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United States Department of Energy

Savannah River Site

Record of Decision
Remedial Alternative Selection for the R-Area Burning/Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (U)

CERCLIS Number 43

WSRC-RP-2004-4004

Revision 1

May 2004

Prepared by:
Westinghouse Savannah River Company LLC
Savannah River Site
Aiken, SC 29808

Prepared for U.S. Department of Energy under Contract No. DE-AC09-96SR18500

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Prepared for
U.S. Department of Energy
and
Westinghouse Savannah River Company LLC
Aiken, South Carolina

RECORD OF DECISION
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**Westinghouse Savannah River Company LLC
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U. S. Department of Energy under Contract DE-AC09-96SR18500
Savannah River Operations Office
Aiken, South Carolina**

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DECLARATION FOR THE RECORD OF DECISION

Unit Name and Location

R-Area Burning/Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (U)

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number: OU-CERCLIS number 43

Savannah River Site

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Identification Number: SC1 890 008 989

Aiken, South Carolina

United States Department of Energy

The R-Area Burning/Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (OU) (RBRP/RRP) is listed as a Resource Conservation and Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for the Savannah River Site (SRS).

The FFA is a legally binding agreement between regulatory agencies [United States Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control (SCDHEC)] and regulated entities [United States Department of Energy (USDOE)] that establishes the responsibilities and schedules for the comprehensive remediation of SRS. The media associated with this operable unit are RBRP soil and RRP soil. The RBRP/RRP OU consists of five subunits: RBRP [pit 131-R (Closed Pit) and pit 131-1R (Open Pit)], the pit perimeter, R-Area Rubble Pile (RRP) (pile and soil beneath the pile), wetland, and groundwater in the vicinity.

Statement of Basis and Purpose

This decision document presents the selected remedy for the RBRP OU, located at the SRS near Aiken, South Carolina. The remedy was chosen in accordance with CERCLA, as amended by the Superfund Amendments Reauthorization Act (SARA), and, to the

extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record File for this site.

The USEPA, SCDHEC, and USDOE concur with the selected remedy.

Assessment of the Site

There has been a release of metals, dioxins/furans, PCE and asbestos at the RBRP/RRP OU into the environment. The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Description of the Selected Remedy

The RBRP/RRP OU future land use will be industrial usage (Future conceptual land use is illustrated in Figure I). Unrestricted land use is inappropriate due to the presence of buried contaminants at the unit and the proximity of RBRP/RRP to the heavy industrial (nuclear) zone of R Area. However, unrestricted land use at the pile area may be possible pending the results of confirmatory sampling after removal and disposal of the soil and debris. This change from restricted to unrestricted land use will be documented and issued for regulatory approval in the Post Closure Report after the confirmatory sampling verifies the area meets the more restrictive cleanup levels. The RCRA Facility Investigation/Remedial Investigation Work Plan Addendum including Baseline Risk Assessment (RFI/RI/WPA with BRA) (WSRC 2003) identified contamination warranting remediation in two subunits: RBRP and RRP. The RFI/RI/BRA determined that there is no problem warranting action (there are no refined constituents of concern [RCOCs]) for the perimeter pit soils, groundwater or wetland of the OU, therefore No Action is selected for these subunits. There is no principal threat source material (PTSM) at this OU. The selected remedy for the RBRP/RRP is Alternative RBRP/RRP #2 Consolidation and Cover: Consolidation of RCRA non-hazardous rubble pile material into/over the open rubble pit sub-unit, low permeability cover over the combination (pits and non-hazardous pile

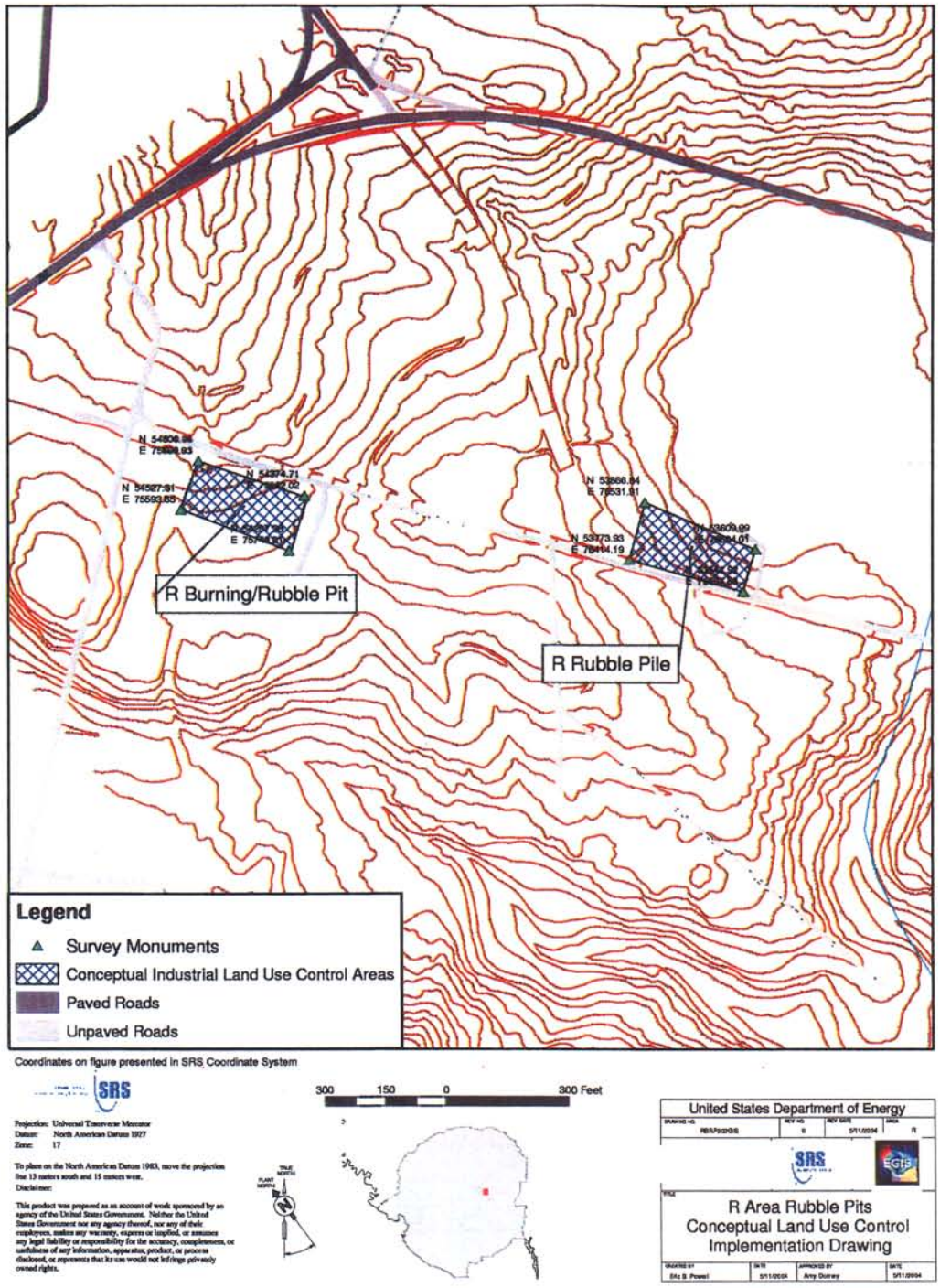

Figure I. R Area Rubble Pits / Rubble Pile Conceptual Future Land Use

material), and offsite disposal of any RCRA hazardous pile materials. A detailed description of all of the remedial alternatives considered is provided in Section IX of this document.

The selected remedy entails the following:

- Excavation of the soil that exceeds the industrial RG levels from the rubble pile material (including 1 foot beneath the rubble pile). The soil removed will be segregated as RCRA hazardous and RCRA non-hazardous based on RCRA requirements. The non-hazardous soil will be placed into the open R-Area Burning Rubble Pits sub-unit. The open pit will be backfilled to grade with rubble pile material, placing any remaining RCRA non-hazardous rubble pile material over both pits.

- A low permeability cover system will be installed over both pits

- Institutional controls will consist of long-term site maintenance (repair of erosion damage and maintaining warning signs) and site controls (deed notifications/restrictions). The objective of institutional controls is to prevent residential use of property that is identified as a waste unit used for hazardous material management. The land use controls (LUC) will ensure no construction on, excavation of, or breaching of the low-permeability cover. Institutional controls and/or Land Use Controls included in the selected remedy to achieve this objective are: property record notices and restrictions, other notices, Site Use Program controls, warning signs, and security surveillance measures.

- Five-year remedy reviews will be conducted.

- The time to the start of construction will be 15 months after the ROD is approved; the duration of construction is 24 months.

The RCRA permit will be revised to reflect selection of the final remedy using the procedures under 40 CFR Part 270, and SCHWMR R.61-79.264.101; 270.

In the long term, if the property is ever transferred to nonfederal ownership, the US Government will take those actions necessary pursuant to Section 120(h) of CERCLA. Those actions will include a deed notification disclosing former waste management and disposal activities as well as remedial actions taken on the site. The contract for sale and the deed will contain the notification required by CERCLA Section 120(h). The deed notification shall, in perpetuity, notify any potential purchaser that the property has been used for the management and disposal of waste. These requirements are also consistent with the intent of the RCRA deed notification requirements at final closure of a RCRA facility if contamination will remain at the unit.

The deed shall also include deed restrictions precluding residential use of the property. However, the need for these deed restrictions may be reevaluated at the time of transfer in the event that exposure assumptions differ and/or the residual contamination no longer poses an unacceptable risk under residential use. Any reevaluation of the need for the deed restrictions will be done through an amended ROD with USEPA and SCDHEC review and approval.

In addition, if the site is ever transferred to nonfederal ownership, a survey plat of the OU will be prepared, certified by a professional land surveyor, and recorded with the appropriate county recording agency.

The selected remedy for the RBRP/RRP OU leaves hazardous substances in place that pose a potential future risk and will require land use restrictions for an indefinite period of time. As agreed on March 30, 2000, among the USDOE, USEPA, and SCDHEC, SRS is implementing a Land Use Control and Assurance Plan (LUCAP) to ensure that the Land Use Controls (LUCs) required by numerous remedial decisions at SRS are properly maintained and periodically verified. The unit-specific Land Use Control Implementation Plan (LUCIP) incorporated by reference into this ROD will provide

details and specific measures required to implement and maintain the LUCs selected as part of this remedy.

The USDOE is responsible for implementing, maintaining, monitoring, reporting upon, and enforcing the LUCs selected under this ROD. The LUCIP, developed as part of this action, will be submitted concurrently with the Corrective Measures Implementation (CMI)/Remedial Action Implementation Plan (RAIP), as required in the FFA for review and approval by USEPA and SCDHEC. Upon final approval, the LUCIP will be appended to the LUCAP and is considered incorporated by reference into the ROD, establishing LUC implementation and maintenance requirements enforceable under CERCLA. The approved LUCIP will establish implementation, monitoring, maintenance, reporting, and enforcement requirements for the unit. The LUCIP will remain in effect unless and until modifications are approved as needed to be protective of human health and the environment. LUCIP modification will only occur through another CERCLA document.

Statutory Determinations

Based on the unit RFI/RI/WPA with BRA report, RBRP and RRP soils pose a threat to human health and the environment. Therefore, Alternative RBRP/RRP #2 Consolidation and Cover has been selected as the remedy for the RBRP/RRP OU. The future land use of the RBRP/RRP OU is assumed to be industrial land use.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. The

remedy in this OU does not satisfy the statutory preference for treatment as a principal element of the remedy because the investigation has determined that the unit does not contain principal threats (i.e., liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials). The selected remedy reduces the toxicity and volume by segregating RCRA hazardous soils for disposal at an appropriate treatment, storage, and disposal facility and reduces the mobility of the low-level threats at the unit with a low-permeability cover.

Data Certification Checklist

This ROD provides the following information:

- RCOCs and their respective concentrations
- Baseline risk represented by the RCOCs
- Cleanup levels established for the RCOCs and the basis for the levels
- Current and reasonably anticipated future land and groundwater use assumptions used in the Baseline Risk Assessment (BRA) and ROD
- Potential land and groundwater use that will be available at the site as a result of the selected remedy
- Estimated capital, operation and maintenance, and total present worth cost; discount rate; and the number of years over which the remedy cost estimates are projected
- Key decision factor(s) that led to selecting the remedy

7/30/04
Date

Jeffrey M. Allison
Manager
U. S. Department of Energy, Savannah River Operations Office

8/20/04
Date

Winston A. Smith
Director
Waste Management Division
U. S. Environmental Protection Agency - Region 4

9/13/04
Date

Robert W. King, Jr.
Deputy Commissioner
Environmental Quality Control
South Carolina Department of Health and Environmental Control

DECISION SUMMARY
REMEDIAL ALTERNATIVE SELECTION (U)

R-Area Burning/Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (U)

CERCLIS Number 43

WSRC-RP-2004-4004
Rev. 1

May 2004

Savannah River Site
Aiken, South Carolina

Prepared By:

Westinghouse Savannah River Company LLC
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U. S. Department of Energy under Contract DE-AC09-96SR18500
Savannah River Operations Office
Aiken, South Carolina

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LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
BAF	Bioaccumulation factor
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CMI	Corrective Measures Implementation
COC	constituent of concern
CSM	conceptual site model
EPC	exposure point concentration
ESD	Explanation of Significant Difference
FFA	Federal Facility Agreement
HBL	health-based limit
HI	Hazard Index
HH	Human Health
HSWA	Hazardous and Solid Waste Amendments
IOU	integrator operable units
IRIS	Integrated Risk Information System, USEPA
LLC	Limited Liability Company
LUC	Land Use Controls
LUCAP	Land Use Controls Assurance Plan
LUCIP	Land Use Controls Implementation Plan
MCL	maximum contaminant level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
OU	operable unit
PCB	polychlorinated biphenyl
PRG	preliminary remedial goals
PTSM	principal threat source material
PW	Present Worth
RAIP	Remedial Action Implementation Plan
RAO	remedial action objective
RBC	Risk-based criteria
RBRP/RRP	R-Area Burning/Rubble Pits (131-R and 131-1R)and Rubble Pile (631-25G) Operable Unit (U)
RCOC	Refined Constituent of Concern
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

RFI	RCRA Facility Investigation
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RG	remedial goal
RGO	Remedial Goal Objective
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments Reauthorization Act
SB/PP	Statement of Basis/Proposed Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SCHWMR	South Carolina Hazardous Waste Management Regulations
SRS	Savannah River Site
SVOC	semivolatile organic compound
TRV	toxicity reference value
UCL	Upper confidence limit
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
WSRC	Westinghouse Savannah River Company, LLC

I. R-AREA BURNING/RUBBLE PITS (131-R AND 131-1R) AND RUBBLE PILE (631-25G) OPERABLE UNIT (U)

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number: 43

Savannah River Site

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Identification Number: SC1 890 008 989

Aiken, South Carolina

United States Department of Energy (USDOE)

Savannah River Site (SRS) occupies approximately 310 square miles of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina (Figure 1). SRS is located approximately 25 miles southeast of Augusta, Georgia, and 20 miles south of Aiken, South Carolina.

The USDOE owns SRS, which historically produced tritium, plutonium, and other special nuclear materials for national defense and the space program. Chemical and radioactive wastes are by-products of nuclear material production processes. Hazardous substances, as defined by the CERCLA, are currently present in the environment at SRS.

The Federal Facility Agreement (FFA) (FFA 1993) for SRS lists the R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and Rubble Pile (631-25G) (RRP) Operable Unit (OU) as a Resource Conservation and Recovery Act Solid Waste Management Unit/Comprehensive Environmental Response, Compensation and Liability Act (RCRA/CERCLA) unit requiring further evaluation. The RBRP/RRP OU was evaluated through an investigation process

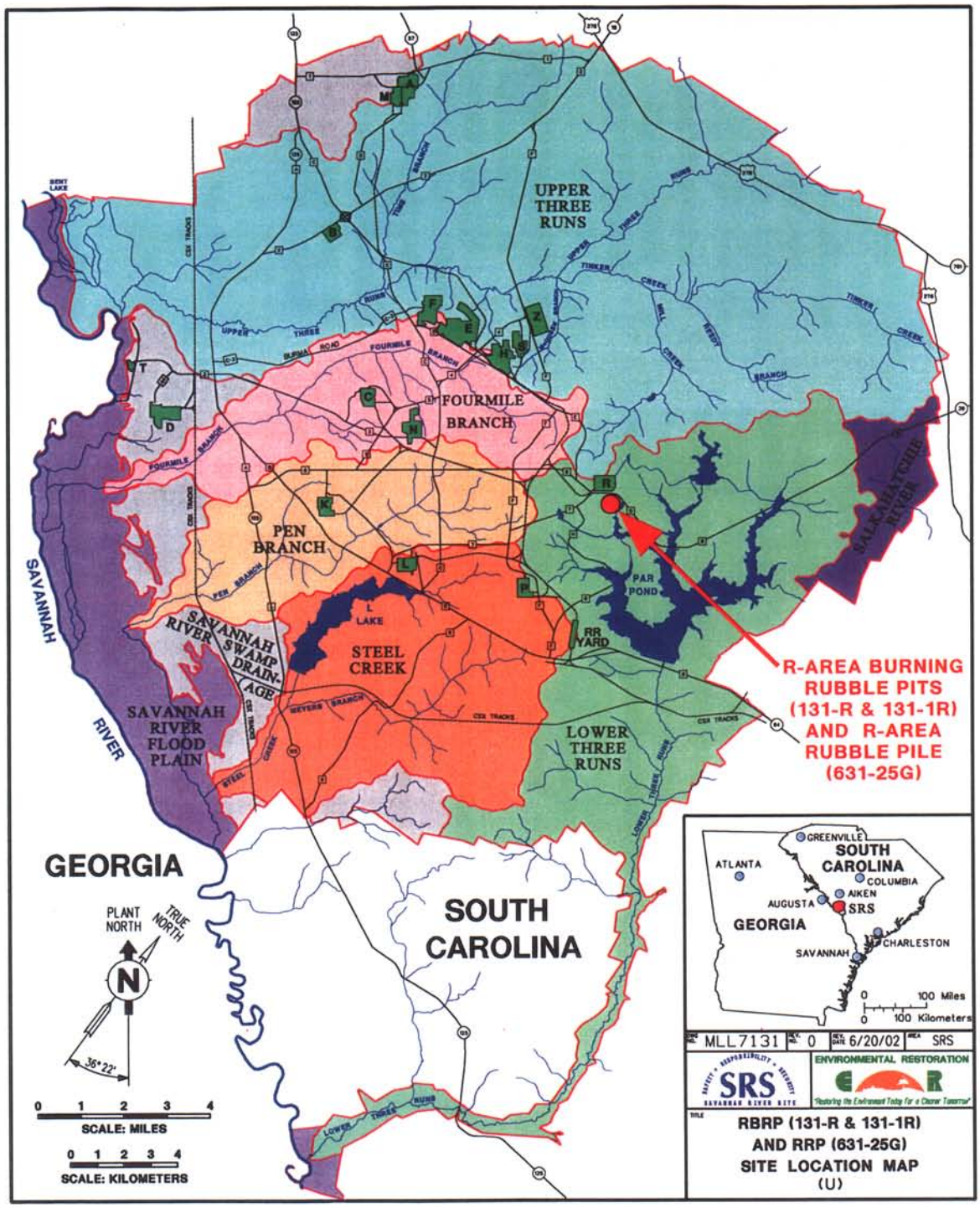

Figure 1. Location of the RBRP within the Savannah River Site

potential impact to human health and the environment of releases of hazardous substances to the environment.

II. SITE AND OPERABLE UNIT COMPLIANCE HISTORY

SRS Operational and Compliance History

The primary mission of SRS has been to produce tritium, plutonium, and other special nuclear materials for our nation's defense programs. Production of nuclear materials for the defense program was discontinued in 1988. SRS has provided nuclear materials for the space program, as well as for medical, industrial, and research efforts up to the present. Chemical and radioactive wastes are byproducts of nuclear material production processes. These wastes have been treated, stored, and in some cases, disposed at SRS. Past disposal practices have resulted in soil and groundwater contamination.

Hazardous waste materials handled at SRS are managed under RCRA, a comprehensive law requiring responsible management of hazardous waste. Certain SRS activities require South Carolina Department of Health and Environmental Control (SCDHEC) operating or post-closure permits under RCRA. SRS received a RCRA hazardous waste permit from the SCDHEC, which was most recently renewed on September 30, 2003. Module VIII of the Hazardous and Solid Waste Amendments (HSWA) portion of the RCRA permit mandates corrective action requirements for non-regulated solid waste management units subject to RCRA 3004(u).

On December 21, 1989, SRS was included on the National Priorities List (NPL). The inclusion created a need to integrate the established RCRA facility investigation (RFI) program with CERCLA requirements to provide for a focused environmental program. In accordance with Section 120 of CERCLA 42 United States Code Section 9620, USDOE has negotiated a FFA (FFA 1993) with United States Environmental Protection Agency (USEPA) and SCDHEC to coordinate remedial activities at SRS into one comprehensive strategy which fulfills these dual regulatory requirements. USDOE

functions as the lead agency for remedial activities at SRS, with concurrence by the USEPA - Region 4 and the SCDHEC.

Operable Unit Operational and Compliance History

The R-Area Burning Rubble Pits (RBRP) and R-Area Rubble Pile (RRP) Operable Unit (OU) is located at SRS, approximately 7.3 km (4.5 mi) from the nearest SRS boundary (Figure 1). The OU includes five sub-units: RBRP [pit 131-R (Closed Pit) and pit 131-1R (Open Pit)], the pit perimeter soils, RRP (pile 631-25G and soil beneath the pile), wetland, and groundwater in the vicinity. There were no prior removal or remedial actions for this operable unit. Listed below are the documents which were prepared, reviewed and approved that validate the recommended remedial alternative of this decision document:

RCRA Facility Investigation / Remedial Investigation Work Plan for the R-Area Burning Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) (U), WSRC-RP-2000-4046, Rev. 1 Issued July 2001

RFI/RI/Work Plan Addendum with Baseline Risk Assessment for the R-Area Burning Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (U), WSRC-RP-2002-4183, Rev. 1; Issued June 2003

Statement of Basis/Proposed Plan for the R-Area Burning/Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (U), WSRC-RP-2003-4117, Rev. 1.1; Issued November 2003

RBRP-Pit 131-R (Closed) and 131-1R (Open) and Perimeter Soils

RBRP is located 335 m (1,100 ft) southeast of R-Reactor Area. RBRP is comprised of two parallel burial trenches, each approximately 70.1 x 9.1 m (230 x 30 ft). One of the pits (131-R) has been backfilled with soil to grade. When operational, this pit was 4.0 m (13 ft) deep. The other pit (131-1R) remains open. When operational, the open pit was

3.0 m (10 ft) deep, but waste disposal and subsequent erosion of the side slopes into the pit has brought the current floor of the pit to 2.4 m (8 ft) below local grade. The combined area of both pits is 1,282 m^2 (13,800 ft^2). The area enclosed by orange marker balls, which define the perimeter of the unit, is 33.5 x 80.8 m (110 x 265 ft) (2,708 m^2 [29,150 ft^2]) (Figure 2).

Few historical records of specific activities at RBRP are known to exist; however, the general operational history of burning/rubble pits at SRS is known. Burning/rubble pits at SRS were used from 1951 to 1973 for periodic burning of combustible wastes such as wood, cardboard, paper, plastics, rubber, rags, oils, and organic liquids of unknown use or origin. Burning in open pits at SRS was discontinued in 1973; after that time, the pits that were still active continued to receive inert debris such as scrap metal and construction materials. Disposal in burning/rubble pits at SRS ended by 1983. Because R -Area ceased operation in May 1964, disposal activities at RBRP probably ceased before 1964 or shortly thereafter. A historical document search indicates that RBRP was active in 1959 and suggests that low-level radiological waste was inadvertently placed in the pit (WSRC 2003). Concrete monuments, typical of those used to mark radiological waste burial sites, are installed at both ends of the closed pit 131-R. However, no radiological contamination has been found at RBRP.

RRP – Pile and Soil Beneath Pile

The R-Area Rubble Pile (RRP) is an area of approximately 0.7 (2833m^2) acres where miscellaneous debris was placed on the ground, forming one contiguous pile generally 0.6 to 0.9 m (2 to 3 ft) deep. RRP is 700 m (2,300 ft) southeast of R-Reactor Area. Disposal practices at the unit likely consisted of dumping truckloads of waste on the land surface. An abandoned road constructed prior to SRS operations passes through the southwestern corner of RRP. The road was paved, and residual asphalt is visible. RRP was in the process of being cleaned up under the SRS general maintenance housekeeping program in January 1991 when workers discovered protective boot covers similar to those used in radioactive work among the debris. The work was halted, and a radiation

survey was performed on February 3, 1991. No detectable contamination was found, indicating the boot covers were disposed of as clean waste. The pile consists of a mixture of debris and soil. Debris identified in the pile includes miscellaneous construction materials, friable asbestos material, stainless steel shavings, empty 55-gallon drums, approximately fifteen 25-gallon containers, railroad ties, building insulation, floor and ceiling tiles, lawn wastes, light bulbs, coiled metal, and small amounts of coal and ash. Friable asbestos is present in a large portion of the unit. The unit has been barricaded to prevent unprotected personnel from entering the area. The disposal dates are unknown, but because R Area was shut down in May 1964, disposal activities probably ceased before 1964 or shortly thereafter.

Wetland

A delineated wetland borders RRP on the east. The wetland is addressed as a sub-unit based on its proximity to the rubble pile. The wetland was dry during Pre-Work Plan characterization in 2000. However, it became saturated during the spring of 2003, and is now occasionally wet. No pathways such as ditches have been identified that would transport contamination from RRP to the wetland. Although no pathways for contaminant transport have been identified, the wetland is assessed as a subunit that could have been impacted by RRP. The total area of the wetland is approximately 5.3 ha (13 ac). Characterization of the wetland (1999-2000) indicated that there is no problem warranting action in the wetland area because no constituents of concern (COCs) were identified.

Groundwater

Groundwater flow is southeast toward Pond 4. The water table aquifer is believed to discharge to Pond 4, approximately 800 m (2,600 ft) southeast of the unit (Figure 2). Groundwater monitoring data indicates that there are no constituents of concern (COCs) for groundwater. All groundwater monitoring well data is below detection limits for contaminants. There is no groundwater problem warranting action for the RBRP/RRP OU.

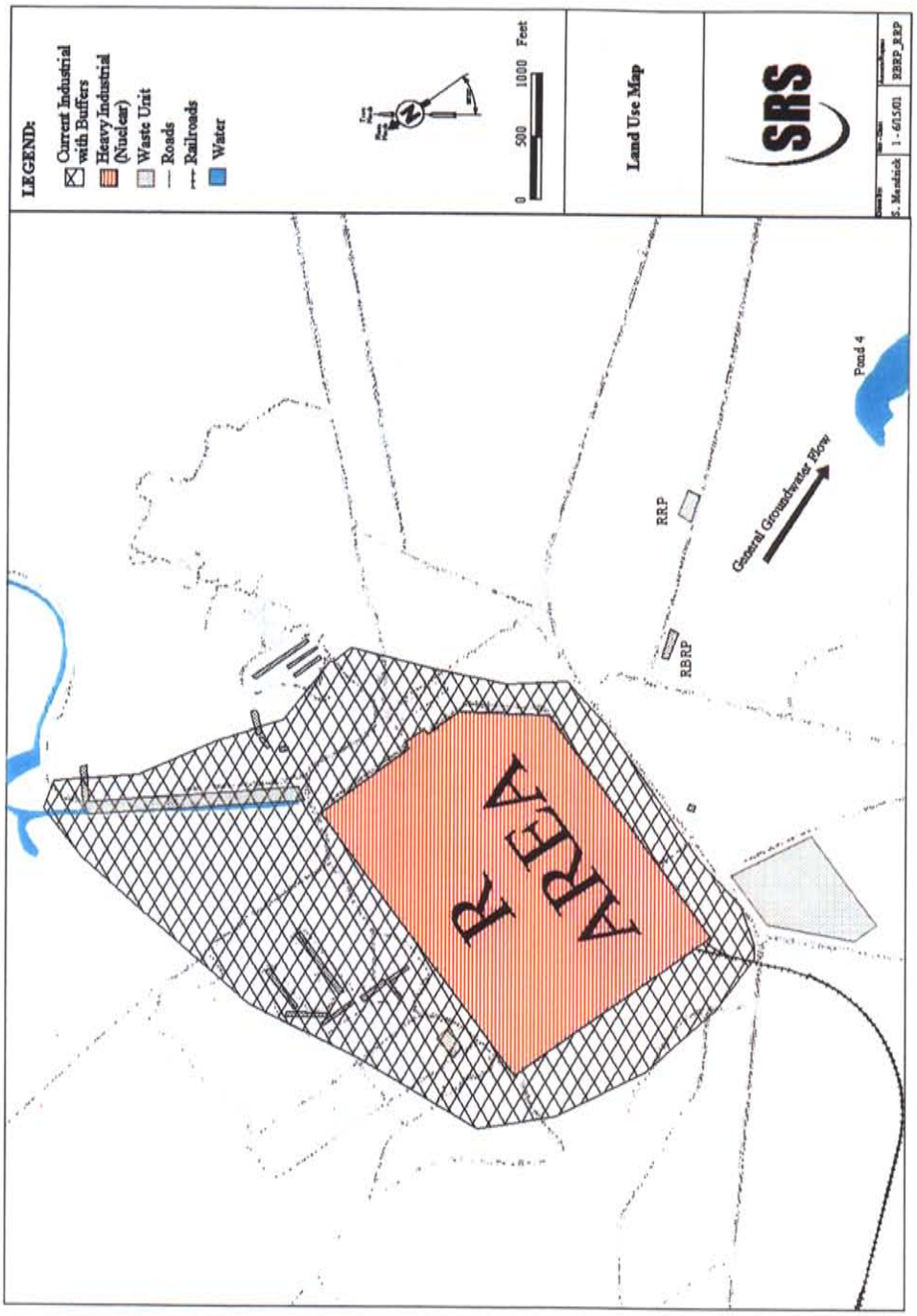

Figure 2. Layout of the RBRP/RRP

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Both RCRA and CERCLA require the public to be given an opportunity to review and comment on the draft permit modification and proposed remedial alternative. Public participation requirements are listed in South Carolina Hazardous Waste Management Regulation (SCHWMR) R.61-79.124 and Sections 113 and 117 of CERCLA (42 United States Code Sections 9613 and 9617). These requirements include establishment of an Administrative Record File that documents the investigation and selection of the remedial alternative for addressing the RBRP/RRP soils and groundwater.

The SRS Public Involvement Plan (USDOE 1994) is designed to facilitate public involvement in the decision-making process for permitting, closure, and the selection of remedial alternatives. The SRS Public Involvement Plan addresses the requirements of RCRA, CERCLA, and the National Environmental Policy Act, 1969 (NEPA). SCHWMR R.61-79.124 and Section 117(a) of CERCLA, as amended, require the advertisement of the draft permit modification and notice of any proposed remedial action and provide the public an opportunity to participate in the selection of the remedial action. The Statement of Basis/Proposed Plan (SB/PP) for the R-Area Burning/Rubble Pits and Rubble Pile Operable Unit, a part of the Administrative Record File, highlights key aspects of the investigation and identifies the preferred action for addressing the RBRP/RRP.

The FFA Administrative Record File, which contains the information pertaining to the selection of the response action, is available at the following locations:

US Department of Energy
Public Reading Room
Gregg-Graniteville Library
University of South Carolina – Aiken
171 University Parkway
Aiken, South Carolina 29801
(803) 641-3465

Thomas Cooper Library
Government Documents Department
University of South Carolina
Columbia, South Carolina 29208
(803) 777-4866

The RCRA Administrative Record File for SCDHEC is available for review by the public at the following locations:

The South Carolina Department of Health and Environmental Control
Bureau of Land and Waste Management
8911 Farrow Road
Columbia, South Carolina 29203
(803) 896-4000

Edisto Savannah District Environmental Quality Control Office
206 Beaufort Street, Northeast
Aiken, South Carolina 29801
(803) 641-7670

The public was notified of the public comment period through mailings of the *SRS Environmental Bulletin*, a newsletter sent to citizens in South Carolina and Georgia, and through notices in the *Aiken Standard*, the *Allendale Citizen Leader*, the *Augusta Chronicle*, the *Barnwell People-Sentinel*, and *The State* newspaper. The public comment period was also announced on local radio stations.

The SB/PP 45-day public comment period began on January 7, 2004 and ended on February 20, 2004. A Responsiveness Summary, prepared to address any comments received during the public comment period, is provided in Appendix A of the ROD. It will also be available in the final RCRA permit.

IV. SCOPE AND ROLE OF THE OPERABLE UNIT

Due to the complexity of multiple contaminant areas, the SRS is divided into integrator operable units (IOUs) for the purpose of managing a comprehensive cleanup strategy. Waste units within an IOU are evaluated and remediated individually.

The RBRP/RRP is located within the Lower Three Runs IOU. Upon disposition of all operable units within the Lower Three Runs IOU, a final comprehensive ROD for the IOU will be pursued with additional public involvement.

There has been a release of metals, dioxins/furans, PCE and asbestos at the RBRP/RRP OU into the environment. The response action selected in this ROD is necessary to protect the public health, welfare, or the environment from actual or threatened releases of hazardous substances into the environment.

The following activities have been or will be performed to support the overall cleanup strategy for the RBRP/RRP OU:

- No previous actions have been performed at this OU.

- This ROD selects the following response actions: Consolidation of RCRA non-hazardous rubble pile material into/over the open rubble pit sub-unit, low permeability cover over the combination (pits and non-hazardous pile material), offsite disposal of any RCRA hazardous pile materials, and institutional controls.

- If the residual contamination following the debris and contaminated soil removal at the Rubble Pile poses a risk less than 1 x 10^{-6} to the hypothetical future resident, an appropriate modification to the ROD will be submitted to eliminate the need for institutional controls at that area.

V. OPERABLE UNIT CHARACTERISTICS

The R-Area Burning Rubble Pits (RBRP) and R-Area Rubble Pile (RRP) Operable Unit (OU) is located at SRS, approximately 7.3 km (4.5 mi) from the nearest SRS boundary (Figure 1). The OU includes five sub-units: RBRP [pit 131-R (Closed Pit) and pit 131-1R (Open Pit)], the pit perimeter, RRP (pile and soil beneath the pile), wetland, and groundwater in the vicinity. There were no prior removal actions for this operable unit. Detailed results of characterization activities at the five sub-units can be found in the RCRA Facility Investigation/Remedial Investigation Work Plan for the R-Area Burning Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) (U) (WSRC 2001). The RFI/RI Work Plan Addendum (WPA) with Baseline Risk Assessment for the R-Area Burning Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (U) (WSRC 2003) includes the risk assessments that were originally developed in the Work Plan.

Conceptual Site Model (CSM) for the RBRP/RRP OU

The primary and secondary sources of contamination and release mechanisms, contaminated media, migration pathways, exposure pathways, and potential receptors are identified in the RBRP/RRP OU CSM (Figures 3a and 3b).

Media Assessment

Soil Investigation

RBRP-Pit 131-R (Closed) and 131-1R (Open)

Characterization of the burning rubble pits and the perimeter soils was performed through a series of sampling events. Generally, the sampling locations of each successive event were selected based on review of data previously collected with the intent of establishing the nature and extent of the contamination.

Investigation began in 1991 with a soil-gas survey that consisted of 10 soil-gas samples collected from within the closed pit and 10 soil-gas samples collected around the open pit. In 1999 a radiological survey of the surface soil over the closed pit and the perimeter soil was performed. A ground penetrating radar survey over the entire waste site area was also performed. These sampling / survey events defined the working conditions for further investigations, the physical boundaries of the pit, and the presence of volatile organic compound (VOC) contaminants within the pits.

Formal characterization of the waste site was conducted from late in 1999 through 2000. Soil samples were collected from the open and closed pits, along with samples from the perimeter soils.

Exploratory trenches were performed as a standard part of characterization at the burning/rubble pits. Three trenches were excavated across the width of the closed

pit to the pit's base depth of 13 ft. A soil sample was also collected from the base of each trench.

The soil samples were analyzed for target analyte list (TAL) inorganics, target compound list (TCL) semivolatile organic compounds (SVOCs), TCL volatile organic compound (VOCs), TCL pesticides/polychlorinated biphenyls (PCBs), dioxins/furans, and radionuclide indicators Gross Alpha and Non-volatile Beta. Speciation of either Alpha emitters or Beta emitters was performed if a screening level of 20 pCi/g for Gross Alpha or 50 pCi/g for non-volatile Beta were exceeded.

Characterization of the burning rubble pits indicates that contaminated soil is confined to the pits. Highest concentrations of contaminants are located at the bottom of the open pit and at what was originally at the base of the closed pit.

Contaminants of concern are metals, dioxins/furans, and tetrachloroethylene (PCE). The metals (cadmium, copper, lead, manganese, thallium) and PCE pose a risk of contaminating groundwater in the future. The dioxins/furans in the open pit pose unacceptable ecological and human health risks. Refer to Figures 4a and 4b along with Table 8 for the Nature and Extent of each COC.

Pit Perimeter Soils

There is no problem warranting action in the pit perimeter soils, because no constituents of concern (COCs) were identified for perimeter soil samples.

RRP – Pile and Soil Beneath Pile

Similar to the burning rubble pits, the characterization of the rubble pile was performed through a series of sampling events. Generally, the sampling locations of each successive event were selected based on review of data previously

collected with the intent of establishing the nature and extent of the contamination.

Investigation began in 1991 with a radiological survey of the surface soil over the entire waste site area. In addition, a soil-gas survey consisting of 46 soil-gas samples collected from surface soils over the entire waste site was performed. In 1994 a Site Evaluation was performed consisting of 30 surface soil samples. Formal characterization of the waste site was conducted from late 1999 through 2000. The soil samples were analyzed for TAL inorganics, TCL SVOCs, TCL VOCs, TCL pesticides/PCBs and radionuclide indicators gross alpha and non-volatile beta. Speciation of either alpha emitters or beta emitters was not required since none of the samples exceeded the screening level of 20 pCi/g for gross alpha or 50 pCi/g for non-volatile beta.

Characterization of the rubble pile indicates that contamination is confined to the rubble pile and one foot of soil beneath the rubble pile. Contaminants of concern are metals and asbestos. Cadmium, lead, and copper are present at levels that pose a threat of contaminating groundwater in the future. Barium, cadmium, copper, lead, and zinc pose unacceptable ecological risks. Figure 4c and Table 8 show the Nature and Extent of each COC.

Wetland

Characterization of the wetland was conducted from 1999-2000. This consisted of collecting soil samples from specific locations (two depths at each location [0 – 1 ft and 1 – 4 ft]). Depths were measured from the existing grade elevation.

The soil samples were analyzed for TAL inorganics, TCL SVOCs, TCL VOCs, TCL pesticides/PCBs, and radionuclide indicators Gross Alpha and Non-volatile Beta. Speciation of either Alpha emitters or Beta emitters was not required since none of the samples exceeded the screening level of 20 pCi/g for Gross Alpha or 50 pCi/g for Non-volatile Beta.

There is no problem warranting action in the wetland area, because no constituents of concern (COCs) were identified in the wetland soil samples.

Groundwater Investigation

Groundwater flow is southeast toward Pond 4. The water table aquifer is believed to discharge to Pond 4, approximately 800 m (2,600 ft) southeast of the unit (Figure 2).

Groundwater monitoring data indicates that there are no constituents of concern (COCs) for groundwater. All groundwater monitoring well data is below detection limits for contaminants.

There is no groundwater problem warranting action for the RBRP/RRP operable unit.

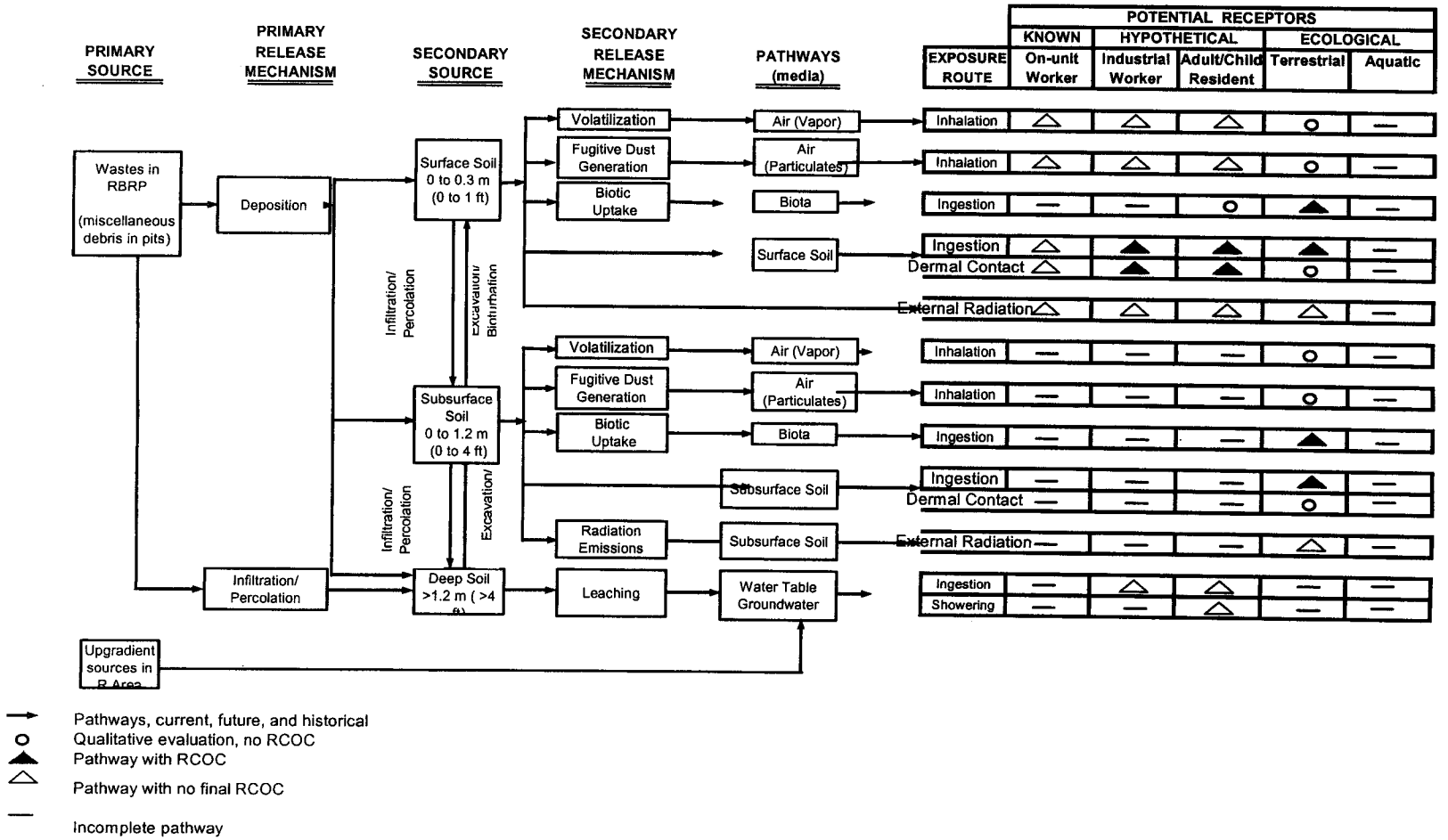

Figure 3a. Conceptual Site Model (RBRP)

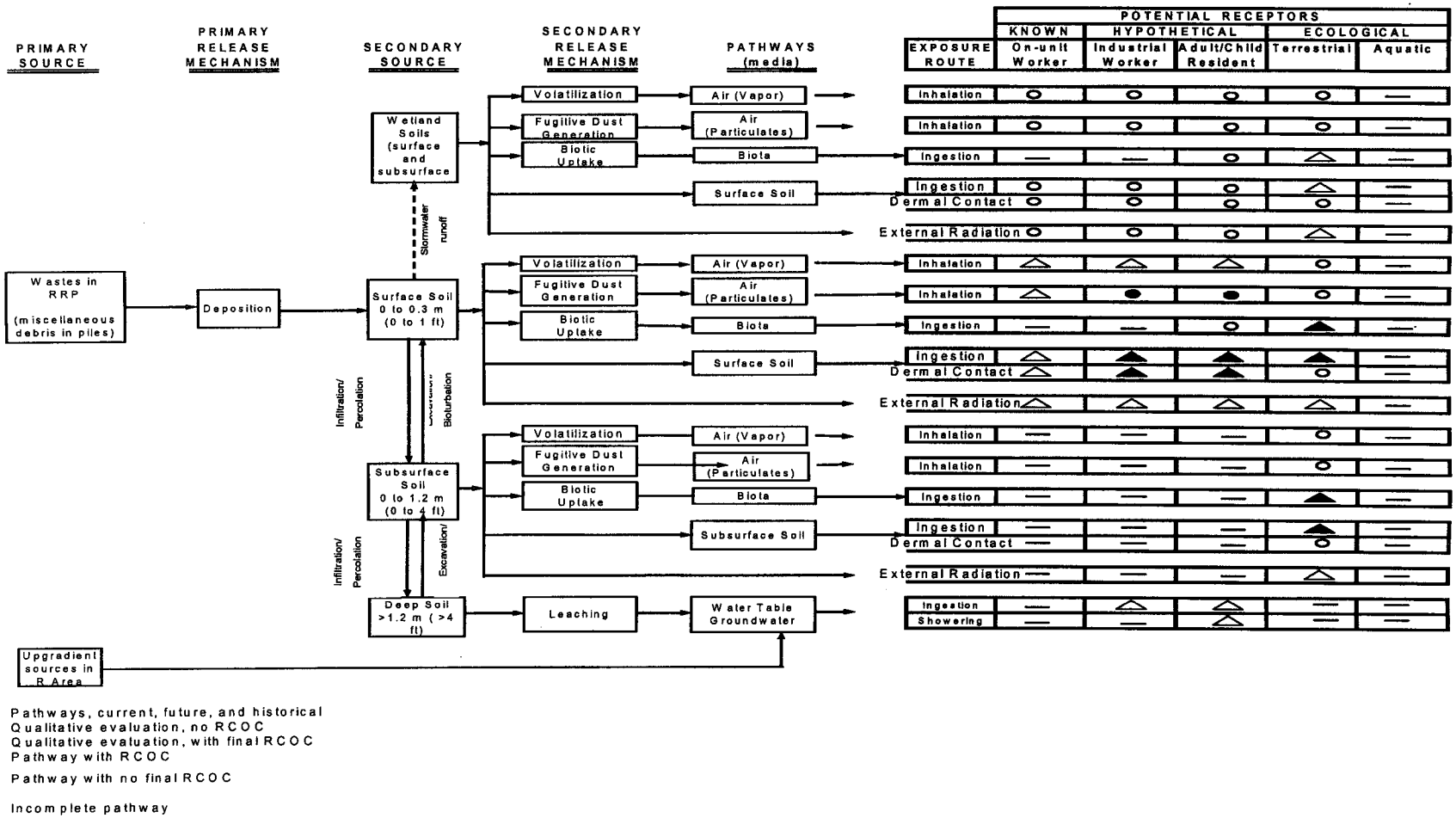

Figure 3b. Conceptual Site Model (RRP)

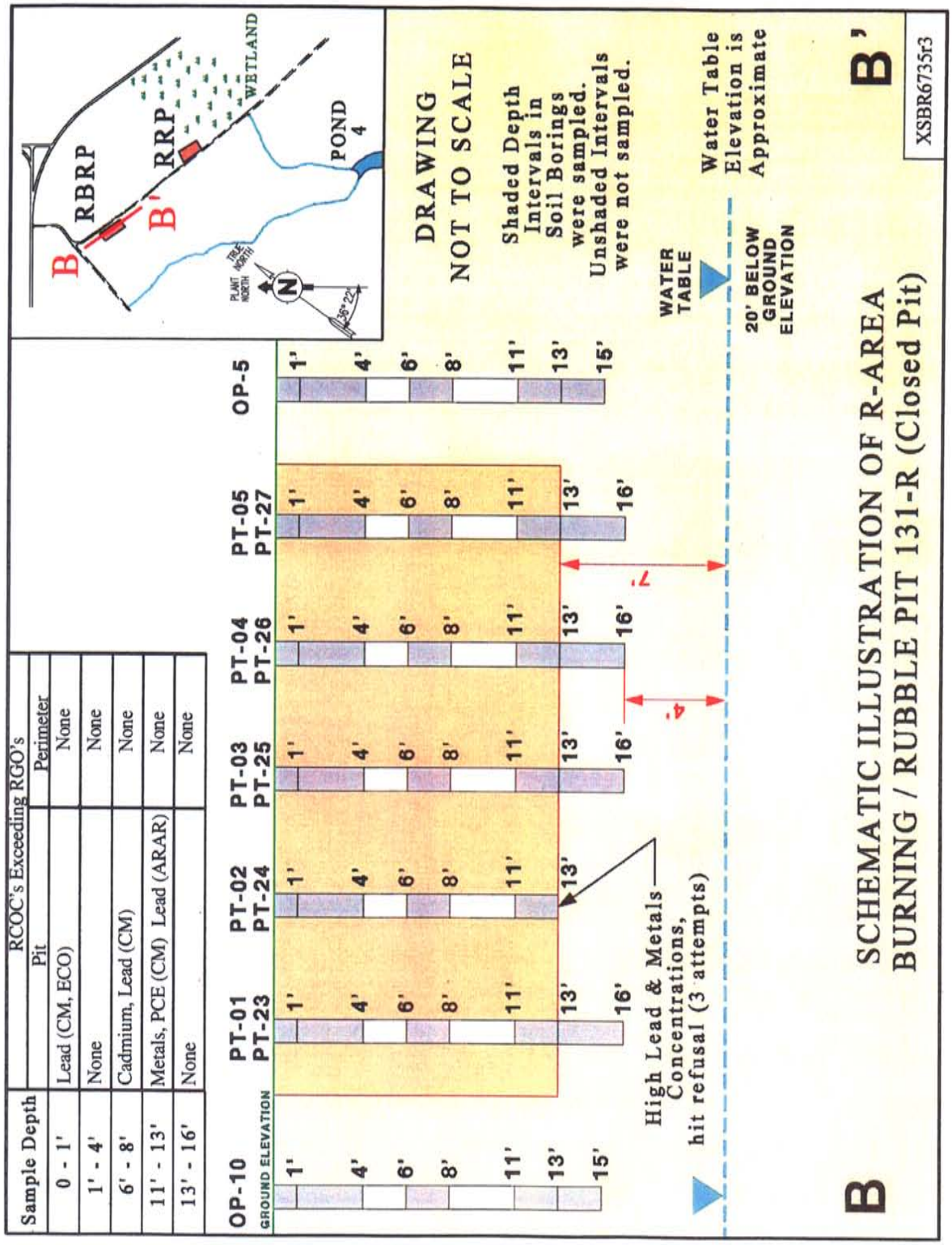

Figure 4a. Schematic Illustration of the RBRP OU (Closed Pit)

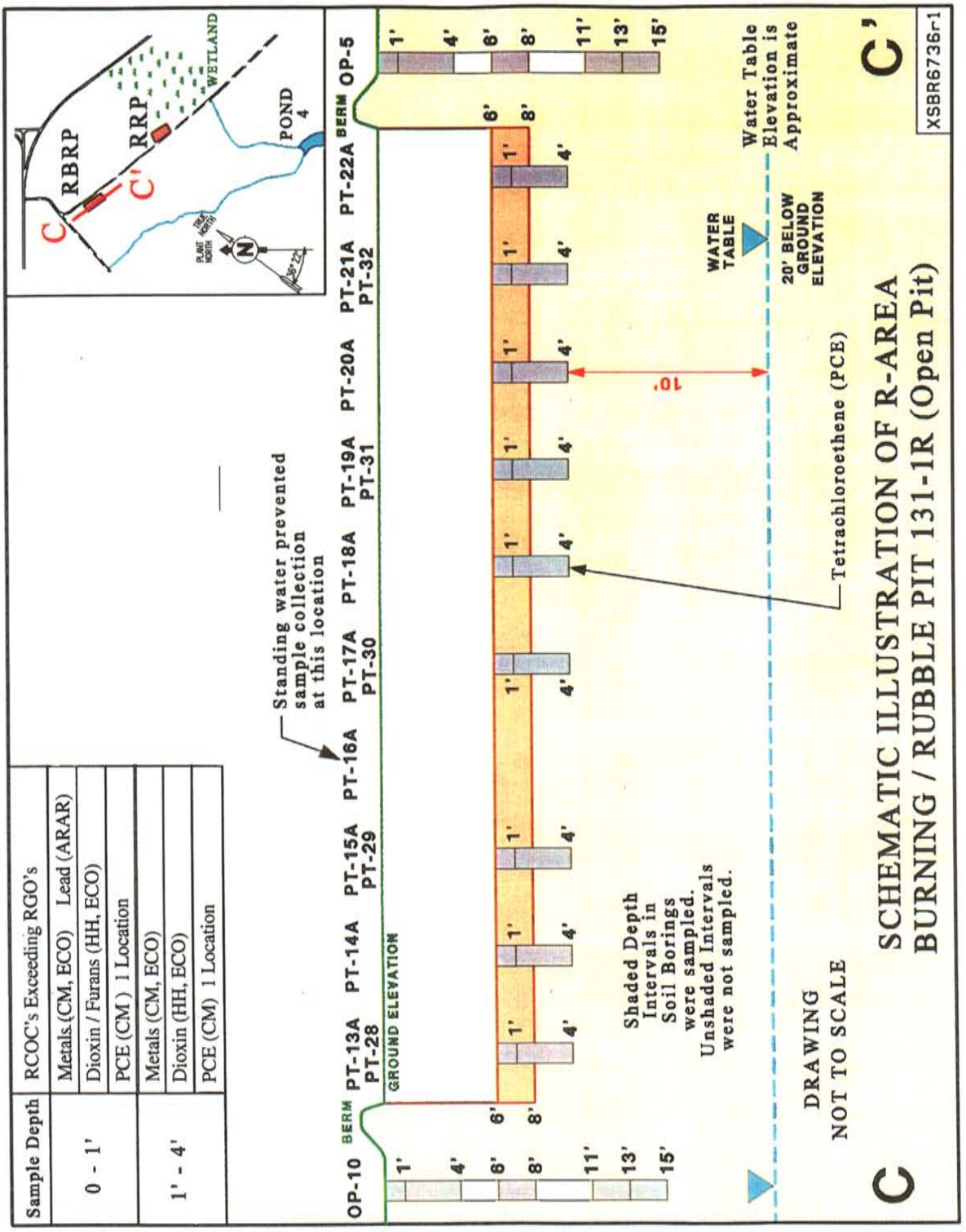

Figure 4b. Schematic Illustration of RBRP (Open Pit)

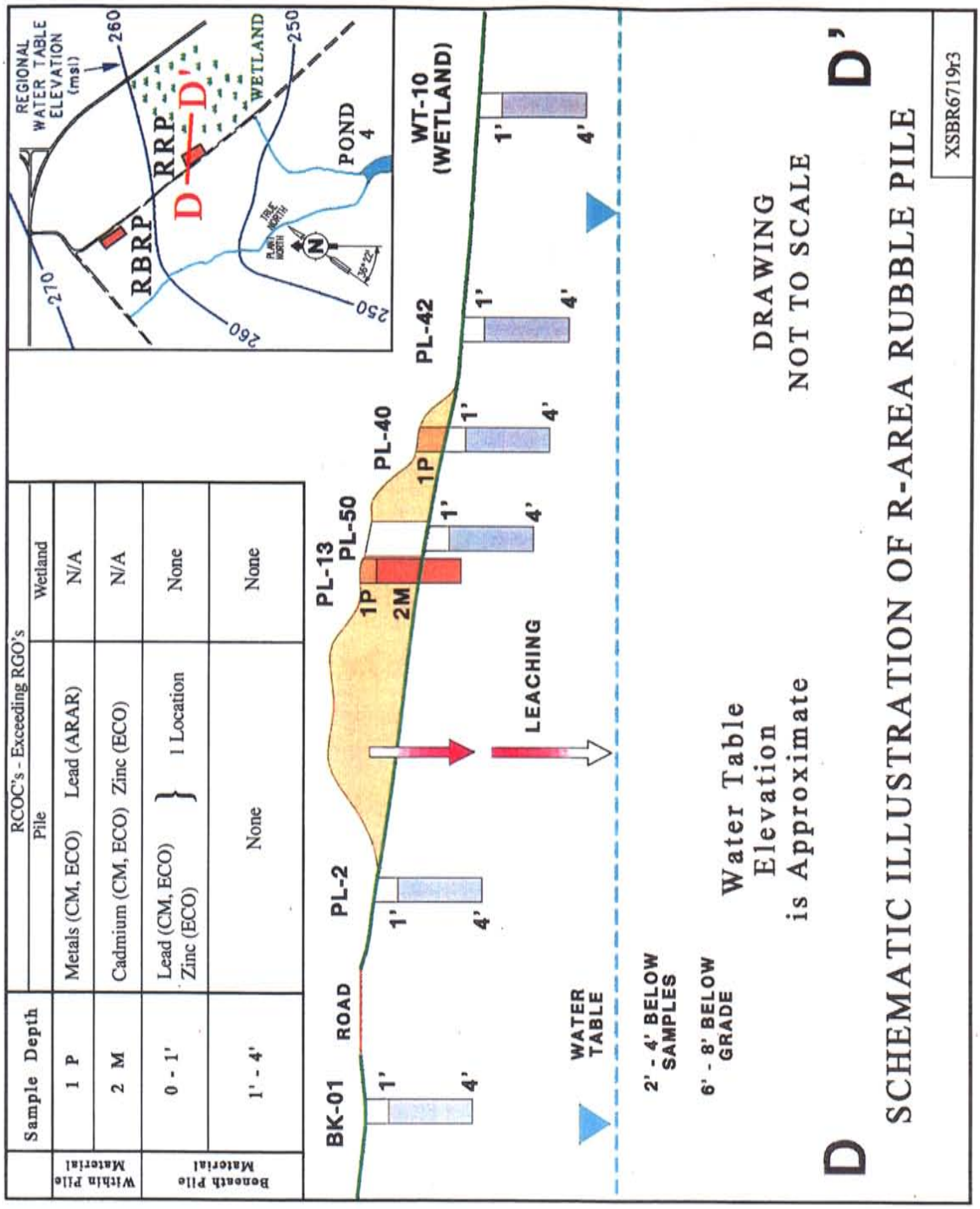

Figure 4c. Schematic Illustration of RRP

Site Specific Factors

Friable asbestos has been observed in the pile and has been identified as a human health (HH) RCOC.

Contaminant Transport Analysis

The soil assessment of RBRP and RRP includes a review of the potential migration pathways and mechanisms for transport of chemical substances found in each of the unit soils. Contaminant fate and transport analyses were performed to select the contaminant migration constituents of concern (CM COCs) based on their potential for leaching to groundwater through the vadose zone soils. This analysis also predicts the rate of leaching and the contaminant concentrations delivered to receptor locations via vadose zone pore water and groundwater.

This assessment uses the vadose zone contaminant migration multi-layered model (VZCOMML) program. Constituents that pass through the screens are identified as CM COCs. Leachability analyses were performed separately for RBRP and RRP under current baseline conditions.

There are no pathways for surface migration of contamination. This is based on a visual inspection and soil samples taken around both waste units. The only pathway for contaminant migration is through the vadose zone to the groundwater and from the groundwater to surface water. The potential receptors are the "Industrial Worker" and the "Adult/Child Resident".

The perimeter soils at RBRP and the wetland soils near RRP are not quantitatively assessed because there is no unit-related contamination in these areas (based on Core Team agreement during the August 1, 2001, Post-Characterization Scoping Meeting).

Constituents which were identified as CM COCs are located within the RBRP and RRP waste unit soils. Figures 4a, 4b, and 4c along with Table 8 show the Nature and Extent of each CMCOC. Table 8 provides the list of constituents and their maximum concentrations. Only one constituent (Lead) was identified as exceeding the RCRA Hazardous Waste level, based on TCLP samples within the RRP.

Media Assessment Results

A RFI/RI/WPA with a BRA (WSRC 2003) was performed to assess the risks posed by the OU to human health and the environment. The assessment included quantitative calculation of human health risks, ecological risks, and the threat posed by future leaching to groundwater. A summary of risks and hazards is presented in Table 8.

Refined constituents of concern (RCOCs) were based upon a future industrial land use scenario, and were only identified in the RBRP and the RRP. There were no RCOCs identified at the other sub-units (perimeter pit soils, groundwater, and wetland).

The following problems warranting action at the RBRP sub-unit are identified:

- Cadmium, copper, lead, manganese, thallium, and tetrachloroethene may leach to groundwater above the maximum contaminant level (MCL) or preliminary remediation goal (PRG) (manganese and copper) in less than 1,000 years and have been identified as contaminant migration refined constituents of concern (CM RCOCs) in the pits.

- Dioxins/furans in the surface soil exceed a risk of $1x10^{-6}$ for the future industrial worker (risk = 4.2×10^{-5}) and are identified as Human Health (HH) RCOCs.

- Lead, zinc, and dioxins/furans exceeded the hazard quotient (HQ) of 1 for the insectivorous birds and mammals, and are identified as ecological RCOCs in the open pit (131-1R).

No PTSM has been identified at RBRP.

The following problems warranting action at the RRP sub-unit are identified:

- Cadmium, copper, and lead may leach to groundwater above the MCL (or PRG – copper) in less than 1,000 years and have been identified as contaminant migration refined constituents of concern (CM RCOCs) in the pile.

- Friable asbestos has been observed in the pile and has been identified as a HH RCOC.

- Ecological RCOCs in the pile (barium, cadmium, copper, lead, and zinc) exceeded the HQ of 1 for the soil-dwelling organisms, herbivorous mammals, and insectivorous birds and mammals.

No PTSM has been identified in the RRP.

The perimeter soils at RBRP and the wetland soils near RRP are not quantitatively assessed because there is no unit-related contamination in these areas (based on Core Team agreement during the August 1, 2001, Post-Characterization Scoping Meeting).

Constituents which were identified as CM COCs are located within the RBRP and RRP waste unit soils. Only one constituent (Lead) was identified as exceeding the RCRA Hazardous Waste level, based on TCLP samples within the RRP. The approximate volumes of soil which require remedial action are:

- RBRP 131-R 2,900 cy.
- RBRP 131-1R 450 cy.
- RRP (sanitary waste) 1,950 cy.
- RRP (RCRA hazardous waste) 150 cy.

Conclusion

Principal threat source materials (PTSM) are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or which would present a significant risk to human health or the environment should exposure occur. The assessments conclude that no PTSM is present at the OU. However, RBRP soil and RRP soil pose risks to human health (under future industrial land use scenario) and the environment. Hence, actual or threatened releases of hazardous substances from RBRP/RRP, if not addressed by the selected remedy or another active measure, may present a current or potential threat to public health, welfare, or the environment.

VI. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Land Uses

The RBRP/RRP OU is located at SRS, approximately 7.3 km (4.5 mi) from the nearest SRS boundary (Figure 1). RBRP is located 335 m (1,100 ft) southeast of R-Reactor Area, and RRP is 700 m (2,300 ft) southeast of R-Reactor Area (Figure 2).

Although RBRP is located outside the R Reactor Area 200 ft buffer zone, future industrial land use is anticipated because of its proximity to the Heavy Industrial (Nuclear) zone of R Area and because of the known presence of buried debris. Remedial Action Objectives (RAOs) and likely response actions will be

developed with the expectation that future land use will be industrial. However, land use controls will be part of any remedial action to ensure protection against unrestricted uses (e.g. residential).

The RBRP/RRP OU is located in an area that has been recommended for future industrial (non-nuclear) use by the SRS Citizens Advisory Board (CAB). According to the Savannah River Site Future Use Project Report (USDOE 1996), residential uses of SRS land should be prohibited.

Groundwater Uses/Surface Water Uses

Groundwater at the OU is not currently being used for human consumption or any other purpose. It is unlikely that drinking water wells will be installed in the future in the potentially affected area because residential use of the area is unlikely due to the proximity of the RBRP OU to the heavy industrial zone of R Area.

USDOE controls drilling and surface water use through SRS's Site Use and Site Clearance Programs. Therefore, as long as USDOE maintains control of SRS, neither surface water nor groundwater will be used as a potential drinking water source or for irrigation.

Future residential use of groundwater or surface water at the OU is not anticipated.

VII. SUMMARY OF OPERABLE UNIT RISKS

Baseline Risk Assessment

As a component of the RFI/Remedial Investigation (RI) process, a baseline risk assessment (BRA) was performed to evaluate risks associated with the RBRP/RRP OU. The BRA estimates what risks the site poses if no action were taken. It provides the bases for taking action and identifies the contaminants and

exposure pathways that need to be addressed by the remedial action. The BRA includes human health and ecological risk assessments. This section of the ROD summarizes the results of the BRA for the RBRP/RRP OU.

Summary of Human Health Risk Assessment

Identification of COCs

The following table (Table 1) presents the COCs and exposure point concentrations (EPCs) for each of the chemical-specific COCs identified at the RBRP/RRP OU. The EPC is the concentration used to estimate the exposure and risk for each COC. The table includes the range of concentrations detected for each COC, as well as the frequency of detection, the EPC, and the statistical method of how the EPC was derived. The EPC is determined as the lesser of the maximum concentration and the 95th percent upper confidence limit on the mean (95% UCL). Additional information regarding the selection of the appropriate EPC is provided in Chapter 3 of the RFI/RI Work Plan Addendum including BRA (WSRC 2003).

Asbestos has been identified as a COC for the RRP. The selection of asbestos as a COC is based on a qualitative determination (i.e. the presence of friable asbestos) and concentrations are not presented.

Table 1. Summary of Constituents of Concern and Medium-Specific Exposure Point Concentrations for the R Area Burning/Rubble Pits

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Route	Constituent of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Direct Contact	Heptachlorodibenzo-p-dioxin isomers	7.4E-04	5.7E-03	mg/kg	3 / 5	3.75E-03	mg/kg	95% UCL
	Octachlorodibenzo-p-dioxin	1.5E-03	3.43E-02	mg/kg	5 / 5	3.43E-02	mg/kg	MAX
	Pentachlorodibenzo-p-dioxin isomers	2.6E-04	2.6E-04	mg/kg	1 / 5	1.81E-04	mg/kg	95% UCL
	Pentachlorodibenzo-p-furan isomers	1.9E-04	8.6E-04	mg/kg	2 / 5	5.72E-04	mg/kg	95% UCL
	Tetrachlorodibenzo-p-dioxin isomers	1.6E-04	1.6E-04	mg/kg	1 / 5	1.17E-04	mg/kg	95% UCL
	Tetrachlorodibenzo-p-furan isomers	2.7E-04	1.7E-03	mg/kg	2 / 5	1.11E-03	mg/kg	95% UCL

Key
MAX: maximum concentration
95% UCL: 95 percent upper confidence limit of the mean

Exposure Assessment

Potential receptors are expected to differ for the current and future land use scenarios. The possible receptor under the current land use is the known on-unit worker. The possible receptor under the future land use is the hypothetical on-unit industrial worker.

Current Land Use

The current population that potentially could be receptors for exposure to constituents associated with the RBRP/RRP OU is the on-unit worker who comes to the area on an infrequent or occasional basis. Known on-unit workers are defined as SRS employees who work at or in the vicinity of the RBRP/RRP OU under current land use conditions. A known on-unit worker may be a researcher,

environmental sampler, or personnel in close proximity to the unit. Although these receptors may be involved in the excavation or collection of contaminated media, they would follow SRS safety procedures and protocols for sampling at hazardous waste units. Nevertheless, limited exposure to unit media is a possibility.

Future Land Use

According to the Savannah River Site: Future Use Project Report (USDOE 1996), "residential uses of SRS land should be prohibited." R Reactor Area is designated as a heavy industrial area surrounded by an industrial buffer zone. If land use designation for the RBRP/RRP OU remains industrial, the only future human receptors expected are industrial workers. However, until deed notifications are established, the possibility exists that new buildings could be constructed and the area near the RBRP/RRP OU could be converted to residential use in the future. Although residential development is unlikely, a hypothetical residential exposure scenario for both adults and children was performed for comparative purposes (WSRC 2003). This is in accordance with USEPA Region IV guidance (USEPA 1995), which states that residential development cannot be entirely ruled out. However, the future land use is not likely to change from the current use.

The potentially exposed receptor presented for the future land use scenario is the hypothetical on-unit industrial worker (adult). The hypothetical on-unit industrial exposure scenario addresses long-term risks to workers who are exposed to unit-related constituents while working within an industrial setting. The hypothetical on-unit industrial worker is an adult who works in an outdoor industrial setting that is in direct proximity to the contaminated media for the majority of his time.

Exposure routes describe the way a chemical or physical agent comes into contact with a receptor (i.e., by ingestion, inhalation, dermal). Exposure points are

locations where contact between contaminant and receptor may occur. If a complete exposure route is suspected, the exposure assessment attempts to quantify contaminant concentrations and uptake at the exposure point. Hazard and risk estimates are then calculated for exposures occurring to environmental media at the exposure point via the relevant exposure routes. Identified below are the probable exposure routes for the RBRP/RRP OU based on the contaminated media and anticipated activities at the exposure points:

- Ingestion (soil)
- Inhalation (of particles and vapors from soil)
- Dermal exposure (soil)

Toxicity Assessment

The following tables (Tables 2 and 3) provide a summary of the cancer and non-cancer toxicity data used in the risk calculations for the COCs identified at the RBRP/RRP OU.

Table 2. Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal						
Constituent of Concern	**Oral Cancer Slope Factor**	**Dermal Cancer Slope Factor**	**Slope Factor Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date (Year)**
Heptachlorodibenzo-p-dioxin isomers	1.50E+03	3.00E+03	(mg/kg)/day	B2	TCDD × 0.01	---
Octachlorodibenzo-p-dioxin	1.50E+02	3.00E+02	(mg/kg)/day	B2	TCDD × 0.001	---
Pentachlorodibenzo-p-dioxin isomers	7.50E+04	1.50E+05	(mg/kg)/day	B2	TCDD × 0.5	---
Pentachlorodibenzo-p-furan isomers	7.50E+04	1.50E+05	(mg/kg)/day	B2	TCDD × 0.5	---
Tetrachlorodibenzo-p-dioxin isomers	1.50E+05	3.00E+05	(mg/kg)/day	B2	IRIS	2002
Tetrachlorodibenzo-p-furan isomers	1.50E+04	3.00E+04	(mg/kg)/day	B2	TCDD × 0.1	---

Pathway: Inhalation							
Constituent of Concern	**Unit Risk**	**Units**	**Inhalation Cancer Slope Factor**	**Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date (Year)**
Heptachlorodibenzo-p-dioxin isomers	4.29E-01	m^3/ug	1.50E+03	(mg/kg)/ day	B2	TCDD × 0.01	---
Octachlorodibenzo-p-dioxin	4.29E-02	m^3/ug	1.50E+02	(mg/kg)/ day	B2	TCDD × 0.001	---
Pentachlorodibenzo-p-dioxin isomers	2.14E+01	m^3/ug	7.50E+04	(mg/kg)/ day	B2	TCDD × 0.5	---
Pentachlorodibenzo-p-furan isomers	2.14E+01	m^3/ug	7.50E+04	(mg/kg)/ day	B2	TCDD × 0.5	---
Tetrachlorodibenzo-p-dioxin isomers	4.29E+01	m^3/ug	1.50E+05	(mg/kg)/ day	B2	HEAST	1997
Tetrachlorodibenzo-p-furan isomers	4.29E+00	m^3/ug	1.50E+04	(mg/kg)/ day	B2	TCDD × 0.1	---

Key
---: No information available
TCDD: Tetrachlorodibenzo-p-dioxin
IRIS: Integrated Risk Information System, USEPA
HEAST: Health Effects Assessment Summary Table
NA: Not Applicable

EPA Group
A- Human carcinogen
B1- Probable human carcinogen – indicates that limited human data are available
B2- Probable human carcinogen – indicates sufficient evidence in animals and inadequate or no evidence in humans
C- Possible human carcinogen
D- Not classifiable as a human carcinogen
E- Evidence of noncarcinogenicity

Table 3. Non-Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal									
Constituent of Concern	**Chronic/ Subchronic**	**Oral RfD Value**	**Oral RfD Units**	**Dermal RfD**	**Dermal RfD Units**	**Primary Target Organ**	**Combined Uncertainty/ Modifying Factors**	**Sources of RfD: Target Organ**	**Dates of RfD: Target Organ (M/D/Y)**
Heptachlorodibenzo -p-dioxin isomers	chronic	None	---	None	---	---	---	---	---
Octachlorodibenzo-p-dioxin	chronic	None	---	None	---	---	---	---	---
Pentachlorodibenzo-p-dioxin isomers	chronic	None	---	None	---	---	---	---	---
Pentachlorodibenzo-p-furan isomers	chronic	None	---	None	---	---	---	---	---
Tetrachlorodibenzo-p-dioxin isomers	chronic	None	---	None	---	---	---	---	---
Tetrachlorodibenzo-p-furan isomers	chronic	None	---	None	---	---	---	---	---
Pathway: Inhalation									
Constituent of Concern	**Chronic/ Subchronic**	**Inhalation RfC**	**Inhalation RfC Units**	**Inhalation RfD**	**Inhalation RfD Units**	**Primary Target Organ**	**Combined Uncertainty/ Modifying Factors**	**Sources of RfC:RfD: Target Organ**	**Dates (M/D/Y)**
Heptachlorodibenzo -p-dioxin isomers	chronic	None	---	None	---	---	---	---	---
Octachlorodibenzo-p-dioxin	chronic	None	---	None	---	---	---	---	---
Pentachlorodibenzo-p-dioxin isomers	chronic	None	---	None	---	---	---	---	---
Pentachlorodibenzo-p-furan isomers	chronic	None	---	None	---	---	---	---	---
Tetrachlorodibenzo-p-dioxin isomers	chronic	None	---	None	---	---	---	---	---
Tetrachlorodibenzo-p-furan isomers	chronic	None	---	None	---	---	---	---	---

Key
---: no information available
RfDs: reference dose
RfC: reference concentration

Risk Characterization

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

where: risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg-day)

SF = slope factor, expressed as (mg/kg-day)-1.

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. USEPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all constituent(s) of concern that

affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI> 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where: CDI = Chronic daily intake

RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or short-term).

The following table (Table 4) provides the cancer risk summary information for the COCs identified at the RBRP/RRP OU. The COCs for the RBRP/RRP OU have no non-carcinogenic hazard data, therefore the non-carcinogenic hazard summary is not provided.

Friable asbestos has been identified in the RRP and has been identified as a human health COC.

Table 4. Risk Characterization Summary for the RBRP - Carcinogens

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Route	Constituent of Concern	Carcinogenic Risk				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total
Soil	Surface Soil	Direct Contact	Heptachlorodibenzo-p-dioxin isomers	9.83×10^{-7}	---	1.26×10^{-6}	N/A	2.24×10^{-6}
			Octachlorodibenzo-p-dioxin	8.99×10^{-7}	---	1.15×10^{-6}	N/A	2.05×10^{-6}
			Pentachlorodibenzo-p-dioxin isomers	2.37×10^{-6}	---	3.04×10^{-6}	N/A	5.41×10^{-6}
			Pentachlorodibenzo-p-furan isomers	7.50×10^{-6}	---	9.59×10^{-6}	N/A	1.71×10^{-5}
			Tetrachlorodibenzo-p-dioxin isomers	3.07×10^{-6}	---	3.93×10^{-6}	N/A	7.00×10^{-6}
			Tetrachlorodibenzo-p-furan isomers	2.19×10^{-6}	---	3.72×10^{-6}	N/A	5.91×10^{-6}
							Surface Soil Direct Contact Risk Total =	3.97×10^{-5}
	Air Particulates	Inhalation of Soil (as Dust)	Heptachlorodibenzo-p-dioxin isomers	---	8.49×10^{-11}	---	N/A	8.49×10^{-11}
			Octachlorodibenzo-p-dioxin	---	7.77×10^{-11}	---	N/A	7.77×10^{-11}
			Pentachlorodibenzo-p-dioxin isomers	---	2.05×10^{-10}	---	N/A	2.05×10^{-10}
			Pentachlorodibenzo-p-furan isomers	---	6.47×10^{-10}	---	N/A	6.47×10^{-10}
			Tetrachlorodibenzo-p-dioxin isomers	---	2.65×10^{-10}	---	N/A	2.65×10^{-10}
			Tetrachlorodibenzo-p-furan isomers	---	2.51×10^{-10}	---	N/A	2.51×10^{-10}
							Inhalation of Air Particulates Risk Total =	1.53×10^{-9}
							Soil Risk Total =	3.97×10^{-5}
							Total Risk =	$\mathbf{3.97 \times 10^{-5}}$

Key
---: Toxicity criteria are not available to quantitatively address this route of exposure.
N/A: Route of exposure is not applicable to this medium.

Summary of Ecological Risk Assessment

Ecological Setting

The ecosystem potentially at risk at the RBRP/RRP OU is primarily a terrestrial environment, composed of a mixed pine and hardwood forest community. This community dominates the areas around the RBRP and the RRP. At RBRP, the canopy is predominantly closed and dominated by loblolly pine and slash pine. At RRP, the canopy is sparse over the unit, but areas immediately adjacent to the unit maintain a developed forest with a predominantly closed canopy. Other plant species include southern red oak, sweetgum, persimmon, and various groundcovers. No threatened, endangered, or sensitive species have been documented at the unit.

Table 5. Ecological Exposure Pathways of Concern

Exposure Medium	Sensitive Environment Flag (Y or N)	Receptor	Endangered/ Threatened Species Flag (Y or N)	Exposure Routes	Assessment Endpoints	Measurement Endpoints
Soil	N	Terrestrial Invertebrates	N	Ingestion and direct contact with chemicals in RRP soils	Ensure that exposure of contaminants in soils do not have a negative impact on diversity and abundance of soil invertebrates	Measured concentrations in soil compared to literature-based toxicity reference values
	N	Insectivorous Mammals	N	Ingestion, indirect ingestion, and direct contact with chemicals in RBRP and RRP soils	Ensure that exposure of contaminants in prey, forage, and soils do not have a negative impact on growth, survival, and reproduction	Measured concentrations in soil used to model food chain uptake and compared to literature-based toxicity reference values
	N	Herbivorous Mammals	N	Ingestion and direct contact with chemicals in RRP soils	Ensure that exposure of contaminants in prey, forage, and soils do not have a negative impact on growth, survival, and reproduction	Measured concentrations in soil used to model food chain uptake and compared to literature-based toxicity reference values
	N	Insectivorous Birds	N	Ingestion and direct contact with chemicals in RBRP and RRP soils	Ensure that exposure of contaminants in prey, forage, and soils do not have a negative impact on growth, survival, and reproduction	Measured concentrations in soil used to model food chain uptake and compared to literature-based toxicity reference values

Identification of COCs

Ecological risks due to soil exposure were assessed for soil invertebrates, herbivorous mammals, insectivorous mammals, omnivorous mammals, insectivorous birds, and carnivorous birds. Available ecological research, including threatened, endangered, and sensitive species surveys, was used to identify specific ecological concerns.

At the RBRP surface and subsurface soil exposure groups, lead, zinc, dioxins, and furans are identified as ecological RCOCs. Based on food chain modeling, each constituent has a HQ greater than one for the insectivorous mammal and/or insectivorous bird community. These ecological communities are expected to be exposed to the RCOCs through ingestion of soil invertebrates and incidental ingestion of soil material.

At the RRP surface and subsurface soil exposure groups, barium, cadmium, copper, lead, and zinc are identified as ecological RCOCs. Based on toxicity reference value comparisons and food chain modeling, each constituent has a HQ greater than one for the soil invertebrate, herbivorous mammal, insectivorous mammal and/or insectivorous bird communities. These ecological communities are expected to be exposed to the RCOCs through direct contact of soil material or ingestion of soil invertebrates and incidental ingestion of soil material.

Table 6. COC Concentrations Expected to Provide Adequate Protection of Ecological Receptors at the RBRP

Habitat Type/ Name	Exposure Medium	COC	Protective Level	Units	Basis	Assessment/Measurement Endpoint
RBRP	Soil	Lead	2.65E+01	mg/kg	HQ = 1	Ensure that exposure of contaminants in prey, forage, and soils do not have a negative impact on growth, survival, and reproduction
		Zinc	5.49E+01	mg/kg	HQ = 1	
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	3.22E-04	mg/kg	HQ = 1	
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	3.22E-05	mg/kg	HQ = 1	
		2,3,7,8-Tetrachlorodibenzo-p-furan	1.31E-06	mg/kg	HQ = 1	
		Heptachlorodibenzo-p-dioxin isomers	3.22E-04	mg/kg	HQ = 1	
		Hexachlorodibenzo-p-dioxin isomers	3.22E-05	mg/kg	HQ = 1	
		Octachlorodibenzo-p-dioxin	3.22E-03	mg/kg	HQ = 1	
		Pentachlorodibenzo-p-furan isomers	3.67E-05	mg/kg	HQ = 1	
		Tetrachlorodibenzo-p-dioxin isomers	3.22E-06	mg/kg	HQ = 1	
		Tetrachlorodibenzo-p-furan isomers	1.31E-06	mg/kg	HQ = 1	

Table 7. COC Concentrations Expected to Provide Adequate Protection of Ecological Receptors at the RRP

Habitat Type/ Name	Exposure Medium	COC	Protective Level	Units	Basis	Assessment/Measurement Endpoint (protocol)
RBRP	Soil	Barium	2.35E+02	mg/kg	HQ = 1	Ensure that exposure of contaminants in prey, forage, and soils do not have a negative impact on species diversity and abundance of soil invertebrates, nor on growth, survival, and reproduction of mammals and birds
		Cadmium	1.38E+00	mg/kg	HQ = 1	
		Copper	5.00E+01	mg/kg	HQ = 1	
		Lead	2.65E+01	mg/kg	HQ = 1	
		Zinc	5.49E+01	mg/kg	HQ = 1	

Summary of the Fate and Transport Analysis

At the RBRP sub-unit, cadmium, copper, lead, manganese, thallium, and tetrachloroethene may leach to groundwater above either the maximum contaminant level (MCL) or preliminary remediation goal (PRG) in less than 1,000 years and have been identified as contaminant migration refined constituents of concern (CM RCOCs) in the pits.

At the RRP subunit, cadmium, copper, and lead may leach to groundwater above either the MCL or PRG in less than 1,000 years and have been identified as CM RCOCs in the pile.

Discussion of Principal Threat Source Material (PTSM)

No principal threat source material (PTSM) has been identified at the RBRP and RRP subunits.

Conclusions

Actual or threatened releases of hazardous substances from these subunits, if not addressed by the selected remedy or one of the other active measures considered, may present a current or potential threat to public health, welfare, or the environment.

VIII. REMEDIAL ACTION OBJECTIVES AND REMEDIAL GOALS

The RFI/RI/WPA with BRA (WSRC 2003) concluded that only the RBRP and RRP sub-units have RCOCs and need remedial action. Therefore, Remedial Action Objectives (RAOs) are developed for these sub-units. No RCOCs were identified for the perimeter pit soils, groundwater, or wetland; therefore RAOs are not developed for these sub-units.

The RAOs for RBRP are:

- Prevent contaminants from leaching to groundwater above maximum contaminant levels/preliminary remediation goals (MCLs/PRGs).
- Prevent future industrial worker exposure to soil contaminants.
- Prevent ecological receptors from exposure to soil contaminants.
- Prevent residential exposure to soil contaminants.

The RAOs for RRP are:

- Prevent constituents from leaching to groundwater above MCLs/PRGs.
- Prevent ecological receptors from exposure to pile and soil contaminants.
- Prevent future industrial worker exposure to lead and friable asbestos.
- Prevent residential exposure to soil contaminants.

In the RFI/RI/WPA with BRA (WSRC 2003), remedial goal options (RGOs) were calculated for each RCOC. RGOs are concentration goals for individual chemicals for specific medium and land use combinations. They are designed to provide conservative, long-term targets for the selection and analysis of remedial alternatives. Table 8 provides a summary of risks and hazards associated with this waste unit.

Table 8. Summary of Risks and Hazards

RCOC	Max. Concentration (mg/kg)	Type of RCOC	Summary of Risks
RBRP			
Cadmium	89.4	CM	Predicted to exceed MCL in less than 1,000 years.
Lead	662.0	CM, ECO	Predicted to exceed MCL (Action Level) in less than 1,000 years. Exceeded the hazard quotient of 1 for insectivorous birds and mammals, identified as ECO RCOCs in open pit.
Copper	8210.0	CM	Predicted to exceed PRGs in less than 1,000 years.
Manganese	13200.0	CM	Predicted to exceed PRGs in less than 1,000 years.
Thallium	22.7	CM	Predicted to exceed MCL in less than 1,000 years.
Tetrachloroethene	4.35	CM	Predicted to exceed MCL in less than 1,000 years.
Zinc	12900.0	ECO	Exceeded the hazard quotient of 1 for insectivorous birds and mammals, identified as ECO RCOCs in open pit.
Dioxins/furans	34.3	ECO, HH_{ind}	Surface soils exceed a risk of $1x10^{-6}$ for the future industrial worker (risk = 4.0×10^{-5}). Exceeded the hazard quotient of 1 for insectivorous birds and mammals, identified as ECO RCOCs in open pit.
RRP			
Cadmium	18.5	CM, ECO	Predicted to exceed MCL in less than 1,000 years. Exceeded the hazard quotient of 1 for insectivorous birds and mammals, soil-dwelling organisms, herbivorous mammals and is identified as ECO RCOCs in open pit.
Lead	562.0	CM, ECO	Predicted to exceed MCL (Action Level) in less than 1,000 years. Exceeded the hazard quotient of 1 for insectivorous birds and mammals, soil-dwelling organisms, herbivorous mammals and is identified as ECO RCOCs in open pit.
Copper	21100	CM, ECO	Predicted to exceed PRG in less than 1,000 years. Exceeded the HQ of 1 for the soil-dwelling organisms, herbivorous mammals, and insectivorous birds and mammals.
Friable Asbestos	Not quantified	HH_{ind}	Friable asbestos has been observed in the pile and has been identified as a HH RCOC
Barium	1360	ECO	Exceeded the HQ of 1 for the soil-dwelling organisms, herbivorous mammals, and insectivorous birds and mammals
Zinc	8750	ECO	Exceeded the HQ of 1 for the soil-dwelling organisms, herbivorous mammals, and insectivorous birds and mammals

CM = Contaminant Migration RCOC
ECO = Ecological RCOC
HH_{ind} = Human health RCOC for the future industrial worker

Human health RGOs are estimates of protective remedial levels for RCOCs based on risk to human receptors, and ecological RGOs are based on risk to ecological receptors. Final remedial goals (RGs) are selected from the RGOs to be protective of both human health and ecological receptors, as well as to comply with federal and state applicable or relevant and appropriate requirements (ARARs).

The RFI/RI/WPA with BRA (WSRC 2003) presents a range of human health RGOs. RGOs were calculated for various land use/receptor scenarios including future industrial workers and hypothetical on-unit residents. A range of RGOs is provided, corresponding to target hazard quotients (HQs) of 0.1, 1, and 3 as well as target cancer risks of 1×10^{-6}, 1×10^{-5}, and 1×10^{-4}. In situations where both non-carcinogenic and carcinogenic toxicity values are available, potential human health RGOs were calculated using both values. The most restrictive human health RGO for each land use scenario is determined by selecting the lowest RGO (i.e., based on either non-cancer or cancer targets) for a target HQ of 0.1 or a risk of 1×10^{-6}.

Ecological RGOs to protect organisms are calculated by methods similar to those used for ecological risk assessment for soil. The method calculates the highest environmental concentrations at which exposure to contaminants in soil is not harmful to biological individuals, ecological populations, or communities. Ecological RGOs are derived for the receptors for which unacceptable, medium-specific risks (HQs > 1) were calculated. RGOs are calculated for both No Observed Adverse Effects Level (NOAEL) and Lowest Observed Adverse Effects Level (LOAEL) toxicity benchmarks. The most restrictive ecological LOAEL- and NOAEL-based RGOs are determined by selecting the lowest RGO for each receptor at risk (e.g., earthworm, shrew, or robin).

To be protective of both human health and the ecological community, the RG is selected as the lower of the (1) most restrictive human health RGO for the expected future land use, and (2) the lowest LOAEL-based RGO. If available,

additional information such as chemical-specific ARARs and other guidance (e.g., TSCA clean-up levels, USEPA - Office of Solid Waste and Emergency Response [OSWER] guidance, and MCLs) may also be considered in selecting RGs.

Because of the generally conservative assumptions used in the RGO calculations, it is possible for a risk-based RGO to be less than what occurs naturally in unimpacted background soils. This RG would not be technically possible to achieve. To avoid this, the RGs are compared to one or more background benchmarks to confirm that the RGs are reasonable and attainable. Table 9 lists the RGOs for the RBRP/RRP OU. Final RGs are selected from the RGOs to be protective of both human health and the environment, as well as to comply with federal and state ARARs. Potential ARARs and to-be-considered (TBC) criteria are identified in Table 10.

Table 9. RGO Table for RBRP/RRP OU

Summary of RGOs - RBRP

RCOC	CM RGO (mg/kg)	HH – Industrial RGO (mg/kg)	ECO RGO (mg/kg)	2x Avg Background (mg/kg)	RG (mg/kg)
Inorganics					
Cadmium	6.70E-01	--	--	1.59E+00	1.59E+00
Copper	1.82E+02	--	--	9.10E+00	1.82E+02
Lead	2.17E+01	--	2.65E+01	1.10E+01	2.17E+01
Manganese	2.35E+02	--	--	2.88E+01	2.35E+02
Thallium	5.35E-01	--	--	--	5.35E-01
Zinc	--	--	5.49E+01	1.24E+01	5.49E+01
Volatile Organics					
Tetrachloroethylene	1.50E-02	--	--	--	1.50E-02
Dioxins/Furans					
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	--	3.22E-04	--	3.22E-04
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	--	--	3.22E-05	--	3.22E-05
2,3,7,8-Tetrachlorodibenzo-p-furan	--	--	1.31E-06	--	1.31E-06
Heptachlorodibenzo-p-dioxin isomers	--	1.67E-03	3.22E-04	--	3.22E-04
Hexachlorodibenzo-p-dioxin isomers	--	--	3.22E-05	--	3.22E-05
Octachlorodibenzo-p-dioxin	--	1.67E-02	3.22E-03	--	3.22E-03
Pentachlorodibenzo-p-dioxin isomers	--	3.35E-05	--	--	3.35E-05
Pentachlorodibenzo-p-furan isomers	--	3.35E-05	3.67E-05	--	3.35E-05
Tetrachlorodibenzo-p-dioxin isomers	--	1.67E-05	3.22E-06	--	3.22E-06
Tetrachlorodibenzo-p-furan isomers	--	1.67E-04	1.31E-06	--	1.31E-06

Summary of RGOs - RRP

Inorganics					
Barium	--	--	2.35E+02	2.78E+01	2.35E+02
Cadmium	6.70E-01	--	1.38E+00	1.59E+00	1.59E+00
Copper	1.82E+02	--	5.00E+01	9.10E+00	5.00E+01
Lead	2.17E+01	--	2.65E+01	1.10E+01	2.17E+01
Zinc	--	--	5.49E+01	1.24E+01	5.49E+01

Table 10. Potential ARARs and TBC Criteria

Citation(s)	Status	Requirement Summary	Reason for Inclusion	Alternative
Chemical				
SC R.61-68 Water Classification	Applicable	States official classified water uses for all surface and groundwater in South Carolina	Mandates meeting MCLs for groundwater. MCLs should generally be met for cleanup of groundwater under the CERCLA program. Under current conditions, contaminant migration COCs are predicted to impact the groundwater above the MCL in the future.	RBRP1, RBRP2, RBRP3
40 CFR 260-268 and SC R.61-79.260-268 Federal and State Hazardous Waste Regulations	Applicable	Defines criteria for determining whether a waste is RCRA hazardous waste and provides treatment, storage and disposal requirements.	RCRA is applicable to all hazardous waste disposal. Lead has been identified as hazardous waste.	RBRP2
Action				
SC R.61-86.1 Standards of Performance for Asbestos Projects	Relevant and Appropriate	Management of Asbestos	Asbestos is a COC in the RRP.	RBRP2
SC R.61-62.5 Air Quality Standard	Relevant and Appropriate	Establishes air quality standards for emissions.	Would apply to air emissions of Standard 2 Toxic Air Pollutants and Standard 8 Ambient Air Quality Standards.	RBRP2, RBRP3
SC R.61-107.16 Subpart F, Solid Waste Management: Industrial Solid Waste Landfills	Relevant and Appropriate	Establishes closure and post-closure care for non-hazardous industrial solid waste landfills.	Applies to waste left in place.	RBRP2
40 CFR 50.6 National Primary and Secondary Ambient Air Quality Standards	Applicable	The concentration of particulate matter (PM_{10}) in ambient air shall not exceed 50 $\mu g/m^3$ (annual arithmetic mean) or 150 $\mu g/m^3$ (24-hour average concentration).	Dust suppression will likely be required to minimize dust emissions during construction/remedial action.	RBRP2

IX. DESCRIPTION OF ALTERNATIVES

Remedy Components, Common Elements, and Distinguishing Features of Each Alternative

The list of potential remedial technologies is short because the problem warranting action at RBRP/RRP is confined to the two pits and the pile material. There is a limited range of appropriate response actions for these problems. Detailed results of characterization activities at the five sub-units can be found in the RCRA Facility Investigation/Remedial Investigation Work Plan for the R-Area Burning Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) (U) (WSRC 2001). The RFI/RI/WPA with Baseline Risk Assessment for the R-Area Burning Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (U) (WSRC 2003) includes the risk assessments that were originally developed in the work plan.

Throughout the RFI/RI process, USDOE, SCDHEC, and USEPA have evaluated a range of possible response actions for the sub-units that require remediation (RBRP and RRP soils). Remedial alternatives were not developed for perimeter pit soils, groundwater, or the wetland because there are no RCOCs and therefore no problem warranting action for those sub-units.

Detailed information regarding the development and evaluation of remedial alternatives and their cost estimates is presented in Appendices A and B of the SB/PP (WSRC 2004). The present worth cost discount rate used in the estimates is 3.9% and was calculated on the O&M costs for a duration of 30 years.

A summary of the three remedial alternatives identified for RBRP/RRP Operable Unit follows:

Alternative RBRP/RRP # 1 -- No Action

- Present Value Cost estimate is $0
- Estimated construction time is 0

Alternative RBRP/RRP # 2 – Consolidation / Cover:

- Present Value Cost estimate is $760,354
- Estimated construction time is 9 months from start of remedial action to mechanical complete

Alternative RBRP/RRP # 3 – Cover / Cover:

- Present Value Cost estimate is $610,142
- Estimated construction time is 9 months from start of remedial action to mechanical complete

Alternative RBRP/RRP #1, No Action, would consist of no additional remedial activities at the OU. Although institutional controls would not be implemented, as a federally-owned facility, SRS must comply with CERCLA 120(h), which states that if a federal agency transfers land to a non-federal agency, they must make full disclosure on the deed of waste management, remediation, investigation, and other activities that occurred or are on-going at the site. The No Action alternative is required by the National Oil and Hazardous Substances Contingency Plan (NCP) to serve as a baseline for comparison with other remedial alternatives. The No Action alternative would not be protective of human health and the environment. There would be no reduction of risk, and potential exposure pathways would remain. Five-year remedy reviews would be conducted. The time to construction would be 0 months; the time until protection is achieved is not applicable because RAOs are not met.

Alternative RBRP/RRP # 2, Consolidation/Cover, consists of consolidation of all RCRA non-hazardous rubble pile material into/over the open rubble pit sub-unit and placement of a low permeability cover over the combination (pits and non-hazardous pile material). The RCRA hazardous soils and/or materials will be sent to an approved offsite disposal facility.

This alternative proposes to remove the soil that exceeds the industrial RG levels from the rubble pile material (including 1 foot beneath the rubble pile). The soil removed will be segregated as RCRA hazardous and RCRA non-hazardous waste based on RCRA requirements. The non-hazardous soil will be placed into the open R-Area Burning Rubble Pits sub-unit. The open pit would be backfilled to grade with rubble pile material, placing any remaining RCRA non-hazardous rubble pile material over both pits. A low permeability cover system would be installed over both pits, along with implementation of institutional controls. The RCRA hazardous soil will be disposed of at an appropriate treatment, storage, and disposal facility. Once the soil that exceeds industrial RGs has been removed, confirmatory soil samples will be collected. The analytical results will be compared to RGs to determine if contamination remains. If contamination remains above industrial RG levels, removal and confirmatory sampling will be repeated until the contamination above these levels has been removed. After removal, any excavations will be returned to grade with clean soil, stabilized and seeded. Institutional controls would consist of long-term site maintenance (repair of erosion damage and maintaining warning signs) and site controls (deed notifications/restrictions). The objective of institutional controls is to prevent residential use of property that is identified as a waste unit used for hazardous material management. The LUC will ensure no construction on, excavation of, or breaching of the low-permeability cover. In addition, the existing SRS Site Use Program is one of the types of site controls (together with deed notification/restriction) included in this alternative. Five-year remedy reviews would be conducted. The time to the start of construction would be 15 months after the ROD is approved; the duration of construction is 24 months.

Alternative RBRP/RRP # 3, Cover/Cover, consists of the installation of two low permeability cover systems; one over the RBRP, and one over the RRP, maintaining institutional controls over both units.

This alternative proposes to (1) place a low permeability cover system over both pits, and implement institutional controls, and (2) place a low permeability cover

system over the rubble pile, and implement institutional controls. Institutional controls would consist of long-term site maintenance (repair of erosion damage and maintaining warning signs) and site controls (deed notifications/restrictions). The objective of institutional controls is to prevent residential use of property that is identified as a waste unit used for hazardous material management. The LUC will ensure no construction on, excavation of, or breaching of the low-permeability cover. In addition, the existing SRS Site Use Program is one of the types of site controls (together with deed notification/restriction) included in this alternative. Five-year remedy reviews would be conducted. The time to the start of construction would be 15 months after the ROD is approved; the duration of construction is 24 months.

X. COMPARATIVE ANALYSIS OF ALTERNATIVES

Description of the Nine Evaluation Criteria

Each of the remedial alternatives is evaluated against the nine criteria established by the NCP 40 Code of Federal Regulations (CFR) 300. The criteria are derived from the statutory requirements of CERCLA Section 121. The criteria provide the basis for evaluating the alternatives and selecting a remedy. The nine criteria are:

Threshold criteria:

- Overall protection of human health and the environment
- Compliance with ARARs

Balancing criteria:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment

Short-term effectiveness

- Implementability
- Cost

Modifying criteria:

- State acceptance
- Community acceptance

Overall Protection of Human Health and the Environment: No Action is not protective because RCOCs would remain at the unit and would pose an unacceptable risk to human health and the environment. Consolidation/Cover and Cover/Cover would be protective because receptors would not be exposed to contamination above the appropriate remedial goals (RGs). Consolidation/Cover is more protective because of the permanent removal of RCRA hazardous waste from RRP.

Compliance with ARARs: ARARs would not be met if no action is taken. Both Cover/Cover and Consolidation/Cover would comply with ARARs. Asbestos and Land Disposal Restrictions (LDR) ARARs are specifically applicable to the Consolidation/Cover alternative, but not to the Cover/Cover alternative. Chemical-specific and action-specific ARARs are identified in Table 10.

Long-term Effectiveness and Permanence: Consolidation/Cover and Cover/Cover offer greater long-term effectiveness when compared to No Action. Whereas the residual risk associated with No Action would be the same as current conditions, the residual risk associated with remedial alternatives 2, and 3 would be less than the target risk range. The water table is close to ground surface (<10 ft) in the vicinity of the rubble pile. This provides some uncertainty as to whether the water table may rise in the future, and whether that might allow contaminants to leach out from under the pile area. An assessment of permanence for No Action

is not applicable because RAOs are not met. Consolidation/Cover (total of one cover) is more effective to manage than Cover/Cover (total of two covers) over a long period of time. A low permeability cover (Consolidation/Cover and Cover/Cover) will reduce contaminant leaching to the groundwater.

Reduction of Toxicity, Mobility, or Volume Though Treatment: The alternatives do not reduce toxicity, mobility, or volume through treatment.

Short-term Effectiveness of Remedial Alternatives: Although Consolidation/Cover and Cover/Cover present greater exposure risks to remedial workers, No Action does not achieve protection and is therefore not an effective alternative. The Consolidation/Cover alternative poses a somewhat increased risk to workers due to disturbing and transporting the rubble pile contents, but the risks can be managed using standard industry safety practices, such as personal protective clothing. There are no exposure concerns for the community.

Implementability: All alternatives are implementable. No Action does not involve any action; therefore, it is readily implementable. Consolidation/Cover will require confirmatory sampling, additional waste characterization, and evaluation of regulatory and waste acceptance requirements for the waste receiving facility, but there are no significant implementability restrictions. The Cover/Cover alternative is also readily implementable.

Cost: No Action is less expensive than the two remaining options (alternative numbers 2 and 3). Cover/Cover is less expensive than Consolidation/Cover. Detailed cost estimates can be found in Appendix B of this document.

State Acceptance: The regulatory agencies have accepted each of the alternatives being compared. Approval of the ROD by SCDHEC and USEPA constitutes acceptance of the selected remedy.

Community Acceptance: The SB/PP provides for community involvement through a document review process and a public comment period. No comments

were received during the public comment period. Public input will be documented in the Responsiveness Summary section of the ROD.

XI. THE SELECTED REMEDY

Detailed Description of the Selected Remedy

Based upon the characterization data and risk assessments in the RFI/RI/WPA with BRA (WSRC 2003), the RAOs, and the detailed evaluation of alternatives, the selected remedy for the OU is:

Alternative RBRP/RRP # 2

Consolidation/Cover: Consolidation of RCRA non-hazardous rubble pile material into/over the rubble pit sub-unit, low permeability cover over the combination (pits and non-hazardous pile material), offsite disposal of any RCRA hazardous pile materials.

The selected remedy proposes to remove the soil that exceeds the industrial RG levels from the rubble pile material (including 1 foot beneath the rubble pile). The soil removed will be segregated as RCRA hazardous and RCRA non-hazardous waste based on RCRA requirements. The non-hazardous soil will be placed into the open R-Area Burning Rubble Pits sub-unit. The open pit will be backfilled to grade with rubble pile material, placing any remaining RCRA non-hazardous rubble pile material over both pits. A low permeability cover system will be installed over both pits, along with implementation of institutional controls. The RCRA hazardous soil will be disposed of at an appropriate treatment, storage, and disposal facility. Once the soil that exceeds industrial RGs has been removed, confirmatory soil samples will be collected. The analytical results will be compared to RGs to determine if contamination remains. If contamination remains above industrial RG levels, removal and confirmatory sampling will be repeated until the contamination above these levels has been removed. After removal, any excavations will be filled to grade with clean soil.

Institutional controls will consist of long-term site maintenance (repair of erosion damage and maintaining warning signs) and site controls (deed notifications/restrictions). The objective of institutional controls will be to prevent residential use of property that is identified as a waste unit used for hazardous material management. The LUC will ensure no construction on, excavation of, or breaching of the low-permeability cover.

In addition, the existing SRS Site Use Program is one of the types of site controls (together with deed notification/restriction) included in the selected remedy. Five-year remedy reviews will be conducted.

Institutional controls will be implemented by:

- Access controls to prevent exposure to on-site workers via the Site Use Program, Site Clearance Program, work control, worker training, worker briefing of health and safety requirements and identification signs located at the waste unit boundaries.

- Access controls to prevent exposure to trespassers, as described in the 1992 RCRA Part B Permit Renewal Application, Volume I, Section F.1, which describes the security procedures and equipment, 24-hour surveillance system, artificial or natural barriers, control entry systems, and warning signs in place at the SRS boundary. Table 11 shows the type of control, purposes of control, duration, implementation, and affected areas.

In the long term, if the property is ever transferred to nonfederal ownership, the US Government will take those actions necessary pursuant to Section 120(h) of CERCLA. Those actions will include a deed notification disclosing former waste management and disposal activities as well as remedial actions taken on the site. The deed notification shall, in perpetuity, notify any potential purchaser that the property has been used for the management and disposal of waste. These requirements are also consistent with the intent of the RCRA deed notification

requirements at final closure of a RCRA facility if contamination will remain at the unit.

The deed shall also include deed restrictions precluding residential use of the property. However, the need for these deed restrictions may be reevaluated at the time of transfer in the event that exposure assumptions differ and/or the residual contamination no longer poses an unacceptable risk under residential use. Any reevaluation of the need for the deed restrictions will be done through an amended ROD with USEPA and SCDHEC review and approval.

In addition, if the site is ever transferred to nonfederal ownership, a survey plat of the OU will be prepared, certified by a professional land surveyor, and recorded with the appropriate county recording agency.

The remedy may change as a result of the remedial design or construction processes. Changes to the remedy described in the ROD will be documented in the Administrative Record utilizing one of the following: a memo, an Explanation of Significant Difference, or ROD Amendment.

The selected remedy for the RBRP/RRP OU leaves hazardous substances in place that pose a potential future risk and will require land use restrictions for an indefinite period of time. As agreed on March 30, 2000, among the USDOE, USEPA, and SCDHEC, SRS is implementing a Land Use Control and Assurance Plan (LUCAP) to ensure that the Land Use Controls (LUCs) required by numerous remedial decisions at SRS are properly maintained and periodically verified. The unit-specific LUCIP referenced in this ROD will provide details and specific measures required to implement and maintain the LUCs selected as part of this remedy. The USDOE is responsible for implementing, maintaining, monitoring, reporting upon, and enforcing the LUCs selected under this ROD. The LUCIP, developed as part of this action, will be submitted concurrently with the CMI/RAIP, as required in the FFA for review and approval by USEPA and SCDHEC. Upon final approval, the LUCIP will be appended to the LUCAP and

is considered incorporated by reference into the ROD, establishing LUC implementation and maintenance requirements enforceable under CERCLA and the *SRS Federal Facility Agreement*. The approved LUCIP will establish implementation, monitoring, maintenance, reporting, and enforcement requirements for the unit. The LUCIP will remain in effect unless and until modifications are approved as needed to be protective of human health and the environment. The deed shall contain provisions to ensure that appropriate land use controls remain with the affected area upon any and all transfers. The LUCs shall be maintained until the concentration of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use. Approval by EPA and DHEC is required for any modification or termination of the ICs.

USDOE has recommended that residential use of SRS land be controlled; therefore, future residential use and potential residential water usage will be restricted to ensure long-term protectiveness. Land use controls, including institutional controls, will restrict the RBRP/RRP OU to future industrial use and will prohibit residential use of the area. Unauthorized excavation will also be prohibited and the waste unit will remain undisturbed. Land use controls selected as part of this action will be maintained for as long as they are necessary and termination of any land use controls will be subject to CERCLA requirements for documenting changes in remedial actions.

The LUC objectives necessary to ensure the protectiveness of the selected remedy are:

- prevent contact, removal, or excavation of RBRP and RRP soil
- protect the integrity of the low permeability cover system
- preclude residential use of the area

Table 11. Land Use Controls for RBRP/RRP OU

Type of Control	Purpose of Control	Duration	Implementation	Affected Areas[a]
1. Property Record Notices[b]	Provide notice to anyone searching records about the existence and location of contaminated areas.	Until the concentration of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use.	Notice recorded by DOE in accordance with state laws at County Register of Deeds office: 1) if the property or any portion thereof is ever transferred to non-federal ownership or 2) upon submittal of Notice Of Intent to Delist (NOID) the OU from the National Contingency Priorities (NCP) List	All waste management areas and other areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions.
2. Property record restrictions[c] Land Use	Restrict use of property by imposing limitations.	Until the concentration of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use.	Drafted and implemented by DOE upon transfer of affected areas. Recorded by DOE in accordance with state law at County Register of Deeds office.	All waste management areas and other areas where hazardous substances are left in place at levels requiring land use restrictions.
3. Other Notices[d]	Provide notice to county/city about the existence and location of waste disposal and residual contamination areas for zoning/planning purposes.	Until the concentration of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use.	Notice recorded by DOE in accordance with state laws at County Register of Deeds office: 1) if the property or any portion thereof is ever transferred to non-federal ownership or 2) upon submittal of Notice Of Intent to Delist (NOID) the OU from the National Contingency Priorities (NCP) List	All waste management areas and other areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions.
4. Site Use Program[e]	Provide notice to worker/developer) i.e., permit requestor) on extent of contamination and prohibit or limit excavation/penetration activity.	As long as property remains under DOE control.	Implemented by Doe and sit contractors Initiated by permit request	Remediation systems, all waste management areas. And areas where levels requiring land use and / or groundwater restrictions.
5. Warning Signs[f]	Provide notice or warning to prevent unauthorized uses	Until the concentration of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use.	Signage maintained by DOE	At select locations throughout SRS
6. Security Surveillance Measures	Control and monitor access by workers/public	Until the concentration of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use.	Established and maintained by DOE Necessity of patrols evaluated upon completion of remedial actions.	Patrol of selected area throughout SRS, as necessary.

[a] Affected areas – Specific locations identified in the SRS LUCIP or subsequent post ROD documents.

[b] Property Record Notices – Refers to any non-enforceable, purely informational document recorded along with the original property acquisition records of DOE and its predecessor agencies that alerts anyone searching property records to important information about residual contamination; waste disposal areas in the property.

[c] Property Record Restrictions – Includes conditions and/or covenants that restrict or prohibit certain uses of real property and are recoded along with original property acquisition records of Doe and its predecessor agencies.

[d] Other Notices – Includes information on the location of waste disposal areas and residual contamination depicted on as survey plat, which is provided to a zoning authority (i.e., city planning commission) for consideration in appropriate zoning decisions for non DOE property.

[e] Site Use Program – Refers to the internal DOE/DOE contractor administrative program(s) that requires the permit requestor to obtain authorization, usually in the form of a permit, before beginning any excavation/penetration activity (e.g., well drilling) for the purpose of ensuring that the proposed activity will not affect underground utilities/structures, or in the case contaminated soil or groundwater, will not disturb the affected areas without the appropriate precautions and safeguards.

[f] Signs – Posted command, warning or direction.

Cost Estimate for the Selected Remedy

Appendix B presents a detailed, activity-based breakdown of the estimated costs associated with implementing and maintaining the remedy.

The information in the cost estimate tables is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to –30 percent of the actual project cost.

Estimated Outcomes of Selected Remedy

The objective of the remediation is to achieve industrial remediation goals and standards and the elimination of the ecological risks for the RBRP and RRP. These goals will be met. However, it may be possible that the selected remedy for the RRP (which is removal and disposal) may also achieve residential standards. This may be accomplished with little or no extra costs due to the fact that the contamination above residential risk-based standards in the rubble pile is co-located with contamination above ecological and industrial risk-based standards. Also, all but one sample location identifies the contaminants being only in the pile material, and not below the normal grade level. Therefore, removal of the soil exceeding industrial standards may also result in the removal of soil exceeding residential standards. This will be validated by performing confirmatory sampling / analysis of the area below the pile once the contaminated media has been removed.

The minimum condition of the RBRP, after the selected remedy is implemented, is that the exposure pathways for the industrial worker and ecological receptors will be eliminated.

The minimum condition of the RRP, after the selected remedy for soil is implemented, is that no soil will remain at the OU above ecological or industrial risk-based standards (minimum RGs and the exposure pathways for both human and ecological receptors will be interrupted). The OU will be available for industrial land use after the contaminated soil/debris is removed.

The Remedial Goals (RG) for the RBRP/RRP OU can be found in Table 9. It is anticipated that the remediation activity will take approximately nine months from Remedial Action start.

Waste Disposal and Transport

- Contamination in the RBRP area is limited to the soil. The contamination in the pile (RRP) is contained in the soil and the debris comprising the pile. The contaminated soils are to be segregated according to type (e.g. non-hazardous solid waste and RCRA hazardous). Per the SB/PP the non-hazardous solid waste will be placed in/on the pit and eventually covered by the low perm cap. The hazardous soils will be stockpiled for shipment offsite to an appropriate Treatment Storage and Disposal Facility (TSDF). The debris will be segregated according to type (e.g. non-hazardous solid waste, potentially hazardous, etc.) characterized and disposed of according to appropriate federal and state regulations and SRS procedures.

- Based upon process history and soil sampling results, the vegetation is not considered contaminated. Therefore the trees are not considered to be waste material. Merchantable trees will be harvested and sold. Trees and above ground vegetation will be removed from the OU. Tree and vegetation roots will be chipped and disposed consistent with the soil type in which they are growing.

- The approach to remediation will be to work (with machinery, etc.) from clean areas toward contaminated areas, thus avoiding contact with the contaminated soils. Wheels, tracks, blades, etc. will always be in contact with clean soil. If a vehicle should come in contact with contaminated soil, it will be decontaminated by dry

brushing or water washing until clean. The soil removed during equipment decontamination will be managed with other contaminated soils. The remaining work will be performed in clean medium. Spoil material brought to the unit that cannot be used as clean backfill in the soil cover will be disposed of as clean material.

- All unused environmental samples may be returned to the waste site, within the Area of Contamination (AOC). This only includes samples that have had no preservatives added.

- Decontamination fluids from the cleaning of items intended for reuse or recycle (e.g. field sampling tools, equipment, or PPE) may be discharged to the ground surface at an area which will not runoff the unit or cause erosion. All decontamination (e.g. dry brushing or water washing) will be conducted inside the AOC.

XII. STATUTORY DETERMINATIONS

Based on the unit RFI/RI/BRA report, the RBRP/RRP poses a threat to human health and the environment. Therefore, Alternative RBRP/RRP # 2 – Consolidation/Cover has been selected as the remedy for the RBRP/RRP Operable Unit. There is no PTSM at the OU. The contamination that is present is categorized as a low-level threat.

Based on information currently available, USDOE, USEPA, and SCDHEC believe the selected alternative provides the best balance of tradeoffs among the other alternatives with respect to the evaluation criteria. USDOE, USEPA, and SCDHEC expect the selected alternative to satisfy the statutory requirements in CERCLA Section 121(b) to: (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The selected remedy in this OU does not satisfy the statutory preference for treatment as a principal element of the remedy because the investigation has determined that the unit does not contain principal threats (i.e., liquids, areas contaminated with high concentrations of toxic

compounds, and highly mobile materials). The selected remedy reduces the toxicity and volume by segregating RCRA hazardous soils for disposal at an appropriate treatment, storage, and disposal facility and reduces the mobility of the low-level threats at the unit with a low-permeability cover.

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal and considering State and community acceptance.

The selected remedy satisfies the criteria for long-term effectiveness by implementing a cover system. The selected remedy has additional short-term risks due to the consolidation process. There are no special implementability issues that sets the selected remedy apart from any other alternatives evaluated. The cost is slightly higher than covering each unit separately.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted no less often than every five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

XIII. EXPLANATION OF SIGNIFICANT CHANGES

There were no comments received during the 45 day public comment period (see Appendix A). Therefore, there are no significant changes made to the ROD based on the public's review.

XIV. RESPONSIVENESS SUMMARY

The Responsiveness Summary is included as Appendix A of this document.

XV. POST-ROD DOCUMENT SCHEDULE AND DESCRIPTION

Figure 5 is an implementation schedule for the RBRP/RRP OU showing the post-ROD document submittals and the remedial action start date. Major milestones are as follows:

- October 4, 2004 Issue signed ROD
- June 20, 2005 Issue Rev. 0 CMI/RAIP
- September 18, 2005 Receive Approval of CMI/RAIP
- September 22, 2005 Remedial Action Start
- SRS will submit a post-construction report 90 days after construction is complete (i.e., after completion of a post-construction walkdown and acceptance by the core team [USDOE, USEPA, and SCDHEC]).

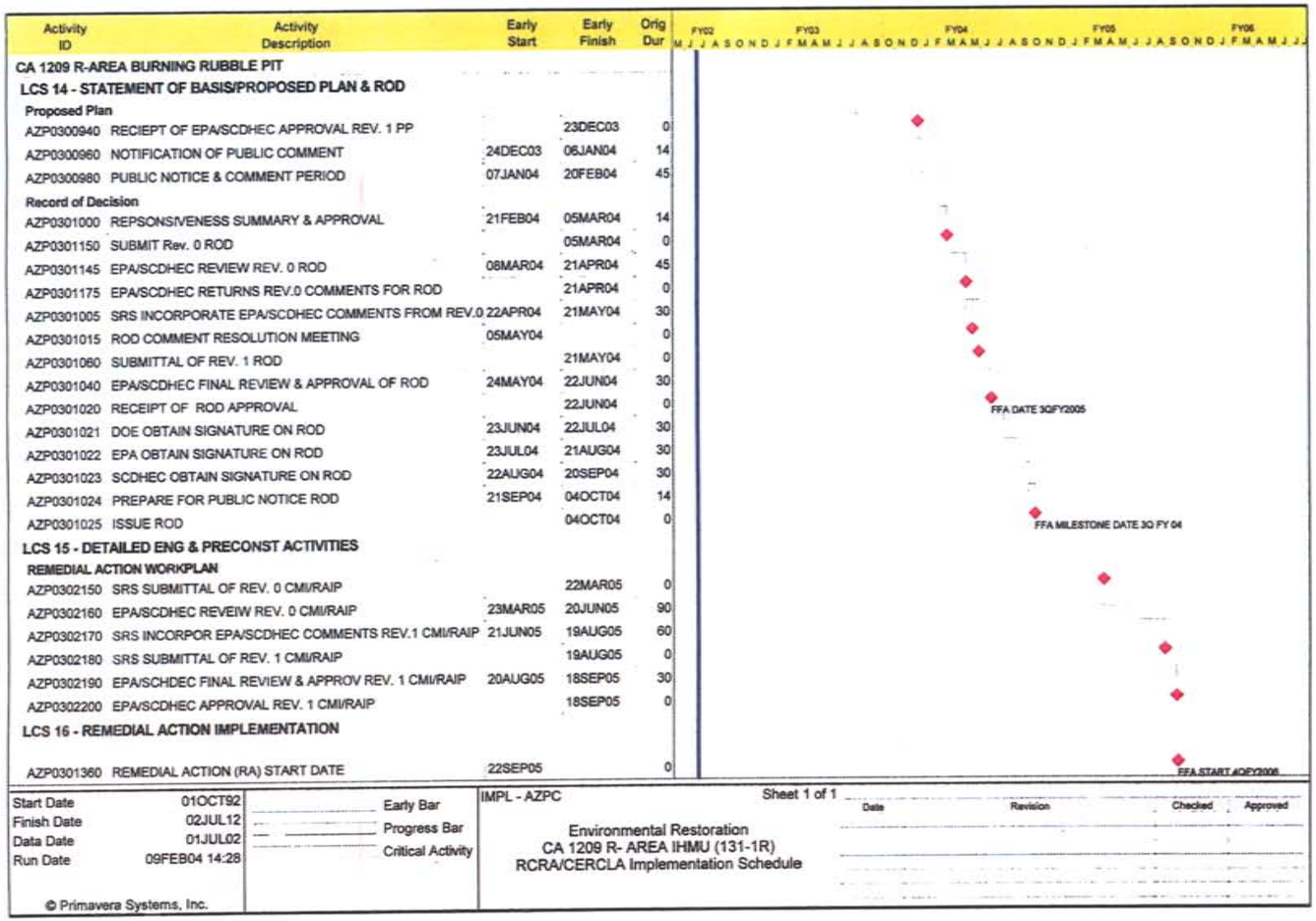

Figure 5. Implementation Schedule for the RBRP/RRP OU

XVI. REFERENCES

FFA 1993. *Federal Facility Agreement for the Savannah River Site,* Administrative Docket No. 89-05-FF (Effective Date: August 16, 1993)

USDOE 1994. *Public Involvement, A Plan for the Savannah River Site,* Savannah River Operations Office, Aiken SC

WSRC, 2001. RCRA Facility Investigation / Remedial Investigation Work Plan for the R-Area Burning Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) (U), WSRC-RP-2000-4046, Rev. 1, July

WSRC, 2003. *RFI/RI/WPA with Baseline Risk Assessment for the R-Area Burning Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (U),* WSRC-RP-2002-4183, Rev. 1, June

WSRC, 2004. *Statement of Basis/Proposed Plan for the R-Area Burning/Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (U),* WSRC-RP-2003-4117, Rev. 1.1, November

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APPENDIX A

RESPONSIVENESS SUMMARY

Responsiveness Summary

Public Comments

The 45-day public comment period for the SB/PP for the RBRP/RRP OU began on January 7, 2004 and ended on February 20, 2004. No comments were received from the public. The Facility Disposition & Site Remediation Committee of the SRS Citizens' Advisory Board was given a briefing on the preferred alternative on February 10, 2004. There were no comments.

APPENDIX B

DETAILED COST ESTIMATES

Estimated Costs for Remedial Alternatives

Alternatives	Total Estimated Costs
No Action	$0
RBRP/RRP # 2 – Consolidation/Cover: Consolidation of RCRA non-hazardous rubble pile material into/over open rubble pit sub-unit, low permeability cover over the combination (pits and non-hazardous pile material), offsite disposal of any RCRA hazardous pile materials, and institutional controls (IC). * Using estimated amount of 150 cubic yards of RCRA Hazardous soils, and a total of 2100 cubic yards	$760,354
RBRP/RRP # 3 – Cover/Cover: Install two low permeability cover systems; one over both rubble pits, and one over the rubble pile, both with institutional controls.	$610,142

RBRP/RRP ALTERNATIVE # 1 - NO ACTION

	Quantity	Units	Unit Cost	Total Cost
Direct Capital Costs				$0
Total Direct Capital Costs				$0
Indirect Capital Costs				
Engineering and design (15% of total direct capital cost)				$0
Project/construction management (30% of total direct capital cost)				$0
Health and safety (10% of total direct capital cost)				$0
Overhead and profit (30% of total direct capital cost)				$0
Contingency (10.8% of total direct capital cost)				$0
Total Indirect Capital Costs				$0
TOTAL ESTIMATED CAPITAL COSTS				$0
TOTAL ESTIMATED O&M COSTS				$0
TOTAL ESTIMATED COST				$0

Summary of Cost Estimates for RBRP/RRP Remedial Alternative # 2

(Assume 150 cubic yards of soil from RRP is RCRA Hazardous)

Consolidation/Cover: Consolidation of RCRA non-hazardous rubble pile material into/over open rubble pit sub-unit, low permeability cover over the combination (pits and non-hazardous pile material), offsite disposal of any RCRA hazardous pile materials.

ACTION: REMOVAL/DISPOSAL	$501,631
ACTION: LOW PERMEABILITY COVER AT RBRP	$258,723
TOTAL FOR ALTERNATIVE # 2	$760,354

Cost Estimate for Disposal of RRP Contaminated Soil and Debris (Hazardous and Non-Hazardous Waste)
(RBRP/RRP Alternative # 2)

Direct Capital Costs	Quantity	Units	Unit Cost	Total Cost
Site Preparation				
Soil Erosion & Sediment Control Plan	1	ls	15,000	$15,000
Erosion control (silt fence and hay bales)	750	lf	4	$2,903
Rubble Pile Dimensions: 125 x 250 feet. Erosion control based upon perimeter				
Clearing & Grubbing	0.7	ac	2,800	$1,960
Rubble Pile Area: approximately 0.7 acres				
Initial Survey	0.7	ac	1,400	$980
Temporary stormwater management	1	ls	10,000	$10,000
Access road upgrade	1	ls	10,000	$10,000
Borrow area development/management	1	ls	15,000	$15,000
Survey, stake non-hazardous, hazardous, and mixed waste	0.7	ac	1,400	$980
Backfill				
Survey after excavation for verification sampling	0.7	ac	1,400	$980
Verification sampling (TAL on 20' centers, 6 x 12 grid)	72	ea	540	$38,880
Excavate, load, haul to unit, place backfill	1129	cy	19	$21,457
Place 1 foot backfill over RRP (0.7 ac)				
Survey after backfill	0.7	ac	1,400	$980
Vegetative layer, topsoil purchase	565	cy	56	$31,621
Place 0.5 foot vegetative layer over RRP (0.7 ac)				
Survey as-built, office computation	1	ls	5,000	$5,000
Grading, mulching, and seeding	0.7	ac	10,000	$7,000
On-unit (RBRP 131-1R open pit) Waste Disposal				
Excavate, load, haul to RBRP 131-1R	1950	cy	13	$25,350
Suspect Hazardous Waste Removal				
Excavate, load, haul to rail car	150	cy	13	$1,950
Sample for disposal (TCLP metals) (already done prior to action)	0	ea	250	$0
Package for shipment (lift liners = 8.33 cy)	0	ea	950	$0
Haul to hazardous waste landfill	182.3	ton	56	$10,206
Disposal soil and liners at hazardous waste landfill	182.3	ton	245	$44,651
Suspect Mixed Waste Removal				
Excavate, load, haul to rail car	0	cy	10	$0
Piles are 2- 3 ft high. Excavation includes 1 foot beneath piles. Volume of soil is approximately 2100 cy.				
Sample for disposal (TCLP metals)	0	ea	250	$0
Package for shipment (lift liners = 8.33 cy)	0	ea	950	$0
Load, haul to mixed waste disposal facility	0	ton	130	$0
Approximately 90 lb / cf				
Disposal soil and liners at mixed waste disposal facility	0	cf	1,741	$0
Subtotal Direct Capital Costs				$244,898
Mobilization/demobilization (2% of subtotal direct capital cost)				$4,898
Total Direct Capital Costs				$249,796
Indirect Capital Costs				
Engineering and design	1	ls	50000	$50,000
Project/construction management (30% of total direct capital cost)				$74,939
Health and safety (10% of total direct capital cost)				$24,980
Overhead markups (30% of total direct capital cost)				$74,939
Contingency (10.8% of total direct capital cost)				$26,978
Total Indirect Capital Costs				$251,835
TOTAL ESTIMATED CAPITAL COSTS				$501,631
Direct O&M Costs				$0
Indirect O&M Costs				$0
TOTAL ESTIMATED O&M COSTS				$0
TOTAL ESTIMATED COST				$501,631

Assumptions and Comments:
All soil volumes are shown fluffed 130%, all soils are considered Vaucluse soils: fluffed weight 1.12 tons/ cy.
Surveying is performed periodically, including (1) initially, the stockpiled soil is staked to separate non-hazardous and hazardous soils, (2) after the stockpiled soil is removed to the staging area, footprint soils are staked to separate non-hazardous and hazardous soils, (3) after footprint soils are removed to staging area, (4) after backfill is placed, and (5) as-built, after vegetative layer is placed.

Cost Estimate for Low Permeability Cover over RBRP (RBRP/RRP Alternative # 2)

Direct Capital Costs		Quantity	Units	Unit Cost	Total Cost
Site Preparation					
Soil Erosion & Sediment Control Plan		1	ls	15,000	$15,000
Erosion control (silt fence and hay bales)		580	lf	4	$2,245
Combined Rubble Pits Dimensions: 2x(230 x 30 feet each). Erosion control based upon perimeter					
Clearing & Grubbing		0.3	ac	2,800	$840
Rubble Pit Area: approximately 0.3 acres					
Initial Survey		0.3	ac	1,400	$420
Temporary stormwater management		1	ls	10,000	$10,000
Access road upgrade		1	ls	10,000	$10,000
Construction of Soil Cover					
Waste Stabilization (Crushed Limestone)		0	ton	103	$0
Place and compact foundation soil in 8" lifts to 95% STD Proctor		968	cy	4.30	$4,162
Geotextile Clay Layer (including testing)		13800	sqft	0.55	$7,590
Geocomposite Drainage Layer (including testing)		13800	sqft	0.50	$6,900
Placement of Geotextile (TYPAR) Filter on Sand Drainage Layer		13800	sqft	0.50	$6,900
Placement of 1'-6" Common Fill		13800	sqft	0.30	$4,140
Placement of 6" Topsoil		242	cy	11.30	$2,735
Survey as-built, office computation		1	ls	5,000	$5,000
Grading, mulching, and seeding		0.3	ac	10,000	$3,000
Subtotal Direct Capital Costs					$78,932
Mobilization/demobilization (2% of subtotal direct capital cost)					$1,579
Total Direct Capital Costs					$80,510
Indirect Capital Costs					
Engineering and design (15% of total direct capital cost)					$12,077
Project/construction management (30% of total direct capital cost)					$24,153
Health and safety (10% of total direct capital cost)					$8,051
Overhead markups (30% of total direct capital cost)					$24,153
Contingency (10.8% of total direct capital cost)					$8,695
Total Indirect Capital Costs					$77,129
TOTAL ESTIMATED CAPITAL COSTS					$157,639
O&M Costs					
Remedy Reviews (every five years for 30 years)		6	ea	15,000	
Interest Rate (i)	0.039				
O&M Present Worth					$48,572
Inspection		1	/yr	1,000	
Maintain Signs		1	ls/yr	500	
Repairs (erosion control, reseeding, etc.)		1	ac/yr	1,500	
Subtotal Annual O&M Costs				$3,000	
Interest Rate (i)	0.039				
Number of Years (n)	30				
Present Worth Factor = {[(1+i)^n])-1} / {[i(1+i)]^n}	17.504				
O&M Present Worth (Annual O&M x PWF)					$52,512
TOTAL ESTIMATED O&M COSTS					$101,084
TOTAL ESTIMATED COST					$258,723

Assumptions and Comments:
All soil volumes are shown fluffed 130%, all soils are considered Vaucluse soils: fluffed weight 1.12 tons/ cy.
Total replacement soils comprise about 2100 cy fluffed.
Surveying is performed periodically, including (1) initially, the stockpiled soil is staked to separate non-hazardous and hazardous soils, (2) after the stockpiled soil is removed to the staging area, footprint soils are staked to separate non-hazardous and hazardous soils, (3) after footprint soils are removed to staging area, (4) after backfill is placed, and (5) as-built, after vegetative layer is placed.

Summary of Cost Estimates for RBRP/RRP Remedial Alternative # 3

Cover/Cover: Install two low permeability cover systems; one over both rubble pits, and one over the rubble pile, both with institutional controls.

* Five-Year Review Requirement Costs are Included in the Action Costs *

Action: Cover RRP	$351,419
Action: Cover RBRP	$258,723
TOTAL FOR ALTERNATIVE # 3	$610,142

Cost Estimate for Low Permeability Cover over RRP (RBRP/RRP Alternative # 3)

Direct Capital Costs		Quantity	Units	Unit Cost	Total Cost
Site Preparation					
Soil Erosion & Sediment Control Plan		1	ls	15,000	$15,000
Erosion control (silt fence and hay bales)		750	lf	4	$2,903
Rubble Pile Dimensions: 125 x 250 feet. Erosion control based upon perimeter					
Clearing & Grubbing		0.7	ac	2,800	$1,960
Rubble Pile Area: approximately 0.7 acres					
Initial Survey		0.7	ac	1,400	$980
Temporary stormwater management		1	ls	10,000	$10,000
Access road upgrade		1	ls	10,000	$10,000
Construction of Soil Cover					
Waste Stabilization (Crushed Limestone)		0	ton	103	$0
Place and compact foundation soil in 8" lifts to 95% STD Proctor		2259	cy	4.30	$9,712
Geotextile Clay Layer (including testing)		30492	sqft	0.55	$16,770
Geocomposite Drainage Layer (including testing)		30492	sqft	0.50	$15,246
Placement of Geotextile (TYPAR) Filter on Sand Drainage Layer		30492	sqft	0.50	$15,246
Placement of 1'-6" Common Fill		30492	sqft	0.30	$9,148
Placement of 6" Topsoil		565	cy	11.30	$6,381
Survey as-built, office computation		1	ls	5,000	$5,000
Grading, mulching, and seeding		0.7	ac	10,000	$7,000
Subtotal Direct Capital Costs					$125,345
Mobilization/demobilization (2% of subtotal direct capital cost)					$2,507
Total Direct Capital Costs					$127,852
Indirect Capital Costs					
Engineering and design (15% of total direct capital cost)					$19,178
Project/construction management (30% of total direct capital cost)					$38,356
Health and safety (10% of total direct capital cost)					$12,785
Overhead markups (30% of total direct capital cost)					$38,356
Contingency (10.8% of total direct capital cost)					$13,808
Total Indirect Capital Costs					$122,482
TOTAL ESTIMATED CAPITAL COSTS					$250,334
O&M Costs					
Remedy Reviews (every five years for 30 years)		6	ea	15,000	
Interest Rate (i)	0.039				
O&M Present Worth					$48,572
Inspection		1	/yr	1,000	
Maintain Signs		1	ls/yr	500	
Repairs (erosion control, reseeding, etc.)		1	ac/yr	1,500	
Subtotal Annual O&M Costs				$3,000	
Interest Rate (i)	0.039				
Number of Years (n)	30				
Present Worth Factor = {[(1+i)^n])-1} / {[i(1+i)]^n}	17.504				
O&M Present Worth (Annual O&M x PWF)					$52,512
TOTAL ESTIMATED O&M COSTS					$101,084
TOTAL ESTIMATED COST					$351,419

Assumptions and Comments:
All soil volumes are shown fluffed 130%, all soils are considered Vaucluse soils: fluffed weight 1.12 tons/ cy.
Total replacement soils comprise about 2100 cy fluffed.
Surveying is performed periodically, including (1) initially, the stockpiled soil is staked to separate non-hazardous and hazardous soils, (2) after the stockpiled soil is removed to the staging area, footprint soils are staked to separate non-hazardous and hazardous soils, (3) after footprint soils are removed to staging area, (4) after backfill is placed, and (5) as-built, after vegetative layer is placed.

Cost Estimate for Low Permeability Cover over RBRP (RBRP/RRP Alternative # 3)

Direct Capital Costs		Quantity	Units	Unit Cost	Total Cost
Site Preparation					
Soil Erosion & Sediment Control Plan		1	ls	15,000	$15,000
Erosion control (silt fence and hay bales)		580	lf	4	$2,245
Combined Rubble Pits Dimensions: 2x(230 x 30 feet each). Erosion control based upon perimeter					
Clearing & Grubbing		0.3	ac	2,800	$840
Rubble Pit Area: approximately 0.3 acres					
Initial Survey		0.3	ac	1,400	$420
Temporary stormwater management		1	ls	10,000	$10,000
Access road upgrade		1	ls	10,000	$10,000
Construction of Soil Cover					
Waste Stabilization (Crushed Limestone)		0	ton	103	$0
Place and compact foundation soil in 8" lifts to 95% STD Proctor		968	cy	4.30	$4,162
Geotextile Clay Layer (including testing)		13800	sqft	0.55	$7,590
Geocomposite Drainage Layer (including testing)		13800	sqft	0.50	$6,900
Placement of Geotextile (TYPAR) Filter on Sand Drainage Layer		13800	sqft	0.50	$6,900
Placement of 1'-6" Common Fill		13800	sqft	0.30	$4,140
Placement of 6" Topsoil		242	cy	11.30	$2,735
Survey as-built, office computation		1	ls	5,000	$5,000
Grading, mulching, and seeding		0.3	ac	10,000	$3,000
Subtotal Direct Capital Costs					$78,932
Mobilization/demobilization (2% of subtotal direct capital cost)					$1,579
Total Direct Capital Costs					$80,510
Indirect Capital Costs					
Engineering and design (15% of total direct capital cost)					$12,077
Project/construction management (30% of total direct capital cost)					$24,153
Health and safety (10% of total direct capital cost)					$8,051
Overhead markups (30% of total direct capital cost)					$24,153
Contingency (10.8% of total direct capital cost)					$8,695
Total Indirect Capital Costs					$77,129
TOTAL ESTIMATED CAPITAL COSTS					$157,639
O&M Costs					
Remedy Reviews (every five years for 30 years)		6	ea	15,000	
Interest Rate (i)	0.039				
O&M Present Worth					$48,572
Inspection		1	/yr	1,000	
Maintain Signs		1	ls/yr	500	
Repairs (erosion control, reseeding, etc.)		1	ac/yr	1,500	
Subtotal Annual O&M Costs				$3,000	
Interest Rate (i)	0.039				
Number of Years (n)	30				
Present Worth Factor = {[(1+i)^n])-1} / {[i(1+i)]^n}	17.504				
O&M Present Worth (Annual O&M x PWF)					$52,512
TOTAL ESTIMATED O&M COSTS					$101,084
TOTAL ESTIMATED COST					$258,723

Assumptions and Comments:
All soil volumes are shown fluffed 130%, all soils are considered Vaucluse soils: fluffed weight 1.12 tons/ cy.
Total replacement soils comprise about 2100 cy fluffed.
Surveying is performed periodically, including (1) initially, the stockpiled soil is staked to separate non-hazardous and hazardous soils, (2) after the stockpiled soil is removed to the staging area, footprint soils are staked to separate non-hazardous a

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