells on and surrounding the MISS would be monitored periodically for radionuclides (U-238, Th-232, Ra-226, total alpha and beta), and water quality in both shallow and deep wells. Surface water along Westerly Brook and the upper catchment of Lodi Brook would be monitored periodically for the same analytes. Sediment from the same locations as the surface water would be monitored for the same analytes also. Water levels would be measured in all monitoring wells. External gamma radiation would be monitored periodically at fence line locations surrounding MISS. Radon gas would be monitored periodically both onsite (indoor air of facilities with inaccessible soils remaining beneath them) and at fence line locations.

The FUSRAP Maywood Superfund Site would maintain any institutional controls necessary for restricting exposure levels and land use. Activities would include continued access restrictions, continued federal government ownership of the MISS, emplacement of institutional controls as necessary on the properties (a one-time cost), limited site maintenance such as fencing, covers, postings, gates, etc., annual and/or periodic monitoring of media, and mandatory CERCLA 5-year reviews.

Alternative 3 – Excavation and Offsite Disposal and Alternative 4 – Excavation, Treatment, and Offsite Disposal: Under these alternatives, groundwater would be monitored for 25 years following the completion of remedial action. Five-year reviews would be conducted on the properties where the restricted use criterion is applied and where inaccessible soils left in place have combined levels of radium-226 and thorium-232 above 5 pCi/g above background.

For Alternatives 2, 3, and 4, labor costs for sampling activities in the field include two people. A Field Sampling Technician would be responsible for collection of field measurements, collection of media samples, and completion of necessary paperwork. The Field Team Leader would be responsible for packaging and shipping of samples, decontamination of equipment, and leadership in areas of Health and Safety and Quality Assurance.

Sampling materials include:

- TETLDs (tissue equivalent thermoluminescent dosimeters) – for obtaining external gamma radiation dose rates;
- RadTrack™ and RadTrack™-modified – for obtaining radon gas emission measurements;
- Water level indicators – for obtaining water level measurements;
- Multi-function water quality meter for measurement of conductivity, temperature, pH, dissolved oxygen, and turbidity; and
- Various sampling, shipping and decontamination materials.

Analysis costs include laboratory measurements for:

- External gamma radiation;
- Radon-222/radon-220;
- Radiological constituents (thorium, radium, uranium, total alpha and beta); and
- Chemical constituents (water quality).

Sampling quantities and frequencies were taken from the BNI 1997 Environmental Surveillance Report for the FUSRAP Maywood Superfund Site.

Remedial Design

Remedial design costs would consist of 5% of the *Total Remedial Action and O&M Cost* minus disposal costs. There would be no costs associated with remedial design for Alternatives 1 and 2.

Contingency

Costs for Contingency would be applied to the project for each alternative. This cost would consist of 25% of the *Subtotal Project Cost (Total Remedial Action and O&M Cost* plus *Remedial Design*) and would be included to account for activities that are not covered in the cost estimate.

Program Management

A cost for Program Management would also be included for each alternative. This cost would consist of 10% of the sum of the *Total Project Cost*.

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APPENDIX C

SITE-SPECIFIC CLEANUP CRITERIA FOR THE FUSRAP MAYWOOD SUPERFUND SITE QUALITATIVE ASSESSMENT OF REMEDIATION WORKER RISK

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115499

Department of Energy

Oak Ridge Operations
P.O. Box 2001
Oak Ridge, Tennessee 37831—

April 13, 1994

Mr. William J. Muszynski, P.E.
Deputy Regional Administrator
U. S. Environmental Protection Agency,
Region II
Jacob K. Javits Federal Building
26 Federal Plaza
New York, New York 10278-0012

Dear Mr. Muszynski:

MAYWOOD SITE - DOE ACCEPTANCE OF EPA'S PROPOSED CLEANUP LEVELS

This letter is response to your letter dated March 23, 1994, which transmits EPA's position on the cleanup levels for radiological contamination at the Maywood site. I am pleased to inform you that DOE is in agreement with the position set forth in your letter and accepts the proposed cleanup criteria.

I would like to take this opportunity to recognize the efforts of our staffs and commend them for their cooperation with one another and their commitment to resolve this complicated issue.

If you have any questions, please do not hesitate to call me at (615) 576-4444.

Sincerely,

Joe La Grone
Manager

cc: T. P. Grumbly, EORS, EM-1
R. J. Guimond, FORS, EM-1

Mr. William J. Muszynski, P.E.
Deputy Regional Administrator
U. S. Environmental Protection Agency,
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Jacob K. Javits Federal Building
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If you have any questions, please do not hesitate to call me at (615) 576-4444.

Sincerely,

Joe La Grone
Manager

CONCURRENCE		
RTG SYMBOL	INITIALS/SIG.	DATE
EW-93	Cange	4/5/94
EW-93	Seay	
EW-9	Price	4/7
EW-90	Adams	4-12
M-3	Rice	
M-2	Smithwic	4/13/9
M-1	La Grone	4/13/

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115499

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II

JACOB K. JAVITS FEDERAL BUILDING

NEW YORK, NEW YORK 10278-0012

2 3 MAR 1994

Mr. Joe La Grone
Manager, Oak Ridge Operations Office
U.S. Department of Energy
P.O. Box 2001
Oak Ridge, Tennessee 37831-8501

Re: EPA Region 2's Position on the Dispute Regarding Cleanup Levels for Radionuclide Contamination at the Maywood Chemical Company Superfund Site, Maywood, NJ

Dear Mr. La Grone:

You and I, as members of the Senior Executive Committee (SEC), have conferred in an attempt to resolve the dispute regarding cleanup levels for radionuclide contamination in soil at the Maywood Chemical Company Superfund Site. Although we were not able to resolve the dispute within the timeframe allocated to us in the Federal Facility Agreement (FFA) between the Department of Energy (DOE) and the Environmental Protection Agency (EPA), I directed my staff to continue working with DOE in performing site-specific risk analyses prior to formulating my final position on the dispute. The purpose of this letter is to notify you, as the DOE representative on the SEC, of my position on the dispute regarding radionuclide cleanup levels for soil at the Maywood Site, pursuant to Chapter XV (Resolution of Disputes) of the FFA. Based on recent discussions between George Pavlou of my staff and Les Price of yours, I understand that this position, as presented in the attachment, is acceptable to DOE, and will be incorporated into the revised Proposed Plan for the Maywood site.

In accordance with Chapter XV of the FFA, DOE may, within 21 days of my issuance of this position, issue a written notice elevating the dispute to the Administrator of EPA for resolution. In the event that DOE elects not to elevate the dispute within the 21 day period, DOE will be deemed to have agreed with EPA Region 2's position with respect to the dispute as presented herein. As noted above, it is my understanding that EPA's position is acceptable to DOE, and that DOE will not elevate the dispute to the Administrator.

I commend our respective staffs for their efforts in resolving this dispute and look forward to finalizing the Proposed Plan without further undue delay. If you have any questions on the above matters, please do not hesitate to call me at (212) 264-2525.

Sincerely,

William J. Muszynski, P.E.
Acting Regional Administrator

Attachment

cc: R. Shinn, Jr., Commissioner, DEPE
S. Cange, DOE-OR
J. Wagoner, DOE-HQ
L. Miller, DEPE

115499

EPA Region 2's Position on Cleanup Levels at Maywood

EPA Region 2's position on cleanup levels at the Maywood Site must be put into the context of the actions which DOE outlined in its draft final Proposed Plan for the Maywood Site (April, 1993): DOE selected Alternative 6 - *Phased Action and Offsite Disposal* - as the proposed remedy. This alternative consisted of two "phases" of activities. In Phase I, the pile of approximately 35,000 cubic yards of contaminated dirt and debris at the Maywood Interim Storage Site (MISS) would be removed and sent to a commercial disposal facility. Phase I also included the complete excavation of the residential properties, including the unremediated portion of the Ballod property. Phase II would include the treatment of the remaining accessible contamination at the Maywood Site (the commercial and government properties which include Stepan Company, the Sears property, and the DOE owned MISS). The "clean stream" from the treatment process would be backfilled on the MISS and portions of the Stepan and Sears properties (over which would be placed a foot of clean cover), and the concentrated residuals would be disposed of at an off-site commercial disposal facility. DOE has also expressed an interest to treat the soil in the MISS pile if, during its removal, treatment becomes viable and cost effective. EPA Region 2 agrees with these proposed actions, but not the cleanup levels associated with them. Below is my position, which, if acceptable to DOE, should be incorporated into a final Proposed Plan.

Phase I (Cleanup of the MISS and Residential Properties):

The preferred alternative for the Maywood site is a phased action, in which soil contaminated above a specified criterion would be excavated, and the disposition of the excavated materials will differ for different phases of the project. During Phase I, contaminated soil from the residential properties, the unremediated portion of the Ballod property and the Maywood Interim Storage Site (MISS) waste pile will be excavated and shipped off-site for commercial disposal in accordance with applicable regulations. As proposed by DOE, if during removal of the MISS pile, treatment becomes viable and cost effective, treatment of the MISS pile may be instituted. Excavated areas on residential properties will be backfilled with clean fill material. Surface and subsurface soil at residential properties and the unremediated portion of the Ballod property will be remediated to 5 pCi/g above background.

Phase II (Cleanup of the Commercial/Government Properties):

Phase II will immediately follow Phase I. During Phase II remediation activities, subsurface soil on commercial/government properties will be excavated and removed to a level of 15 pCi/g above background with an "as low as reasonably achievable" (ALARA) goal of 5 pCi/g above background. On the basis of a site-specific risk analysis, these levels are deemed protective for currently zoned commercial/industrial properties. Most excavated areas will be backfilled with clean fill material. Any property that is subject to backfilling of treated material during Phase II (the MISS, and possibly portions of the Stepan and Sears property) will be covered by at least 30 cm of clean fill "to grade." Treated residuals will be at a concentration no greater than 15 pCi/g above background. Consistent with ALARA, if the soil treatment technology, at the time of its implementation, proves capable of treating soils to lower residual concentrations in a cost-effective manner, then DOE shall adopt a lower concentration limit for replacement of treated soils.

DOE will institute ALARA during its field excavation and removal program at commercial/government properties. For the proposed actions, an ALARA goal of 5 pCi/g for Ra-226 and Ra-228, combined, above background, will be instituted for subsurface soils. The design plan for site remediation will include a cleanup confirmation program developed to achieve both the specified cleanup criterion (15 pCi/g) and subsurface ALARA goal (5 pCi/g). At the 26 residential properties previously remediated at the Maywood site, post-remediation verification data show that, although DOE utilized a 15 pCi/g cleanup criterion, measured concentrations of thorium-232 following remediation were below 5 pCi/g above background in over 95% of samples, and radium-226 and uranium concentrations were generally at or near background levels. Subsurface cleanup is therefore expected to attain the subsurface ALARA goal in most cases, consistent with previous removal actions. At those commercial/government properties subject to backfilling of treated residuals, subsurface soil concentrations are expected to range between 5 pCi/g and 15 pCi/g above background; how far below 15 pCi/g is dependent upon the capabilities of the soil treatment technology.

Pursuant to CERCLA §121(c) and the Federal Facility Agreement, following successful remediation, the Maywood site will be subject to 5-year reviews to assure that human health and the environment remain protected by the remedial action being implemented. In addition, DOE will remediate, as may be necessary, any areas of the site which have not been remediated due to their inaccessibility, at such time as those areas become accessible for remediation through demolition, relocation, renovation, excavation or otherwise. Also, DOE and EPA, will request that the Borough of Maywood and the townships of Rochelle Park and Lodi during and after the proposed action inform DOE and EPA of any land use or zoning changes affecting any portion of the commercial/government areas of the site and of any permit, building, construction, excavation or demolition activity that might affect unremediated portions of the site (or involve offsite removal of remediated backfill material).

United States Government

Department of Energ

memorandum

DATE: APR 2 5 1994

REPLY TO ATTN OF: EM-421 (W. A. Williams, 903-8149)

SUBJECT: Uranium Guideline for the Maywood, New Jersey Site

TO: L. Price, OR

This is in response to the request for approval of the uranium guideline for the Maywood Site of the Formerly Utilized Sites Remedial Action Program (FUSRAP), pursuant to Department of Energy (DOE) Order 5400.5. The Site, located in northern New Jersey, was used by a private party for the production of thorium and rare earths from ores. In addition, tailings from the thorium production were carried to off-site locations in Maywood, Lodi, and Rochelle Park, New Jersey. Your staff requested approval of a residual uranium guideline of 100 picoCuries per gram of total uranium, based on a supporting analysis by Argonne National Laboratory (ANL). Further, your staff estimated that the waste volume from remedial action would not be affected by the choice of the guideline because of the co-location of uranium and thorium in the soils to be remediated. Under these conditions, cleanup of the thorium to its authorized guideline (5 picoCuries/gram (pCi/g) for surface soil and up to 15 pCi/g for subsurface soil) will result in a simultaneous cleanup of uranium to levels far below the requested guideline.

Basic Dose Requirement:

The Maywood Site is located in northern New Jersey, and the present land use is industrial. Vicinity properties are used for residential, commercial, governmental, and industrial purposes. Although some vicinity properties have been cleaned up, others have not. For the remediation of the site, it is necessary to determine (using site specific data) the level of uranium that would lead to an exposure of 100 millirem per year for all plausible land uses. A draft analysis was performed by ANL and was submitted with the request.

The ANL analysis calculated a maximum residual concentration of total uranium in soil of 1,400 picoCuries per gram (pCi/g) to 13,000 pCi/g, depending on future land use. These concentrations are equivalent to 100 millirem per year for various land uses. The recommended 100 pCi/g is equivalent to 1.6 millirem per year for an industrial worker (Scenario A in the ANL Report). For recreational use, the exposure is less than 1 millirem per year (Scenario B). For subsistence farming use, the recommended guideline is 7 millirem per year, assuming the use of an on-site water well (Scenario C), and 6 millirem per year, assuming that off-site water is used for drinking, livestock, and irrigation purposes (Scenario D).

Based on the ANL analysis, the recommended value of 100 pCi/g of total uranium is within DOE's dose guideline of 100 millirem per year, which must be met under all worst case, plausible scenarios, including the assumed residential and agricultural use.

<u>As Low As Reasonably Achievable (ALARA) Analysis</u>:

In addition to meeting the basic radiation protection guideline, any cleanup guideline must be analyzed to keep exposures ALARA. In the application of ALARA, practical considerations, costs, and benefits are also taken into account. For practical considerations, it is likely that the contaminated areas will be cleaned up to a level below whatever guideline is established. This is likely for three reasons. First, in order to remove all material above the guideline, some soil contaminated below the guideline will be removed. This will have the practical effect of lowering the guideline as it is applied during cleanup operations. Second, during cleanup operations, it is difficult to precisely delineate the point at which contamination above the guideline ends. As a result, remedial personnel will remove all suspect materials to avoid repeated cleanup operations on the same property. Finally, the uranium is co-located with thorium, and the removal of thorium to meet the applicable guideline will remove uranium at the same time. For these reasons, it is likely that cleanup for uranium will be accomplished at some level lower than the approved cleanup guideline.

A final practical consideration is the use of clean fill material to replace excavated materials. This will cause a shielding and covering effect on the remaining soils, reducing gamma ray, dust, and radon exposures. If the site were to be used for residential or agricultural use in the future, the clean fill would also reduce the projected doses by diluting the residual contamination. The ANL analysis does not assume that there is any clean fill or cover placed over the site after cleanup. For this reason, the doses calculated in the ANL report are clearly a worst case scenario. In the actual application of a cleanup guideline, it is very likely that a cleanup level substantially below the established guideline will be achieved.

Selection of a uranium guideline significantly below 100 pCi/g would, as the request stated, negatively impact the project by reducing the utility of field measurements for confirming the cleanup of uranium. Although other measurement techniques could be used, the cost is much higher, and there is no potential benefit since the uranium is co-located with thorium-232, and remediation of thorium contaminated soils will result in residual uranium concentrations much lower than those under consideration.

<u>Summary and Approval</u>:

Based on the above considerations, a guideline of 100 pCi/g for total uranium above background levels is approved for use in the cleanup of the Maywood Site, pursuant to DOE Order 5400.5, Chapter IV, Section 5a. This guideline should be implemented in conjunction with the authorized guidelines for radium and thorium using the "sum-of-the-fractions" method.

In addition, please direct ANL to finalize the dose report for publication.

We also recommend that your staff discuss the site characterization data and the approved guidelines with the State and Environmental Protection Agency staff at an appropriate time.

for Albert J. Johnson
James W. Wagoner II
Director
Division of Off-Site Programs
Office of Eastern Area Programs
Office of Environmental Restoration

cc:
S. Cange, OR
C. Yu, ANL
D. Dunning, ANL
R. Rodriguez, ORNL

134526 ~~117690~~

Argonne National Laboratory
9700 South Cass Avenue, Argonne, Illinois 60439

DERIVATION OF URANIUM RESIDUAL RADIOACTIVE MATERIAL GUIDELINES FOR THE MAYWOOD SITE

by

D.E. Dunning
Environmental Assessment Division

May 1994

work sponsored by

U.S. Department of Energy
Oak Ridge Operations Office
Formerly Utilized Sites Remedial Action Program
Oak Ridge, Tennessee

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FIGURES

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TABLES (Cont.)

DERIVATION OF URANIUM RESIDUAL RADIOACTIVE MATERIAL GUIDELINES FOR THE MAYWOOD SITE

by D.E. Dunning

SUMMARY

Residual radioactive material guidelines for uranium were derived for the Maywood site located in the Boroughs of Maywood and Lodi and the Township of Rochelle Park, New Jersey. The Maywood site became contaminated as a result of thorium-processing operations conducted at the former Maywood Chemical Works (MCW) facility from the early 1900s through 1959. Properties within the Maywood site include the Maywood Interim Storage Site (MISS); the Stepan Company (formerly MCW) property; and numerous residential, commercial, federal, state, and municipal properties that became contaminated as a result of the former thorium-processing operations. Several vicinity properties have been remediated by previous removal actions. The U.S. Department of Energy (DOE) is responsible for cleanup activities at the Maywood site under its Formerly Utilized Sites Remedial Action Program (FUSRAP), as defined in the Federal Facilities Agreement (FFA) between DOE and the U.S. Environmental Protection Agency (EPA) for the site. Remedial actions at the Maywood site are being conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended. In addition, DOE has chosen to integrate the values of the National Environmental Policy Act (NEPA). The DOE is currently preparing a comprehensive remedial investigation/feasibility study-environmental impact statement (RI/FS-EIS) for remedial action at the Maywood site.

Uranium guidelines were derived on the basis of the requirement that the 50-year committed effective dose equivalent to a hypothetical individual who lives or works in the immediate vicinity of the Maywood site should not exceed 100 mrem/yr following decontamination. The DOE residual radioactive material guideline computer code, RESRAD, which implements the methodology described in the DOE manual for implementing residual radioactive material guidelines, was used in this evaluation. Four potential scenarios were considered for the site; the scenarios vary with regard to time spent at the site, sources of water used, and sources of food consumed. The results of the evaluation indicate that the basic dose limit of 100 mrem/yr will not be exceeded for uranium (including uranium-234, uranium-235, and uranium-238) within 1,000 years, provided that the soil concentration of combined uranium (uranium-234, uranium-235, and uranium-238) at the Maywood site does not exceed the following levels: 3,800 pCi/g for Scenario A (industrial worker); 8,300 pCi/g for Scenario B (recreationist); 1,400 pCi/g for Scenario C (resident using a water source not affected by site conditions as the only water source); and 910 pCi/g for Scenario D (resident farmer using well water as the only water source). The uranium guidelines derived in this report apply to the combined activity concentration of uranium-234, uranium-235, and uranium-238, and were calculated on the basis of a dose limit of 100 mrem/yr. In setting the final uranium guidelines for the Maywood site, DOE will apply the as low as reasonably achievable (ALARA) policy to the decision-making process, along with other factors, such as whether a particular scenario is reasonable and appropriate and whether the contamination is isolated and localized.

1 INTRODUCTION AND BRIEF HISTORY

The Formerly Utilized Sites Remedial Action Program (FUSRAP) was established in 1974 by the U.S. Atomic Energy Commission (AEC), a predecessor of the U.S. Department of Energy (DOE). The mandate of the program is to identify, evaluate, and, if necessary, decontaminate sites previously used by the AEC or its predecessor, the Manhattan Engineer District (MED), or otherwise designated for FUSRAP responsibility.

The Maywood site is located in Bergen County, New Jersey. The U.S. Congress assigned DOE the responsibility of cleaning up the contamination at the Maywood site that resulted from past thorium-processing operations at the Maywood Chemical Works (MCW) from the early 1900s through 1959. Remedial actions at the Maywood site are being conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). In addition, DOE has chosen to integrate the values of the National Environmental Policy Act (NEPA), which ensure that the environmental consequences of a proposed action are considered as part of the decision-making process for that action. The DOE is currently preparing a comprehensive remedial investigation/feasibility study-environmental impact statement (RI/FS-EIS) for remedial action at the Maywood site. This report presents guidelines for residual uranium concentrations in soils at the Maywood site. The guidelines were derived with the RESRAD computer code (Gilbert et al. 1989; Yu et al. 1993) on the basis of a dose limit of 100 mrem/yr.

1.1 SITE DESCRIPTION AND SETTING

The Maywood site is composed of properties in the Boroughs of Maywood and Lodi and the Township of Rochelle Park, New Jersey. The three municipalities adjoin each other and are located in a highly developed area of northeastern New Jersey, approximately 20 km (12 mi) north-northwest of New York City and 21 km (13 mi) northeast of Newark, New Jersey (Figure 1). The Maywood site became contaminated, at least in part, as a result of thorium processing and disposal activities that took place during the operation of the former MCW facility from the early 1900s through 1959. The Maywood site consists of the Maywood Interim Storage Site (MISS); the Stepan Company property (formerly the MCW); and numerous residential, commercial, federal, state, and municipal properties in Maywood, Rochelle Park, and Lodi, New Jersey. These properties became radioactively contaminated as a result of thorium-processing operations at the MCW. The site is listed on the National Priorities List (NPL) as the Maywood Chemical Company.

The U.S. Congress has assigned DOE the responsibility of cleaning up contamination at the site that resulted from thorium-processing operations by the former MCW. The U.S. Environmental Protection Agency (EPA) oversees the Maywood site cleanup. Each agency's responsibilities are described in a Federal Facilities Agreement (FFA) negotiated by

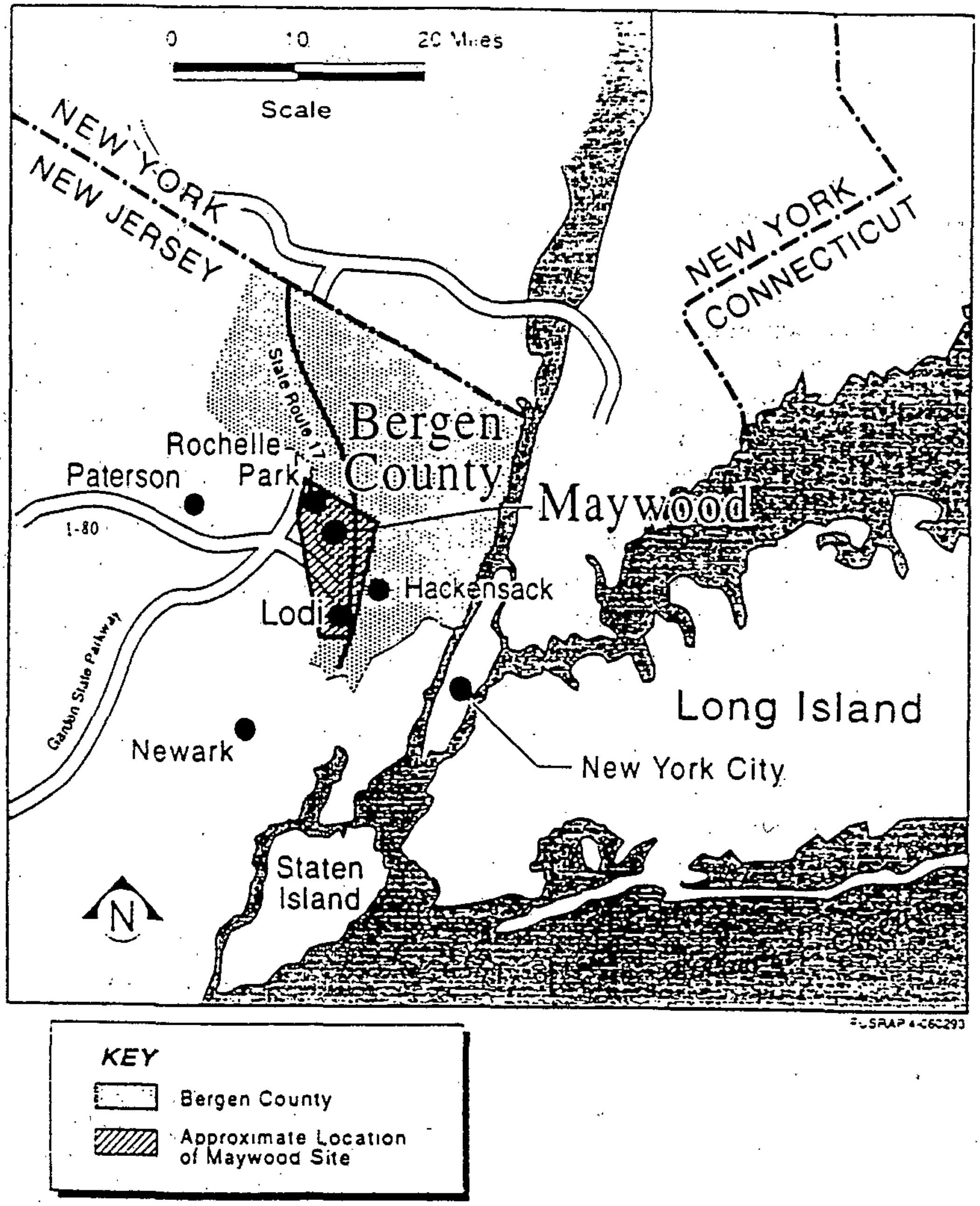

FIGURE 1 Location of the Maywood Site

DOE and EPA Region II. The DOE is primarily responsible for addressing radioactive contamination and the contaminants that meet the definition of FUSRAP waste as set forth in the FFA. A separate RI/FS is being conducted by the Stepan Company, owner of the former MCW property, and focuses on chemical contamination at the site under an administrative order of consent (1987) and an administrative order (1991). Although DOE and Stepan Company RI/FS activities are being conducted independently, EPA oversight over both actions, in consultation with the parties, will ensure that sufficient coordination occurs between the parties to fully address the Maywood site.

For the purpose of developing and evaluating remedial action alternatives, the Maywood site has been divided into multiple operable units (OUs) on the basis of land use and environmental media of concern. The location of the properties composing these OUs is shown in Figure 2. Each OU is briefly described below.

The MISS is a 4.7-ha (11.7-acre) property owned by DOE and located in the Borough of Maywood and the Township of Rochelle Park. The MISS property was previously part of a 12-ha (30-acre) property owned by the Stepan Company and formerly part of the MCW; DOE acquired the property from the Stepan Company in 1985. The property contains an interim waste storage pile, two buildings (Building 76 and a pumphouse), two partially buried structures, temporary office trailers, a reservoir, and two rail spurs. The property is bordered on the west by State Route 17; on the north by a New York, Susquehanna, and Western Railroad line; and on the south and east by commercial and industrial properties. Residential properties are located north of the railroad line and within 274 m (300 yd) to the north of the MISS property boundary. The interim storage pile at the MISS occupies approximately 0.8 ha (2 acres) and contains about 27,000 m^3 (35,000 yd^3) of contaminated soils and materials from previous removal actions conducted on vicinity properties at the Maywood site. A building at the MISS (Building 76) houses containerized solid waste from previous removal actions and site investigations. Former waste retention ponds are also located at the MISS. The property is enclosed by a chain-link fence, and access is restricted within the fenced area. Major features of the MISS property are indicated in Figure 3.

The Stepan Company, a pharmaceutical manufacturer, is located at 100 West Hunter Avenue in the Borough of Maywood, adjacent to the MISS. The property covers 7.4 ha (18 acres), approximately two-thirds of which contains buildings, some in or near locations where the MCW thorium-processing operations occurred. Burial pits containing thorium-processing and other wastes are located on the site (see Figure 3). The property (excluding the main office and parking area) is enclosed by a chain-link fence, and access is restricted within the fenced area.

Residential vicinity properties in the Boroughs of Maywood and Lodi and the Township of Rochelle Park contain radioactive contamination from thorium-processing operations. These properties were identified by DOE through surveys performed by Oak Ridge National Laboratory (ORNL). Nine residential properties in Rochelle Park on Grove Avenue and Park Way and eight residential properties in Maywood on Davison Avenue and Latham Street were completely decontaminated by DOE between 1984 and 1986 and independently verified for use without restriction. Eight residential properties in Lodi have also been decontaminated and have been independently verified as clean; one additional property in Lodi was partially remediated during previous removal actions. Of the remaining 32 contaminated residential properties to be addressed by DOE, 30 are located in Lodi and two are located in Maywood.

Commercial/government vicinity properties include 27 properties located in Maywood, Rochelle Park, and Lodi. Twenty commercial vicinity properties are part of the Maywood site. State and federally owned properties include right-of-ways for Interstate 80, a State

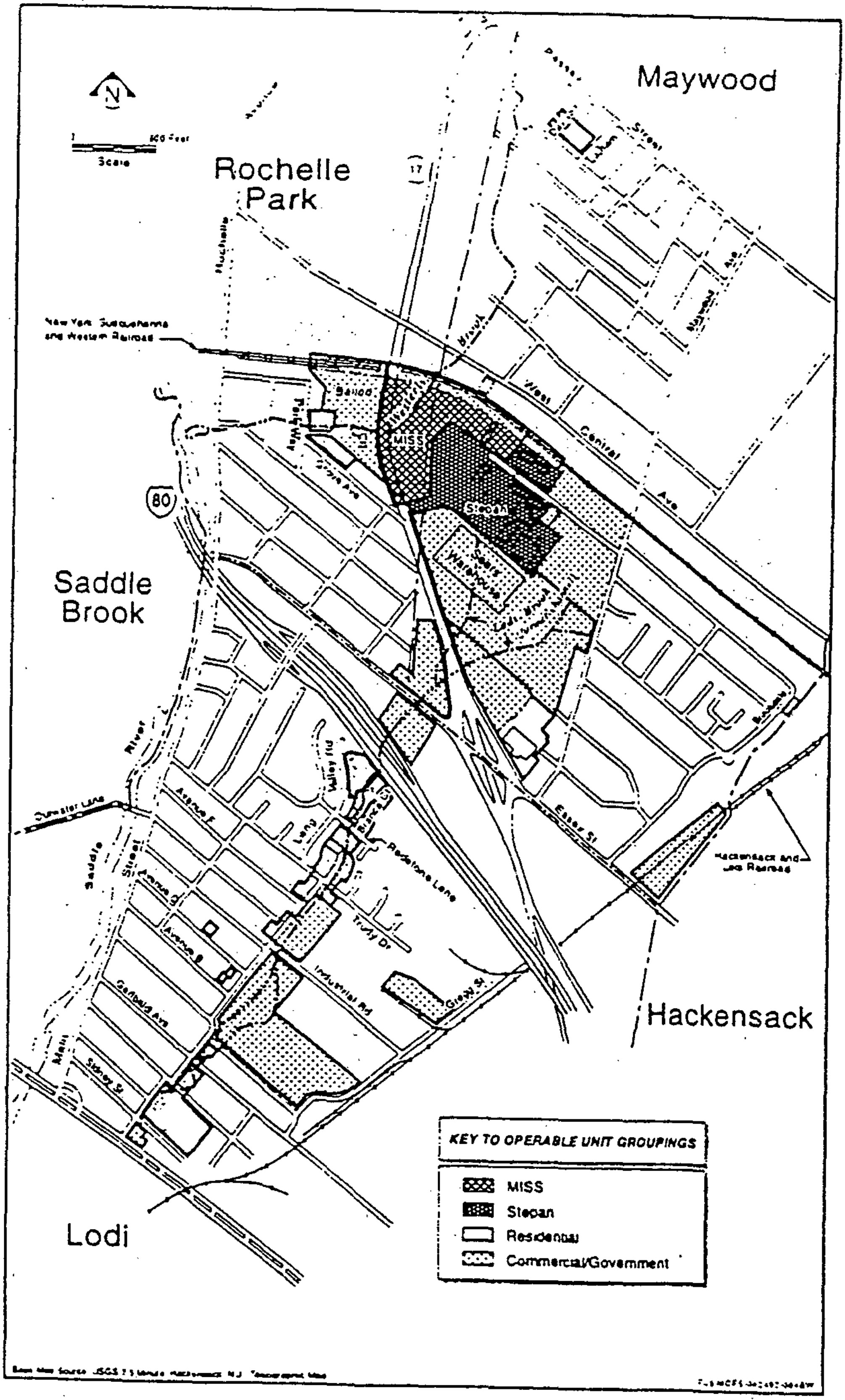

FIGURE 2 Map of the Maywood Site Showing the Locations of the Maywood Interim Storage Site and Vicinity Properties

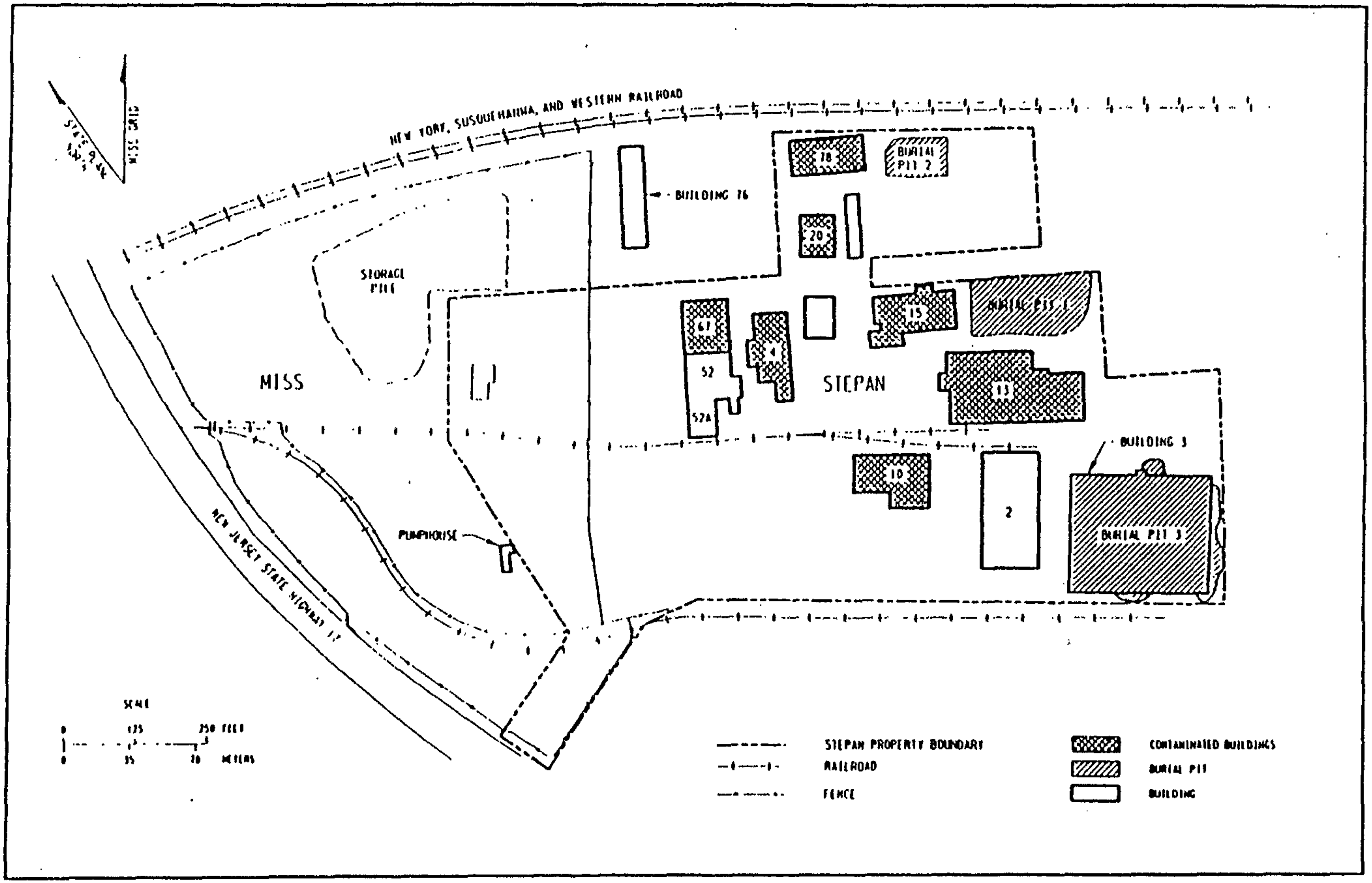

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FIGURE 3 Site Map of the Maywood Interim Storage Site and Adjacent Stepan Company Property

Route 17 embankment, and the New Jersey Vehicle Inspection Station. Four municipal properties (three parks and a fire station), residential streets suspected to have contaminated soils below the surface, and contaminated sediments from Lodi Brook are also included in this OU. The majority of these properties were contaminated through the same processes as the residential properties — transport of contaminated sediments along former stream channels or use of contaminated material as fill and mulch. Three of these properties (Ballod, Sears, and State Route 17) were once part of the former MCW property and were used, at least in part, for waste disposal. A portion of one property (Ballod) was remediated during a previous removal action.

Contaminated buildings and structures are located on the MISS and Stepan properties only. As indicated in Figure 3, radiologically contaminated buildings include the pumphouse at the MISS and the guardhouse and Buildings 4, 10, 13, 15, 20, 67, and 78 on the Stepan property. The radiological contamination is generally localized in discrete areas within buildings and is fixed in place on building floors and surfaces and not readily transferable (i.e., removable by incidental contact). The pumphouse is no longer in use; however, the contaminated buildings at Stepan are part of an active industrial complex. The contaminated buildings are all old buildings that existed during the time that the MCW was processing thorium. No buildings on vicinity properties were found to be contaminated other than one residence in Lodi that contained contaminated building materials from the MCW; the contaminated portion of the structure has been removed and reconstructed.

The regional climate at the Maywood site is humid, with a normal annual precipitation of about 107 cm (42.3 in.). Mean monthly temperatures range from 0.4°C (31°F) in January to 24.9°C (76.8°F) in July. The prevailing winds are from the northwest during October through April and from the southwest during the remainder of the year.

The Maywood site lies within the Saddle River drainage basin. A small portion of the site is located within the 100-year floodplain of the Saddle River. Westerly Brook flows under the MISS property and State Route 17 through a concrete culvert and eventually discharges into the Saddle River approximately 0.8 km (0.5 mi) to the west. Another perennial stream on the Maywood site, Lodi Brook, originates as two branches on the Sears property; most of the original stream channel has been replaced by a subsurface storm drain system, but the former channel correlates with the distribution of contaminated materials in the Borough of Lodi. Lodi Brook empties into the Saddle River downstream of Westerly Brook's confluence with the river. Depth-to-groundwater is shallow and ranges from approximately 1 to 4.6 m (3 to 15 ft) below ground surface.

1.2 SITE HISTORY

The MCW was constructed in 1895. In 1916, the plant began extracting thorium and rare earths from monazite sands for use in manufacturing industrial products such as mantles for gas lanterns. The plant also produced a variety of other materials, including lithium compounds, detergents, alkaloids, and oils. The plant stopped accepting monazite sands for extraction in 1956 but processed stockpiled materials until 1959. On the basis of available historical information and knowledge of the chemical processes involved, the chemicals identified as having been used in the thorium extraction process include sulfuric acid, nitric acid, ammonium hydroxide, and ammonium oxalate. Oxalic acid was also used at the site in the production of higher-grade thorium.

The waste was generated from the extraction process in slurry form. Until 1932, the slurry was pumped to two earthen-diked areas west of the plant. At that time, the disposal areas were affected by the construction of State Route 17, which separated the diked areas from the plant and partially buried them. Waste retention ponds also existed throughout the area of the MCW that is now the MISS.

Some of the process wastes were removed for use as mulch and fill on nearby properties, thereby contaminating those properties with radioactive materials. Although the fill consisted primarily of tea and coca leaves from other MCW processes, these materials were apparently contaminated with the thorium-processing wastes. Additional wastes migrated off the property via natural drainage associated with the former Lodi Brook. Most of the open stream channel in Lodi has been replaced by a subsurface storm drain system.

The MCW received a radioactive materials license from the AEC in 1954. The MCW sold the site to the Stepan Company in 1959, which received a license from the AEC in 1961. Although the Stepan Company never processed radioactive materials, the company agreed to take certain corrective measures in the former disposal area on the west side of State Route 17 (now known as the Ballod property). The Stepan Company began to clean up residual thorium-processing wastes in 1963. From 1966 through 1968, Stepan removed residues and tailings from the Ballod property and reburied them on the Stepan property in three burial pits (Figure 3). After these actions were completed, the AEC certified the portion of the property west of State Route 17 for use without radiological restrictions in 1968.

Radioactive contamination, however, was discovered in the northeast corner of the property in 1980 after a private citizen reported radioactive contamination near State Route 17 to the New Jersey Department of Environmental Protection (NJDEP). A survey of the area (State Route 17, Ballod property, and Stepan property) conducted by the NJDEP identified the contaminants as thorium-232 and radium-226. The U.S. Nuclear Regulatory Commission (NRC) was notified of the results and undertook additional surveys from November 1980 to January 1981; these surveys confirmed high concentrations of thorium-232 in soil samples collected from both the Stepan and Ballod properties. Accordingly, the NRC requested a comprehensive survey of the area.

In January 1981, the EG&G Energy Measurements Group conducted an aerial radiological survey of the Stepan property and surrounding properties. The survey, which covered a 10-km^2 (3.9-mi^2) area, indicated contamination not only on the Stepan and Ballod properties but also in areas to the north and south of the Ballod property. During February 1981, ORNL performed a separate radiological ground survey of the Ballod property, the results of which eventually led to its designation for remedial action under FUSRAP. In June 1981, an additional radiological survey of the Stepan and Ballod properties commissioned by the Stepan Company produced similar findings.

By enacting a provision of the Energy and Water Development Appropriations Act of 1984, Congress authorized DOE to undertake a decontamination research and development project at the Maywood site. Accordingly, the site was assigned to FUSRAP, and DOE negotiated access to a 4.7-ha (11.7-acre) portion of the Stepan Company property for use as an interim storage facility for contaminated materials that were to be removed from vicinity properties. This area is now known as the MISS. In September 1985, ownership of the MISS was transferred to DOE.

In late 1983, DOE initiated a program of surveys of properties in the vicinity of the former MCW plant. From 1984 to 1986, DOE conducted removal actions on 25 properties and placed the waste in temporary storage on the MISS. The interim waste storage pile contains about 27,000 m^3 (35,000 yd^3) of contaminated soil and debris removed from these vicinity properties; the interim storage pile occupies approximately 0.8 ha (2 acres) with an average height of 5.5 m (18 ft). The DOE has maintained a comprehensive environmental monitoring program at the MISS since 1984.

A time-critical removal action was conducted in July 1991 to decontaminate a residential property at 90 Avenue C in Lodi, in response to radiological surveys that identified interior gamma exposure rates above DOE guidelines within a portion of the building. The original owner of the residence was an employee of the MCW, who apparently used discarded building and fill materials from the MCW to construct an addition to the house. Contaminated soil and building materials generated during this removal action were packaged in appropriate containers and placed in Building 76 at the MISS for interim storage.

Eighty-five properties, including the Stepan property and the MISS, have (or have had) residual contamination resulting from MCW thorium-processing activities and are included as a part of the Maywood site. The properties include 56 residential properties (25 of which have been previously remediated and 1 partially remediated), 3 properties owned by the state or federal government, 4 municipal properties, and 20 commercial properties (1 of which has been partially remediated). Vicinity properties are believed to have been contaminated by the use of the waste materials as mulch and fill or through sediment transport via Lodi Brook.

The Maywood site was placed on the National Priorities List (NPL) by the EPA on September 8, 1983. All remedial actions at the site conducted by DOE are being coordinated with EPA Region II under CERCLA. The limits of DOE's responsibilities for the Maywood site are defined under a negotiated FFA between DOE and EPA Region II that became effective April 22, 1991.

Implementation of comprehensive remedial actions will be preceded by completion of the RI/FS-EIS process for the site (Argonne National Laboratory/Bechtel National, Inc. [ANL/BNI] 1992). It is DOE's policy (DOE 1989) to integrate the values of NEPA with the procedural and documentation requirements of CERCLA at sites for which it has responsibility. The combined RI/FS-EIS process will conclude in the issuance of a record of decision (ROD) that will identify the selected remedy for the Maywood site.

1.3 DERIVATION OF CLEANUP GUIDELINES

Because no generic cleanup guidelines for uranium applicable to remedial actions at FUSRAP sites are available, uranium guidelines are derived on a site-specific basis. The purpose of this report is to present the derivation of the residual radioactive material guidelines for uranium (i.e., uranium-234, uranium-235, and uranium-238) that are applicable to remedial action at the Maywood site; that is, the residual concentration of uranium in a homogeneously contaminated area that must not be exceeded if the site is to be released for use without radiological restrictions. On the assumption that the uranium is the only radionuclide present at an above-background concentration, the derivation of site-specific uranium guidelines for the Maywood site was based on the dose limit of 100 mrem/yr (DOE 1990). The RESRAD computer code, which implements the methodology described in the DOE manual for implementing residual radioactive material guidelines (Gilbert et al. 1989; Yu et al. 1993), was used to derive these guidelines. The DOE will establish the final uranium guidelines for the Maywood site by applying the as low as reasonably achievable (ALARA) policy to the derived guidelines presented in this report, along with other factors, such as whether a particular scenario is reasonable and appropriate and whether the contamination is isolated and localized.

2 SCENARIO DEFINITIONS

Current land use at properties composing the Maywood site ranges from residential to commercial/industrial to recreational. Four potential exposure scenarios were considered in deriving site-specific uranium guidelines, including each of these land use categories. In all scenarios it is assumed that, at some time within 1,000 years, the site will be released for use without radiological restrictions following decontamination.

Scenario A assumes industrial use of the site; this is considered the most likely future scenario at the MISS, the Stepan Company property, and numerous commercial/industrial properties within the Maywood site. A hypothetical employee is assumed to work in the area of the site for 8 hours per day (7 hours indoors and 1 hour outdoors), 5 days per week, 50 weeks per year. The industrial worker does not ingest drinking water, plant foods, or fish from the decontaminated area, or ingest meat or milk from livestock raised in the decontaminated area.

Scenario B assumes recreational use of the site; for example, it is assumed that, at some time in the future, the site will be used as a public park; this is considered the expected scenario for the three municipal parks included within the Maywood site. A hypothetical person is assumed to spend 15 hours per week, 50 weeks per year in the decontaminated area of the park. The recreational user does not ingest drinking water, plant foods, or fish from the decontaminated area, or ingest meat or milk from livestock raised in the decontaminated area.

Scenario C assumes residential use of the site; the Maywood site includes numerous residential properties, and continued residential land use is expected. All water used by the resident is assumed to come from a distant source not affected by site conditions (e.g., a municipal water supply); the site is currently served by a municipal water supply, and there is no known use of groundwater at the site as a drinking water source. The resident ingests produce grown in a garden in the decontaminated area but does not ingest meat or milk from livestock raised in the decontaminated area nor fish grown in the decontaminated area.

Scenario D assumes the presence of a resident farmer at the site who drinks water obtained from a well located at the downgradient edge of the decontaminated area, ingests produce grown in a garden in the decontaminated area, ingests meat and milk from livestock raised in the decontaminated area, and ingests fish taken from a pond that is assumed to be constructed adjacent to and downgradient of the decontaminated area. All water used for drinking, irrigation, and livestock is assumed to be drawn from the on-site well. There is no current agricultural activity at the site, and production of livestock or construction of a fishing pond in the decontaminated area are considered extremely unlikely.

Potential radiation doses resulting from nine exposure pathways were analyzed: (1) direct exposure to external radiation from the decontaminated soil material; (2) internal radiation from inhalation of contaminated dust; (3) internal radiation from inhalation of emanating radon-222; (4) internal radiation from incidental ingestion of soil; (5) internal radiation from ingestion of plant foods grown in the decontaminated area and irrigated with water drawn from a well located at the downgradient edge of the decontaminated area; (6) internal radiation from ingestion of meat from livestock fed with fodder grown in the decontaminated area and irrigated with water drawn from the on-site well; (7) internal radiation from ingestion of milk from livestock fed with fodder grown in the decontaminated area and irrigated with water drawn from the on-site well; (8) internal radiation from ingestion of fish from a pond downgradient from the decontaminated area; and (9) internal radiation from drinking water drawn from the on-site well.

The RESRAD computer code, version 5.01 (Yu et al. 1993), was used to calculate the potential radiation doses to each of the hypothetical future receptors on the basis of the following assumptions:

- The resident spends 5,900 hours per year on-site in the decontaminated area (16.5 hours/day indoors and 0.5 hour/day outdoors for 350 days/year). The industrial worker spends 2,000 hours per year on-site (7 hours/day indoors and 1 hour/day outdoors for 250 days/year). The recreationist spends 750 hours per year on-site, all outdoors. The resident farmer spends 4,380 hours per year indoors, 2,190 hours outdoors in the decontaminated area, and 2,190 hours away from the site. Exposure times for the resident and employee were selected for consistency with the baseline risk assessment for the site (DOE 1993).

- For all scenarios, the contaminated zone is taken to be the MISS property.

- After remedial action, no cover material is placed over the decontaminated area.

- The walls, floor, and foundation of the house or commercial building reduce external exposure by 20%, and the indoor dust level is 40% of the outdoor dust level.

- The depth of the house or building foundation is 1 m (3 ft) below ground surface, with an effective radon diffusion coefficient of 2×10^{-8} m^2/s.

- Under Scenario D, a well located at the downgradient edge of the decontaminated area is assumed to provide 100% of the drinking water consumed by the resident farmer and is also used for irrigating vegetables in the on-site garden and fodder for livestock. Under Scenarios A, B, and C, all water is assumed to come from a distant source unaffected by site conditions.

- Under Scenarios C and D, the resident or resident farmer is assumed to consume produce grown in a garden in the decontaminated area. The industrial worker and recreationist do not consume produce from an on-site garden.

- Under Scenario D, the resident farmer is assumed to obtain meat and milk from livestock raised (i.e., foraged) in the decontaminated area. The industrial worker, recreationist, and resident do not consume meat or milk from livestock raised in the decontaminated area.

- An adjacent pond is assumed to provide 50% of the aquatic food (fish) consumed by the resident farmer (Scenario D). The industrial worker, recreationist, and resident do not consume fish from the decontaminated area.

- Hydrogeologic properties of the Maywood site were taken from the remedial investigation report (DOE 1992b), baseline risk assessment (DOE 1993), and FS-EIS (DOE 1994) for the site.

Most exposure parameter values were selected for consistency with values used in the baseline risk assessment (DOE 1993) and FS-EIS (DOE 1994); however, some additional exposure pathways that were determined in the baseline risk assessment to be implausible and/or inappropriate for the Maywood site (e.g., ingestion of meat and milk from livestock raised on-site) are considered here for completeness. Table 1 provides a summary of the exposure pathways considered for Scenarios A, B, C, and D. RESRAD input parameter values used in the analysis are tabulated in the Appendix.

TABLE 1 Summary of Pathways for Scenarios A, B, C, and D at the Maywood Site[a]

Pathway	Scenario A	Scenario B	Scenario C	Scenario D
External exposure	Yes	Yes	Yes	Yes
Particulate inhalation	Yes	Yes	Yes	Yes
Radon inhalation	Yes	Yes	Yes	Yes
Ingestion of soil	Yes	Yes	Yes	Yes
Ingestion of produce	No	No	Yes	Yes
Ingestion of meat from on-site livestock	No	No	No	Yes
Ingestion of milk from on-site livestock	No	No	No	Yes
Ingestion of fish from an on-site pond	No	No	No	Yes
Ingestion of water from an on-site well[b]	No	No	No	Yes

[a] Scenario A, industrial worker; Scenario B, recreationist; Scenario C, resident using a distant water source unaffected by site conditions; Scenario D, resident farmer using an on-site well as the only water source.

[b] Source of water used: 100% well water for drinking, irrigation, and livestock for Scenario D; 100% distant source for all purposes for Scenarios A, B, and C.

3 DOSE/SOURCE CONCENTRATION RATIOS

The RESRAD computer code, version 5.01 (Yu et al. 1993), was used to calculate the dose/source ratio $DSR_{ip}(t)$ for uranium isotope i and pathway p at time t after decontamination. The time frame considered in this analysis was 1,000 years. Radioactive decay and ingrowth were considered in deriving the dose/source concentration ratios. The various parameters used in the RESRAD code for this analysis are listed in the Appendix. The calculated maximum dose/source concentration ratios for all pathways are presented in Tables 2 through 5 for Scenarios A, B, C, and D, respectively. For Scenarios A, B, and C, the maximum dose/source concentration ratios are predicted to occur at time zero (immediately after decontamination). For Scenario D, the maximum dose/source concentration ratio for uranium isotopes is estimated to occur approximately 1,000 years following decontamination. The primary exposure pathway for Scenarios A and B is predicted to be inhalation of resuspended particulates for uranium-234 and external exposure for uranium-235 and uranium-238. For Scenario C, the primary pathway is predicted to be ingestion of produce from an on-site garden for uranium-234 and external exposure for uranium-235 and uranium-238. For Scenario D, the primary pathway is predicted to be ingestion of groundwater for uranium-234 and uranium-238 and external exposure for uranium-235.

The summation of $DSR_{ip}(t)$ for all pathways p is the $DSR_i(t)$ for the ith isotope, that is,

$$DSR_i(t) = \sum_p DSR_{ip}(t) \quad .$$

The total dose/source concentration ratio for total uranium (enriched, depleted, or normal) can be calculated as

$$DSR(t) = \sum_i W_i \, DSR_i(t) \quad ,$$

where W_i is the existing activity concentration fraction at the site for uranium-234, uranium-235, and uranium-238. For this analysis, W_i is assumed to represent the natural activity concentration ratios of 1/2.046, 1/2.046, and 0.046/2.046 for uranium-238, uranium-234, and uranium-235, respectively. The total dose/source concentration ratios for single uranium isotopes and total uranium are provided in Table 6. These ratios were used to determine the allowable residual radioactivity for uranium at the Maywood site.

Uncertainty in the derivation of dose/source concentration ratios arises from the distribution of possible input parameter values as well as uncertainty in the conceptual model used to represent the site. Depending on the scenario, different parameters more strongly influence the results in each case. For Scenarios A, B, and C, the particulate inhalation, external exposure, and produce ingestion (Scenario C only) pathways contribute most of the dose, so uncertainty in parameters affecting these pathways (e.g., occupancy factors, thickness of the contaminated zone, shielding provided by buildings and site features, mass

TABLE 2 Maximum Dose/Source Concentration Ratios for Scenario A (industrial worker) at the Maywood Site

Pathway	Maximum Dose/Source Concentration Ratio (mrem/yr)/(pCi/g)[a]		
	Uranium-234	Uranium-235	Uranium-238
External exposure	2.6×10^{-4}	1.7×10^{-1}	2.5×10^{-2}
Particulate inhalation	9.3×10^{-3}	8.6×10^{-3}	8.6×10^{-3}
Radon inhalation	0	0	0
Ingestion of soil	3.6×10^{-4}	3.4×10^{-4}	3.4×10^{-4}
Ingestion of produce from on-site garden	0	0	0
Ingestion of meat from on-site livestock	0	0	0
Ingestion of milk from on-site livestock	0	0	0
Ingestion of fish from on-site pond	0	0	0
Ingestion of water from on-site well	0	0	0

[a] Maximum dose/source concentration ratios are predicted to occur at time zero (immediately following decontamination); all values are reported to two significant figures.

TABLE 3 Maximum Dose/Source Concentration Ratios for Scenario B (recreationist) at the Maywood Site

Pathway	Maximum Dose/Source Concentration Ratio (mrem/yr)/(pCi/g)[a]		
	Uranium-234	Uranium-235	Uranium-238
External exposure	1.2×10^{-4}	7.8×10^{-2}	1.1×10^{-2}
Particulate inhalation	4.1×10^{-3}	3.7×10^{-3}	3.7×10^{-3}
Radon inhalation	0	0	0
Ingestion of soil	7.8×10^{-4}	7.5×10^{-4}	7.5×10^{-4}
Ingestion of produce from on-site garden	0	0	0
Ingestion of meat from on-site livestock	0	0	0
Ingestion of milk from on-site livestock	0	0	0
Ingestion of fish from on-site pond	0	0	0
Ingestion of water from on-site well	0	0	0

[a] Maximum dose/source concentration ratios are predicted to occur at time zero (immediately following decontamination); all values are reported to two significant figures.

TABLE 4 Maximum Dose/Source Concentration Ratios for Scenario C (resident) at the Maywood Site

Pathway	Maximum Dose/Source Concentration Ratio (mrem/yr)/(pCi/g)[a]		
	Uranium-234	Uranium-235	Uranium-238
External exposure	7.4×10^{-4}	4.9×10^{-1}	7.0×10^{-2}
Particulate inhalation	7.9×10^{-3}	7.3×10^{-3}	7.3×10^{-3}
Radon inhalation	0	0	0
Ingestion of soil	2.5×10^{-3}	2.5×10^{-3}	2.5×10^{-3}
Ingestion of produce from on-site garden	1.8×10^{-2}	1.8×10^{-2}	1.8×10^{-2}
Ingestion of meat from on-site livestock	0	0	0
Ingestion of milk from on-site livestock	0	0	0
Ingestion of fish from on-site pond	0	0	0
Ingestion of water from on-site well	0	0	0

[a] Maximum dose/source concentration ratios are predicted to occur at time zero (immediately following decontamination); all values are reported to two significant figures.

TABLE 5 Maximum Dose/Source Concentration Ratios for Scenario D (resident farmer) at the Maywood Site

Pathway	Maximum Dose/Source Concentration Ratio (mrem/yr)/(pCi/g)[a]		
	Uranium-234	Uranium-235	Uranium-238
External exposure	1.3×10^{-2}	3.3×10^{-1}	4.3×10^{-2}
Particulate inhalation	6.6×10^{-3}	1.7×10^{-2}	6.0×10^{-3}
Radon inhalation	1.8×10^{-3}	0	1.6×10^{-6}
Ingestion of soil	2.2×10^{-3}	7.9×10^{-3}	2.0×10^{-3}
Ingestion of produce from on-site garden	1.4×10^{-2}	6.9×10^{-2}	9.9×10^{-3}
Ingestion of meat from on-site livestock	2.9×10^{-3}	6.2×10^{-2}	2.1×10^{-3}
Ingestion of milk from on-site livestock	6.2×10^{-3}	5.7×10^{-3}	5.4×10^{-3}
Ingestion of fish from on-site pond	1.5×10^{-3}	1.5×10^{-3}	1.5×10^{-3}
Ingestion of water from on-site well	4.6×10^{-2}	4.7×10^{-2}	4.5×10^{-2}

[a] Maximum dose/source concentration ratios are predicted to occur approximately 1,000 years following decontamination (based on total uranium); all values are reported to two significant figures.

TABLE 6 Total Dose/Source Concentration Ratios for Uranium at the Maywood Site

Radionuclide	Total Dose/Source Concentration Ratio (mrem/yr)/(pCi/g)[a]			
	Scenario A	Scenario B	Scenario C	Scenario D
Uranium-234	9.9×10^{-3}	5.0×10^{-3}	2.9×10^{-2}	9.4×10^{-2}
Uranium-235	1.8×10^{-1}	8.3×10^{-2}	5.2×10^{-1}	5.2×10^{-1}
Uranium-238	3.4×10^{-2}	1.6×10^{-2}	9.7×10^{-2}	1.1×10^{-1}
Total uranium	2.6×10^{-2}	1.2×10^{-2}	7.3×10^{-2}	1.1×10^{-1}

[a] *All values are reported to two significant figures.*

loading of contaminated airborne particulates, inhalation rate, and produce ingestion rate) have the greatest impact on model predictions, and parameters related to other pathways have relatively little impact. Because the maximum dose occurs at time zero for these scenarios, uncertainties in parameters related to the leaching of radionuclides from the contaminated zone do not affect the results. However, the opposite is true for Scenario D, in which a large fraction of the total dose is contributed by the drinking water pathway; in this case, the predicted dose is very sensitive to uncertainties in soil properties, meteorological parameters, distribution coefficients, water consumption rates, thickness of the contaminated zone, and other parameters related to the leaching and transport of radionuclides.

For the purposes of this analysis, site-specific parameter values, primarily from the RI/FS-EIS documentation for the Maywood site, have been used when available. RESRAD default values have been used when no site-specific data were available. These default values are based on national average or reasonable maximum values. The contaminated zone thickness of 2 m used to derive the dose/source concentration ratios is based on the assumption that the soil is uniformly contaminated to that depth; in reality, following decontamination of the site, the residual contamination would occur in localized areas and primarily in the near-surface soil and would not be dispersed uniformly throughout the site to this depth. Therefore, the calculated dose/source ratios are conservative. Furthermore, some of the exposure pathways evaluated in this analysis have been included for purposes of completeness, but are considered very unlikely. For example, the production of meat and milk from livestock raised on-site is considered very unlikely given the location and physical characteristics of the site. Similarly, development of a fishing pond at the site is not likely, given the physical and hydrogeologic characteristics of the site, surrounding land use, and the availability of other fishing resources in the area.

4 RESIDUAL RADIOACTIVE MATERIAL GUIDELINES

The residual radioactive material guideline is the concentration of residual radioactive material that can remain in a decontaminated area and still allow use of the area without radiological restrictions. Given the DOE radiation dose limit of 100 mrem/yr effective dose equivalent to a member of the public (DOE 1990, 1992a), the residual radioactive material guideline, *G*, for uranium at the Maywood site can be calculated as

$$G = DL \ / \ DSR \ ,$$

where *DL* is the applicable radiation dose limit (100 mrem/yr) and *DSR* is the total dose/source concentration ratio listed in Table 6. The calculated residual radioactive material guidelines for individual uranium isotopes (uranium-234, uranium-235, and uranium-238) and total uranium are presented in Table 7.

In the calculation of the total uranium guidelines, it was assumed that the activity concentration ratio of uranium-238, uranium-234, and uranium-235 is 1:1:0.046. The derived guidelines for total uranium are 3,800 pCi/g for Scenario A, 8,300 pCi/g for Scenario B, 1,400 pCi/g for Scenario C, and 910 pCi/g for Scenario D. If uranium-238 is measured as the indicator radionuclide, then the uranium-238 limits for total uranium can be calculated by dividing the total uranium guidelines by 2.046. The resulting limits are 1,900 pCi/g, 4,100 pCi/g, 680 pCi/g, and 440 pCi/g for Scenarios A, B, C, and D, respectively.

In implementing the derived radionuclide guidelines for decontamination of a site, the law of the sum of fractions applies. That is, the summation of the fractions of radionuclide concentrations S_i remaining on-site, averaged over an area of 100 m^2 (120 yd^2) and a depth of 15 cm (6 in.) and divided by its guideline, G_i , should not be greater than unity:

$$\sum_i S_i / G_i \leq 1 \quad .$$

The derived guidelines are for a large, homogeneously contaminated area. For an isolated, small area of contamination (i.e., a hot spot), the allowable concentration that can remain on-site may be higher than the homogeneous guideline, depending on the size of the area of contamination and in accordance with Table 8.

TABLE 7 Residual Radioactive Material Guidelines for Uranium at the Maywood Site

	Guideline (pCi/g)[a]			
Radionuclide	Scenario A	Scenario B	Scenario C	Scenario D
Uranium-234	1.0×10^4	2.0×10^4	3.4×10^3	1.1×10^3
Uranium-235	5.5×10^2	1.2×10^3	1.9×10^2	1.8×10^2
Uranium-238	3.0×10^3	6.4×10^3	1.0×10^3	8.8×10^2
Total uranium	3.8×10^3	8.3×10^3	1.4×10^3	9.1×10^2

[a] All values are reported to two significant figures.

TABLE 8 Ranges for Hot Spot Multiplication Factors

Range	Factor (multiple of authorized limit)
$< 1\ m^2$	10[a]
$1 - <3\ m^2$	6
$3 - <10\ m^2$	3
$10 - 25\ m^2$	2

[a] Areas less than 1 m^2 are to be averaged over a 1-m^2 area, and that average shall not exceed 10 times the authorized limit.

Source: Gilbert et al. (1989).

5 REFERENCES

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APPENDIX:

PARAMETERS USED IN THE ANALYSIS OF THE MAYWOOD SITE

The parametric values used in the RESRAD code for the analysis of the Maywood site are listed in Table A.1. Some parameters are specific to the Maywood site; other values are generic.

TABLE A.1 Parameters Used in the RESRAD Code for the Analysis of the Maywood Site

Parameter	Unit	Value			
		Scenario A	Scenario B	Scenario C	Scenario D
Area of contaminated zone[a,b]	m^2	47,000	47,000	47,000	47,000
Thickness of contaminated zone[b]	m	2	2	2	2
Length parallel to aquifer flow[b]	m	220	220	220	220
Cover depth[b]	m	0	0	0	0
Density of contaminated zone[b]	g/cm^3	1.6	1.6	1.6	1.6
Contaminated zone erosion rate[b]	m/yr	0.0006	0.0006	0.0006	0.0006
Contaminated zone total porosity[a]	-[c]	0.45	0.45	0.45	0.45
Contaminated zone effective porosity[a]	-[c]	0.26	0.26	0.26	0.26
Contaminated zone hydraulic conductivity[a]	m/yr	1.23	1.23	1.23	1.23
Contaminated zone b parameter[a]	-[c]	5.3	5.3	5.3	5.3
Evapotranspiration coefficient[a]	-[c]	0.46	0.46	0.46	0.46
Precipitation[a]	m/yr	1.07	1.07	1.07	1.07
Irrigation[b]	m/yr	0.2	0.2	0.2	0.2
Irrigation mode[b]	-[c]	not used	not used	not used	overhead
Runoff coefficient[a]	-[c]	0.25	0.25	0.25	0.25
Watershed area for pond[a]	m^2	not used	not used	not used	55,750
Density of saturated zone[b]	g/cm^3	1.6	1.6	1.6	1.6
Saturated zone total porosity[a]	-[c]	0.45	0.45	0.45	0.45
Saturated zone effective porosity[a]	-[c]	0.26	0.26	0.26	0.26
Saturated zone hydraulic conductivity[a]	m/yr	123	123	123	123
Saturated zone hydraulic gradient[a]	-[c]	0.01	0.01	0.01	0.01
Saturated zone b parameter[a]	-[c]	5.3	5.3	5.3	5.3
Water table drop rate[b]	m/yr	0.0006	0.0006	0.0006	0.0006
Well pump intake depth[b] (below water table)	m	not used	not used	not used	10
Model: nondispersion (ND) or mass-balance (MB)[b]	-[c]	not used	not used	not used	ND
Well pumping rate[b]	m^3/yr	not used	not used	not used	250
Number of unsaturated zone strata[b]	-[c]	1	1	1	1
Unsaturated zone 1 thickness[a]	m	1	1	1	1
Unsaturated zone 1 soil density[a]	g/cm^3	1.6	1.6	1.6	1.6
Unsaturated zone 1 total porosity[a]	-[c]	0.45	0.45	0.45	0.45
Unsaturated zone 1 effective porosity[a]	-[c]	0.26	0.26	0.26	0.26

TABLE A.1 (Cont.)

Parameter	Unit	Value: Scenario A	Scenario B	Scenario C	Scenario D
Unsaturated zone 1 soil b parameter[a]	-[c]	5.3	5.3	5.3	5.3
Unsaturated zone 1 hydraulic conductivity[a]	m/yr	1.23	1.23	1.23	1.23
Distribution coefficient (all zones)					
Uranium-238[d]	cm^3/g	250	250	250	250
Uranium-235[d]	cm^3/g	250	250	250	250
Uranium-234[d]	cm^3/g	250	250	250	250
Protactinium-231[d,e]	cm^3/g	2500	2500	2500	2500
Thorium-230[d,e]	cm^3/g	60,000	60,000	60,000	60,000
Actinium-227[d,e]	cm^3/g	1500	1500	1500	1500
Radium-226[d,e]	cm^3/g	450	450	450	450
Lead-210[d,e]	cm^3/g	900	900	900	900
Inhalation rate[f]	m^3/yr	21,900	12,264	7300	7300
Mass loading for inhalation[f,g]	g/m^3	0.00003	0.00003	0.00003	0.00003
Indoor occupancy time fraction[f]	-[c]	0.20	0	0.65	0.65
Outdoor occupancy time fraction[f]	-[c]	0.03	0.086	0.02	0.02
Shielding factor from external radiation afforded by indoor occupancy[b]	-[c]	0.8	not used	0.8	0.8
Fraction of outdoor dust present indoors[b]	-[c]	0.4	not used	0.4	0.4
Shape factor, external gamma[b]	-[c]	1	1	1	1
Dilution length for airborne dust inhalation[b]	m	3	3	3	3
Soil ingestion rate[f]	g/yr	12.5	35	35	35
Homegrown fruit, vegetable, and grain consumption[f]	kg/yr	not used	not used	24	24
Homegrown leafy vegetable consumption[f]	kg/yr	not used	not used	4	4
Milk consumption from livestock[b]	L/yr	not used	not used	not used	92
Meat consumption from livestock[b]	kg/yr	not used	not used	not used	63
Fish consumption[b]	kg/yr	not used	not used	not used	5.4
Other seafood consumption[b]	kg/yr	not used	not used	not used	not used
Drinking water intake[f]	L/yr	not used	not used	not used	700
Fraction of drinking water from on-site well[b]	-[c]	not used	not used	not used	1
Fraction of aquatic food from on-site pond[b]	-[c]	not used	not used	not used	0.5
Livestock fodder intake for meat[b]	kg/d	not used	not used	not used	68
Livestock fodder intake for milk[b]	kg/d	not used	not used	not used	55
Livestock water intake for meat[b]	L/d	not used	not used	not used	50
Livestock water intake for milk[b]	L/d	not used	not used	not used	160
Mass loading for foliar deposition[b]	g/m^3	not used	not used	0.0001	0.0001
Depth of soil mixing layer[b]	m	0.15	0.15	0.15	0.15
Depth of roots[b]	m	not used	not used	0.9	0.9
Contaminated fraction					
Drinking water[b]	-[c]	not used	not used	0	1
Household water[b]	-[c]	not used	not used	0	1
Livestock water[b]	-[c]	not used	not used	not used	1
Irrigation water[b]	-[c]	not used	not used	not used	1
Produce[b]	-[c]	not used	not used	not used	1
Meat[b]	-[c]	not used	not used	not used	-1
Milk[b]	-[c]	not used	not used	not used	-1

TABLE A.1 (Cont.)

Parameter	Unit	Value			
		Scenario A	Scenario B	Scenario C	Scenario D
Groundwater fractional usage (balance from surface water)					
Drinking water[b]	-[c]	not used	not used	not used	1
Household water[b]	-[c]	not used	not used	not used	1
Livestock water[b]	-[c]	not used	not used	not used	1
Irrigation[b]	-[c]	not used	not used	not used	1
Total porosity of the house or building[b]	-[c]	0.1	not used	0.1	0.1
Volumetric water content of cover material[b]	-[c]	not used	not used	not used	not used
Volumetric water content of the foundation[b]	-[c]	0.05	not used	0.05	0.05
Diffusion coefficient for radon gas	m^2/s				
in cover material		not used	not used	not used	not used
in foundation material[b,f]		2.0×10^{-8}	not used	2.0×10^{-8}	2.0×10^{-8}
in contaminated zone material[b,f]		2.0×10^{-6}	2.0×10^{-6}	2.0×10^{-6}	2.0×10^{-6}
Emanating power of radon gas[b,f]	-[c]	0.2	0.2	0.2	0.2
Radon vertical dimension of mixing[b]	m	2.0	2.0	2.0	2.0
Average annual wind speed[a]	m/s	5.3	5.3	5.3	5.3
Average building air exchange rate[b,f]	hr^{-1}	1.0	not used	1.0	1.0
Height of the building (room)[b]	m	2.5	not used	2.5	2.5
Bulk density of building foundation[b]	g/cm^3	2.4	not used	2.4	2.4
Thickness of building foundation[b]	m	0.15	not used	0.15	0.15
Building depth below ground surface[b]	m	1.0	not used	1.0	1.0

[a] Values based on site specifications as documented by DOE (1992, 1993a, and 1994).

[b] Values based on scenario assumptions or default parameter value.

[c] Parameter is dimensionless.

[d] Distribution coefficient values for uranium are based on laboratory analyses of site-specific soil samples from the Wayne site (DOE 1993b); values for radioactive decay products are based on published values for similar soil types (Baes et al. 1984; Sheppard and Thibault 1990).

[e] Radionuclide is a decay product.

[f] Values based on scenario assumptions specified by DOE (1993a).

[g] Mass loading for inhalation assumes that the total mass loading of airborne particulates is 200 μg/m³, that 50% of the airborne particulates originated from soil or soil-like material, and that 30% of the airborne particulates are of respirable size (DOE 1993a).

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Qualitative Assessment of Remediation Worker Risk

Remediation workers will be exposed to site contaminants while implementing Alternative 3 or 4. This exposure will be controlled according through the use of site controls (e.g., dust suppression, access restrictions, protective clothing), internal radiation monitoring, if appropriate (i.e., bioassay samples), and external radiation monitoring (i.e., personal dosimeters). Construction activities will comply with a USACE-approved health and safety plan and will comply with appropriate federal regulations (e.g., 10 CFR 20 limits for radiation workers and OSHA regulations for general construction activities). Because exposure to a remediation worker will be closely monitored and controlled, it is exceedingly difficult to predict exposures based on current site conditions alone. That is, a default residential scenario may be defined and exposure estimates to a resident are usually considered conservative but reasonably accurate. The exposure to a remediation worker is highly unpredictable given the use of remote handling and heavy equipment such as backhoes, access restriction and personal protective clothing, general health and safety practices, and ALARA (as low as reasonably achievable). For these reasons, the exposure to a remediation worker is only considered qualitatively. It is, therefore, assumed that a remediation worker's exposure will be controlled to within the appropriate limits and will be ALARA.

EXPOSURE TO THE GENERAL PUBLIC DURING REMEDIAL ACTION

Potential health impacts of remedial action at the FUSRAP Maywood Superfund Site were assessed by estimating the radiological risks to the general public that could result from exposure to FUSRAP Maywood Superfund Site releases. Such releases could occur during the excavation, treatment, transportation, and disposal activities associated with implementing any one of the action alternatives for the FUSRAP Maywood Superfund Site cleanup.

The scope of this assessment is limited to impacts resulting from remedial action activities. Other components of the risk assessment process are presented in the Baseline Risk Assessment (BRA) (DOE 1993). Assessment of health impacts to the general public during the remediation action period was conducted in accordance with EPA methodology provided in the *Risk Assessment Guidance for Superfund, Part C - Risk Evaluation of Remedial Alternatives* (EPA 1991). Risks associated with no action at the FUSRAP Maywood Superfund Site were estimated in accordance with EPA methodology for conducting baseline risk assessments. The methodologies used for the exposure assessment, toxicity assessment, and risk characterization are described in detail in the BRA.

From the analysis of preliminary alternatives in Section 4, four final remedial action alternatives were identified for detailed evaluation. Alternative 1, the no-action alternative, was evaluated for the purpose of comparison with the action alternatives. The potential impacts to human health and the environment associated with Alternative 1 are presented in the BRA. Alternative 2, which maintains status quo at the FUSRAP Maywood Superfund Site (monitoring and institutional controls), would not result in additional exposures over Alternative 1. The impacts associated with the two excavation alternatives, Alternatives 3 and 4, are discussed below.

POTENTIAL RECEPTORS AND EXPOSURE SCENARIOS

Table C-1 summarizes the alternatives presenting a remedial action exposure scenario to the general public considered in this assessment. The general public could potentially be exposed to radioactive COCs from the FUSRAP Maywood Superfund Site via airborne dust and gaseous emissions generated during the remediation effort and following remediation for action alternatives where impacted material remains encapsulated at the FUSRAP Maywood Superfund Site. Potential receptors include nearby residents and individuals working at commercial facilities near the FUSRAP Maywood Superfund Site.

Table C-1. Alternatives Evaluated for General Public Exposure

Alternative	General Public During Remediation
1	NP
2	NP
3	Evaluated
4	Evaluated

NP = no pathway

Although other potential receptors could be identified for the general public (e.g., individuals driving by the FUSRAP Maywood Superfund Site, or visitors to the FUSRAP Maywood Superfund Site), risks to these receptors were not evaluated because their exposures would be substantially less than those estimated for the specific receptors identified in this analysis. In addition to assessing the potential health risks to individual receptors, the potential collective health risks associated with exposures to airborne radioactive COCs were assessed for the population within an 80-km (50-mi.) radius of the FUSRAP Maywood Superfund Site.

EXPOSURE PATHWAYS

The principal source of possible exposures at Maywood is radiologically contaminated soil. Remedial action activities such as excavation and loading for disposal could provide a mechanism for COC release. Fugitive dust would be generated during waste excavation, loading, treatment, unloading, and waste placement activities. Surface water and sediment transport would be subject to engineering controls and would not be expected to contribute to COC migration.

The principal COC release mechanisms and transport media associated with such activities are:

- Emission of gamma radiation from radioactively impacted material to the atmosphere,
- Resuspension of radioactively impacted particulate material to the atmosphere through erosion of soil or agitation of soil during remediation,
- Emission of radon gas from radium impacted soil to the atmosphere, and

The potential routes of human exposure to FUSRAP Maywood Superfund Site COCs presented in this assessment are:

- Inhalation of radon and its short-lived decay products,
- External gamma irradiation,
- Inhalation of radioactively impacted airborne dust,
- Incidental ingestion of radioactively impacted soil, and
- Groundwater ingestion.

EXPOSURE POINT CONCENTRATIONS

Soil

Exposure point concentrations of radioactive COCs were estimated for each alternative. Because the different remedial action alternatives at the FUSRAP Maywood Superfund Site involve the handling of material from several distinct source areas that are impacted with varying concentrations of different COCs, and the workers are assumed to be relatively mobile, COC concentrations were developed which are representative of the FUSRAP Maywood Superfund

Site as a whole. The data from all boreholes and soil samplings (both surface and subsurface) from the individual areas site-wide were aggregated for Alternatives 3 and 4 and overall FUSRAP Maywood Superfund Site exposure point concentrations for radionuclides were obtained. The upper confidence limit on the mean (i.e., UCL_{95}) was calculated based on log-normally distributed statistics and was used as the reasonable maximum exposure (RME) point concentration. The RME is reported in this assessment as a reasonable estimate of the maximum exposure likely to be received to estimate all risk exposures. The concentrations of radioactive COCs for the areas undergoing remediation in each of the alternatives are presented in Table C-2.

Table C-2. Radionuclide Concentrations (pCi/g) in FUSRAP Maywood Superfund Site Soils

Alternative[a]	Th-232 + D[b]			Ra-226 + D		U-238 + D			U-235 + D[c]		
	Th-232	**Ra-228**	**Th-228**	**Ra-226**	**Pb-210**	**U-238**	**U-234**	**Th-230**	**U-235**	**Pa-231**	**Ac-227**
3 and 4	**4.0**	4.0	4.0	0.91	0.91	4.0	4.0	4.0	0.2	0.2	0.2

Shaded area indicates measured concentrations.

[a] All the soil that is remediated under an alternative is aggregated as a homogeneous unit. The values are calculated RME concentrations.

[b] + D denotes secular equilibrium was assumed to derive concentrations for associated decay products (non-shaded areas)

[c] U-235 + D concentrations are 5% of U-238 value.

The soil data presented in the RI Report (BNI 1992) and historical data from the FUSRAP Maywood Superfund Site were used in this assessment. Soil samples were analyzed for U-238, Ra-226, and Th-232. The decay progeny associated with these nuclides are assumed to be in secular equilibrium. Alternatives involve either complete or substantial excavation of the impacted material. The exposure point concentrations for these alternatives were developed by aggregating all soil data for the FUSRAP Maywood Superfund Site. The data set includes between 4,848 and 5,020 individual samples, depending on the analyte.

Air

Airborne COCs concentrations of radionuclides other than radon were estimated from the concentrations in soil being remediated. Separate methods were used to estimate onsite concentrations and fugitive emissions offsite. The methods are discussed below.

Onsite

Onsite receptors will be exposed to airborne COCs resuspended from the soil. A mass loading value of 6×10^{-4} g/m^3 was assumed to represent the concentration of dust in air at the FUSRAP Maywood Superfund Site (Yu et al. 1993). All of the dust was assumed to originate from impacted soil. The respirable portion of the total particulate concentration was assumed to be 30% (Paustenbach 1989).

The COC concentration in onsite air (pCi/m^3) potentially available for inhalation was estimated for each radiological COC as follows:

$$C_{air,i} = C_{soil,i} \times Dust_{air} \times 0.3 \times 0.1$$

where:

$C_{soil,i}$	=	soil concentration of radionuclide i (pCi/g),
$Dust_{air}$	=	mass loading of dust in air (6×10^{-4} g/m^3),
0.3	=	30% of the dust is of respirable size, and
0.1	=	concentration reduction by respiratory protection.

Offsite

Particulate concentrations at the exposure points beyond the FUSRAP Maywood Superfund Site perimeter were estimated by determining the concentration of each radionuclide released from the FUSRAP Maywood Superfund Site. The airborne release rate from the FUSRAP Maywood Superfund Site was based on EPA-derived (EPA 1985) emission factors for construction activities. The alternatives (2 through 4) involve various combinations of dust generating operations such as loading and unloading radioactive soil (batch drops), wind erosion of exposed materials, and movement of equipment across impacted areas. All volume, project duration and other applicable data were taken from the 1997 Maywood detailed cost analysis. To simplify modeling and to provide conservative dose estimates, it is assumed that the same fugitive emissions are released by Alternatives 3 and 4.

The following equation was used to estimate the COC release rate during material loading and unloading:

$$Ci/y = C_R \times 1 \times 10^{-12} \times F_{3or10} \times M_{3or10,alt,T\,or\,UT} \times 1{,}000 / YTI$$

where:

C_R	=	radionuclide concentration in soil (pCi/g),
1×10^{-12}	=	conversion from pCi to Ci (Ci/pCi),
F_{3or10}	=	emission factor for a 3 yd^3 drop or a 10 yd^3 batch drop (kilogram/megagram or kg/Mg)
$M_{5or10,alt,TorUT}$	=	total soil mass from 3 or 10 yd^3 batch drops during a specified alternative with treated or untreated soil (Mg),
1,000	=	conversion from grams to kilograms (g/kg), and
YTI	=	years to implement or alternative duration is 6.0 for Alternatives 2, 3, and 4 and 7.0 for Alternative 5.

A 90 percent dust control efficiency is applied to treated soil due to a combination of chemical and water treatment. A 50 percent dust control efficiency is applied to untreated soil from water spraying (EPA 1985).

Fugitive emissions from vehicular traffic (during excavation) was estimated using the following equation:

$$Ci/y = C_R \times 1 \times 10^{-12} \times F_V \times M_{V,alt} \times 1{,}000 / YTI$$

where:

C_R	=	radionuclide concentration in soil (pCi/g),
1×10^{-12}	=	conversion from pCi to Ci (Ci/pCi),
F_v	=	emission factor for a dust mass released per vehicular kilometer traveled (kg/VKT)
$M_{v,alt}$	=	total VKT during a specified alternative (km),

1,000	=	conversion from grams to kilograms (g/kg), and
YTI	=	years to implement or alternative duration (years).

Vehicle miles were estimated assuming that a ten-wheel, 10 yd^3 truck was used to transport the impacted material. The release fraction was developed using methodology from EPA 1985, where the truck was assumed to weigh 25 tons empty, averaging 2 mph over 100 meters per trip (one-way) between the excavation face and the loadout or treatment facility. A 50% dust control efficiency over general construction conditions was also assumed.

Fugitive emissions from wind erosion (during excavation) was calculated using the following equation:

$$Ci/y = C_R \times 1 \times 10^{-12} \times F_W \times M_{W,alt} \times 1{,}000 / YTI$$

where:

C_R	=	radionuclide concentration in soil (pCi/g),
1×10^{-12}	=	conversion from pCi to Ci (Ci/pCi),
F_w	=	emission factor for a dust mass released per unit surface area per day (kg/hectare/day)
$M_{w,alt}$	=	surface area times the number of days the material is exposed for each alternative (hectare days),
1,000	=	conversion from grams to kilograms (g/kg), and
YTI	=	years to implement or alternative duration (years).

The surface area was determined by assuming one week's worth of excavated material would be exposed year round (approximately 0.1 hectare for all alternatives). A 40-week work year is assumed.

The alternative-specific parameters and the resultant estimates of airborne dust emissions for the cleanup period are presented in Table C-3. Only estimates for fugitive dust originating from impacted areas were used in this assessment; estimates of dust generated by the movement of construction equipment on unimpacted areas were not included.

The fugitive dust emissions were used to estimate potential inhalation exposures for offsite receptors. The radionuclide emission rates for the various alternatives are presented in Table C-4. The predicted emissions are for the complete implementation of the given alternative. Since the excavation/treatment phases of all alternatives exceed one work year, the calculated total emissions were divided by the total number of years to complete action, representing the annual emission rate. Changes in the implementation time would change the annual fugitive dust release rate, and hence the annual dose to the maximum exposed individual, but not the cumulative collective population dose.

ESTIMATED DOSES AND INTAKES OF COCs

Estimates of exposure are based on the COC concentrations at the exposure points and scenario specific assumptions and intake parameters.

For radioactive COCs the exposure is expressed in terms of the effective dose equivalent for all exposure pathways.

Table C-3. Estimated Airborne Fugitive Dust Releases

Alternative	Years to Implement	Fugitive Emissions (kg/yr) Vehicular Traffic	Pre-Treatment[a]	Post-Treatment[b]	Wind Blown	Total[c]
3 Excavation of Accessible Soils	≈ 6.0	567	122	5.9	525	1,220
4 Excavation of Accessible Soils with Treatment	≈ 6.0	567	122	5.9	525	1,220

[a] With 50% dust control efficiency.
[b] With 90% dust control efficiency.
[c] Total emissions for remediation, annual emissions are assumed to be reduced by dividing the total emissions by the implementation time.
N/A = not applicable

Table C-4. Radionuclide Emissions (Ci/yr) for CAP88 Analysis

Alternative	Th-232 + D			Ra-226 + D[a]		U-238 + D			U-235 + D[b]		
	Th-232	Ra-228	Th-228	Ra-226	Pb-210	U-238	U-234	Th-230	U-235	Pa-231	Ac-227
3 and 4	4.88E-06	4.88E-06	4.88E-06	1.11E-06	1.11E-96	4.88E-06	4.88E-06	4.88E-06	2.24E-07	2.24E-07	2.24E-07

Shaded area indicates measured concentrations
[a] + D denotes secular equilibrium was assumed to derive concentrations for associated decay products (non-shaded areas)
[b] U-235 + D concentrations are 5% of U-238 value

General Public

The general public could be exposed both to COCs released during the remediation period and to materials remaining onsite after remediation. Fugitive dust emissions are the principal release mechanism during remediation. After remediation, members of the general public who reoccupy the FUSRAP Maywood Superfund Site could be exposed to residual COCs.

The CAP-88PC computer code (Parks 1991) was used to estimate both collective population, and maximally exposed individual, dose and risk. CAP-88PC is intended for use in estimating radiation dose equivalents and risks from radionuclides emitted into the air. The code consists of computer models, databases, and associated utility programs developed by the EPA for assessing compliance of radionuclide releases with limits established under the Clean Air Act. CAP-88PC considers exposures to emitted radionuclides from inhalation of and immersion in impacted air; ingestion of meat, milk, and vegetables; and direct exposure to impacted land surfaces. The analysis was performed using the urban setting default parameters for ingestion quantities and other exposure sources. Radiation dose equivalents to the maximally exposed individual and to regional populations within 80 km (50 mi) of the emission source were calculated. Doses for the maximally exposed individual are estimated for the location of highest risk. The collective population dose is found by summing, for all sector segments, the intake and exposure rates multiplied by the appropriate dose conversion factor. Collective population dose is reported in person-rem/year.

CAP-88PC uses a modified Gaussian plume equation to calculate radionuclide-specific average ground level air concentrations at selected locations. Radon exposures were not modeled because actual radon measurements at the FUSRAP Maywood Superfund Site indicate that radon flux is minimal and would not significantly contribute to the dose and risk estimates.

Radiological exposures were calculated for an individual receptor with pathway-specific equations and receptor-specific intake parameters. For each pathway, the exposure point concentration was multiplied by the quantity of the intake and the appropriate dose conversion factor, which gives the dose (in mrem) for a unit intake of a radionuclide. In addition to inhalation, airborne COCs released during the cleanup period could settle on the ground, resulting in three additional pathways: direct external gamma irradiation, incidental ingestion of soil and ingestion of food. Although these three potential exposure pathways are not expected to be significant, the radiation doses from these pathways were included for completeness.

The estimated dose to the hypothetical maximally exposed member of the general public at 50 m (160 ft) from the FUSRAP Maywood Superfund Site is 0.049 mrem/yr for Alternatives 3 and 4. As shown on Table C-5, the estimated dose is even smaller for the other alternatives. The results of this analysis indicate that no individual would receive a dose from the combined exposure pathways that could be associated with FUSRAP Maywood Superfund Site activities in excess of 15 mrem/year.

Table C-5. Maximum Individual and Collective Population Dose and Risk Summary

Alternative	Maximum Individual[(a)]			Population Collective Dose[(a)]	
	Dose Rate (mrem/yr)	Total Dose[b] (mrem)	Risk[c]	Dose Rate (mrem/yr)	Total Dose[b] (mrem)
Alternatives 3 and 4	0.049	0.29	1.7×10^{-7}	0.25	1.5

[a] To offsite member of the public from fugitive emissions.

[b] Total dose = (Dose Rate) × (Alternative Duration) where Alternative Duration is 6.0 years for Alternatives 2, 3, and 4, and 7.0 years for Alternative 5.

[c] Risk = (Total Dose) × (6×10^{-7}) where 6×10^{-7} is the risk of excess cancers per mrem.

Radiological risks to the public were estimated using a dose to risk conversion factor. The maximum individual dose for each alternative (Table C-5) was multiplied by 6×10^{-7} excess cancers per mrem to estimate the annual risk from remediation. The annual risk was multiplied by the implementation time (in years) to estimate the total excess cancer risk from each alternative.

Offsite population doses from radioactive COCs were calculated for all persons residing within a 80 km (50 mi.) radius of the FUSRAP Maywood Superfund Site (Table C-5). The population distribution assumed for the CAP-88 calculations was derived using 1990 census data (von Buelow 1994). The maximum estimated collective dose to the population residing within this area during the remedial action period is 1.5 person-rem.

HEALTH RISK EVALUATION FROM EXPOSURE TO COCs

Radiological risks were determined using a dose to risk conversion factor of 6×10^{-7}, integrating the annual doses over the implementation time. The health risk evaluated is the induction of cancer related to exposure to low levels of ionizing radiation. The lifetime individual risks to members of the general public from radiation exposure during remedial action activities would be low, i.e., much less than 1×10^{-6} for all receptors. It is unlikely that any cancer induction in offsite individuals would result from FUSRAP Maywood Superfund Site cleanup.

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SECTION 5 TO APPENDIX C

ASSESSMENT OF REMEDIAL ALTERNATIVE PROTECTIVENESS

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1 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) is addressing this site under its Formerly Utilized Sites Remedial Action Program (FUSRAP) and has prepared a Feasibility Study (FS) to which this document is attached as a section 5 of appendix (C). Potential human health impacts due to remedial action at the FUSRAP Maywood Superfund Site (the "Site") were assessed by estimating the risks to workers and the general public that could result from exposure to radiological contaminants on, or released from, the site. Potential exposures include exposure to potentially contaminated dust during remediation, exposure of workers preparing the site for release, contaminants in fugitive emissions released during excavation activities, and exposure of future occupants after the site is released. Potential impacts for the remedial action alternatives were evaluated to estimate the increased likelihood of cancer induction as a result of exposure to site contaminants. The approach used for the human health evaluation is based on the Environmental Protection Agency (EPA) guidance in *Risk Assessment for Superfund Volume I, Human Health Evaluation Manual (Part A)* (RAGS Part A) (EPA 1989). Assessment of health impacts to workers and the general public during the remediation action period was conducted in accordance with EPA methodology provided in the *Risk Assessment Guidance for Superfund, Part C - Risk Evaluation of Remedial Alternatives* (EPA 1991).

Four cleanup alternatives are considered as defined below:

Alternative 1 - No Action: Site is released for unrestricted use in its current condition;
Alternative 2 - Monitoring and Institutional Controls: Site is released for unrestricted use in its current condition with continued monitoring of site conditions and institutional controls such as access restrictions to prevent additional exposures beyond current uses of some properties at the Site and to reduce exposures at other properties at the Site;
Alternative 3 – Excavation and Disposal of Accessible and Inaccessible Soils: Site is released after removal and offsite disposal of contaminated accessible and inaccessible soils above the appropriate clean up criteria, with institutional controls for properties which are not remediated to the unrestricted use criterion; and
Alternative 4 – Excavation, Treatment, and Disposal of Accessible Soils; and Excavation and Disposal of Inaccessible Soils: Site is released after removal and offsite disposal of contaminated accessible and inaccessible soils above the appropriate clean up criteria, and, if treatment is proven effective, treated soils are used as backfill on commercial properties, with institutional controls for properties which are not remediated to the unrestricted use criterion. A clean cover of at least 1 foot in thickness is maintained over all areas subject to backfilling with treated materials.

Five exposure scenarios are evaluated including an onsite residential, an offsite residential, an industrial worker, a maintenance worker, and a remediation worker. The offsite residential scenario is used to estimate the risks from release of fugitive emissions during remedial activities for Alternatives 3 and 4. The offsite resident and the remediation worker are evaluated to address the short-term effectiveness (i.e., approximating risks that occur during the implementation of remedial alternatives) of each alternative. The risks to the offsite resident and the remediation worker are discussed in the Qualitative Assessment of Remediation Worker Risk and Exposure To the General Public During Remediation sections of this appendix (See page C-37 and C-38). All other scenarios are considered to evaluate the long-term effectiveness (approximating risks from exposure to onsite residual contamination) of each alternative and are presented below.

The site Baseline Risk Assessment (BRA) (DOE 1993a) evaluated the baseline risk from exposure to contaminants at the Site. Risks from exposure to chemicals are estimated using standard RAGS equations (EPA 1989) and slope factors found in Integrated Risk Information System (IRIS) (EPA 1998) and Health Effects Assessment Summary Tables (HEAST) (EPA 1995). The BRA is summarized in section 2.6 of this document. Since the release of the BRA for public comment, additional site information has been collected. Risks from post remedial action exposure to radionuclides in soil for Alternatives 3 and 4 are estimated using the RESRAD computer code Version 6.0 (which uses the RAGS methodology and HEAST factors, and which was developed by Argonne National Laboratory).

2 SELECTION OF CONTAMINANTS OF POTENTIAL CONCERN (COPCs)

2.1 RADIONUCLIDE SCREENING

The FUSRAP Maywood Superfund Site is being addressed under FUSRAP because is contains elevated concentrations of radionuclides as a result of processing monazite sands and because the Site was assigned by the U.S. Congress to DOE, who then designated the Site for FUSRAP. In 1997-8 the USACE was then identified as the lead agency for FUSRAP implementation. Monazite sands are known to contain elevated concentrations of radionuclides from the three naturally occurring decay series. Radionuclide contaminants of potential concern (COPCs), therefore, include all members of the uranium, thorium, and actinium series. Cancer slope factors are limited to radionuclides with half-lives of six months or longer. Short-lived decay products are included in slope factors for the long-lived radionuclides so that they need not be included explicitly. The list of long-lived radionuclides includes uranium-238 (U-238), U-234, thorium-230 (Th-230) and radium-226 (Ra-226) from the uranium series, Th-232, Ra-228 and Th-228 from the thorium series; and U-235, Pa-231 and Ac-227 from the actinium series. The site database contains mostly data on U-238, Ra-226 and Th-232 and little or no data on remaining radionuclides. However, the intimate relationship between radionuclides in these series can be used to estimate concentrations for the other radionuclides. Therefore, this is not considered to be a data gap.

While concentrations of U-238 and Ra-226 may be estimated by summarizing characterization data, concentrations of U-234 and Th-230 must be estimated using different means. Because U-238 and U-234 are chemically identical, and the uranium was neither depleted or enriched, it can be assumed that these radionuclides are in equilibrium (i.e., are present at the same concentration). Because the thorium extraction process at Maywood would have removed Th-230 as well as Th-232, Th-230 is likely not in equilibrium with other radionuclides in the series.

Radionuclides in the thorium series are assumed to be in " equilibrium" (when a long-lived radionuclide decays into a short-lived daughter, and the activity of the daughter radionuclide approaches that of the parent, reaching equilibrium) because sufficient time has passed since the last extraction operations. In fact, an analysis of site data show Th-232 (the first long-lived radionuclide, with a half-life of 14 billion years) in equilibrium with Th-228 (the last long-lived radionuclide, with a half-life of 1.9 years).

Members of the actinium series are assumed to be present at approximately five % of the U-238 concentration. This is because the uranium was neither enriched nor depleted, thus all uranium including U-235 is assumed to be present in natural abundance. In nature, U-235 is present at 4.6 % of the U-238 concentration. Because there is no evidence that the extraction process affected Pa-231 or Ac-227, they are assumed to be present in equilibrium with (at the same concentration as) U-235. All members of the actinium series are, therefore, assumed to be present at 4.6 % of the U-238 concentration.

The relative radionuclde concentrations are calculated based on the relative magnitude of measured Th-232, Ra-226, and U-238, concentrations in soils at the FUSRAP Maywood Superfund

Site. The concentration of Ra-226 is assumed to be approximately 25percent of the Th-232 concentration, based on a review of site characterization data (the Ra-226:Th-232 concentration ratio ranges from approximately 0.05 to 0.28 for residential properties, and from 0.005 to 0.26 for commercial\industrial properties, with a site-wide average of 0.23), and the composite concentration of Ra-226 and Th-232 is constrained to 15 picocurries/gram (pCi\g) (EPA 1994). Th-230 concentrations are assumed to be equivalent to Ra-226 concentrations in soil (a conservative measure since Th-230 would have been removed in the MCW milling operation). The 5 and 15 pCi/g criteria are not applicable to uranium, for which a site-specific concentration limit is derived; however, a review of the site characterization data indicates that the U-238 concentration measurements in soil are similar to the Th-232 concentrations (the U-238: Th-232 ratio ranges from 0.35 to 1.7 for residential properties and from 0.14 to 3.3 for commercial\industrial properties, with a site-wide average of 1.0), and the concentration of U-238 and progeny is assumed to be equal to the residual Th-232 concentration for evaluation of residual risk (EPA 1994).

2.2 NONRADIONUCLIDE SCREENING

This appendix focuses upon the cancer risk associated with radiological contaminants at the Site. As indicated in the body of the FS, the U.S. Department of Energy's ["DOE", predecessor to USACE for implementation of the FUSRAP)] BRA for the Site also calculated some potentially significant ecological risk associated with some wetlands at the Site. For this reason, Alternative 1 (No Action) is considered unprotective for ecological risk, as well as for human health. Alternatives 3 and 4 are considered protective for ecological risk, as well as for human health, because the sediment contamination in the wetlands is above the human health criterion for soil/sediment, and the contaminated sediments would be removed from the wetland. (Such activity would comply with New Jersey's Freshwater Wetland Mitigation Requirements, which are considered an ARAR in this FS.) Alternative 2, Monitoring and Institutional Controls, is also presumed to be unprotective for ecological risk, since institutional controls would not be effective for reducing nonhuman exposure to contamination. However, the ecological assessment completed by DOE in 1993 is considered a screening level assessment. It is possible that additional data could be collected on the Site, and a more detailed ecological assessment completed, consistent with EPA guidance, and find protective levels of ecological risk. (As more data is collected in order to complete more detailed ecological assessments, uncertainty is often reduced, resulting in lower levels of ecological risk.)

DOE's 1993 BRA also addressed cancer risk from chemical, non-radiological contaminants. Except for groundwater, which is not addressed by this FS as part of this operable unit, no cancer risks for chemicals above the CERCLA protective range were calculated for the Site. While it is true that both the radiological and chemical carcinogens at the Site may both present some human cancer risk, the chemical cancer risk calculated by DOE in the 1993 BRA would not cause Alternatives 2, 3 or 4 to exceed the CERCLA protective range if chemical and radiological cancer risks were added.

Finally, DOE's 1993 BRA also addressed noncancer toxicity related to potential human exposure to chemical contamination at the Site. Again except for groundwater, which is not addressed by this FS as part of this operable unit, no unprotective levels of human noncancer risk were calculated (See section 2.6.2.3 of the Feasibility Study).

3 EXPOSURE ASSESSMENT

3.1 LAND USE

If the Site were released without restrictions or institutional controls after the final remedy has been implemented, there are several potential land uses. Areas surrounding portions of the Site are residential, so one option is that the land is converted into residential parcels. A residential exposure scenario is evaluated under Alternatives 1, 3, and 4. It is conceivable that a commercial/industrial facility could be constructed on portions of the Site after its release. Because the industrial scenario is the current zoned land use, an industrial receptor is considered under Alternatives 1, 2, 3, and 4. Site security measures could continue after the final remedy is implemented. The future land uses which are considered reasonable, therefore, include residential as well as industrial uses.

3.1.1 Identification of Receptors

Table C-1 summarizes the potential receptors and exposure pathways considered in this assessment. Exposure pathways include direct gamma, soil ingestion, soil/dust inhalation, drinking water (although groundwater is not considered part of the operable unit addressed by this FS) and produce consumption (resident only). All receptors are exposed on-site to contaminants in soil, or in the case of the industrial worker, additional exposure to radiological contaminants in building surfaces is also considered. The offsite resident and the remediation worker are considered to evaluate the short-term effectiveness of each alternative. The onsite resident, industrial worker, maintenance worker and recreational receptor are considered to evaluate the long-term effectiveness of each alternative. Exposure to drinking groundwater was included as a conservative measure, however the potential for groundwater contamination is currently being investigated and will be addressed under a separate operable unit.

Onsite Resident

The onsite resident is assumed to live on site for 365 days per year for 30 years. Each day the resident is assumed to spend 16.4 hours indoors and 2.0 hours outdoors onsite. This individual ingests 70 g of soil and breaths 6000 m^3 of air per year. It is also assumed that the resident has a small garden equating to 17.136 kilograms per year of homegrown crops and obtains all drinking water (700 l/yr) from an onsite well. No cover is assumed to be maintained. However, contamination onsite is initially present in the subsurface soils and is assumed to be brought to the surface (with mixing) during construction of the residence. Exposure pathways include external gamma, inhalation, ingestion, drinking water, and produce ingestion.

Industrial Worker

The industrial worker is assumed to be onsite for 6.3 hours per day while indoors and 1.75 hour per day while outdoors. The worker is at the site for 250 days per year for 30 years. It is assumed that the industrial worker ingests 12.5 mg of soil and breaths 12000 m^3 of air per year and obtains 100% of his/her drinking water (700 l/yr) from an onsite well. For Alternatives 1, 2, and 3, no clean cover is assumed to be present, however, contamination onsite is initially present in the subsurface soils and is brought to the surface (with mixing) during facility construction so the industrial worker is exposed to contaminants in soils. A clean 1 ft cover is maintained over treated backfill material for Alternative 4. It is also assumed that the industrial worker has an office or work space in a building built on a portion of the site with residual contamination or treated backfill for Alternative 4. Exposure pathways include external gamma, inhalation, ingestion, and drinking water.

Table C-1. Potential Receptors

Alternative	Exposure Scenarios and Pathways		
	Scenario	**Pathways**	**Assumptions**
1	Residential	Direct gamma, soil ingestion, dust inhalation, drinking water, and produce consumption.	Site released in current condition.
	Industrial	Direct gamma, soil ingestion, dust inhalation, and drinking water	Site released in current condition.
2	Monitoring	Direct gamma, soil ingestion, and dust inhalation.	Cover and institutional controls assumed to preclude exposures greater than the criteria.
3	Residential	Direct gamma, soil ingestion, dust inhalation, drinking water, and produce consumption.	Exposed to residual contaminants in soil after remedial action.
	Industrial	Direct gamma, soil ingestion, dust inhalation, and drinking water	Exposed to residual contaminants in soil after remedial action.
4	Residential	Direct gamma, soil ingestion, dust inhalation, drinking water, and produce consumption.	Exposed to residual contaminants in soil after remedial action.
	Industrial	Direct gamma, soil ingestion, dust inhalation, and drinking water	Exposed to residual contaminants in soil after remedial action potentially including backfill with treated material.

Maintenance Worker

Given the discussion for an industrial worker above, the industrial worker receptor represents a reasonable maximum risk for a maintenance worker that visits the Site routinely and whose activities involves limited soil disturbances, such as lawn mowing.

Treated material may be used as backfill in Alternative 4. It is assumed that a 1ft clean cover will be maintained and any maintenance requiring breaching of the cover will be conducted using methods designed to reduce exposures to radiological contaminants thus risks would be controlled accordingly. The industrial worker receptor represents a maximum risk for a maintenance worker without breaching the cover.

3.1.2 Short-term Effectiveness

The offsite resident and the remediation worker are evaluated to address the short-term effectiveness (i.e., approximating risks that occur during the implementation of remedial alternatives) of each alternative. The risks to the offsite resident and the remediation worker are discussed in the Qualitative Assessment of Remediation Worker Risk and Exposure To the General Public During Remediation sections of this appendix (See page C-37 and C-38).

3.1.3 Long-term Effectiveness

Long-term effectiveness is an evaluation of those risks that occur after the implementation of each alternative. Three potential receptors are considered in this evaluation including an onsite resident, a maintenance worker, and an industrial worker. These potential receptors are considered the most plausible and maximum exposed individuals as defined by the remedial alternative. Each potential receptor is defined below. Tables C-2 and C-3 include site-specific parameters used in RESRAD calculations to complete exposure calculations. Exposure parameters were taken from the 1997 Exposure Factors Handbook Volumes 1, 2, and 3, where available. When acceptable exposure assumptions could not be obtained from the 1997 Exposure Factors Handbook, then values from RESRAD, the State of New Jersey guidance, or other EPA risk assessment guidance were then used.

Table C-2. RESRAD Input Parameters

Parameter	Units	Value
Breathing Rate	m^3/yr	6000
Soil ingestion rate	g/yr	70
Onsite crop ingestion	g/yr	17,136
Drinking water intake	l/yr	700
Shielding factors	none	0.8 (basement)
Outside shielding factor	none	1
Fraction of time indoors	none	68%
Fraction of time outdoors	none	8%
Exposure duration	yr	30
Contaminated area	m^2	1000
Percolation rate	m/yr	0.54
Soil density	g/cm^3	1.6
Unsaturated zone thickness	m	0.5
Contaminated zone thickness	m	0.3
Length parallel to aquifer flow	m	32
Density of fill	g/cm^3	1.5
Soil erosion rate	m/yr	6E-5
Fraction of drinking water from onsite well	none	1
Commercial/Industrial (If Different from Residential)		
Parameter	**Units**	**Value**
Breathing Rate	m^3/yr	12000
Soil ingestion rate	g/yr	12.5
Crop ingestion	kg/yr	0
Shielding factors	none	0.56 (slab assumed)
Outside shielding factor	none	1
Fraction of time indoors	none	18%
Fraction of time outdoors	none	5%
Exposure duration	yr	30

Table C-3. Site Specific Geotechnical and Other Assumptions.

Parameter	Units	Value
Contaminated zone porosity	-	0.45
Contaminated zone hydraulic conductivity	m/yr	1.23
Saturated zone porosity	-	0.45
Saturated zone effective porosity	-	0.26
Saturated zone hydraulic conductivity	m/yr	123
Hydraulic gradient	-	0.01
Unsaturated zone thickness	m	1-4 (0.5 assumed)
Unsaturated zone porosity	-	0.45
Unsaturated zone effective porosity	-	0.26
Unsaturated zone hydraulic conductivity	m/yr	1.23
Precipitation rate	m/yr	1.07
Run off coefficient	-	0.25
Soil b parameter	-	5.3
Well intake depth	m	10
Soil erosion rate	m/yr	6E-5
Distribution Coefficients (Kd)	cm^3/g	Thorium – 60,000 Radium – 450 Uranium – 250 Lead – 900 Actinium – 1,500 Protactinium – 2,500

3.2 MIGRATION AND EXPOSURE PATHWAYS

Radiologically contaminated soil is the principal source of contamination at the FUSRAP Maywood Superfund Site. Exposure pathways associated with COPCs in soil include direct gamma radiation, soil ingestion, soil inhalation, drinking water, and produce ingestion (resident only).

3.3 EXPOSURE POINT CONCENTRATIONS

There are two potential modes of exposure at the Site including exposure to contaminants in soil and exposure to contaminants in the site building. Development of the exposure concentrations for each mode is provided below.

3.3.1 Soil

Exposure point concentrations of radiological contaminants were estimated for each alternative. The Alternative 1 (No Action) source term (e.g. activity of radiologically contaminated soil) is from the BRA. Because Alternative 2 only requires monitoring and institutional controls, the source term for Alternative 2 is the same as for Alternative 1 for all potential receptors. The Alternative 3 and 4 source terms are developed to estimate residual concentrations in site soil after remedial actions are complete and change based on the expected land use (residential or industrial).

The net (above background) concentrations of radioactive contaminants are given in Table C-4. Analytical data collected near the Site show background values for soil to be approximately 0.7 pCi/g for Ra-226, 1 pCi/g for Th-230, 1 pCi/g for Th-232 and 1 pCi/g for U-238 (USACE 2000). Note that Table C-4 also lists source terms assuming the remedial action leaves soil concentrations for the entire Site at the FS soil criteria (e.g., Ra-226 + Th-232 = 5 pCi/g above background resulting in total uranium = 9 pCi/g). Although residual risk is not always modeled at the concentration limits, given that residual concentrations can be estimated using a database of soil sampling results, the limits are modeled in this assessment as requested by EPA Region II. The actual residuals are expected to be less for Alternatives 3 and 4.

The soil data presented in the Remedial Investigation Report (DOE 1992), and historical data from the Site were used in this assessment. Over a thousand soil samples were analyzed for U-238, Ra-226, and Th-232. Decay progeny associated with these radionuclides are assumed to be in secular equilibrium. The Th-230 concentration is assumed to be equal to the Ra-226 concentration based on an analysis of the Th-230 data set and the fact that Th-230 would have been removed in the process extracting Th-232, thus reducing the Th-230 concentration compared to U-238.

The residual radionuclide concentrations assumed for this analysis are considered to be conservative based on an analysis of post-remediation data at the vicinity properties previously cleaned up by USACE to the proposed criteria. A review of these data indicate that residual concentrations of Th-232 are generally below 2 pCi\g (i.e., in only 10% of the 811 final status soil samples collected; Th-232 was greater than 2 pCi\g above background; with only 4 samples greater than 5 pCi/g), and the data suggests the radium source term considered in this analysis is conservative.

Table C-4. Net Residual Radionuclide Concentrations in Soil (pCi/g)[a]

Alternative	Th-232 +D[b]			Ra-226 +D		Th-230	U-238 +D		U-235 +D[c]		
	Th-232	Ra-228	Th-228	Ra-226	Pb-210	Th-230	U-238	U-234	U-235	Pa-231	Ac-227
1 and 2[f]	47	47	47	5	5	27	27	27	1.3	1.3	1.3
3[d] residential	4	4	4	0.91	0.91	1	4	4	0.18	0.18	0.18
3 and 4 industrial	12	12	12	3	3	3	12	12	0.55	0.55	0.55
4[d] maximum treated backfill (industrial only)	12	12	12	3	3	3	12	12	0.55	0.55	0.55
3 and 4 [e]	2	2	2	.45	.45	1	2	2	0.01	0.01	0.01

Shaded area indicates measured concentrations

[a] Background has been subtracted from listed values. If the net value is less than 0.0, 0.0 is listed. Background is assumed to be 0.7 pCi/g for Ra-226, 1 pCi/g for Th-230, 1 pCi/g for Th-232 and 1 pCi/g for U-238. Relevant decay products are assumed to be in equilibrium with their respective long-lived parent. Background for U-235 and decay products assumed to be 0.05 pCi/g.

[b] +D denotes secular equilibrium was assumed to derive concentrations for associated decay products (non-shaded boxes)

[c] U-235 +D concentrations are 5% of U-238 value

[d] Estimated assuming the final concentration = the target cleanup criteria

[e] Estimated residual concentrations after removing contaminant concentrations above the cleanup criteria

[f] Mean surface concentrations from maximum risk property (7H in BRA) Note: the BRA assumed Th-230 = U-238

The exposure point concentrations for Alternatives 1 and 2 were taken from the BRA property (7H) with the maximum risk calculated in the BRA (the property at 96 Park Way was excluded as previously addressed under a removal action). The exposure point concentrations for Alternative 3 and 4 (without treatment) were derived by applying the site isotopic ratios (see section 2.1) to the dispute resolution criteria. For Alternative 4 with treatment, the residual soil data was derived by applying the site isotopic ratios to the maximum allowable concentration for treated backfill as stated in the dispute resolution. [The EPA and DOE (USACE's predecessor on the FUSRAP) had a dispute regarding soil cleanup levels on this site. This dispute was resolved in 1994, and the dispute resolution is contained in section 1 this appendix (C)]. The residual exposure point concentration was developed through analysis of the final status survey samples from properties addressed in recent removal actions.

3.3.2 Onsite Buildings

Buildings on the former Maywood Chemical Works Property may have been contaminated as a result of site activities. All existing buildings have industrial uses. Exposure to residual contamination in buildings as well as site soils results in a cumulative dose and risk to employees which should be considered. Additional data collection is necessary to adequately address site buildings (as explained in FS sections 2.1.5 and 2.4.6) and this concern.

4 RISK CHARACTERIZATION

4.1 METHODOLOGY

Cancer risk from radionuclides is estimated using the RESRAD code Version 6.0 (Yu et al. 1993). The code uses the RAGS methodology to estimate risks from the uptake of radionuclides and the exposure to external gamma radiation over time. In addition to providing results consistent with the basic RAGS methods, RESRAD supplements RAGS by considering the following:

- Decay and ingrowth of radionuclides over time;
- Physical removal of radionuclides (erosion, leaching, etc.) over time; and
- Radiation shielding from material used as clean cover.

RESRAD uses cancer slope factors tabulated in HEAST and lists risks over time so that an assessor may select the year of maximum exposure.

Risk and dose for Alternative 1 are from the BRA. Estimated risk and dose from Alternative 2 is based on institutional controls being implemented to preclude human exposures to site soils in excess of the FS's soil cleanup criteria.

To estimate risks and dose from Alternatives 3 and 4, the parameter values listed in Table C-2, C-3, and the soil concentrations listed in Table C-4 were entered into the RESRAD model. Other scenario-specific information such as exposure pathways and possible cover depths were entered and the model was executed to provide final risk estimates. Results were obtained for years 0 (current year), 1, 3, 10, 30, 100, 300 and 1000.

4.2 UNCERTAINTIES

Exposure parameters were selected to provide a conservative, yet reasonable, estimate of potential exposure and then risks to each receptor. Site-specific measurements and data were used, as appropriate, to describe site conditions as accurately as possible. Where site-specific data were not available, parameter values were chosen to provide reasonably conservative estimates of risk, or standard default values recommended by the RESRAD code or the Exposure Factors Handbook (EPA 1997) were used.

The accuracy of risk calculations is ultimately limited to the accuracy of the site data and risk models. The data used in the assessment include results from several characterization efforts and include different target analytes, analysis methods, and reporting requirements. The data in this assessment are used assuming the best knowledge of the distribution of contaminants in site soils with the goal of providing conservative, yet reasonable, estimates of risk. As an example: Characterization data indicates the typical depth of contamination is greater than 4 feet (site average of 6.5 feet with maximum of 14 feet) resulting in a post remedial action depth of clean backfill (not a maintained cover) greater than 6 feet. To ensure a conservative estimate, contamination was modeled at a 3 foot depth (accounts for regrading of site). The depth of a slab footing was set at 4 feet and a basement was 7 feet below grade. This meant that in either a slab or basement construction scenario some contaminated material would be mixed with the backfill and brought to the surface during construction. Modeling the contamination at other depths would not change the concentration on the surface as long as it is 4 feet or less for the slab scenario and 7 feet or less for the basement scenario. Characterization data indicates, and the requirements for clean backfill and a cover over treated backfill in excavated areas ensures, minimal post remedial action surface contamination. Modeling the cleanup criteria at the surface would be extremely conservative as it is not representative of site conditions and would result in exposures exceeding the NJAC 7:28-12 criteria.

The models used to calculate risks are accepted by EPA and are assumed to provide a reasonable prediction of site risks. After implementation of the final remedial alternative, additional post remedial action data may be used to improve residual risk estimates.

Lifetime cancer risk estimates are provided for exposure to radiological and are compared to the CERCLA target risk range of 10^{-4} to 10^{-6} (defined here as 3E-4 to 1E-6). Radiological risk slope factors have been developed primarily using data from Japanese atomic bomb survivors. These individuals received large doses of radiation over a short period of time. By contrast, potential receptors in this assessment receive relatively small radiological doses over a long period of time. Although cancerous effects have only been detected at doses several orders of magnitude larger than those estimated at the Site, it is assumed that the slope factors apply to both large and small radiological doses.

4.3 RESULTS

Estimated radiological risks for each alternative and receptor are summarized in the following sections. Results are compared to the CERCLA target risk range of 10^{-4} to 10^{-6} and 15 mrem/yr dose limit. Only Alternative 1 is not protective of human health given the ARAR dose criteria and the CERCLA risk range.

The results of the radiological risk assessment for the FUSRAP Maywood Superfund Site are presented in Table C-5.

Table C-5. Radiological Risk Estimates

Alternative	Receptor Risks (lifetime^{-1}) (a)		
	Residential	**Industrial**	**Transient/Maintenance**
1	2 E-2	4 E-3	b
2	b	3 E-4	b
3 (criteria)	1 E-4	1 E-4	1 E-4
3 (residuals)	5 E-5	b	b
4[(c)] (treated backfill)	b	5 E-5	5 E-5

(a) All values rounded to one significant digit.
(b) Not evaluated for this alternative.
(c) Same risks for Alternative 3 if treatment not utilized. Treated fill requires minimum of 1 foot cover

The results of the radiological dose assessment for the Site are presented in Table C-6.

Table C-6. Radiological Dose Estimates

Alternative	Receptor Dose (mrem/yr) (a)		
	Residential	**Industrial**	**Transient/Maintenance**
1	859	281	191[d]
2	b	15	b
3 (criteria)	7	6	6
3 (residuals)	3.5	b	b
4[c] (treated back fill)	b	4.5	4.5

(a) All values rounded to significant digit.
(b) Not evaluated for this alternative.
(c) Same dose for Alternative 3 if treatment not utilized. Treated fill requires minimum of 1 foot cover.
(d) Maximum as reported from BRA property 6H. Property 7H not evaluated.

The risks to the future resident were estimated for Alternatives 1, 3, and 4. Radiological risks for Alternatives 1 which assumes no remediation, is estimated to be 2 E-2, which significantly exceeds the upper bound of the CERCLA target cancer risk range. Risks to residents under Alternative 2 were not analyzed since this alternative would preclude residential receptors. The radiological risk for Alternative 3 and 4 (without treatment) is estimated to be 1.2 E-4 if it is assumed that all of the site soils are at the limit (i.e., 5 pCi/g above background for Th-232 + Ra-226) or 5.4 E-5 using residual concentration estimates. Treated backfill would not be utilized on properties that may become residential.

The risks to a future industrial worker were estimated for Alternatives 1, 2, 3, and 4. Radiological risks for Alternatives 1 which assumes no remediation, is estimated to be 4 E-3, which exceeds the upper bound of the target risk range. The BRA estimates risks to current employees exceed the CERCLA risk range on some properties, however, under Alternative 2 these exposures would be controlled to ensure that cancer risks do not exceed the CERCLA cancer risk range nor cause a dose of 15 mrem/year to be exceeded. The radiological risk for Alternative 3 and 4 (without treatment) is estimated to be 1.0 E-4 if it is assumed that all of the site soils are at the limit (i.e., 15 pCi/g above background for Th-232 + Ra-226).

If treatment is proven effective, the use of treated material as backfill on some properties in Alternative 4 would be protective. It is assumed that a 1ft clean cover will be maintained and any maintenance requiring breaching of the cover will be conducted using methods designed to reduce exposures to radiological contaminants thus risks would be controlled accordingly. The radiological risk for Alternative 4 (with treatment) is estimated to be 5.4 E-5 if it is assumed that all of the treated fill is at the criterion(i.e., 15 pCi/g above background for Th-232 + Ra-226) and the cover remains intact. The industrial worker receptor represents a maximum risk for a maintenance worker without breaching the cover.

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APPENDIX D

CORRESPONDENCE REGARDING ENDANGERED SPECIES

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Fish and Wildlife Enhancement
927 North Main Street (Bldg. D1)
Pleasantville, New Jersey 08232

Tel: 609-646-9310
FAX: 609-646-0352

IN REPLY REFER TO:

ES-92/184

February 18, 1992

Dr. Richard E. Ambrose
Science Applications International Corporation
P.O. Box 2501, 800 Oak Ridge Turnpike
Oak Ridge, Tennessee 37831

Dear Dr. Ambrose:

This letter responds to your January 17, 1992, request to the U.S. Fish and Wildlife Service (Service) for information on the presence of endangered and threatened species within the vicinity of the Maywood Site located in Maywood, Rochelle Park, and Lodi in Bergen County, New Jersey. The Maywood Site is included in the U.S. Department of Energy's Formerly Utilized Site Remedial Action Program and the U.S. Environmental Protection Agency's National Priority List Sites.

This response is provided pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) to ensure the protection of endangered and threatened species and is intended to assist your assessments, investigations, and planning being conducted pursuant to Section 104(a) of the Comprehensive Environmental Response, Compensation and Liability Act (P.L. 96-510 94 Stat. 2767) as amended by the Superfund Amendments and Reauthorization Act (42 U.S.C. 9601 et seq.). These comments do not represent any position the U.S. Department of the Interior may adopt concerning possible injury to natural resources under the Department's trusteeship.

Enclosed are current summaries of federally listed and candidate species in New Jersey for your information. Except for an occasional transient bald eagle (*Haliaeetus leucocephalus*) or peregrine falcon (*Falco peregrinus*), no other federally listed or proposed threatened or endangered flora or fauna are known to occur at the Maywood Site. Therefore, no further consultation pursuant to Section 7 of the Endangered Species Act is required by the Service. If additional information on listed and proposed species becomes available or if project plans change, this determination may be reconsidered.

Candidate species are species under consideration by the Service for possible inclusion on the List of Endangered and Threatened Wildlife and Plants. Although these species receive no substantive or procedural protection under the Endangered Species Act, the Service encourages federal agencies and other planners to consider candidate species in the project planning process. The Natural Heritage Program provides the most up-to-date data source for candidate species in the state, as well as maintaining information on State listed species, and may be contacted at the following address:

Mr. Thomas Breden
Natural Heritage Program
Division of Parks and Forestry
CN 404
Trenton, New Jersey 08625
(609/984-0097)

Should the Natural Heritage Program data search reveal the presence of any candidate species on the site, the Service must be contacted to ensure that these species are not adversely affected by project activities.

Further information on State listed wildlife species may be obtained from the following office:

Ms. JoAnn Frier-Murza
Endangered and Nongame Species Program
Division of Fish, Game and Wildlife
CN 400
Trenton, New Jersey 08625
(609/292-9101)

Information contained in this letter and additional information obtained from the aforementioned sources represents the public interest for fish and wildlife resources and should warrant full consideration in the project planning process. The Service requests that no part of this letter be taken out of context and if reproduced, the letter should appear in its entirety.

Please contact Dana Peters of my staff if you have any questions or require further assistance regarding threatened or endangered species.

Sincerely,

Clifford G. Day
Supervisor

Enclosures

Revised 8/30/91

FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES IN NEW JERSEY

An **ENDANGERED SPECIES** is any species that is in danger of extinction throughout all or a significant portion of its range.

A **THREATENED SPECIES** is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

FISHES

Sturgeon, shortnose*	*Acipenser brevirostrum*	E

REPTILES

Turtle, Atl. Ridley*	*Lepidochelys kempii*	E
Turtle, green*	*Chelonia mydas*	T
Turtle, hawksbill*	*Eretmochelys imbricata*	E
Turtle, leatherback*	*Dermochelys coriacea*	E
Turtle, loggerhead*	*Caretta caretta*	T

BIRDS

Eagle, bald	*Haliaeetus leucocephalus*	E
Falcon, Am. peregrine	*Falco peregrinus anatum*	E
Falcon, Arctic peregrine	*Falco peregrinus tundrius*	T
Plover, piping	*Charadrius melodus*	T
Tern, roseate	*Sterna dougallii dougallii*	E

MAMMALS

Whale, blue*	*Balaenoptera musculus*	E
Whale, finback*	*Balaenoptera physalus*	E
Whale, humpback*	*Megaptera novaeangliae*	E
Whale, right*	*Balaena glacialis*	E
Whale, sei*	*Balaenoptera borealis*	E
Whale, sperm*	*Physeter catodon*	E

INVERTEBRATES

Dwarf wedge mussel	*Alasmidonta heterodon*	E+
Beetle, northeastern beach tiger	*Cicindela dorsalis dorsalis*	T+
Butterfly, Mitchell satyr	*Neonympha m. mitchellii*	E+
American burying beetle	*Nicrophorus americanus*	E+

PLANTS

Pogonia, small whorled	*Isotria medeoloides*	E
Swamp pink	*Helonias bullata*	T
Orchid, eastern prairie fringed	*Platanthera leucophaea*	T+
Knieskern's beaked rush	*Rhynchospora knieskernii*	T
American chaffseed	*Schwalbea americana*	PE
Joint-vetch, sensitive	*Aeschynomene virginica*	PT

STATUS:

E: endangered species
T: threatened species
+: presumed extirpated
PE: proposed endangered
PT: proposed threatened

* Except for sea turtle nesting habitat, principal responsibility for these species is vested with the National Marine Fisheries Service.

Note: for a complete listing of Endangered and Threatened Wildlife and Plants refer to 50 CFR 17.11 and 17.12, January 1, 1989)

CANDIDATE SPECIES IN NEW JERSEY

CANDIDATE SPECIES are species that appear to warrant consideration for addition to the List of Endangered and Threatened Wildlife and Plants. Although these species receive no substantive or procedural protection under the Endangered Species Act, the Service encourages federal agencies and other planners to give consideration to these species in the environmental planning process.

VERTEBRATES

Turtle, bog	Clemmys muhlenbergi	2
Terrapin, northern diamondback	Malaclemys terrapin terrapin	2
Snake, northern pine	Pituophis melanoleucas melanoleucas	2
Shrike, migrant loggerhead	Lanius ludovicianus migrans	2
Bat, eastern small-footed	Myotis subulatus leibii	2
Rabbit, New England cottontail	Sylvilagus transitionalis	2
Shrew, long-tailed	Sorex dispar	2
Shrew, Tuckahoe masked	Sorex cinereus nigriculus	2
Woodrat, eastern	Neotoma floridana magister	2

INVERTEBRATES

Beetle, cobblestone tiger	Cicindela marginipennis	2
Butterfly, regal fritillary	Speyeria idalia	2
Butterfly, tawny crescent	Phyciodes batesi	2
Dragonfly, banded bog skimmer	Williamsonia lintneri	2
Moth, Albarufan dagger	Acronicta albarufa	2
Moth, Bucholz' dart	Agrotis bucholzi	2
Moth, Daecke's pyralid	Crambus daeckeellus	2*
Moth, Hebard's noctuid	Erythroecia hebardi	2
Moth, Lemmer's noctuid	Lithophane lemmeri	2
Moth, precious underwing	Catocala pretiosa	2

PLANTS

Blazingstar	Liatris borealis	2
Bog asphodel	Narthecium americanum	1
Boneset, Pine Barrens	Eupatorium resinosum	2
Bulrush, Long's	Scirpus longii	2
Butternut	Juglans cinerea	2
Chaffseed	Schwalbea americana	PE
Joint-vetch, sensitive	Aeschynomene virginica	PT
Lobelia, Boykin's	Lobelia boykinii	2
Meadowbeauty, awned	Rhexia aristosa	2

Meadowbeauty, awned	Rhexia aristosa	2
Micranthemum, Nuttall's	Micranthemum micranthemoides	1*
Morning-glory, Pickering's	Stylisma pickeringii var. pickeringii	2
Panic grass, Hirst's	Panicum hirstii	2
Pigweed, sea-beach	Amaranthus pumilus	2
Pondweed	Potamogeton confervoides	2
Rush, New Jersey	Juncus caesariensis	2
Sedge, variable	Carex polymorpha	2
Spring beauty	Claytonia sp.	2
Spurge, Darlington's	Euphorbia purpurea	2
Tick-trefoil, ground-spreading	Desmodium humifusum	2
Verbena	Verbena riparia	2?

STATUS:

1: Taxa for which the Service currently has substantial information to support the appropriateness of proposing to list the species as threatened or endangered. Development and publication of proposed rules on these species is anticipated.

2: Taxa for which information now in possession of the Service indicates that proposing to list the species as threatened or endangered is possibly appropriate, but for which conclusive data are not available to support proposed rules at this time.

PE: Proposed Endangered species

PT: Proposed Threatened species

* indicates those species for which there have been no authenticated records in New Jersey since 1963; some of these are possibly extinct, but further research is needed to determine their status with any confidence.

? indicates those species for which occurrence in New Jersey is questionable.

Note: for complete listings of taxa under review, refer to Federal Register Vol. 54, No. 4, January 6, 1989 (Animal) and Vol. 55., No. 35, February 21, 1990 (Plants).

State of New Jersey
Department of Environmental Protection and Energy
Division of Parks and Forestry
Office of Natural Lands Management
CN 404 Trenton New Jersey 08625-0404
(609) 984-1339
FAX (609) 984-1427

Scott A. Weiner
Commissioner

October 25, 1991

Debbie Spiers
Science Applications International Corp.
14062 Denver West Parkway #110
Golden, Colorado 80401

Re: Maywood Site

Dear Ms. Spiers:

Thank you for your data request regarding rare species information for the above referenced project site in Bergen County.

The Natural Heritage Data Base does not have any records for rare plants, animals or natural communities on the site. The attached list of rare species is from records in the general vicinity of the project site (within approx. 3 mi. for animals, 1.5 mi. for plants and communities). Additionally, enclosed is a list of rare vertebrates of Bergen County together with a description of their habitats. If suitable habitat is present at the project site, these species would have potential to be present. If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend you contact the Division of Fish, Game and Wildlife Endangered and Nongame Species Program.

PLEASE SEE THE ATTACHED 'CAUTIONS AND RESTRICTIONS ON NHP DATA'.

Thank you for consulting the Natural Heritage Program. The fee to cover the cost of processing this data request is $30.00. Payment should be made payable to Treasurer, State of New Jersey and mailed to Office of Natural Lands Management, DEPE Div. of Parks and Forestry, CN404, Trenton, NJ 08625-0404. To ensure that your payment is properly credited, please provide a copy of this letter with your remittance. Feel free to contact us again regarding any future data requests.

Sincerely,

Elena A. Williams

Elena A. Williams
Senior Planner
Natural Heritage Program

cc: JoAnn Frier-Murza
Thomas Hampton

CAUTIONS AND RESTRICTIONS ON NATURAL HERITAGE DATA

The quantity and quality of data collected by the Natural Heritage Program is dependent on the research and observations of many individuals and organizations. Not all of this information is the result of comprehensive or site-specific field surveys. Some natural areas in New Jersey have never been thoroughly surveyed. As a result, new locations for plant and animal species are continuously added to the data base. Since data acquisition is a dynamic, ongoing process, the Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of New Jersey. Information supplied by the Natural Heritage Program summarizes existing data known to the program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The attached data is provided as one source of information to assist others in the preservation of natural diversity.

This office cannot provide a letter of interpretation or a statement addressing the classification of wetlands as defined by the Freshwater Wetlands Act. Requests for such determination should be sent to the DEP Division of Coastal Resources, Bureau of Freshwater Wetlands, CN 402, Trenton, NJ 08625.

This cautions and restrictions notice must be included whenever information provided by the Natural Heritage Database is published.

25 OCT 1991

GENERAL VICINITY OF PROJECT SITE
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.
*** Vertebrates								
AMMODRAMUS SAVANNARUM	GRASSHOPPER SPARROW		T/T		G4	S2	[redacted]	Y
CLEMMYS MUHLENBERGII	BOG TURTLE	C2	E		G3	S2	[redacted]	Y
*** Vascular plants								
CAREX ROSTRATA	BEAKED SEDGE				G5	S2	[redacted]	Y
LEMNA PERPUSILLA	MINUTE DUCKWEED				G5	SH	[redacted]	Y
MELANTHIUM VIRGINICUM	VIRGINIA BUNCHFLOWER		E		G5	S1	[redacted]	Y
TROLLIUS LAXUS SSP LAXUS	SPREADING GLOBE FLOWER	3C	E		G4T3Q	S1	[redacted]	Y
VERBENA SIMPLEX	NARROW-LEAVED VERVAIN		E		G5	SH	[redacted]	Y

7 Records Processed

5/18/87

NEW JERSEY NATURAL HERITAGE PROGRAM
POTENTIAL THREATENED AND ENDANGERED VERTEBRATE SPECIES
IN BERGEN COUNTY

AMERICAN BITTERN BOTAURUS LENTIGINOSUS	FEDERAL STATUS: STATE STATUS: LT	COUNTY OCCURRENCE: ?

HABITAT COMMENTS
Fresh water bogs, swamps, wet fields, cattail and bulrush marshes, brackish and saltwater marshes and meadows.

BALD EAGLE HALIAEETUS LEUCOCEPHALUS	FEDERAL STATUS: LELT STATE STATUS: LE	COUNTY OCCURRENCE: T*

HABITAT COMMENTS
Primarily near seacoasts, rivers, and large lakes.

BARRED OWL STRIX VARIA	FEDERAL STATUS: STATE STATUS: LT	COUNTY OCCURRENCE: W

HABITAT COMMENTS
Dense woodland and forest (conif. or hardwood), swamps, wooded river valleys, cabbage palm-live oak hammocks, especially where bordering streams, marshes, and meadows.

BOG TURTLE CLEMMYS MUHLENBERGII	FEDERAL STATUS: C2 STATE STATUS: LE	COUNTY OCCURRENCE: Y

HABITAT COMMENTS
Slow, shallow rivulets of sphagnum bogs, swamps, and marshy meadows; sea level to 1200 m in Appalachians. Commonly basks on tussocks in morning in spring and early summer. Hibernates in subterreanean rivulet or seepage area.

BROOK TROUT SALVELINUS FONTINALIS	FEDERAL STATUS: STATE STATUS: LT	COUNTY OCCURRENCE: Y

HABITAT COMMENTS
Clear cool well-oxygenated streams and lakes. May move from streams into lakes or sea to avoid high temps. in summer.

COOPER'S HAWK ACCIPITER COOPERII	FEDERAL STATUS: STATE STATUS: LE	COUNTY OCCURRENCE: Y

HABITAT COMMENTS
Primarily mature forest, either broadleaf or coniferous, mostly the former; also open woodland and forest edge.

5/18/87

GRASSHOPPER SPARROW
AMMODRAMUS SAVANNARUM
FEDERAL STATUS:
STATE STATUS: LT
COUNTY OCCURRENCE: B

HABITAT COMMENTS
Prairie, old fields, open grasslands, cultivated fields, savanna.

GREAT BLUE HERON
ARDEA HERODIAS
FEDERAL STATUS:
STATE STATUS: LT
COUNTY OCCURRENCE: N*

HABITAT COMMENTS
Freshwater and brackish marshes, along lakes, rivers, bays, lagoons, ocean beaches, mangroves, fields, and meadows.

LONGTAIL SALAMANDER
EURYCEA LONGICAUDA
FEDERAL STATUS:
STATE STATUS: LT
COUNTY OCCURRENCE: ?

HABITAT COMMENTS
Streamsides, spring runs, cave mouths, forested floodplains in South. May disperse into wooded terrestrial habitats in wet weather. Hides under rocks, logs, and other debris.

NORTHERN GOSHAWK
ACCIPITER GENTILIS
FEDERAL STATUS:
STATE STATUS: LT
COUNTY OCCURRENCE: W*

HABITAT COMMENTS
Deciduous and coniferous forest, forest edge and open woodland, foraging also in cultivated regions; primarily in mountains towards the south.

NORTHERN HARRIER
CIRCUS CYANEUS
FEDERAL STATUS:
STATE STATUS: LE
COUNTY OCCURRENCE: Y

HABITAT COMMENTS
Marshes, meadows, grasslands, and cultivated fields. Perches on ground or on stumps or posts.

OSPREY
PANDION HALIAETUS
FEDERAL STATUS:
STATE STATUS: LT
COUNTY OCCURRENCE: T*

HABITAT COMMENTS
Primarily along rivers, lakes, and seacoasts, occurring widely in migration, often crossing land between bodies of water.

PIED-BILLED GREBE
PODILYMBUS PODICEPS
FEDERAL STATUS:
STATE STATUS: LE
COUNTY OCCURRENCE: Y

HABITAT COMMENTS
Lakes, ponds, sluggish streams, and marshes; in migration and in winter also in brackish bays and estuaries.

5/18/87

RED-HEADED WOODPECKER
<u>MELANERPES ERYTHROCEPHALUS</u>
FEDERAL STATUS:
STATE STATUS: LT
COUNTY OCCURRENCE: ?

HABITAT COMMENTS
Open woodland, especially with beech or oak, open situations with scattered trees, parks, cultivated areas and gardens.

RED-SHOULDERED HAWK
<u>BUTEO LINEATUS</u>
FEDERAL STATUS:
STATE STATUS: LT
COUNTY OCCURRENCE: Y

HABITAT COMMENTS
Moist and riverine forest, and in e. N. Am. in wooded swamps, foraging in forest edge and open woodland.

SAVANNAH SPARROW
<u>PASSERCULUS SANDWICHENSIS</u>
FEDERAL STATUS:
STATE STATUS: LT
COUNTY OCCURRENCE: Y

HABITAT COMMENTS
"Open areas, especially grasslands, tundra, meadows, bogs, farmlands, grassy areas with scattered bushes, and marshes, including salt marshes in the BELDINGI and ROSTRATUS groups (Subtropical and Temperate zones)".

SEDGE WREN
<u>CISTOTHORUS PLATENSIS</u>
FEDERAL STATUS:
STATE STATUS: LE
COUNTY OCCURRENCE: ?

HABITAT COMMENTS
Grasslands and savanna, especially where wet or boggy, sedge marshes, locally in dry cultivated grainfields. In migration and winter also in brushy grasslands.

SHORT-EARED OWL
<u>ASIO FLAMMEUS</u>
FEDERAL STATUS:
STATE STATUS: LE/S
COUNTY OCCURRENCE: W*

HABITAT COMMENTS
Open country, including prairie, meadows, tundra, moorlands, marshes, savanna, dunes, fields, and open woodland. Roosts by day on ground or on low open perches.

TIMBER RATTLESNAKE
<u>CROTALUS HORRIDUS</u>
FEDERAL STATUS:
STATE STATUS: LE
COUNTY OCCURRENCE: Y

HABITAT COMMENTS
Wooded rocky hillsides in north; swampy areas, canebrake thickets, and floodplains in south. Near streams in late summer in some areas. Often hibernates in burrows and crevices of rock outcroppings.

5/18/87

UPLAND SANDPIPER FEDERAL STATUS: COUNTY
BARTRAMIA LONGICAUDA STATE STATUS: LE OCCURRENCE: B

HABITAT COMMENTS
Grasslands, especially prairies, dry meadows, pastures, and (in Alaska) scattered woodlands at timberline; very rarely in migration along shores and mudflats.

VESPER SPARROW FEDERAL STATUS: COUNTY
POOECETES GRAMINEUS STATE STATUS: LE OCCURRENCE: Y

HABITAT COMMENTS
"Plains, prairie, dry shrublands, savanna, weedy pastures, fields, sagebrush, arid scrub and woodland clearings."

WOOD TURTLE FEDERAL STATUS: COUNTY
CLEMMYS INSCULPTA STATE STATUS: LT OCCURRENCE: Y

HABITAT COMMENTS
Vicinity of streams and rivers. In streams and in wooded areas and fields adjacent to streams in summer. In streams in spring and fall. Hibernates in banks or bottoms of streams in winter.

DEFINITION OF ACRONYMS

FEDERAL STATUS

LE=listed endangered.
LT=listed threatened.
PE=proposed endangered.
PT=proposed threatened.
C2=candidate for listing.

STATE STATUS

LE=listed as endangered. (short-eared owl winter pop. listed as stable:S)
LT=listed as threatened.

COUNTY OCCURRENCE

Y=present year-round, breeds.
N=present year-round, not recorded breeding.
B=present during the summer, breeds.
W=present during the winter.
T=present as a transient.
?=present status undetermined.
*=indicates that the county is within the species known breeding range.

State of New Jersey
Department of Environmental Protection and Energy
Natural and Historic Resources
Division of Parks and Forestry
Office of New Jersey Heritage
CN 404
Trenton, NJ 08625-0404
Tel. # 609-292-2023
Fax. # 609-292-8115

Scott A. Weiner
Commissioner

James F. Hall
Assistant Commissioner

ONJH-B92-7

February 27, 1992

Richard E. Ambrose, Ph.D.
Senior Staff Scientist
Science Applications International Corporation
P.O. Box 2501
Oak Ridge, TN 37831

Bergen County, New Jersey
Maywood Borough [+Lodi Borough & Rochelle Park Township]
Maywood Chemical Works- Maywood Interim Storage + Vicinity
Feasibility Study-Environmental Impact Statement
Formerly Utilized Sites Remedial Action Program
U.S. Department of Energy

National Priority List
Comprehensive Environmental Response, Compensation, and Liability Act
Superfund Amendment Reauthorization Act of 1986 [P.L.99-499]
U.S. Environmental Protection Agency, Region II

Dear Dr. Ambrose:

In reply to your request of January 17, I would like to request information as described herein and as checked off on the accompanying schedule.

1. Maywood Interim Storage Site (= Maywood Chemical Works; then called Stepan [sic] Company). Please confirm that the only undertaking here ("action") is the temporary storage in the northern corner of contaminated soil which eventually will be transported. If this is not the case, please explain.

2. The twenty-five properties that have already been fully decontaminated: please describe the action that has been accomplished and in color mark the properties on your Figure 2.

3. The one partially decontaminated project: what has been done, what will be done, and where is it located on Figure 2?

4. "... the 56 properties not yet fully decontaminated". Please color-code these on Figure 2.

In accordance with your request I am furnishing information in my records, derived from the Bergen County Historic Sites Survey 1984-1985, a "reconnaissance-level" inventory of potentially significant buildings.

Maywood Borough -0234

0234-9 West side of Maywood Avenue, South of West Hunter Avenue, Maywood Chemical Company complex (Pfizer and Stefan), 1920-present.

"Industrial vernacular; 1 and 2; brick; regular bays, pilasters between bays; gables, pitches vary, brick cornices. This complex of industrial buildings is an [sic] remnant of Maywood's industrial past. At the turn-of-the [sic] century a number of chemical manufacturers located in the community and this complex is the most interesting physical reminder of them. The Pfizer buildings are going to be demolished for an office and warehouse building. Demolished prior to 2-82"

"Level of Significance: Matrix: A building with historical significance as part of the general development of the area which also has architectural significance due to style, size, rarity of design, or rarity of building type".

0234-10 South side of West Hunter Avenue, West of Maywood Avenue, Peerless Engine Company #2 Firehouse. 1908.

"Vernacular firehouse; 2; brick; 1 bay, garage door on 1st story, triple window on 2nd; gable; corner pilasters, pediment; 1-story addition at east. This unpretentious building is a representative example of an early 20th c. firehouse in a small town".

"Level of Significance: Matrix..."

Lodi Borough -0231

No properties inventoried by Bergen County.

Rochelle Park Borough -0254

0254 -1 St. Peter's Episcopal Chapel, NE corner of Rochelle Avenue and Beeker Avenue. Deemed by the survey to be National Register Eligible as part of a historic district.

-2 106 Rochelle Avenue.

-3 Van der Horn House, 8 Lexington Avenue.

-4 26 St. Ann's Place.

-5 66 Park Way. Possibly eligible

-6 C. Devon House, 101 Rochelle Avenue.

-7 Rochelle Park Railroad Station, Railroad Avenue. Considered possibly eligible by the survey.

I recommend that a background study for cultural resources be carried out by an investigator who meets the National Park Service's Professional Qualifications Standards (attached), for the relevant discipline(s).

When I have received the requested information I shall be able to continue my review.

The project reviewer is Mr. Jonathan Gell.

Sincerely yours,

C. Terry Pfoutz

C. Terry Pfoutz
State Historic
Preservation Specialist

CTP:vs

Attachment

c. Mr. John Vetter, Environmental Impacts, U.S. E.P.A.

Disk#4A:\B92-7

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF PARKS AND FORESTRY
OFFICE OF NEW JERSEY HERITAGE
CN 404
TRENTON, NJ 08625
(609) 292-2023

PROJECT Bergen County, New Jersey. Maywood Borough [+Lodi Borough & Rochelle Park Township] Maywood Chemical Works &c. Feasibility Study-E.I.S.
F.U.S.R.A.P. U.S. Departmentof Energy "Superfund"

ONJH PROJECT CONTACT Mr. Jonathan Gell DATE OF REQUEST 6 February 1992

OFFICE OF NEW JERSEY HERITAGE
INFORMATION REQUESTED FOR PROJECT REVIEWS

The Office of New Jersey Heritage needs to receive the following information in order to review your project. If you have already submitted project information to the Office, additional information should be submitted for those areas which are checked. If you have any questions regarding the information requested, please contact the Office of New Jersey Heritage project contact. FAXED information is generally not acceptable.

The formal project title (and short description by which it is known).

Any official project identification numbers.

The county and municipality where the project is located.

Project neighborhood location and street address.

✓ **U.S.G.S. Topographic Quadrangle maps and sheet titles, illustrating the project location and surrounding area.** The project location should be clearly and accurately delineated on the U.S.G.S. quadrangle sheet, and if appropriate, other map sources of equivalent accuracy and scale. As appropriate, a photocopied 8 1/2 inch by 11 inch map section may be used; however, the reproduction must be very sharp. The title of the quadrangle sheet and date of the edition must be included.

The federal agency (and "program") funding, licensing, permitting, reviewing, or undertaking the project.

✓ **The names and addresses of State, Federal, or other project sponsors.**

Other source(s) of project funds.

✓ The federal official responsible for the undertaking: title name, address, phone.

Project manager or contact person, address, and telephone number.

The name(s) of the administrative official(s) and address(es) of the project's municipality or county (e.g. the mayor or other municipal official who may be involved with the review or implementation of the project, and municipal contacts for historic preservation).

Names and addresses of historic preservation consultant or other pertinent project consultants (e.g. engineering, environmental, or planning consultants).

Previous related projects or project portions, and anticipated sequels to this project or project phase.

Project schedule, critical dates.

A narrative project description and detailed project plans: describing and illustrating the project including its areal extent, whether razing existing buildings or structures would be part of the project, and a description of related activities associated with the project (for example, construction of access roads or paved parking areas, the locations of construction laydown or equipment storage areas).

A description of the project site's natural environment including terrain, on-site drainages, soil types, and vegetation.

A description of the project site as it exists today and previous uses of this piece of land, providing information as far back in history and as well documented as possible. This should include a detailed description of the existing and previous on-site buildings and structures, paved areas, and other information to provide a description of the current and former site conditions particularly **ground disturbance.** The description should be accompanied by a detailed site plan illustrating the project, as well as any important or notable buildings and landscape features.

A discussion of representative buildings in the project vicinity including their current and former uses and approximate dates of construction. For buildings older than fifty years and visible from the project site, clear color or black and white photographs (3" by 5" or larger) and descriptions are necessary. Polaroid photographs are **not** acceptable. If there are many older buildings (as in a streetscape), they may be grouped in sets of two or three, provided that each is clearly visible. Each print should be captioned and numbered in a continuous sequence. A sketch map of the project area should be keyed to the photographs to illustrate the location and orientation of the camera for each.

A set of clear photographs, ~~3~~ 4" **by** ~~5~~ 6" **or larger** (Polaroid photographs are not acceptable): OF TYPICAL AND REPRESENTATIVE STRUCTURE AND STREETSCAPES IN THE SEVERAL SUBDIVISIONS OF THE PROJECT

a. ~~taken from~~ outside the project site looking ~~inward to~~ illustrate ground ~~conditions and on-site~~ buildings, structures~~, and~~ landscape elements~~, etc. and~~

b. ~~taken on-site~~ looking outward to illustrate ~~the~~ project vicinity~~, e.g. in the four cardinal directions or their~~ equivalent.

Each print should be captioned and numbered. As above, the photographs should be numbered, and the sketch map of the project area should be keyed to the photographs to illustrate the location and orientation of the camera for each.

A detailed statement of the likely effects of the project on historic sites, landscapes, and buildings, and archaeological sites, both on the project site and in its vicinity must be included. If you believe that your project will have **no effect** on properties listed in or eligible for listing in the National Register of Historic Places, this should be stated and justified in your submission.

Additional information or comments

ER:drf4:proinfol

115716

Department of Energy

Oak Ridge Operations
P.O. Box 2001
Oak Ridge, Tennessee 37831—8723

April 21, 1994

Mr. Jonathan Gell
State of New Jersey Department of
Environmental Protection and Energy
Natural and Historic Resources
Division of Parks and Forestry
Office of New Jersey Heritage
CN 404
Trenton, New Jersey 08625-0404

Dear Mr. Gell:

MAYWOOD SITE - TRANSMITTAL OF THE STATE IA ARCHAEOLOGICAL AND HISTORICAL STUDY

The purpose of this letter is to transmit one copy of the Phase IA Archaeological and Historical Study of the Maywood Site. The study concludes that although the buildings on the Maywood Interim Storage Site (MISS) and Stepan appear eligible for the National Register of Historic Places as a district, the decontamination measures would have no effect on the buildings. Although the demolition of building 76 on MISS would have an adverse effect by removing a contributing building to the district, an appropriate mitigation measure may be to document the building with large format black and white archival photographs. In addition, no further archaeological research is recommended.

Your approval or comments are requested by May 16, 1994, to meet the scheduled publication date of the Feasibility Study and Proposed Plan. If you have any questions, or if I can be of any assistance, please contact me at (615) 576-5724. Your cooperation is appreciated.

Sincerely,

Susan M. Cange

Susan M. Cange, Site Manager
Former Sites Restoration Division

Enclosure

Department of Energy
Oak Ridge Operations
P.O. Box 2001
Oak Ridge, Tennessee 37831—8723

July 8, 1994

Jonathan Gell
State of New Jersey
Department of Environmental Protection
Division of Parks and Forestry
CN 404
Trenton, New Jersey 08625

Dear Mr. Gell:

MAYWOOD SITE - STAGE 1A ARCHAEOLOGICAL AND HISTORICAL STUDY REPORT

The purpose of this letter is to forward comments received from the Environmental Protection Agency (EPA) on the subject document and to inquire as to the status of your review of the report. I would appreciate any guidance that you can provide to me on the resolution of these comments. Further, if you think it is necessary, I would like to arrange for a meeting, as suggested by EPA, to review the steps necessary to comply with NHPA. I would appreciate hearing from you as soon as possible so that we can resolve any outstanding issues before signing a Record of Decision for the site.

I look forward to hearing from you. My telephone number is (615) 576-5724.

Sincerely,

Susan M. Cange, Site Manager
Former Sites Restoration Division

Enclosure

cc: Jeff Gratz, EPA
Nick Marton, NJDEP

116936

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY Jun 1 1 42 PM '94

REGION II

JACOB K. JAVITS FEDERAL BUILDING

NEW YORK, NEW YORK 10278-0012

MAY 2 6 1994

Ms. Susan Cange
New Jersey Site Manager
Former Sites Restoration Division
Department of Energy
P.O. Box 2001
Oak Ridge, TN 37831-8723

Re: EPA Review of DOE's Draft *Stage 1A Archaeological and Historical Study of the Maywood Site*

Dear Ms. Cange:

The U.S. Environmental Protection Agency (EPA) has reviewed the U.S. Department of Energy (DOE) draft *Stage 1A Archaeological and Historical Study of the Maywood Site* (April, 1994), prepared for DOE by Science Applications International Corporation. We have the following comments:

1. The report indicates that the Maywood Site may qualify for inclusion in the National Register of Historic Places (National Register) as an historic district. However, the report does not state the appropriate steps that DOE will take, as a lead federal agency, to comply with the subsequent requirements of the National Historic Preservation Act (NHPA). Initially, a determination of eligibility for the National Register must be made in consultation with the New Jersey State Historic Preservation Officer (SHPO). At a minimum, this requires preparation of a report, accompanied by appropriate graphic documentation, detailing the nature and significance of the resource.

   If National Register eligibility is confirmed with the SHPO, a determination of effect should be made based upon the remedial actions which are anticipated to be implemented. The results of the effect determination are then evaluated to guide development of appropriate mitigation measures. Please note that mitigation through data recordation is more detailed than is suggested in the report, and that it cannot be accomplished by depositing a few photographs in the Stepan Company archives. Rather, there are specific data recordation requirements which must be met and coordinated with the U.S. Department of the Interior. We recommend that DOE contact the SHPO to arrange a meeting to review the steps associated with compliance with the NHPA for this site.

2. Information is presented on the historic settlement of the project area. However, the mapped information presented concerning the structures associated with the site (in particular, the Schaefer Works and the Maywood Chemical Works) does not clearly

illustrate the many changes which took place between their initial and current configurations. Utilization of graphic overlay techniques would have been a more appropriate approach to demonstrate the features of the industrial complex and is recommended for any associated follow up reports.

3. We have 2 concerns regarding the study's consideration of prehistoric resources:

- The background review concludes that it is not possible to assess archeolcgical sensitivity within the project area due to lack of data. This conclusion appears inconsistent with the reported presence of riverine features during prehistoric times. This inconsistency between the characterizations based on the prehistoric setting and the contemporary configuration should be addressed and resolved.

- Soil boring data collected in conjunction with contaminant measurements was used to determine the presence or absence of archeological materials. While this technique can be quite effective when carried out with oversight by professional archaeologists, during the Maywood investigation no archaeologists were present and locations of the boring samples were keyed to the needs of the contaminant survey, not with the objective of investigating archaeological features of either the prehistoric or historic periods. Thus, the use of data from these borings appears to be inconclusive. Also, ground truth exploration should have been conducted to confirm the effectiveness of the soil borings.

We are willing to participate in a meeting to discuss the above concerns and comments. If you have any questions, please call me at (212) 264-6667.

Sincerely,

Jeffrey Gratz, Project Manager
Federal Facilities Section

cc: N. Marton, NJDEPE

136423 312

Department of Energy

Oak Ridge Operations
P.O. Box 2001
Oak Ridge, Tennessee 37831—8723

November 8, 1995

Mr. Michael Gregg
New Jersey Department of Environmental Protection
Division of Parks and Forestry
CN 404
Trenton, New Jersey 08625

Dear Mr. Gregg:

MAYWOOD SITE - STAGE IA ARCHAEOLOGICAL STUDY AND STAGE IIA HISTORICAL STUDY

The Stage IA Archaeological Study and Stage IIA Historical Study of the Maywood site has been completed. The conclusions in the report indicate that 14 of the buildings associated with the Maywood site appear to be eligible for the National Register of Historic Places (NRHP) as a district. Seven of these buildings, located on the Stepan property, are contaminated and will require interior decontamination. Another of these buildings, the warehouse (Building 76) at the Maywood Interim Storage Site, has contaminated soil beneath it that will probably require demolition of the building.

The buildings on the Stepan property appear eligible for the NRHP as a district for their architectural merit. However, the decontamination techniques will not affect the integrity of the materials, workmanship, and association of the buildings. Therefore, the types of decontamination techniques that would be used would have no effect on the buildings. Additional research was conducted on Building 76 to evaluate the impacts of demolition. Further comparison of the building construction date, building use, building materials, and significance of the building with the NRHP eligibility criteria, indicates that the warehouse is not a primary building having architectural merit or direct association to the historical district. A memorandum prepared by Alex Cole, the principal author of the historical study, outlining this information is enclosed. Based on her research we have reached the conclusion that no further National Historic Preservation Act (NHPA) documentation is necessary to complete remediation of this site.

A copy of the archaeological and historical study is enclosed for review and record retention purposes. Please note that this document was previously submitted to Mr. Jonathan Gell for review and comment. However, no comments were received and we have proceeded with finalizing this document. Please provide any comments you may have concerning this document or the conclusions that have been reached by December 8, 1995. If you have no comments, submittal of this document will conclude the Section 106 NHPA requirements for the Maywood site and a copy of the report will be submitted to the Administrative Record for the Maywood site and will be made available to the public.

136423

If you have any questions or comments, please contact me at (423) 576-5724.

Sincerely,

Susan M. Cange, Site Manager
Former Sites Restoration Division

Enclosures

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
ENVIRONMENTAL PROGRAMS DIVISION

MEMORANDUM

TO: *Heather Cothron*

FROM: *Alex Cole*

SUBJECT: *Building 76, MISS Property*

DATE: *October 10, 1995*

The Stage IA Archaeological Study and Stage II Historical Study of the Maywood Site (July 1995) indicated that Building 76 was potentially eligible for the NRHP as a contributing member to a potential Maywood Chemical Company Historic District under Criteria A and C of the National Register of Historic Places (NRHP) criteria. Further clarification of its level of significance in comparison with the other buildings within the district was requested. This memo provides additional information and evaluation of building 76.

Building Date. In the absence of building permits for Building 76 (as for all the buildings), its date of construction was estimated using historical maps and site plans and an aerial photograph of the site. The aerial view, dating to 1928, shows that the building is not there. A Sanborn Map dating from 1926 corrected to 1950, and a site map of 1951 show the building in place. Two other buildings in the district date from this 1928-1951 time period, building 78, the Navy building, constructed in the 1940s, and the garage. The remaining buildings date between 1910 and 1928. It is difficult to date a vernacular building, such as this warehouse, that used common building materials of corrugated metal; it is this consultant's view that the building was built in the 1940s.

Building Use. The Sanborn Map of 1926 corrected to 1950 lists the building as a factory building. The 1951 site plan of Maywood Chemical Company, a more accurate source, however, lists the building as a warehouse. There were two other warehouses adjacent to the building to the west, that were demolished in the 1970s, possibly indicating that this was a warehouse section of the property.

Building Material. Building 76 is corrugated metal over a wood frame. It is the only building in the district of this material, and is representative of the large number of iron clad manufacturing and warehouse buildings that formerly stood on the site. The remainder of the buildings are of brick, or in the case of the garage, of concrete block.

Building Significance. The building is a contributing property to a district potentially significant at the local level under Criterion A of the NRHP for its association with the chemical industry which was a strong factor in the growth and development of Maywood in the late nineteenth and early twentieth centuries. The dates of significance have been determined as 1910, when the

816 State Street,Suite 500, Santa Barbara, California 93101 (805) 966-0811

Maywood Chemical Company was founded, through the 1940s when the Navy commissioned building 78. The Company was known for its extraction of lithium, thorium, caffeine and cocaine, and the production of detergents, alkaloids, essential oils, and flavoring extracts for soft drinks. This building is not directly associated with a particular process or substance, being listed as a warehouse or factory building. With the exception of the garage, the remaining buildings within the district are associated with specific processes: #1 was used to store coca leaves and manufacture cocaine; #4 was the boiler plant; #10 was used to extract caffeine from tea waste through the use of toluol; #10H was used for experimental alcohol extraction of cocoa products; #14 was a laboratory; #20 was used to crystallize and grind caffeine; #52 contained reducing furnaces; #52A served as storage for lithium ore; #67 was used to manufacture lithia salts; #78 was used to process rare earth salts to manufacture lithium hydroxide. Within this context of use, Building 76 is the only facility not connected to a specific chemical manufacturing process.

Building 76 is a contributing property to a district potentially significant additionally under Criterion C of the NRHP; such a district represents a "significant and distinguishable entity whose components may lack individual distinction." Criterion C evaluates architectural merit; in the case of a district it evaluates the architectural merit of the buildings as a group where none of the buildings would be considered outstanding if treated individually. The greatest concentration of buildings with architectural merit are the brick buildings from the 1920s with their piers and corbelled cornices. Building #76, the only corrugated metal building in the district, does not have architectural merit but is included for its associative merit as a representative of the many iron clad buildings that formerly were on the site.

Within the context of the proposed district, it is the consultant's opinion that Building 76, with the garage and Building 78, are considered secondary buildings. Building 76 served as a warehouse, rather than a specialized manufacturing plant, and as a vernacular building, contains no specific architectural elements of style. The brick buildings dating from the 1920s are considered primary buildings, notable for their architectural merit and for their direct association with the chemical industry, through the type of manufacturing housed within them.

816 State Street, Suite 500, Santa Barbara, California 93101 (805) 966-0811

State of New Jersey
Christine Todd Whitman
Governor
Department of Environmental Protection
Division of Parks and Forestry
Historic Preservation Office
CN-404
Trenton, N.J. 08625-0404
TEL: (609) 292-2023
FAX: (609) 984-0578
Robert C. Shinn, Jr.
Commissioner

HPO-B96-46

February 9, 1996

Ms. Susan M. Cange, Site Manager
Former Sites Restoration Division
Department of Energy
Oak Ridge Operations
P.O. Box 2001
Oak Ridge, Tennessee 37831-8723

Dear Ms. Cange:

As Deputy State Historic Preservation Officer for New Jersey, in accordance with 36 C.F.R. Part 800: Protection of Historic Properties, as published in the Federal Register, 2 September 1986 (Volume 51, Number 169, pages 311115-31125), I am commenting officially upon the project designated below.

I am providing final Section 106 comments regarding the following project:

PROJECT TITLE: Bergen County, New Jersey
Maywood Borough [+Lodi Borough & Rochelle Park Township]
Maywood Chemical Works- Maywood Interim Storage + Vicinity
Feasibility Study-Environmental Impact Statement
Formerly Utilized Sites Remedial Action Program

FEDERAL AGENCY: U. S. Department of Energy

I. 800.4 Identifying Historic Properties

I concur with your submitted report, "Stage IA Archaeological Study and Stage II Historical Study of the Maywood Site," Science Applications International Corporation, July 1995, that the Maywood Chemical Company Historic District (14 buildings) is eligible for the National

Register of Historic Places. As per Science Applications' October 10, 1995 memo, Building 76 is of value for its potential contribution to historical research; not connected to a specific chemical manufacturing process, it is representative of ironclad buildings on the site.

While I concur with EPA's concerns about the Stage IA archaeological survey (EPA's May 26, 1994 letter to you), given the level of disturbance at the site, the only moderate potential for archaeological sites, and the amount of time that has passed since our last comments, I accept your conclusions that no intact archaeological deposits [of significance] are likely to exist at the site and that no further archaeological work is needed.

II. 800.5 Assessing Effects

The project, which includes the demolition of Building 76, would have no adverse effect in accordance with 800.9(c)(1), if the building is documented with 5X7 black and white photographs (as suggested in your April 21, 1994 to us) and the final report is revised to include a clear map showing the boundaries of the eligible historic district (standard professional practice). Please submit a final report, including the photographs of Building 76, printed on bond paper, in a hard-cover binder, and with original photographs. (I have attached the HPO's report guidelines for future reference.)

III. Additional Comments

I apologize for the delay in responding to your November 8, 1995 letter. If you have any questions please call Terry Pfoutz, Supervising Historic Preservation Specialist, regarding architecture or Mike Gregg regarding archaeology, at (609) 984-0140.

Thank you.

Sincerely yours,

Dorothy P. Guzzo

Dorothy P. Guzzo
Deputy State Historic
Preservation Officer

DPG:vp

Code#96-343(94-1030)TP/MG
Disk#12A:B96-46

State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

DIVISION OF PARKS AND FORESTRY
HISTORIC PRESERVATION OFFICE
CN-404
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TEL: (609) 292-2023
FAX: (609) 984-0578

GUIDELINES FOR PREPARING CULTURAL RESOURCES MANAGEMENT ARCHAEOLOGICAL REPORTS SUBMITTED TO THE HISTORIC PRESERVATION OFFICE
DECEMBER 1994

Reports must be submitted as individual documents for accessioning in the Historic Preservation Office (HPO) contract and grant report reference library. This requires providing a copy in a hard-covered binder suitable for shelving and printed on bond paper. The text print must be letter quality, although appendices (e.g., soil logs) may be dot matrix if legible. In addition, **an Annotated Bibliography form must be filled out and submitted as a separate sheet with each report.**

Title Page

1. Title, including phase of work (IA, IB, II, and/or III), municipality, and county.
2. Author(s), including contributors. If an organization's policy prohibits identification of authors on the title page, this information should be included elsewhere in the report.
3. Organization report is prepared by.
4. Agency and/or client report is submitted to.
5. Contract number, if appropriate.
6. Date of report submission or completion.

Acknowledgments (optional)

Management Summary

1. Project type.
2. Location and size of project area.
3. Review authority.
4. Field methods.
5. Results.
6. Evaluations, impacts, and recommendations.
7. Location where copies of report on file.

Table of Contents

Lists of Figures, Plates, and Tables

Figures, plates, and tables should be incorporated into the text on the page following the citation. They should not be appended. Like the text, **all maps, figures, etc. must be on archivally stable paper.**

1. **The report must contain original photographs.** Photographs should be black and white and a minimum of 3" x 5" in size; 5" x 7" or larger photographs may sometimes be necessary for clarity. Photograph captions for site overviews must include direction or orientation. For larger projects, photograph locations should be keyed to a site map. Photographs of features, etc., must include scale, title board, and orientation. Captions should identify photographer and date of exposure.
2. All maps, including reproductions of historic maps, must include a north arrow, accurate bar scale, delineation of the project area, legend, map title, and year of publication. Reports must include the project area accurately delineated on a U.S.G.S. 7.5' topographic map and a county soils survey map, if available for that area. A map showing the project area in relation to New Jersey's physiographic provinces is recommended.
3. Cross section and profile drawings must include scale, elevation, orientation, soil descriptions, and soil colors (Munsell). Detailed plan view drawings should be keyed to the site map.

Introduction

1. Project purpose and goals, such as a summary of the scope of work, including applicable regulations or permits as known.
2. Project administration and contracting agency.
3. General description, including location, number of person days in the field, and project conditions or constraints.

Background Research

This section will vary in length and scope depending on the level of investigation and should relate directly to the project area and vicinity. For all levels of investigation, the background research must be sufficient to enable evaluating National Register eligibility by providing historic contexts for identified sites. For historic sites, background research should be sufficient to identify associations with significant people and events.

1. Environmental setting, including topography, soils, hydrology, and geology.
2. Summary of paleoenvironment, present climate, and current vegetation.
3. Past and present land uses and current conditions.
4. Overview of prehistoric and historic culture history of project locale, including the surveyed area. "Canned" histories should be avoided. This section should provide contexts for research questions, survey methods, site evaluations, and recommendations for further work.
5. Review of known sites, previous investigations and research in the project area and vicinity, and information provided by local collectors and ASNJ local chapter members. Attached is a list of standard references (e.g., Skinner and Schrabisch 1913; Cross 1941) that must be consulted for all projects.
6. Primary documentary research for the project area, including historic maps, deeds, or other pertinent information. Detailed individual property title searches may be appended.

<u>Research Design</u>

This section is required for all reports and will vary in scope and depth depending on the level and scope of the investigation. It outlines the purpose of investigation, basic assumptions about the location and type of cultural resources within the project area, and the rationale for the methods employed in the investigation.

1. Research objectives and theoretical context, with reference to the HPO historic contexts.
2. Specific research problems or questions.
3. Methods to be employed to address the research objectives and questions.
4. A discussion of the expected results, including hypotheses to be tested.

<u>Methods</u>

1. Description of field and laboratory methods employed, including rationale, discussion of biases, and problems or obstacles encountered. This should include discussion of materials not collected in the field (field sorting) and discarded in the laboratory. Details regarding lab procedures may be presented in artifact appendices.

2. An estimated percentage of total project area investigated, with discussion of sampling design and

rationale. This must include descriptions of shovel test and test excavation unit sizes. **Archivally stable** maps showing location of survey and testing must be included in this section.

3. Discussion of changes made during fieldwork from the stated methods, and the rationale for these changes (e.g., as the result of field conditions).
4. Definition of "site" used in the survey.

Field Results

1. Clear description of all areas investigated, including those where resources were not recovered or observed. This section must include the total number of tests excavated.
2. Summary of soils and stratigraphy, including areas and types of disturbance. A description of the stratigraphy of representative shovel tests should be included as an appendix.
3. The description of each identified site must include topographic setting and stratigraphy, size, noted structures or features, artifact types, and an estimate of artifact density. **References to sites in the text, figure captions, and table titles in the final report must include Smithsonian numbers.**
4. Maps, figures, and photographs of test locations, features, and soil profiles, as appropriate.

Artifact Analysis

A separate analysis chapter may not be necessary, depending on the scope of the investigation and field results. Descriptions of limited quantities of artifacts may be incorporated into the field results with references to the artifact inventory appendix.

1. Artifact descriptions and results of analyses. Definitions of artifact classes and attributes should be provided along with pertinent references.
2. Photographs or drawings of selected or representative artifacts, including scale.
A complete inventory of artifacts by provenience and class should be included as an appendix.
4. Tables or other summary information.
5. **Identification of repository for artifact collection and project files.**

Interpretations

1. Discussion of results in terms of the background cultural context, research design, goals, and research problems with reference to the HPO historic contexts.

2. Discussion of constraints and reliability of methods.
3. Discussion of potential research questions based on the results and conclusions.

<u>Evaluation of National Register Eligibility, Project Effects, and Site Recommendations: Phase I and Phase II Reports</u>

This section will vary in length depending on the level of investigation. Documentation must be sufficient to allow the reviewer to make independent evaluations of the New Jersey Register and National Register eligibility of identified properties. This includes sufficient documentation to evaluate significance using the four National Register criteria. A Phase I report should address potential eligibility, rather than a full evaluation. Recommendations that a site is not eligible must be fully documented as described below. A Phase II report must contain a full evaluation and include adequate information on both horizontal and vertical extent of the site.

1. Evaluation of each site in terms of known information and research potential, within the context of current broad questions in anthropological and historical theory. The eligibility of each site should be assessed for listing in the New Jersey and National Registers of Historic Places, using the National Register criteria for evaluation. The factors considered in making the assessment need to be fully described. The eligibility of each property must be evaluated within the HPO historic context framework. Significance statements must be fully developed with reference to historic contexts.
2. Description of both direct and indirect impacts from the project on each site identified. This should include depicting identified sites on project maps, if available.
3. Depending on the level of investigation, appropriate recommendations for each site, including no further work, additional investigations, data recovery, or avoidance. Other specific recommendations may also be appropriate, e.g., special analyses that should be undertaken if there is additional work at the site.

<u>Sources</u>

All sources may be listed together.

1. References cited and consulted <u>(American Antiquity</u> format).
2. Maps.
3. Archival documentation.

4. Personal communications from informants, including oral histories.
5. Pertinent project correspondence.

<u>Appendices</u>

1. Qualifications of Principal Investigator, Field Director, and Laboratory Supervisor, if applicable.
2. Scope-of-Work.
3. Representative soils logs.
4. Artifact inventory by provenience.
5. Specialized analyses and deed research, if appl.
6. Site forms for all recorded sites.

STANDARD REFERENCES TO BE CONSULTED

Bello, Charles A. (compiler and editor)
1986 Index, Bulletin No. 1, 1948 through Bulletin No. 40, 1986. **Bulletin of the Archaeological Society of New Jersey** No. 41:1-27.

1990 Index, Bulletin No. 41, 1986 through Bulletin No. 45, 1990. **Bulletin of the Archaeological Society of New Jersey** No. 45:96-110.

Chesler, Olga (editor)
1982 **The Paleo-Indian Period to the Present: A Review of Research Problems and Survey Priorities.** New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of New Jersey Heritage, Trenton.

1984 **Historic Preservation Planning in New Jersey: Selected Papers on the Identification, Evaluation, and Protection of Cultural Resources.** New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of New Jersey Heritage, Trenton.

Cross, Dorothy
1941 **Archaeology of New Jersey, vol. I.** Archaeological Society of New Jersey and New Jersey State Museum, Trenton.

New Jersey Department of Environmental Protection
1979-1985 **Annotated Bibliography: Cultural Resource Survey Reports Submitted to the New Jersey State Historic Preservation Officer.** 5 vols. Division of Parks and Forestry, Office of New Jersey Heritage, Trenton. Reports submitted since 1985 are available for review at the HPO.

1990 **New Jersey and National Registers of Historic Places as of December 31, 1988.** Division of Parks and Forestry, Office of New Jersey Heritage, Trenton.

1994 **New Jersey & National Register of Historic Places, 1989-1992 Addendum.** Division of Parks and Forestry, Historic Preservation Office, Trenton.

New Jersey Pinelands Commission
1980 **New Jersey Pinelands Comprehensive Management Plan.** New Lisbon NJ.

1991 **Pinelands Cultural Resource Management Plan for Historic Period Sties.** New Lisbon NJ.

Schrabisch, Max
1915 **Indian Habitations in Sussex County, New Jersey.** Bulletin No. 13. Geological Survey of New Jersey, Union Hill.

1917 **Archaeology of Warren and Hunterdon Counties.** Bulletin No. 18 (Geologic Series). Reports of the Department of Conservation and Development, Trenton.

Skinner, Alanson and Max Schrabisch
1913 **A Preliminary Report of the Archaeological Survey of the State of New Jersey.** Bulletin No. 9. Geological Survey of New Jersey, Trenton.

Spier, Leslie
1915 **Indian Remains near Plainfield, Union Co., and along the Lower Delaware Valley.** Bulletin No. 13. Geological Survey of New Jersey, Union Hill.

An up-to-date listing of New Jersey and National Register properties is available for review at the HPO. Also available for study at the HPO are New Jersey Historic Sites Inventory records and Historic Preservation Fund Survey and Planning Grant reports. County historic site surveys are available for review at the HPO and local government offices.

Selected Criteria Used In Review of Archaeological Reports

1. Is the Annotated Bibliography form attached?

2. Is the project information (e.g. agencies, regulatory citations, project boundaries) accurate and complete?

3. Is the environmental and background information adequate? Are previous investigations in the area described?

4. Is the research design clearly stated and related to the HPO historic contexts?

5. Is the fieldwork clearly presented? Are all investigated areas clearly identified, described in the text, and illustrated on maps? Are all identified sites clearly and adequately described and mapped?

6. Are artifacts and features described, illustrated, and analyzed? Is the artifact inventory appended? Is the artifact repository identified?

7. Do site interpretations refer to the background context, stated research design, and HPO historic contexts?

8. Are the integrity and significance of each site fully explored and justified? Are both primary and secondary impacts of the project fully assessed for each resource? Do the recommendations take into account the evaluations of eligibility and the full range of project impacts?

9. Are maps, photos, tables, and figures clearly presented, and do they contain all appropriate information?

10. Are references complete?

11. Are the appropriate appendices contained within the body of the report, including site forms, soil logs, artifact inventories, and resumes?

12. Is the report, including all maps and figures, on archivally stable paper and securely bound?

HISTORIC PRESERVATION OFFICE
BIBLIOGRAPHIC ABSTRACT INFORMATION

Author(s):

Report Title:

Location:
(County and Municipality)

Drainage Basin:

USGS Quadrangle:

Project:
(Agency, type of review, and <u>brief</u> project description)

Level of Survey:

Cultural Resources Identified:

NEW JERSEY HISTORIC PRESERVATION OFFICE, HISTORIC CONTEXTS

Under the National Historic Preservation Act, each State Historic Preservation Office is responsible for preparing and implementing a "comprehensive statewide historic preservation plan." A State Historic Preservation Plan is a concise document that describes a vision for historic preservation in the state as a whole and sets future direction for the State Historic Preservation Office. It provides direction and guidance for decision-making by addressing, at a general level, the state's full range of historic resources including objects, buildings, structures, districts, and archaeological sites. Information on historic resources used to develop and update the State Historic Preservation Plan is derived from a variety of sources including historic context documents, theme studies, resource inventories, and National Register nominations. Historic context documents are emphasized in developing and revising a State Plan.

As of December 1994, the New Jersey State Historic Preservation Office (HPO) is in the process of drafting its State Plan. However, a reference file of historic context documents has already been developed. Historic contexts enable considerations of historic properties in terms of chronological timeframes, cultural themes (or topics), and geographic areas. The historic context files in the HPO are organized mainly by chronological categories and cultural themes. The following chronological categories were proposed in 1988 and have been utilized quite consistently over the past six years:

1.	Paleo-Indian	11,500-8000 years ago
2.	Early Archaic	10,000-6000 years ago
3.	Late Archaic	6000-3000 years ago
4.	Early/Middle Woodland	3000-1200 years ago
5.	Late Woodland	1200 years ago-A.D. 1801
6.	European Intrusion	A.D. 1500-1700
7.	Initial Colonial Settlement	A.D. 1630-1775
8.	Early Industrialization, Urbanization, and Agricultural Development	A.D. 1750-1860
9.	Suburban Development	A.D. 1840-1940

10. Immigration and Agricultural, Industrial, Commercial, and Urban Expansion — A.D. 1850-1920

11. Metropolitan New Jersey — A.D. 1910-1945

12. Modern New Jersey — A.D. 1945-present

The sections of the historic context files dealing with cultural themes or topics identify a variety of subjects. Examples include Afro-Americans in New Jersey, Maritime New Jersey, Military History, and Transportation. These and all other historic context files are open for updating and expansion. New topics can be added as needed.

The third aspect of historic contexts is spatial or geographic variation. Therefore, the historic context files also contain information regarding human use of New Jersey by geographic area. Considerations of geographic variations are found primarily within individual sections of the files dealing with specific time periods and themes/topics.

Preparers of archaeological reports are urged to become familiar with the historic context files. Ideally, these files should contain, or provide reference to, current information upon which a great deal of HPO planning and decision-making is based. Of particular concern to archaeological report writers, this decision-making includes evaluations of National Register eligibility for prehistoric and historic archaeological sites.

DRF/MLG:C:\WD\REPORTS

- ___ Historic Preservation Planning in New Jersey: Selected Papers on the Identification, Evaluation and Protection of Cultural Resources
- ___ New Jersey's Archeological Resources from the Paleo-Indian Period to the Present: A Review of Research Problems and Survey Priorities
- ___ How to Research the History of a House
- ___ Historic Preservation Fund Survey & Planning Grant Activities in New Jersey 1975-1991.
- ___ New Jersey Historic Preservation Commissions Directory
- ___ Municipal Land Use Law, New Jersey Statues Annotated, Historic Preservation Related Sections
- ___ New Jersey Register of Historic Places Act, New Jersey Laws of 1970, Chapter 268 and Regulations for Project Authorization
- Local Preservation:
  - ___ "Historic Preservation" and "Historic Properties"
  - ___ What Are The National Register Criteria?
  - ___ What Is The National Historic Preservation Act?
  - ___ Q and A About Historic Properties Survey
  - ___ What is "Section 106 Review?"
  - ___ When Preservation Commissions Go To Court
  - ___ Subdivision Regulation and Historic Preservation
  - ___ Choosing an Archeological Consultant
  - ___ Is There Archeology In Your Community?
  - ___ What Are The Historic Preservation Tax Incentives?
  - ___ Q and A About the "SHPO"
  - ___ Local Preservation: A Selected Bibliography
  - ___ Zoning and Historic Preservation
- ___ Historic Preservation Law: A New Hybrid Statute with New Legal Problems
- ___ A Five-Minute Look at Section 106

- -

Name ______________________

Address ______________________

____

Postage Required

Historic Preservation Office
CN-404
Trenton, New Jersey 08625-0404

NEW JERSEY STATE HISTORIC PRESERVATION PROGRAM

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APPENDIX E

DESCRIPTION OF THE THORIUM PROCESS USED AT MAYWOOD CHEMICAL WORKS

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APPENDIX E

DESCRIPTION OF THE THORIUM PROCESS USED AT MAYWOOD CHEMICAL WORKS

The thorium process used at the MCW is described in a Stepan Company internal memorandum dated July 26, 1963. This memorandum was provided by Stepan to the Nuclear Regulatory Commission, and is a part of the NRC docket (Docket No. 40-8610) for the Stepan Chemical Company. This memorandum describes the thorium process which obtained thorium nitrate and thorium oxide from monazite sands. A summary of this process as described in the memorandum is provided here.

Note that the term °Be is used throughout this project description. °Be, or "degrees Baume", is an industry density term from which concentrations may be calculated. The conversion of °Be to moles per liter requires knowledge of the density of a solution and the concentration at that density.

The sand processing used sulfuric acid (H_2SO_4) and monazite sands and water. It depended on the fact that thorium sulfate is soluble in concentrations less than 40° Be and the other rare earth sulfates are insoluble in hot solutions at this concentration. Materials were cooked and agitated, then the rare earth salts were allowed to settle out. The 40° Be (thorium sulfate) liquid was decanted off the top and pumped into a storage tank to be used for manufacturing thorium salts. The rare earth salts were dissolved in cold water and pumped to storage tanks.

The thorium salts were manufactured by evaporating the thorium sulfate liquid until the solution is concentrated to 56° Be. At this concentration, the thorium salts in solution were precipitated. The salts precipitated were a mixture of thorium phosphate (ThP_2O_5); sulfate (SO_4); and hydrogen sulfite (HSO_3). The acid solution remaining from this precipitation was pumped to a storage tank and sold as spent sulfuric acid. The precipitated salts were then dissolved in cold water to make a solution of 40° Be, then pumped to a lead storage tank or directed to Building 21 for processing to thorium salts.

The 40° Be liquor from this process was diluted to 20° Be, allowed to settle, and then decanted to another tank. The residue was allowed to accumulate for several batches after which it was filtered and stored in metal drums. This "black mud" was saved as the source of mesothorium. The decanted solution was precipitated with oxalic acid, and allowed to settle. After settling, the remaining solution was pumped to the lime tank for disposal. The precipitated thorium oxalate was washed several times in the same tank until laboratory tests showed it free from acid. The thorium oxalate was then filtered and stored in wooden service containers.

"Soda ash extraction" was then performed on the thorium oxalate by adding it to soda ash solution and converting it to carbonate. At this point, the rare earth salts were insoluble and the thorium carbonate was soluble. The solution was then agitated, heated, and filtered in a press. The liquor (thorium carbonate) was placed in tank #2, and the press cake (rare earth carbonate) was returned to tank #1 to be washed and re-filtered. The washed rare earth carbonate cake was returned to a separate processing operation where it was used in the manufacturing of rare earth chloride cake.

The thorium carbonate solution in tank #2 was then treated with caustic soda and a laboratory control to determine the amount of caustic. The thorium was then precipitated as thorium hydroxide, filtered in a press, washed, and pressed again until free from alkalies. The filtrate was returned to tank #1 as soda ash liquor for the next batch. (In time, this soda ash became so contaminated with silicates that a new batch was made, and the old batch was pumped to the lime tanks for disposal). This material was referred to as thorium hydroxide technical.

The thorium hydroxide was then dissolved in hydrogen chloride and made to 30° Be. Sulfuric acid was then added to the solution, which was cooled with ice and constantly agitated by hand. Thorium sulfate precipitates from this solution and was filtered. The solution was then returned to another process to recover the rare earth values.

Thorium sulfate was then dissolved in cold water. Aqua ammonia was added, and hand agitated. Thorium hydroxide precipitated and was filtered. The liquor was discarded and the hydroxide was dissolved in hydrogen chloride, and the precipitation of thorium sulfate is repeated as above. Precipitations continued until no rare earths were determined present, then the thorium sulfate was re-converted to thorium hydroxide with aqua ammonia, and filtered as pure thorium hydroxide.

Thorium nitrate was then made from the thorium hydroxide by adding nitric acid and allowing it to settle. The clear solution was transferred to another crock; hydrogen sulfide was then bubbled through to precipitate the heavy metals. The solution was filtered, then evaporated in enamel pots. Thorium nitrate [$Th(NO_3)_4$] stirred out while cooking.

To make thorium oxide, the evaporation process for thorium nitrate was stopped before the temperature reached 150°C, and additional nitric acid was added. This liquor, on cooling, produced a large crystal. The crystal was filtered out, and the liquor went back as sodium hydroxide for the next batch. The crystals were placed in silica dishes and ignited to the oxide over gas burners. When the open gas burners had ignited all that was possible at that temperature, the material was placed in gas furnaces in the Lanthanum Building, where the final ignition was made. The resulting oxide was sifted through a 60 mesh sieve, packed, and shipped as thorium oxide (ThO_2).