INSTALLATION ACTION PLAN for RADFORD ARMY AMMUNITION PLANT

FORGING A STRONG DEFENSE

U.S. Army Industrial Operations Command

MARCH 2000

PURPOSE

The purpose of the Installation Action Plan (IAP) is to outline the total multi-year restoration program for an installation. The plan will define Installation Restoration Program (IRP) requirements and propose a comprehensive approach and associated costs to conduct future investigations and remedial actions at each Solid Waste Management Unit (SWMU) at the installation and other areas of concern.

In an effort to coordinate planning information between the IRP manager, major army commands (MACOMs), installations, executing agencies, regulatory agencies, and the public, an IAP has been completed for the Radford Army Ammunition Plant (RFAAP). The IAP is used to track requirements, schedules and tenative budgets for all major Army installation restoration programs.

All site specific funding and schedule information has been prepared according to projected overall Army funding levels and is therefore subject to change during the document's annual review. Under current project funding, all remedies will be in place at the RFAAP by the end of 2014.

RADFORD AAP

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APPROVAL

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INFORMATION SHARING

AMC, as well as MSCs and installations believe that it should make its environmental restoration information available openly. This Installation Action Plan will be forwarded to the following people:

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RAB Co-chair
all RAB members

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ACRONYMS & ABBREVIATIONS

ABA	Abondoned Burn Area
AEC	Army Environmental Center
ALF	Abandoned Landfill
ADRA	Ammunition Demilitarization and Renovation Area
ATSDR	Agency for Toxic Substances & Disease Registry
CAAP	Cornhusker Army Ammunition Plant
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CHAAP	Cornhusker Army Ammunition Plant
CRS	Cornhusker Railcar Services
Cr	Chromium
Cu	Copper
DCE	Deputy Commanding Engineer
DERA	Defense Environmental Restoration Account
DERP/MIS	Defense Environmental Restoration Program/Management Infromation System
DMA	Demolition Area
DNT	2,4 Dinitrotoluene
DRMO	Defense Reutilization and Marketing Office
DRMS	Defense Reutilization and Marketing Service
DSA	Diesel Spill Area
DSERTS	Defense Site Environmental Restoration Tracking System
EFFTF	Existing Fire-Fighting Training Facility
ENSR	Environmental Contractor
EPA	Environmental Protection Agency
ER,A	Environmental Restoration, Army (formally called DERA)
EPIC	Environmental Photographic Interpretation Center
FD -A	Fuel Disposal Site A
Fe	Iron
FFA	Federal Facilities Agreement
FFSRA	Federal Facility Site Remediation Agreement
FS	Feasibility Study
FY	Fiscal Year
GOCO	Government Owned Contractor Operated
gpm	gallons per minute
HMX	Cycloteramethylenetrinitramine
HRS	Hazard Ranking Score
IAG	Interagency Agreement
IAP	Installation Action Plan
IRA	Interim Remedial Action
IRIP	Installation Restoration Incineration Program
IRP	Installation Restoration Program
K	Thousand
LAP	Load, Assemble, and Pack
LTM	Long Term Monitoring
MCL	Maximum Contaminant Level
NDEQ	Nebraska Department of Environmental Quality
NB	Nitrobenzene
NE	Not Evaluated
NFA	No Further Action
NPL	National Priority List

ACRONYMS & ABBREVIATIONS

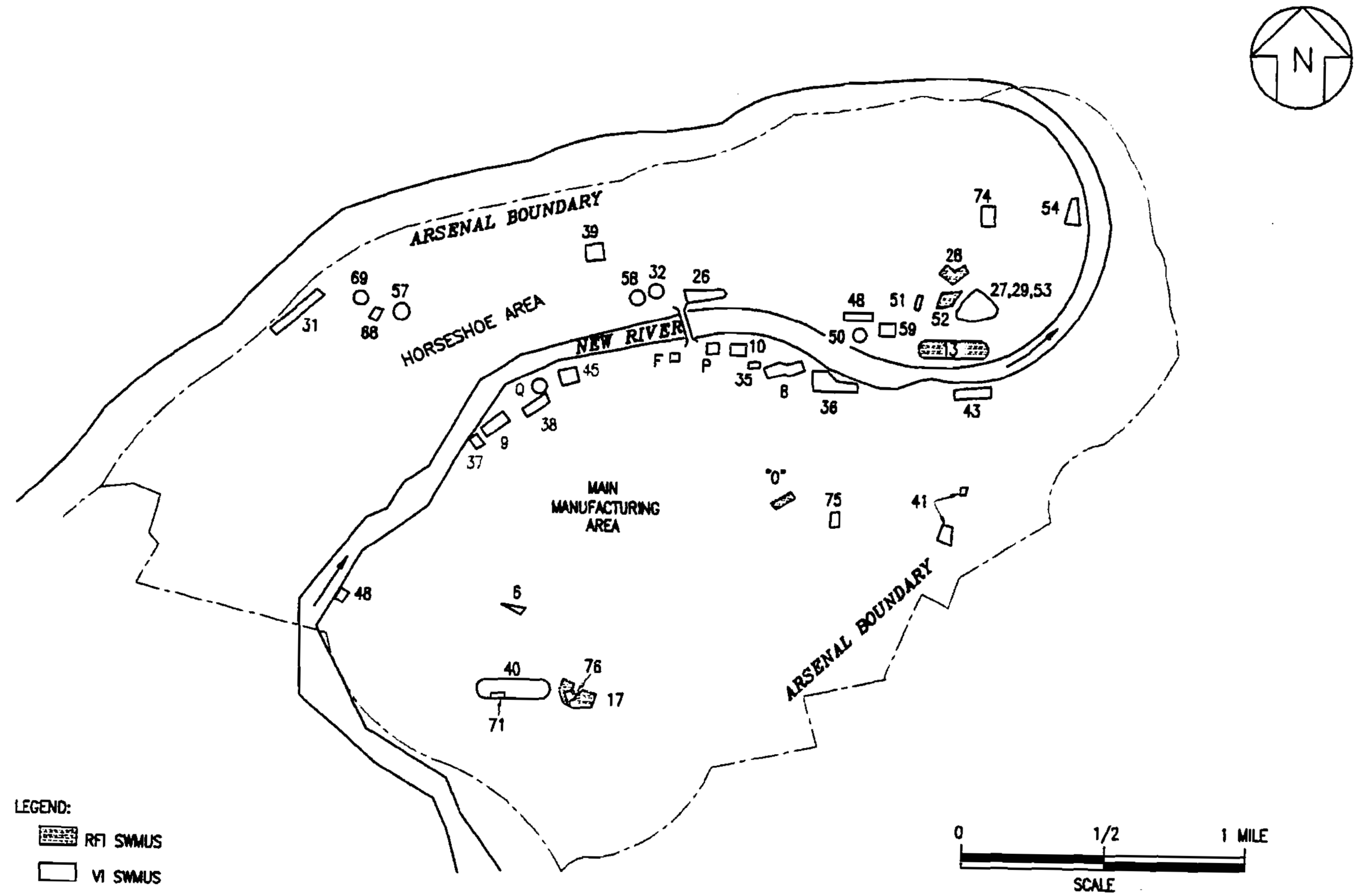
LIST OF ACRONYMS AND ABBREVIATIONS CONTINUED...

OB/OD	Open Burn/Open Detonation
OU	Operable Unit
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
POL	Petroleum, Oil & Lubricants
PP	Proposed Plan
ppb	parts per billion
RA	Remedial Action
RA(C)	Remedial Action - Construction
RA(O)	Remedial Action - Operation
RAB	Restoration Advisory Board
RBC	Risk Based Concentrations
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RDX	Cyclonite
REM	Removal
RI	Remedial Investigation
RIP	Remedy in Place
ROD	Record of Decision
RRSE	Relative Risk Site Evaluation
Sb	Antimony
SI	Site Inspection
SOC	Statement of Condition
SOP	Standard Operating Procedures
STP	Sewage Treatment Plant
SWMU	Solid Waste Management Uniit
SVOC	Semi-Volatile Organic Compounds
TCE	Trichloroethylene
TNB	1,3,5 Trinitrobenzene
TNT	Trinitrotoluene
TPHC	Total Petroleum Hydrocarbons
TRC	Technical Review Committee
Ug/g	microgram per gallon
Ug/l	microgram per liter
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USACE	United States ArmyCorps of Engineers
USAEC	United States Army Environmental Center
USAEHA	United States Army Environmental Hygiene Agency (replaced by CHPPM)
USATHMA	United States Army Toxic and Hazardous Material Agency (replaced by AEC)
UST	Underground Storage Tank
UXO	Unexploded Ordnance
VOC	Volatile Organic Compounds

DSERTS / SWMU CHART

DSERTS to SWMU CONVERSION

RFAAP-001	(SWMU #51)
RFAAP-002	(SWMY #71)
RFAAP-003	(SWMU #69)
RFAAP-004	(SWMU #74)
RFAAP-005	(SWMU #13)
RFAAP-006	(SWMU F)
RFAAP-007	(SWMU #28)
RFAAP-008	(SWMU #27)
RFAAP-009	(SWMU #40)
RFAAP-010	(S8,A,35,37)
RFAAP-011	(SWMU #41)
RFAAP-012	(SWMU #6)
RFAAP-013	(SWMUs #48, 49)
RFAAP-014	(SWMU #54)
RFAAP-015	(SWMU #26)
RFAAP-016	(SWMU #39)
RFAAP-017	(SWMUs #53, 29)
RFAAP-018	(SWMU #48)
RFAAP-019	(SWMU #32)
RFAAP-020	(SWMU #29)
RFAAP-021	(SWMU #46)
RFAAP-022	(SWMU #57)
RFAAP-023	(SWMU #43)
RFAAP-024	(SWMU #45)
RFAAP-025	(SWMU #50)
RFAAP-026	(SWMU #31)
RFAAP-027	(SWMU #58)
RFAAP-028	(SWMU #59)
RFAAP-029	(SWMU #52)
RFAAP-030	(SWMU #30)
RFAAP-031	(SWMU Q)
RFAAP-032	(SWMUs #61,76,76)
RFAAP-033	(SWMU #68)
RFAAP-035	(SEWERLINES)
RFAAP-036	(SWMU #10)
RFAAP-037	(SWMU P)
RFAAP-038	(SWMU O)
RFAAP-039	(HWMU #16)
RFAAP-040	(LEAD FURN.)
RFAAP-041	(HWMU #4)
RFAAP-042	(HWMU #5)
RFAAP-043	(HWMU #7)
RFAAP-044	(N.R.P.)
RFAAP-045	(BLDG 4343)



BASE MAP SOURCE: USATHAMA,1976

U.S. Army Environmental Center

ICF KAISER

RFAAP
May 1998

FIGURE 2-2
LAYOUT AND SWMU
LOCATION MAP

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SUMMARY

SUMMARY

STATUS	RCRA Corrective Action Permit (Dec 1989) - EPA and Virginia HRS of 43 (Internal Score)
NUMBER OF DSERTS SITES:	44 DSERTS sites 31 Active ER.A Eligible Sites 8 Response Complete 5 Response Complete with Long Term Monitoring
DIFFERENT DSERTS SITE TYPES:	2 Burn Areas; 2 Contaminated Buildings; 1 UnderGround Storage Tank; 6 Landfills; 2 Surface Impoundment/Lagoons; 1 Sewage Treatment Plant; 7 Industrial Discharge Points; 1 Oil Water Separator; 1 Pistol Range; 1 Above Ground Storage Tank; 2 Incinerator; 3 Storage Areas; 2 Spill Site Areas; 1 Explosive Ordnance Disposal; 1 Other (Land Farm)
CONTAMINANTS OF CONCERN:	Explosives, Heavy Metals, POL, Solvents
MEDIA OF CONCERN:	Groundwater, Soil, Sediment
COMPLETED REM/IRA/RA:	• IRA - Removal action at RAAP-003,SWMU #69, 1994 ($80,000) • IRA - Regrading of RAAP-023,SWMU #43, 1997 ($105,000) • IRA - Removal action at RAAP-033,SWMU #68, 1997 ($147,702) • IRA – Removal action at RAAP-040, FLFA, 1998 ($98,673) • IRA – Removal action at RAAP-045, NRU, 1998 ($395,533)
CURRENT IRP PHASES:	PA/SI completed for all sites; RC at 8 sites; RI/FS at 3 sites(RA(C) also at 1 site) none at 27 sites; RA at 1 site; LTM at 5 sites
PROJECTED IRP PHASES:	RI/FS at 16 sites, RD at 25 sites, RA(C) at 24 sites RA(O) at 2 sites, LTM at 27 sites RC at 13 sites
IDENTIFIED POSSIBLE REM/IRA/RA:	
FUNDING:	PRIOR YEAR THROUGH 1999: $ 14,740 K FY2000: $ 3,526K FUTURE REQUIREMENTS: $ 93,547 K TOTAL: $ 111,813 K
DURATION:	YEAR OF IRP INCEPTION: 1990 YEAR OF IRP COMPLETION EXCLUDING LTM: 2013 YEAR OF IRP COMPLETION INCLUDING LTM: 2025

INSTALLATION INFORMATION & DESCRIPTIONS

INSTALLATION INFORMATION

LOCALE

RFAAP is located in the western part of Virginia, approximately 40 miles west of Roanoke. RFAAP consists of 4,000 acres in mountainous terrain. The New River flows through the installation. Land usage in the area is primarily agricultural with some residential use.

COMMAND ORGANIZATION

MAJOR COMMAND: U.S. Army Materiel Command; Engineering, Housing, Environmental and Installation Logistics, Environmental Quality Division

SUBCOMMAND: U.S. Army Industrial Operations Command

INSTALLATION: RFAAP, Restoration Program Manager. RFAAP is a government owned, contractor operated facility. Alliant Techsystems Corporation is the operating contractor.

INSTALLATION RESTORATION PROGRAM (IRP) EXECUTING AGENCY

- Investigation Phase Executing Agency: Radford Army Ammunition Plant executes its own IRP.
- Remedial Design/Action Phase Executing Agency: The U.S. Army Corps of Engineers (ACE), Norfolk and Baltimore Districts as well as some IRAs conducted through Radford Army Ammunition Plant.

REGULATOR PARTICIPATION

FEDERAL: U.S. Environmental Protection Agency (EPA), Region III (RCRA and Office of Superfund)

STATE: Virginia Department of Environmental Quality

REGULATORY STATUS

- Non-NPL (National Priorities List), but future listing is probable. EPA Region III, Office of Superfund has shown strong interest in RFAAP-044, The New River Unit in Dublin, VA.
- Resource Conservation and Recovery Act (RCRA) Permit, December 13, 1989

MAJOR CHANGES TO ACTION PLAN FROM PREVIOUS YEAR (FY 99)

- Completed investigative activities at NRU & FLFA.
- Completed SWMU 54 interim action.

INSTALLATION DESCRIPTION

Radford Army Ammunition Plant (RFAAP) is located in the mountains of southwest Virginia in Pulaski and Montgomery Counties. Although RFAAP consists of two noncontiguous units (Main Manufacturing Area and New River Storage Area), the environmental program to date has dealt primarily with the Main Manufacturing Area. Therefore any references to "RFAAP" in this document refers to the Main Manufacturing Area only. The Main area is located approximately 5 miles northeast of the city of Radford, Virginia, which is approximately 10 miles west of Blacksburg and 47 miles southwest of Roanoke. The New River Storage Area is located about 6 miles west of the Main Area, near the town of Dublin.

RFAAP lies in one of a series of narrow valleys typical of the eastern range of the Appalachian Mountains. Oriented in a northeast-southwest direction, the valley is approximately 25 miles long, 8 miles in width at southeast end and narrowing to 2 miles in the northeast end. RFAAP lies along the New River in the relatively narrow northeastern corner of the valley. The New River divides RFAAP into two areas. Within the New River meander exists the "Horseshoe Area" and south of this area is the Main Manufacturing Area.

RFAAP's primary mission, the manufacturing of propellants, began in 1941 and continues today. Since 1968, RFAAP has also produced TNT on an intermittent basis.

The working population at RFAAP varies greatly with mission requirements. There are currently about 1,500 employees at RFAAP.

CONTAMINATION ASSESSMENT

CONTAMINATION ASSESSMENT

In a RCRA Facility Investigation completed by EPA in 1987, 98 Solid Waste Management Units (SWMUs) were identified. Of the 98 total units, EPA has determined that corrective actions work at 43 units is required. The requirements for corrective action are specified in a RCRA permit issued by EPA in 1989. The first phase of investigations at the SWMUs was completed in October 1992 by AEC's contractor, Dames and Moore. Various investigations and actions have since been completed and submitted to the EPA and the State of Virginia as listed in Table 1 below. EPA and the State of Virginia are currently reviewing results of these investigations. In some cases SWMUs are grouped together based on similar histories or proximity.

PREVIOUS STUDIES

Title	Author	Date
RCRA Facility Assessment of Radford Army Ammunition Plant, Radford Virginia	U.S. Environmental Protection Agency (USEPA)	1997
Verification Inspection Report for Radford Army Ammunition Plant	Dames & More Inc.	1992
SWMU 69 Closure Report, RAAP	Dames & More Inc.	1994
RCRA Facility Investigation for SWMU 17, 31, 48, 54 at Radford Army Ammunition Plant, Radford Virginia	Parsons Engineering and Science, Inc	Jan-96
Site Management Plan	ICF Kaiser Engineers, Inc	May-98
RFAAP master Workplan	ICF Kaiser Engineers, Inc	Apr-98
Supplemental RFI for SWMU 54	ATK,	Dec-98
Closure Report for SWMU 8, Eastern Lagoon	ATK,	Dec-98
Closure Report Documentation for SWMU 10, Biological Treatment Plant Equalization Basin	ICF Kaiser Engineers, Inc	Jan-99
RCRA Facility Investigation for SWMU 31, 39, 48, 49, 58	ICF Kaiser Engineers, Inc	Jan-99
Workplan Addenda for SWMU 54 Interim Action	ATK	Jan-99
Workplan Addendum #009	IT Corporation	

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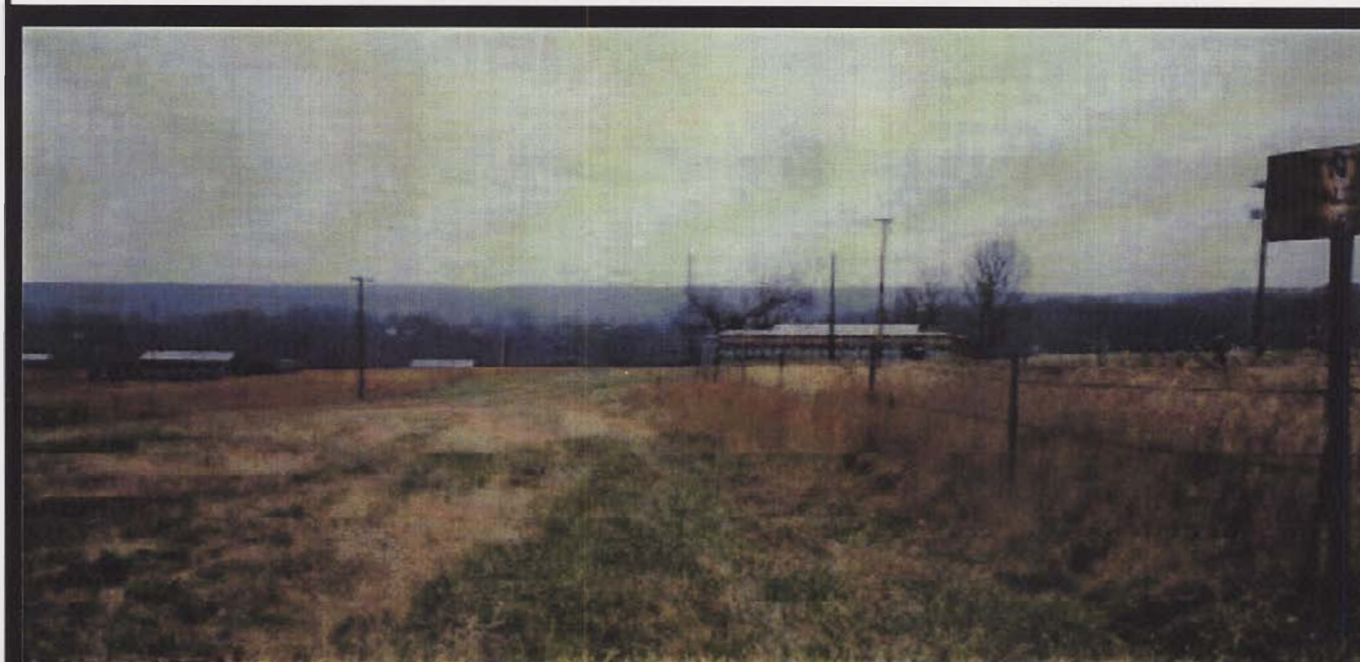
SITE DESCRIPTIONS

SWMU 51



1.0 BACKGROUND

SWMU 51 reportedly consists of one trench, approximately 200 feet long by 20 feet wide, located within the southern half of the central trench of a series of three north-south trending disposal trenches (Figure 5-1.1). The remaining trenches were reportedly used for asbestos disposal (SWMU 30) and are not part of this unit. This unit is located approximately 200 feet west of SWMU 52 (Closed Sanitary Landfill) and 200 feet southwest of SWMU 28 (Closed Sanitary Landfill).

SWMU 51 is surrounded by a barbed-wire fence that apparently encompasses more than just the reported SWMU 51 trench. The enclosed area appears to correlate to the southern halves of both the central and eastern trenches. A central barbed-wire fence divides the enclosed area into east and west halves suggesting that the southern halves of both trenches were also used for TNT waste burial. The trench has been filled to natural grade and is weed covered.

An unknown quantity of TNT neutralization sludge from the treatment of red water was disposed of in this unlined trench in the 1970s. Red water was a waste product generated during the production of TNT. It contained numerous TNT byproducts including alpha, beta, and gamma TNT isomers and TNT sodium disulfates. The source of sludge was the red water treatment plant's equalization/neutralization basin.

In addition to sludge disposal, an estimated 10 tons of red water ash was reportedly disposed of in the trench from 1968 to 1972. During this period, red water was concentrated by evaporation and burned in four rotary kilns located in the TNT manufacturing area (USATHAMA, 1976). The ash produced from these kilns was disposed of in SWMU 41 (Red Water Ash Landfill), SWMUs 42 and 51.

Red water ash has been described as yellowish-tan in color when dry. When wet it turns a dark red and generates a dark red leachate. It is corrosive and fine-grained, though it may contain large clinkers.

2.0 ENVIRONMENTAL SETTING

SWMU 51 is located on a plateau in the southeastern section of the Horseshoe Area adjacent to HWMU 16 (Hazardous Waste Landfill) and SWMU 30. The elevation of the plateau ranges from approximately 1,810 to 1,840 feet msl. The plateau is generally flat to slightly sloping.

The subsurface stratigraphy, depth to bedrock, hydraulic conductivity, and hydrogeologic interrelationships in the vicinity of SWMU 51 are similar to those of SWMUs 28 and 52.

The groundwater in the vicinity of SWMU 51 is present in an unconfined aquifer with the water table encountered between 32 to 69 feet bgs. The highest elevation was measured below the western side of SWMU 51, and the lowest elevation was measured at the eastern side of HWMU 16.

The measured water table elevations

indicate that SWMU 51 overlies a water table mound. If this is true, then no upgradient monitoring location is available. The water table aquifer is recharged by infiltration of precipitation through permeable soils naturally found in this area. Recharge would be more likely to occur through the natural, undisturbed soils which have not been capped and graded when the landfills were closed. The series of trenches dug for SWMU 51 waste disposal have not been capped and graded, and therefore allow increased infiltration of precipitation and recharge to the aquifer.

A dye-trace study is being conducted in the Horseshoe Area to determine the groundwater conditions in this area.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a preliminary data review, evaluation, and visual site inspection.
- **1992 - RCRA Facility Investigation, Dames & Moore,** included the installation, sampling, and analysis of four soil and rock borings and four monitoring wells, in conjunction with SWMUs 28 and 52.

SWMUs 28, 51, and 52 are geographically proximate to each other in the eastern end of the Horseshoe area. Each SWMU consists of a subsurface burial area of waste material. The three SWMUs encompass an area approximately 15 acres. Because of the proximate nature of the SWMUs and the similar disposal methods used at each SWMU, one combined study area was delineated for the RFI.

RFI sampling program provided chemical data for evaluating the impact SWMUs 28, 51, and 52 have on groundwater migrating from the combined landfill area. Subsurface conditions were evaluated during the soil and rock boring program. Upgradient and downgradient hydrogeologic characteristics were evaluated through the installation of four monitoring wells.

3.1 SOILS

Remediation of soils is not necessary since these SWMUs are landfill disposal areas and potential contamination rarely occurs through groundwater. Surface soils have not been impacted by SWMU practices and all exposed areas are naturally clean fill used to cover the waste. However, a summary of the U.S. Department of Agriculture (USDA) soil properties may be useful since infiltration of precipitation is an important mechanism for recharging groundwater. The landfill area was constructed upon Braddock loam (2-7 percent slope) and Cotaco loam (2-7 percent slope) soils (SCS, 1985).

3.2 GROUNDWATER

A total of thirteen groundwater samples were collected in the vicinity of SWMUs 28, 51, and 52. The results of the chemical analyses indicated the presence of metals, explosives, VOCs, and SVOCs in groundwater as presented in Table 5-1.1. The majority of metals are common constituents of groundwater and were detected at levels expected to be present in groundwater of a limestone formation. All metal concentrations were less than HBN criteria and do not appear to be anomalously high.

SVOCs were detected in several samples that appeared to be related to manufacturing activities. Low levels of two explosives were detected in three groundwater samples. The explosive 1,3-dinitrobenzene (13DNB) was detected downgradient of SWMU 52 in the groundwater sample from well 16-3, but at a level slightly greater than the analytical detection limit. Concentrations of the explosive ***2,6-dinitrotoluene (26DNT)*** exceeded the HBN criterion in samples from well 16-4 and 51MW2. ***Bis(2-ethylhexyl) phthalate*** in sample 16-4 also exceeded the HBN criterion. The samples were collected east and south of the TNT Sludge Neutralization Disposal Area (SWMU 51). However, these constituents were not detected in groundwater west of SWMU 51 (e.g., sample 51MW). Soils at 51MW1 were different from those found at 16-4 and 51MW2, and this well could be sampling a perched groundwater zone and not the unconfined aquifer.

Concentrations of the VOCs ***1,1,2-trichloroethane*** and ***1,1,2,2-tetrachloroethane*** were detected above HBN criteria in the groundwater sample taken downgradient of SWMU 52 from well 16-3. Concentrations of ***1,1-dichloroethane*** in the samples from MW9 also exceeded the HBN criterion. Both samples were collected in the area downgradient of HWMU 16. No other detection of ***1,1-dichloroethane*** occurred. ***Bis(2-ethylhexyl) phthalate*** also exceeded the HBN criterion in the two samples in which it was detected. (Note: Bis(2-ethylhexyl) phthalate was detected in method blanks and is considered a laboratory artifact).

Methylene chloride was detected in MW9 and WC2-A wells, which are located downgradient of HWMU 16 near the leachate drain. Duplicate MW9 samples verified original results, therefore methylene chloride is probably present in the groundwater and is not a laboratory contaminant. Based on the results of other groundwater samples collected in the vicinity of SWMU 52 (e.g. C4, CDH-2, and 16-3), the nature of the material disposed of in HWMU 16, and the location of MW9 and WC2-A indicated that the presence of these constituents in groundwater is likely due to HWMU 16.

Based on the contamination assessment presented above, ***26DNT, 1,1-dichloroethane, 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane*** and methylene chloride have been identified as contaminants of concern for groundwater downgradient of SWMU 28. ***26DNT*** may be attributable to SWMU 51, but the other two contaminants appear to be related to HWMU 16 rather than to the RFI SWMUs. Samples were not collected from other environmental media.

No groundwater wells, except for monitoring purposes, are located downgradient of SWMU 28. Groundwater in the vicinity of SWMU 28 generally flows radially away from the center of the landfill area and may discharge to the New River. Future land use is considered to be similar to current land use scenario. RFAAP will continue to remain an active army installation and there are no plans for future residential development. Therefore, it is highly unlikely that groundwater wells would be installed in the future in the vicinity of SWMU 28. Based on this evaluation, potential groundwater exposure pathways are not considered operable under the current or future land use scenario.

3.3 SURFACE WATER AND SEDIMENT

The southern portion of SWMU 28 appears to discharge eastwardly into the storm sewer located to the east of SWMU 28. Surface water runoff in the northern portion of SWMU 28 appears to flow north until reaching the drainage and storm sewers associated with the road to the north of SWMU 28. Surface water along the northern road flows east. Storm sewers and natural drainage patterns along the paved road on the eastern boundary of the plateau appear to flow northeast and discharge into a tributary of the New River, approximately 500 feet northeast of SWMU 28. The tributary flows northeast about 700 feet where it joins with another tributary of the New River, just east of SWMU 74. The tributary flows east to this point and discharges into the New River approximately 1,500 feet east of SWMU 74 and approximately 300 feet northeast of SWMU 54.

4.0 RECOMMENDED ACTION

- Collect confirmatory groundwater and soil samples for SVOCs, VOCs, and explosives to support the site screening process and a baseline risk assessment, as applicable.
- Evaluate the source of explosives.

Confirmatory sampling should be performed to verify the presence of SVOCs and VOCs detected in groundwater samples. Groundwater monitoring for HWMU 16 is being conducted in accordance with VDEQ in wells near SWMU 51. Resampling should be performed on samples where laboratory anomalies resulted in the qualification of data.

DSERTS #: RAAP-002 FLASH BURN PARTS AREA RRSE: 1A

SWMU 71

1.0 BACKGROUND

SWMU 71 (the inactive Flash Burn Parts Area) consists of an open, hard-packed gravel area about 50 feet long by 25 feet wide. Between 1962 to 1982, the purpose of the SWMU was to flash burn metal process pipes contaminated with propellant. Reportedly, oil soaked straw was used on occasion to create the burning environment for decontamination. The pipes were then reused or sold for scrap.

2.0 ENVIRONMENTAL SETTING

SWMU 71 is located in the south-central portion of the Main Manufacturing Area in the southwest corner of the Sanitary Landfill (SWMU 40) (Figure 5-2.1). The topography of SWMU 71 is generally level but is steeply sloping immediately north of SWMU 40. The elevation of SWMU 71 is approximately 1,900 feet msl. SWMU 71 is approximately 300 feet west of SWMU 17. There is a gravel storage lot to the south of SWMU 71. The area is accessible by paved roads.

Although site-specific subsurface investigations have not been conducted in this area, SWMU 40 soil borings indicated that bedrock was only a few feet bgs and consisted of badly weathered and broken limestone layers. Several feet of SWMU 40 landfill material probably underlies SWMU 71 and overlies the natural ground surface.

It is known that SWMU 71 is located over karst limestone bedrock with a deep water table. Groundwater is expected to be encountered at a depth greater than 100 feet with an unknown flow direction.

Surface water runoff appears to flow generally northward with discharge to the New River, which is approximately 1.2 miles south of the SWMU.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included the collection and analysis of three shallow soil samples.
- **1993-1994 - Dye-Tracing Study, Engineering-Science, Inc. (USAEC, 1994),** identified a groundwater conduit to the New River through the karst limestone in the south-central section of the Main Manufacturing Area.
- **1994 - Verification Investigation, Dames & Moore, Phase II,** included the collection and analysis of 12 surface and subsurface soil samples.

To determine whether surface soils have been impacted through the release of hazardous constituents during flashing operations, three surface soil samples were collected within this unit (Figure 5-2.1). Though not required by the permit, this action was recommended due to the use of fuel oil in the flashing operations. Based on the results, 12 additional soil samples were collected to delineate the extent of contamination.

In 1993 and 1994, a two-stage dye-trace study was conducted by Engineering-Science, Inc. in an effort to better identify groundwater flow paths through the karst limestone in the south-central section of the Main Manufacturing Area.

3.1 SOIL

During Phase I, three surface soil samples were collected. Each sample was collected from a depth of 0 to 6 inches below any gravel or surface organic root zone and was analyzed for target analyte list (TAL) metals, explosives, and total petroleum hydrocarbons (TPHs). Metals detected at concentrations above the PQL are presented in Table 5-2.1. ***Arsenic, beryllium, cobalt,*** and ***thallium*** concentrations exceeded their HBNs. TPH was reported for all samples, confirming the reported use of waste oil or fuel to flash the material. Explosives were not detected in any of the samples.

Based on these results, 12 additional soil samples were collected in 1993: 7 surface soil and 5 subsurface soil. Each sample was analyzed for TAL metals, TCLP metals, and TPH (Table 5-2.2). Three metals exceeded their respective HBNs, namely ***arsenic, beryllium,*** and ***cobalt.*** Two TCLP metals (barium and cadmium) were detected, but neither exceeded its HBN. TPH was detected in five surface soil samples and two subsurface soil samples.

3.2 DYE-TRACE STUDY

The dye-trace study conducted between September 23, 1993 and July 8, 1994, was designed to determine groundwater flow directions through the karst limestone in the south-central section of the Main Manufacturing Area. Flow directions were determined by identifying hydrogeologic connections between areas of groundwater recharge (upland sinkholes near SWMUs 17 and 40) and their respective discharge areas in and around the facility.

Based on the results of this investigation, one spring, SPG3, was identified as being hydraulically connected to the sinkhole that SWMU 17A occupies. The flow path identified by the dye-trace closely parallels a west-northwest to east-southeast trending fracture trace that can be extended to connect the dye injection point with the dye resurgence point. This leads to the conclusion that a direct conduit exists between SWMU 17A and SPG3, most likely created by a solution opening along a subsurface fracture. The extended fracture trace runs south of SWMU 71 and may also drain groundwater from the vicinity of SWMU 71. The groundwater flow rate through this conduit under low flow conditions is calculated to range between 2,095 feet per day (ft/day) and 3,716 ft/day, and under high flow conditions is calculated to average 4,800 ft/day.

4.0 RISK ASSESSMENT

Potential soil exposure routes typically include incidental ingestion, inhalation, and dermal absorption of soil contamination. The area is covered by gravel, and it is highly unlikely that receptors would be in contact with this soil, or that contaminants may become airborne for the following reasons: (1) SWMU 71 is an inactive area and access to RFAAP is strictly controlled, thereby precluding contact by receptors; and (2) future land use is assumed to be the current industrial land use scenario.

Summary of Screening Level Risk Assessment

Samples Collected

Surface and subsurface soils.

Medium	No.	Location
Surface soil	10	0-6″
Subsurface	5	4′

4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Chemicals of potential concern (COPCs) were selected based on results exceeding HBNs and background levels. Surface soils exhibited HBN exceedance for ***arsenic, beryllium, thallium,*** and ***TPH.*** Constituents justified for deletion included arsenic and TPH.

4.2 EXPOSURE ASSESSMENT

In order to evaluate the probability and magnitude of potential adverse effects on human health associated with actual or potential exposures to site-related chemicals at SWMU 71, a separate COPCs screening should be conducted. The exposure pathways that are recommended for quantitative evaluation of arsenic, beryllium, cobalt, and thallium include:

Groundwater

Groundwater samples may be necessary to assess groundwater contamination and flow direction at the site since, according to the VI, borings conducted at the site indicate that bedrock is only a few feet bgs and consists of badly weathered and broken limestone layers. If COPCs are selected in groundwater based on the review of future analytical data, potential risks associated with future worker exposures to groundwater via ingestion of drinking water should be quantitatively evaluated.

Surface Soil

- Incidental ingestion of chemicals in soil by a future worker; and
- Dermal absorption of chemicals in soil by a future worker.

Surface Water/Sediment

Although there is no surface water or sediment near SWMU 71, the SWMU is steeply sloping immediately north of SWMU 40, and surface water runoff flows generally northward to the New River. As a result, surface water and sediment samples collected in drainage ditches or swales may be needed to determine whether high chemical concentrations are migrating from the site.

5.0 RECOMMENDED ACTION

Confirmatory soil samples will be collected for metals analysis to verify previous investigative results and provide additional data to support the quantitative human health baseline risk assessment.

DSERTS #: RAAP-003 FINISHING POND FACILITY, CHROMIC RRSE: 1A

SWMU 69

1.0 BACKGROUND

SWMU 69 is the unlined pond downgradient of SWMU 68 and receives runoff from that area. Since 1974, "Oakite 33"—an acidic rust stripper consisting of phosphoric acid and butyl cellosolve mixture—has been used instead of chromic acid to clean rocket encasements (USEPA, 1987). Spent Oakite was adjusted to a pH of 5.0 with soda ash prior to discharge to SWMU 69. A closure report for SWMU 69 is dated August 30, 1994.

2.0 ENVIRONMENTAL SETTING

The topography in the area of SWMU 69 is moderately sloping towards the northwest. The area further north of SWMU 69 is moderately steeply sloping towards the north. The elevation at SWMU 69 is approximately 1,790 to 1,800 feet msl. There are buildings, paved roads, and overhead pipes in the vicinity of SWMU 69.

Although no site-specific hydrogeologic investigation has been conducted in this area, groundwater is estimated to flow at a depth range between 20 to 40 feet bgs northwestward with discharge to the New River.

Surface water in the area of SWMU 69 appears to flow westward towards a tributary of the New River. The tributary flows north and discharges into the New River, which is approximately 1,400 feet from the SWMU. Overflow from the pond traveled through a weir that discharged to the northwest.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included sampling and analysis of surface water and sediment and the evaluation of soil samples downgradient of the retention facility to determine the impact of overflow on hazardous constituent transport.
- **1994 - Closure Report, Dames & Moore,** included the collection of two sediment samples for contaminant characterization, the excavation of contaminated soils, and the collection of eight confirmatory soil samples.

Two surface soil samples were collected downgradient of the pond adjacent to the chromic acid treatment tanks (SWMU 68) to evaluate whether past overflows transported potentially hazardous constituents from the pond to the surrounding soils. To evaluate whether the pond has received hazardous constituents from past discharges, one surface water sample was collected. To evaluate whether contaminants had accumulated in the pond sediments, one sediment sample was collected. The sample was collected from 0 to 1 foot below the sediment/water interface.

3.1 SOIL

Two soil samples were collected from a depth of 0 to 6 inches below any surface organic root zone and analyzed for pH and TAL metals. Samples collected slightly downslope of the SWMU 69 settling pond contained several metals (Table 5-3.1). Eighteen metals were detected in a second soil sample, 69SS2, also collected downslope of the pond. Of the metals detected, six metals exceeded HBN criteria. These metals are ***antimony, arsenic, beryllium, cobalt, lead,*** and ***thallium.*** ***Thallium*** was detected at a level greater than the HBN; however, it is not expected to be a concern because it is relatively immobile in the environment and is not expected to impact surface water, groundwater, or the underlying soil. These results may indicate downslope transport of wastes originating from the pond.

3.2 SURFACE WATER

The surface water sample was analyzed for TAL metals, TOC, TOX, and pH. Table 5-3.2 presents the analytical results for metals exceeding the PQL. ***Antimony, cadmium, chromium, cobalt, copper, lead, manganese, nickel,*** and ***zinc*** exceeded HBNs by factors ranging from slightly greater than one for copper to nearly four orders of magnitude for cobalt.

Metals detected at elevated levels without applicable health criteria indicate that the pond sample is defined as "very hard" by conventional water quality standards. TOC was reported within a range normally found in surface water environments; however, the TOX concentration for this sample was elevated.

3.3 SEDIMENT

One sediment sample was analyzed for TAL metals and pH. ***Antimony, arsenic, cadmium, chromium, cobalt, lead,*** and ***thallium*** exceeded HBNs by factors ranging from slightly greater than three for thallium to greater than 25 for cobalt (Table 5-3.3). All other metal concentrations above the PQL were substantially below the respective HBNs.

In soil or sediment, the persistence of the metals depends on their leachability and ability to degrade. Many of the metals exceeding HBN criteria are readily sorbed to soil constituents, and the downward transport of these constituents to groundwater is expected to be inhibited by their relative immobility in soil and a deep water table. However, leachability data for samples collected at this site are not presently available. The contaminants in the pond, however, may be transported via surface water runoff or sediment movement during overflow events at the pond. The results of sample 69SS1 indicated that contaminants have impacted shallow soil downslope of the pond.

3.4 INTERIM MEASURES

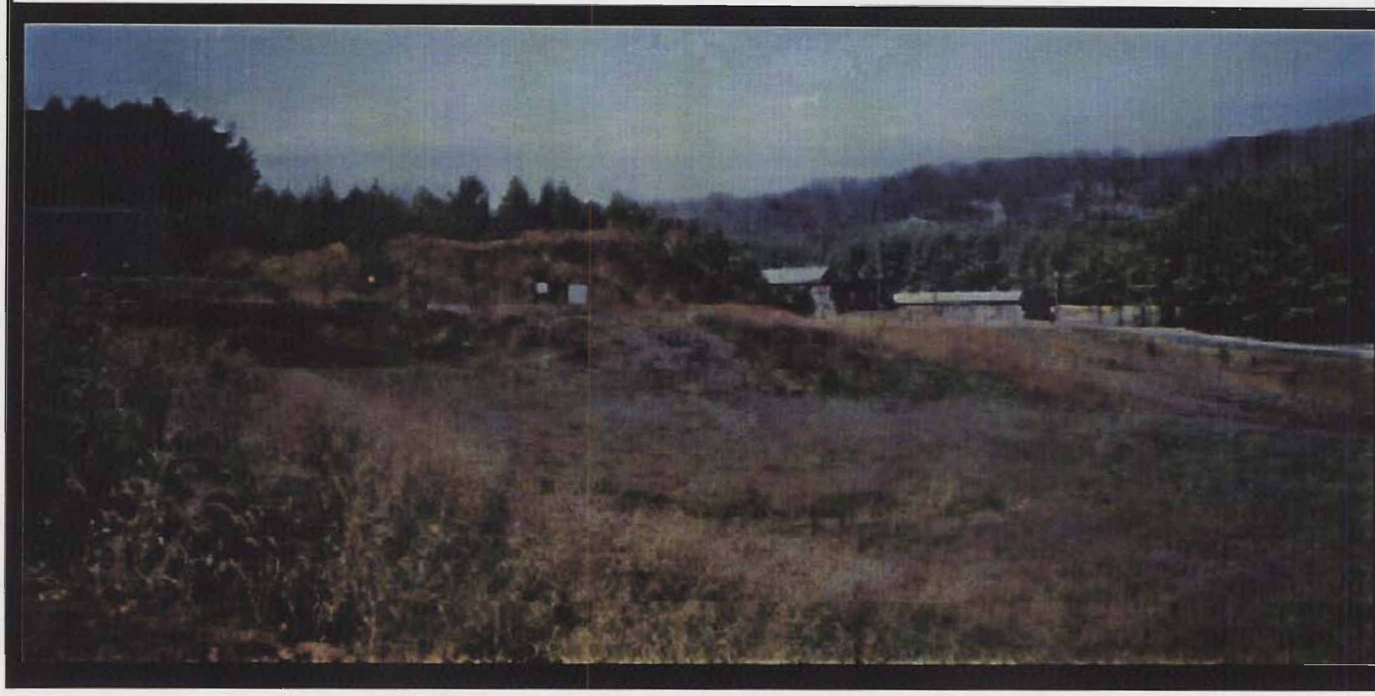
Interim measures were taken in accordance with the VI recommendations. Lead was selected as the indicator for field screening of soils due to its presence in pond sediment. X-ray fluorescence spectrometry (XRF) was used to screen soils and sediments for excavation. Approximately 3,500 square feet of surface area was disturbed. Fly ash was mixed with the sediments and soils and removed. Excavated materials were disposed of at SWMU 29, a permitted landfill, in accordance with VDEQ authorization. Eight soil samples were collected from the excavated pit to confirm removal of contaminated material. These samples were analyzed for total TAL metals and full Toxicity Characteristic Leachate Procedure (TCLP). Barium, cadmium, 2,4-dichlorophenoxyacetic acid (2,4-D), and chloroform were detected in the TCLP. ***Arsenic, beryllium, cobalt,*** and ***thallium*** were detected above HBNs.

4.0 RECOMMENDED ACTION

An interim action was completed in 1994 that consisted of removal of water and contaminated soil. The resulting excavation was backfilled with clean soil and reseeded. No further action is proposed for this site at this time.

DSERTS #: RAAP-004 INERT LANDFILL #3 RRSE: 3A

SWMU 74



1.0 BACKGROUND

SWMU 74 is an unlined unit that was permitted by the Virginia Department of Health in May 1984 (Permit No. 433) as "Debris Landfill No. 2" to receive construction waste, demolition waste, wood, tree trimmings, stumps, and inert waste materials (Figure 5-4.1).

The landfill is being area-filled in two lifts, with wastes pushed off the edge of existing fill from west to east. The landfill is currently about half filled, and the estimated remaining life of the landfill is two to three years.

In addition to the above specific inert wastes, the following materials have been observed as being disposed of in the landfill: cardboard, fluorescent light bulbs, wet coal or asphalt, and laboratory chemical and empty reagent 5-gallon cans.

2.0 ENVIRONMENTAL SETTING

Inert Landfill No. 3 (SWMU 74) is located in the central portion of the Horseshoe Area, approximately 800 feet northeast of the SWMU 28 (Closed Sanitary Landfill).

The topography in this area is moderately steep sloping towards the east. The maximum elevation is approximately 1,780 feet msl in the southwest portion of SWMU 74, and the minimum elevation is approximately 1,732 feet msl in the eastern portion of the site. A drainage ditch borders the southeastern and northeastern boundary of SWMU 74.

The geology of the SWMU was evaluated during the VI (Dames & Moore, 1992) through the drilling of one downgradient soil and rock boring. Subsurface conditions consisted of fine- to coarse-grained, medium to very dense, alluvial floodplain deposits that generally became coarser-grained with depth. Soils encountered graded from a non-plastic sandy silt to a well-graded sand. Approximately 5 feet of silty gravel were encountered overlying weathered limestone bedrock, which was approximately 25 feet below ground level. Limestone was weathered and fractured with frequent pitting and calcite healed fracture zones. Geologic conditions encountered at this site were consistent with other floodplain areas in the Horseshoe Area of RFAAP.

Groundwater flows eastward to the New River. A relatively shallow, unconfined groundwater table was encountered within the fractured bedrock at a depth of approximately 38 feet. Subsequent stabilized groundwater levels were measured at approximately 25 feet at the overburden soil bedrock contact. Groundwater monitoring is conducted quarterly as required by VDEQ.

Surface water runoff appears to flow east towards the drainage ditches bordering SWMU 74. The ditches flow east/southeast towards the New River, which is approximately 1,800 feet from the SWMU.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.

- **1992 - Verification Investigation, Dames & Moore,** included ground-water well installation and sampling/ analysis.

Because this landfill is operated as an inert landfill under an existing Virginia Solid Waste Permit, it is unlikely that hazardous constituents are associated with this SWMU. However, to evaluate whether groundwater quality has been impacted by waste disposed in this unit, one well was installed downgradient of the landfill to a depth of 50.4 feet.

Following well installation and development, the groundwater level in the well was recorded and a sample was collected and analyzed for metals, VOCs, SVOCs, TOC, TOX, and pH. The six metals detected in sample 74MW1 are common constituents of groundwater and were reported at levels expected to be present in groundwater flowing through limestone. All metals were detected at concentrations below the HBN criteria. VOCs and SVOCs were not detected in this sample. TOC and TOX were reported at moderately low concentrations. The results of the chemical analyses (Table 5-4.1) of sample 74MW1 do not indicate the presence of contamination downgradient of Inert Landfill No. 3.

4.0 RECOMMENDED ACTION

The operation and closure of SWMU 74 is addressed under state permit No. 433.

DSERTS #: RAAP-005 **WASTE PROPELLANT BURNING GROUND** **RRSE: 1A**

SWMU 13

1.0 BACKGROUND

The burning grounds have been used for the burning of waste explosives, propellants, and laboratory wastes (propellant and explosive residues, samples, and analytical residues) since manufacturing operations began at RFAAP in 1941. The 20-acre unit currently consists of eight burning pads (Figure 5-5.1). Approximately 600 tons of waste propellant are burned at SWMU 13 annually.

SWMU 13 consists of the following components:

- Burning pans
- Former open burning ground areas
- Runoff settling basin
- Mobile temporary storage units

The burning pans and mobile temporary storage units were installed in 1985. Prior to that time and at least as early as 1971, wastes were burned directly on mounded earth at the same location currently in use.

The burning pads are approximately 3 feet thick and are constructed of earth, a 6-inch clay liner, and gravel. Each burning pad contains two burning pans. The 16 burning pans are constructed of metal and are approximately 18 feet long by 6 feet wide by 1 foot deep.

Ash is shoveled from the pans and surrounding soils into ash wagons and moved to the designated ash storage area at the burning ground. Residual material is then taken to the less than 90 day accumulation area roll-off box. It is tested for TCLP and reactivity to determine proper disposal methods.

During the late 1970s, prior to initial operation of the Hazardous Waste Landfill (SWMU 16) in 1980, ash from the Waste Propellant Burning Ground was reportedly disposed of at SWMU 54 (Propellant Ash Disposal Area).

There is the potential for surface soil contamination at SWMU 13 from a number of sources. Prior to use of the burning pans, wastes were burned directly on the ground surface. During current use of the pans, wastes and ash could be spilled onto the ground. In addition, surface water runoff could carry any spilled wastes or ash to the settling basin. Fallout from burning could also contaminate area surface soils.

2.0 ENVIRONMENTAL SETTING

The Waste Propellant Burning Ground (SWMU 13) is located in the southeast section of the Horseshoe Area on the northern bank of the New River within the 100-year floodplain. It covers approximately 20 acres.

The topography of SWMU 13 slopes slightly to the south, with an elevation of approximately 1,699 to 1,701 feet msl on the northern side and 1,693 to 1,695 feet msl on the southern side. An earthen berm approximately 5 feet high separates SWMU 13 into western and eastern sections. A riprap berm borders the southern side of SWMU 13. A settling basin that collects runoff from the burning ground exists on the eastern side of SWMU 13. The settling basin is approximately 30 feet long, 20 feet wide, and 4 feet deep. SWMU 13 is approximately 750 feet downgradient (south) of SWMUs 27, 29, and 53. A settling pond approximately 30 feet upgradient from SWMU 13 collects surface runoff from

SWMUs 27, 29, and 53.

The topography north of SWMU 13 is steeply sloping towards the south. The topography south of SWMU 13, just after the berm, is moderately steeply sloping towards the New River, which is approximately 50 feet south of the burning ground.

3.0 PREVIOUS INVESTIGATIONS

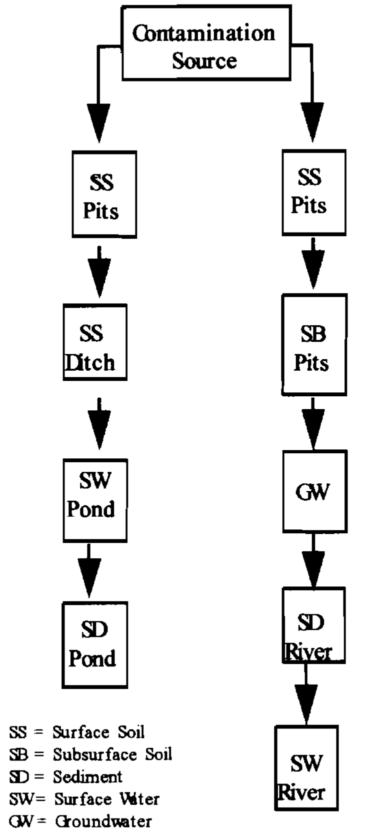
- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - RCRA Facility Investigation, Dames & Moore,** included the sampling and analysis of surface soil, subsurface soil, and sediment as well as installation and sampling of groundwater wells.

The Virginia Department of Waste Management (VDWM) requested a groundwater quality assessment (GQA) for SWMU 13 as part of RFAAP's application to permit the burning grounds as a RCRA disposal facility. To evaluate potential soil contamination at the Waste Propellant Burning Ground, a RFI was conducted by Dames & Moore in 1992. The RFI program included the analysis of soil samples collected from borings in the area of the former burn pits, which were used prior to 1971. Chemical results from these samples have been used to assess the potential migration of contaminants via surface water transport. The GQA was performed using the sampling program for the RFI program as presented in the Work Plan (Dames & Moore, 1992), which was completed in April 1992 and subsequently submitted to VDWM. The RFI for SWMU 13 includes the data presented in the GQA as well as additional background, quality assurance/quality control (QA/QC), and New River sampling data. RFI activities included the sampling and analysis of surface and subsurface soil, surface water, and groundwater. The available data have been evaluated to determine the presence of potential hazardous constituents or hazardous waste, the extent and magnitude of contamination, and potential pathways of contaminant migration (Figure 5-5.2).

3.1 SOIL

Three types of soil samples were collected for the SWMU 13 RFI. Background soil samples were to be collected from six borings conducted around the burning ground, but the two borings south of the burning pads (13SB4 and 13SB5) could not be located outside of the potentially affected area and can be considered as source area samples. Sixteen composite soil samples were collected from borings drilled on either side of the former berms associated with the burn pits to expand the evaluation presented in the 1987 U.S. Army Environmental Hygiene Agency (USAEHA) investigation. Four surface soil samples were collected along the southern drainage ditch to evaluate the potential contamination due to pad soil erosion.

Figure 5-5.2 Contamination Pathways



Results for samples detected above the PQL are presented in Table 5-5.1. Concentrations of ***arsenic, beryllium, cobalt, lead,*** and ***thallium*** exceeded HBN criteria, but only lead appears to be present at anomalously high concentrations in the soil. ***Arsenic, beryllium,*** and ***cobalt*** levels were similar to concentrations of these metals in samples collected upslope of the site. ***Beryllium,*** another element slightly elevated above the HBN but also reported in upslope samples, has a low solubility and is expected to be adsorbed onto clay mineral surfaces at low pH and to be complexed into insoluble compounds at high pH. In most natural environments, beryllium is likely to be sorbed or precipitated, rather than dissolved, and is not expected to impact surface water, groundwater, or the underlying soil. Elevated levels of lead were limited to surface soil samples collected at 0.5 foot bgs and were not reported in samples collected at 5 and 10 feet bgs.

Six explosives were detected in 13 discrete and composite soil samples. With the exception of a low concentration of HMX detected at 10 feet bgs, explosives were limited to soil samples collected at 0.5 foot bgs.

Explosives were not detected in soil samples collected at depths of 5 and 10 feet below the burning pads. Two soil samples collected from the drainage ditch nearest the settling pond exhibited the greatest number and concentrations of explosives in samples collected at the site. The concentrations of explosives in 13SS2 exceeded the HBN criteria by factors ranging from three for ***2,4,6-trinitrotoluene (246TNT)*** to 10 for ***2,4-dinitrotoluene (24DNT).*** TNT isomers were also tentatively identified in TCLP analyses of the uppermost soil samples at three locations where ***246TNT*** was also detected . Concentrations of ***24DNT*** in channel soil samples exceeded the HBN criterion by factors ranging from 11 to 37.

Trace concentrations of five VOCs were detected; however, concentrations were several orders of magnitude less than the HBN criteria and are not considered a concern at the site. The detected SVOCs, which were limited to the shallow soil and sediment samples (e.g., less than 1 foot), were reported at low concentrations and at few locations, are relatively immobile in soil and are not expected to impact surface water, groundwater, or underlying soil. Soil analyses indicate that soils underlying the surface soils have not been impacted by the surface burning activities at SWMU 13.

Potential soil exposure routes typically include incidental ingestion, inhalation, and dermal absorption of soil contamination. Because lead, ***24DNT, 26DNT, 246TNT,*** and ***1,3,5-trinitrobenzene (135TNB)*** were detected at elevated levels in surface soil and the area is currently active, there is the possibility of contaminated dust to become airborne and for personnel in the vicinity of SWMU 13 to be exposed via inhalation of contaminated dust.

It should be noted that this exposure pathway evaluates the potential for exposure to particulate emissions from contaminated soil due to wind erosion, and is not meant to evaluate the potential for air emissions that may occur during burning operations. Personnel may also be exposed via incidental ingestion of contaminated soil. Because dermal contact with soil is expected to be insignificant (personnel wear protective equipment such as coveralls and gloves), the dermal absorption of soil contamination pathway is not considered a significant exposure pathway and is not further evaluated.

NG was detected in the surface soil samples collected from SWMU 13 for the 1987 USAEHA study. Detected concentrations in the samples ranged from below detection to 17.1 micrograms per gram (µg/g). No health risk evaluation data for NG are available to determine unacceptable risk levels using the detected concentrations. However, a review of pharmaceutical use of NG and some example dosages (Chemical Database, 1992) may provide relevant comparison information. Two to three kilograms of soil would roughly contain the same amount of NG needed to provide a toxic dosage. The ingestion of this much soil is not likely to occur, and apart from the possible physical hazard associated with NG, the risk to health due to NG in site soils is considered very low.

The HBNs were developed for screening purposes assuming a worst case residential land use scenario. Because future land use is considered to be the same as the current industrial land use scenario, exceedances of HBNs do not necessarily indicate a contamination problem at RFAAP, but do indicate the necessity for a more detailed analysis (e.g., RFAAP will continue to remain an active army installation and there are no plans for future residential development of RFAAP). Because ***lead, 24DNT, 26DNT, 246TNT,*** and ***135TNB*** exceeded HBNs developed for the residential land use scenario in site soil, these contaminants will be evaluated using a more realistic military land use scenario.

Two potentially complete exposure pathways—incidental soil ingestion and dust inhalation—were identified for SWMU 13 and were quantitatively evaluated. The total potential carcinogenic risk and noncarcinogenic hazard for the incidental ingestion of soil are 5E-08 and 3E-02, respectively. The hazard index is below one (1), indicating a low potential for noncarcinogenic effects. The potential carcinogenic risk is below the USEPA target risk range (10^{-4} to 10^{-6}). Potential carcinogenic risks and non-carcinogenic hazards for the dust inhalation pathway could not be calculated because inhalation slope factors and reference doses are not available. Even though the risk due to NG in site soil could not be calculated, the detected concentrations appear low enough for no significant risk to be present.

Although wildlife may have access to this area, it is not likely that wildlife would frequent this area because this area is active and paved roads are present in the surrounding area. In addition, a fence separates the burning area from the New River, precluding wildlife access via the river bank. Therefore, potential exposure of environmental receptors to the surface soil contamination at SWMU 13 appears to be minimal and these exposure pathways are not further evaluated.

3.2 GROUNDWATER

Seven groundwater samples were collected and analyzed for metals, explosives, VOCs, SVOCs, TOC, TOX, and nitrate/nitrite. The results of the chemical analyses indicated concentrations of VOCs and explosives in groundwater downgradient of the burning pads. A summary of the groundwater analytical results, including the results of the filtered and unfiltered samples for metals, are presented in Table 5-5.2.

A total of 14 metals were detected in one or more of the groundwater samples collected from the two upgradient and five downgradient wells of the burning pads; however, none of the detected values exceeded the HBN criteria.

Two explosives (HMX and RDX) were also detected in each downgradient well, excluding 13MW6, but the concentrations were low (less than 7 µg/L) and did not exceed the HBNs. The detection of explosives in these wells is most likely due to the migration of contaminants from the settling pond sediments.

VOCs were detected in five groundwater samples. ***Carbon tetrachloride*** and ***trichloroethylene (TCE)*** were detected in downgradient samples at concentrations that exceeded the HBN criteria. The distribution of ***TCE*** was more widespread as it was detected in all downgradient samples except 13MW6. However, ***carbon tetrachloride*** was detected in only one sample.

The occurrence of the two non-naturally occurring VOCs in the upgradient wells suggests two potential sources. Several SWMUs, some of which are landfills, are located topographically upgradient of the burning ground. The presence of contaminants in the upgradient wells may be attributable to the migration of contaminants from these upgradient SWMUs. However, activities at the burning ground also may be contributing to the volatile groundwater contamination. Both VOCs detected are commonly found in pesticide/herbicide formulations. Since the wells are completed in a maintained grassy area, the application of lawn chemicals may be a more likely source for these groundwater contaminants. Their lack of detection in the downgradient wells or in any SWMU 13 soil sample would likely eliminate burning ground operations as the source. The surface water and sediment samples collected for the VI in the SWMU 29 settling pond upgradient of well 13MW1 did not show detectable concentrations of 1,2-dichloroethane or 1,2-dichloropropane. This supports the possibility that on-site lawn chemicals may be responsible for these two VOCs rather than upgradient sources.

As indicated in Table 5-5.2, nitrogen (as nitrate and nitrite) was analyzed to establish the general groundwater quality in the vicinity of SWMU 13. However, all nitrogen concentrations (including nitrate and nitrite) were below the HBN criterion of 10,000 µg/L and are not considered a concern. Groundwater monitoring is conducted quarterly in accordance with VDEQ.

No drinking water supply wells are located downgradient of SWMU 13. Groundwater in the vicinity of SWMU 13 generally flows to the south and discharges to the New River. Future land use is the same as the current industrial land use scenario. Therefore, it is highly unlikely that groundwater wells would be installed in the future in the vicinity of SWMU 13.

As discussed above, there is the potential for discharge of groundwater contamination to the New River from SWMU 13. Persons boating, fishing, or swimming in the river could potentially be exposed to contaminants migrating from SWMU 13 via shallow groundwater. In addition, a drinking water intake is located six miles downstream of RFAAP. Nevertheless, potential exposure is considered negligible for the following reasons: (1) the significant capacity of the river should result in significant dilution; and (2) the low levels of ***carbon tetrachloride*** (maximum concentration of 10.5 µg/L) and ***TCE*** (maximum concentration of 10.5 µg/L) detected in groundwater were only a factor of two above their respective HBNs. None of the contaminants of concern were detected in New River surface water samples. Therefore, these potential exposure pathways are not considered significant and are not evaluated further.

There is potential for impact to aquatic life if there is discharge of groundwater contamination to the New River. Although data are insufficient for establishing aquatic life criteria for ***TCE*** and ***carbon tetrachloride***, the lowest-observed-effect-levels (LOELs) for chronic effects to freshwater aquatic life are reported as 21,900 µg/L and 35,200 µg/L, respectively (USEPA, 1986). As discussed above, detection of ***TCE*** in SWMU 13 groundwater does not appear to be of environmental concern.

3.3 SURFACE WATER

Surface water samples were collected from the runoff settling pond and along the north bank of the New River. Samples were analyzed for TAL metals, explosives, VOCs, SVOCs, nitrite/nitrate, TOC, and TOX (Table 5-5.3).

3.3.1 Settling Pond

One surface water sample was collected from the settling pond that receives runoff from the eastern half of SWMU 13. This sample generally contained the same constituents as the associated sediment sample. ***Lead, 24DNT,*** and ***26DNT*** concentrations exceeded HBNs in both media, and ***chromium, cobalt,*** and ***246TNT*** exceeded HBNs in the surface water.

3.3.2 New River

Three surface water samples were taken near the north bank of the New River at the same locations as the similarly numbered sediment samples. One sample each was collected upstream of (NRSW1), adjacent to (NRSW3), and downstream of (NRSW4) SWMU 13. These samples were analyzed for TAL metals, explosives, VOCs, and SVOCs (Table 5-5.3). A duplicate of NRSW3 was analyzed for explosives and VOCs.

Nine TAL metals were detected, but none of the metals exceeded their HBNs. The other five metals do not have HBNs because they are common constituents of drinking water. None of the concentrations appeared anomalously high.

No explosives or SVOCs were detected in any sample. Only one VOC (carbon disulfide) was detected in NRSW1 and one of the NRSW3 samples, but at concentrations less than 1 percent of the HBN. Carbon disulfide is not associated with the contaminants found at SWMU 13 and its presence is not likely due to migration from the burning ground.

In summary, no adverse impacts to the New River due to SWMU 13 contaminants were identified from the collected surface water samples.

3.4 SEDIMENT

3.4.1 Settling Pond

Two sediment samples were collected from the settling pond to evaluate the soil eroded from the eastern pad area and transported to the pond via runoff. Table 5-5.4 presents the analytical results for sediment samples exceeding the PQL. ***Lead*** exceeded the HBN criterion in several surface sediment samples and may be a concern at the site. However, elevated levels of lead were limited to sediment samples collected from 0.5 foot bgs and were not reported in samples collected at 5 and 10 feet bgs.

Six explosives were detected in 13 discrete and composite soil samples and sediment samples. With the exception of a low concentration of HMX detected at 10 feet bgs at 13SB5, explosives were limited to sediment samples collected at 0.5 foot bgs. Explosives were not detected in soil samples collected at 5 and 10 feet bgs below the burning pads. However, explosives were detected in the Settling Pond sediment samples collected at 1 foot bgs and are probably present throughout the sediment layer. ***24DNT*** and ***26DNT*** in both sediment samples, and ***135TNB*** and ***246TNT*** in a surface soil sample, exceeded HBN criteria.

Trace concentrations of five VOCs were detected; however, concentrations were several orders of magnitude less than the HBN criteria and are not considered a concern at the site. Reported SVOCs were limited to the shallow sediment samples (e.g., less than 1 foot bgs) and were reported at low concentrations and at few locations. Analyses indicated that soils underlying the sediments had not been impacted by the surface burning activities at SWMU 13.

3.4.2 New River

Four sediment samples were collected from the northern bank of the New River. One sample (NRSE1) was collected upgradient of SWMU 13. Two samples (NRSE2 and NRSE3) were collected adjacent to SWMU 13 and downgradient from the two monitoring wells most impacted (13MW3 and 13MW7). The sample (NRSE4) was collected downgradient of SWMU 13. These samples were analyzed for TAL metals, explosives, VOCs, and SVOCs. A duplicate of NRSE3 was also submitted for explosives and VOC analyses.

Metals were detected in these samples; ***beryllium*** and ***lead*** concentrations exceeded HBNs. ***Beryllium*** was detected only once at a concentration less than 5 percent greater than the comparison criterion, and ***lead*** was detected only once at a concentration 2 percent above the HBN. Even though ***lead*** concentrations are elevated in on-site soils, the collected data do not indicate that SWMU 13 is the source for the ***lead*** in the one sample that exceeded the HBN.

No explosives or VOCs were detected in the four New River sediment samples or the duplicate of NRSE3. Five SVOCs were detected in the downgradient sample NRSE4, but each SVOC was detected at concentrations much less than its respective HBN. Overall, no adverse impact to New River sediments can be supported by the collected data.

4.0 RECOMMENDED ACTION

Confirmatory groundwater, surface water, and sediment samples will be collected for the analysis of metals, SVOCs, VOCs, explosives, and applicable conventional chemicals to verify previous investigation results and support the quantitative risk assessment. These environmental actions will be initiated when operations cease.

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DSERTS #: RAAP-006 FORMER DRUM STORAGE AREA RRSE: 2A

AREA F

1.0 BACKGROUND

The area is a gravel lot approximately 50 feet long by 50 feet wide (Figure 5-6.1). Empty drums throughout RFAAP were stacked on their sides in Area F prior to being sold for recycle. The drums were reportedly rinsed out prior to storage.

Storage of drums on this lot was discontinued in 1991 when a second lot was constructed 150 feet to the east, west of Building 4934-1. The new lot is approximately 60 feet long by 60 feet wide.

2.0 ENVIRONMENTAL SETTING

The topography in the area of Area F is generally level, sloping gently towards the north. The elevation in the two storage areas is approximately 1,700 to 1,710 feet msl.

The old drum storage area is located southeast of Warehouse No. 2 (9387-2) and approximately 300 feet south of the New River.

The new drum storage area is located to the west of Building 4934-1 and approximately 300 feet south of the New River.

No site-specific subsurface investigations have been conducted in this area. Based on subsurface conditions identified in similar areas, approximately 20 to 30 feet of unconsolidated soil should overlie fractured limestone or dolostone of the Elbrook Formation.

It is assumed that groundwater flows northward towards the New River within fractured bedrock. Groundwater is estimated at an elevation of 1,690 feet msl and 10 to 20 feet bgs.

Runoff within the site area flows northward into a ditch along the road and then eastward into a culvert that drains northward, north of Building 4934-10. A series of culverts and drainage ditches eventually channel the water to the New River.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included the sampling and analysis of eight surface soil samples.

Although only empty, rinsed drums have reportedly been stored at this unit, visible staining of the gravel surface suggested the possibility that hazardous constituents had been released to surface soils as a result of spillage of drum residues. Surface soil samples were evaluated to address this concern.

A total of seven surface soil samples were collected from areas of visible staining in the new gravel lot and former drum storage. Gravel was cleared within each stained area to expose underlying soils, which were sampled at a depth of 0 to 6 inches and analyzed for VOCs and SVOCs (see Figure 5-6.1). Analytical chemistry results are presented in Table 5-6.1 for concentrations greater than the PQL.

<u>**New Gravel Lot**</u>: Although no primary target VOCs or SVOCs were detected in any sample, high levels of unknown SVOC tentatively identified compounds (TICs)

were detected. SVOC TICs consist of natural fatty acids (e.g., hexadecanoic acids) and petroleum hydrocarbons that may be related to minor oil, lubricant, or solvent spills.

Former Drum Storage Area: Acetone and trichloroflorومethane were the only VOCs detected in this area. Results were lower than associated HBNs. No SVOCs were detected in this area.

4.0 RECOMMENDED ACTION

SVOC TICs and detected VOCs were associated with petrochemicals contained in drums previously stored in this area. It is reported that the drums were removed and the stained soil excavated. No further action is required in this area.

DSERTS #: RAAP-007 CLOSED SANITARY LANDFILL RRSE: 1A

SWMU 28

1.0 BACKGROUND

SWMU 28 is a landfill located in the southeast section of the Horseshoe Area (Figure 5-7.1). It replaced the sanitary landfill immediately to the south (SWMU 52), which reached design capacity and was closed in 1984. SWMU 28 is contiguous with the Hazardous Waste Landfill (HWMU 16). SWMU 28 was permitted by the Virginia Department of Health (Permit No. 401) in April 1983 as a sanitary landfill to receive municipal solid, agricultural, debris, inert, and asbestos wastes. The asbestos waste was required to be bagged, labeled, and placed in a designated area, now identified as SWMU 30, which is located 100 feet west/southwest of SWMU 28. The daily estimated volume of disposal as reported in the permit was 0.25 ton of asbestos and 2 tons of municipal waste. In 1992, SWMU 28 was capped in accordance with VDEQ.

Landfill plans for SWMU 28 called for five trenches to be excavated and filled. Three trenches are oriented in a northwest/southeast direction and range in length from approximately 225 to 300 feet. Each trench is approximately 30 feet wide.
The remaining two trenches are oriented in a northeast/southwest direction, approximately 450 and 250 feet long, respectively, and 30 feet wide. When filled, the trenches were covered with clean soil and seeded to prevent erosion of the cover.

2.0 ENVIRONMENTAL SETTING

SWMU 28 is approximately 200 feet northeast of the TNT Neutralization Sludge Disposal Area (SWMU 51) and south of SWMU 52 (Closed Sanitary Landfill), generally at the area of highest elevation within RFAAP. It consists of a subsurface burial area of waste material with the three SWMUs encompassing an area of approximately 15 acres. HWMU 16 is located in the central part of the study area and contaminants migrating from this HWMU could have a measurable impact on the groundwater being evaluated. Groundwater monitoring is being done as part of HWMU 16 in accordance with VDEQ.

SWMUs 28 and 30 and HWMU 16 are located on a plateau in the southeastern section of the Horseshoe Area. The elevation of the plateau ranges from approximately 1,810 to 1,840 feet msl. The plateau is generally flat to slightly sloping. The HWMU 16 cap results in a higher raised area on the plateau.

Generally, the subsurface stratigraphy consists of three distinct strata: unconsolidated alluvium, residual soils weathered from bedrock, and limestone/dolostone bedrock. The area is underlain by two general units of unconsolidated deposits. The first unit is composed of terrace deposits generally consisting of reddish-brown silty clay that mantle the surface to a depth of up to 38 feet. Fine- to coarse-grained, yellowish-brown sand layers containing large cobbles (river jack) are found throughout the deposits. The second unit consists of fine-grained residual deposits composed of yellow-brown micaceous clayey silt, probably a very weathered shale and siltstone layer.

Available permeability data for the terrace deposits indicate that the clay material exhibited a permeability range from less than 3.28 x 10^{-6} to 1.31 x 10^{-4} centimeters per second (cm/sec). Average permeability for the sand and gravel unit is 2.31 x 10^{-3} cm/sec with a range between 2.0 x 10^{-5} and 5.72 x 10^{-3} cm/sec (USACE, 1981).

The depth to bedrock in the landfill area varies from 30 to 70 feet bgs. The bedrock surface under the western half of the area is at a higher elevation than the eastern half. The bedrock surface elevation decreases significantly toward the northeast where a depression is apparent. The bedrock low is a likely result of the formation of a sinkhole.

Bedrock encountered in the vicinity of the landfill area consists primarily of a gray argillaceous limestone/dolostone with interbedded greenish-gray mudstone and siltstone. This unit is variable with intense zones of fracturing and weathering and occasional brecciated and vuggy zones. Frequent solution channels were also observed in rock cores. The high degree of weathering and fracturing was confirmed by low rock quality density (RQD) and recovery values for rock coring, and by the large quantities of drilling water lost to fractures when the boring for well 28MW2 was drilled.

The groundwater below SWMU 28 is present in an unconfined aquifer with the water table encountered from 32 to 69 feet bgs. The highest groundwater elevation, part of an elongated north-south trending water table mound, was measured below the western side of SWMU 28, while the lowest elevation was measured below the eastern side of HWMU 16. The groundwater high corresponds with a topographic and bedrock high.

Groundwater flows radially from the water table mound, so the majority of SWMU 28 overlies groundwater flowing eastward toward the bedrock low and draining into the bedrock depression east of SWMU 28. This supports the interpretation that the depression is a sinkhole. The RFI estimated the gradient to be 9 percent. Wells 16-1, WC2-A, and MW9 should act as downgradient monitoring wells. Due to the water table mound, no well is situated to act as an upgradient well. Instead, the water table aquifer is recharged by infiltration of precipitation through permeable and natural, undisturbed soils, rather than through the landfill caps, which were graded when the landfills were closed.

Groundwater flowing from the study area would eventually discharge into the New River without migrating to any off-post areas.

Three rising head slug tests were performed on wells installed on the west and south side of the SWMU 28 landfill. The calculated hydraulic conductivities for these wells ranged from 6.27 x 10^{-7} cm/sec to 4.17 x 10^{-5} cm/sec. Data and results from the rising head slug tests are summarized in Table 7-1. These hydraulic conductivity values are within the normal range of values for flow within fractured limestone and dolomite bedrock (Freeze and Cherry, 1979). However these conductivity values are generally less than those hydraulic conductivity values given for the wells tested on the east side of the landfill in 1987 (F&R, 1987) where the hydraulic conductivities for those wells ranged from 9.5 x 10^{-3} cm/sec to 1.2 x 10^{-5} cm/sec (Table 7-1). These values indicated groundwater flow is through more fractured/weathered bedrock likely attributable to karst features in the area.

Utilizing groundwater level measurements taken during the RFI program and the above hydraulic conductivity values, estimated groundwater flow velocities below the landfill area were determined. The calculated groundwater flow velocities below the landfill are as follows: approximately 37 feet per year (ft/yr) in western portion; 1 ft/yr in the northern portion; and 186 ft/yr in the eastern portion.

The significant hydrogeologic features of SWMU 28 are:

- the depth to the water table is significantly below the bottom of the fill (15 to 35 feet);
- the sinkhole underlying the sediment below the northeastern corner of the study area acts as a groundwater drain;
- the water table generally coincides with the bedrock surface and, therefore, groundwater flow is predominantly through the fractured bedrock;
- groundwater can flow in every direction away from the area, but discharge occurs into the New River prior to leaving RFAAP; and
- groundwater originates at the site via infiltration of precipitation through unconsolidated sediments.

These hydrogeologic features combine to form a disposal area that can be ideal for waste landfilling if proper management practices are utilized. Groundwater recharge can be controlled through the proper capping and drainage of the area and, therefore, migration of groundwater can also be controlled. The deep water table means that neither surface nor groundwater will interact with the waste if infiltration of precipitation is prevented. Additionally, the location of the study area in the Horseshoe Area does not allow for contaminants to migrate to off-post well users through the groundwater, since discharge will occur into the New River.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - RCRA Facility Investigation, Dames & Moore,** included the installation, sampling, and analysis of four soil and rock borings and four monitoring wells, in conjunction with SWMUs 51 and 52.
- **1997 - Dye-Tracing Study, Engineering-Science, Inc.** Information will be provided when it becomes available.

SWMUs 28, 51, and 52 are geographically proximate to each other in the eastern end of the Horseshoe area. Each SWMU consists of a subsurface burial area of waste material. The three SWMUs encompass an area of approximately 15 acres. Because of the proximate nature of the SWMUs and the similar disposal methods used at each SWMU, one combined study area was delineated for the RFI.

RFI sampling program provided chemical data for evaluating the impact SWMUs 28, 51, and 52 have on groundwater migrating from the combined landfill area. Subsurface conditions were evaluated during the soil and rock boring program. Upgradient and downgradient hydrogeologic characteristics were evaluated through the installation of four monitoring wells.

3.1 SOILS

Remediation of soils is not a potential corrective action since these SWMUs are landfill disposal areas; therefore, potential contamination would occur through groundwater. Surface soils have not been impacted by SWMU practices and all exposed areas used naturally clean fill to cover the waste. However, a summary of the USDA soil properties may be useful since infiltration of precipitation is an important mechanism for recharging groundwater. The landfill area was constructed upon Braddock loam (2-7 percent slope) and Cotaco loam (2-7 percent slope) soils (SCS, 1985).

3.2 GROUNDWATER

A total of thirteen groundwater samples were collected in the vicinity of SWMUs 28, 51, and 52. The results of the chemical analyses indicated the presence of metals, explosives, VOCs, and SVOCs in groundwater as presented in Table 5-7.1. The majority of metals are common constituents of groundwater and were detected at levels expected to be present in groundwater of a limestone formation. All metal concentrations were less than HBN criteria.

SVOCs were detected in several samples that appeared to be related to manufacturing activities. Low levels of two explosives were detected in three groundwater samples. The explosive 13DNB was detected downgradient of SWMU 52 in the groundwater sample from well 16-3 at a level slightly greater than the analytical detection limit. Concentrations of the explosive ***26DNT*** exceeded the HBN criterion in samples from well 16-4 and 51MW2. ***Bis(2-ethylhexyl) phthalate*** in sample 16-4 also exceeded the HBN criterion. The samples were collected east and south of the TNT Sludge Neutralization Disposal Area (SWMU 51). However, these constituents were not detected in groundwater west of SWMU 51 (e.g., sample 51MW). Soils at 51MW1 were different from those found at 16-4 and 51MW2 indicating this well could be sampling a perched groundwater zone and not the unconfined aquifer.

Concentrations of the VOCs ***1,1,2-trichloroethane*** and ***1,1,2,2-tetrachloroethane*** were detected above HBN criteria in the groundwater sample taken downgradient of SWMU 52 from well 16-3. Concentrations of ***1,1-dichloroethane*** in the groundwater samples from MW9 also exceeded the HBN criterion. Both samples were collected in the area downgradient of HWMU 16. No other detection of ***1,1-dichloroethane*** occurred. ***Bis(2-ethylhexyl) phthalate*** also exceeded the HBN criterion in the two samples in which it was detected. (Note: ***Bis(2-ethylhexyl) phthalate*** was detected in method blanks and is considered a laboratory artifact).

Methylene chloride was detected in MW9 and WC2-A monitoring wells, which are located downgradient of SWMU 28 and HWMU 16 near the groundwater drain. Duplicate MW9 verified original results, therefore, methylene chloride is probably present in the groundwater and is not a laboratory contaminant. Results from other groundwater wells in the vicinity of SWMU 52 (e.g., C4, CDH-2, and 16-3), HWMU 16 disposal practices, and the location of MW9 and WC2-A suggest that the presence of these constituents in groundwater is due to HWMU 16.

Based on the contamination assessment presented above, ***26DNT, DCA,*** and methylene chloride have been identified as contaminants of concern for groundwater downgradient of SWMU 28. ***26DNT*** may be attributable to SWMU 51, but the other two contaminants appear to be related to HWMU 16 rather than to the RFI SWMUs. Samples were not collected from other environmental media.

No groundwater wells, except for monitoring purposes, are located downgradient of SWMU 28. Groundwater in the vicinity of SWMU 28 generally flows radially away from the center of the landfill area and may discharge to the New River. Future land use is considered to be similar to the current industrial land use scenario. RFAAP will continue to remain an active army installation and there are no plans for future residential development. Therefore, it is highly unlikely that groundwater wells would be installed in the future in the vicinity of SWMU 28. Based on this evaluation, potential groundwater exposure pathways are not considered operable under the current or future land use scenario.

3.3 SURFACE WATER AND SEDIMENT

The southern portion of SWMU 28 discharges eastward into the storm sewer. Surface water runoff in the northern portion of SWMU 28 flows north until reaching the drainage and storm sewers associated with the road to the north of SWMU 28. Surface water along the northern road flows east. Storm sewers and natural drainage patterns along the paved road on the eastern boundary of the plateau flow northeast and discharge into a tributary of the New River, approximately 500 feet northeast of SWMU 28. The tributary flows northeast about 700 feet where it joins with another tributary just east of SWMU 74. The tributary flows east and discharges into the New River approximately 1,500 feet east of SWMU 74 and approximately 300 feet northeast of SWMU 54.

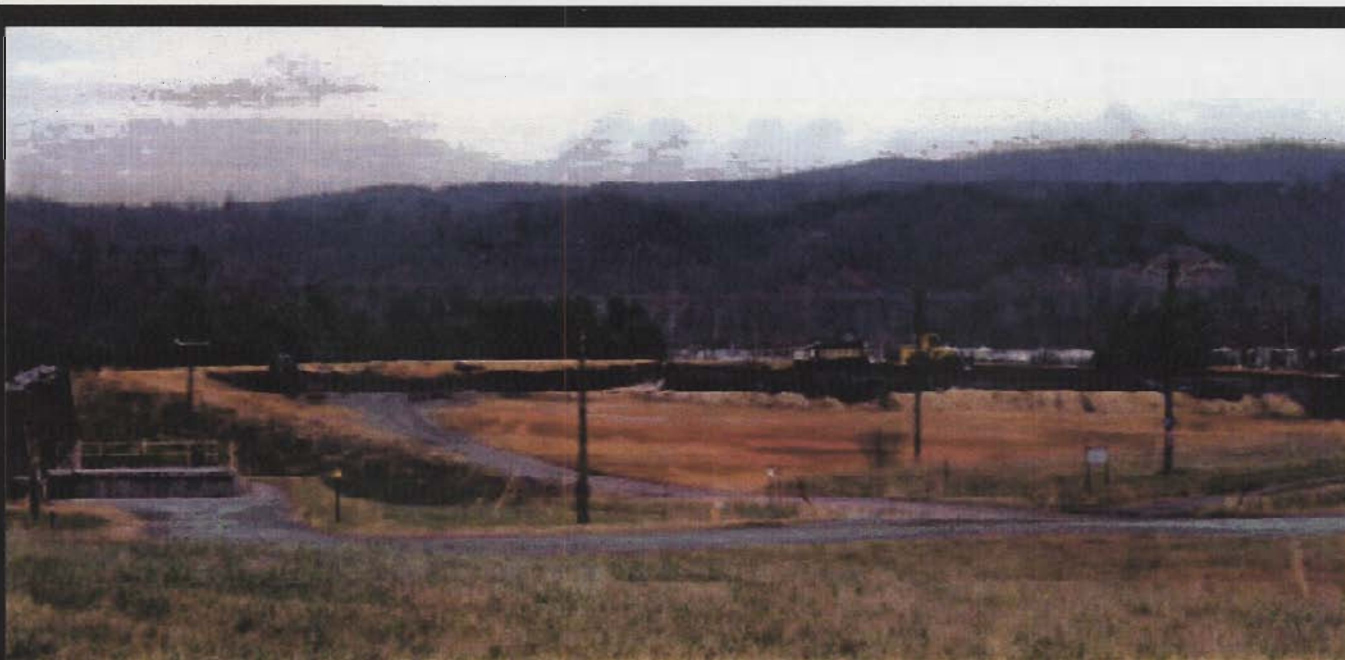
4.0 RECOMMENDED ACTION

- Collect confirmatory groundwater and soil samples for SVOCs, VOCs, and explosives to support the site screening process and a baseline risk assessment, as applicable.
- Evaluate the source of explosives.

Confirmatory sampling should be performed to verify the presence of SVOCs and VOCs detected in groundwater samples. Groundwater monitoring for HWMU 16 is being conducted in accordance with VDEQ in wells near SWMU 51. Resampling should be performed on samples where laboratory anomalies resulted in the qualification of data.

DSERTS #: RAAP-008 **$CaSO_4$ TREATMENT/DISPOSAL AREA** **RRSE: 1A**

SWMU 27



1.0 BACKGROUND

SWMU 27, the Calcium Sulfate Landfill, is a closed, unlined earthen landfill located in the southeastern section of the Horseshoe Area. It is located within the boundary of Fly Ash Landfill (FAL) No. 2 (SWMU 29) and is also contiguous with SWMU 53 (Figure 5-8.1). The landfill was used for disposal of calcium sulfate sludge generated from the neutralization of sulfuric acid at the A-B Line and C-Line acidic wastewater treatment plants between 1981 and 1982. The landfill has been described as triangular-shaped and approximately 150 feet long (USEPA, 1987). Since disposal operations ceased, this unit has been completely covered by FAL No. 2.

The source of refuse disposed of at the landfill was estimated as follows in the permit application (Webb, 1982): bottom ash and fly ash from Powerhouse No. 1; calcium sulfate from the SAR Treatment Plant; sludge from water treatment plant Building 409 (HWMU 16); sludge from water treatment plant Building 407; and fly ash from Powerhouse No. 2.

2.0 ENVIRONMENTAL SETTING

SWMU 27 is approximately 200 feet east of SWMU 52, 300 feet east of SWMUs 28 and 16, and 600 feet north of SWMU 13. Subsurface conditions are analagous to SWMU 29.

3.0 PREVIOUS INVESTIGATIONS

- **1980 - land disposal study**, indicated that the site was geologically suitable for ash landfill operations.
- **1986 - visual site inspection,** sludge from the Biological Treatment Plant was observed being disposed of in SWMU 29.
- **1987 - RCRA Facility Assessment, USEPA,** included the analysis of water quality parameters of groundwater samples from the monitoring wells.
- **1992 - Verification Investigation, Dames & Moore, Phase I,** included the collection and analysis of surface water and sediment samples.
- **1994 - Verification Investigation, Dames & Moore, Phase II,** included the collection and analysis of groundwater samples.
- **1996 - RCRA Facility Investigation, Parsons Engineering Science,** included background soil investigation.

SWMUs 27, 29, and 53 are located in the same area, and in accordance with permit provisions for SWMU grouping, these units were investigated as one study area. SWMUs 27 and 53 were small disposal areas that were covered with SWMU 29 after the closure of SWMU 26 (FAL No. 1). VI activities were conducted in two phases. Phase I included the collection of one surface water and three sediment samples in the drainage ditch and settling pond downslope of the landfill (Dames & Moore, 1992). Quarterly groundwater samples collected as part of the installation monitoring program were evaluated to determine the impact of the landfill on groundwater quality. Phase II included the collection and analysis of groundwater samples (Dames & Moore, 1994).

SWMU 27

3.1 GROUNDWATER

Phase I

Groundwater data were evaluated from downgradient wells FAL2, FAL3, and Well 7 for August 1991, December 1991, and February 1992 sampling rounds. Samples were analyzed for metals, SVOCs (only December 1991 sampling round), and water quality parameters. SVOCs were not detected in any of the samples. Chromium, iron, lead, manganese, mercury, and sodium were detected above the PQLs. Although sample results were below the HBNs, the following anomalies were observed:

- Chromium was reported in FAL3 and Well 7. This constituent is normally not detected at RFAAP.
- Lead was detected in FAL2 at a concentration three times its normal concentration.
- The February 1992 sampling episode showed elevated concentrations of metals for FAL2.

Lead is included as a constituent in the formulation of several propellants including:

Single-base	
lead carbonate	BS-NACO
Double-base	
lead salicylate	AHH, ARP, PNJ, M21
lead 2-ethylhexoate	
lead beta resorcylate	ARP
lead 2,4-dihydroxybenzoate	PNJ
lead stearate	M16, M21

Phase II

Groundwater samples were collected from wells FAL2, FAL3, Well 7, and analyzed for metals (dissolved), explosives, VOCs, SVOCs, TOC, and TOX (Table 5-8.1). Although neither explosives nor VOCs were detected, several SVOC TICs were detected. Metals detected included barium, calcium, potassium, magnesium, manganese, and sodium. Results were below their respective HBNs.

Upgradient versus downgradient concentrations of metals indicated that barium and potassium were greater upgradient. These two metals may be associated with propellant manufacturing activities. Potassium is included as a propellant component in the following formulations:

Single-Base	
Potassium nitrate	Benite, CBI Powder
Potassium sulfate	HES 6706.1, IMR5010, M1 , M6, M10, IMR4895, IMR7383, IMR8097 25 mm BM, IMR8208
Double-Base	
Potassium perchlorate	M7TOW, M7
Potassium nitrate	M2, M5, M8, M9, M26
Potassium sulfate	M16, N4
Triple-Base	
Potassium nitrate	M30A2
Potassium sulfate	M30A1
Cast and Extruded	
Potassium sulfate	PNJ for TOW

Barium may be available as barium nitrate, $Ba(NO_3)_2$, which is used as an oxidizing agent and included in double-base solvent (M26) and solventless (M2, M5) formulations.

Propellant	%Barium by weight
M2	1.4 ±0.25
M5	0.5 ±1.6
M26	0.75 ±0.2

3.2 SURFACE WATER

One surface water sample was collected in the settling pond and analyzed for explosives, VOCs, SVOCs, metals, TOC, and TOX (Table 5-8.2). Explosives, VOCs, and SVOCs were not detected in the sample. Metals were detected at concentrations below the HBNs.

3.3 SEDIMENT

One sediment sample was collected in the drainage ditch and two in the settling pond downgradient of the SWMU 29 that receives its runoff (Table 5-8.3). Explosives were not detected in any of the samples. VOCs were detected in trace concentrations in the pond (toluene and trichlorotrifluoroethane) and the ditch (trichlorotrifluoroethane). SVOCs detected included 2-methynapthalene, napthalene, phenanthrene, and dibenzofuran. These compounds are generally associated with petroleum products, such as coal tar, gasoline, solvents, power plant emissions, and coal ash and cinders.

Metals exceeding the respective HBNs included ***arsenic, beryllium,*** and ***cobalt***. Several other metals were present at high concentrations, including aluminum, barium, chromium, iron, manganese, mercury, and potassium.

4.0 RECOMMENDED ACTION

Verify compliance activities at SWMU 29 are sufficient to address SWMUs 27 and 53. Additional environmental activities associated with this SWMU will be addressed in conjunction with SWMU 29.

DSERTS #: RAAP-009 LANDFILL IN NITRO AREA RRSE: 1A

SWMU 40

1.0 BACKGROUND

This sanitary landfill was reportedly used in the 1970s and early 1980s for the disposal of uncontaminated paper, municipal refuse, cement, and rubber tires (USEPA, 1987; USATHAMA, 1976). It is not known whether hazardous wastes or wastes containing hazardous constituents were ever disposed of in the landfill. Since its closure, excavated "clean" soils have been stockpiled on top of the unit by the U.S. Army Corps of Engineers (USACE) as a result of current construction activities at RFAAP. Between 1991 and 1992, a fenced enclosure for asbestos storage was constructed over the northeast corner of this SWMU. The unit was strictly an area fill, and the unit was closed with a soil cap and grass cover.

2.0 ENVIRONMENTAL SETTING

SWMU 40 is an area of gently to steeply sloping ridges located in the south-central section of the Main Manufacturing Area.

The landfill is approximately one acre in size. This landfill was constructed on a natural depression that runs east to west in this part of RFAAP. The ground surface of the SWMU slopes from a maximum elevation of 1,906 msl at the southern boundary to 1,890 msl at the northern boundary of the SWMU. The SWMU is bordered by trees on the west and a grassy slope on the north that ends at the biological treatment plant. In addition to being surrounded by several asphalt roads and other facility buildings, SWMU 40 is adjacent to the burning grounds (SWMU 17) to the east, and it contains SWMU 71, Flash Burn Parts Area.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included the installation of groundwater monitoring wells; however, wells were not sampled because all four borings were dry.
- **1993-94 - Dye-tracing Study, Engineering-Science, Inc. (USAEC, 1994),** identified a groundwater conduit to the New River through the karst limestone in the south-central section of the Main Manufacturing Area.
- **1996 - RCRA Facility Investigation Study, Parsons Engineering-Science, Inc. (USAEC, 1996),** included the collection and analysis of one groundwater sample.

3.1 VERIFICATION INVESTIGATION

To evaluate whether groundwater quality had been impacted by this landfill, four wells were planned in the VI conducted by Dames & Moore in 1992: two along bedrock strike and two along bedrock dip (Figure 5-9.1).

The subsurface geology at SWMU 40 was investigated through the drilling of four soil and rock borings to depths ranging from 50 to 162 feet. Borings completed east and west of SWMU 40 encountered a thin layer of silty clay over limestone and dolostone bedrock. Borings completed north and south of SWMU 40 encountered a thicker overburden sequence (14 to 17 feet) of silty clay overlying limestone or dolostone bedrock. Up to 160 feet of Elbrook Formation bedrock was penetrated during drilling. Bedrock in the vicinity generally consists of argillaceous limestone and dolostone with abundant clayey zones. The consistency of bedrock ranged from soft to hard with numerous zones of intense weathering and fracturing, and exhibited typical karst characteristics with evidence of fractures, voids, and solution cavities.

The first borehole installed at SWMU 40 was 40MW3A, west of SWMU 40. From 38 to 44 feet bgs, a significant mud-filled cavity was encountered, preventing further drilling, and the borehole was abandoned. Boring 40MW1A, east of SWMU 40, was installed to a depth of 162 feet. Voids were encountered between 21.5 and 23 feet bgs. This borehole was abandoned because no water was encountered during drilling. Borehole 40MW2 was advanced to a depth of 59 feet. No water was encountered at this depth, but well 40MW2 was installed to intercept any possible high water table at a future date. Borehole 40MW4 was advanced to a total depth of 90 feet. No water was encountered in this boring, but well 40MW4 was installed to a final depth of 62.8 feet (due to collapse) to intercept any possible high water table at a future date.

The proposed groundwater sampling was not conducted because all four borings were dry. Though two wells were installed (40MW2 and 40MW4) at a depth of 60 feet bgs, subsequent measurements did not indicate any influx of water. A piezometer installed near SWMU 17 at a similar elevation showed water levels during the VI program between 78 and 90 feet bgs (elevation 1,814 to 1,836 msl).

3.2 DYE-TRACE STUDY

The dye-trace study was conducted by Engineering-Science, Inc. in an effort to better identify groundwater flow paths through the karst limestone in the south-central section of the Main Manufacturing Area.

The dye-trace study test conducted between September 23, 1993 and July 8, 1994 was designed to determine groundwater flow directions through the karst limestone in the south-central section of the main manufacturing area by identifying hydrogeologic connections between areas of groundwater recharge (upland sinkholes near SWMUs 17 and 40) and their respective discharge areas in and around the facility. Based on the results of this investigation, one spring (SPG3) was identified as being hydraulically connected to the sinkhole that SWMU 17A occupies. Furthermore, the flow path identified by the dye-trace closely parallels a west-northwest to east-southeast trending fracture trace that can be extended to connect the dye injection point with the dye resurgence point. This leads to the conclusion that a direct conduit exists between SWMU 17A and SPG3, most likely created by a solution opening along a subsurface fracture. The extended fracture trace runs just south of SWMU 40 and may also drain groundwater in the vicinity of SWMU 40. The groundwater flow rate through this conduit under low flow conditions is calculated to range between 2,095 ft/day and 3,716 ft/day, and under high flow conditions is calculated to average 4,800 ft/day.

3.3 RCRA FACILITY INVESTIGATION

One groundwater sample was collected from 40MW3 and analyzed for metals. Barium and beryllium were the only metals detected over PQLs, and neither was detected above its HBN (Table 5-9.1).

Based on the subsurface conditions encountered in the vicinity of SWMU 40, it is likely that any water-carried contaminants from the landfill migrate rapidly through karst solution features in the limestone bedrock and eventually discharge westward to the New River.

4.0 RECOMMENDED ACTION

Collect confirmatory samples of groundwater and subsurface media for metals, explosives, and SVOCs to support the site screening process.

DSERTS #: RAAP-010 $CaSO_4$ TREATMENT/DISPOSAL AREA RRSE: 1A

SWMU 8

1.0 BACKGROUND

SWMU 8 consists of two unlined, below-grade earthen lagoons located in the northeast section of the Main Manufacturing Area along the south bank of the New River (Figure 5-10.1.1). The lagoons were designed to manage neutralized acidic wastewater from the NC A-B Line Acidic Wastewater Treatment Plant (SWMU 19). Each lagoon is rectangular and approximately 200 feet long, 150 feet wide, and 10 feet deep. Operations of the lagoons began in the early 1950s during the Korean War (USACE, 1981).

The treatment plant neutralization process involves treating hydrated lime with sulfuric acid to produce calcium sulfate and water according to the formula:

$Ca(OH)_2 + H_2SO_4 \Rightarrow CaSO_4 + H_2O$

Calcium sulfate wastewater flows through a series of weir gates in the lagoons. Calcium sulfate precipitates out and settles to the bottom of the lagoons as sludge. The supernatant is discharged to the New River via Outfall 007, Virginia Pollutant Discharge Elimination System (VPDES) (Permit No. VA 0000248), which is adjacent to the unit (USATHAMA, 1976). The lagoons are operated on an alternating basis to accommodate maintenance and dredging.

Sludge is dredged from the lagoons on a periodic basis (generally every 5 to 7 months) and is placed in the adjacent drying bed (SWMU 36). Prior to 1982, sludge from the beds were disposed of in FAL No. 1 (SWMU 26), the Calcium Sulfate Landfill (SWMU 27), Calcium Sulfate Disposal Area (SWMU 50), and an area near SWMU 38. Since 1982, dried sludge removed from the beds has been disposed of in FAL No. 2 (SWMU 29).

2.0 ENVIRONMENTAL SETTING

Soil and rock borings completed in the vicinity of SWMU 8 as part of the hydrogeologic investigation (USACE, 1981) indicated the presence of two major lithologic units—unconsolidated sand with gravel and clay lenses overlying limestone/dolostone bedrock.

The consolidated deposits consist primarily of fine- to coarse-grained, yellow-brown sand varying in thickness between 14 and 30 feet, and thickening away from the river. Although zones of large cobbles (river jack) are present, they are not as prevalent here as in other parts of RFAAP. Silty brown clay lenses found at the land surface may represent recent deposition during flood events.

Underlying the sand unit is the gray limestone/dolostone of the Elbrook Formation. The limestone/dolostone in this area is highly argillaceous and highly fractured and fragmented. Permeability tests supported the observation that the formation was highly fractured and that groundwater flows through these channels with virtually no restrictions.

The water table within this unit is found at depths ranging from 10 to 23 feet bgs with flow towards the New River. Available data indicate that the water table may also slope towards Stroubles Creek on the east side of SWMU 36 (USACE, 1981).

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA**, included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore**, included the collection of one sludge sample from each of the two lagoons.
- **1998 – Closure Report, Alliant Techsystems**, included removal and sampling activities associated with the installation of a concrete settling tank to replace the eastern earthen lagoon at the unit.

One sample was collected from each of the SWMU 8 lagoons during the VI to evaluate whether any hazardous constituent concentrations exceeded HBNs specified in the permit.

Removal and sampling activities were performed during the closure to replace the eastern earthen lagoon with a concrete settling tank.

3.1 VERIFICATION INVESTIGATION

One sample was collected from along the edge of each of the two lagoons within the top foot of sludge. Parameters analyzed included VOCs, SVOCs, and TCLP metals. Table 5-10.1.1 presents chemical results for analytes that exceeded the PQL.

Chloroform and 1,1,1-trichloroethane were the only VOCs detected in either of the sludge samples *(Note: 1,1,1-trichloroethane was detected in SWMUs 36 and 50.)* Reported concentrations were significantly lower than the corresponding HBN. No SVOCs were detected in either sample.

Barium, chromium, and silver were reported at detectable concentrations in the TCLP extract, which indicated that leachable levels of these metals were available from lagoon sludge. However, results were reported less than regulatory levels specified in 40 CFR 261.24 *(Note: barium and chromium were detected in SWMUs 9, 36, 37, 38, 50; and silver was detected in SWMUs 9, 36, 37, and Area Q.)*

Barium may be available as barium nitrate, $Ba(NO_3)_2$, which is used as an oxidizing agent and included in double-base solvent (M26) and solventless (M2, M5) formulations.

Propellant	Percent by weight
M2	1.4±0.25
M5	0.5±1.6
M26	0.75±0.2

3.2 SWMU CLOSURE

A closure was performed at the eastern lagoon to remove contaminated material from the lagoon and determine whether contamination levels in the remaining soils were below regulatory criteria. Closure activities included (1) demolition and removal; and (2) sampling and analysis.

3.2.1 Demolition and Removal

Activities included the removal of accumulated calcium sulfate sludge, unwanted structures, and subsoil to a depth of two feet below the nominal surface. The calcium sulfate sludge was transferred to the SWMU 36 drying beds. Removed structures were taken to a permitted landfill.

3.2.2 Sampling and Analysis

Seven monitoring points and one duplicate location were obtained by means of random grid sampling. Eighteen core samples were collected 0 to 1 foot and analyzed for VOCs, TPH-GRO, TPH-DRO, SVOCs, explosives, PAHs, TAL metals, and wet chemistry.

Analytical results were determined to be below the clean-up goals of the Corrective Action Permit. A summary of all detected constituents is presented in Table 5-10.1.2.

4.0 RECOMMENDED ACTION

Based on closure report results, no further action is recommended for this site. Subsurface sampling results were determined to be below the levels of concern. The potential sources of contamination have been removed and disposed of. A concrete tank has replaced the eastern lagoon and will prevent the infiltration of surface water. Site conditions at the eastern basin do not pose a threat to human health or the surrounding environment.

DSERTS #: RAAP-010 **$CaSO_4$ TREATMENT/DISPOSAL AREA** **RRSE: 1A**

SWMU 9

1.0 BACKGROUND

SWMU 9 consists of two unlined, below-grade earthen lagoons located in the northwest section of the Main Manufacturing Area. The lagoons were designed to manage neutralized acidic wastewater from the NC C-Line Acidic Wastewater Treatment Plant (SWMU 20). Each lagoon is rectangular and approximately 150 feet long, 75 feet wide, and 8 to 10 feet deep (Figure 5-10.2.1). Operation of the lagoons began in the early 1950s during the Korean War (USACE, 1981).

The treatment plant neutralization process involves treating hydrated lime with sulfuric acid to produce calcium sulfate and water according to the formula:

$$Ca(OH)_2 + H_2SO_4 \Rightarrow CaSO_4 + H_2O$$

Calcium sulfate wastewater is gravity-fed into SWMU 9 through an underground process sewer pipe. The wastewater then flows through a series of weir gates in the lagoons. Calcium sulfate precipitates out and settles to the bottom of the lagoons as sludge. The supernatant is discharged to the New River via Outfall 005 (VPDES Permit No. VA 0000248), which is adjacent to the unit (USATHAMA, 1976). The lagoons are operated on an alternating basis to accommodate maintenance and dredging.

Sludge is dredged from the lagoons on a periodic basis (generally every five to seven months) and is placed in the adjacent drying beds (SWMU 37, 38, and Area Q). It is assumed that sludge disposal practices were similar to SWMU 8. Prior to 1982, sludge from the beds was disposed of in FAL No. 1 (SWMU 26), the Calcium Sulfate Landfill (SWMU 27), Calcium Sulfate Disposal Area (SWMU 50), and an area near SWMU 38. Since 1982, dried sludge removed from the beds has been disposed of in FAL No. 2 (SWMU 29).

2.0 ENVIRONMENTAL SETTING

Soil and rock borings completed during a hydrogeologic investigation (USACE, 1981) indicated the presence of two major lithologic units: unconsolidated sand with gravel and clay lenses overlying limestone/dolostone bedrock.

The unconsolidated deposits consist primarily of fine- to coarse-grained, yellowish-brown sand approximately 30 feet thick. Lenses of brown, silty clay were dominant in the upper part of the unit and large cobbles (river jack) more dominant with depth.

The bedrock is highly argillaceous and moderately weathered and fractured. Additionally, a large mudstone unit is present. Permeability tests conducted to determine the ability of the material at SWMU 9 to transmit fluids suggest that the unit is poorly sorted.

The water table is generally along the bedrock surface at depths ranging from 26 to 29 feet bgs. Although data is limited, the water table appears to be virtually flat. Available water level data indicate that when water levels in the New River are altered by releases from the dam upstream of RFAAP, the water table fluctuates accordingly. Groundwater flow in the vicinity of SWMU 9 is towards the New River.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA**, included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore**, included the collection of one sludge sample from each of the two lagoons.

One sample was collected from each SWMU 9 lagoon to evaluate whether any hazardous constituent concentrations in the sludge exceeded HBNs specified in the permit.

One sludge sample was collected from along the edges of each of the two lagoons within the top foot. Parameters analyzed included VOCs, SVOCs, and TCLP metals. Table 5-10.2.1 presents chemical results for analytes exceeding the PQL.

Chloroform and acetone were the only VOCs detected in either of the sludge samples.

Reported concentrations were significantly lower than the corresponding HBN.

(Note: Acetone was also detected in SWMU 36.) (Note: di-n-butyl phthalate was detected in SWMUs 36, 37, 38, and Area Q.)

Acetone is associated with a number of propellant production activities. It is included in the production of MR-23 adhesive and a byproduct of the following formulations: M7, M8, M9, M26, AHH casting powder, and M7 TOW.

Di-n-butyl phthalate and four unknown SVOCs were detected in the eastern lagoon.

Di-n-butyl phthalate is an inert, gelatinizing agent used to improve physical and processing characteristics, including decreasing the propellant ignitability. Based on the waste propellant composition (Permit, Appendix BB), the following propellants contain di-n-butyl phthalate:

Propellant	Percent by weight
M1	5.0±1.0
M6	3.0±1.0
M6+2	3.0±1.0
IMR7383	2.0-4.0
M14 MP	2.0±1.0
NOSOL18	8.1±0.5

It is possible that SVOC TICs are related to waste propellant components that are not included on the USEPA target compound list (TCL).

Barium, cadmium, chromium, lead, and silver were reported at detectable concentrations in the TCLP extract, which indicated that leachable levels of these metals were available from lagoon sludge. However, results were reported less than regulatory levels specified in 40 CFR 261.24. *(Note: Barium and chromium were detected in SWMUs 8, 36, 37, 38, 50, and Area Q; lead was detected in SWMU 50; silver was detected in SWMUs 8, 36, 37, and Area Q.)*

Barium may be available as $Ba(NO_3)_2$, which is used as an oxidizing agent and included in double-base solvent (M26) and solventless (M2, M5) formulations.

Propellant	Percent by weight
M2	1.4±0.25
M5	0.5±1.6
M26	0.75±0.2

Examples of lead usage in propellant formulations include the following:

Propellant Compound	Percent by weight
BS-NACO	
lead carbonate	1.0±0.2
AHH	
lead salicylate	2.3 (nominal)
lead 2-ethylhexoate	2.3 (nominal)
ARP	
lead salicylate	17±1.0
lead beta resorcylate	3.0±0.25
PNJ	
lead salicylate	2.93
lead 2,4-dihydroxybenzoate	2.93
M16	
lead stearate	0.5
M21	
lead stearate	0.5
lead salicylate	2.5

4.0 RECOMMENDED ACTION

Discrete sludge samples will be collected for explosives, metals, and SVOCs to verify VI no further action recommendations.

DSERTS #: RAAP-010 $CaSO_4$ TREATMENT/DISPOSAL AREA RRSE: 1A

SWMU 35

1.0 BACKGROUND

SWMU 35, a Calcium Sulfate Drying Bed, is located along the New River in the northeast section of the Main Manufacturing Area. SWMU 35 is located immediately east of SWMU 10 and west of and adjacent to SWMU 8 (Calcium Sulfate Settling Lagoons) (Figure 5-10.3.1). SWMU 35 has been previously described as "an abandoned lagoon" (USACE, 1981). The drying bed was excavated into the natural grade and is unlined.

Until approximately 1980, calcium sulfate sludge was dredged from SWMU 8 and pumped into SWMU 35 to dehydrate every five to seven months. After drying, the sludge was removed for disposal. The sludge was disposed of in various locations at RFAAP.

SWMU 35 is approximately 160 feet long by 80 feet wide with approximately 8 feet of sediment remaining in the basin. RFAAP reported that sediment from SWMU 10 was probably deposited in SWMU 35, most likely during the early 1980s.

SWMU 35 is a surface depression with the level of sediment within it approximately 4 feet below natural grade. The northern rim of the basin is a little lower (1,703 feet msl) than the southern rim (1,704 feet msl). No drainage into SWMU 35 should be able to exit via surface runoff.

Surface ditches are present northeast of SWMU 35 which have a decrease in elevation to less than 1,695 feet msl before leaving the site underneath the fence.

2.0 ENVIRONMENTAL SETTING

Subsurface conditions were investigated at the study area in 1991 to confirm previously described conditions (Geophex, 1990). Unconsolidated soil deposits, which thicken away from the river, consist of a brown clayey silt overlying a fine- to coarse-grained, micaceous, yellowish-brown sand. Several feet of yellowish-brown sand and gravel overlie bedrock. These alluvial floodplain deposits vary in thickness between 14 and 30 feet.

Zones of large cobbles (river jack) are present south of SWMUs 10 and 35, but are not as common as found at other sites at RFAAP.

Silty brown clay lenses found at the land surface may represent recent deposition during flood events.

Underlying the unconsolidated soils in the SWMU 10 and SWMU 35 area is the gray argillaceous limestone/dolostone of the Elbrook Formation. The limestone/dolostone is highly fractured and fragmented with calcite healed fractures and zones of filled and unfilled vugs. Up to 41 feet of the Elbrook Formation was penetrated during the 1990 boring program (Geophex, 1990).

The hydrogeologic conditions within the unconsolidated soil were investigated through field examination of soil samples, laboratory permeability/conductivity tests, grain-size hydrometer analysis and Atterberg Limits tests, and a field rising-head (slug) test on monitoring well 10MW1. The hydrogeologic conditions of the bedrock were investigated by field examination of rock cores from the 10MW1 and field hydraulic conductivity data.

Groundwater elevations measured from wells located in the SWMU 10 area are provided on Table 5-36.1.

A relatively shallow groundwater table was encountered from 14 to 23 feet bgs in the study area. The unconfined water table was generally present several feet above the bedrock surface within either the micaceous sand or sand and gravel layer. Based on groundwater measurements obtained in January and March 1992, the unconfined water table gradient slopes north toward the New River at approximately 0.011 feet per foot (ft/ft), generally following the slope of the bedrock surface.

Although no mounding or other irregular groundwater pattern has been observed at SWMU 10 (except for a slight change in the groundwater flow direction toward the outfall 029 area, which has a deep ravine leading to the New River), a significant mounding effect appears to be associated with SWMU 35 due to the unlined nature of this basin. Surface water can percolate through this basin and directly recharge the unconfined aquifer. SWMU 8 also appears to cause a mounding effect, which alters the groundwater flow in this area since this basin is also unlined. The general groundwater flow direction in the area is northward towards the New River at an average hydraulic gradient of about 0.02 ft/ft.

Groundwater flow below the area primarily occurs through three geologic units: the unconsolidated micaceous sand; the unconsolidated sand and gravel; and the unconsolidated bedrock. The hydrogeological characteristics of each unit are different resulting in different groundwater flow velocities. The lowest permeabilities and hydraulic conductivities for the water bearing units are found in the unconsolidated micaceous sand unit, and the highest permeabilities and hydraulic conductivities are found in the sand and gravel.

The average permeability/hydraulic conductivities for the micaceous sand unit are 5.0×10^{-4} cm/sec and an average of 2.73×10^{-3} cm/sec for the sand and gravel unit. The hydraulic conductivity measured for bedrock at D-3D was 2.6×10^{-4} cm/sec, but the bedrock has irregular water bearing fractures, and measured values should always be considered only a rough approximation.

Groundwater in the unconsolidated water table aquifer will flow predominantly through the sand and gravel layer northward and out at the basin areas. As the sand and gravel layer pinches out, groundwater would then continue to flow northward to the New River predominantly through the micaceous sand unit, which potential contaminants could flow through if leaked from the basin.

Assuming the representative water bearing unit to be the micaceous sand layer, the groundwater flow velocity may be calculated by knowing the estimated average hydraulic conductivity (5.0×10^{-4} cm/sec), the hydraulic gradient (0.011 ft/ft), and the estimated formation porosity (30 percent). By using the Darcy equation and standard equation of hydraulics, the estimated average linear horizontal groundwater flow velocity is 1.8×10^{-5} cm/sec (19 ft/yr). For example, substituting the hydraulic gradient measured in July 1993 (0.019 ft/ft), the estimated groundwater flow velocity is 3.3×10^{-5} cm/sec (34 ft/yr).

The horizontal groundwater velocity for the sand and gravel unit can also be estimated using the average hydraulic conductivity/permeability (2.73×10^{-3} cm/sec), the measured gradient (1.1 percent) and an estimate of porosity for sand and gravel (25 percent). Using these values and the Darcy equation gives an average linear velocity of 1.2×10^{-4} cm/sec (124 ft/yr). Substituting the hydraulic gradient measured in July 1993 (0.019 ft/ft), the estimated groundwater flow velocity is 1.8×10^{-4} cm/sec (188 ft/yr).

The estimated porosity of 30 percent used for the micaceous sand layer is based on a range of porosities common for unconsolidated non-plastic silty sand (25-40 percent), and the estimated porosity of 25 percent used for the sand and gravel layer is based on a range of porosities common for unconsolidated sand and gravel mixtures (10-25 percent; Johnson Filtration Systems, Inc., 1986).

The SWMU 10 Equalization Basin is fully encircled by a concrete wall which prevents surface water runoff outside of the basin from mixing with waste in the basin. Surface water runoff in the vicinity of the Bio-Plant would flow northward to the New River following the general drainage pattern downslope to the river. However, runoff south and east of SWMU 10 flows toward the SWMU 35 settling basin. No runoff from SWMU 35 migrates out of the confines of the basin.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore,** included groundwater sampling and analysis, and soil boring sampling for the construction of hydrogeologic cross sections for the determination of groundwater elevations.
- **1994 - Verification Investigation, Dames & Moore, Rounds II and III,** included groundwater sampling and analysis in Round I wells, and in additional upgradient and downgradient wells.

3.1 SOIL

One soil sample was collected below the SWMU 35 sediment and above the water table to provide an indication of vertical migration of contaminants. Results detected above the PQL are presented in Table 5-10.3.1. Samples were analyzed for metals, VOCs, and SVOCs. Metals detected in the samples above the PQL included arsenic, barium, chromium, lead, and silver. ***Arsenic*** and ***lead*** exceeded HBN criteria. Although barium concentrations were elevated in both samples, results were below the HBN. Barium and lead were also detected in the TCLP extract below the respective regulatory criteria. No VOCs or SVOCs exceeded HBN criteria.

3.2 GROUNDWATER

Groundwater samples were collected from wells upgradient (3) and downgradient (4) of SWMUs 10 and 35 and analyzed for VOCs, SVOCs, explosives, metals, water quality parameters, pH, TOC, and TOX.

3.2.1 Round I

The first round of samples were collected in August 1990 as part of a construction site assessment (Dames & Moore, 1990) and included downgradient (D-3, DDH2) and upgradient (DDH4) wells. Table 5-10.3.2 presents the analytical results detected above the PQL.

Although VOCs were not detected in the downgradient sample, chloroform was detected at a concentration below the HBN in the upgradient well. SVOCs were not detected in any of the samples. HMX was detected in all samples at concentrations below the HBN. Additionally, TETRYL was detected in well D-3. Barium and lead were the only metals detected in all samples. Results for both elements were below HBN criteria.

3.2.2 Round II

A second round of samples was collected from downgradient (10MW1, D-3D, DDH2) and upgradient (DG-1, DDH4, D-4) wells (Dames & Moore, 1991). The additional upgradient (DG-1) and downgradient (10MW1) wells were added to this sampling round to better define the magnitude of groundwater contamination associated with SWMU 35. Table 5-10.3.3 presents the analytical results for concentrations exceeding the PQL.

VOCs detected in groundwater samples included carbon disulfide, chloroform, chloromethane, 1,2-dichloroethane and toluene. None of the reported concentration exceeded HBN criteria. One SVOC TIC, ***bis(2-ethylhexyl) phthalate,*** exceeded its HBN.

Explosives detected above the PQL included HMX, 24DNT, and 26DNT. HMX was detected in all six wells with the highest concentration reported in DDH4. Upgradient concentrations generally tended to be higher than downgradient concentrations (with the exception of DDH2) and all results were below the HBN criterion. ***24DNT*** was detected in two downgradient wells (10MW1, D-3D) at concentrations exceeding the HBN.

Antimony, chromium, cobalt, lead, and ***manganese*** were detected above HBN criteria in the two unfiltered upgradient groundwater samples. It was assumed that these metals were not related to SWMU 10 or 35 because the results were associated with upgradient samples and represented different source areas.

Water quality parameters were analyzed to establish the general groundwater quality in the study area and included nitrogen, chloride, sulfate, total phosphorous, and total phenols. All the constituents were detected at reportable quantities in both upgradient and downgradient wells with the exception of phenol. Nitrogen, chloride, and sulfate were generally detected in downgradient wells at higher concentrations. ***Nitrate/ nitrite*** concentrations in wells downgradient of SWMU 10 (D-3, D-3D, DDH2) exceeded the HBN criterion. Additionally, downgradient sulfate concentrations were elevated above background levels.

3.2.3 Round III

The third groundwater sampling round was conducted based on second round results and included four wells downgradient of SWMU 10 (10MW1, D-3D, D-3, DDH2); one well downgradient of SWMU 35 (D-5); and four wells upgradient (DG-1, DDH4, D-4, D-2) of both SWMUs. Based on 1990 and 1991 analytical results, samples were analyzed for total and dissolved lead and chromium, explosives, TOC, TOX, nitrate/nitrite, total kjeldahl nitrogen (TKN), sulfate, and pH. Table 5-10.3.4 presents the analytical results for concentrations exceeding the PQL. HMX was the only explosive detected in low level concentrations in seven of nine wells.

Chromium and ***lead*** were detected in the unfiltered samples with concentrations exceeding HBN criteria for upgradient wells D-4 (chromium and lead) and D-2 (chromium only). Analysis of the previous data indicated the following:

- Elevated concentrations of chromium and lead continued to be detected in samples from upgradient well D-4.
- Elevated concentrations of chromium and lead in upgradient sample D-4 had decreased.
- Chromium and lead concentrations had increased over time in the downgradient well DDH2.
- Total chromium and lead concentrations remained elevated in the upgradient wells when compared to the downgradient wells.

Water quality parameters results were consistent with previously reported data. Nitrogen was detected in eight of the nine wells generally at higher concentrations in the upgradient wells. Chloride and sulfate were generally detected in downgradient wells at higher concentrations. The ***nitrate/nitrite*** concentration in the SWMU 35 upgradient well (D-2) and downgradient wells (D-3D, D-3, DDH2, D-5) exceeded the HBN criterion. Additionally, sulfate concentrations were elevated above background levels.

3.3 SEDIMENT

Three sediment samples were collected within the drying bed and analyzed for VOCs, SVOCs, explosives, metals, and TCLP metals. Table 5-10.3.4 presents the analytical results for concentrations exceeding the PQL. VOCs detected included trace levels of acetone and toluene. SVOCs detected above the PQL included di-n-butyl phthalate and N-nitrosodiphenylamine. The ***N-nitrosodiphenylamine*** and ***24DNT*** were detected above their respective HBN.

Metals detected above the PQL included arsenic, barium, chromium , lead, mercury, and silver. ***Arsenic*** exceeded the HBN criterion for both samples in which it was analyzed. ***Lead*** exceeded its HBN in all three samples. Although barium concentrations were elevated in both samples, results were below the HBN.

3.4 SURFACE WATER

One surface water sample was collected from within the Equalization Basin and analyzed for VOCs, SVOCs, explosives, and metals. Table 5-10.3.6 presents the analytical results for samples exceeding PQLs.

Chloroform was the only target VOC detected in the sample. A VOC TIC was detected at a concentration of 4,000 parts per billion (ppb). SVOCs detected in the sample included ***2-nitroaniline*** and ***N-nitrosodiphenylamine***, which were detected above the associated HBN criterion. Explosives detected above the PQL included 24DNT and HMX. Additionally, the ***24DNT*** result exceeded the HBN criterion. Although barium, chromium, and lead were detected in the Basin, lead was the only element exceeding the criterion.

4.0 RISK ASSESSMENT

Summary of Screening Level Risk Assessment

Samples Collected

Groundwater samples were collected upgradient and downgradient of the SWMU. Surface soil samples were collected adjacent but outside of the SWMU basins. One subsurface soil sample was collected above the water table below the SWMU 35 sediment. Sediment samples were collected from both SWMU 10 and 35. One surface water sample was collected from SWMU 10.

Medium	No.	Location
Groundwater	4	Upgradient
	6	Downgradient
Surface Soil	2	0-6 "

Subsurface soil	1	SWMU 35
Sediment	1	SWMU 10
	3	SWMU 35
Surface water	1	SWMU 10

4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

COPCs were selected based on results exceeding HBNs and background. Groundwater contaminants included: 24DNT (also detected in sediment and surface water); 26DNT; bis(2-ethylhexyl) phthalate; nitrate/nitrite; and sulfate. With the exception of 26DNT, chemicals from this medium were selected as COPCs. 26DNT was deleted because of its low frequency of detection. Lead and N-nitrosodiphenylamine were selected as COPCs due to their detection in sediment and surface water.

4.2 EXPOSURE ASSESSMENT

If groundwater and/or surface water COPCs are selected based on the review of future analytical data, then the quantitative evaluation should be considered for the following exposure pathways:

Groundwater

- Ingestion of chemicals in groundwater by future workers.

Soil

- Incidental ingestion of chemicals in soil by future workers; and
- Dermal absorption of chemicals in soil by future workers.

Sediment

- Incidental ingestion of chemicals in basin sediment by workers;
- Dermal absorption of chemicals in basin sediment by workers;
- Incidental ingestion of chemicals in sediment by recreational visitors wading along the banks of the New River; and
- Dermal absorption of chemicals in sediment by recreational visitors wading along the banks of the New River.

Surface Water

- Incidental ingestion of chemicals in basin surface water by workers;
- Dermal absorption of chemicals in surface water by workers;
- Incidental ingestion of chemicals in surface water by recreational visitors swimming in the New River; and
- Dermal absorption of chemicals in surface water by recreational visitors swimming in the New River.

5.0 RECOMMENDED ACTION

Collect confirmatory samples from available media for explosives, SVOCs, metals, and select conventional analyses to support the quantitative baseline risk assessment.

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DSERTS #: RAAP-010 $CaSO_4$ DRYING BED RRSE: 1A

SWMU 36

1.0 BACKGROUND

SWMU 36 consists of three separate unlined drying beds located along the New River in the northeast section of the Main Manufacturing Area adjacent to SWMU 8. The drying beds were excavated into the natural grade and are of different ages as suggested by aerial photographs (USEPA, 1987). The north bed is closest to the New River and appears to be the original drying bed. The adjacent south bed appears to be the next oldest. These two beds are approximately 200 feet long, 50 feet wide, and 10 feet deep. The east bed is approximately 60 feet wide by 200 feet long. The depth of this bed is unknown.

Calcium sulfate sludge has been disposed of in various locations throughout RFAAP, including FAL Nos. 1 and 2 (SWMUs 26 and 29), the Calcium Sulfate Landfill (SWMU 27), Calcium Sulfate Disposal Area (SWMU 50), and trenches east of SWMU 38.

2.0 ENVIRONMENTAL SETTING

Because of its close proximity to SWMU 8, it is assumed that this unit exhibits similar subsurface and hydrogeologic characteristics (Figure 5-10.4.1). Soil and rock borings completed in the vicinity of SWMU 8 as part of the hydrogeologic investigation (USACE, 1981) indicated the presence of two major lithologic units: unconsolidated sand with gravel and clay lenses overlying limestone/dolostone bedrock.

The consolidated deposits consist primarily of fine- to coarse-grained, yellow-brown sand varying in thickness between 14 and 30 feet, and thickening away from the river. Although zones of large cobbles (river jack) are present, they are not as prevalent here as in other parts of RFAAP. Silty brown clay lenses found at the land surface may represent recent deposition during flood events.

Underlying the sand unit is the gray limestone/dolostone of the Elbrook Formation. The limestone/dolostone in this area is highly argillaceous and highly fracturedand fragmented. Permeability tests supported the observation that the formation was highly fractured and that groundwater flows through these channels with virtually no restrictions.

The water table within this unit is found at depths ranging from 10 to 23 feet bgs with flow towards the New River. Available data indicate that the water table may also slope towards Stroubles Creek on the east side of SWMU 36 (USACE, 1981).

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore,** included the collection of three sediment samples.

SWMU 36

One sample was collected from each SWMU 36 drying bed to evaluate whether any hazardous constituent concentration exceeded HBNs specified in the permit.

The drying beds were dry during the investigation period and a composite sample was extracted from the central portion of the bed. A 5-foot boring was drilled and sampled to ensure collection of numerous sludge drying episodes. Parameters analyzed included VOCs, SVOCs, and TCLP metals. Table 5-10.4.1 presents chemical results for analyte concentrations exceeding the PQL.

Acetone (north bed) and 1,1,1-trichloroethane (south bed) were the only VOCs detected in either of the drying beds. SVOCs were detected in all three beds: di-n-butyl phthalate, N-nitrosodiphenylamine, fluoranthene and phenanthrene were detected in the north bed; di-n-butyl phthalate, phenanthrene, and N-nitrosophenylamine were detected in the south bed; and N-nitrosodiphenylamine was detected in the east bed. Reported concentrations were significantly lower than the corresponding HBN. *(Note: Acetone was also detected in SWMU 9; di-n-butyl phthalate was detected in SWMUs 9, 36, 37, 38, and Area Q; N-nitrosodiphenylamine was detected in SWMUs 37 and 38; phenanthrene and fluoranthene were detected in SWMU 50.)*

Acetone is associated with a number of propellant production activities. It is included in the production of MR-23 adhesive and a byproduct of the following formulations: M7, M8, M9, M26, AHH casting powder, and M7 TOW.

Di-n-butyl phthalate is an inert, gelatinizing agent used to improve physical and processing characteristics, including decreasing the propellant ignitability. Based on the waste propellant composition (Permit, Appendix BB), the following propellants contain di-n-butyl phthalate:

Propellant	Percent by weight
M1	5.0±1.0
M6	3.0±1.0
M6+2	3.0±1.0
IMR7383	2.0-4.0
M14 MP	2.0±1.0
NOSOL18	8.1±0.5

N-Nitrosodiphenylamine $(C_6H_5)_2NNO$ is the initial nitration product of diphenylamine, which is used as a single-base propellant stabilizer to increase storage life. Diphenylamine prevents autocatalysis of NC decomposition reactions. N-Nitrosodiphenylamine is formed when nitrogen oxide (generated from NC decomposition) combines with diphenylamine according to the formula: $(C_6H_5)_2NH + NO_2 \rightarrow (C_6H_5)_2NNO$. Based on the waste propellant composition (Permit, Appendix BB), the following propellants contain diphenylamine:

Propellant	Percent by weight
CBI Powder	1.5±0.2
IMR4895	0.5-1.25
IMR5010	0.5-1.25
IMRR7383	0.5-1.25
IMR8097	0.5-1.25
IMR 8208	1.0
M1	0.9±1.2
M6	0.9±1.2
M10	1.0±0.3
M6+2	0.9±1.2
M14 MP	1.0±0.1
25mm BM	0.5-1.3

Phenanthrene is a polynuclear aromatic compound generally associated with petroleum products, such as coal tar, gasoline, solvents, power plant emissions, and coal ash and cinders. *(Note: Phenanthrene was detected in SWMU 50.)*

Barium, chromium, and silver were reported at detectable concentrations in the TCLP extract, which indicated that leachable levels of these metals were available from lagoon sludge. However, results were reported less than regulatory levels specified in 40 CFR 261.34. *(Note: Barium and chromium were detected in SWMUs 8, 36, 37, 38, 50, and Area Q; silver was detected in SWMUs 8, 36, 37, and Area Q.)*

4.0 RECOMMENDED ACTION

Discrete sludge samples will be collected for explosives, metals, and SVOCs to verify VI no further action recommendations.

DSERTS #: RAAP-010 **$CaSO_4$ TREATMENT/DISPOSAL AREA** **RRSE: 1A**

SWMU 37

1.0 BACKGROUND

SWMU 37 is an unlined drying bed located along the New River in the northwest section of the Main Manufacturing Area immediately southwest of and adjacent to SWMU 9 (Figure 5-10.5.1). The SWMU is approximately 100 feet long, 80 feet wide, and 8 feet deep. The drying bed was excavated into the natural grade.

Calcium sulfate sludge has been disposed of in various locations throughout RFAAP, including FAL Nos. 1 and 2 (SWMU 26 and 29), the Calcium Sulfate Landfill (SWMU 27), Calcium Sulfate Disposal Area (SWMU 50), and trenches east of SWMU 38.

2.0 ENVIRONMENTAL SETTING

The unconsolidated deposits consist primarily of fine- to coarse-grained, yellowish-brown sand approximately 30 feet thick. Lenses of brown, silty clay were dominant in the upper part of the unit, and large cobbles (river jack) were more dominant with depth.

The bedrock is highly argillaceous and moderately weathered and fractured. Additionally, a large mudstone unit is present. Permeability tests conducted to determine the ability of the material at SWMU 9 to transmit fluids suggest that the unit is poorly sorted.

The water table is generally along the bedrock surface at depths ranging from 26 to 29 feet bgs. Although data is limited, the water table appears to be virtually flat. Available water level data indicate that when water levels in the New River are altered by releases from the dam upstream of RFAAP, the water table fluctuates accordingly. Groundwater flow in the vicinity of SWMU 9 is towards the New River.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore,** included the collection of one composite sludge sample.

One sludge sample was collected from SWMU 37 to evaluate whether any hazardous constituent concentrations exceeded HBNs specified in the permit.

The lagoon was dry during the investigation period and a composite sample was extracted from the central portion of the bed. A 5-foot boring was drilled and sampled to ensure collection of numerous sludge drying episodes. Parameters analyzed included VOCs, SVOCs , and TCLP metals. Table 5-10.5.1 presents chemical results for analyte concentrations exceeding the PQL.

VOCs were not detected in any of the drying bed samples. Two SVOCs, di-n-butyl phthalate and N-Nitrosodiphenylamine, were detected in samples above the PQL but less than corresponding HBNs. Several unknown SVOC TICs were also detected. (*Note: Di-n-butyl phthalate was also detected in SWMUs 9, 36, 38, and Area Q; N-nitrosodiphenylamine was detected in SWMUs 36 and 38.*)

Di-n-butyl phthalate is an inert, gelatinizing agent used to improve physical and processing characteristics, including decreasing the propellant ignitability. Based on the waste propellant composition (Permit, Appendix BB), the following propellants contain di-n-butyl phthalate:

Propellant	Percent by weight
M1	5.0±1.0
M6	3.0±1.0
M6+2	3.0±1.0
IMR7383	2.0-4.0
M14 MP	2.0±1.0
NOSOL18	8.1±0.5

N-Nitrosodiphenylamine $(C_6H_5)_2NNO$ is the initial nitration product of diphenylamine, which is used as a single-base propellant stabilizer to increase storage life by preventing autocatalysis of NC decomposition reactions. N-Nitrosodiphenylamine is formed when nitrogen oxide (generated from NC decomposition) combines with diphenylamine according to the formula:

$$(C_6H_5)_2NH + NO_2 \rightarrow (C_6H_5)_2NNO$$

Based on the waste propellant composition (Permit, Appendix BB), the following propellants contain diphenylamine:

Propellant	Percent by weight
CBI Powder	1.5±0.2
IMR4895	0.5-1.25
IMR5010	0.5-1.25
IMR7383	0.5-1.25
IMR8097	0.5-1.25
IMR 208	1.0
M1	0.9±1.2
M6	0.9±1.2
M10	1.0±0.3
M6+2	0.9±1.2
M14 MP	1.0±0.1
25mm BM	0.5-1.3

It is possible that SVOC TICs are related to waste propellant components that are not included on the USEPA TCL.

Barium, chromium, and silver were reported at detectable concentrations in the TCLP extract, which indicated that leachable levels of these metals were available from lagoon sludge. Results were reported less than regulatory levels specified in 40 CFR 261.24. *(Note: Barium and chromium were detected in SWMUs 8, 9, 36, 38, 50, and Area Q; silver was detected in SWMUs 8, 9, 36, and Area Q.)*

Barium may be available as $Ba(NO_3)_2$, which is used as an oxidizing agent and included in double-base solvent (M26) and solventless (M2, M5) formulations.

Propellant	Percent by weight
M2	1.4±0.25
M5	0.5±1.6
M26	0.75±0.2

4.0 RECOMMENDED ACTION

Discrete sludge samples will be collected for explosives, metals, and SVOCs to verify VI no further action recommendations.

DSERTS #: RAAP-010 $CaSO_4$ TREATMENT/DISPOSAL AREA RRSE: 1A

SWMU 38

1.0 BACKGROUND

SWMU 38 is an unlined drying bed located along the New River in the northwest section of the Main Manufacturing Area. The SWMU is approximately 225 feet long, 40 feet wide, and 8 feet deep. The drying bed was excavated into the natural grade. Immediately northwest of and adjacent to SWMU 38 is Area Q, which was reported to be used as a sludge drying bed when SWMU 38 was full. Sludge was pumped from SWMU 38 to Area Q via pipes that ran through a depression in the berm surrounding the drying bed.

Calcium sulfate sludge has been disposed of in various locations throughout RFAAP, including FAL Nos. 1 and 2 (SWMU 26 and 29), the Calcium Sulfate Landfill (SWMU 27), Calcium Sulfate Disposal Area (SWMU 50), and trenches east of SWMU 38.

2.0 ENVIRONMENTAL SETTING

Because of its close proximity to SWMU 9, it is assumed that this unit exhibits similar subsurface and hydrogeologic characteristics (Figure 5-10.6.1). Soil and rock borings completed during a hydrogeologic investigation of SWMU 9 (USACE, 1981) indicated the presence of two major lithologic units: unconsolidated sand with gravel and clay lenses overlying limestone/dolostone bedrock.

The unconsolidated deposits consist primarily of fine- to coarse-grained, yellowish-brown sand approximately 30 feet thick. Lenses of brown, silty clay were dominant in the upper part of the unit and large cobbles (river jack) were more dominant with depth.

The bedrock is highly argillaceous and moderately weathered and fractured. Additionally, a large mudstone unit is present. Permeability tests conducted to determine the ability of the material at SWMU 9 to transmit fluids suggest that the unit is poorly sorted.

The water table is generally along the bedrock surface at depths ranging from 26 to 29 feet bgs. Although data is limited, the water table appears to be virtually flat. Available water level data indicate that when water levels in the New River are altered by releases from the dam upstream of RFAAP, the water table fluctuates accordingly. Groundwater flow in the vicinity of SWMU 9 is towards the New River.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA**, included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore**, included the collection of one composite sludge sample.

One sludge sample was collected from SWMU 38 as provided in the permit to evaluate whether any hazardous constituent concentrations exceeded HBNs specified in the permit.

The drying bed contained liquid during the investigation period. One sample was collected from along the edge of the bed within the top one foot of sludge. Parameters analyzed included VOCs, SVOCs, and TCLP metals. Table 5-10.6.1 presents chemical results for analytes exceeding the PQL.

VOCs were not detected in the sludge sample. Two SVOCs, di-n-butyl phthalate and N-nitrosodiphenylamine, were detected in the sludge sample at concentration levels below corresponding HBNs. (*Note: Di-n-butyl phthalate was also detected in SWMUs 9, 36, 37, and Area Q; N-nitrosodiphenylamine was detected in SWMUs 36 and 37.)*

Di-n-butyl phthalate is an inert, gelatinizing agent used to improve physical and processing characteristics, including decreasing the propellant ignitability. Based on the waste propellant composition (Permit, Appendix BB), the following propellants contain di-n-butyl phthalate:

Propellant	Percent by weight
M1	5.0±1.0
M6	3.0±1.0
M6+2	3.0±1.0
IMR7383	2.0-4.0
M14 MP	2.0±1.0
NOSOL18	8.1±0.5

N-Nitrosodiphenylamine $(C_6H_5)_2NNO$ is the initial nitration product of diphenylamine, which is used as a single-base propellant stabilizer to increase storage life. Diphenylamine prevents autocatalysis of NC decomposition reactions. N-Nitrosodiphenylamine is formed when nitrogen oxide (generated from NC decomposition) combines with diphenylamine according to the formula:

$$(C_6H_5)_2NH + NO_2 \rightarrow (C_6H_5)_2NNO$$

Based on the waste propellant composition (Permit, Appendix BB), the following propellants contain diphenylamine:

Propellant	Percent by weight
CBI Powder	1.5±0.2
IMR4895	0.5-1.25
IMR5010	0.5-1.25
IMR7383	0.5-1.25
IMR8097	0.5-1.25
IMR8208	1.0
M1	0.9±1.2
M6	0.9±1.2
M10	1.0±0.3
M6+2	0.9±1.2
M14 MP	1.0±0.1
25mm BM	0.5-1.3

Barium and chromium were reported at detectable concentrations in the TCLP extract, which indicated that leachable levels of these metals were available from lagoon sludge. However, results were reported less than regulatory levels specified in 40 CFR 261.24. *(Note: Barium and chromium were detected in SWMUs 8, 9, 36, 37, 50, and Area Q.)*

Barium may be available as $Ba(NO_3)_2$, which is used as an oxidizing agent and included in double-base solvent (M26) and solventless (M2, M5) formulations.

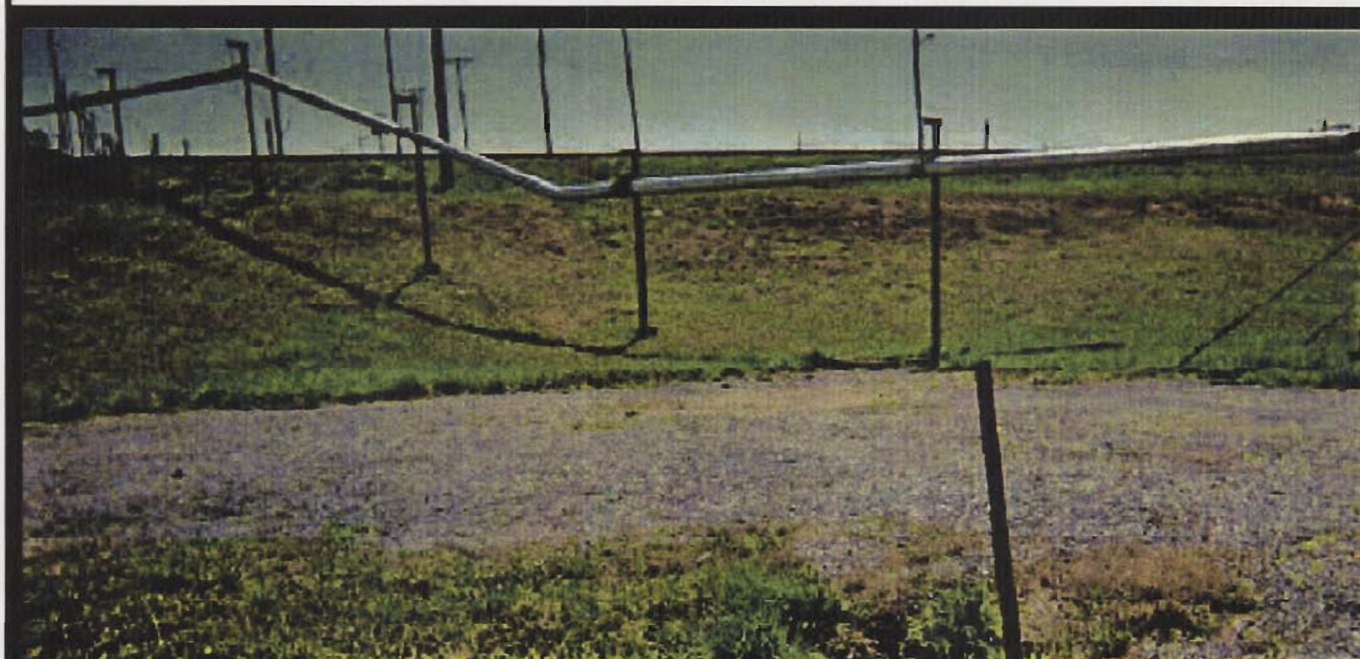
Propellant	Percent by weight
M2	1.4±0.25
M5	0.5±1.6
M26	0.75±0.2

4.0 RECOMMENDED ACTION

Discrete sludge samples will be collected for explosives, metals, and SVOCs to verify VI no further action recommendations.

DSERTS #: RAAP-010 **NITROCELLULOSE LINE A-RAINWATER DITCH** **RRSE: 1A**

AREA A



1.0 BACKGROUND

Area A is located near Building 1558 in the NC A-Line production area. A low depression in the soil, which appears to be an unlined rainwater ditch approximately one foot deep, was identified during the April 1987 Visual Site Inspection as being void of vegetation and exhibiting discolored soil. The culvert appears to receive runoff from the A-Line (Visual Inspection Field Notes, 1987).

2.0 ENVIRONMENTAL SETTING

Area A is located in the eastern portion of the Main Manufacturing Area, approximately 600 feet west of Area O. According to geologic mapping of the base conducted by Parsons Engineering-Science (1996), bedrock under Area A is the Elbrook Formation. The area also rests atop unconsolidated Quaternary terrace deposits, which generally consist of poorly stratified deposits of dark brown to dark reddish-brown, well-rounded cobbles in an extensively weathered soil matrix. The thickness of unconsolidated sediments is unknown.

General groundwater flow direction in the vicinity of Area A is northeast toward the New River and Stroubles Creek. However, northeastward flow may be disrupted by karst features in the underlying bedrock. Area A is situated in or near a sinkhole and there are several fractures nearby.

Surface water runoff in the area is mainly through culverts such as the ditch identified in Area A. The direction of eventual discharge is northeast to Stroubles Creek or north to the New River. It is unknown whether there are storm drains or manholes in the vicinity.

3.0 PREVIOUS INVESTIGATION

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection that identified the ditch as an area of concern.

No sampling or further investigations have been reported in existing documents for Area A.

4.0 RECOMMENDED ACTION

Sample available media for metals and SVOCs to support the site screening process.

DSERTS #: RAAP-011 RED WATER ASH BURIAL GROUND RRSE: 1A

SWMU 41

1.0 BACKGROUND

SWMU 41 consists of two non-contiguous disposal areas, an unlined lagoon and a landfill. The lagoon is located approximately 100 feet west of Stroubles Creek (Figure 5-11.1).

Red water was a waste product generated during the production of TNT. Its name is derived from its characteristically intense red color. Red water contained numerous TNT byproducts, including alpha, beta, and gamma TNT isomers and TNT sodium disulfates. It characteristically had a pH of approximately 8 and consisted of approximately 30 percent solids. Red water is a listed hazardous waste (K047). Red water ash has been described as yellowish-tan in color when dry. When wet, it turns a dark red and generates a dark red leachate. It is corrosive and fine-grained, though it may contain large clinkers.

From 1968 to 1972, prior to construction of the red water treatment plant, red water was concentrated by evaporation and burned in four rotary kilns located in the TNT manufacturing area (USATHAMA, 1976). The ash produced from these kilns was disposed of in SWMU 41 and SWMU 51 (TNT Neutralization Sludge Disposal Area).

The larger of the two disposal areas at SWMU 41 was a landfill that was never permitted and did not undergo formal closure. The unit was used for red water ash disposal from approximately 1967 to 1971. The approximate size of the unit is 150 feet long by 100 feet wide', and it is located within a larger, relatively flat fill area approximately 600 feet southwest of the lagoon and 150 feet west of a tributary of Stroubles Creek. RFAAP personnel have described the landfill as an excavated bowl that was lined with clay soils prior to ash disposal. The ash is suspected to be approximately 20 feet deep in places. Following disposal, the USACE used this area as the disposal area for "clean" soil excavated at nearby building construction sites. Up to 30 feet of this soil may be present over the ash.

A second ash disposal area approximately 70 feet long by 50 feet wide is located 600 feet to the northeast. This area consisted of an unlined lagoon that received runoff from the washing of trucks used to haul red water ash. Ash was also disposed of in the lagoon, which was eventually covered with four to six feet of soil.

Potential leachate from the lagoon has reportedly been observed downslope from the disposal area, in the vicinity of Stroubles Creek.

From 1972 to 1974, the red water was sold to the paper industry.

2.0 ENVIRONMENTAL SETTING

SWMU 41 is located in the southeast section of the Main Manufacturing Area at RFAAP, east of the barracks area and adjacent to the out-of-service TNT wastewater treatment unit.

The topography in the immediate area of the lagoon is moderately sloping northeast towards Stroubles Creek. The elevation of the lagoon is approximately 1,770 to 1,780 feet msl.

The topography in the area of the landfill slopes lightly over the plateau area and then slopes steeply towards the creek on the northeast. The elevation of the landfill ranges from 1,803 feet msl on the southwestern side to 1,795 feet msl on the northeastern side.

Subsurface conditions were investigated during the VI (Dames & Moore, 1992) through the drilling of soil borings in the vicinity of and within the SWMU. Soil borings installed in the upper plateau area and also downgradient of the landfill area indicated the presence of fill extending from the ground surface to weathered bedrock at approximately 30 feet. Encountered soils were generally described as silty clay.

The soil boring installed in the center of the Red Water Ash Lagoon was advanced to a depth of 15 feet bgs. Ash was encountered between a depth of 6 to 13 feet bgs. Soils below the waste appeared to be natural and were generally described as silty clay.

Weathered bedrock was generally encountered at approximately 30 feet bgs. The bedrock surface slopes northward at approximately 15 to 25 percent in the upper plateau area. Rock corings were completed in two of the borings through a maximum bedrock thickness of approximately 70 feet. Bedrock was generally described as highly interbedded argillaceous gray limestone and dolostone with occasional thick beds of green shale limestone and dolostone included brecciated and conglomeratic zones and vuggy and filled surfaces. Evidence of faulting and deformation of the limestone/dolostone bedrock is evident and likely the result of intense deformation associated with the geologic thrust sheet fenster in this area of RFAAP.

Groundwater flow is northeast to Stroubles Creek. An unconfined groundwater table was encountered within bedrock at depths ranging from 20 to 50 feet bgs.

Surface water from the landfill appears to flow northeastward towards a tributary of Stroubles Creek. The tributary flows north and discharges into Stroubles Creek, just south of the lagoon. Surface water from the lagoon appears to flow east/northeast and discharges into Stroubles Creek, which flows north and discharges to the New River, approximately 2,800 feet north of SWMU 41.

There are paved roads, out-of-service equalization basins, a subcontractor storage yard, and the inactive TNT area in the vicinity of SWMU 41. There is also a softball field across Stroubles Creek several hundred feet northeast of the lagoon.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.

- **1992 - Verification Investigation, Dames & Moore,** included the collection and analysis of groundwater samples in the vicinity of the landfill, ash and soil samples from the lagoon north of the landfill, and a surface water sample from Stroubles Creek.

SWMU 41 is composed of two non-contiguous disposal areas, the landfill and a lagoon area. To evaluate the potential impact of buried red water ash on the groundwater quality in the vicinity of the landfill, three monitoring wells were installed. Additionally, ash and soil samples from the lagoon north of the landfill and a surface water sample from Stroubles Creek were obtained.

3.1 SOIL

Two subsurface soil samples were collected from one soil boring in the lagoon. One sample was collected from the landfill ash material, and one was collected from underlying soil. Analytical results are presented in Table 5-11.1. The same 16 metals were detected in both the ash and underlying soil samples collected from the former wastewater lagoon. ***Arsenic*** and ***cobalt*** exceeded HBN criteria. Aluminum, barium, calcium, lead, magnesium, manganese, potassium, sodium, and zinc concentrations were higher in the ash sample than in the underlying soil sample, but did not exceed HBN criteria.

Neither explosives nor SVOCs were detected in the ash or soil sample.

3.2 GROUNDWATER

Eleven metals were detected in groundwater samples collected from three wells installed near the landfill. ***Antimony*** exceeded its HBN in well 41MW2 (Table 5-11.2). Sample 41MW2, collected downgradient and nearest the landfill, exhibited the highest concentrations of many of the inorganic constituents. One SVOC, ***bis(2-ethylhexyl) phthalate,*** was identified in one sample (41MW2) at a concentration of 5.64 µg/L, which slightly exceeded the HBN criterion of 3 µg/L.

3.3 SURFACE WATER

Seven metals were detected above the PQLs in the surface water sample collected in Stroubles Creek (Table 5-11.3). The metals are common earth elements that are expected to be dissolved in surface water and were reported at concentrations less than the HBN criteria. One explosive (246TNT) was detected in the sample but was reported at a level less than the HBN criterion. No SVOCs were detected in the creek sample.

The source for the 246TNT in the surface water sample cannot be identified as SWMU 41 since no explosives were detected in any of the on-site samples. Two non-site scenarios are possible for the 246TNT in the Stroubles Creek sample based on the known RFAAP history. One is that material in Stroubles Creek or a tributary was adversely impacted when the TNT area was destroyed by the explosion in 1974. A second scenario is that the karst geology is resulting in an upgradient discharge of contaminated groundwater from an off-site source area, such as SWMU 17 (Contaminated Waste Burning Areas).

4.0 RISK ASSESSMENT

Summary of Screening Level Risk Assessment

Samples Collected

Groundwater upgradient and downgradient of the landfill; subsurface soil from the center of the lagoon; and surface water where lagoon seep enters Stroubles Creek.

Medium	No.	Location
Groundwater	1	Upgradient
	2	Downgradient
Subsurface	1	6-13′
	1	Under ash
Surface water	1	Seep

4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

COPCs were selected based on results exceeding HBNs and background. Groundwater was the only medium that had exceedances for arsenic and bis(2-ethylhexyl) phthalate. Bis(2-ethylhexyl) phthalate was deleted because of its detection in blanks associated with the sample.

4.2 EXPOSURE ASSESSMENT

No shallow groundwater wells other than for monitoring purposes are located downgradient of SWMU 41. Shallow groundwater would not likely migrate toward any groundwater users in the vicinity of RFAAP since it most likely discharges to the tributary of Stroubles Creek. RFAAP will continue to remain an active army installation, and there are no plans for future residential development. Therefore, it is highly unlikely that drinking water wells would be installed in the future between SWMU 41 and the tributary of Stroubles Creek. Although there is the potential for workers or trespassers to contact the surface water of the Stroubles Creek tributary, these events would presumably be isolated and infrequent. Based on this evaluation, potential groundwater exposure pathways for humans are not considered operable under the current or future land use scenario.

In addition, there is the potential for impacted aquatic life due to discharge. Although data are insufficient for establishing aquatic life criteria for antimony, the LOEL for chronic effects to freshwater aquatic life is reported as 1,600 µg/L (USEPA, 1986). Because antimony was detected at a concentration of 68 µg/L in hallow groundwater and dilution is expected to occur upon discharge to the tributary of Stroubles Creek, this one low detection of antimony in SWMU 41 groundwater does not appear to be of concern.

If groundwater and/or surface water COPCs are selected based on the review of future analytical data, then the quantitative evaluation should be considered for the following exposure pathways:

Groundwater

- Ingestion of chemicals in groundwater by future workers.

Surface Soil

- Incidental ingestion of chemicals in soil by future workers; and
- Dermal absorption of chemicals in soil by future workers.

Subsurface Soil

- Incidental ingestion of chemicals in subsurface soil by future workers;
- Dermal absorption of chemicals in subsurface soil by future workers; and
- Inhalation of ash particulates by future excavation workers.

Sediment

- Incidental ingestion of chemicals in sediment by trespassers playing in Stroubles Creek; and
- Dermal absorption of chemicals in sediment by trespassers playing in Stroubles Creek.

Surface Water

- Incidental ingestion of chemicals in surface water by trespassers playing in Stroubles Creek; and
- Dermal absorption of chemicals in surface water by trespassers playing in Stroubles Creek.

5.0 RECOMMENDED ACTION

Collect confirmatory samples from available media and analyze for metals, explosives, and SVOCs to support the site screening process.

DSERTS #: RAAP-012 ACID WASTEWATER LAGOON RRSE: 2A

SWMU 6

1.0 BACKGROUND

The Acidic Wastewater Lagoon (SWMU 6) was an unlined surface impoundment that was filled in 1987. The lagoon was located approximately 2,000 feet northwest of the Administration Area (Figure 5-12.1). The lagoon, described in previous investigation reports as "tear-dropped" or "triangular" in shape, was approximately 80 feet long by 30 feet wide at its widest point. From 1974 to 1980, the lagoon received overflow and rinse waters from an acid storage tank area in the C-Line NC manufacturing area. The lagoon received wastewaters that typically exhibited the characteristic of a corrosive liquid (D002). There were no overflow controls at the lagoon.

Between 1980 and 1987, the C-Line NC manufacturing area was shut down, including the acid wastewater lagoon. In 1987, the lagoon was filled with soil and replaced by a cement holding tank from which water flowed to the C-Line Waste Acid Treatment Plant, Building 420-2. RCRA closure activities have not occurred at SWMU 6 (USEPA, 1987).

2.0 ENVIRONMENTAL SETTING

SWMU 6 is a flat level area, approximately 1,800 feet msl, located between two upland ridges in the middle of the industrial area. To the north, the ridge rises approximately six feet; the ridge to the south rises approximately 10 feet. SWMU 6 is located where buildings, overhead pipes, railroad tracks, and asphalt road are present. The lagoon was completely filled, and the area is now level with adjacent areas and covered with grass.

SWMU 6 is suspected to occupy a collapsed sinkhole because of a history of collapses and subsidences of roads and foundations near the former lagoon. Previous investigations in SWMU 6 conducted in 1981 encountered subsurface cavities during the drilling and installation of monitoring wells MW13, MW14, MW15, and MW16. Also, 300 pounds of filter sand was reportedly lost into a subsurface cavity during the grouting of well MW16 (USAEHA, 1981).

A geophysical survey investigation conducted at SWMU 6 in 1984 indicated the presence of a soil horizon at 17.6 feet bgs.

This horizon was interpreted as a lithologic change in the overburden. A break in the profile was interpreted as a possible collapsed sinkhole (USACE, 1984).

Generally, the subsurface conditions encountered in the vicinity of SWMU 6 consist of a reddish-brown silty clay extending in each boring to bedrock or borehole termination. Depth to Elbrook Formation bedrock ranged from 21 feet to greater than 45 feet. Two additional borings performed in the depression within SWMU 6 for the VI program confirmed these findings.

Infiltration into the sinkhole would probably result in rapid groundwater flow through fractures and cavities away from SWMU 6 toward the New River; however, the actual path and direction of the flow cannot be easily determined due to the karst nature of the bedrock. Groundwater has occasionally been present in monitoring wells MW14 and MW15 and may be the result of perched water within the overburden clay layer rather than unconfined water table conditions.

Based on topography, surface water runoff from upland ridges on the northern and southern sides of the SWMU is expected to flow into the SWMU area. The surface runoff within SWMU 6 likely flows into storm sewer catch basins that are located on the northeast and southeast ends of the SWMU.

3.0 PREVIOUS INVESTIGATIONS

- **1981 - Army Pollution Abatement Study, USAEHA,** included the installation of four monitoring wells.
- **1987 - RCRA Facility Assessment, USEPA,** identified acid wastewater lagoon and conducted preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included the sampling and analysis of four soil samples and one groundwater sample.

In 1987, the lagoon was filled with soil and replaced by a holding tank, from which water flows to the C-Line Waste Acid Treatment Plant, Building 420-2. Because RCRA closure activities had not occurred at SWMU 6, samples were collected to characterize the subsurface conditions below the fill material.

3.1 SOIL

Four soil samples were collected from two soil borings in the Acid Wastewater Lagoon and were analyzed only for metals. One sample from each boring was collected at a depth ranging from 14 to 18 feet in soil suspected to be contaminated by past waste disposal activities. A second sample was collected from presumably "clean" soil below the suspected contaminated zone at a depth of 20 to 22 feet. Table 5-12.1 presents the data for sample results exceeding the PQL. (***Arsenic, cobalt,*** and ***thallium*** exceeded the HBN criteria. However, ***thallium*** did not exceed the PQL.)

3.2 GROUNDWATER

Three additional wells are located in the vicinity of the SWMU; however, the wells were dry during the sampling event. One groundwater sample was collected at MW13 and analyzed for metals only. Six metals were detected above the respective PQL as shown in Table 5-12.2; metal concentrations were less than HBN criteria and were not considered a concern at the site.

4.0 RECOMMENDED ACTION

Collect confirmatory samples from available media to support the site screening process no further action recommendation.

DSERTS #: RAAP-013 REDWATER ASH BURIAL #2 RRSE: 1A

SWMU 49

1.0 BACKGROUND

SWMU 49 is contiguous to SWMUs 48 and 50. During the 1987 RFA, the three SWMUs were classified together because no distinction could be made between the areas by visual observation. During the 1992 VI and the 1996 RFI, a potential location for SWMU 49 was not stated, but SWMU 48 was divided into an upper and a lower disposal area. SWMU 49 was determined to be the area of SWMU 48 called the "lower disposal unit" by previous investigations.

Although disposal at SWMUs 48, 49, and 50 reportedly took place in the 1970s, all the units are currently inactive. SWMU 49 was identified from aerial photography as disturbed ground during active disposal in the contiguous SWMUs. SWMU 49 reportedly received 10 tons of redwater ash during its active life. There are no known release controls for the unit. No visual signs of release were noted during the April 1987 Visual Site Inspection.

2.0 ENVIRONMENTAL SETTING

SWMU 49 is located in the Horseshoe Area, approximately 3,400 feet east of the main bridge over the New River. The estimated dimensions of the SWMU are 75 feet by 50 feet (Figure 5-13.1) (Parsons Engineering, 1996). It is located adjacent to a narrow drive constructed of gravel and bottom ash, 30 feet south of SWMU 59 and 75 feet east of SWMU 50. Approximately 100 feet south of SWMU 49, the topography forms a ridge crest and then slopes steeply down to the New River. The elevation of the SWMU is 1,820 feet msl, about 120 feet above the New River. The area is grassy and wooded with young trees.

Subsurface conditions in the vicinity of SWMU 49 were characterized during subsurface investigative activities at the unit. The subsurface geology consists of alluvium and residual deposits (physically and chemically weathered bedrock) consisting of clay and silt with some sand and gravel. Depth to bedrock is 63 feet bgs. Bedrock consists of highly fractured interbedded siltstone, limestone, and dolomite of the Elbrook Formation. The Max Meadows Breccia is evident in outcroppings along the slope leading to the river. In the outcrop along the slope immediately south of SWMU 49, the tectonic breccia and the limestone and dolomite is highly weathered with many solution cavities.

Groundwater was encountered in bedrock varying from 99 feet bgs (1757 feet msl) in the north to 122 feet bgs (1682 feet msl) in the south. The groundwater gradient was found to be 0.072 ft/ft to the south, toward the New River. Observations and measurements of the groundwater are consistent with karst subsurface features. Two fracture traces oriented north-south have been identified near the SWMU, one approximately 650 ft west of the SWMU and one approximately 100 ft east of the SWMU. A less prominent east-west fracture trace has been identified just north of the SWMU.

Groundwater occurrence in the vicinity of SWMUs 16, 30, and 51, slightly north of the study area, is not consistent with the bedrock groundwater table found in the wells at SWMUs 48 and 49. Groundwater in monitoring wells 16-4, 51MW1, and 51MW2 was encountered as much as 70 feet higher in elevation. It is possible that this area represents a different groundwater zone and that a perched water table may be present in the sediments overlying the bedrock (although these wells were partially screened in rock). It is likely that this groundwater zone eventually discharges to the New River as well, but the hydraulic relationship between the shallow groundwater and the groundwater measured in the wells at SWMUs 48 and 49 is not completely understood.

Based on topography, surface water runoff from SWMU 49 is expected to flow approximately 700 feet southwest to the New River. According to RFAAP utility maps, there are no manholes, catch basins, or storm drains located in the immediate vicinity of SWMU 49.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included the collection of one subsurface soil sample from one boring and a subsurface soil gas survey.
- **1996 - RCRA Facility Investigation, Parsons Engineering-Science,** included hydrogeologic investigations, installation and sampling of four SWMU-vicinity monitoring wells (6 subsurface soil samples, 4 groundwater samples), one soil boring (2 samples), and 3 surface soil samples.
- **1998 – RCRA Facility Investigation, ICF Kaiser,** included one soil boring (6 subsurface soil samples) and three groundwater samples from existing monitoring wells 48MW1, 48MW2, and 48MW3.

The VI field program at SWMU 49 included the collection and analysis of one soil sample to determine the presence of contaminants. A subsurface soil gas survey was conducted to further investigate apparent petroleum fuel contamination of soils. In addition, a baseline risk assessment was conducted to further investigate human and environmental exposure pathways. The risk assessment combined soil and groundwater samples from SWMUs 48 and 49.

The 1996 RFI was undertaken to determine the source and extent of the contamination detected during the VI beneath SWMU 49, to address any impact on groundwater quality, and to further assess the possible presence of explosive contamination in SWMU 49.

The 1998 RFI was undertaken to (1) determine the level and extent of contamination, (2) determine whether contamination was leaching into the groundwater, and (3) to confirm previous investigation data associated with this SWMU. Sampling locations are shown in Figure 5-13.1

3.1 VERIFICATION INVESTIGATION

3.1.1 Soil

One sample was collected at 20 feet bgs from boring 48SB3. This soil sample exhibited a fuel-like odor. All samples were analyzed for metals, VOCs, and SVOCs.

Metals, VOCs, and SVOCs detected above the PQL are presented in Table 5-13.1. ***Beryllium*** and ***cobalt*** were the only parameters exceeding HBN criteria.

3.1.2 Subsurface Soil Gas Survey

A subsurface soil gas survey was performed at SWMU 49 in the vicinity of soil boring 48SB3 to further investigate apparent petroleum fuel contamination of soils.

Eight soil gas samples, spaced on a 50-foot grid, were collected at a depth of 4 feet, and were analyzed for pentane/MBTE, benzene, toluene, ethylbenzene, and xylenes. Results of the soil gas survey indicated that concentrations of subsurface vapors for the above analytes were below detectable limits (1.0 ppb) except for one sample that exhibited a total volatile concentration of 1.1 ppb, which was slightly above the detection limit.

The absence of detectable concentrations of volatile petroleum compounds during the soil gas survey correlated with the low concentrations of VOCs detected in soil samples from soil boring 48SB3. SVOCs present at 20 to 22 feet bgs were not detectable during the soil gas survey.

3.2 RCRA FACILITY INVESTIGATION- 1996

To support RFI objectives, the following investigation activities were performed:

- Installation of one upgradient and two downgradient monitoring wells around SWMU 49;
- Collection and analysis of two subsurface soil samples (deep and shallow) from each of the three well borings and one boring in the center of the SWMU to define the extent and boundaries of the area impacted by the disposed wastes;
- Collection and analysis of groundwater samples from the upgradient and two downgradient monitoring wells; and
- Collection of three surface soil samples to assess potential surface exposure routes.

3.2.1 Soil

Three surface soil samples were collected and analyzed for metals, SVOCs, and TPH. The results for analytes detected over PQLs are presented in Table 5-13.2. ***Arsenic*** and ***beryllium*** concentrations were detected above HBN criteria.

Two subsurface samples were collected from soil boring 48SB5 at depths of 19 and 37 feet. Subsurface samples were analyzed for SVOCs and TPH. The results for analytes detected over PQLs are presented in Table 5-13.2. The TPH result was very high in the shallow 48SB5 sample (3,570 µg/g). None of the reported analytes were above HBN criteria.

3.2.2 Groundwater

Groundwater samples were collected from all four SWMU-vicinity monitoring wells. Field measurements of the groundwater were also recorded. Slug insertion and removal aquifer tests were performed on the three lower disposal area monitoring wells. Sampling in three wells occurred in January 1995. 48MW4 was installed and sampled in July 1995. All four groundwater samples were analyzed for metals, VOCs, and SVOCs. Additional parameters analyzed for in the three lower disposal area wells included TOC, TOX, TPH, chloride, hardness, and COD. The results for analytes detected over PQLs are presented in Table 5-13.3.

HBNs were exceeded in several well samples including the following:

- ***eryllium*** in the SWMU 49 upgradient and two downgradient wells;
- ***11DCA*** and ***TCE*** in 48MW1 located upgradient of SWMU 49;
- ***Bis-(2 ethylhexyl phthalate)***, ***TCE***, and ***carbon tetrachloride*** in wells 48MW2 and 48MW3 located downgradient of SWMU 49.

3.3 RCRA FACILITY INVESTIGATION – 1998

3.3.1 Subsurface Soil

Six subsurface soil samples were collected from one soil boring (49SB1) advanced to a depth of sixty feet to determine whether contamination was leaching to the groundwater. Samples were collected at ten-foot intervals and analyzed for metals, VOCs, SVOCs, and explosives. The analytical results for detected metals are presented in Table 5-13.4, and for organics in Table 5-13.5.

Detected metal results indicated that ***arsenic***, ***chromium***, and ***iron*** concentrations were detected above residential RBCs in all six samples, with the exception of ***chromium***, which did not exceed the residential RBC criterion in sample 49SB1B. ***Arsenic*** concentrations exceeded the industrial RBC in samples 49SB1C, 49SB1D, and 49SB1E, collected at depths of 28-32, 38-40, and 48-50 ft bgs, respectively.

Trace level organics were detected below residential RBC criteria and included VOCs (ethylbenzene, o-xylene, m-xylene and p-xylene), PAHs, and explosives (***2-am-4,6-DNT***, ***TETRYL***, and ***2,4,6-TNT***).

3.3.2 Groundwater

Groundwater samples were collected from the three existing monitoring wells to confirm previous 1996 RFI results that exceeded HBNs. Samples were analyzed for total and dissolved metals, VOCs, SVOCs, explosives, pH, TOC, and TOX. The analytical results for detected metals are presented in Table 5-13.6 and for organics in Table 5-13.7.

Metals results indicated that only iron concentrations were detected above the Tap Water RBC criterion in the total metals fraction in downgradient monitoring well 48MW2.

Organic results indicated that three VOCs (***carbon tetrachloride***, ***trichloroethene***, and ***1,2-dichloroethane***) were detected above the Tap Water RBC criteria in all three wells.

4.0 RECOMMENDED ACTION

Supplementary RFI activities are recommended at SWMU 49 to (1) determine the nature, extent, and source of organic groundwater contamination at the unit, (2) augment previous investigation data, and (3) enhance the current site conceptual model.

A quantitative baseline risk assessment will be performed in conjunction with SWMU 48.

DSERTS #: RAAP-014 PROPELLANT BURNING ASH DISPOSAL AREA RRSE: 1A

SWMU 54

1.0 BACKGROUND

SWMU 54 is an inactive disposal area for ash from the Incinerator Propellant Burning Ground (SWMU 13). Ash from propellant burning operations at SWMU 13 was reportedly disposed of at SWMU 54 during the late 1970s, prior to startup of the Hazardous Waste Landfill (HWMU 16) in 1980. The quantity of ash disposed of in this unit is estimated to be 10 tons (USATHAMA, 1976).

According to plant personnel, disposal occurred on the surface, with no routine disposal in pits or trenches. Ash residue is visible where surface soil has been disturbed.

There are two known areas of disposal at SWMU 54. The southern unit (Area A) was delineated and investigated during the VI (1992) and the CMS (1996). The northern unit (Area B) was identified during the RFI (1997) and is currently under investigation.

2.0 ENVIRONMENTAL SETTING

The Propellant Burning Ash Disposal Area (SWMU 54) is located in the easternmost section of the Horseshoe Area, just outside Gate 19-D of the RFAAP fence (Figure 5-14.1). SWMU 54 is generally a flat level area with a ground surface elevation of approximately 1,700 feet msl.

The disposal areas are visible as grassy clearings with irregular surface topography. The southern unit is an elongated triangular area of hummocky grass-covered soil, with several 2- to 4-foot high piles and 3- to 5-foot deep pits. The northern unit is a gently sloping grass-covered area containing several broad, indistinct mounds approximately 2 to 4 feet high. The total area of the SWMU is estimated to be less than 1 acre.

SWMU 54 is bordered to the east, west, and north by tree-covered areas and to the immediate south by a grassy flat area. The New River is located approximately 180 feet east of the SWMU.

Subsurface conditions at the southern unit were evaluated during the VI (Dames & Moore, 1992) through the drilling of soil and rock borings. Fine-grained, loose to medium dense, micaceous silty sands underlain by a thin layer (1 to 3 feet) of silty gravel over bedrock was encountered. The silty gravel layer generally became thicker downgradient of the SWMU. Greenish-gray shale and limestone bedrock were encountered at approximately 19 to 21 feet bgs and was penetrated to a depth of approximately 60 feet bgs. Shale and limestone were highly interbedded and generally soft and weathered.

Groundwater flow is eastward toward the New River at a hydraulic gradient of approximately 1 to 2 percent. A relatively shallow, unconfined groundwater table was encountered within the fractured shale and limestone bedrock at the southern unit. Subsequent stabilized groundwater levels were measured at approximately 18 to 23 feet bgs within the silty sand layer upgradient and within the silty gravel downgradient of the SWMU. Surface water runoff is expected to flow eastward, with discharge to the New River.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** identified the disposal area for ash from burning of propellants and conducted preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** conducted at the southern unit to evaluate whether groundwater quality had been impacted by ash disposal; VI activities included the installation and sampling of 3 groundwater wells.
- **1996 – RCRA Facility Investigation, Parsons Engineering-Science,** soil samples were collected at the southern unit to define the extent of ash and the limits of soil contamination; groundwater samples were collected from each of the three monitoring wells; one surface water and one sediment sample was collected from the New River at the likely discharge point of groundwater from beneath the southern unit of the SWMU.
- **1997 – RCRA Facility Investigation, ICF Kaiser,** soil borings were advanced in the northern unit of the SWMU to determine the presence of contamination associated with disposal activities.
- **1998– Supplemental RCRA Facility Investigation, Alliant Techsystems, Inc.**, included a geophysical survey, installation of a new groundwater monitoring well and the collection and analysis of soil, groundwater, and a waste sample(s) to characterize the nature and extent of contamination and summarize potential risks to humans.
- **1999 – Interim Action, U.S. Corps of Engineers, Norfolk District**, investigative activities were performed at the SWMU in conjunction with the CMS.

During the 1987 RCRA Facility Assessment (RFA), a sample of the ash disposed in the Hazardous Waste Landfill (HWMU 16) was analyzed for RCRA metals. Results indicated that the ash content exceeded the Virginia maximum allowable TCLP concentration for lead (51 mg/l, compared with the maximum allowable concentration of 5 mg/l) (USEPA, 1987). It was assumed that ash disposed of in the southern unit of SWMU 54 exhibited similar characteristics.

Sampling locations are shown in Figure 5-14.1.

3.1 VERIFICATION INVESTIGATION

Three wells (one upgradient and two downgradient of the disposal area) were installed at the southern unit during the VI to evaluate whether groundwater quality had been impacted by ash disposed of in the unit. The maximum depth of these wells is 60 feet.

3.1.1 Geophysical Survey

The southern unit (Area A) of SWMU 54 is one of four areas at the facility for which geophysical methods were employed in order to delineate the boundaries of the area and to locate buried materials.

Electromagnetic (EM) and magnetic surveys were conducted at the southern unit to map possible locations of ash disposal. EM and magnetic readings were measured at intervals of 15 feet along north-south transects made at 15-foot spacings. These spacings were considered appropriate given the size and physical characteristics of the site. The survey covered an area 135 feet by 300 feet.

The anomalies in the EM and magnetic data centered at the southern mound and pit appear to be from a combination of buried conductive materials and metals. This could represent an object roughly the size of 800 pounds of iron, with the surrounding soil having a high conductivity. The conductivity anomalies were never negative, which indicates that if they are caused by metal, the metal would be located relatively deep in the ground. The anomaly in the EM data found at the northern mound and pit appears to indicate burial of non-metallic material. The pits in these two areas appear to be borrow areas for cover material for the mounds.

3.1.2 Groundwater

The VI field program at the southern unit included the analysis of three groundwater samples collected from one upgradient well (54MW1) and two downgradient wells (54MW2 and 54MW3). Wells 54MW2 and 54MW3 downgradient of the southern disposal area and were constructed to intercept groundwater in the first water-bearing formation below the site. Samples were analyzed for TAL metals, explosives, VOCs, and SVOCs. The results of the chemical analyses of the groundwater samples indicated that low concentrations of two explosives and one VOC were present in groundwater samples collected downgradient of the southern disposal area. However, these concentrations did not exceed HBN criteria and were not considered a concern. Results of the chemical analyses are presented in Table 5-14.1.

A number of metals were detected in the three groundwater samples collected at the southern unit of SWMU 54. Concentrations of all metals were one or more orders of magnitude less than applicable HBN criteria and were not considered a concern.

Two explosives, 246TNT and HMX, were detected in downgradient groundwater samples 54MW2 and 54MW3, respectively, but were not detected in the upgradient sample. Concentrations reported were less than the HBN criteria.

Carbon disulfide was the only VOC detected in all groundwater samples. This compound is usually a natural VOC derived from decomposing organic matter and was not considered a concern at this SWMU because levels were below the HBN. TOC and TOX levels decreased slightly in the downgradient direction and suggested that the southern unit of SWMU 54 had no impact on TOC and TOX concentrations. No primary target SVOCs were detected in any samples.

3.2 RCRA FACILITY INVESTIGATION - 1996

Soil, sediment, surface water, and groundwater samples were collected and analyzed during the 1996 RFI to define the extent of contamination at the unit.

The focus of the 1996 RFI investigation was the southern unit (Area A). A total of 16 soil borings were installed around and below the north and south mounds located within the southern unit. Discreet subsurface soil samples were collected from shallow (0 to 2 feet) and deep (15 to 17 feet) depths, with the exception of the hand-augured sample 54SB15 collected between 4 to 6 feet. Groundwater samples were collected from each of the associated monitoring wells. One composite sample was collected from the north and south mounds for waste characterization purposes.

3.2.1 Subsurface Soil

Thirty-three subsurface soil samples were collected and analyzed for metals and explosives. Sample results greater than the PQL are presented in Table 5-14.2 In general, metal and explosive contamination was detected in shallow subsurface soil samples. Metal analytes detected above PQLs included arsenic, silver, barium, beryllium, cadmium, chromium, lead, mercury, and nickel. ***Mercury*** was considered to be a potential human health risk and determined to be one of the risk drivers for subsurface soils. Although lead was detected at human health threat levels, the concentrations were not above lead background levels.

Explosive compounds detected above the method PQL included 24DNT, 246TNT, HMX, and RDX. 246TNT was considered to be a potential human health risk and determined to be one of the risk drivers for subsurface soils.

3.2.2 Groundwater

Three groundwater samples were collected from monitoring wells upgradient and downgradient of SWMU 54 and analyzed for metals, explosives, pH, TOC, and TOX (Table 5-14.1). Metal constituents detected above the PQL included: antimony, arsenic, barium, beryllium, chromium, and lead. ***Antimony, arsenic,*** and ***beryllium*** were detected at concentrations considered to be potential human health risks and were characterized as groundwater risk drivers.

HMX was the only explosive compound detected above the method PQL and was characterized as the organic risk driver for groundwater.

3.2.3 Surface Water

Surface water sample NRSW5 was collected during the RFI from a location downriver of SWMU 54 and was analyzed for metals, explosives, pH, TOC, and TOX. A duplicate, NRSW8, was collected from this area, and analytical results were compliant with Region III precision criterion for aqueous samples. Barium was the only analyte detected above the PQL, and the concentration was below the HBN (Table 5-14.3).

3.2.4 Sediment

Sediment sample NRSE5 was collected and analyzed for metals and explosives. Arsenic, beryllium, lead, nickel, and 246TNT were detected in the New River sediment sample collected downriver of the SWMU (Table 5-14.4). The presence of these analytes in the sediment suggest potential migration from subsurface and groundwater media.

3.2.5 Waste Characterization

The south mound composite waste ash sample exceeded the TCLP lead regulatory level. The Hazardous Waste Landfill (HWMU 16) ash exhibited similar lead characteristics. TCLP results confirmed the assumption that ash disposed of in SWMU 54 exhibits a similar characteristic to the ash disposed of in HWMU 16.

3.3 RCRA FACILITY INVESTIGATION - 1997

Soil samples were collected at the unit during the 1997 RFI to determine the presence of contamination associated with disposal activities.

Three soil borings were advanced in the northern unit (Area B) of the SWMU to determine the nature and extent of contamination associated with previous disposal activities. Sample locations were selected using a biased strategy that was based on visual observations of ground disturbance and recommendations from facility representatives.

Soil boring results indicated the presence of a disposal area within a raised mound at boring location A. Visual observations indicated the presence of nitrocellulose at depths of 3.5 and 7.0 feet bgs and rolled propellant at a depth of 4.0 to 7.0 feet bgs. On-site analysis performed by the installation verified the presence of nitrocellulose.

3.4 SUPPLEMENTAL RCRA FACILITY INVESTIGATION – 1997

One monitoring well was installed and a geophysical survey and soil sampling were conducted at the SWMU during the 1997 Supplemental RFI to characterize the nature and extent of contamination and summarize potential risks to humans.

Supplemental RFI activities were limited to the northern unit (Area B) of the SWMU. Investigative activities included the installation of a downgradient monitoring well, a geophysical survey and the colection and analysis of two groundwater, twelve soil samples, and a waste characterization sample.

3.4.1 Geophysical Survey

A geophysical survey was conducted at the northern unit (Area B) using ground-penetrating radar (GPR) to locate potential burial areas (disturbed areas) where further investigation should be performed. The survey consisted of transects completed over the grass-covered (central) portion of the area. The survey stopped at the edge of the trees because mature growth indicated that no disturbances (burial) had occurred within the woods.

Preliminary results of the survey indicated that several potential shallow burial areas (less than five feet deep) and a few slightly deeper areas (less than 10 feet deep) existed within an area of approximately 0.25 acres.

3.4.2 Soil

Six surface and five subsurface soil samples were collected to characterize potential contamination at the northern unit (Area B). Subsurface soil borings were advanced to a depth of 10 ft bgs, with the exception of 54BSB3, which was advanced to 12 ft bgs. All samples were analyzed for SVOCs, VOCs, explosives, metals, and wet chemistry. A summary of detected results is presented in Table 5-14.5.

Analytical results indicated that four SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene] exceeded HBNs and residential RBCs. Six explosives were detected, four of which exceeded HBN criteria, and three exceeded residential RBCs. Arsenic, lead, and mercury were detected above HBNs and residential RBCs.

3.4.3 Groundwater

One groundwater monitoring well (54MW4) was installed downgradient of the disposal area inside the tree line at the northern unit (Area B). Groundwater samples collected from 54MW4 and 54MW1 were analyzed for SVOCs, VOCs, explosives, metals, and wet chemistry. A summary of the detected results is presented in Table 5-14.1.

Results indicated that only six metals and one explosive were detected below levels of concern in the two wells sampled. The available data suggested that groundwater is not contaminated at levels posing a risk to human health or the environment.

3.4.4 Waste Characterization

A composite sample (SC1) of soil mixed with ash residue was collected from the northern unit (Area B). The sample was analyzed for RCRA hazardous characteristics TCLP-SVOCs, VOCs, metals; ignitability; and reactivity. TCLP-metals were the only parameter detected above PQLs. A summary of detected results is presented in Table 5-14.5. Analytical results indicated that the sample did not exhibit hazardous characteristics.

3.5 INTERIM ACTION

An interim action was performed to remove 'hot spots' associated with previous disposal activities. The lateral and vertical extent of chemicals of concern was profiled, and soils demonstrating hazardous characteristics were removed.

Characterization of the southern unit (Area A) subsurface soils for high explosives and related residues included:

- Surficial soil characterization to determine the lateral and vertical contamination extent for interim measures implementation of fencing to prevent direct contact with contaminated areas. Surface soil samples were screened using immunoassay techniques to determine metal and explosive contamination. Sample results were used to position the perimeter fence to ensure its location was outside of the contamination zone.
- Subsurface high explosive and metals characterization to optimize the sampling and analysis program design for the excavation of samples exhibiting hazardous characteristics. A grid was established to delineate 'hot spot' areas for removal.
- Completion of 'hot spot' removal activities. Soils demonstrated to exhibit RCRA waste characteristics were removed and disposed of off-site in accordance with state and federal regulatory specifications.

4.0 RISK ASSESSMENT

Summary of Screening Level Risk Assessment

Samples Collected

Medium	No.	Location
Subsurface soil	14	0 to 2′
	2	10 to 15
	1	11 to 12′
	10	15 to 17′
	2	22 to 24′
Groundwater	1	Upgradient
	2	Downgradient
Surface Water	1	Downriver
Sediment	1	Downriver

4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

COPCs were selected based on results exceeding HBNs and background. Subsurface soil contaminants included arsenic, silver, barium, beryllium, cadmium, chromium lead, mercury, nickel, 24DNT, 246TNT, HMX, and RDX. Constituents justified for deletion included arsenic, silver, barium, beryllium, cadmium, chromium, nickel, and 26DNT.

4.2 EXPOSURE ASSESSMENT

The Commonwealth of Virginia has classified the stretch of the New River passing though the confines of RFAAP as water generally satisfactory for beneficial uses, which include public or municipal water supply, secondary contact recreation, and propagation of fish and aquatic life.

Additionally, the VI and RFI stated that this site should be recognized as an area for which potential exposure to human and environmental receptors is high, and that potential human receptors to propellant ash may consist of boaters, tubers, canoers, and other recreationists that may camp/picnic in this area.

The VI for SWMU 54 further stated that surface water runoff may cause migration of contaminants beyond the boundaries of the waste disposal area and could cause contamination of surface water or sediment in the New River. RFI sediment results confirmed this assumption.

An overview of the exposure assessment is presented in Table 5-14.6. Given the potential for recreationists to contact environmental media at the site, additional sampling is necessary at SWMU 54 in order to characterize the extent of contamination. Specifically, surface soil samples should be collected at the disposal area, and sediment samples should be collected along the banks of the New River closest to the site. As stated in the RFI, a corrective measures study is recommended for the purposes of defining methods of removing or immobilizing the ash.

If groundwater and/or surface water COPCs are selected based on the review of future analytical data, then the quantitative evaluation should be considered for the following exposure pathways:

Groundwater

- Ingestion of chemicals in groundwater by a future worker.

Soil

- Incidental ingestion of chemicals in soil by a future worker;
- Dermal absorption of chemicals in soil by a future worker;
- Incidental ingestion of chemicals in soil during deer hunting activities; and
- Dermal absorption of chemicals in soil by a recreational visitor.

Sediment

- Incidental ingestion of chemicals in sediment by a recreational visitor wading along the banks of the New River; and
- Dermal absorption of chemicals in sediment by a recreational visitor wading along the banks of the New River.

Surface Water

- Incidental ingestion of chemicals in surface water by a recreational visitor swimming in the New River; and
- Dermal absorption of chemicals in surface water by a recreational visitor swimming in the New River.

5.0 RECOMMENDED ACTION

Collect confirmatory groundwater and subsurface soil sampling to support the quantitative baseline risk assessment.

DSERTS #: RAAP-015 FLY ASH LANDFILL #1 RRSE: 3A

SWMU 26

1.0 BACKGROUND

SWMU 26 is a closed, unlined landfill originally called FAL No. 1, located in the south-central section of the Horseshoe Area, about 600 feet northeast of the main bridge over the New River (Figure 5-15.1). It is situated on the north slope of an east-west trending ridge that rises more than 170 feet above the river. The highest point on the landfill has an elevation of more than 1,850 feet msl. The landfill was formed by excavating a deep, flat-bottomed pit, primarily into the north sloping portion of the ridge (USACE, 1981). The unit is approximately 1,100 feet long by 250 feet wide.

Fly ash disposal at SWMU 26 began in 1971 (USATHAMA, 1984). Prior to 1971, fly ash was discharged directly to the New River. The VDEQ granted a solid waste management (groundwater) permit (Permit No. 399) to operate the landfill in April 1983. As per the permit, the landfill is currently monitored quarterly as a solid waste disposal unit. The permit specified that the landfill could receive "fly and bottom ash wastes from Powerhouses 1 and 2 on the plant premises."

This permit did not allow the disposal of asbestos or hazardous waste at the landfill. However, in addition to fly ash, unknown quantities of calcium sulfate sludge from SWMUs 36, 37, and 38, and asbestos were reportedly disposed of in the landfill (USEPA, 1987). During the active life of the unit, 60 to 100 tons/day of fly ash were reportedly disposed of in the landfill (USATHAMA, 1984). The landfill reached capacity and was closed in 1987. Quarterly groundwater monitoring is ongoing.

2.0 ENVIRONMENTAL SETTING

SWMU 26 is situated on the north slope of an east-west trending ridge that rises about 170 feet above the river. The SWMU itself is a large grassy field with an unimproved road on the southern boundary which leads to monitoring wells B1, B1R, and BDH3. Located approximately 100 feet to the west is a gravel trailer lot with SWMU 32 located west of this lot. Explosives storage buildings are located a few hundred feet west, north, and east of SWMU 26.

Soil and rock borings completed at and near SWMU 26 indicated the presence of two major lithologic units: unconsolidated sand with gravel and clay lenses overlying limestone/dolostone bedrock. The unconsolidated deposits consist primarily of fine- to coarse-grained, yellowish-brown sand.

Underlying the sand and gravel unit is the gray limestone/dolostone of the Elbrook Formation. Thirty-four field and laboratory permeability tests were conducted by USACE to determine the ability of the earth material at FAL No. 1 to transmit fluids. The unconsolidated material exhibits an average permeability of 4.06×10^{-3} cm/sec, with a range between 2.8×10^{-6} and 1.09×10^{-2} cm/sec. The lower permeabilities (2.8×10^{-6} cm/sec and 1.3×10^{-5} cm/sec) were found in the clay lenses of the unit. Average permeability of the sand and gravel sections of the unit is 6.62×10^{-3} cm/sec, with a range between 3.00×10^{-4} and 1.09×10^{-2} cm/sec. The results of in-situ permeability tests performed on the limestone/dolostone indicated an average permeability of 2.85×10^{-5} cm/sec.

Considering the high level of fracturing encountered in the limestone beneath SWMU 26, it can likely be assumed that there are open channels in the rock through which fluids flow with virtually no restrictions. In these flow channels, permeability could be considered to be almost limitless.

The water table at the SWMU 26 area is found within the limestone/dolostone. The water table should slope both north and south away from the east-west ridge immediately south of SWMU 26. Groundwater beneath SWMU 26 appears to be mounded under the ridgeline and the southernmost section of the landfill. Because of this, well BDH3 may not be a true upgradient well. If BDH3 is not an upgradient well, then no upgradient well location is possible for this site. The groundwater table elevations decrease rapidly to the north with the water level in well B-4 at only a slightly greater elevation than the elevation of the New River. This suggests that the karst development of the bedrock is very mature in this part of the Horseshoe Area.

Based on topography, surface water runoff is expected to flow northeast following the topography and then into drainage ditches along the central north-south road for approximately 2,400 feet before discharging into the New River north of the Horseshoe Area. RFAAP utility maps show no manholes, catch basins, or storm drains located in the immediate vicinity of SWMU 26.

3.0 PREVIOUS INVESTIGATIONS

- **1980** - seven monitoring wells and one boring were completed around SWMU 26 as part of a hydrogeologic evaluation of four SWMUs at RFAAP (USACE, 1981).
- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1988** - one well and one boring were completed near SWMU 26 as part of a landfill siting investigation (CTM, 1988).
- **1992 - Verification Investigation, Dames & Moore,** included the sampling and analysis of four groundwater monitoring wells.

There are currently eight monitoring wells in the vicinity of SWMU 26 (Figure 5-15.1). It was proposed in the VI Work Plan that four of these wells be inspected to determine whether they were suitable for sampling. If a well was not suitable for any reason, another appropriate well was substituted with USATHAMA approval. The four wells, which were installed as part of a previous investigation, were constructed to intercept groundwater in the first water-bearing formation below the site.

Well BDH-1 was unsuitable for sampling and GM-1 was dry, so the following wells—B2, B4, BDH2 (downgradient) and BDH3 (upgradient)—were sampled and analyzed for metals, VOCs, SVOCs, TOC, TOX, and pH. Analytical results for chemicals exceeding PQLs are presented in Table 5-15.1. ***Bis(2-ethylhexyl) phthalate*** was the only SVOC in these samples that exceeded the HBN criterion.

Low concentrations of four VOCs were reported for the sample collected from BDH3, indicating that contamination had impacted groundwater south of the landfill. Although, trichlorofluoromethane was detected in BDH3, VOC concentrations for all samples were less than the HBN criteria.

In total, nine metals were detected in the four groundwater samples collected at SWMU 26. Concentrations of all metals were less than applicable HBN criteria.

4.0 RECOMMENDED ACTION

SWMU 26 is a closed fly ash landfill under state permit No. 399.

DSERTS #: RAAP-016 | WASTEWATER PONDS FROM PROPELLANT INCINERATOR | RRSE: 1A

SWMU 39

1.0 BACKGROUND

SWMU 39 consists of two unlined earthen ponds located in the north-central section of the Horseshoe Area, adjacent to and associated with the Hazardous Waste Incinerator. The SWMU is also adjacent to a former concrete-lined spray pond, which was previously investigated and associated with this SWMU.

The settling ponds were excavated approximately 6 to 8 feet into the natural grade. These ponds received overflow from the spray pond that served as a cooling pond for incinerator scrubber and cooling water. Caustic was reportedly added to neutralize the water. Sludge has never been removed from the ponds.

In August 1990, it was determined that the incinerator scrubber wastewaters that collected and formed sludge in the former spray pond contained lead concentrations meeting the standards for hazardous waste (Alliant Techsystems, 1998). In the need to address the lead contaminated sludge that collected in the spray pond, a risk-based closure was performed by Alliant Techsystems. In July-October 1997, two feet of contaminated soil beneath the concrete-lined pond was removed, and the pond was subsequently backfilled.

2.0 ENVIRONMENTAL SETTING

SWMU 39 is generally a flat level area, at approximately 1,700 feet msl. A small section of the southern boundary rises to a maximum elevation of approximately 1,720 feet msl. The subsurface geology consists of an upper layer (6 to 10 ft bgs) of soil that is generally fine-grained, yellowish-red or reddish-brown sandy silt, sandy clay, or silty sand. Below this layer, the soil is yellowish-red to brown sand and silty gravel. This soil becomes more gravely with depth and usually has a layer of cobbles (river jack) present above the bedrock surface. A relatively thick layer of unconsolidated soil (alluvium, 16.5 to 19.5 feet thick) exists over limestone and dolostone bedrock.

Bedrock is generally a light gray to bluish-gray argillaceous limestone and dolostone (Elbrook Formation), and exhibits typical karst characteristics with evidence of subsurface solution features. The consistency of bedrock ranged from soft to hard with numerous weathered and fractured zones. Mud-filled voids and solution cavities were encountered in borings 39MW1 between 20 and 30 feet, 39MW3 between 20 and 35 feet, 39MW7 between 21 and 25 feet, and 39MW8 between 33 and 37 feet.

Groundwater conditions in the SWMU 39 vicinity are controlled by the karstic nature of the Elbrook Formation. Groundwater was encountered during 1998 RFI well installation within fracture and solution zones at depths ranging from 23 to 33 feet. Stabilized groundwater depths measured in monitoring wells 39MW2, 39MW7, and 39MW8 on May 12, 1998, ranged from 18 to 21 feet (1679 to 1682 ft msl). Based on calculations, the suspected groundwater flow in the vicinity of SWMU 39 was to the southwest at a shallow hydraulic gradient of about 0.0033 ft/ft. Based on the observed subsurface conditions, groundwater movement below SWMU 39 would likely be rapid through fractures, voids, and solution cavities with eventual discharge into the New River.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore, Phase I,** included the collection of surface soil and sludge samples.
- **1994 - Verification Investigation, Dames & Moore, Phase II,** included the installation and sampling of three monitoring wells.
- **1997 - RCRA Facility Investigation, Alliant Techsystems,** included the installation, sampling, and slug testing of three monitoring wells around the former spray pond.
- **1997 – Risk-Based Closure of the Former Incinerator Spray Pond, Alliant Techsystems,** included removal and sampling activities associated with the closure of the former spray pond.
- **1998 - RCRA Facility Investigation, ICF Kaiser,** included the collection of surface and subsurface soil samples and the installation and sampling of two monitoring wells and one existing monitoring well.

The RCRA permit recommended the characterization of SWMU 39 waste to determine hazardous characteristics as outlined in 40 CFR 261 Subpart C (toxicity, ignitability, corrosivity, and reactivity), prior to conducting the VI. One sludge sample was collected from the spray pond (Olver, 1983) and subsequent analysis indicated that the sludge did not exhibit any of the characteristics of a hazardous waste.

Sampling locations are presented in Figure 5-16.1.

3.1 VERIFICATION INVESTIGATION - 1992

The VI conducted by Dames & Moore in 1992 identified two potential environmental concerns at SWMU 39, including: surface soils adjacent to the spray pond from windblown spray; and groundwater from leaching of hazardous constituents accumulating in the sediments of the concrete-lined spray pond and the two unlined settling ponds. Potential surface soil contamination was evaluated through the collection and analysis of surface soil samples east of the spray pond in the area most likely to receive windblown spray. Sludge samples were collected from the unlined ponds to determine the potential for contamination leaching to groundwater.

3.1.1 Surface Soil

Three surface soil samples were collected at a depth of 0 to 6 inches below the surface gravel and organic root zone and were analyzed for explosives, metals, and SVOCs. Although explosives and SVOCs were not detected, several metals were detected above the PQL as presented in Table 5-16.1. ***Arsenic, beryllium, cobalt,*** and ***thallium*** were detected above HBN criteria. Iron and magnesium were present at elevated levels.

The VI concluded that windblown spray had not caused significant downwind soil contamination. No further action was recommended for this environmental medium.

3.1.2 Sediment

Composite sludge samples were collected from two locations within the spray pond and three locations within the northern and southern settling ponds at a depth of 0 to 1 foot below the water/sludge interface. Samples were analyzed for metals, SVOCs, and explosives.

Explosives were not detected in any of the pond sediments. SVOCs were detected above the PQL in the spray and northern settling ponds samples (Table 5-16.2). Detected SVOCs consisted of PAHs, which are associated with petroleum products such as commercial coal tar, gasoline, solvents, power plant emissions, and coal ash and cinders. None of the reported concentrations were above HBNs.

Antimony, arsenic, barium, beryllium, cobalt, copper, lead, and ***thallium*** were detected above HBNs (Table 5-16.2). Lead and copper were present at high concentrations in the spray pond (9.7 percent lead, 5.7 percent copper) and the northern settling pond (2.1 percent lead).

3.2 VERIFICATION INVESTIGATION - 1994

A second VI was conducted by Dames & Moore in 1993 as a result of the 1992 investigation, which indicated an adverse impact to groundwater from pond sediments. Groundwater monitoring wells were installed around the spray and settling ponds to characterize the impact to groundwater.

3.2.1 Groundwater

The hydrogeologic investigation conducted in 1993, included an investigation of subsurface conditions and aquifer characteristics, installation of one upgradient and two downgradient monitoring wells, and the collection and analysis of three groundwater samples. Groundwater samples were analyzed for dissolved (filtered) and total (unfiltered) metals, and SVOCs.

Metals detected above PQLs are presented in Table 5-16.3. As expected, unfiltered samples contained higher concentrations of constituents than the corresponding filtered samples from the same well. The majority of metals detected and the highest concentrations were present in the samples from wells associated with the northernmost settling pond (39MW2 and 39MW3). Several of the constituents detected, such as aluminum, calcium, iron, potassium, magnesium, and sodium, can be characterized as naturally occurring inorganics. The concentrations of these metals were within the range expected for groundwater in a karst environment containing carbonate and dolomite rocks.

Unfiltered metal results detected above HBN criteria included ***antimony*** and ***chromium.*** Additionally, lead was detected at elevated concentrations, but below its HBN criterion. The elevated levels of antimony, lead, and chromium detected in groundwater could be associated with high concentrations of these metals detected in pond sediment.

The results of the filtered samples indicate that only naturally occurring inorganics were reported as dissolved metals constituents. Except for barium and potassium, the highest concentrations of inorganic constituents were reported in samples from the two apparently downgradient monitoring wells.

3.3 RCRA FACILITY INVESTIGATION – 1997

An RFI was conducted by Alliant Techsystems in 1997 to assess SWMU groundwater characteristics (e.g., hydraulic conductivity and linear velocity).

3.3.1 Groundwater

Monitoring wells 39MW4, 39MW5, and 39MW6 were installed around the former spray pond and sampled for metals, select SVOCs, and wet chemistry. These and other select groundwater wells at the SWMU are monitored by Alliant Techsystems for quality on a quarterly basis to satisfy the State of Virginia groundwater monitoring and reporting requirements contained in 9 VAC 20-60-570.

3.4 RISK-BASED CLOSURE OF THE FORMER INCINERATOR SPRAY POND

Because sludges contaminated with lead meeting the levels of toxicity required for classification as a characteristic hazardous waste under Part III of the VHWMR were continuing to accumulate in the Incinerator Spray Pond (ISP), the VADEQ issued an enforcement order for operations to be ceased at the ISP. A Schedule Of Compliance contained in the order required submission and implementation of a closure plan.

3.4.1 Concrete and Piping Removal

The ISP consisted of a concrete basin with metal pipes through which air was circulated in order to prevent formation of sludges in the basin. Accumulated stormwater and sludges were removed from the ISP prior to demolition activities. The stormwater was scheduled to be pumped to the wastewater treatment plant. Remaining sludges were drummed and sent off-site for treatment as D008 characteristic hazardous waste. The ISP was then demolished and the associated concrete basin and pipes were removed.

Prior to disposal of the concrete, a representative sample from the basin was collected and analyzed for TCLP lead. Results indicated a lead concentration of approximately 0.5 parts per million (ppm). The piping was decontaminated and sold as scrap metal to a recycler.

3.4.2 Soil Removal and Sampling

Random grid soil samples were collected during the removal of soil beneath the removed concrete basin. Samples collected from the surficial soil directly below, six inches below, and twelve inches below the removed-concrete basin were screened onsite for lead using a PaceScan 3000 instrument, with a lead detection limit of 12.5 ppm. Screening results indicated that lead concentrations exceeded the 19 ppm threshold in surficial soil and six inches below the basin. None of the screening samples from the twelve inch depth exceeded the 19 ppm threshold.

Confirmation samples were collected and analyzed for hazardous constituents of concern (HCOCs) by a laboratory from twelve inches below the removed concrete basin to certify clean closure. Analytical results indicated that barium, chromium, and lead concentrations exceeded thresholds in the twelve inch samples.

Based on exceedences detected in samples collected at the twelve inch depth, additional samples were collected from eighteen and twenty-four inch depths at the same locations as the twelve inch depth samples. Analytical results indicated that arsenic, barium, and chromium concentrations exceeded threshold values in the twenty-four inch depth samples.

3.4.3 Risk Assessment

Based on exceedences detected in the twenty-four inch samples, clean closure could not be established at the ISP. A risk assessment was conducted to demonstrate that the HCOC concentrations would not pose an unacceptable risk to the potentially exposed population.

It was determined that the maximum concentrations of the detected HCOCs (1) did not pose an unacceptable risk under the current use and to a potential future residential population and (2) did not pose a threat to migrate from the soil to groundwater at levels equal to or above the MCLs. HCOC concentrations remaining in the ISP met the acceptable risk levels as outlined in the ISP Closure Plan and the Virginia Risk Guidance for risk-based closure.

After completion of the risk assessment for risk-based closure, the ISP was backfilled with clean soil and restored to its natural state.

3.5 RCRA FACILITY INVESTIGATION – 1998

An RFI was also conducted in 1998 by ICF Kaiser to (1) further characterize the nature and extent of contamination through the investigation of surface and subsurface soil and groundwater, and (2) to determine the direction of groundwater flow through the installation of two additional monitoring wells.

3.5.1 Soil

A total of twenty-four soil samples (2 surface and 22 subsurface) were collected. Surface soil samples 39SB1A and 39SB3A were collected at the west end of the settling ponds during the advancement of soil borings 39SB1 and 39SB2. Surface soil samples were analyzed for metals, SVOCs, and PAHs.

Subsurface soil samples were collected during the advancement of four soil borings (two in each pond) and two monitoring well borings to further characterize SWMU subsurface soil conditions. Subsurface soil samples were analyzed for metals, SVOCs, PAHs, grain size, percent moisture, and bulk density.

SVOCs and PAHs were not detected in either the surface soil or the subsurface soil. The analytical results for detected metals are presented in Table 5-16.4. ***Arsenic***, ***chromium***, and ***iron*** concentrations exceeded residential RBCs in nearly all samples. ***Lead*** also exceeded the residential and industrial RBC at location 39SB1, in the northern settling pond. However, lead concentrations decreased with depth, while other metals did not exhibit a similar trend with depth. Additionally, several metals exceeded SSL Transfer criteria in all samples.

3.5.2 Groundwater

Monitoring wells 39MW7 and 39MW8 were installed to determine the extent of groundwater contamination and direction of groundwater flow. 39MW7 was installed on the north side and 39MW8 was installed on the south side of the ponds. Groundwater samples were collected from the newly installed wells and from existing well 39MW2. Samples were analyzed for total and dissolved metals, SVOCs, PAHs, TOC, and TOX.

SVOCs and PAHs were not detected above the reporting limit. The analytical results for detected metals in groundwater are presented in Table 5-16.5. Lead, a primary constituent of concern at the settling ponds, was not detected in any of the groundwater samples. It should be noted that the practical quantitation limit for ***thallium*** is greater than the Tap Water RBC.

4.0 RISK ASSESSMENT

Summary of Screening Level Risk Assessment:

Samples Collected

Surface soil samples were collected east of the spray pond, and composite sediment/sludge samples were collected from each pond.

Medium	No.	Location
Surface soil	3	0 to 6″
Subsurface soil	3	multiple

4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

COPCs were selected based on results exceeding HBNs and background. Surface soil contaminants included beryllium and thallium. These samples were deleted from selection as a COPC due to low solubility. Sediment/sludge contaminants included antimony, arsenic, barium, beryllium, cobalt, copper, lead, and thallium. These analytes were selected as COPCs.

4.2 EXPOSURE ASSESSMENT

A sufficient number of surface soil samples were collected at SWMU 39 to suggest that surficial soil had not been significantly impacted by windblown water from the spray pond. Therefore, no further action was recommended for surface soil. However, in order to quantitatively evaluate potential risks to workers exposed to basin sediment and surface water, it was recommended that additional pond sediment/sludge and surface water samples be collected. Additional sediment samples are also necessary to assess the potential for leaching of contaminants to groundwater. An overview of the exposure assessment is presented in Table 5-16.4

If groundwater and/or surface water COPCs are selected based on the review of future analytical data, then the quantitative evaluation should be considered for the following exposure pathways:

Groundwater

- Ingestion of chemicals in groundwater by future workers.

Sediment

- Incidental ingestion of chemicals in basin sediment by workers; and
- Dermal absorption of chemicals in basin sediment by workers.

Surface Water

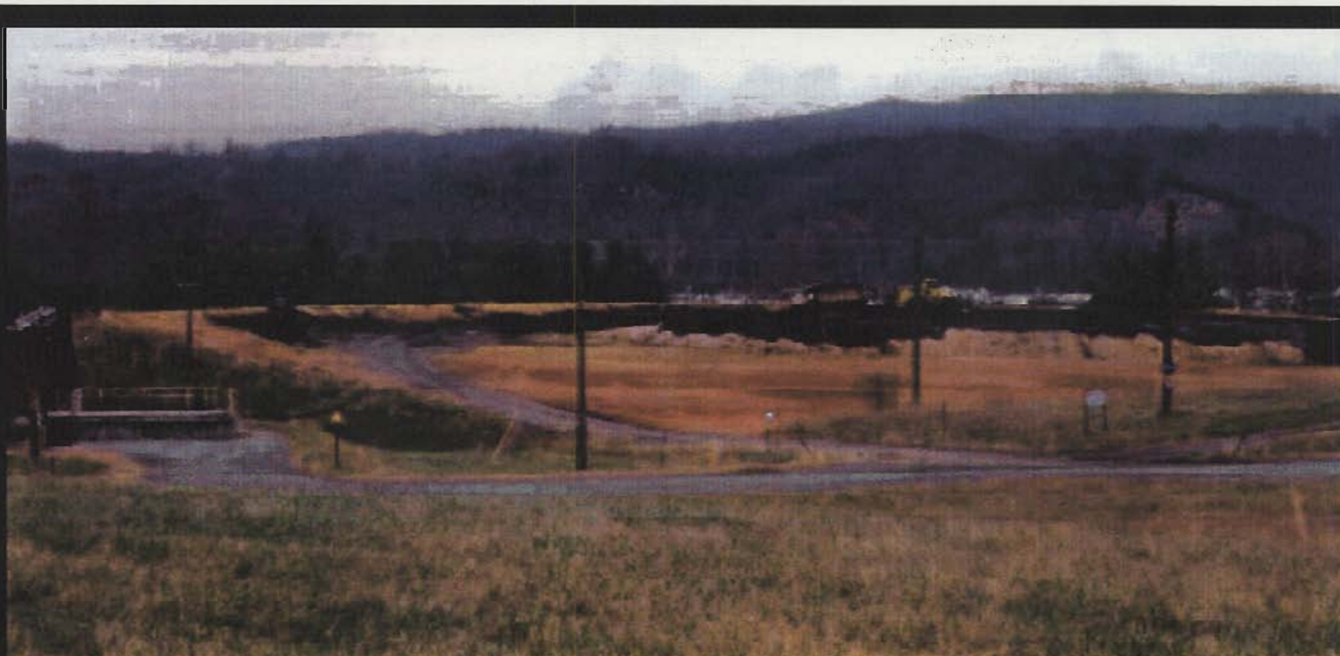
- Incidental ingestion of chemicals in basin surface water by workers;
- Dermal absorption of chemicals in basin surface water by workers;
- Incidental ingestion of chemicals in surface water by persons swimming in the New River; and
- Dermal absorption of chemicals in surface water by persons swimming in the New River.

5.0 RECOMMENDED ACTION

Evaluation of existing data to support the quantitative baseline risk assessment.

DSERTS #: RAAP-017 ACTIVATED CARBON DISPOSAL AREA RRSE: 3A

SWMU 53



1.0 BACKGROUND

SWMU 53, the Activated Carbon Disposal Area, is located within SWMU 29 (Figure 5-17.1). When observed in 1986, the disposal area was described as a 500-foot-long by 50-foot-wide plateau of an unknown height (USEPA, 1987). Although the date of disposal is unknown, it is assumed that disposal occurred before October 1981 when FAL No. 2 was constructed.

It was reported, but not confirmed, that the activated carbon disposed of at SWMU 53 was from alcohol recovery units (USEPA, 1987). Since 1986, the disposal area has been completely covered by subsequent fly ash landfilling operations.

2.0 ENVIRONMENTAL SETTING

SWMU 53 is located in the southeastern section of the Horseshoe Area. This SWMU is approximately 200 feet east of SWMU 52, 300 feet east of SWMUs 28 and 16, and 600 feet north of SWMU 13. SWMU 53 is located within the boundary of SWMUs 27 and 29.

3.0 PREVIOUS INVESTIGATIONS

- **1980 - Land Disposal Study,** indicated that the site was geologically suitable for ash landfill operations.
- **1986 - Visual Site Inspection,** sludge from the Biological Treatment Plant was observed being disposed of in SWMU 29.
- **1987 - RCRA Facility Assessment, USEPA,** included the analysis of water quality parameters of groundwater samples from the monitoring wells.
- **1992 - Verification Investigation, Dames & Moore, Phase I,** included the collection and analysis of surface water and sediment samples.
- **1994 - Verfication Investigation, Dames & Moore, Phase II,** included the collection and analysis of groundwater samples.

SWMUs 27, 29, and 53 are located in the same area, and in accordance with permit provisions for SWMU grouping, these units were investigated as one study area. SWMUs 27 and 53 are small disposal areas that were covered with SWMU 29 after the closure of SWMU 26 (FAL No. 1). VI activities were conducted in two phases. Phase I included the collection of one surface water and three sediment samples in the drainage ditch and settling pond downslope of the landfill. Quarterly groundwater samples collected as part of the installation monitoring program were evaluated to determine the impact of the landfill on groundwater quality. Phase II included the collection and analysis of groundwater samples.

3.1 GROUNDWATER

Phase I

Groundwater data were evaluated from downgradient wells FAL2, FAL3, and Well

7 for August 1991, December 1991, and February 1992 sampling rounds. Samples were analyzed for metals, SVOCs (only December 1991 sampling round), and water quality parameters. SVOCs were not detected in any of the samples. Chromium, iron, lead, manganese, mercury, and sodium were detected above the PQLs. Although sample results were below the HBNs, the following anomalies were observed:

Chromium was reported in well FAL3 and Well 7. This constituent is normally not detected at RFAAP.

- Lead was detected in well FAL2 at a concentration 3 times its normal concentration.
- The February 1992 sampling episode showed in elevated concentrations of metals for well FAL2.

Lead is included as a constituent in the formulation of several propellants, including the following:

Single-base	
lead carbonate	BS-NACO
Double-base	
lead salicylate	AHH, ARP, PNJ, M21
lead 2-ethylhexoate	AHH
lead beta resorcylate	ARP
lead 2,4-dihydroxybenzoate	PNJ
lead stearate	M16, M21

Phase II

Groundwater samples were collected from wells FAL2, FAL3, Well 7, and analyzed for metals (filtered), explosives, VOCs, SVOCs, TOC, and TOX (Table 5-17.1). Although neither explosives nor VOCs were detected, several SVOC TICs were detected. Metals detected included barium, calcium, potassium, magnesium, manganese, and sodium. Results were below their respective HBNs.

Upgradient versus downgradient concentrations of metals indicated that barium and potassium were greater upgradient. These two metals may be associated with propellant manufacturing activities.

Potassium is included as a propellant component in the following formulations:

Single-Base	
Potassium nitrate	Benite, CBI Powder
Potassium sulfate	HES 6706.1, IMR5010, M1, M6, M10, IMR4895, IMR7383, IMR8097 25 mm BM, IMR8208
Double-Base	
Potassium perchlorate	M7TOW, M7
Potassium nitrate	M2, M5, M8, M9, M26
Potassium sulfate	M16, N4
Triple-Base	
Potassium nitrate	M30A2
Potassium sulfate	M30A1
Cast and Extruded	
Potassium sulfate	PNJ for TOW

Barium may be available as $Ba(NO_3)_2$, which is used as an oxidizing agent and included in double-base solvent (M26) and solventless (M2, M5) formulations.

Propellant	%Barium by weight
M2	1.4 ±0.25
M5	0.5 ±1.6
M26	0.75 ±0.2

3.2 SURFACE WATER

One surface water sample was collected in the settling pond for explosives, VOCs, SVOCs, metals, TOC, and TOX (Table 5-17.2). Explosives, VOCs, and SVOCs were not detected in the sample. Metals were detected at concentrations below the HBNs.

3.3 SEDIMENT

One sediment sample was collected in the drainage ditch, and two sediment samples were collected in the settling pond downgradient of SWMU 29 that receive SWMU 53 runoff (Table 5-17.3). Explosives were not detected in any of the samples. VOCs were detected in trace concentrations in the pond (toluene and trichlorotrifluoroethane) and the ditch (trichlorotrifluoroethane). SVOCs detected included 2-methylnapthalene, naphthalene, phenanthrene, and dibenzofuran. These compounds are generally associated with petroleum products, such as coal tar, gasoline, solvents, power plant emissions, and coal ash and cinders.

Metals exceeding the respective HBN included ***arsenic***, ***beryllium***, and ***cobalt***. Several other metals were present at high concentrations, including aluminum, barium, chromium, iron, manganese, mercury, and potassium.

4.0 RECOMMENDED ACTION

Verify compliance activities at SWMU 29 are sufficient to address SWMUs 27 and 53. Additional environmental activities associated with this SWMU will be addressed in conjunction with SWMU 29.

DSERTS #: RAAP-018 OILY WATER BURIAL AREA RRSE: 1A

SWMU 48

1.0 BACKGROUND

USEPA reported this unit as contiguous to SWMU 49 (Red Water Ash Disposal Area) and SWMU 50 (Calcium Sulfate Disposal Area), with no distinction possible by visual observation (USEPA, 1987). During the VI (Dames and Moore, 1992) and the RFI (Parsons Engineering, 1996) SWMU 48 was divided into an upper and a lower disposal area. SWMU 48 was determined to be the area called the "upper disposal unit" by previous investigations.

2.0 ENVIRONMENTAL SETTING

The Oily Wastewater Disposal Area (SWMU 48) is located in the RFAAP Horseshoe Area, approximately 3,400 feet east of the main bridge over the New River (Figure 5-18.1).

SWMU 48 is a long, narrow, raised grassy mound which trends east to west next to the asphalt road. Aerial photographs taken in 1971 and 1986 indicate that the SWMU consisted of two sets of unlined trenches that are classified in this report as the northern and southern trenches. Prior to off-post waste oil reclamation (1971), approximately 200,000 gallons of oily wastewater removed from oil/water separators throughout RFAAP was disposed in the northern trenches.

An interpretation of the 1971 aerial photograph (USEPA, 1992), stated that activity was first noted in the SWMU in the 1971 photograph. The northern trenches are defined in the aerial photograph as light colored east to west trending scars of disturbed soil that parallel the asphalt road. The site had revegetated by 1981.

The southern trench was first observed in the 1986 aerial photograph, positioned at a slight angle below the northern trenches. It appears that disposal activity was complete at this time, indicating that the trench was created, filled, abandoned, and revegetated between 1971 and 1986. This trench is marked by the growth of grass visibly different from the surrounding vegetation (e.g., greener and thicker) and by extensive ground subsidence. Documentation for disposal activities in this trench is currently unknown, but soil borings and the advancement of a test pit during the 1998 RFI indicate the burial of a black pelletized material and a light colored fibrous material.

Ground elevation is approximately 1,830 msl. SWMU 50 is approximately 30 feet to the south of SWMU 48, SWMU 49 is 200 feet to the southeast, and SWMU 59 is approximately 75 feet to the east.

A wooded area is located to the southwest and an asphalt parking lot approximately 200 feet to the west, which has been identified as a propellant holding area.

Approximately 450 feet south of SWMU 48, the topography forms a ridge crest and then slopes steeply down to the New River. The elevation of the SWMU is 1,830 feet msl, about 130 feet above the New River.

Subsurface conditions in the vicinity of SWMU 48 were characterized during subsurface investigations conducted at the unit. The subsurface geology consists of alluvium and residual deposits consisting of clay and silt with some sand and gravel. Depth to bedrock below the SWMU is approximately 55 feet bgs. Bedrock consists of highly fractured interbedded siltstone, limestone, and dolostone of the

Elbrook Formation. The Max Meadows Breccia is evident in outcrops along the slope leading to the river. In the outcrop along the slope, the tectonic breccia and the limestone and dolostone are highly weathered with many solution cavities.

Depth to groundwater (48MW4) measured in April 1998 was 78 ft (1736 feet msl). The groundwater gradient was found to be 0.191 ft/ft to the south, toward the New River. The topography also descends to the New River, forming a ridge crest approximately 450 feet south of SWMU 48, and sloping steeply down about 120 feet to the New River. A fracture trace oriented north-south and connecting several sinkholes has been identified approximately 250 feet west of the SWMU (Engineering Science, Inc., 1994). A less prominent east-west fracture trace has been identified east of the SWMU.

Groundwater occurrence in the vicinity of SWMUs 16, 30, and 51, slightly north of the study area, is not consistent with the bedrock groundwater table found in the wells at SWMUs 48 and 49. Groundwater in monitoring wells 16-4, 51MW1, and 51MW2 was encountered as much as 70 feet higher in elevation. It is possible that this area represents a different groundwater zone and that a perched water table may be present in the sediments overlying the bedrock (although these wells were partially screened in rock). It is likely that this groundwater zone eventually discharges to the New River as well, but the hydraulic relationship between the shallow groundwater and the groundwater measured in the wells at SWMUs 48 and 49 is not completely understood.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included the collection of four soil samples from two soil borings at SWMU 48 and a Baseline Risk Assessment.
- **1996 - RCRA Facility Investigation, Parsons Engineering-Science,** included hydrogeologic investigations, installation and sampling of four SWMU-vicinty monitoring wells (6 subsurface soil samples, 4 groundwater samples), and 3 surface soil samples.
- **1998 – RCRA Facility Investigation, ICF Kaiser,** included the collection and analysis of four test pit soil samples, five subsurface soil samples, and groundwater samples from existing monitoring well 48MW4.

The VI was performed at SWMU 48 to characterize the nature and extent of contamination. A baseline risk assessment was also conducted to further investigate human and environmental exposure pathways.

The 1996 RFI was undertaken to determine the source and extent of the contamination detected during the VI, address any impact on groundwater quality, and to further assess the possible presence of oily waste in SWMU 48 and explosives contamination in SWMU 49.

The 1998 RFI was performed to further refine the understanding of the nature and extent of contamination associated with the northern and southern trenches.

Sampling locations are shown in Figure 5-18.2

3.1 VERIFICATION INVESTIGATION

3.1.1 Soil

Four soil samples were collected from two soil borings within the unit. Samples from borings 48SB1 and 48SB2 were collected at 7.5 and 10 feet bgs, respectively, in the vicinity of suspected contamination. Samples were also obtained at both locations from apparently "clean" soil below the suspected contamination at depths of 13 and 20 feet in 48SB1 and 48SB2, respectively. All samples were analyzed for metals, VOCs, and SVOCs.

Metals detected above PQLs are presented in Table 5-18.1. ***Arsenic, beryllium,*** and ***cobalt*** concentrations exceeded HBN criteria. TCLP metal concentrations did not exceed RCRA waste characterization regulatory levels.

VOCs and SVOCs detected in boring 48SB2 were below their respective HBN. Two explosives detected in the SVOC analysis, ***24DNT*** and ***26DNT,*** exceeded their HBN criteria in the shallow subsurface sample collected in 48SB2 at a depth of 10 feet. The results of the deeper soil sample obtained from 48SB2 confirmed that 24DNT and 26DNT had not impacted soil at a depth of 22 feet. The BRA in the VI examined risk levels for two explosives.

3.2 RCRA FACILITY INVESTIGATION 1996

To support RFI objectives, the following investigation activities were performed:

- The installation of one monitoring well at SWMU 48;
- Collection and analysis of groundwater samples from the installed monitoring well;
- Collection and analysis of two soil samples from the well boring (deep and shallow), and a composite soil sample for disposal characterization;
- The collection of three surface soil samples to assess potential surface exposure routes; and
- The collection of two additional soil samples from one soil boring located between 48SB1 and 48SB2 to confirm or deny the presence of potentially released oily waste and explosives between SWMUs 48 and 49.

3.2.1 Soil

Three surface and seven subsurface soil samples were analyzed for metals, VOCs, SVOCs, explosives and TPH. Results for analytes detected over PQLs are presented in Table 5-18.2. ***Arsenic*** and ***beryllium*** exceeded HBN criteria in surface soil samples.

3.2.2 Groundwater

Groundwater samples were collected from all four SWMU-vicinity monitoring wells. Field measurements of the groundwater were also recorded. Slug insertion and removal aquifer tests were performed on the three lower disposal area monitoring wells. Sampling in three wells occurred in January and July 1995. 48MW4 was installed in July 1995 and sampled only once. All four groundwater samples were analyzed for metals, VOCs, and SVOCs. Additional parameters analyzed for in the three lower disposal area wells included TOC, TOX, TPH, chloride, hardness, and COD. The results for analytes detected over PQLs are presented in Table 5-18.3.

HBNs were exceeded in several well samples including the following:

- ***Barium*** in 48MW4 located within SWMU 48 and upgradient of SWMU49;

- ***11DCA*** and ***TCE*** in 48MW 4 located downgradient of SWMU 48 and upgradient of SWMU 49;

- ***Barium***, ***Bis(2-ethylhexyl) phthalate***, ***TCE***, and ***carbon tetrachloride*** in wells 48MW2 and 48MW3 located within SWMU 49.

3.3 RCRA FACILITY INVESTIGATION 1998

3.3.1 Test Pit Soil

Test pit evaluation was used to determined the southern trench boundary and assist in positioning subsurface characterization sampling locations. Subsidence within the southern trench that had occurred in late 1997 appeared to correspond with the southern trench boundary. To verify this assumption, a test pit was oriented so that the northern half of the test pit was situated within the southern trench boundary, and the southern half was situated outside of the southern trench boundary. Visual observation of test pit soils supported the assumption that the subsidence defined the southern trench boundary.

Samples 48TP1 and 48TP2 were collected from within the southern trench boundary. Samples 48TP3 and 48TP4 were collected outside the fill material, south of the disposal trench boundary. These samples were analyzed to determine the nature of the material Ii.e., natural, fill) and whether suspected contamination had leached into the surrounding soil.

Samples were analyzed for metals, VOCs, SVOCs, and explosives. The analytical results for detected metals are presented in Table 5-18.4, and for detected organics in Table 5-18.5.

Analytical results indicated that ***arsenic*** concentrations were detected above residential RBCs in all four test pit samples; ***iron*** exceeded the residential RBC in three out of the four samples. Organics, consisting of VOCs and explosives, were only detected in test pit sample 48TP1. 48TP1 contained the following low concentrations of explosive material (note: **4-am-*2,6 DNT*** exceeded the residential RBC), ***HMX***, ***RDX***, ***1,3,5-trinitrobenzene***, ***1,3-dinitrobenzene***, ***nitrobenzene***, ***2,4-dnitro-toluene***, ***2,6-dinitrotoluene***, and ***4-amino-2,6-dinitrotoluene***.

3.3.2 Subsurface Soil

Five subsurface soil samples were collected from two soil borings (48SB6 and 48SB7) to characterize the nature of materials disposed in the southern trench and to determine the depth of the fill material. Samples were analyzed for metals, VOCs, SVOCs, and explosives. The analytical results for detected metals are presented in Table 5-18.6, and for detected organics in Table 5-18.7.

Detected metal results indicated that ***arsenic*** and ***iron*** concentrations exceeded the residential and industrial RBCs in both borings. Several metals were also detected above SSL Transfer criteria in both borings. Detected organic results indicated that volatiles, including ***benzene***, ***toluene***, ***o,m***, and ***p xylenes***, and trace level SVOCs (PAHs, phthalates, and nitroamines) were detected below residential RBCs in both borings. Explosives were encountered along the west end of the southern trench at highly elevated concentrations in 48SB7A, and trace levels (with the exception of ***2,4,6-TNT***) in 48SB7B. **2,4,6-TNT** exceeded the residential RBC in both samples collected in boring 48SB7, and exceeded the industrial RBC criterion in sample 48SB7A only.

3.3.3 Groundwater

Groundwater samples were collected from 48MW4 to confirm results that exceeded HBNs during the 1996 RFI. Samples were analyzed for total and dissolved metals, VOCs, SVOCs, explosives, TOC, and TOX. The analytical results for detected metals are presented in Table 5-18.8.

Organic compounds were not detected in any of the groundwater samples. Several total and dissolved metals were detected above reporting limits but did not exceed Tap Water RBC criteria.

4.0 RISK ASSESSMENT

Summary of Screening Level Risk Assessment

Samples Collected

Subsurface soil samples were collected from the north (N) and south (S) disposal areas. Soil gas samples were also collected.

Medium	No.	Location
Soil Gas	8	4′
Subsurface soil	1	N. 9.5′
	1	N. 12′
	1	N. 14′
	1	N. 22′
	1	S.

4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

COPCs were selected based on results exceeding HBNs and background. Subsurface soil contaminants included 24DNT, 26DNT, and beryllium. The organic compounds were selected as COPCs. The justification for not selecting beryllium was that it could be naturally occurring at the site.

4.2 EXPOSURE ASSESSMENT

Although potential soil exposure routes typically include incidental ingestion, inhalation, and dermal absorption, exposure via these routes are generally limited to the top 2 feet of soil. It is highly unlikely that receptors would contact soil at depths of 12 feet. Therefore, these pathways were not considered operable exposure pathways for SWMU 48.

Because there is the potential for discharge of groundwater contamination to the New River, persons boating, fishing, or swimming in the river could potentially be exposed to contaminants migrating from SWMU 48 via shallow groundwater. In addition, a drinking water intake is located 6 miles downstream of SWMU 48.

If groundwater and/or surface water COPCs are selected based on the review of future analytical data, then the quantitative evaluation should be considered for the following exposure pathways:

Groundwater

- Ingestion of chemicals in groundwater by future workers.

Soil

- Incidental ingestion of chemicals in soil by future workers; and

- Dermal absorption of chemicals in soil by future workers.

Sediment

- sediment by Incidental ingestion of chemicals by recreational visitors wading along the banks of the New River; and

- Dermal absorption of chemicals in sediment by recreational visitors wading along the banks of the New River.

Surface Water

- Incidental ingestion of chemicals in surface water by recreational visitors swimming in the New River; and
- Dermal absorption of chemicals in surface water by recreational visitors swimming in the New River.

An overview of exposure assessment is presented in Table 5-18.9.

5.0 RECOMMENDED ACTION

Supplemental RFI activities are recommended at SWMU 48 to augment the current site conceptual model in preparation for the quantitative baseline risk assessment.

DSERTS #: RAAP-019 INERT LANDFILL #1 RRSE: 2A

SWMU 32

1.0 BACKGROUND

SWMU 32 (Inert Waste Landfill No. 1) is a closed, unlined landfill located in the Horseshoe Area of RFAAP, approximately 600 feet north of the main bridge over the New River and 100 feet east of the Rubble Pile (SWMU 58) (Figure 5-19.1). Although the 8-acre landfill was permitted by the Virginia Department of Health (Permit No. 400) in April 1983, the unit reportedly began receiving waste, plastics, excavated soil, and inert wastes in 1978. Approximately 50 to 100 tons/day of debris wastes were to be disposed of in the landfill, according to the permit.

The unit reached capacity and was closed sometime between July 1986 and April 1987 (USEPA, 1987). The closed landfill is approximately 30 feet thick. Indications are that wastes were deposited on the original ground surface, without excavation, and periodically covered with soil. It has been reported that in addition to inert materials, such as soil, concrete, and fiberglass, the following materials were disposed of in the landfill: asphalt, cardboard boxes, fluorescent lamp tubes, bottom ash, wet coal, and empty laboratory containers (including some labeled sulfuric acid, sec-butyl alcohol, and lead salicylate) (USEPA, 1987; USATHAMA, 1984).

The unit was closed with a 2-foot clay cap and topsoil, and then seeded. One area is covered with gravel and used for trailer parking. Erosional gullies have been repaired with riprap.

2.0 ENVIRONMENTAL SETTING

SWMU 32 is located in an area of broad and gently sloping ridges within the Horseshoe Area. The ground surface of the SWMU slopes from a maximum elevation of 1,770 feet msl at the southern end of the SWMU to a minimum elevation of 1,720 feet msl at the northern end of the SWMU.

SWMU 32 is in the middle of a storage area where buildings, asphalt roads, and a nearby overhead steam pipe are located; there are four storage buildings around the SWMU, one at each corner. A gravel trailer lot is located in the southeastern section of the SWMU.

The subsurface conditions at SWMU 32 were investigated during the drilling of two soil and rock borings to 57 to 88 feet bgs. In the upgradient boring, unconsolidated silty clay and clayey silt was encountered to a depth of 24 feet overlying limestone/dolostone of the Elbrook Formation. In boring 32MW1 (Figure 5-19.1), the unconsolidated soils consisted of silty sands and gravels to a depth of 21 feet overlying limestone/dolostone of the Elbrook Formation.

Bedrock encountered in the vicinity of SWMU 32 consisted of fractured limestone and dolostone of the Elbrook Formation. Karst solution features were encountered in borings just upgradient of SWMU 32. A large void was encountered between 45 and 55 feet bgs and another void between 56 and 57 feet bgs. No obvious solution features were encountered in boring 32MW1, downgradient of SWMU 32.

Groundwater was not encountered in boring 32MW2A, upgradient of SWMU 32. Groundwater was encountered at approximately 77 feet bgs in boring 32MW1 within limestone or dolostone bedrock.

SWMU 32

Based on the local topography and hydrogeologic conditions, the inferred direction of groundwater flow is northward toward the New River. Groundwater flow through the solution features encountered in the vicinity of SWMU 32 would likely be rapid.

Based on topography, surface water runoff from within SWMU 32 generally flows north from the SWMU to the New River.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included the installation and sampling of two groundwater monitoring wells.

Because SWMU 32 was operated as an inert landfill under a Virginia Solid Waste Permit according to permit requirements, it appears unlikely that hazardous constituents are associated with it. However, to evaluate whether groundwater quality had been impacted by wastes disposed of in this landfill, two wells were installed upgradient and downgradient of the landfill.

One groundwater sample (32MW1) was collected downgradient of SWMU 32 to evaluate the impact of the landfill on groundwater quality. Following well installation and development, a sample was collected and analyzed for metals, VOCs, SVOCs, TOC, TOX, and pH. The results of the chemical analyses exceeding PQLs are presented in Table 5-19.1. The chemical analyses indicated that the groundwater quality had not been impacted by the landfill. Metal concentrations were one or more orders of magnitude less than applicable HBNs and were similar to those reported in upgradient groundwater samples obtained from other areas of RFAAP. VOCs and SVOCs were not detected in the 32MW1 sample.

4.0 RECOMMENDED ACTION

SWMU 32 is a closed inert landfill under state permit No. 400.

DSERTS #: RAAP-020 FLY ASH LANDFILL #2 RRSE: 3A

SWMU 29

1.0 BACKGROUND

SWMU 29 (FAL No. 2) was originally listed as an active, unlined earthen landfill located in the southeast section of the Horseshoe Area. It is approximately 200 feet east of the Closed Sanitary Landfill (SWMU 52). SWMU 29 was constructed in October and November 1981. The 10-acre unit was permitted by the Virginia Department of Health in May 1982 (Permit No. 353) as an industrial waste landfill that could receive "fly ash, calcium sulfate sludge, and sludge from water treatment plants" (Va DOH, 1982).

The permit application presented the operation of the landfill as taking place in two stages of both trench fill and area fill methods. Both methods specified the fill direction to be from east to west. Stage 1 was to consist of the excavation and filling of seven trenches, about 50 feet wide and averaging 25 feet deep, and ranging in length from 280 to 720 feet. The unit is currently operating in Stage 2, which consists of area filling, in five lifts, of 10-foot layers on top of the previously filled trenches.

During area filling, berms are constructed to control blowing ash. A site for a third fly ash landfill is currently being investigated by RFAAP to replace this unit, which is nearing capacity.

Daily cover is not required at SWMU 29 because of the inert characteristics of the wastes being landfilled. The permit requires 2 feet of cover to be placed on each trench or fill area as it is filled. Final cover will consist of at least 2 feet of compacted natural soil, graded to slopes of 3:1 and seeded with grass to retard erosion and minimize rainwater percolation.

Runoff is directed south to a central drainage ditch that coincides with and is effluent to a natural topographic ravine (USAEHA, 1980). Surface water from the landfill drains to a ditch that leads to a retention pond located approximately 300 feet south of the landfill and 150 feet north of SWMU 13. The holding pond is considered to be a component of SWMU 29.

2.0 ENVIRONMENTAL SETTING

SWMU 29 is located in the southeastern section of the Horseshoe Area and is contained in the same area as SWMUs 27 and 53 (Figure 5-20.1). SWMU 29 is approximately 300 feet east of SWMUs 28 and 16, and 600 feet north of SWMU 13.

The topography of the Horseshoe Area is characterized by three prominent terraces and escarpments that are remnants of ancient New River floodplains. SWMU 29 occupies the eastern middle terrace flat and the escarpment face of the upper terrace in the horseshoe meander loop. The original topography of the eastern half of SWMU 29 was generally level, approximately 1,760 to 1,770 feet msl. The original topography of the western half of SWMU 29 was moderately steeply sloping towards the east. The maximum elevation is approximately 1,820 feet msl at the western edge.

3.0 PREVIOUS INVESTIGATIONS

- **1980 - Land Disposal Study,** indicated that the site was geologically suitable for ash landfill operations.
- **1986 - Visual Site Inspection,** sludge from the Biological Treatment Plant was observed being disposed of in SWMU 29.

- **1987 - RCRA Facility Assessment, USEPA,** included the analysis of water quality parameters of groundwater samples from the monitoring wells.
- **1992 - Verification Investigation, Dames & Moore, Phase I,** included the collection and analysis of surface water and sediment samples.
- **1994 - Verification Investigation, Dames & Moore, Phase II,** included the collection and analysis of groundwater samples.

SWMUs 27, 29, and 53 are located in the same area, and in accordance with permit provisions for SWMU grouping, these units were investigated as one study area. SWMUs 27 and 53 are small disposal areas that were covered with SWMU 29 after the closure of SWMU 26 (FAL No. 1). VI activities were conducted in two phases. Phase I included the collection of one surface water and three sediment samples in the drainage ditch and settling pond downslope of the landfill. Quarterly groundwater samples collected as part of the installation monitoring program were evaluated to determine the impact of the landfill on groundwater quality. Phase II included the collection and analysis of groundwater samples.

3.1 GROUNDWATER

Phase I

Groundwater data were evaluated from downgradient well FAL2, well FAL3, and Well 7 for August 1991, December 1991, and February 1992 sampling rounds. Samples were analyzed for metals, SVOCs (only December 1991 sampling round), and water quality parameters. SVOCs were not detected in any of the samples. Chromium, iron, lead, manganese, mercury, and sodium were detected above the PQLs. Although sample results were below the HBNs, the following anomalies were observed:

- Chromium was reported in well FAL3 and Well 7. This constituent is normally not detected at RFAAP.
- Lead was detected in well FAL2 at a concentration three times its normal concentration.
- The February 1992 sampling episode showed elevated concentrations of metals for well FAL2.

Lead is included as a constituent in the formulation of several propellants, including:

Single-base	
lead carbonate	BS-NACO
Double-base	
lead salicylate	AHH, ARP, PNJ, M21
lead 2-ethylhexoate	AHH
lead beta resorcylate	ARP
lead 2,4-dihydroxybenzoate	PNJ
lead stearate	M16, M21

Phase II

Groundwater samples were collected from well FAL2, well FAL3, Well 7, and analyzed for metals (filtered), explosives, VOCs, SVOCs, TOC, and TOX (Table 5-20.1). Although neither explosives nor VOCs were detected, several SVOC TICs were detected. Metals detected included barium, calcium, potassium, magnesium, manganese, and sodium. Results were below their respective HBNs.

Upgradient versus downgradient concentrations of metals indicated that barium and potassium were greater upgradient. These two metals may be associated with propellant manufacturing activities. Potassium is included as a propellant component in the following formulations:

Single-Base	
Potassium nitrate	Benite, CBI Powder
Potassium sulfate	HES 6706.1, IMR5010, M1, M6, M10, IMR4895, IMR7383, IMR8097 25 mm BM, IMR8208
Double-Base	
Potassium perchlorate	M7TOW, M7
Potassium nitrate	M2, M5, M8, M9, M26
Potassium sulfate	M16, N4
Triple-Base	
Potassium nitrate	M30A2
Potassium sulfate	M30A1
Cast and Extruded	
Potassium sulfate	PNJ for TOW

Barium may be available as $Ba(NO_3)_2$, which is used as an oxidizing agent and included in double-base solvent (M26) and solventless (M2, M5) formulations.

Propellant	%Barium by weight
M2	1.4 ±0.25
M5	0.5 ±1.6
M26	0.75 ±0.2

3.2 SURFACE WATER

One surface water sample was collected in the settling pond for explosives, VOCs, SVOCs, metals, TOC, and TOX (Table 5-20.2). Explosives, VOCs, and SVOCs were not detected in the sample. Metals were detected at concentrations below the HBNs.

3.3 SEDIMENT

One sediment sample was collected in the drainage ditch and two in the settling pond downgradient of SWMU 29 that receives its runoff (Table 5-20.3). Explosives were not detected in any of the samples. VOCs were detected in trace concentrations in the pond (toluene and tri-chlorotrifluoroethane) and the ditch (tri-chlorotrifluoroethane). SVOCs detected included 2-methylnapthalene, naphthalene, phenanthrene, and dibenzofuran. These compounds are generally associated with petroleum products, such as coal tar, gasoline, solvents, power plant emissions, and coal ash and cinders.

Metals exceeding the respective HBNs included ***arsenic, beryllium,*** and ***cobalt.*** Several other metals were present at high concentrations, including aluminum, barium, chromium, iron, manganese, mercury, and potassium.

4.0 RECOMMENDED ACTION

The operation and closure of SWMU 29 is addressed under state permit No. 353.

DSERTS #: RAAP-021 PROPELLANT BURIAL RRSE: 3A

SWMU 46

1.0 BACKGROUND

The reported location of SWMU 46 is a small depression with no outward drainage. Approximately one ton of propellants and propellant-contaminated soil was reportedly disposed of at this location as a one time occurrence because of a railroad derailment in the 1950s (USATHAMA, 1976).

The actual size of the Waste Propellant Disposal Area is not known. However, based on the waste quantity reportedly disposed, it is probably quite small.

USEPA identified the location of this unit as a 0.5-acre hummocky area 50 to 100 feet southeast of the bank of the New River. However, during the March 1990 facility visit, a broken-off sign identifying "BURIED EXPLOSIVE WASTE" was found in a low area between the railroad tracks and the driveway leading to Building 456. RFAAP personnel verified that the sign was originally placed in the area where it was found. In addition, RFAAP personnel indicated the area identified by USEPA as the location of sanitary septic tank sludge burial in the 1970s.

2.0 ENVIRONMENTAL SETTING

The Waste Propellant Disposal Area (SWMU 46) lies approximately 300 feet southeast/east of the New River in the northwest section of the Main Manufacturing Area. The actual size of SWMU 46 is not known.

The elevation of the area is approximately 1,710 to 1,720 feet msl. The filter house is northwest of SWMU 46. There are railroad tracks and paved roads in the area. The septic tank sludge disposal area is approximately 150 feet southwest of SWMU 46.

A limited subsurface investigation was conducted during the VI in the vicinity of the "Buried Explosive Waste" sign (Figure 5-21.1). Subsurface conditions consisted of undisturbed natural soils to a depth of 3 feet bgs. It is assumed subsurface features are consistent with other SWMUs along the New River floodplain.

Although no site-specific investigations were conducted in this area, it is assumed that groundwater overlies weathered Elbrook Formation bedrock and flows north with discharge to the New River, which is located 300 feet northwest.

Because SWMU 46 is a small depression with no outward drainage, surface water runon could potentially percolate into the subsurface and enter the water table.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included the analyses of two soil samples collected from a depth of approximately 1 foot.

Contamination was suspected because a sign was found labeled "Buried Explosive Waste"; however, the sign had been torn from its metal base. Geophysical methods were used at this location to try to locate a metal base for the sign, which apparently was broken off at ground level. Two areas of anomalous features, where the sign stub may exist, were identified at 20 feet north and 45 feet west of the gate, and at 21 feet north and 35 feet west of the gate; however, the metal base of the sign was not found. Evidence indicates that this area may not have been the location of the buried propellant. During the VI, two shallow soil samples from representative portions of the site were collected to confirm the potential explosives contamination. The samples were analyzed for metals and explosives.

3.1 SOIL

Four test pits were excavated in the area identified as the buried explosive waste area. There was no visual evidence of contamination or disturbed soils. Two soil samples were collected from separate pits and analyzed for metals and explosives. The four large test pits excavated revealed apparently undisturbed natural soils to a depth of 3 feet bgs. Soils encountered consisted of fine-grained sandy silts.

Analytical results for samples 46SS1 and 46SS2 are presented in Table 5-21.1. Eighteen metals were collected in samples collected in the northeastern and southwestern portions of the propellant disposal area. Concentrations of ***arsenic, beryllium,*** and ***cobalt*** in both samples and ***thallium*** in one sample (46SS2) exceeded HBN criteria. No explosives were detected in either sample.

4.0 RECOMMENDED ACTION

Based on previous investigation results, no further action is recommended at this time.

DSERTS #: RAAP-022 POND BY BUILDINGS 4931/4932 RRSE: 3A

SWMU 57

1.0 BACKGROUND

SWMU 57 is an enclosed area that is designated as an acid settling pond in RFAAP Facility drawings. The pond is reported to be connected to Building 4931 by an underground pipe. However, available construction plans for the adjacent chromic acid treatment plant do not show this pond.

2.0 ENVIRONMENTAL SETTING

SWMU 57 is located in the western section of the Horseshoe Area, east of the Cast Propellant Area, north of Building 4931, and northeast of Building 4928 (Figure 5-22.1).

The SWMU is approximately 30 feet in diameter and is surrounded by a gravel berm with apparently no outlet. It is located on a plateau area above a hillside that slopes northwestward to the New River, which is located approximately 1,500 feet from the SWMU.

The elevation of SWMU 57 is approximately 1,790 feet msl. There are numerous buildings, paved roads, and overhead pipes in the vicinity of SWMU 57.

No site-specific subsurface or hydrogeologic investigations have been conducted in this area. Soils underlying the SWMU are estimated to be approximately 20 feet of clay, silt, and sand with occasional seams of cobbles and boulders overlying the karstic limestone/dolostone of the Elbrook Formation. Groundwater is estimated to flow northwestward with discharge to the New River.
Surface water appears to flow northwestward to a tributary of the New River. The tributary flows north and discharges into the New River. There are no manholes, catch basins, or storm drains present in the immediate vicinity. The berm around SWMU 57 prevents both runon and runoff from the pond, even though a surface drainage ditch flows around the pond.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included sampling and analysis of one surface water and one sediment sample.

The role that this man-made pond played in the manufacturing process is not clear, and the origin of the liquid in the pond during the investigation is uncertain, though precipitation was a likely source. VI activities included the collection and analysis of surface water and sediment samples to support a waste characterization of this unit.

3.1 SURFACE WATER

One surface water sample was collected from SWMU 57 to evaluate the characteristics of the liquid in the pond. The sample was analyzed for TAL metals, VOCs, SVOCs, TOC, TOX, and pH. ***1,1,2,2-tetrachloroethane*** was detected above the HBN. Several metals were detected above the PQLs but below the HBN, as shown in Table 5-22.1. TOC was reported within a range normally found in surface water environments, and TOX was reported at a concentration of 104 µg/L.

3.2 SEDIMENT

To evaluate the characteristics of the sediment in the pond, one sediment sample was collected from a depth of 0 to 12 inches below the water/sediment interface. The sample was analyzed for metals, VOCs, and SVOCs. Analytical results for metals that were detected above PQLs and HBNs are presented in Table 5-22.2. ***Arsenic*** and ***cobalt*** were the only metals that exceeded HBNs.

4.0 RECOMMENDED ACTION

Collect confirmatory samples to support the site screening process.

DSERTS #: RAAP-023 **SANITARY LANDFILL #2** **RRSE: 3A**

SWMU 43

1.0 BACKGROUND

SWMU 43 is a closed, unlined sanitary landfill located immediately adjacent to the New River in the northeast section of the RFAAP Main Manufacturing Area (Figure 5-23.1). The exact boundaries of the unit have not been determined because no plan or site documents are available.

The landfill reportedly received 300 tons of paper and refuse over its active life; however, based on the estimated size of the landfill the quantities were probably larger. Soil cover has been monitored through facility inspections.

The USATHAMA, 1984 report described a sanitary landfill in the same location as having operated from 1958 to 1969. It was reported by RFAAP personnel that this landfill was operated from about 1967 through the early 1970s. Aerial photographs support potential landfill operations at the unit prior to 1962.

2.0 ENVIRONMENTAL SETTING

SWMU 43 is a flat level area at an approximate elevation of 1,700 feet msl. A drainage ditch located in the center of the SWMU divides the area into east and west sections.

Based on aerial photography, the landfill apparently extends east-west approximately 600 feet on either side of the drainage ditch. The north-south boundaries are the riverbank and paved roadway, respectively.

The western section is mostly grassy but has a small concrete pad, gravel parking area, and a pile of soil located adjacent to the roadway. The eastern section is covered entirely with grass. There are very few buildings in this section of the plant.

Elongated depressions, which would correspond to the disposal trenches, are visible. The east half appears to have undergone subsidence since the landfill was covered.

The geology of the SWMU was investigated during the VI (Dames & Moore, 1992) through the drilling of two soil and rock borings south of the SWMU and four soil and rock borings north of the SWMU.

Subsurface conditions consist of fine- to coarse-grained alluvial deposits, which progressively thicken away from the New River. Alluvial deposits encountered in the vicinity consist mainly of fine-grained micaeous brown, sandy silts and silty sand with some interbedded silty clays.

Eighteen feet of sanitary landfill material was encountered during the drilling of two downgradient borings drilled along the fence bordering the SWMU. Under the landfill material, a relatively thin layer of undisturbed fine grain silt to silty sand over weathered limestone rock was encountered. Where sediments were thicker in the upgradient borings, a basal layer of either river jack (silty gravel) or silty clay was present above weathered limestone bedrock.

Bedrock encountered in the vicinity of SWMU 43 generally consisted of highly argillaceous gray limestone and gray conglomeratic and brecciated limestone. Typically, limestone in this area was weathered to highly weathered, and fractured with vuggy and pitted zones and occasional clay seams.

During rock coring, large quantities of water were lost in fractured and weathered zones within the bedrock. The observed depth to limestone rock ranged from 23 to 30 feet in southern well bores and 17 to 23 feet in northern well bores.

Groundwater flows northward toward the New River at a hydraulic gradient of approximately 0.5 to 1 percent. An unconfined groundwater table was encountered from 18 to 23 feet bgs within the overburden soils in the upgradient well. Groundwater was encountered within the limestone bedrock at wells installed within the landfill and in downgradient wells.

Surface water runoff from the SWMU is expected to flow towards a drainage ditch located in the center of the SWMU and is assumed to flow northward to the New River. Trench depressions also collect surface water that has the potential for infiltrating into the landfill. Several groundwater seeps were observed discharging from the base of the embankment north of SWMU 43 along the New River. The seeps were detected at an elevation of approximately 1,681 feet msl.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore,** included the collection of six groundwater and two surface water samples.

SWMU 43 was identified in the RFA (USEPA, 1987) as having a potential for releasing contaminants into the environment and was included in the RCRA Permit for Corrective Action and Incineration Operation (USEPA, 1989) as warranting investigation. Subsequently, a VI was conducted by Dames & Moore in 1992 to evaluate whether toxic or hazardous contaminants are present and are migrating, or have the potential to migrate beyond the boundaries of the identified SWMU unit. The VI program at SWMU 43 involved the installation and sampling of six monitoring wells in the vicinity of the unit. During the drilling of monitoring wells the subsurface geology in each borehole was explored and described.

3.1 GROUNDWATER

One well was installed upgradient of each section of the landfill (43MW1 and 43MW2), and two wells were installed downgradient of each section (43MW3, 43MW4, 43MW5, and 43MW6) (Figure 5-23.1). The maximum depth of these six wells is 42 feet.

During installation of the monitoring wells, water levels were documented. In the two upgradient wells, the water table was encountered within the overburden soils from 18 to 23 feet bgs. In the two eastern downgradient wells (43MW5 and 43MW6), the water table was encountered at the overburden/bedrock interface around 20 feet bgs. In the two western downgradient wells (43MW3 and 43MW4), it was encountered within the limestone bedrock. After groundwater levels stabilized, the hydraulic gradient confirmed that the general direction of groundwater flow is north toward the New River. Stabilized measurements also showed that groundwater elevations were 2 to 3 feet higher downgradient of the eastern unit. Groundwater elevations were 1682.41 and 1682.98 feet msl at 43MW3 and 43MW4, and 1685.17 and 1684.85 feet msl at 43MW5 and 43MW6. This is probably related to increased surface water recharge in the eastern unit. Visible trench depressions observed on the surface of the unit were very soft and contained standing water. This water slowly infiltrates the soil and recharges the aquifer, producing a higher water table under the eastern unit.

Groundwater samples were collected from the six wells and analyzed for metals, VOCs, SVOCs, TOC, TOX, and pH. Although the results of the chemical analyses indicate the presence of metals, VOCs, and an SVOC in groundwater at SWMU 43 (Table 5-23.1), no constituents exceeded HBN criteria. TOC, TOX, and pH were generally similar in upgradient and downgradient samples.

3.2 SURFACE WATER

Two surface water samples were collected from the groundwater seeps and were analyzed for metals, VOCs, SVOCs, TOC, and TOX (Table 5-23.2). The results of the chemical analyses indicated the presence of ten metals and one VOC below HBNs in surface water samples collected. No SVOCs were detected.

4.0 RECOMMENDED ACTION

Collect confirmatory samples from available media and analyze for VOCs, SVOCs, and metals to support the no further action recommendation.

DSERTS #: RAAP-024 **LANDFILL #3** **RRSE: 1A**

SWMU 45

1.0 BACKGROUND

SWMU 45, an inactive sanitary landfill, is located approximately 3,000 feet west of the main bridge over the New River in the north-central section of the Main Manufacturing Area (Figures 5-24.1). The USATHAMA, 1984 report described this unit as the first known landfill at RFAAP and stated it operated between 1957 and 1961. Aerial photography from 1949 shows a cleared area with white ground scarring in the area between but south of wells installed in its northeastern sector.

In 1962, there still were no trees evident, but the scarring was not visible in the aerial photography. However, a darker, possibly disturbed, area was visible in the area south of well 45MW2. In 1971, aerial photography showed none of the 1949 or 1962 scarring patterns, but a different white-scarred area was evident along the former access road approximately 100 feet north of well 45MW1. The RFA (USEPA, 1987) described SWMU 45 (landfill #3) as having operated during the 1970s. The latter dates of landfill operation appear to be consistent with recollections of plant personnel, the aerial photography, and the apparent ages of the pine trees.

The unit was never operated as a permitted landfill. Paper and municipal refuse were the only materials reportedly disposed of in SWMU 45. It was also reported that wastes were placed in trenches and burned prior to burial. Evidence of burning has been observed in the area.

2.0 ENVIRONMENTAL SETTING

SWMU 45 is located in a generally flat area. The exact boundaries of the unit have not been determined since no operational plans or diagrams are available. The ground surface of the SWMU slightly slopes from a maximum elevation of 1,707 feet msl at the southern end of the SWMU to a minimum elevation of 1,703 feet msl at the northern end of the SWMU.

The area is overgrown with pine trees that were planted after landfill operations ceased. In addition, soil mounds and excavations are visible. The main asphalt road is located approximately 200 feet to the south, and the SWMU 9 area is located approximately 1,500 feet to the southwest. At the southern border of SWMU 45, adjacent to the main asphalt road, is a set of railroad tracks that run generally east to west.

During drilling, a shallow unconfined groundwater table was encountered within the fine-grained silts and silty sands or the silty gravel layer. Subsequently, stabilized groundwater levels were measured at approximately 21 to 25 feet. Groundwater levels in SWMU 45 fluctuated several feet during the VI program, probably the result of seasonal variations in precipitation water levels in the New River. Groundwater flow is northward with discharge into the New River.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included a geophysical survey and the installation and sampling of three groundwater monitoring wells.

A geophysical survey was conducted over the approximate five-acre unit identified in Figure 5-24.1, and resulted in the placement of three monitoring wells—one upgradient and two downgradient of the landfill area. Groundwater levels were measured in each well. Groundwater samples were collected and analyzed for metals, VOCs, SVOCs, explosives, TOC, TOX, and pH. In addition, a baseline risk assessment was conducted.

3.1 GEOPHYSICAL SURVEY

The following discussion summarizes the findings of SWMU 45's geophysical investigation (Dames & Moore, 1992).

EM and magnetometer surveys were conducted to identify the potential boundaries of the landfill. For the initial survey, measurements were taken at intervals of 10 feet along seven parallel north-south lines that were placed 100 feet apart. Additional data were collected at smaller intervals to increase resolution in areas where anomalous features were observed. The survey covered an area 265 by 600 feet. Figure 15-2 presents the summary interpretation of the geophysical data.

Two anomalies were identified during the initial survey. The first, a large, lined oval, displayed a weak magnetic high of approximately 50 gammas and contains conductive material. The middle of this anomaly coincided with the visible outline of a former trench. It is possible that the width of the buried material is about the same as the width of the oval. It is also possible that conductive material originally buried in the smaller trench migrated, resulting in a size increase of the detected anomaly. This anomaly was interpreted as one of the following:

- Magnetic earthen cover material.
- Buried materials are themselves somewhat magnetic, such as sludge.
- A fire burned the earth, leaving it magnetized.

The third interpretation could indicate that wastes were placed in landfill trenches and burned during landfill operations. The second anomaly identified was more intense and appeared to be a large buried metal object. The best fit for the metal object was found at a depth of approximately 2 feet, with a width of approximately 18 feet, and thickness of approximately 8 feet.

3.2 GEOLOGY

Three soil borings were drilled and three groundwater monitoring wells (45MW1, 45MW2, 45MW3) were installed in the vicinity of SWMU 45, as shown in Figure 5-24.1. The subsurface lithology encountered during drilling consisted of fine-grained alluvial deposits composed of micaceous sandy silts and silty sands underlain by a thin layer of river jack (silty gravel). Fine-grained silts and clayey sands were encountered beneath the river jack layer. Boring 45MW3 was terminated at 26 feet on top of weathered limestone bedrock. Bedrock was not encountered in the other borings in SWMU 45; however, based on the observed subsurface conditions, bedrock would likely be encountered just below the depths penetrated.

3.3 GROUNDWATER

The results of the chemical analyses indicated the presence of eight metals, two VOCs, and one SVOC in groundwater at SWMU 45 (Table 5-24.1). The concentrations of all metals were below HBNs and reflect normal ion variability in the groundwater. Two VOCs, carbon disulfide and toluene, were detected in the upgradient well and one downgradient well; however, concentrations were several orders of magnitude less than their respective HBNs. One SVOC, ***bis(2-chloroethyl) ether***, was detected in 45MW3 at a concentration greater than the HBN. Bis(2-chloroethyl) ether can be formed from the chlorination of water when ethyl ether is present. Its presence may indicate the past disposal of solvents or solvent-based propellants.

4.0 RISK ASSESSMENT

Summary of Screening Level Risk Assessment

Samples Collected

Groundwater samples were collected upgradient and downgradient of the landfill. The upgradient location is questionable.

Medium	No.	Location
Groundwater	1	Upgradient
	2	Downgradient

4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

COPCs were selected based on results exceeding HBNs and background. Although groundwater had exceedances for bis(2-ethylhexyl) phthalate, it was deleted because of its detection in blanks associated with the sample.

4.2 EXPOSURE ASSESSMENT

No groundwater wells, other than for monitoring purposes, are located downgradient of SWMU 45. Shallow groundwater would not migrate toward any groundwater users in the vicinity of RFAAP, which will continue to remain an army installation with no plans for future residential development. Therefore, it is highly unlikely that groundwater wells would be installed in the future between SWMU 45 and the New River. Based on this evaluation, potential groundwater exposure pathways are not considered operable under the current or future land use scenario.

Subsequent modeling of groundwater contamination in surface water, and collection of surface water samples from the New River, would provide useful information for assessing risks associated with surface water exposures. Surface soil and sediment samples should be assessed in order to quantitatively evaluate potential risks to workers at the site and trespassers wading along the banks of the New River.

If groundwater and/or surface water COPCs are selected based on the review of future analytical data, then the quantitative evaluation should be considered for the following exposure pathways:

Groundwater

- Ingestion of chemicals in groundwater by future workers.

Soil

- Incidental ingestion of chemicals in soil by future workers; and
- Dermal absorption of chemicals in soil by future workers.

Sediment

- Incidental ingestion of chemicals in sediment by recreational visitors wading along the banks of the New River; and
- Dermal absorption of chemicals in sediment by recreational visitors

wading along the banks of the New River.

Surface Water

- Incidental ingestion of chemicals in surface water by recreational visitors wading in Stroubles Creek; and
- Dermal absorption of chemicals in surface water by recreational visitors swimming in the New River.

Table 5-24.2 presents the exposure assessment overview.

5.0 RECOMMENDED ACTION

Confirmatory sampling of available media to support a quantitative baseline risk assessment.

DSERTS #: RAAP-025 $CaSO_4$ TREATMENT/DISPOSAL AREA RRSE: 3A

SWMU 50

1.0 BACKGROUND

SWMU 50 is an open area south of SWMU 48, approximately 300 feet long by 300 feet wide (Figure 5-25.1). Based on a review of historical aerial photographs and an interview with plant personnel, it was determined that the area was used for sludge disposal. Until 1982, this was the major disposal area at RFAAP for sludge removed from the calcium sulfate drying beds (SWMUs 35, 36, 37, 38, and Area Q). Stressed vegetation is visible along the northern and eastern edges.

2.0 ENVIRONMENTAL SETTING

Because of its close proximity to SWMU 48, it is assumed that this unit exhibits similar subsurface and hydrogeologic characteristics.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA**, included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore**, included the collection of two subsurface soil samples.

Samples were collected from the SWMUs as provided in the permit to evaluate whether any hazardous constituent concentrations exceeded HBNs specified in the permit.

Two soil borings were drilled to a depth of five feet. One subsurface soil sample was collected from each boring. Parameters analyzed included metals, VOCs, and SVOCs. VOCs were only detected in the northern sample and included chloroform and 1,1,1-trichloroethane. SVOCs were detected in both sample, including: 2-methylnapthalene, napthalene, and phenanthrene in the northern sample; and SVOC TICs in the southern sample. All reported results were below respective HBNs. Table 5-25.1 presents chemical results for analyte concentrations exceeding the PQL. *(Note: Chloroform and 1,1,1-trichloroethane were also detected in SWMU 8; phenanthrene was detected in SWMU 36.)*

Napthalene, 2-methylnapthalene, and phenanthrene are PAHs generally associated with petroleum products, such as coal tar, gasoline, solvents, power plant emissions, and coal ash and cinders. *(Note: Phenanthrene was detected in SWMU 36.)*

Arsenic, barium, chromium, and lead were reported at detectable concentrations in the TCLP extract, which indicated that leachable levels of these metals were available. However, results were reported less than regulatory levels specified in 40 CFR 261.24, except for ***lead***, which exceeded its HBN in sample 150SL1. *(Note: Barium and chromium were detected in SWMUs 8, 9, 36, 37, and 38; lead was detected in SWMU 9.)*

Barium may be available as barium nitrate, $Ba(NO_3)_2$, which is used as an oxidizing agent and included in double-base solvent (M26) and solventless (M2, M5) formulations.

Propellant	Percent by weight
M2	1.4±0.25
M5	0.5±1.6
M26	0.75±0.2

SWMU 50

Example of lead usage in propellant formulations include:

Propellant Compound	Percent by weight
BS-NACO	1.0±0.2
lead carbonate	
AHH	
lead salicylate	2.3 (nominal)
lead 2-ethylhexoate	2.3 (nominal)
ARP	
lead salicylate	17±1.0
lead beta resorcylate	3.0±0.25
PNJ	
lead salicylate	2.93
lead 2,4-dihydroxybenzoate	2.93
M16	
lead stearate	0.5
M21	
lead stearate	0.5
lead salicylate	2.5

4.0 RECOMMENDED ACTION

Confirmatory subsurface soil sampling for VOCs, SVOCs, explosives, and metals. Groundwater will be evaluated in conjunction with SWMU 48 investigative activities.

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DSERTS #: RAAP-026 COAL ASH SETTLING LAGOONS RRSE: 1A

SWMU 31

1.0 BACKGROUND

SWMU 31 consists of three unlined settling lagoons located in the northwest section of the Horseshoe Area. The unit has previously been referred to as both the "fly ash settling lagoon" and the "bottom ash settling lagoon," suggesting the probability that both fly ash and bottom ash have been discharged into it. In addition, the flocculating basin underdrainage and filter backwash water from Water Plant 4330 reportedly flowed to this unit (USATHAMA 1976).

SWMU 31 is associated with Power House No. 2, which burned low sulfur coal to supply steam at 150 pounds per square inch (psi) to the buildings in the Horseshoe Area. Power House No. 2 has not been active since January 1993 (Engineering-Science, 1994). Prior to 1971, when electrostatic precipitators were installed at the power house, fly ash contaminated wastewater was discharged directly to the New River (USATHAMA, 1984).

During active use of Power House No. 2, water carrying fly ash from the power house flowed down a below-grade, concrete-lined sluice waterway to the small primary settling lagoon (approximately 100 feet long by 50 feet wide), which was constructed in 1962. At one time, the supernatant from the primary settling lagoon was emptied directly into the New River via Outfall 024 (Permit No. VA 0000248).

In 1978 or 1979, additional components were added to the unit; wastewater now flows from the primary settling lagoon through a below-ground pipe to a concrete sump. The sump is 18 to 20 feet deep, 2 feet of which is above grade. From the concrete sump, water is discharged to the secondary settling lagoon, which is approximately 150 feet wide by 200 feet long. From the secondary settling lagoon, water is discharged to the tertiary settling lagoon (approximately 150 feet wide by 250 feet long).

Facility representatives indicate that the water currently flowing into the primary settling lagoon consists of either overflow from the drinking water settling tanks or backwash from the cleaning of the filters at the drinking water settling tanks. On average, 20,000 gallons of overflow water per day is released to the primary lagoon at a relatively constant flow rate. At a minimum, the filters require cleaning once every three days. This process involves passing 2,800 gallons of water per minute through the filters for 20 minutes to remove accumulated river sediment. The 56,000 gallons of turbid sediment-rich water yielded by this process is discharged to the primary settling lagoon. The yield is then split so that equal volumes of this water are discharged to the secondary and tertiary settling lagoons.

The effluent from the tertiary settling lagoon is designed to discharge to the New River through the new location of Outfall 024 following pH adjustment with sulfuric acid. However, facility representatives indicate that there has never been a discharge. All water discharged to the basin apparently percolates through the basin into the surrounding soils or evaporates.

Coal ash that settled out in the three lagoons was periodically dredged and disposed in FAL No. 2 (SWMU 29). Previously, coal ash was disposed in FAL No. 1 (SWMU 26).

2.0 ENVIRONMENTAL SETTING

SWMU 31 is located on a nearly level terrace adjacent to the New River at an approximate elevation of 1,700 feet msl. The New River flows from northeast to southwest along the northern boundary of the SWMU. The river is approximately 100 feet from the lagoons. The facility's New River water intake (No. 2) is approximately 300 feet upstream of Outfall 024.

Inactive railroad tracks run along the southern boundary of SWMU 31. The tracks are elevated approximately 15 feet above the level terrace. South of the tracks, the elevation increases further, so that the SWMU vicinity is a "stepped" terrace leading down to the New River.

SWMU 31 subsurface characteristics were evaluated during the installation of four groundwater monitoring wells during the 1996 RFI. Samples were collected either continuously or at five foot intervals in each boring. The vertical extent of all investigatory drilling activities was approximately 53 feet, ranging from 1715 feet msl to 1662 feet msl.

The subsurface is generally comprised of unconsolidated alluvial sediments overlying the weathered limestone of the Elbrook Formation. The SWMU 31 vicinity displays the characteristic terraces of the unconsolidated sediments at RFAAP. There is a general fining upwards textural sequence as silts and clays overlie gravels and silty sands. Below the gravels and sands, the bedrock interface was encountered. The unconsolidated sediments were 25 to 28 feet thick along the New River.

A dark brown silt layer containing varying amounts of clay was typically encountered overlying a silty sand. At 6 to 8 feet bgs, a dark brown sand, silt, and gravel layer was present approximately 5 to 7 feet thick. Below this layer was a brown silt, clay, and gravel section, which extended to the bedrock interface. To the east, a brown clay layer exists at 5 to 8 feet bgs between well borings 31MW3 and 31MW2.

The gravely layers often contain the cobbles or boulders (river jack) that occur throughout the alluvial strata along the river. The bedrock is a gray weathered limestone which was partially penetrated by hollow stem augers in some borings, but which required air drilling methods to complete the wells in other borings. The rock samples at the bedrock interface were determined to be limestone by hydrochloric acid effervescence testing.

One upgradient and three downgradient wells were installed to determine the migration of metals from the lagoons. Downgradient wells (31MW2, 31MW3, and 31MW4) were screened in the alluvial sediments overlying the Elbrook Formation bedrock. The upgradient well (31MW1) was screened at the bedrock interface.

The potentiometric surface of the groundwater is approximately the same elevation as the secondary and tertiary lagoon sediment levels. Because these lagoons were excavated to the bedrock surface, the bottoms of the lagoon are essentially at the groundwater table. Groundwater elevations have been observed to fluctuate seasonally from 2 to 7 feet at this SWMU.

Subsurface conditions in the vicinity of 31MW1 were slightly different than for the wells along the river. Although the same layers were encountered at similar elevations, the sandy gravel layer was considerably drier in this area than near the river. The well boring was advanced into a wet zone of the bedrock to ensure that the well would not be dry. The result was a screened interval lower than the other wells. The groundwater potentiometric level in this area is consistent with flow toward the river, but the overburden may contain more clay, or the bedrock may have fewer fractures, resulting in slower recharge of groundwater in 31MW1.

The direction of groundwater flow at SWMU 31 is north to northwest, toward the New River. Based on calculations, the hydraulic gradient is approximately 0.013 ft/ft.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore,** included the collection of three composite sludge samples.
- **1996 - RCRA Facility Investigation, Parsons Engineering Science,** included collection and analysis of six sediment samples, four groundwater samples, and eight subsurface soil samples to determine the migration of metals from the lagoons.
- **1998 – RCRA Facility Investigation, ICF Kaiser,** included the collection of three surface water samples, three sludge samples, eight subsurface soil samples, and four groundwater samples to further verify the nature and extent of SWMU contamination.

Sample locations are presented in Figure 5-26.1.

3.1 VERIFICATION INVESTIGATION

Three composite sludge samples, one from each of the three settling lagoons, were collected at the unit for waste characterization purposes. Samples were collected from the top one foot of sludge beneath the water/sludge interface and analyzed for metals and SVOCs. Metals that were detected above the PQL are presented in Table 5-26.1. ***Arsenic, beryllium,*** and ***cobalt*** exceeded the HBN criteria in all samples. ***Thallium*** was detected in sample 31SL2 (e.g., from the secondary lagoon) at a concentration greater than the HBN criterion.P Seven SVOCs were detected in the sludge samples. Most of the detected SVOCs were PAHs and other saturated hydrocarbons associated with petroleum products such as commercial coal tar, gasoline, solvents, power plant emissions and coal ash and cinders.

3.2 1996 - RCRA FACILITY INVESTIGATION

3.2.1 Sediment

Two composite sediment samples representing the total sediment column were collected from each lagoon to determine potential disposal characteristics of the lagoon sediments. Sample results indicated that the lagoon sediments were within TCLP regulatory limits for all parameters. Because sediment samples were only collected for disposal classification purposes, analytical results were not quantifiable for risk assessment use.

3.2.2 Subsurface Soil

Two soil samples were collected from each of the four well borings and analyzed for metals. Seven metals were detected above the PQLs as presented in Table 5-26.2. ***Arsenic*** and ***beryllium*** were detected above HBNs.

3.2.3 Groundwater

Groundwater samples were collected from the upgradient and downgradient wells during the months of January and July 1995 and sampled for total and dissolved metals, TOC, and TOX. Results for samples greater than the PQL are contained in Table 5-26.3. Antimony, barium, and chromium were identified as chemicals of concern.

3.3 1998 – RCRA FACILITY INVESTIGATION

3.3.1 Surface Water

One surface water sample was collected at the outfall of each lagoon and analyzed for metals, SVOCs, and PAHs. Detected metals results are presented in Table 5-26.4. Results indicated that none of the detected metals exceeded Tap Water RBC values. ***Aluminum*** concentrations exceeded the Biological Technical Assistance Group screening criterion.

3.3.2 Sludge

Composite surficial (0 to 0.5 feet below the sludge/water interface) samples were collected from two locations around the outfalls of each settling lagoon and analyzed for metals, SVOCs, and PAHs. Analytical results for metals are presented in Table 5-26.5. Analytical results for detected organics are presented in Table 5-26.6.

Sludge results indicated that only ***arsenic*** concentrations were detected above the industrial RBC in each lagoon. ***Aluminum, arsenic***, and ***chromium*** were detected above residential RBCs in all three sludge samples; ***iron*** concentrations exceeding the residential RBC in the tertiary lagoon. Several metals and three PAHs (fluoranthene, phenanthrene, and pyrene) were detected above the BTAG screening criteria.

3.3.3 Subsurface Soil

Two soil samples were collected from each of four soil borings and analyzed for metals, SVOCs, and PAHs. Detected results for metals are presented in Table 5-26.7, and for organics in Table 5-26.8.

Arsenic, chromium, and ***iron*** concentrations were detected above residential RBCs in all four borings. Only ***arsenic*** was detected above the industrial RBC criterion at 10 to 12 ft bgs in borings 31SB1 and 31SB3, and at 20 to 24 ft bgs in boring 31SB4. Antimony, chromium, and nickel concentrations exceeded the SSL Transfer criteria in nearly all samples.

Several trace level SVOCs, which consisted mostly of PAHs, were detected below residential RBCs in three out of the four borings.

3.3.4 Groundwater

Four groundwater samples were collected from the existing monitoring wells and analyzed for total and dissolved metals, SVOCs, PAHs, TOC, and TOX. Detected results for metals are presented in Table 5-26.9, and for organics in Table 5-26.10.

4.0 RECOMMENDED ACTION

Additional RFI activities recommended at SWMU 31 to augment the existing data and evaulate potential metal and PAH contamination identified during RFI activities to support a no further action decision.

DSERTS #: RAAP-027 RUBBLE PILE RRSE: 2A

SWMU 58

1.0 BACKGROUND

SWMU 58, the Rubble Pile, is approximately 50 feet high and roughly triangular in shape with each side approximately 300 feet long. Erosion of the soil cover is evident.

According to facility representatives interviewed during the March 1990 facility visit, SWMU 58 was used as a one-time disposal site in 1979. During clearing activities, prior to construction of the CAMBL, pine trees, and surface debris were pushed into a pile and then covered with dirt and fill material. It was believed that no other materials were disposed of at SWMU 58.

2.0 ENVIRONMENTAL SETTING

SWMU 58 is located in the south-central portion of the Horseshoe Area, approximately 2,600 feet east of the main bridge over the New River and directly west of SWMU 32 (Inert Waste Landfill No. 1). It is located along the lower portion of the plateau at approximately 1,740 feet msl.

Topography in the area of SWMU 58 is moderately sloping towards the north. There are several buildings, an overhead steam pipe, and gravel and paved roads in the vicinity.

Subsurface soil conditions were characterized during the 1998 RFI. The subsurface consisted of varying quantities of fill material (bottom ash, coal, concrete) and silt, sand, gravel, and clay to bedrock. Although bedrock may be relatively level, depth to bedrock ranged from 22.5 ft to 59 ft bgs. Bedrock consisted of gray limestone and dolostone of the Elbrook Formation.

Although no site-specific hydrogeologic investigations have been conducted in this area, groundwater conditions are assumed to be similar to SWMUs 26 and 32. Groundwater is expected to flow northward.

Surface water appears to flow in all directions from the debris pile at SWMU 58. Runoff is expected to flow northward following topography towards the New River, which is approximately 2,000 feet north of the SWMU.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included the collection and analysis of surface soil samples to evaluate potential soil contamination.
- **1998 - RCRA Facility Investigation, ICF Kaiser,** included the collection and analysis of subsurface soil samples to verify VI results soil borings.

Sampling locations are presented in Figure 5-27.1.

3.1 VERIFICATION INVESTIGATION 1992

3.1.1 Surface Soil

The VI field program included the collection and analysis of three soil samples for metals, VOCs, and SVOCs. Samples were collected from beneath the cover material along the edges of the rubble pile at a depth of 0 to 1 foot. Analytical results are presented in Table 5-27.1 for results that exceeded HBNs and PQLs.

Although primary target VOCs and SVOCs were not detected in any of the soil samples, SVOC TICs were detected at trace levels. Additionally, a number of metals were detected in all three samples. ***Arsenic, beryllium, cobalt,*** and ***thallium*** concentrations exceeded HBNs in at least one sample.

3.2 RCRA FACILITY INVESTIGATION - 1998

3.2.1 Subsurface Soil

Five subsurface soil samples were collected from three soil borings (58SB1, 58SB2, and 58SB3) to determine whether materials in the rubble pile or previous activities at the site caused contamination to underlying soil. Samples were analyzed for metals, VOCs, and SVOCs. Analytical results for detected metals are presented in Table 5-27.2, and for organics in Table 5-27.3.

Chromium and ***iron*** were detected above residential RBCs in four out of five samples. ***Arsenic*** concentrations exceeded residential and industrial RBCs in all five samples. Additionally, several metals exceeded SSL Transfer criteria.

Only one PAH (***benzo[a]pyrene***) was detected above the residential RBC. Two VOCs (cis-1,2-Dichloroethene and trichloroethene) exceeded SSL Transfer criteria in four samples.

4.0 RECOMMENDED ACTION

The rubble that comprises SWMU 58 does not enable surface water runoff to be considered an unfeasible migratory route. Although analytical results indicated trace level concentrations of metals, VOCs and PAHs in deep subsurface soil samples, these contaminants could be associated with construction debris encountered during the investigation. The available information suggests a low risk of potential releases from this SWMU. Further environmental action is not a high priority at this time based on site conditions.

DSERTS #: RAAP-028 BOTTOM ASH PILE RRSE: 3A

SWMU 59

1.0 BACKGROUND

SWMU 59, the Bottom Ash Pile, is located near SWMUs 48 and 50 in the Horseshoe Area of RFAAP, approximately 3,400 feet east of the main bridge over the New River (Figure 5-28.1).

Bottom ash is permitted to be buried in landfills on the installation (in particular FAL No. 2). Some bottom ash is apparently stored in piles around RFAAP for use on roadbeds and as landfill cover material (USEPA, 1987).

It can be assumed that this pile or similar piles have existed at RFAAP since operation of the power plant began.

2.0 ENVIRONMENTAL SETTING

SWMU 59 is located on a plateau area of the eastern portion of the Horseshoe Area. The elevation of SWMU 59 is approximately 1,810 to 1,820 feet msl, gently sloping to the south. Further south, the hillside steeply slopes south towards the New River, which is approximately 500 feet south of the SWMU.

SWMU 59 is surrounded by SWMUs 48, 49, 50, 51, 52, 29, 27, and 53. SWMU 13 is approximately 600 feet south of SWMU 59. SWMU 49 is approximately 50 feet south of SWMU 59.

Although neither subsurface nor hydrogeologic investigations have been performed in this area, its close proximity to SWMU 48 would indicate similar conditions.

Surface water appears to flow south and southwest with discharge into the New River. There are no manholes, catch basins, or storm drains located in the immediate vicinity.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - Verification Investigation, Dames & Moore,** included the collection of two soil samples.

Scientific studies have demonstrated that coal bottom ash can leach hazardous constituents to the environment. Sampling was conducted at this unit to evaluate whether soil contamination exists beneath the ash pile.

Two soil samples were collected from below the bottom ash at SWMU 59 at a depth of 0 to 12 inches. Each sample was analyzed for TAL metals and SVOCs. A duplicate sample was also analyzed. Analytical results for samples exceeding PQLs and HBNs are presented in Table 5-28.1. ***Arsenic, beryllium,*** and ***cobalt*** exceeded the HBN in the sample taken below the northwest corner of SWMU 59.

Phenanthrene was the only SVOC detected in any of the samples. This compound is a PAH compound generally associated with commercial coal tar, gasoline, power plant emissions, and coal ash and cinders. The reported concentration was below the HBN. The source of this compound may be due to runoff from the nearby asphalt road rather than the bottom ash pile.

4.0 RECOMMENDED ACTION

Confirmatory subsurface soil samples will be collected and analyzed for metals and SVOCs. Groundwater characteristics will be evaluated in conjunction with SWMU 48.

DSERTS #: RAAP-029 CLOSED SANITARY LANDFILL RRSE: 1A

SWMU 52

1.0 BACKGROUND

SWMU 52 is a closed sanitary landfill contiguous to and immediately south of the Closed Hazardous Waste Landfill (HWMU 16) (Figure 5-29.1). SWMU 52 was first used in 1976 and was closed in 1984 when it reached design capacity. The unit was not permitted by the Commonwealth of Virginia.

SWMU 52 reportedly contains three trenches, each approximately 500 feet long by 35 feet wide by 14 feet deep. The landfill was used primarily for the disposal of municipal refuse though some asbestos (in double plastic bags) were disposed of in this area (USACE, 1981).

2.0 ENVIRONMENTAL SETTING

SWMU 52 is located on a plateau in the southeastern section of the Horseshoe Area adjacent to HWMU 16 and SWMU 30. It is also proximate to SWMUs 28 and 51. The elevation of the plateau ranges from approximately 1,810 to 1,840 feet msl. The plateau is generally flat to slightly sloping.

SWMU 52 is the southeasternmost SWMU on the plateau and gently slopes toward the east. The maximum elevation of SWMU 52 is approximately 1,834 feet msl in the northeast corner, and the minimum elevation is approximately 1,811 feet msl on the eastern boundary.

Surface water runoff appears to flow towards the drainage ditches and storm sewers surrounding SWMU 52. Surface water along the eastern road flows north. Storm sewers and natural drainage patterns along the paved road on the eastern boundary of the plateau appear to flow northeast and discharge into a tributary of the New River. The tributary flows northeast about 700 feet where it joins with another tributary of the New River just east of SWMU 74. The tributary flows east to this point and discharges into the New River approximately 1,500 feet east of SWMU 74 and approximately 300 feet northeast of SWMU 54.

The subsurface stratigraphy, depth to bedrock, hydraulic conductivity, and hydrogeologic interrelationships in the vicinity of SWMU 52 are similar to those of SWMUs 28 and 51.

Based on the available information in the RFI program, groundwater flows radially from the western portion of the landfill area. Groundwater below SWMU 52 appears to flow eastward or northeastward. The flow gradient for SWMU 52 is approximately 6 percent, which is fairly steep for a groundwater gradient. Groundwater flowing from SWMU 52 would eventually discharge into the New River without migrating to any off-post areas.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a preliminary data review, evaluation, and visual site inspection.
- **1992 - RCRA Facility Investigation, Dames & Moore,** included the installation, sampling, and analysis of four soil and rock borings and four monitoring wells in the vicinity of and in conjunction with SWMUs 28 and 51.

SWMUs 28, 51, and 52 are geographically proximate to each other in the eastern end of the Horseshoe Area. Each SWMU consists of a subsurface burial area of waste *material. The three SWMUs encompass an area of approximately 15 acres. Because of the proximate nature of the SWMUs and the similar disposal methods used at each SWMU, one combined study area was delineated for the RFI.*

The RFI sampling program provided chemical data for evaluating the impact SWMUs 28, 51, and 52 have on groundwater migrating from the combined landfill area. Subsurface conditions were evaluated during the soil and rock boring program. Upgradient and downgradient hydrogeologic characteristics were evaluated through the installation of four monitoring wells.

3.1 SOIL

Remediation of soil is not a potential corrective action since these SWMUs are landfill disposal areas and potential contamination can occur through groundwater. Surface soils have not been impacted by SWMU practices and all exposed areas have naturally clean fill to cover the waste. However, a summary of the USDA soil properties may be useful since infiltration of precipitation is an important mechanism for recharging groundwater. The landfill area was constructed upon Braddock loam (2-7 percent slope) and Cotaco loam (2-7 percent slope) soils (SCS, 1985).

3.2 GROUNDWATER

A total of thirteen groundwater samples were collected in the vicinity of SWMUs 28, 51, and 52. The results of the chemical analyses indicated the presence of metals, explosives, VOCs and SVOCs in groundwater as presented in Table 5-29.1. The majority of metals are common constituents of groundwater and were detected at levels expected to be present in groundwater of a limestone formation. All metal concentrations were less than HBN criteria and do not appear to be anomalously high.

SVOCs were detected in several samples that appeared to be related to manufacturing activities. Low levels of two explosives were detected in three groundwater samples. The explosive 13DNB was detected downgradient of SWMU 52 in the groundwater sample from well 16-3 at a level slightly greater than the analytical detection limit. Concentrations of the explosive ***26DNT*** exceeded the HBN criterion in samples from well 16-4 and 51MW2. ***Bis(2-ethylhexyl) phthalate*** in sample 16-4 also exceeded the HBN criterion. The samples were collected east and south of the TNT Sludge Neutralization Disposal Area (SWMU 51). However, these constituents were not detected in groundwater west of SWMU 51 (e.g., sample 51MW). Soils at 51MW1 were different from those found at 16-4 and 51MW2, and this well could be sampling a perched groundwater zone and not the unconfined aquifer.

Concentrations of the VOCs ***1,1,2-trichloroethane*** and ***1,1,2,2-tetrachloroethane*** were detected above HBN criteria in the groundwater sample taken downgradient of SWMU 52 from well 16-3. Concentrations of ***1,1-dichloroethane*** in the groundwater samples from MW9 also exceeded the HBN criterion. Both samples were collected in the area downgradient of HWMU 16. No other detection of ***1,1-dichloroethane*** occurred. ***Bis(2-ethylhexyl) phthalate*** also exceeded the HBN criterion in the two samples in which it was detected. (Note: ***Bis(2-ethylhexyl)*** phthalate was detected in method blanks and is considered a laboratory artifact).

Methylene chloride was detected in MW9 and WC2-A monitoring sample, both wells located downgradient of HWMU 16 near the groundwater drain. Duplicate MW9 samples verified original results, therefore, methylene chloride is probably present in the groundwater and is not a laboratory contaminant. However, the results of other groundwater samples collected in the vicinity of SWMU 52 (e.g., C4, CDH-2, and 16-3), the nature of the material disposed of in HWMU 16 and the location of MW9 and WC2-A indicated that the presence of these constituents in groundwater is likely due to HWMU 16.

Based on the contamination assessment presented above, ***26DNT, 1,1-dichloroethane,*** and methylene chloride have been identified as contaminants of concern for groundwater downgradient of SWMU 52. ***26DNT*** may be attributable to SWMU 51, but the other two contaminants appear to be related to HWMU 16 rather than to the RFI SWMUs. Samples were not collected from other environmental media.

No groundwater wells, except for monitoring purposes, are located downgradient of SWMU 52. Groundwater in the vicinity of SWMU 52 generally flows east to east-northeast and may discharge to the New River. Future land use is considered to be similar to the current land use scenario. RFAAP will continue to remain an active army installation and there are no plans for future residential development. Therefore, it is highly unlikely that groundwater wells would be installed in the future in the vicinity of SWMU 52. Based on this evaluation, potential groundwater exposure pathways are not considered operable under the current or future land use scenario.

4.0 RECOMMENDED ACTION

- Collect confirmatory groundwater and soil samples for SVOCs, VOCs, and explosives to support the site screening process and a baseline risk assessment, as applicable.
- Evaluate the source of explosives.

Confirmatory sampling should be performed to verify the presence of SVOCs and VOCs detected in groundwater samples. Groundwater monitoring for HWMU 16 is being conducted in accordance with VDEQ in wells near SWMU 51. Resampling should be performed on samples where laboratory anomalies resulted in the qualification of data.

DSERTS #: RAAP-030 **AIR CURTAIN DESTRUCTOR AND OPEN BURNING GROUND** **RRSE: 1A**

SWMU 17

1.0 BACKGROUND

SWMU 17 is located in the south-central part of the Main Manufacturing Area. A detailed location map of SWMU 17/ SWMU 40 is presented as Figure 5-30.1. SWMU 17 is used for burning wastes potentially contaminated with explosives or propellants and is subdivided into five separate areas (A through E) based on history and operations. The general SWMU 17 vicinity discussions address the monitoring wells placed in and around the unit and the groundwater discharge point at the New River as determined by the dye-tracing study. The discharge point is approximately 4,800 feet west of the SWMU 17 boundary.

SWMU 17A: Stage and Burn Area

Materials consisting mostly of large metallic items and large combustible items contaminated with propellants and explosives are accumulated into large piles in the Stage and Burn Area. The materials are piled on the ground by crane to a height of approximately 30 feet and then ignited.

Facility representatives reported that waste oil and diesel fuel are used to fuel the burning operations. Wood, paper, and cardboard contaminated with propellants and explosives are often added to the piles to increase combustion. Waste oil used for these operations was stored in the two waste oil underground storage tanks (USTs) (SWMU 76 on Figure 5-30.1) formerly located along the Stage and Burn Area embankment east of the waste pile. Following burning of the waste pile, scrap metal is removed from the residue and accumulated in piles to be sold for recycling. If ash is characterized as hazardous, it is transported off post for proper disposal. Non-hazardous ash is shipped off post to an industrial landfill.

When the USTs were removed in 1991, lead slag was detected in soils at the SWMU 76 area. This unnumbered SWMU was identified as the FLFA, a facility used at the time of World War II. Typically, a lead furnace would function as a lead recovery operation in which lead recovered during routine operations at RFAAP would be melted and cast into ingots for salvage.

Based on the occurrence of lead slag, lead was probably off-loaded on the rim of the depression with the lead smelter at the bottom of the slope. Operations would have likely included a series of racks in which lead would be melted with an overhead heater. Molten lead would then be retained in a tank and drained into molds.

It is not known precisely how long the Lead Furnace was in operation, but available maps of RFAAP, dated 1968 to 1988, show the location of the Lead Furnace. The SWMU location has apparently been used for various activities since the Lead Furnace operations were discontinued.

SWMU 17A is included in the RCRA Permit as a VI site for the most recent use as a waste oil storage and transfer location area (SWMU 76).

SWMU 17B: Air Curtain Destructor (ACD) Staging Area

SWMU 17B is a staging area for the ACD. It is divided into two bays; one is covered with a roof and the other is open. Both are constructed with concrete floors and 6-foot high concrete walls on three sides. Materials are accumulated in this staging area prior to burning in the ACD. Adjacent to the uncovered storage bay is a below-grade, concrete-lined settling basin that collects surface water runoff from the staging pads. The pit is equipped with a sump pump that, at one time, periodically pumped the collected water into an unlined drainage ditch leading to the Runoff Drainage Basin (17E). Currently, runoff is collected in a sump and treated at RFAAP's industrial sewage treatment plant.

SWMU 17C: ACD

Contaminated wastes small enough to feed into the burn chamber are burned in the ACD (17C), a large concrete pit enclosed within a metal structure. Forced air blowers increase burning efficiency. The system does not qualify as an incinerator under USEPA definitions and is considered simply a form of controlled open burning (USAEHA, 1980).

SWMU 17D: Ash Staging Area

SWMU 17D is a staging area adjacent to the ACD. It is used for accumulating and storing ACD ash and scrap metal prior to disposal. The staging area is currently composed of a storage shed with a concrete floor. Prior to construction of the shed, the ash and scrap metal were staged on the ground.

SWMU 17E: Runoff Drainage Basin

Directly west of the ACD Ash Staging Area (17D) is SWMU 17E. It is an unlined settling basin. This unit appears to be a natural drainage depression rather than a constructed basin. Surface water runoff from the ACD and Ash Staging Area drains into SWMU 17E; water from the settling basin at SWMU 17B also discharges to this drainage basin.

2.0 ENVIRONMENTAL SETTING

SWMU 17 comprises two large sinkholes which dominate the area and the surrounding buildings which support the burning operations. The westernmost sinkhole is approximately 400 feet long by 200 feet wide by 30 feet deep. SWMU 76 is upgradient to the east of SWMU 17 at an elevation of 1,895 feet msl, and Buildings 7219 and 534 are to the south. A single dirt road leads down to the burning area. The southern part of the sinkhole collects surface runoff water and is often ponded.
SWMU 17A is situated within the westernmost of the two prominent sinkholes which form the dominant geomorphological feature of SWMU 17. The elevation of the area is approximately 1,875 feet msl. SWMU 17A is located in a depression.

The other major sinkhole is to the east and south of the 17A sinkhole. The two sinkholes are separated by approximately 100 feet of level ground 30 to 40 feet above the sinkhole floors. Wells 17PZ1 and 17MW2 are located on this high ground. This sinkhole is approximately 600 feet long by 350 feet wide by 40 feet deep. It also has a single dirt road leading to the level floor.

SWMUs 17B, 17C, 17D, and 17E are located in this eastern sinkhole. 17B and 17C are constructed on a level grade slightly above the sinkhole floor. The western section of the sinkhole collects surface water runoff and is often ponded.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1992 - RCRA Facility Investigation, Dames & Moore,** included the sampling and analysis of surface and subsurface soil, surface water, and sediment in the five componet areas of the unit.
- **1994 - Dye-Trace Study, Engineering-Science, Inc.,** included the installation and sampling of six goundwater monitoring wells.
- **1996 - RCRA Facility Investigation, Parsons Engineering-Science, Inc.,** included the sampling and analysis of four groundwater wells in the vicinity of SWMU 17.

The RFI program involved the evaluation of the potential impact to surface water and sediment of low areas/basins receiving runoff from various SWMU 17 operations. During the RFI, a baseline risk assessment for SWMU 17 was performed separately for each component area using the contaminants of concern identified in the RFI. In addition, a dye-trace study and an RFI were conducted in 1993-1994 and 1996 respectively, and are included in the sections below.

3.1 SWMU 17A

Because potentially contaminated wastes are burned directly on the ground surface at the Stage and Burn Area (17A), shallow soil samples were collected from SWMU 17A to determine if soils have been impacted by burning activities. Samples were collected from two locations (Figure 5-30.1) at a depth of 0 to 1 foot bgs and were analyzed for TAL metals, TCLP metals, and explosives. One surface water sample was collected from accumulated surface water in a low area at the southern end of the SWMU 17A area to assess the potential for contaminant migration via surface water runoff or infiltration.

3.1.1 Soil

Soil samples were analyzed for TAL metals and explosives. Analytical results above the PQL are presented in Table 5-30.1. ***Arsenic, beryllium, cobalt, copper, lead,*** and ***thallium*** exceeded the HBN criteria in one or more samples. One explosive, 24DNT, was detected in one soil sample at a concentration of 0.963 μg/g, which is approximately equal to the HBN criterion of 1 μg/g.

3.1.2 Surface Water

Surface water samples collected downgradient of SWMU 17A were analyzed for metals, explosives, TOC, and TOX (Table 5-30.2). ***Arsenic, chromium,*** and ***lead*** exceeded the HBNs by factors ranging from two to three times. The explosive ***24DNT*** was detected in the surface water sample at a concentration of 0.372 μg/L, which exceeded the HBN criterion of 0.05 μg/L. This compound was the only explosive detected in Stage and Burn Area soil samples and may be a concern. TOC and TOX concentrations for 17ASW1 were 9,330 μg/L and 80.2 μg/L, respectively.

3.1.3 Baseline Risk Assessment

Two metals (arsenic and lead) were identified as contaminants of concern for soil. Four contaminants of concern (arsenic, chromium, lead, and 24DNT) were identified for surface water collected downgradient of the Stage and Burn Area. The potential impact of these contaminants to human health and the environment is discussed below.

Contamination was detected in surface soil of the Stage and Burn Area. Contaminated materials and combustibles are piled on the ground to a height of approximately 30 feet and ignited. Potential soil exposure routes typically include incidental ingestion, inhalation, and dermal absorption of soil contamination. Because arsenic and lead were detected at elevated levels in surface soil and the area is currently active, there is the possibility of contaminated dust becoming airborne and of personnel in the vicinity of SWMU 17A being exposed via inhalation of contaminated dust. It should be noted that this exposure pathway evaluates the potential for exposure to particulate emissions from contaminated soil due to wind erosion, and is not meant to evaluate the potential for air emissions that may occur during burning operations. Personnel may also be exposed via incidental ingestion of contaminated soil. Because the dermal absorption of inorganics is expected to be insignificant, and only metals were identified as contaminants of concern in site soil, the dermal absorption soil contamination pathway is not considered a significant exposure pathway and is not further evaluated.

HBNs were developed for screening purposes assuming a worst case residential land use scenario. RFAAP will continue to remain an active army installation and there are no plans for future residential development. Results above HBN criteria may not necessarily indicate a contamination problem at RFAAP, but do indicate the necessity for a more detailed analysis. Because ***arsenic*** and ***lead*** exceeded HBNs developed for the residential land use scenario in site soil, these contaminants will be evaluated using a more realistic military land use scenario.

The areal extent of arsenic and lead contamination is unknown.

3.2 SWMU 17B

One sediment sample was collected at the ACD Staging Area (17B) from the concrete-lined settling basin to determine if runoff from the staging bays is potentially carrying contaminants.

3.2.1 Sediment

One sediment sample was obtained from the collection basin which receives surface water drainage from the staging pads and was analyzed for TAL metals, TCLP metals, and explosives. As shown in Table 5-30.3, a number of metals and one explosive was detected above PQLs. ***Arsenic, cobalt,*** and ***lead*** concentrations exceeded the HBN criteria. A moderately high concentration (e.g., 56 µg/g) of the explosive ***24DNT*** in this sample exceeded the HBN of 1 µg/g. Although arsenic, barium, chromium, and silver were detected in the TCLP leachate, reported concentrations were one to two orders of magnitude less than the TCLP criteria.

3.2.2 Baseline Risk Assessment

Based on the contamination assessment presented in the RFI, arsenic, lead, and 24DNT were identified as contaminants of concern for the sediment sample collected from this site.

The sediment sample was collected from a concrete-lined settling basin that collects surface water runoff from the staging pads. The pit is equipped with a sump pump that periodically pumps the collected water into a drainage ditch leading to the Runoff Drainage Basin (SWMU 17E). There are no potential human receptors to the sediment within this basin, except for personnel who may occasionally contact the sediment during cleaning operations. Because personnel would presumably follow SOPs and wear protective equipment (e.g., gloves), and exposure is expected to be infrequent, exposure to contaminants in the sediment via incidental ingestion and dermal absorption of contaminants is expected to be insignificant and these exposure pathways are not evaluated further. Because the sediment is frequently covered with surface water, it is not likely that sediment would become airborne as dust; therefore, the exposure pathway of the inhalation of contaminated dust is not considered operable for this site. Although surface water samples were not collected from the basin, personnel exposure to surface water would also be infrequent and is considered insignificant. Potential exposure to wildlife is considered negligible, and exposure to environmental receptors is not further evaluated.

3.3 SWMU 17C

At the ACD (17C), there is the possibility for contamination of surface soils from the accumulation of burned scrap metal and potentially contaminated ACD ash. To determine if soils are contaminated, surface and near-surface soil samples were collected from the locations shown in Figure 5-30.1.

3.3.1 Soil

Soil samples were collected from 0 to 1 foot bgs and 3 to 4 feet bgs and analyzed for TAL metals and explosives. Analytical results for concentrations reported above the PQL are shown in Table 5-30.1. ***Arsenic, beryllium,*** and ***cobalt*** exceeded the HBN criteria in all samples. Concentrations of ***barium*** in 17CSS1 and ***thallium*** in three of four samples also exceeded the HBN criteria. Most of the elevated metal concentrations were reported for the two samples collected from 17CSS2, which was located at the southern end of the site. One explosive compound, 24DNT, was detected, but the concentration of the explosive (0.558 µg/g) did not exceed the permit HBN criterion of 1 µg/g.

3.4 SWMU 17D

The soil at ACD Ash Staging Area (17D), west of the ACD, was sampled to assess potential soil contamination from the storage of ACD ash. In addition, the soil at the coal bottom ash pile at this unit was sampled to evaluate the impact from this potential contaminant source.

3.4.1 Soil

Soil samples were collected from 0 to 1 foot bgs and were analyzed for TAL metals and explosives. The results of the chemical analyses are presented in Table 5-30.1. ***Arsenic, cobalt, lead,*** and ***thallium*** concentrations exceeded HBN criteria. Explosives were not detected in either sample.

3.4.2 Baseline Risk Assessment

The ACD Ash Staging Area is currently active and is used for accumulating and storing ACD ash and scrap metal prior to disposal. Potential soil exposure routes typically include incidental ingestion, inhalation, and dermal absorption of soil contamination. Because ***arsenic, lead,*** and ***thallium*** were detected at an elevated level in surface soil and the area is currently active, there is the possibility of contaminated dust to become airborne and for personnel in the vicinity of SWMU 17D to be exposed via inhalation of contaminated dust. Personnel may also be exposed via incidental ingestion of contaminated soil. Because the dermal absorption of inorganics is expected to be insignificant, and only metals were identified as contaminants of concern in site soil, the contamination pathway of the dermal absorption of soil is not significant and is not further evaluated.

The HBNs were developed for screening purposes assuming a worst case residential land use scenario. Because future land use is considered to be similar to the current land use scenario (e.g., RFAAP will continue to remain an active army installation and there are no plans for future residential development of RFAAP), exceedances of HBNs may not necessarily indicate a contamination problem at RFAAP, but do indicate the necessity for a more detailed analysis. Because ***arsenic, lead,*** and ***thallium*** exceeded HBNs developed for the residential land use scenario in site soil, these contaminants will be evaluated using a more realistic military land use scenario. The surface soil sample was collected from near the coal bottom ash pile. Although wildlife may have access to the burn area, because this area is active and paved roads/buildings are present in the surrounding area, it is not likely that wildlife would frequent this area. Therefore, potential exposure to environmental receptors to the surface soil contamination at the ACD Ash Staging Area appears to be minimal, and these exposure pathways are not further evaluated.

3.5 SWMU 17E

One surface water sample and one sediment sample were collected from the basin to determine whether potential hazardous waste constituents are migrating from SWMUs 17B, 17C, and 17D to the Runoff Drainage Basin (17E) via surface water runoff.

3.5.1 Surface Water

Surface water samples were analyzed for TAL metals, explosives, TOC, TOX, and pH. Analytical results for constituents detected above the PQL are presented in Table 5-30.2. ***Arsenic, chromium,*** and ***lead*** concentrations exceeded the HBNs. Additionally, the explosive ***24DNT*** was detected at a concentration approximately twice the HBN criterion of 0.05 µg/L.

3.5.2 Sediment

Sediment samples were collected from 0 to 12 inches below the sediment/surface water interface and were analyzed for TAL metals, TCLP metals, and explosives. Analytical results for constituents detected above the PQL are presented in Table 5-30.3. ***Arsenic, cobalt,*** and ***lead*** concentrations exceeded the HBN criteria. The explosive ***24DNT*** was detected in sample 17ESE1 at a concentration which slightly exceeded the HBN of 1 µg/g.

3.5.3 Baseline Risk Assessment

Arsenic, lead, and ***24DNT*** were contaminants of concern in the sediment, but exposure to this medium is considered negligible compared to the surface water overlying the sediment and will not be evaluated.

The surface water sample was collected from the runoff drainage basin, which is an unlined natural drainage depression. Due to topography, there is no surface water outflow from the basin. There are no potential human receptors to the surface water within this basin, except for personnel who may occasionally contact the surface water during cleaning operations. Personnel would presumably wear protective equipment (e.g., gloves) and exposure is expected to be infrequent. Therefore, exposure to contaminants in the surface water via incidental ingestion and dermal absorption of contaminants is expected to be insignificant, and these exposure pathways are not evaluated further.

3.6 DYE-TRACE STUDY

The dye-trace study test conducted between September 23, 1993 and July 8, 1994, was designed to determine groundwater flow directions through the karst limestone in the south-central section of the Main Manufacturing Area by identifying hydrogeologic connections between areas of groundwater recharge (upland sinkholes near SWMUs 17 and 40) and their respective discharge areas in and around the facility.

Based on the results of this investigation, one spring, SPG3, was identified as being hydraulically connected to the sinkhole that SWMU 17A occupies. Furthermore, the flow path identified by the dye-trace closely parallels a west-northwest to east-southeast trending fracture trace that can be extended to connect both the dye injection point and the dye resurgence point. This led to the conclusion that a direct conduit existed between SWMU 17A and SPG3, most likely created by a solution opening along a subsurface fracture. The groundwater flow rate through this conduit under low flow conditions is calculated to range between 2,095 ft/day and 3,716 ft/day and under high flow conditions is calculated to average 4,800 ft/day.

3.7 SWMU 17 (VICINITY)

As part of the 1996 RFI conducted by Dames & Moore, groundwater smples were collected in the vicinity of SWMU 17 from four of the six monitoring wells installed during the dye-trace study in 1994. Two of the wells could not be sampled because they were dry. Samples were collected at wells 17PZ1, 17MW2, 17MW3, and 40MW3 and analyzed for metals, explosives, TOC, and TOX (Table 5-30.4).

Concentrations of ***antimony*** and ***beryllium*** exceeded HBN criteria in well 17MW2, located between the two sub-areas of SWMU 17. Well 17PZ1 also contained concentrations of ***beryllium*** that exceeded the HBN.

4.0 RECOMMENDED ACTION

Confirmatory groundwater, surface water, and sediment samples will be collected for the analysis of metals, SVOCs, VOCs, explosives, and applicable conventional chemicals to verify previous investigation results and support the quantitative risk assessment. These environmental actions will be initiated when operations cease.

DSERTS #: RAAP-031 $CaSO_4$ TREATMENT/DISPOSAL AREA RRSE: 3A

AREA Q

1.0 BACKGROUND

Area Q is an abandoned lagoon located along the New River in the northwest section of the Main Manufacturing Area (Figure 5-31.1). The SWMU is immediately northwest and adjacent to SWMU 38, and was reported to be used as a sludge drying bed when SWMU 38 reached capacity. Sludge was pumped from SWMU 38 to Area Q via pipes that ran through a depression in the berm surrounding the drying bed.

Calcium sulfate sludge has been disposed of in various locations throughout RFAAP, including FAL Nos. 1 and 2 (SWMU 26 and 29), the Calcium Sulfate Landfill (SWMU 27), Calcium Sulfate Disposal Area (SWMU 50), and trenches east of SWMU 38.

2.0 ENVIRONMENTAL SETTING

Because of its close proximity to SWMU 9, it is assumed that this unit exhibits similar subsurface and hydrogeologic characteristics. Soil and rock borings completed during a hydrogeologic investigation of SWMU 9 (USACE, 1981) indicated the presence of two major lithologic units: unconsolidated sand with gravel and clay lenses overlying limestone/dolostone bedrock.

The unconsolidated deposits consist primarily of fine- to coarse-grained, yellowish-brown sand approximately 30 feet thick. Lenses of brown, silty clay were dominant in the upper part of the unit, and large cobbles (river jack) were more dominant with depth.

The bedrock is highly argillaceous and moderately weathered and fractured. Additionally, a large mudstone unit is present. Permeability tests conducted to determine the ability of the material at SWMU 9 to transmit fluids suggest that the unit is poorly sorted.

The water table is generally along the bedrock surface at depths ranging from 26 to 29 feet bgs. Although data is limited, the water table appears to be virtually flat. Available water level data indicate that when water levels in the New River are altered by releases from the dam upstream of RFAAP, the water table fluctuates accordingly. Groundwater flow in the vicinity of SWMU 9 is towards the New River.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore,** included the collection of one composite sludge sample.

A sludge sample was collected from Area Q to evaluate whether any hazardous constituent concentrations exceeded HBNs specified in the permit.

The lagoon was dry during the investigation period and a composite sample was extracted from the central portion of the bed. A 5-foot boring was drilled and sampled to ensure collection of numerous sludge drying episodes. Parameters analyzed included VOCs, SVOCs, and TCLP metals. Table 5-31.1 presents chemical results for analytes exceeding the PQL.

AREA Q

VOCs were not detected in the sludge sample. SVOCs detected included di-n-butyl phthalate and four unknown SVOCs. The detected SVOCs were below the HBN. *(Note: Di-n-butyl phthalate was also detected in SWMUs 9, 37, and 38.)s*

Di-n-butyl phthalate is an inert, gelatinizing agent used to improve physical and processing characteristics, including decreasing the propellant ignitability. Based on the waste propellant composition (Permit, Appendix BB), the following propellants contain di-n-butyl phthalate:

Propellant	Percent by weight
M1	5.0±1.0
M6	3.0±1.0
M6+2	3.0±1.0
IMR7383	2.0-4.0
M14 MP	2.0±1.0
NOSOL18	8.1±0.5

Barium was reported at a detectable concentration in the TCLP extract, which indicated that leachable levels of these metals were available from lagoon sludge. However, the result was less than regulatory levels specified in 40 CFR 261.24.

Barium may be available as $Ba(NO_3)_2$, which is used as an oxidizing agent and included in double-base solvent (M26) and solventless (M2, M5) formulations.

Propellant	Percent by weight
M2	1.4±0.25
M5	0.5±1.6
M26	0.7±0.2

4.0 RECOMMENDED ACTION

Discrete sludge samples will be collected for explosives, metals, and SVOCs to verify VI no further action recommendations.

DSERTS #: RAAP-032 MOBILE WASTE OIL TANKS RRSE: 3A

SWMU 61

1.0 BACKGROUND

A number of oil/water separators and waste storage tanks located throughout RFAAP are used for the collection of waste oil generated primarily from machinery and vehicle engines. Oil from these locations was collected in the Mobile Waste Oil Tanks (SWMU 61) for either shipment offsite or reuse. The waste oil was previously transported to the Waste Oil USTs south of the Oleum Plant (SWMU 76). Waste oil is presently transported to ASTs in Buildings 1624 and 1601 for storage until shipped off site for disposal.

Leaks and spills of waste oil during handling and collection were cleaned up before employees left the site (Procedure 4-27-120; Section 29.1.1). A major spill from overfilling or a leak would be cleaned up as an emergency, according to procedures described in the Emergency Response Plan (Procedure 4-14-44; Section 29.1.2) and the Oil Discharge Contingency Plan (Section 29.1.3).

2.0 PREVIOUS INVESTIGATION

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation. Discolored soil was observed beneath the mobile tanks by several operating buildings.

3.0 RECOMMENDED ACTION

Based on the above discussion, no further action is recommended.

DSERTS #: RAAP-032 **WASTE OIL UNDERGROUND STORAGE TANK (INERT GAS PLANT)** **RRSE: 3A**

SWMU 75

1.0 BACKGROUND

This UST was located in the Main Manufacturing Area, 20 feet west of the Inert Gas Compressor Building A-421. It was removed as part of the UST removal program in April 1995. The UST was reportedly a single-walled tank with a capacity of 600 to 700 gallons. It was used to store waste oil and hydraulic fluids that are generated in the inert gas plant compressor house. The contents of the UST were periodically pumped out into 55-gallon drums for the use as fuel at the Hazardous Waste Incinerator (USEPA, 1987).

Drips and spills around the tanks access ports that occurred when filling the tank were cleaned up before employees left the job site (Procedure 4-27-120; Section 29.1.1). Contaminated soil was removed from the premises and was properly disposed. A major spill from overfilling would have been treated as an emergency and procedures described by the Emergency Response Plan (Procedure 4-14-44; Section 29.1.2) were followed.

2.0 PREVIOUS INVESTIGATIONS

- **1985 - RFAAP UST Removal Program**
- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation. Discolored soil was observed around the tank access port.

3.0 RECOMMENDED ACTION

No further action is recommended.

DSERTS #: RAAP-032 **WASTE OIL UNDERGROUND STORAGE TANKS (SOUTH OF OLEUM PLANT)** **RRSE: 3A**

SWMU 76

1.0 BACKGROUND

SWMU 76 consists of two waste oil USTs that were located within the Stage and Burn Area (SWMU 17A) in the south-central part of the Main Manufacturing Area. The capacity of Tank No. 1 was 5,500 gallons; the capacity of Tank No. 2 was 2,640 gallons. Waste oil from machinery and vehicle engines throughout RFAAP was collected in the Mobile Waste Oil Tanks (SWMU 61) and then stored in the SWMU 76 tanks. The waste oil was then sold to an off-post firm for reclamation or used to fuel fires in the Contaminated Waste Stage and Burn Area (SWMU 17A).

The two USTs at SWMU 76 were removed in May 1991. On May 29, 1991, a spill of oily waste water and sludge occurred while removing the 5,500-gallon UST. As the tank was being lifted by a crane from its resting place, it tilted, causing excessive strain on the discharge elbow connection, resulting in a 9-foot section of 4-inch drain line to break off.

Approximately 250 gallons of the oil waste water sludge, which was not removed prior to the tank removal, drained out into a trench alongside the tank. The materials impacted were analyzed in order to determine proper disposal procedures (Hercules, 1991). The entire spill was contained within an area 20 feet long by 3.5 feet wide by 6 inches deep.

The oily waste water sludge was removed from the contaminant area using a suction pump and was temporarily placed in a waste oil storage tank in the solvents area for off-site treatment. The remaining material within the trench was absorbed with an absorbent compound. Approximately 13 cubic yards of dirt/absorbed material were removed from the area and disposed off site as a hazardous waste due to lead and chromium concentrations. Approximately one cubic yard of soil was removed from in front of the tank (Hercules, 1991).

Soil samples were collected under the spill area and analyzed for TPH, lead, and chromium. Analytical results indicated that the TPH concentration was approximately 1,600 milligrams per kilogram (mg/kg) after the spill and less than 60 mg/kg TPH after cleanup (Hercules, 1991). The lead content was relatively high.

Research into the history of this area revealed that a lead furnace was in operation during World War II in this area. This area has been evaluated under the FLFA (RFAAP-040). The laboratory analysis at SWMU 76 from the USTs closure report was considered adequate, without further investigation, to conclude that the previous presence of the USTs no longer causes an environmental concern or threat due to petroleum hydrocarbons.

2.0 PREVIOUS INVESTIGATION

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation. Discolored soil was observed around the tank access port.

3.0 RECOMMENDED ACTION

No further action is recommended.

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DSERTS #: RAAP-033 **CHROMIC ACID TREATMENT TANKS** **RRSE: 1A**

SWMU 68

1.0 BACKGROUND

SWMU 68 is located 100 feet northwest of SWMU 57 where the plateau of the Horseshoe Area begins sloping towards the New River. The unit consisted of two 4,000-gallon aboveground tanks, which were 9 feet tall and 8.5 feet in diameter. The tanks were labeled "Chromic Acid Treatment Plant." There was no secondary containment beneath the tanks.

Prior to 1974, the tanks were used to treat spent chromic acid generated from the cleaning of rocket encasements (USEPA, 1987). Hexavalent chromic acid was batch treated using hydroxide precipitation, adjusted to a pH of 1.5 using sulfuric acid, and then reduced to the trivalent state (Cr^{+3}) using sodium metabisulfate. High calcium lime was added to adjust the pH to 8.6. The treated wastewater was then discharged to SWMU 69.

Since 1974, "Oakite 33" (an acidic rust stripper consisting of phosphoric acid and butyl cellosolve mixture) was used instead of chromic acid to clean the rocket encasements (USEPA, 1987). The pH of the spent Oakite 33 was adjusted to pH 5.0 with soda ash prior to discharge to SWMU 69.

2.0 ENVIRONMENTAL SETTING

SWMU 68 is located in the vicinity of Building 4931 in the western section of the Horseshoe Area (refer to Figure 33-1). The area is surrounded by buildings, paved roads, and overhead pipes. The topography in the area of SWMU 68 is moderately sloping northwest. The elevation is approximately 1,800 feet msl.

RFAAP has not performed site-specific groundwater investigations in this area. Surface water in the vicinity of SWMU 68 appears to flow westward towards a tributary that flows 1,400 feet north of the unit and discharges into the New River. Based on the review of RFAAP utility maps (Dames & Moore, 1992), there does not appear to be any manholes, catch basins, or storm drains present in the vicinity. Drainage from SWMU 68 was engineered to flow into SWMU 69.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation. No releases were observed.
- **1992 – Verification Investigation, Dames & Moore,** included the sampling and analysis of two shallow soil samples for TAL metals and pH.
- **1997 – RCRA Facility Investigation, ICF Kaiser,** included the sampling and analysis of upgradient surface and subsurface soil samples to establish background concentrations for metals, the removal of two ASTs and appurtenant piping, and the sampling and analysis of confirmation samples to confirm the removal of contaminated soil.
- **1998 – Closure, ICF Kaiser,** consisted of removing sources of potential contamination (chromic acid treatment tanks) and restoring the site to complement the natural terrain of the surrounding area.

3.1 VERIFICATION INVESTIGATION

To evaluate whether surface soils in the vicinity of the treatment tanks (SWMU 68) were contaminated as a result of past spills, leaks, or overflows of waste chromic acid, two surface soil samples were collected from two locations downgradient of the tanks (Figure 5-33.1).

The two samples were collected from a depth of 0 to 6 inches below the surface organic root zone and were analyzed for pH and TAL metals. The results of the chemical analyses for the two shallow soil samples collected at SWMU 68 are presented in Table 5-33.1. ***Arsenic, beryllium, cobalt,*** and ***thallium*** exceeded HBN criteria.

3.2 RCRA FACILITY INVESTIGATION

3.2.1 Background Soil Sampling

To establish background concentrations for metals for determining whether metal concentrations at the SWMU were naturally-occurring or related to previous operations, surface and subsurface soil samples were collected from near-upgradient, cross-gradient, and far-upgradient locations (Figure 5-33.2).

One surface (0-6 inches bgs) and one subsurface (generally 4-5 feet bgs) soil sample was col-lected at each location to assess vertical distribution of upgradient metal concentrations within the soil profile. The sample results are presented in Table 5-33.2. ***Arsenic, beryllium,*** and ***cobalt*** exceeded HBN criteria in all samples. ***Iron*** exceeded HBN criteria in four subsurface soil samples. ***Antimony*** exceeded HBN criteria in only one surface soil sample.

3.2.2 Confirmation Soil Sampling

To determine if the SWMU subsurface soil had been adversely impacted by process-related metals below 4 feet bgs, twelve test pits were advanced beneath the former ASTs, and confirmation samples were collected.

One confirmation sample and one duplicate sample was collected from approximately 4 to 4.5 feet bgs in each test pit and analyzed for metals. The sample results are presented in Table 5-33.3. ***Arsenic, beryllium, cobalt,*** and ***iron*** exceeded HBN criteria in all samples. A comparison to background metals results indicated that confirmation samples were within background values.

3.2.3 Contingency Soil Sampling

To evaluate the potential for further subsurface migration, a contingency sample was collected below the test pit in the northwest quadrant.

A contingency sample was collected from 8.0 to 8.5 feet bgs using a hand auger and was analyzed for TAL metals. The sample results are presented in Table 5-33.4. ***Arsenic, beryllium, cobalt,*** and ***iron*** exceeded HBN criteria. A comparison to background metals results indicated that the contingency sample was within background values. The contingency sample confirmed that process-related subsurface contamination had not occurred.

3.3 SITE CLOSURE

To remove from further action SWMUs and/or areas of concern that do not pose a threat to human health or the environment.

An evaluation of confirmation sample results to permit HBNs, facility-wide background levels, and generic soil screen levels (DAF=1) demonstrated that previous SWMU process-related activities had not adversely impacted subsurface conditions.

4.0 RECOMMENDED ACTION

No further action is recommended.

SWMU 10

1.0 BACKGROUND

SWMU 10 consists of the biological plant equalization basin, which was constructed over a former NC lagoon. The biological treatment system was built in 1978-1979 and became operational in 1980. Prior to 1980, these wastewaters were discharged directly to the New River. SWMU 10 is currently listed under a VDEQ Closure Plan.

This system treats wastewaters of widely varying characteristics, including non-acidic wastewaters from propellant manufacturing (on both a batch and continuous basis), pretreated wastewaters from NG manufacturing and alcohol rectification, and wastes from recovery of ethyl ether (USEPA, 1987).

RFAAP personnel indicated that the area between the road and the railroad tracks was once used for trench burial of sediments removed from SWMUs 8, 35, and 36. The outlines of these trenches are still visible when the area is examined.

Explosive manufacturing at RFAAP and associated Bio-Plant operations were suspended until mid-April 1994 when a temporary system of several 20,000 gallon ASTs were assembled and connected to the inflowing waste stream. Production areas resumed operations at a level which would not exceed the combined holding capacity of the ASTs and treatment facilities.

2.0 ENVIRONMENTAL SETTING

This unit, located along the New River in the north-central part of the Main Manufacturing Area, is the first of nine components that make up a biological wastewater treatment system at RFAAP.

The SWMU 10 area is relatively flat with a slight slope northward toward the New River. Surface elevations range from 1,708 feet msl near the road to 1,698 feet msl on the northern side of both basins.

The walls of the Equalization Basin were constructed above natural grade with the interior extending to below the natural grade. The whole structure consists of concrete or a soil/concrete mixture.

Surface ditches are present northwest of SWMU 10 which have a decrease in elevation to less than 1,695 feet msl before leaving the site underneath the fence.

Subsurface conditions were investigated at the study area in 1991 to confirm previously described conditions (Geophex, 1990). Unconsolidated soil deposits, which thicken away from the river, consist of a brown clayey silt overlying a fine- to coarse-grained, micaceous, yellowish-brown sand. Several feet of yellowish-brown sand and gravel overlie bedrock. These alluvial floodplain deposits vary in thickness between 14 and 30 feet. Zones of large cobbles (river jack) are present south of SWMUs 10 and 35, but are not as common as found at other sites at RFAAP. Silty brown clay lenses found on the land surface may represent recent deposition during flood events.

Underlying the unconsolidated soils in the SWMU 10 and SWMU 35 area is the gray argillaceous limestone/dolostone of the Elbrook Formation. The limestone/dolostone is highly fractured and fragmented with calcite healed fractures and zones of filled and unfilled vugs. Up to 41 feet of the Elbrook Formation was penetrated during the 1990 boring program (Geophex, 1990).

The hydrogeologic conditions within the unconsolidated soil were investigated through field examination of soil samples, laboratory permeability/conductivity tests, grain-size hydrometer analysis and Atterberg Limits tests, and a field rising-head (slug) test on monitoring well 10MW1. The hydrogeologic conditions of the bedrock were investigated by field examination of rock cores from the 10MW1 and field hydraulic conductivity data.

A relatively shallow groundwater table was encountered from 14 to 23 feet bgs in the study area. The unconfined water table was generally present several feet above the bedrock surface within either the micaceous sand or sand and gravel layer. Based on groundwater measurements obtained in January and March 1992, the unconfined water table gradient slopes north toward the New River at approximately 0.011 ft/ft, generally following the slope of the bedrock surface.

Although no mounding or other irregular groundwater pattern has been observed at SWMU 10 (except for a slight change in the groundwater flow direction toward the Outfall 029 area, which has a deep ravine leading to the New River), a significant mounding effect appears to be associated with SWMU 35 due to the unlined nature of this basin. Surface water can percolate through this basin and directly recharge the unconfined aquifer. SWMU 8 also appears to cause a mounding effect, which alters the groundwater flow in this area since this basin is also unlined. The general groundwater flow direction in the area is northward towards the New River at an average hydraulic gradient of about 0.02 ft/ft.

Groundwater flow below the area primarily occurs through three geologic units: the unconsolidated micaceous sand; the unconsolidated sand and gravel; and the unconsolidated bedrock. The hydrogeological characteristics of each unit are different resulting in different groundwater flow velocities. The lowest permeabilities and hydraulic conductivities for the water bearing units are found in the unconsolidated micaceous sand unit, and the highest permeabilities and hydraulic conductivities are found in the sand and gravel.

The average permeability/hydraulic conductivities for the micaceous sand unit are 5.0×10^{-4} cm/sec and an average of 2.73×10^{-3} cm/sec for the sand and gravel unit. The hydraulic conductivity measured for bedrock at D-3D was 2.6×10^{-4} cm/sec, but the bedrock has irregular water bearing fractures, and measured values should always be considered only a rough approximation.

Groundwater in the unconsolidated water table aquifer will flow predominantly through the sand and gravel layer northward and out at the basin areas. As the sand and gravel layer pinches out, groundwater would then continue to flow northward to the New River predominantly through the micaceous sand unit, which potential contaminants could flow through if leaked from the basin.

Assuming the representative water bearing unit to be the micaceous sand layer, the groundwater flow velocity may be calculated by knowing the estimated average hydraulic conductivity (5.0×10^{-4} cm/sec), the hydraulic gradient (0.011 ft/ft), and the estimated formation porosity (30 percent). By using the Darcy equation and standard equation of hydraulics, the estimated average linear horizontal groundwater flow velocity is 1.8×10^{-5} cm/sec (19 ft/yr). For example, substituting the hydraulic gradient measured in July 1993 (0.019 ft/ft), the estimated groundwater flow velocity is 3.3 $\times 10^{-5}$ cm/sec (34 ft/yr).

The horizontal groundwater velocity for the sand and gravel unit can also be estimated using the average hydraulic conductivity/permeability (2.73×10^{-3} cm/sec), the measured gradient (1.1 percent), and an estimate of porosity for sand and gravel (25 percent). Using these values and the Darcy equation gives an average linear velocity of 1.2×10^{-4} cm/sec (124 ft/yr). Substituting the hydraulic gradient measured in July 1993 (0.019 ft/ft), the estimated groundwater flow velocity is 1.8×10^{-4} cm/sec (188 ft/yr).

The estimated porosity of 30 percent used for the micaceous sand layer is based on a range of porosities common for unconsolidated non-plastic silty sand (25 to 40 percent), and the estimated porosity of 25 percent used for the sand and gravel layer is based on a range of porosities common for unconsolidated sand and gravel mixtures (10-25 percent; Johnson Filtration Systems, Inc., 1986).

The SWMU 10 Equalization Basin is fully encircled by a concrete wall which prevents surface water runoff outside of the basin from mixing with waste in the basin. Surface water runoff in the vicinity of the Bio-Plant would flow northward to the New River following the general drainage pattern downslope to the river. However, runoff south and east of SWMU 10 flows toward the SWMU 35 settling basin, which is an unlined depression. No runoff from SWMU 35 migrates out of the confines of the basin. Because of the aboveground and fully enclosed construction of the Equalization Basin, no significant interaction with surface water leaving the area is likely for SWMU 10.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a preliminary data review, evaluation, and visual site inspection.
- **1992 - Verification Investigation, Dames & Moore,** included groundwater sampling and analysis, and soil boring sampling for the construction of hydrogeologic cross sections for the determination of groundwater elevations.
- **1994 - Verification Investigation, Rounds II and III, Dames & Moore,** included groundwater sampling in Round I wells and in additional upgradient and downgradient wells.
- **1998 - Equalization Basin Closure,** included earthwork demolition, removal and decontamination/disposal of piping, pumps, soil/cement liner and concerete, contaminated subsurface soil removal, backfill, and grading.

3.1 SOIL

Two soil samples were collected from the surficial soil at a depth of 0.5 feet in an area south of SWMU 10. These samples were considered representative of ambient area concentrations and assumed not to be affected by the SWMU. Samples were analyzed for VOCs, SVOCs, explosives, metals, and TCLP metals. Table 5-36.1 presents analytical results for sample concentrations exceeding the PQL.

VOCs were not detected in any of the samples. SVOCs detected were generally PAHs and other saturated hydrocarbons associated with petroleum products, such as commercial coal tar, gasoline, solvents, power plant emissions, and coal ash and cinders.

Metals detected in the sample above the PQL included arsenic, barium, chromium, lead, mercury, and silver. ***Arsenic*** exceeded the HBN criterion in both samples. Although barium concentrations were elevated in both samples, results were below the HBN.

3.2 GROUNDWATER

Groundwater samples were collected from wells upgradient (3) and downgradient (4) of SWMUs 10 and 35 and analyzed for VOCs, SVOCs, explosives, metals, water quality parameters, pH, TOC, and TOX.

3.2.1 Round I

The first round of samples were collected in August 1990 as part of a construction site assessment (Dames & Moore, 1990) and included downgradient (D-3, DDH2) and upgradient (DDH4) wells. Table 5-36.2 presents the analytical results detected above the PQL.

Although VOCs were not detected in the downgradient sample, chloroform was detected at a concentration below the HBN in the upgradient well. SVOCs were not detected in any of the samples. HMX was detected in all samples at concentration levels below the HBN. Additionally, TETRYL was detected in D-3. Barium and lead were the only metals detected in all samples. Results for both elements were below HBN criteria.

3.2.2 Round II

A second round of samples was collected from downgradient (10MW1, D-3D, DDH2) and upgradient (DG-1, DDH4, D-4) wells (Dames & Moore, 1991). The additional upgradient (DG-1) and downgradient (10MW1) wells were added to this sampling round to better define the magnitude of groundwater contamination associated with SWMU 35. Table 5-36.3 presents the analytical results for concentrations exceeding the PQL.

VOCs detected in groundwater samples included carbon disulfide, chloroform, chloromethane, 1,2-dichloroethane, and toluene. None of the reported concentrations exceeded HBN criteria. One SVOC TIC, ***bis(2-ethylhexyl) phthalate*** exceeded its HBN.

Explosives detected above the PQL included HMX, 24DNT, and 26DNT. HMX was detected in all six wells with the highest concentration reported in DDH4. Upgradient concentrations generally tended to be higher than downgradient concentrations (with the exception of DDH2), and all results were below the HBN criterion. ***24DNT*** was detected in two downgradient wells (10MW1, D-3D) at concentrations exceeding the HBN.

Antimony, chromium, cobalt, lead, and ***manganese*** were detected above HBN criteria in the two unfiltered upgradient groundwater samples. It was assumed that these metals were not related to SWMU 10 or 35 because the results were associated with upgradient samples and represented different source areas.

Water quality parameters were analyzed to establish the general groundwater quality in the study area and included nitrogen, chloride, sulfate, total phosphorous, and total phenols. All the constituents were detected at reportable quantities in both upgradient and downgradient wells with the exception of phenol. Nitrogen, chloride, and sulfate were generally detected in downgradient wells at higher concentrations. ***Nitrate/nitrite*** concentrations in wells downgradient of SWMU 10 (D-3, D-3D, DDH2) exceeded the HBN criterion. Additionally, downgradient sulfate concentrations were elevated above background levels.

3.2.3 Round III

The third groundwater sampling round was conducted based on second round results and included four wells downgradient of SWMU 10 (10MW1, D-3D, D-3, DDH2), one well downgradient of SWMU 35 (D-5), and four wells upgradient (DG-1, DDH4, D-4, D-2) of both SWMUs. Based on 1990 and 1991 analytical results, samples were analyzed for explosives, total and dissolved lead and chromium, TOC, TOX, nitrate/nitrite, TKN, sulfate, and pH. Table 5-36.4 presents the analytical results for concentrations in seven of nine wells.

Chromium and ***lead*** were detected in the unfiltered samples with concentrations exceeding HBN criteria for upgradient wells D-4 (chromium and lead) and D-2 (chromium only). Analysis of the previous data indicated the following:

- Elevated concentrations of chromium and lead continue to be detected in samples from upgradient well D-4.
- Elevated concentrations of chromium and lead in upgradient sample D-4 have decreased.
- Chromium and lead concentrations have increased over time in the downgradient well DDH2.
- Total chromium and lead concentrations remain elevated in the upgradient wells when compared to the downgradient wells.

Water quality parameter results were consistent with previously reported data. Nitrogen was detected in eight of the nine wells, generally at higher concentrations in the upgradient wells. Chloride and sulfate were generally detected in downgradient wells at higher concentrations. The ***nitrate/nitrite*** concentration in the SWMU 35 upgradient well (D-2) and downgradient wells (D-3D, D-3, DDH2, D-5) exceeded the HBN criterion. Additionally, sulfate concentrations were elevated above background levels.

3.3 SURFACE WATER

One surface water sample was collected from within the Equalization Basin and analyzed for VOCs, SVOCs, explosives, and metals. Table 5-36.5 presents the analytical results for samples exceeding PQLs.

Chloroform was the only target VOC detected in the sample. A VOC TIC was detected at a concentration of 4,000 ppb. SVOCs detected in the sample included ***2-nitroaniline*** and ***N-nitrosodiphenylamine,*** which was detected above the associated HBN criterion. Explosives detected above the PQL included 24DNT and HMX. Additionally, the ***24DNT*** result exceeded the HBN criterion. Although barium, chromium, and lead were detected in the Equalization Basin, ***lead*** was the only element exceeding HBN criterion.

3.4 SEDIMENT

One sediment sample was collected from within the Equalization Basin and analyzed for VOCs, SVOCs, explosives, metals, and

TCLP metals (Table 5-36.6). VOCs detected included trace concentrations of acetone and toluene. SVOCs detected included 24DNT, di-n-butyl phthalate, di-ethyl phthalate, fluoranthene, N-nitrosodipheny-lamine, and phenanthrene. ***24DNT*** and ***N-nitrosodipheny-lamine*** exceeded HBN criteria.

Explosive compounds, 246DNT, 24DNT, HMX, and RDX, were detected at concentrations greater than the PQL. Additionally, ***24DNT*** exceedance result was confirmed in the SVOC analysis.

Metals detected above the PQL included arsenic, barium, chromium, lead, mercury, and silver. ***Arsenic*** and ***lead*** results exceeded HBN criteria. TCLP extract results were obtained for arsenic, barium, lead, and nickel. ***Lead*** results exceeded the regulatory criterion. One data anomaly was missing PQL data for nickel analysis.

3.5 EQUALIZATION BASIN CLOSURE

The general closure approach included the removal of water and sludge from the Bioplant Equalization Basin prior to closure. Pumps and ancillary piping were removed for off-site disposal in accordance with the DEQ-approved Closure Plan (Alliant Tech-Systems, 1995). Soil sampling and testing were performed to verify the removal of contaminated soil. The excavation was then backfilled with clean soil, graded to promote positive drainage, and revegetated.

Clean closure was achieved for all constituents with the exception of fluoranthene, which was closed to a residential risk-based level. DEQ concurred that clean closure for soils had only been attained for the equalization basin. The groundwater beneath the sludge drying bed is still undergoing closure and may be subject to the post-closure permit process established under Title 9 of the Virginia Administrative Code, Chapter 20-60, if clean closure can not be achieved.

4.0 RISK ASSESSMENT

Summary of Screening Level Risk Assessment

Samples Collected

Groundwater samples were collected up-gradient and downgradient of the SWMU. Surface soil samples were collected adjacent but outside of the SWMU basins. One subsurface soil sample was collected above the water table below the SWMU 35 sediment. Sediment samples were collected from both SWMUs 10 and 35. One surface water sample was collected from SWMU 10.

Medium	No.	Location
Groundwater	4	Upgradient
	6	Downgradient
Surface Soil	2	0-6″
Subsurface soil	1	SWMU 35
Sediment	1	SWMU 10
	3	SWMU 35
Surface water	1	SWMU 10

4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

COPCs were selected based on results exceeding HBNs and background. Groundwater contaminants included: 24DNT (also detected in sediment and surface water), 26DNT, bis(2-ethylhexyl) phthalate, nitrate/nitrite, and sulfate. With the exception of 26DNT, chemicals from this medium were selected as COPCs. 26DNT was deleted because of its low frequency of detection. Lead and N-nitrosodiphenylamine were selected as COPCs due to their detection in sediment and surface water.

4.2 EXPOSURE ASSESSMENT

If groundwater and/or surface water COPCs are selected based on the review of future analytical data, then the quantitative evaluation should be considered for the following exposure pathways:

Groundwater

- Ingestion of chemicals in groundwater by a future worker.

Soil

- Incidental ingestion of chemicals in soil by a future worker; and
- Dermal absorption of chemicals in soil by a future worker.

Sediment

- Incidental ingestion of chemicals in basin sediment by a worker;
- Dermal absorption of chemicals in basin sediment by a worker;
- Incidental ingestion of chemicals in sediment by a recreational visitor wading along the banks of the New River; and
- Dermal absorption of chemicals in sediment by a recreational visitor wading along the banks of the New River.

Surface Water

- Incidental ingestion of chemicals in basin surface water by a worker;
- Dermal absorption of chemicals in surface water by a worker;
- Incidental ingestion of chemicals in surface water by a recreational visitor swimming in the New River; and
- Dermal absorption of chemicals in surface water by a recreational visitor swimming in the New River.

An overview of exposure assessment is presented in tabular format on the following page.

5.0 RECOMMENDED ACTION

The Bioplant Basin has received clean closure for soils. Available media should be sampled in support of the quantitative baseline risk assessment.

DSERTS #: RAAP-037 BATTERY STORAGE AREA RRSE: 3A

AREA P

1.0 BACKGROUND

The Spent Battery Storage Area (Area P) consists of an open lot several acres in size that is used for the storage of shredded scrap metal and decommissioned tanks.

An estimated 20 to 30 spent batteries are generated at RFAAP each month. Battery electrolyte is drained and disposed of in the RFAAP acid sewer system. Cleaned batteries are accumulated in this storage area prior to shipment off post. Spent batteries are sold when 40,000 pounds have been accumulated, approximately once every 1 to 15 years (Pieper, 1989).

2.0 ENVIRONMENTAL SETTING

The area is approximately 200 feet long by 50 feet wide and is located within the scrap metal salvage yard. It is adjacent to the New River 600 feet west of the Biological Treatment Plant (SWMU 10).

The topography in the area of Area P is generally level, sloping generally towards the north. The elevation is approximately 1,700 feet msl at the northeastern corner of Area P and approaches 1,710 feet msl along the southern border.

Although no site-specific hydrogeologic studies have been conducted in this area, it is assumed to have similar groundwater conditions as SWMU 10. Groundwater has been interpreted to be at an elevation of approximately 1,690 feet msl with flow northward to the New River.

Surface water runoff appears to flow north and discharge into the New River, which flows east in this area. According to utility maps, there are no manholes, catch basins, or storm drains in the immediate SWMU vicinity.

3.0 PREVIOUS INVESTIGATIONS

- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.

- **1992 - Verification Investigation, Dames & Moore,** included the evaluation of soils within the SWMU to determine the impact of spent battery acid spillage through the collection of surface water samples.

To evaluate whether soils at Area P had been impacted from the possible spillage of spent battery electrolyte, five surface and five subsurface soil samples were collected within the fenced area. Results from subsurface samples were used to evaluate the potential for vertical migration of contaminants through the underlying soils. Each sample was analyzed for TAL metals and pH.

At each of five locations (Figure 5-37.1), the gravel was cleared to expose underlying soils. Surface soil samples were collected from 0 to 6 inches bgs, and subsurface soil samples were collected from 4 to 5 feet bgs. Results of the chemical analyses of the soil and sediment samples are presented in Table 5-37.1. ***Arsenic, beryllium,*** and ***cobalt*** were detected at concentrations greater than HBN criteria.

The results of pH analysis indicated that soil samples varied from neutral to slightly basic. The deeper sample exhibited lower pH than the shallow sample, contrary to what would be expected had battery acid impacted the soil.

U7

DSERTS #: RAAP-038 UNDERGROUND FUEL OIL SPILL RRSE: 1A

AREA O

1.0 BACKGROUND

Area O consists of one 269,000-gallon AST that is situated on a concrete base and surrounded by a concrete secondary containment system. The tank contains fuel oil.

2.0 ENVIRONMENTAL SETTING

Area O, the Underground Fuel Oil Spill, is located in the east section of the Main Manufacturing Area, southwest of the Inert Gas Plant. Area O is present on the southeast side of a northeastward sloping drainage valley. Surface elevations at the valley range from 1,775 feet msl near well P-1 to 1,740 feet msl at the asphalt road northeast of the tanks. The southeast side of the valley remains relatively level up to about 300 feet from the tanks where the hillside has a 30 foot drop over only 150 feet. At the base of the scarp is the site of the former Acidic Wastewater Lagoon (SWMU 4). The base of the tank containment structure has an elevation of 1,771 feet msl. The land surface immediately to the southeast is 1,775 feet msl, and the ground surface to the northwest near the road is 1,760 feet msl.

3.0 PREVIOUS INVESTIGATIONS

- **1982 - Oil Audit, USACE,** placed fuel leakage of underground pipeline connecting a filling station to fuel tanks at approximately 3,000 gallons.
- **1983** - Four monitoring wells were installed to characterize groundwater flow and quality at the site.
- **1987 - RCRA Facility Assessment, USEPA,** included a visual site inspection and preliminary evaluation.
- **1990 - Facility Visit,** plant personnel stated that the leaking fuel line was not a filling station, as described in 1982, but a discharge line connecting the northeasternmost fuel tank to a pumping station. This line was replaced with an aboveground line.
- **1992 - RCRA Facility Investigation, Dames & Moore,** included a topographic and a soil gas survey. In addition, existing and newly installed monitoring wells were sampled to determine if groundwater had been contaminated by the Fuel Oil Spill.
- **1994 - RCRA Facility Investigation, Phase II, Dames & Moore,** included groundwater sampling and analysis at previously sampled wells.

The RFI sampling program has provided chemical data for evaluating the impact of Area O on groundwater and soil due to a release of fuel oil. The results of the RFI boring and well installation program, in conjunction with data acquired in previous investigations, have been used to define the hydrogeologic conditions at the site. The RFI and previous investigations have led to the following conclusions:

- Approximately 10 to 35 feet of unconsolidated sediments underlie Area O and overlay limestone/dolostone of the Elbrook Formation. Most of the sediment consists of silt and clay, except for a thin layer of river jack (cobbles and boulders) occasionally present on bedrock.
- The bedrock surface is irregular with the surface elevation higher northeast

of the leak area and lower to the southwest. A basin-shaped depression in the bedrock surface is present under the tank area.

- An unconfined water table which flows northeastward is present below the site. The water table is present in soil on the northwest side of the area and in rock on the southeast side.
- Discharge zones for the unconfined aquifer are present in the road side ditches northwest and northeast of the tank area. Seeps in the hillside northeast of the site have been observed to have greater discharges after rainfall events.
- Ambient groundwater velocities downgradient of the tank area were estimated to be 28 ft/yr in the river jack/broken rock zone and 5 ft/yr in the bedrock. The velocity through the plastic silt and clay was estimated to be 0.1 ft/yr but flow is probably faster due to secondary permeability features. The most likely path for contaminant migration appears to be through the river jack/broken rock zone during periods of precipitation and high groundwater levels.
- Only borings next to the tanks had detectable VOCs and SVOCs, but none exceeded an HBN (Table 5-38.1).
- Several VOCs were detected in groundwater samples but only sporadically, at concentrations below HBNs (Table 5-38.2). TCL SVOCs were only detected in the groundwater sample from well S4W-1 with three of the eight SVOCs exceeding HBNs—***N-nitrosodiphenylamine, phenanthrene,*** and ***bis(2-ethylhexl) phthalate*** (a laboratory artifact). SVOC TICs were detected in eight of the nine wells sampled.
- Contaminants appear to be localized to the soil and groundwater within the bedrock depression under the tanks.
- VOCs and SVOCs were detected in the sample from the seep adjacent to well S4W-1. Only the SVOC ***phenanthrene*** exceeded its HBN.
- ***Chloromethane*** and ***phenanthrene*** exceeded HBN criteria in surface water samples (Table 5-38.3).
- Only trace levels (near the PQL) of a few VOCs and SVOCs were detected in sediment collected from the ditch near the seep. No organic exceeded an HBN (Table 5-38.4).

4.0 RISK ASSESSMENT

Summary of Screening Level Risk Assessment

Samples Collected

Groundwater samples were collected within the vicinity of Area O. Subsurface soil samples were collected from soil borings. Soil gas samples were collected near the seep and around the ASTs. Sediment samples were collected upgradient and downgradient from the seep. One surface water sample was collected from the seep.

Medium	No.	Location
Groundwater	12	Area O
Subsurface soil	11	
Sediment	1	upgradient
	1	downgradient
Surface water	1	seep
Soil gas	22	seep/ABTs

4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Table 5-38.5 presents an overview of the exposure assessment. COPCs were selected based on results exceeding HBNs and background. Groundwater contaminants included N-nitrosodiphenylamine, phenanthrene (also detected in surface water), bis(2-ethylhexyl) phthalate, and nitrate/nitrite. Bis(2-ethylhexyl) phthalate was detected from the COPC due to its presence in associated sample blanks. No justification was provided for the deletion of nitrate/nitrite from the selection of COPCs.

4.2 EXPOSURE ASSESSMENT

Private residences exist immediately adjacent to the RFAAP installation, and a softball field is located across Stroubles Creek. In addition, the Commonwealth of Virginia has classified Stroubles Creek and the stretch of the New River passing though the confines of RFAAP as water generally satisfactory for beneficial uses, which include public or municipal water supply, secondary contact recreation, and propagation of fish and aquatic life.

Given the potential for workers and trespassers to contact environmental media at the site, additional sampling is necessary at Area O in order to characterize the extent of contamination. Specifically, additional sediment and surface water samples should be collected near the seep, and additional surface water and sediment samples should also be collected at areas of Stroubles Creek closest to the site. Shallow soil samples (e.g., 0 to 6 feet deep) should be collected throughout the site for use in assessing surface exposures routes (e.g., ingestion, inhalation, and dermal exposures).

If groundwater and/or surface water COPCs are selected based on the review of future analytical data, then the quantitative evaluation should be considered for the following exposure pathways:

Groundwater

- Ingestion of chemicals in groundwater by a future worker.

Soil

- Incidental ingestion of chemicals in soil by a future worker; and
- Dermal absorption of chemicals in soil by a future worker.

Sediment

- Incidental ingestion of chemicals in sediment by a trespasser playing in Stroubles Creek;
- Dermal absorption of chemicals in sediment by a trespasser playing in Stroubles Creek;
- Incidental ingestion of chemicals in sediment by a trespasser wading in seep area; and
- Dermal absorption of chemicals in sediment by a trespasser wading in seep area.

Surface Water

- Incidental ingestion of chemicals in surface water by trespassers playing in Stroubles Creek;
- Dermal absorption of chemicals in surface water by trespassers playing in Stroubles Creek;

Incidental ingestion of chemicals in surface water by trespassers playing in seep area; and

- Dermal absorption of chemicals in surface water by trespassers playing in seep area.

5.0 RECOMMENDED ACTION

Confirmatory sampling of the available media to support the quantitation baseline risk assessment.

4.0 RECOMMENDED ACTION

Confirmatory groundwater, surface water, and sediment samples will be collected for the analysis of metals, SVOCs, VOCs, explosives, and applicable conventional chemicals to verify previous investigation results and support the quantitative risk assessment. These environmental actions will be initiated when operations cease.

DSERTS #: RAAP-040 RRSE: 1A

FORMER LEAD FURNACE AREA

1.0 BACKGROUND

During World War II a lead furnace was in operation in the southeastern portion of SWMU 17A (Stage and Burn Area), which is located in the south-central portion of the Main Manufacturing Area (Figure 5-40.1). Typically, lead recovered during routine operations at RFAAP would be melted in the furnace and cast into ingots for salvage. Based on the occurrence of lead slag, lead was probably off-loaded on the rim of the depression with the lead smelter at the bottom of the slope.

It is not known precisely how long the Lead Furnace was in operation, but available maps of RFAAP, dated 1968 to 1988, show the location of the Lead Furnace. The SWMU location has apparently been used for various activities and is listed in the RCRA Permit as a waste oil and transfer location area (SWMU 76).

2.0 ENVIRONMENTAL SETTING

The FLFA is located at the foot of a steeply sloping hillside in a depression formed by a sinkhole. The elevation of the area is approximately 1,875 feet msl. The location of the removed waste oil tanks (SWMU 76) is upgradient to the east of the FLFA at an elevation of 1,895 feet msl. Buildings 7219 and 534 are to the south. There are paved and gravel roads in the vicinity.

Subsurface soil investigations have shown that the bedrock surface is variable and consists of broken and weathered limestone. Unconsolidated soil above bedrock consists of surficial fill material

No specific hydrogeologic study has been conducted at this site. However, groundwater conditions are karstic and very irregular. Depth to groundwater is approximately 100 feet and flow direction is uncertain.

Based on topography, surface water in the area of the FLFA would flow from the surrounding hillsides and collect in the areas of lower elevations of SWMU 17A. This water runoff would probably percolate into the surface and enter the water table. According to RFAAP utility maps, there are no manholes, catch basins, or storm drains in the vicinity of the FLFA.

3.0 PREVIOUS INVESTIGATIONS

- **1992 - Verification Investigation, Dames & Moore,** included the sampling and analysis of subsurface soil in the vicinity of the FLFA located within SWMU 17A and a Baseline Risk Assessment.

- **1998 – RCRA Facility Investigation, ICF Kaiser,** included the collection and analysis of subsurface soil samples, a removal action, and site restoration.

This SWMU was not identified in the RFA and was not included in the RCRA Permit, but was added to the VI by USTHAMA in response to conditions uncovered when waste oil tanks at SWMU 76 were removed in 1991. Solid lead slag was observed in the soil around and below the tanks, and soil samples contained high lead concentrations. In response to these discoveries, USATHAMA added an exploratory program to the VI consisting of three borings. Borings were to be drilled to a depth of 10 feet or refusal with the collection of two soil samples from each boring.

An RFI was conducted in response to the findings of the VI, which indicated high concentrations of lead in soil in the vicinity of the FLFA. Investigative activities included subsurface soil sampling, structure, *debris, and lead-contaminated soil removal, and site restoration.*

Sampling locations are presented in Figure 5-40.1.

3.1 VERIFICATION INVESTIGATION

3.1.1 Subsurface Soil

The VI program included the collection of six soil samples from three soil borings at the FLFA. Samples were obtained at two discrete intervals and at depths no greater than 10 feet bgs. The soil samples were analyzed for TAL metals (total) and TCLP metals. Analytical results are presented in Table 5-40.1.

Sample results indicated that concentrations of ***antimony, arsenic, beryllium, cobalt, mercury,*** and ***thallium*** in the soil samples exceeded the HBN criteria. These elements are not highly mobile in the environment and were not expected to impact surface water, groundwater, or underlying soil as indicated by the results of the TCLP analyses. *Lead,* however, exceeded its HBN in two subsurface samples. The lead concentration in the deepest sample collected from 17SB2 was reported to be 500 times greater than the soil HBN, and is a concern at the site. The TCLP concentration for lead in this sample also exceeded the regulatory level by a factor of 100. The TCLP results demonstrated that lead was mobilized at a high concentration and may have impacted underlying soil or groundwater at the site. The TCLP results for sample 17SB3 indicated that lead may be a concern in groundwater below the FLFA.

3.1.2 Baseline Risk Assessment

Although surface soil samples were not collected, surface soil was reportedly highly contaminated with lead and lead slag through visual observation. Workers do not frequently enter the area; however, burn activities occur approximately once per week, trucks frequently dump in the area, and cranes operate in the area.

Potential exposure routes included incidental ingestion, inhalation, and dermal absorption. Due to the nature of operations conducted in this area, the air inhalation pathway appears to be the most viable and significant exposure pathway; exposure via incidental ingestion and dermal absorption is expected to be low. Because of the high lead concentrations assumed to be present in the surface soil, and the frequent activity occurring in this area, exposure to human receptors via inhalation of lead contamination was expected to be moderate to high.

An evaluation of the potential for toxic effects upon inhalation exposure to lead indicates that such exposure was associated with neurological and hematological effects. Adverse hematological effects in children occur at blood levels of 10 to 15 micrograms per deciliter (μg/dL), and possibly lower (USEPA, 1991). Irreversible chronic neuropathy, characterized by decreased glomerular filtration rates, interstitial fibrosis, mitochondrial changes, and azotemia, is sometimes found in chronically exposed workers with blood lead levels of 40 to 60 μg/dL (USEPA, 1991).

Because lead has no known toxicity threshold, USEPA has not calculated RfDs for lead exposure (USEPA, 1992); instead USEPA has developed an intake biokinetic (UBK) model for assessing exposure to lead. Although lead is classified as a B2 carcinogen, inhalation carcinogenicity studies present conflicting data.

Based on the fact that surface soil samples are expected to be highly contaminated with lead, that workers in or near the FLFA may potentially receive moderate to high exposure, and that toxic effects from lead via the inhalation pathway are well documented, the potential hazard to human receptors cannot be quantified is estimated to be moderate to high.

Results of the TCLP analysis indicated that lead may have impacted underlying groundwater at the site. No groundwater wells have been identified at the FLFA and no hydrogeologic data is available. Because the SWMU is located in a sinkhole and groundwater migration pathways are unknown, the potential for groundwater exposure cannot be evaluated.

Because this site is located in a sinkhole at the bottom of a steep hill, it is unlikely that environmental receptors frequent this area. Therefore, potential exposure to environmental receptors was estimated to be low. Secondly, because there are no surface water bodies in the vicinity of this site, discharge of contaminated groundwater to surface water was not considered an operable migration pathway; therefore, there were no potential environmental groundwater receptors.

3.2 RCRA FACILITY INVESTIGATION

The RFI was conducted to delineate the extent of lead-contaminated soil attributable to FLFA historical operations. The investigation consisted of the following elements:

- Collection and field screening of subsurface soil samples to qualitatively determine the removal of lead contaminated soil;
- Collection, analysis, and confirmatory evaluation of subsurface soil samples to confirm the removal of lead-contaminated soil;
- Removal of FLFA structures, debris, and lead-contaminated soil; and
- Site restoration activities to complement the natural terrain and local flora and fauna of the surrounding area.

3.2.1 Preliminary Delineation

Twelve preliminary subsurface soil samples were collected to delineate lead concentrations exceeding 200 μg/g (RFAAP lead action level).

Analytical results are presented in Table 5-40.2. Sample results indicated that lead concentrations exceeded 200 μg/g in 3 of the 12 samples. Results also indicated that lead contamination was limited to 0 to 2 feet bgs, with the exception of LFSB5A (4 to 6 feet bgs).

3.2.2 Removal Action

All structures, debris, and lead soil concentrations in excess of 200 μg/g attributable to the FLFA were removed and disposed of in accordance with state and federal regulations.

3.2.3 Soil Screening

A total of 17 subsurface soil samples were collected and screened using lead field test kits. Qualitative real-time lead concentrations were used to guide the removal of lead-contaminated soil.

3.2.4 Confirmatory Analysis

Eight subsurface soil samples were collected and analyzed for lead content by a laboratory to determine if all lead-contaminated soil to verify that soil with lead concentration in excess of 200 μg/g had been removed.

Analytical results are presented in Table 5-40.3. Sample results indicated that only one sample (LFTP8) contained lead concentrations in excess of 200 μg/g. This sample was determined to be outside of the FLFA boundary.

3.2.5 Boundary Verification

Five shallow soil samples were collected from 4 borings advanced with a hand auger north of the FLFA boundary to demonstrate that lead-contamination extended beyond the FLFA boundary. Samples were analyzed by a laboratory for lead content.

Analytical results are presented in Table 5-40.4. Sample results indicated that lead concentrations were detected in excess of 200 µg/g in 2 out of five samples. Results demonstrated that lead-contaminated soil not attributable to FLFA historical operations exists throughout the area.

3.2.6 Site Restoration

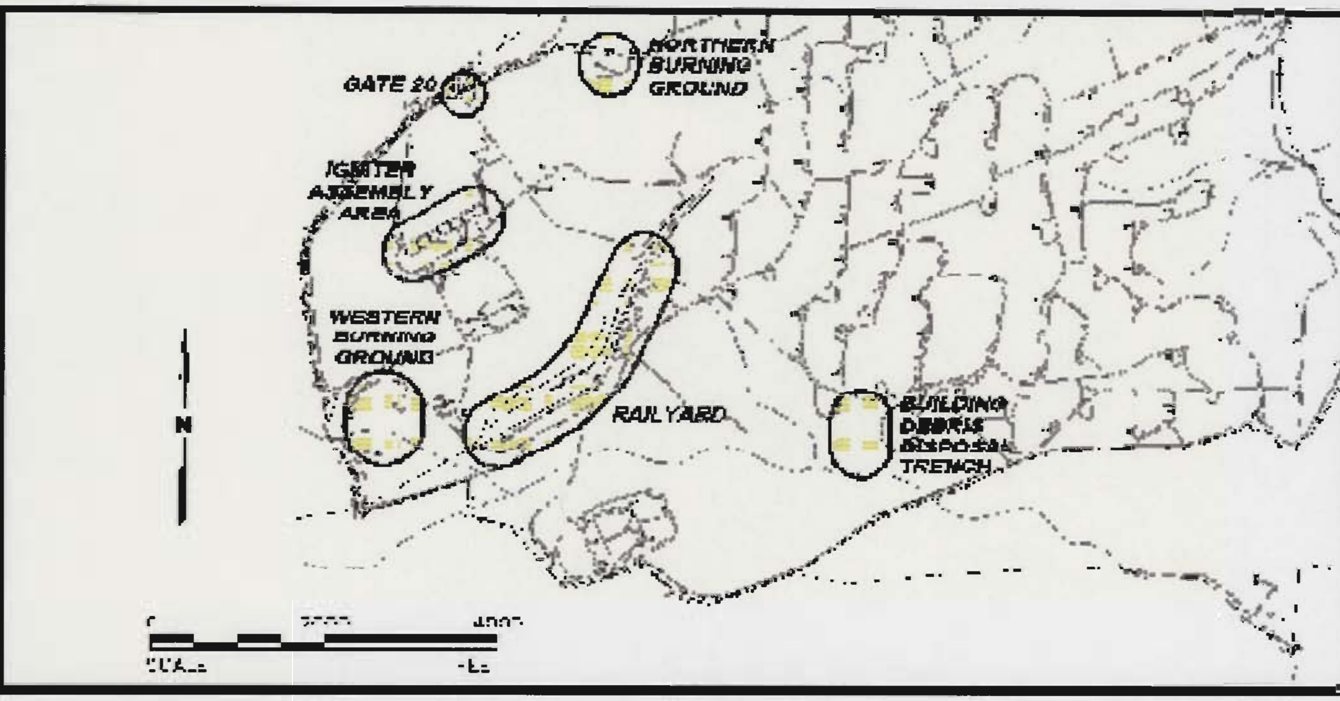
Site restoration activities were conducted to complement the natural terrain and local flora and fauna of the surrounding area. Activities included backfilling with clean soil, grading, seeding.

4.0 RECOMMENDED ACTION

RFI results support a no further action recommendation for this site. Lead-contaminated soil attributable to the FLFA has been removed below levels of concern. Site conditions at the FLFA do not pose a threat to human health or the surrounding environment.

DSERTS #: RAAP-044 **RRSE: 1A**

NEW RIVER UNIT



1.0 BACKGROUND

The NRU is located approximately 6 miles west of the RFAAP Main Manufacturing Area and consists of approximately 2,813 acres. Between 1940 and 1945, the NRU was used for the loading of propellants and igniter charges and the manufacturing of igniter charge bags. Between 1943 and 1945, operations were expanded to include an additional bag-loading line, rolled powder operations, flash-reducer loading lines, and black-powder drying facilities. Production ended after World War II, and the plant was officially designated as part of the RFAAP installation.

Since 1947, approximately 1,000 acres in the western section of the plant have been sold or transferred for other uses. The central bag-loading and igniter, burning ground, and rail shipping areas exist on the remaining acreage. The buildings associated with these areas are no longer in use. The wooden structures have been removed and only the concrete walls remain standing. The floors in many of these buildings contain conductive flooring composed of asbestos and heavy metals.

Nearly 150 high-explosives magazines and black and smokeless powder igloos are also located in the NRU. These facilities are currently being used for storage of explosives and powder produced at the Main Manufacturing Area.

NRU areas previously investigated include:

Area A:	North Burning Ground
Area B:	Igniter and Flash Reducer Loading Area
Area C:	Burning Ground
Area D:	Rail Yard
Area E:	Bag Loading Area
Area F:	Sink Hole

2.0 ENVIRONMENTAL SETTING

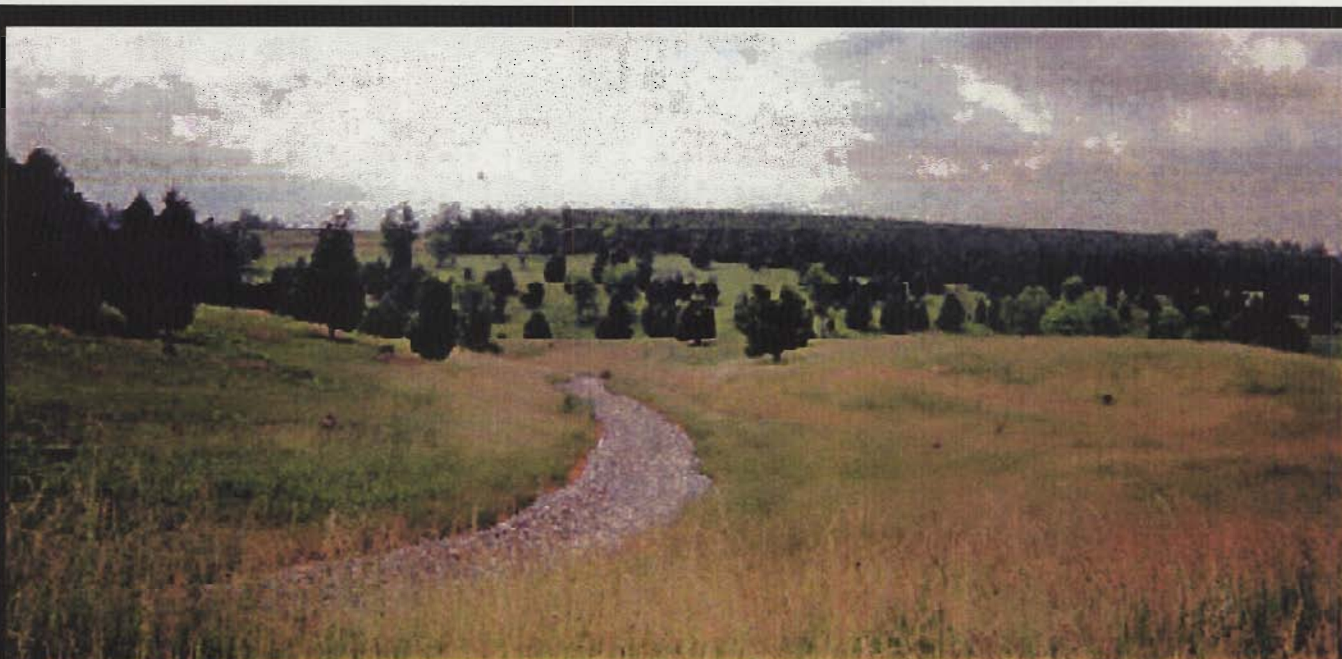
The topography at the NRU varies from gentle to strong slopes. Numerous sink holes are scattered about the site. Most of the area is covered with grass, and much of the acreage has been revegetated with pine forest. The NRU is underlain by gently to strongly sloping soil that developed from weathered products of shale interbedded with thin layers of limestone. These soils have a surface layer of dark, yellowish-brown sandy clayey silt approximately 8 inches thick. The soil exhibits three distinct layers to a depth of 5 feet: an upper part of strong brown silty clay; a middle part of strong brown clay; and a lower part of silty sandy clay. These have been altered in places for urban use. In some places half of the original soil has been removed and the fill material can go as deep as 3 feet. The permeability is slow in the undisturbed parts, but varies in the fill areas. Soil is strongly acidic and can corrode uncoated steel. Sheet and rill erosion is moderate to high (Cauley, et al., 1985). Several man-made surface water impoundments are observed in the aerial photographs. Surface water from the site eventually flows one mile south to Claytor Lake, a lake in the New River produced by Claytor Dam.

3.0 PREVIOUS INVESTIGATIONS

Previous investigation discussions are included in the specific area descriptions. Sampling programs for investigative activities conducted in the NRU area presented in Tables 5-44.1.1, 5-44.1.2, 5-44.1.3. Investigation results are presented in Table 5-44.2.

DSERTS #: RAAP-044 **RRSE: 1A**

BUILDING DEBRIS DISPOSAL TRENCH



1.0 BACKGROUND

The Building Debris Disposal Trench is located in the southern portion of the New River Unit (NRU) of Radford Army Ammunition Plant (RFAAP) (refer to page 5-44.1). The trench was used as a disposal area for miscellaneous building debris derived from the dismantling of various NRU buildings. The length of the trench runs from north to south and is approximately 950 ft long by 15 ft wide. The head of the trench begins at A Avenue, at an approximate elevation of 2,000 feet (ft) above mean sea level (msl), slopes downward to the south and ends at an unnamed creek (approximately 1,960 ft msl) which flows through the installation.

2.0 ENVIRONMENTAL SETTING

The area surrounding the Building Debris Disposal Trench is typically gently to strongly sloping grass-covered hills. The surface layer of soil is generally dark yellowish brown silty clay to approximately one foot. The subsoil to approximately four feet generally ranges from a strong brown silty clay to a brownish yellow silty clay. The substratum (below 4 feet) is brownish yellow silty clay to a depth of approximately 5.5 feet. The bedrock surface is variable and consists of weathered shale interbedded with layers of limestone. Bedrock outcrops are visible along the length of the trench.

3.0 PREVIOUS INVESTIGATIONS

- **1997 – Preliminary Sampling, Alliant Techsystems,** included the collection of one soil sample, one surface water sample, and one tar sample.
- **1998 – Independent Sampling, Gannett Fleming,** included the collection of three sediment samples and one surface water sample.
- **1998 – Remedial Investigation, ICF Kaiser,** included a geophysical survey, the removal of building debris from the trench, and the collection and analysis of thirty-four subsurface soil samples, three surface soil samples, seven surface water samples, seven sediment samples, and one wood chip sample.

3.1 PRELIMINARY SAMPLING - 1997

One surface soil sample was collected directly downgradient of a corroded drum containing tar that had leaked onto the soil. The sample was analyzed for TCL SVOCs. Analytical results are presented in Table 5-44.2.1.

One surface water sample was collected from the unnamed creek south of the trench and analyzed for TCL SVOCs. Sample results indicated that detected concentrations were below the estimated quantitation limit.

A sample was collected and analyzed for TCLP-SVOCs. Analytical results were below detection limits.

3.2 INDEPENDENT SAMPLING 1998

3.2.1 Surface Water / Sediment

One surface water (SW-07) and three sediment samples (SD-06, SD-07, SD-08) were collected form the unnamed creek south of the disposal trench. All samples were analyzed for TAL metals, TCL VOCs, TCL SVOCs, explosives, and pesticides/PCBs. Surface water analytical results are presented in Table 5-44.2.2 and for sediment in Table 5-44.2.3

3.3 REMEDIAL INVESTIGATION 1998

3.3.1 Geophysical Survey

A geophysical survey was conducted along both sides of the trench to locate buried drums and other miscellaneous metallic subsurface debris. Following survey completion, survey data and data contour map, were reviewed, and preliminary on-site interpretations were made. Results of the survey indicated that metallic subsurface debris was largely limited to the interior of the disposal trench. Low amplitude anomalies were detected immediately adjacent to the trench and were determined to be relatively small objects.

3.3.2 Surface Water/Sediment

One upgradient and two downgradient colocated surface water/sediment samples were collected to determine if runoff from the trench caused contamination to the unnamed creek. Four additional colocated surface water/sediment samples were collected in response to a flash flood event to characterize potential contamination that may have been transported to the creek from the disposal trench. Samples DTSW/SD1-2, DTSW/SD2-2, and DTSW/SD3-2 were collected from the same locations as the previous corresponding surface water/sediment samples. Sample DTSW/SD4 was collected at the property boundary, approximately 545 ft downstream of the confluence of the trench delta and the creek. All samples were analyzed for metals, VOCs, SVOCs, explosives, and PAHs. Surface water analytical results are presented in Table 5-44.2.4 and for sediments in Tables 5-44.2.5 (metal results) and Table 5-44.2.6 (organic results).

3.3.3 Surface Soil

Three surface soil samples (DTSS1, DTSS2, and DTSS3) were collected in the trench delta to assess potential soil contamination that may have occurred from the transport of trench contaminates during the flash flood event. Surface soil samples were analyzed for metals, VOCs, SVOCs, explosives, and pesticides/PCBs. Analytical results for metals are presented in Table 5-44.2.7 and for organics in Table 5-44.2.8.

3.3.4 Subsurface Soil

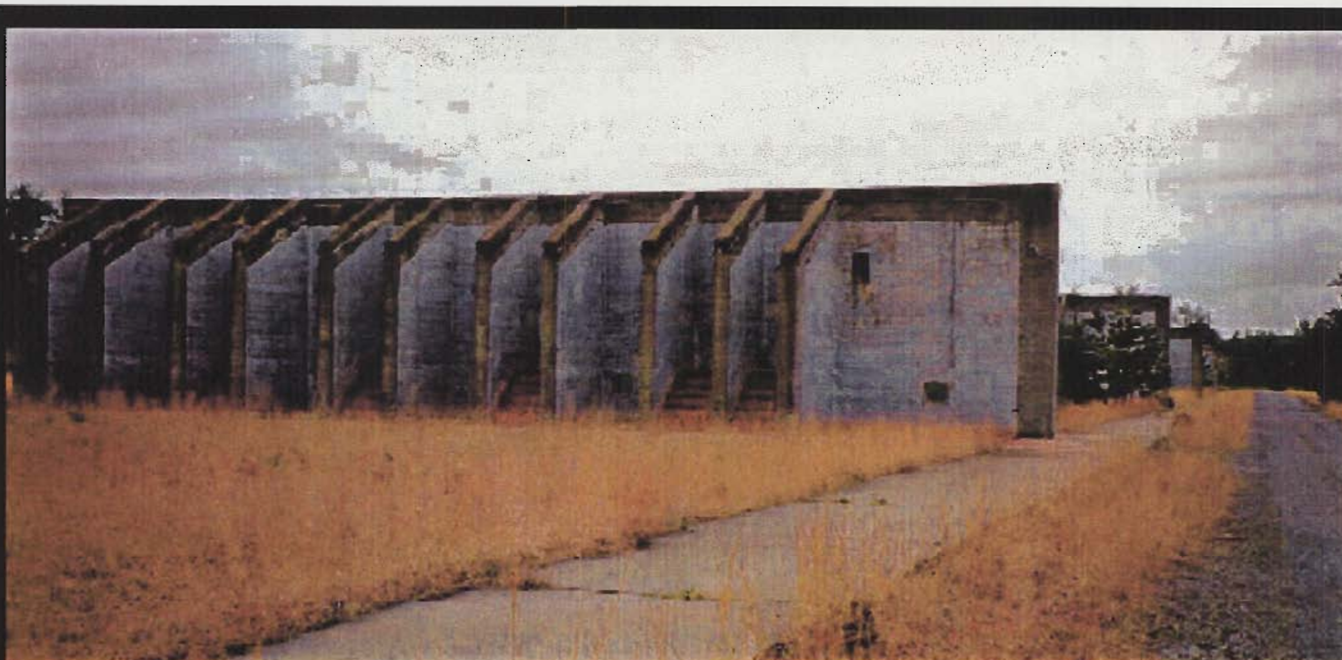
Subsequent to the removal of debris and visibly contaminated soil, thirty-four subsurface soil samples (DTSB1 to DTSB23 and DTSB35 to DTSB45) were collected. Samples were collected from the trench floor from a depth of 0 to 0.5 ft below the visibly contaminated soil layers at an average distance of 17.5 ft apart. All samples were analyzed for metals, VOCs, SVOCs, explosives, and PAHs. Analytical results for metals are presented in Table 5-44.2.9 and organic results are presented in Table 5-44.2.10.

4.0 RECOMMENDED ACTION

Remedial investigation sample results are currently being evaluated and will be included in the next SMP revision. Potential sources of contamination have been removed, and appropriate erosion control measures have been implemented at the site to prevent potentially negative impacts (erosion) to the unnamed creek. Preliminary assessment results indicate that existing site conditions do not pose a threat to human health or the surrounding environment.

DSERTS #: RAAP-044 **RRSE: 1A**

IGNITER ASSEMBLY AREA



1.0 BACKGROUND

The Igniter Assembly Area is located in the western portion of the NRU, approximately 2,200 ft west of the Rail Yard and approximately 2,000 ft north of the Western Burning Ground. The site is approximately 1,000 ft long by 250 ft wide and consists of eight assembly buildings (refer to Figure 5-44.1). Each building is approximately 100 ft long by 20 ft wide with loading rooms along both sides of a central concrete wall. The wooden structures, including the roofing, have been removed and only the concrete walls, floors, and foundations remain. The floors in these buildings contain a conductive flooring material that consists of asbestos and heavy metals. The flooring has degraded to varying degrees in each of the buildings and red leachate has migrated into the surrounding soil.

2.0 ENVIRONMENTAL SETTING

The areas between most of the buildings are generally flat with grassy depressions and are wooded with pine and cedar tree seedlings. Vegetation in the remaining areas is limited to grass. The soils in these areas vary from fill material to native soils and drainage runs from northwest to southeast towards a drainage ditch between the buildings and Cameron Road. Stratigraphic characterization completed during the 1998 RI indicated that the subsurface at the Igniter Assembly Area consists of yellowish-red to dark yellowish-brown to strong brown silt and silty clay. Below this lies a layer of mottled, moderately hard to soft clay with intermixed quartz gravel and weathered bedrock (saprolite) concretions. This material grades downward to a tight saprolitic clay at approximately 25 ft bgs. Depth to groundwater is unknown.

3.0 PREVIOUS INVESTIGATIONS

- **1997 – Independent Sampling, Gannett Fleming**, included the collection of two surface soil samples within the vicinity of the Igniter Assembly buildings.
- **1998 - Independent Sampling, Gannett Fleming**, included the collection of five surface soil samples and one conductive flooring sample.
- **1998 – Remedial Investigation, ICF Kaiser**, included the collection of test pit samples, subsurface soil samples, air samples, and a conductive floor sample to further characterize the nature and extent of contamination.

3.1 INDEPENDENT SAMPLING—1997

Two surface soil samples (SS-03 and

SS-11) were collected from 0 to 0.5 ft bgs in the vicinity of Buildings 8102-8 and 8102-5. . The samples were analyzed for metals, VOCs, SVOCs, explosives, and pesticides/PCBs. Analytical results are presented in Table 5-44.3.1.

3.2 INDEPENDENT SAMPLING—1998

Twenty-one shallow soil samples were collected at one foot interval depths from 0 to 3 ft bgs in the vicinity of Buildings 8102-7 and 8102-2 to further characterize soil contamination and verify previous investigation results reported during the 1997 Independent Sampling (Gannett Fleming, Inc.). Samples collected in the vicinity of Building 8102-7 were analyzed for metals, SVOCs, PAHs, and VOCs. Samples collected in the vicinity of Building 8102-2 were analyzed for metals, SVOCs, PAHs, VOCs, and pesticides/PCBs. Analytical results are presented in Table 5-44.3.2.

3.3 REMEDIAL INVESTIGATION

The purpose of the 1998 Remedial Investigation was to further characterize the nature and extent of contamination at the Igniter Assembly Area through the investigation of subsurface soils and conductive flooring.

3.3.1 Subsurface Soil

A total of 11 subsurface soil samples were collected from each of five borings (IASB1 through IASB5) advanced using a truck mounted Geoprobe® to characterize the nature and extent of contamination and to determine whether remedial action is warranted for this area. A shallow sample (from within the upper 2 ft of the subsurface) and a medium depth sample (from within 4 to 6 ft bgs) were collected from each boring. Additionally, one deep sample (IASB2C) was collected from boring IASB2 to characterize the lower subsurface region. All samples were analyzed for metals and SVOCs. Analytical results are presented in Table 5-44.3.3 for metals and Table 5-44.3.4 for organic compound results.

3.3.2 Test Pit Activities

Two test pits (IATP1 and IATP2) were advanced perpendicular to the concrete foundations on the northeast corner of Buildings 8012-1 and 8012-7, respectively, to characterize the soil profile and determine the nature and extent of contamination due to the runoff of conductive flooring material from the buildings. A substantial quantity of leachate was encountered in the surface soil immediately surrounding the buildings. A total of four soil samples were collected from within each pit. All samples were analyzed for metals. Shallow samples were also analyzed for SVOCs. Additionally, all of the samples, with the exception of IATP1C and IATP1D were analyzed for explosives. Analytical results are presented in Table 5-44.3.5 for metals and 5-44.3.6 for organic compound results.

3.3.3 Conductive Flooring

One conductive floor sample was collected from the northeast corner of Building 8102-1 to verify floor material composition and determine transport and mobility. A small chunk of the red conductive flooring material was collected from the surface of the building foundation and was considered representative of the material found in each of the buildings. The sample was analyzed for metals, SVOCs, ACM, and TCLP metals. Analytical results are presented in Table 5-44.3.7.

3.3.4 Air Samples

A negative exposure assessment of the airborne concentration of asbestos fibers was conducted using a Gilian "GilAir" personal monitoring/sampling pump at the Igniter Assembly Area. A total of three air samples were collected from three filter cassettes and analyzed for ACM. Samples were collected for an evaluation of (1) background airborne concentrations of asbestos during undisturbed conditions, (2) excursion level of airborne asbestos during the advancement of a test pit, and (3) a time-weighted average of airborne asbestos during the advancement of a test pit. ACM was not detected in any of these samples.

4.0 RECOMMENDED ACTION

An RI Report is currently being developed for the site to evaluate the nature and extent of contamination associated with former igniter assembly activities. An evaluation of the results will be presented in the next SMP revision.

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DSERTS #: RAAP-044 **RRSE: 1A**

NORTHERN BURNING GROUND

1.0 BACKGROUND

The Northern Burning Ground is located in the northern portion of the NRU, approximately 2,000 ft east of Gate 20, along Guard Road. The approximate area of concern at the burning ground is 350 ft long by 250 ft wide. A dirt road follows the outer perimeter of the site, defining the outermost boundary of the area of concern (refer to page 5-44.1). A drainage ditch parallels Guard Road on the north side of the site.

2.0 ENVIRONMENTAL SETTING

The Northern Burning Ground is a generally level area at an elevation of approximately 2,100 ft mean sea level (ft msl). The site is wooded with pines and contains a sparse undergrowth of mimosa trees and grass. Stratigraphic characterization performed during remedial investigation activities (ICF KE, 1998) indicated that the subsurface consists of a layer of yellowish brown to dark brown sandy clayey silt to a depth of nine feet. Below this layer the soil is predominantly strong brown clay with some silt. Magnesium concretions in the form of black stained veins were observed beginning at a depth of 12 feet below ground surface (ft bgs) and continued to 55 ft bgs. Groundwater was encountered at 54 ft below ground surface.

3.0 PREVIOUS INVESTIGATIONS

- **1997 – Independent Sampling, Gannett/Fleming**, included the collection of two surface soil samples.
- **1998 – Remedial Investigation, ICF Kaiser,** included a geophysical survey and the collection of 11 subsurface soil samples to further characterize the nature and extent of contamination and potential exposure pathways.

3.1 INDEPENDENT SAMPLING—1997

3.1.1 Surface Soil

Two surface soil samples (SS-01 and SS-02) were collected from 0.5 to 0.7 ft bgs in the central portion of the burning area, south of Guard Road. The samples were analyzed for metals, SVOCs, VOCs, PCBs, and pesticides. Surface soil sample SS-02 was also sampled for explosives. Analytical results are presented in Table 5-44.4.1. Explosives, PCBs and pesticides were not detected above nominal quantification limits (NQLs) and are not included in this table.

3.2 REMEDIAL INVESTIGATION—1998

3.2.1 Geophysical Survey

Due to a lack of historical information on the exact location of burning ground operations, a geophysical survey was conducted at the site to assist in the selection of subsurface soil sample locations. Aerial photographs of the site were used to guide the geophysical survey within this area. After the survey was completed the survey data and data contour map (which was produced in the field) were reviewed and preliminary on-site interpretations were made by the subcontractor. After discussing the survey results and interpretations of the data contour map with ICF KE, highly anomalous areas were marked on the ground by the geophysical subcontractor.

3.2.2 Subsurface Soil

A total of eleven subsurface soil samples were collected from five soil borings (NBGSB1 through NBGSB5) using the Geoprobe direct push sampling method. Samples were collected at shallow and intermediate depths at each boring. Additionally, a deep sample was collected at boring NBGSB1 to characterize the lower subsurface region.

All samples were analyzed for metals, VOCs, SVOCs, and explosives. Analytical results are presented in Table 5-44.4.2 for detected metals, Table 5-44.4.3 for VOCs, and Table 5-44.3.4 for SVOCs.

4.0 RECOMMENDED ACTION

Additional RI activities were performed at the Northern Burning Ground during the summer of 1999 to augment the existing data and enhance the current site conceptual model. Investigative activities included the collection of additional subsurface soil samples in the vicinity of previous 1998 RI sample locations, where high concentrations of lead were detected, and in the sinkhole adjacent to the burning ground. An evaluation of the sample results will be presented in the next SMP revision.

DSERTS #: RAAP-044 **RRSE: 1A**

WESTERN BURNING GROUND

1.0 BACKGROUND

The Western Burning Ground is located in the western portion of the NRU, approximately 1,100 ft west of the Rail Yard and approximately 2,000 ft south of the Igniter Assembly Area (refer to page 5-44.1). The burning ground is approximately 170 ft long by 100 ft wide. It is immediately surrounded on three sides by an approximately 4 ft high earthen berm.

2.0 ENVIRONMENTAL SETTING

The Western Burning Ground is a generally flat area at an elevation of approximately 2,050 ft mean sea level (ft msl). Surface water runoff is expected to flow to the northwest. The site is wooded with a sparse growth of pine trees on the bermed sides of the site.

An unnamed lake was constructed south of the burning ground during the early 1990s and is fed by Wiggins Spring, a natural spring located at the head of the lake. The lake drains under an earthen dam into the unnamed creek south of the burning ground. According to facility representatives, the lake is stocked with various species of fish for recreational fishing.

Stratigraphic characterization completed during the 1998 remedial investigation indicated that the subsurface consists of a layer of brownish yellow hard to very hard clay, variably mixed with gray gravel, to a depth of six feet. This is followed by an approximately three and one half foot thick brownish yellow soft clay seam. Below this layer, the soil grades to a gray hard clay (weathered bedrock product). Surface water at the site is expected to flow to the northwest.

3.0 PREVIOUS INVESTIGATIONS

- **1997 - Independent Sampling, Gannett/Fleming,** included the collection of three surface soil samples, two surface water samples, and two sediment samples.
- **1998 - Remedial Investigation, ICF Kaiser,** included a geophysical survey and the collection of 11 subsurface soil samples to further characterize the nature and extent of contamination and potential exposure pathways.

3.1 INDEPENDENT SAMPLING 1997

3.1.1 Surface Soil

Three surface soil samples (SS-04, SS-04a, and SS-05) were collected from 0 to 0.5 ft bgs near the central portion of the burning area. Samples were analyzed for metals, VOCs, SVOCs, pesticides/PCBs, and dioxins/furans. Surface soil sample SS-05 was also analyzed for explosives. Analytical results are presented in Table 5-44.5.1. Explosives were not detected above NQLs, and therefore, are not included in the table.

3.1.2 Surface Water

Two surface water samples (SW-01 and SW-02) were collected in the vicinity of Wiggins Spring, which is at the head of the unnamed lake, south of the burning ground. Samples were analyzed for metals, VOCs, SVOCs, and pesticides/PCBs. Surface water sample SW-02 was also analyzed for explosives. Analytical results are presented in Table 5-44.5.2.

3.1.3 Sediment

Two sediment samples were collected in the vicinity of Wiggins Spring. Samples were analyzed for metals, VOCs, SVOCs, pesticides/PCBs, and explosives. Analytical results are presented in Table 5-44.5.3.

3.2 REMEDIAL INVESTIGATION 1998

3.2.1 Geophysical Survey

Due to a lack of historical information on the exact location of burning ground operations, a geophysical survey was conducted at the site to assist in the selection of subsurface soil sample locations. Aerial photographs of the site were used to guide the geophysical survey within this area. After the survey was completed the survey data and data contour map (which was produced in the field) were reviewed and preliminary on-site interpretations were made by the subcontractor. After discussing the survey results and interpretations of the data contour map with ICF KE, highly anomalous areas were marked on the ground by the geophysical subcontractor.

3.2.2 Subsurface Soil

A total of eight subsurface soil samples were collected from five soil borings (WBGSB1 through WBGSB5) using the Geoprobe direct push sampling method. Two samples were collected from each of two borings (WBGSB1 and WBGSB2), and one shallow sample was collected from each of the three remaining borings (WBGSB3, WGBSB4, and WBGSB5). Deeper samples were not collected from these latter locations due to refusal. Additionally, one deep soil sample was collected from boring WGBSB2 to further characterize the lower subsurface region.

All samples were analyzed for metals, VOCs, and SVOCs. Analytical results for metals are presented in Table 5-44.5.4, VOCs in Table 5-44.5.5, and SVOCs in Table 5-44.5.6.

3.2.3 Surface Water/Sediment

Three colocated surface water/sediment samples were collected from the unnamed lake and creek south of the burning ground to assess potential contamination associated with activities at the burning ground. All samples were analyzed for metals, VOCs, SVOCs, and explosives. Analytical results for deleted parameters in surface water are presented in Table 5-44.5.7. Sediments results for metal parameters are presented in Table 5-44.5.8 and for organics in Table 5-44.5.9.

4.0 RECOMMENDED ACTION

Additional RI activities were performed at the Western Burning Ground during the summer of 1999 to augment the existing data and enhance the current site conceptual model. Investigative activities included the collection of additional subsurface soil, surface water, and sediment samples. Several test pits were advanced and test pit soil samples were collected to delineate the extent of lead contamination. An evaluation of the sample results will be presented in the next SMP revision.

DSERTS #: RAAP-044 **RRSE: 1A**

RAIL YARD

1.0 BACKGROUND

The Rail Yard is located approximately 2,600 ft south of the Northern Burning Ground and approximately 1,100 ft east of the Western Burning Ground. It encompasses an open area approximately 3,200 ft long by 530 ft wide with four small bermed spurs to the north. The area contains three open transfer platforms and one bermed transfer platform (refer to page 5-44.1). Two large grass covered mounds exist in aerial photographs between Tracks A and B from 1949 through 1991, and are still present at the site. According to facility representatives, heavily packaged NIKE and JOHN rockets and propellants were loaded onto railcars at the site during the 1960s.

2.0 ENVIRONMENTAL SETTING

The Rail Yard is surrounded by dense vegetation to the west and north, open fields to the east, and by the unnamed creek to the south. Surface water drainage is expected to flow to the southeast, eventually entering the unnamed creek to the south. Stratigraphic characterization performed during remedial investigation activities (ICF KE, 1998) indicated that the subsurface consists of a layer of mostly strong brown clay with some silt to a depth of one to two ft bgs. Beneath this layer, to a depth of at least 23 ft bgs, the soil is predominantly strong brown with some yellowish-brown to yellowish-red soft to very hard clay. Depth to groundwater is unknown.

3.0 PREVIOUS INVESTIGATIONS

- **1997 - Independent Sampling, Gannett Fleming**, included the collection of one sludge sample and two surface soil samples.
- **1998 - Independent Sampling, Gannett Fleming,** included the collection of one sludge sample, three surface soil samples, and one platform water sample.
- **1998 – Remedial Investigation, ICF Kaiser,** included the collection of 15 subsurface soil samples to further characterize the nature and extent of contamination and potential exposure pathways.

3.1 INDEPENDENT SAMPLING 1997

3.1.1 Surface Soil

Two surface soil samples (SS-07 and SS-08) were collected from 0 to 0.5 ft bgs in the vicinity of transfer platform 603. Samples were analyzed for metals, VOCs, SVOCs, pesticides/PCBs, and explosives. Analytical results are presented in Table 5-44.6.1

3.1.2 Sludge

One sludge sample (SL-05) was collected between Tracks B and C, north of the transfer platform 603. Sample was analyzed for metals, VOCs, SVOCs, pesticides/PCBs, and explosives. Results indicated that ***arsenic*** was detected above the Industrial RBC. Analytical results are presented in Table 5-44.6.2.

3.2 INDEPENDENT SAMPLING - 1998

3.2.1 Surface Soil

One shallow surface soil sample (SS-08a) was collected from 0 to 0.5 ft bgs in the area between Track A and transfer platform 603. This sample was analyzed for metals, VOCs, SVOCs, pesticides/PCBs, and explosives. Additionally, three shallow surface soil samples (TR-02A, TR-02B, and TR-02C) were collected from 0 to 0.2 ft bgs in the area adjacent to a utility pole (with transformer) near Calhoun Road. These samples were collected for PCB field screening analysis. Soil was collected from locations TR-02A and TR-02C and submitted for confirmatory laboratory analysis.

These samples were analyzed for SVOCs and pesticides/PCBs. Analytical results are presented in Table 5-44.6.3.

3.2.2 Sludge

One composite sludge sample (SL-08) and a duplicate sample (SL-108) were collected inside of transfer platform 602. Sample was analyzed for metals, VOCs, SVOCs, pesticides/PCBs, and explosives. Analytical results are presented in Table 5-44.6.4.

3.2.3 Surface water

One surface water sample (WW-04) was collected inside of transfer platform 603. This sample was analyzed for metals, VOCs, SVOCs, pesticides/PCBs, and explosives. Analytical results are presented in Table 5-44.6.5.

3.3 REMEDIAL INVESTIGATION - 1998

3.3.1 Subsurface Soil

A total of fifteen subsurface soil samples were collected from seven soil borings (RYSB1 through RYSB7) using the Geoprobe direct push sampling method. Samples were collected at shallow and intermediate depths at each boring. Additionally, a deep sample (RYSB1C) was collected at boring RYSB1 to characterize the lower subsurface region.

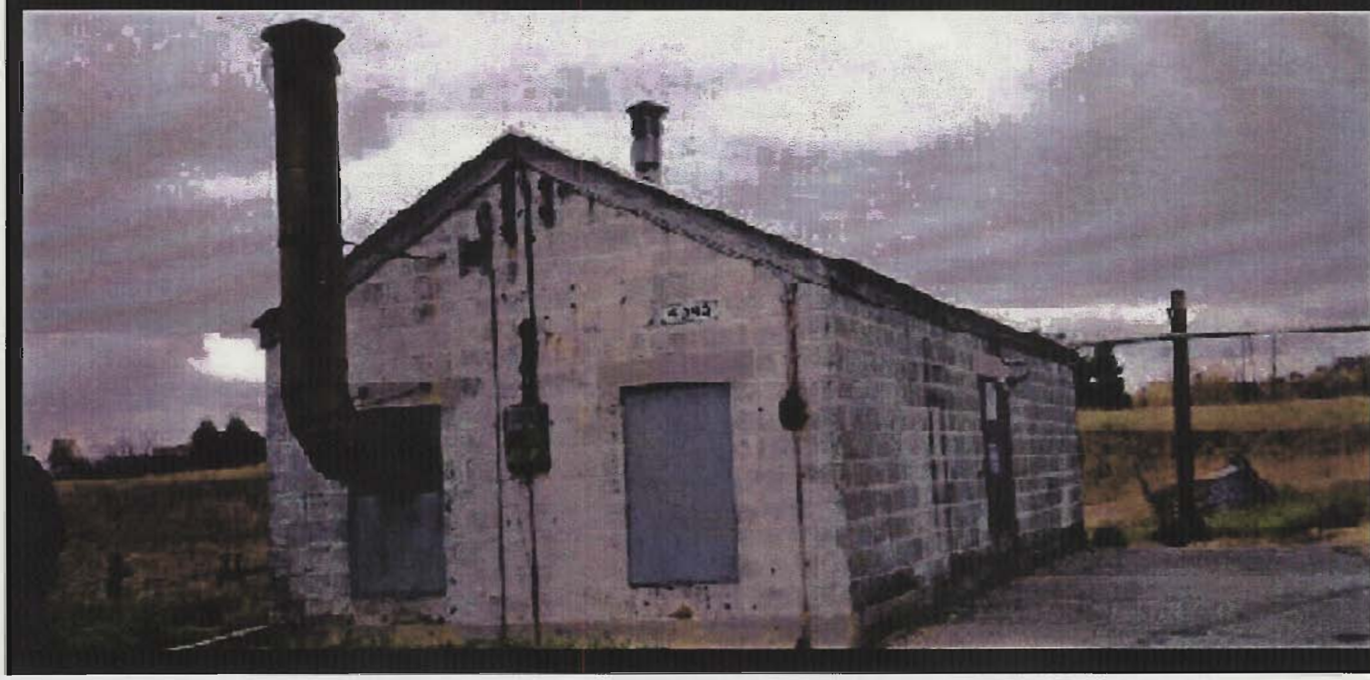
All samples were analyzed for metals, SVOCs, and explosives. Analytical results are presented in Table 5-44.6.6 for metals and 5-44.6.7 for organics.

4.0 RECOMMENDED ACTION

A preliminary assessment of the data indicates that this site requires no further action. Remedial investigation sample results are currently being evaluated and will be included in the next SMP revision.

DSERTS #: RAAP-045 FORMER CADMIUM PLATING FACILITY RRSE: 1B

BUILDING 4343



1.0 BACKGROUND

Building 4343, the Former Cadmium Plating Facility, was originally designated as the Fire Water Pump House. The building was used to house a five inch one stage, 500 gallon per minute gasoline powered pump. A 550 gallon underground tank located approximately 40 feet south of building 4343 was used to store the gasoline for the pump. The tank was subsequently removed on June 11, 1998.

In 1956, the building was converted to support NIKE ignitor grain cadmium plating operations. Conversion activities included the installation of a drying cabinet, cadmium plating baths, an exterior lead catch tank, and an exhaust system. The pump and pump engine were removed and floor sumps were filled to level.

2.0 ENVIRONMENTAL SETTING

Building 4343 (Figure 5-45.1) is situated in the Horseshoe Section of the RFAAP Main Manufacturing Plant. It is located within the Pilot B Area of the Rocket Manufacturing Area.

The area surrounding the building is mowed grass at an elevation of approximately 1830 ft msl. Surface water runoff flows to the north to a drainage ditch that grades to approximately 1810 ft msl.

3.0 PREVIOUS INVESTIGATION

Previous investigation activities at Building 4343 include one round of surface soil sampling (Alliant Techsystems 1996). Surface soil samples were collected from five locations around Building 4343 to determine the extent of cadmium contamination. Samples were analyzed only for TCLP cadmium; results from four sample locations exceeded the cadmium regulatory limit of 1 mg/L.

4.0 RECOMMENDED ACTION

An RFI is currently being performed to characterize the nature and extent of contamination at the site associated with former cadmium plating activities. The site investigation consists of the following elements:

- Collection of surface and subsurface soil samples from approximately 40 site-wide locations to characterize the nature and extent of contamination.
- Collection of sludge samples from two sumps associated with the building.
- Collection of six wipe samples from the concrete floor of the building interior to assess metals contamination within the interior of the building.

Investigative results are currently being evaluated and will be included in the next SMP revision.

135

ER, A DSERTS SITES
PHASE STATUS
COST TO COMPLETE

RFAAP-001 SWMU NO. 51
TNT WASTE ACID NEUTRALIZATION PITS

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS						539	
IRA							
RD							41
RA(C)							1148
RA(O)							
LTM							265

PROJECTED TOTAL: $1,992,000

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:
Metals,explosives, VOCs, and SVOC

MEDIA OF CONCERN:
Sediments, Surface water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS,RD,RA(C), RA(O), LTM

RFAAP-002 SWMU NO. 71
FLASH BURN PARTS AREA

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							314
IRA							
RD							20
RA(C)							285
RA(O)							
LTM							267

PROJECTED TOTAL: $886,000

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:
metals,explosives, and total petroleum hydro-carbons

MEDIA OF CONCERN:
Groundwater, Soil

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), LTM

RFAAP-003 SWMU NO. 69
FINISHING FACILITY POND

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:
Metals, VOC's

MEDIA OF CONCERN:
Groundwater, Soil, and Sediment

COMPLETED IRP PHASE:
PA/SI, RI

CURRENT IRP PHASE:
RC

FUTURE IRP PHASE:
RC

RFAAP-004 SWMU NO. 74
INERT LANDFILL NO 3

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							567
IRA							
RD							104
RA(C)							2287
RA(O)							1076
LTM							351

PROJECTED TOTAL: $4,385,000

IRP STATUS

RRSE RATING: Low Risk (3A)

CONTAMINANTS OF CONCERN:
Metals, VOC's, SVOC's

MEDIA OF CONCERN:
Groundwater, Soil

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), RA(O), LTM

RFAAP-005 SWMU NO. 13
BURNING GROUND

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							676
IRA							
RD							373
RA(C)							14939
RA(O)							
LTM							816

PROJECTED TOTAL: $16,805,000

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:
Metals, VOC's, SVOV's

MEDIA OF CONCERN:
Groundwater, Soil

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), LTM

RFAAP-006 SWMU F
DRUM STORAGE 9387-2

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							8
RA(O)							
LTM							34

PROJECTED TOTAL: $42,000

IRP STATUS

RRSE RATING: Medium Risk (2A)

CONTAMINANTS OF CONCERN:
POL

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI, RA(C)

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RA(C), LTM

RFAAP-007 SWMU NO.28
SANITARY LANDFILL IN H AREA

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							223
IRA							
RD							
RA(C)							
RA(O)							830
LTM							396

PROJECTED TOTAL: $1,449,000

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:

Explosives,Lead, Dioxins

MEDIA OF CONCERN:

Soil, Groundwater

COMPLETED IRP PHASE:

PA/SI, RI

CURRENT IRP PHASE:

none

FUTURE IRP PHASE:

RI/FS, RA(O), LTM

RFAAP-008 SWMU 27
BURIAL SITES OF $CaSO_4$

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							695
IRA							
RD							167
RA(C)							2212
RA(O)							989
LTM							327

PROJECTED TOTAL: $4,390,000

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:

Metals, VOC's SVOC's

MEDIA OF CONCERN:

Soil, Groundwater

COMPLETED IRP PHASE:

PA/SI

CURRENT IRP PHASE:

none

FUTURE IRP PHASE:

RI/FS, RD, RA(C), RA(O), LTM

RFAAP-009 SWMU NO. 40 LANDFILL IN NITRO AREA

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS					573		
IRA							
RD						37	
RA(C)						674	
RA(O)							66
LTM							367

PROJECTED TOTAL: $1,717,000

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:
Explosives

MEDIA OF CONCERN:
Soil, Groundwater, Surface Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI, RD, RA(C), RA(O), LTM

RFAAP-010 SWMU NO.'S 8,9,35,37,38, A DRYING BEDS

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							892
IRA							
RD							136
RA(C)							5242
RA(O)							
LTM							1812

PROJECTED TOTAL: $8,082,000

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:
Metals, VOC's SVOC's

MEDIA OF CONCERN:
Soil, Groundwater, Surface Water

COMPLETED IRP PHASE:
PA/SI, RI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), LTM

RFAAP-011 SWMU NO. 41
RED WATER ASH BURIAL GROUND

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							505
IRA							
RD							91
RA(C)							715
RA(O)							316
LTM							256

PROJECTED TOTAL: $1,883,000

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:
Metals, Explosives, VOC's, SVOC's

MEDIA OF CONCERN:
Soil, Groundwater, Surface Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), RA(O), LTM

RFAAP-012 SWMU NO. 6
ACID WASTEWATER LAGOON

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							204
IRA							
RD							
RA(C)							
RA(O)							
LTM							39

PROJECTED TOTAL: $243,000

IRP STATUS

RRSE RATING: Medium Risk (2A)

CONTAMINANTS OF CONCERN:
Explosives, SVOC's, metals

MEDIA OF CONCERN:
Groundwater, Soil, Surface Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, LTM

RFAAP-013 SWMU NO. 48, 49
BURIAL AREA RED WATER ASH 2

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM							79

PROJECTED TOTAL: $79,000

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:
Explosives, Metals, VOC's, SVOC's

MEDIA OF CONCERN:
Groundwater, Surface Water, Soil

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
LTM

RFAAP-014 SWMU NO. 54
BURIAL AREA PROPELLENT ASH

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS	150			608			
IRA	1338						
RD					13		
RA(C)						254	
RA(O)							
LTM					19	46	205

PROJECTED TOTAL: $2,633,000

IRP STATUS

RRSE RATING: High Risk (1A)

CONTAMINANTS OF CONCERN:
Explosives, Metals, VOC's

MEDIA OF CONCERN:
Groundwater, Soil, Surface Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
RI/FS, IRA

FUTURE IRP PHASE:
RD, RA(C), LTM

RFAAP-015 SWMU NO. 26
BURIAL AREA FLY ASH NO. 1

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM							375

PROJECTED TOTAL: $375,000

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:
Explosives, Metals, VOC's

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
LTM

RFAAP-016 SWMU NO. 39
WASTEWATER PONDS FROM EXP PROP.

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS	318						
IRA							
RD				46			
RA(C)							1855
RA(O)							
LTM							330

PROJECTED TOTAL: $2,549,000

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Explosives, metals, SVOC's, VOC's

MEDIA OF CONCERN:
Soil, Groundwater, Surface Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), LTM

RFAAP-017 SWMU NO. 53, 29
BURIAL ACTIVATED CARBON DISPOSAL

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:
Explosives, Metals

MEDIA OF CONCERN:
Groundwater, Soil, Surface Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
none

RFAAP-018 SWMU NO. 48
BURIAL OILY WASTE WATER

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS	318						
IRA							
RD					209		
RA(C)							5243
RA(O)							
LTM							369

PROJECTED TOTAL: $6,139,000

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Explosives, Metals

MEDIA OF CONCERN:
Soil, Groundwater, Surface Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), LTM

RFAAP-019 SWMU 32
INERT LANDFILL NO. 1

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM							39

PROJECTED TOTAL: $39,000

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:

Explosives, Chemicals

MEDIA OF CONCERN:

Soil, Groundwater, Surface Water

COMPLETED IRP PHASE:

PA/SI

CURRENT IRP PHASE:

none

FUTURE IRP PHASE:

LTM

RFAAP-020 SWMU NO. 29
BURIAL FLY ASH NO. 2

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM							68

PROJECTED TOTAL: $68,000

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:

VOC's SVOC's, metals

MEDIA OF CONCERN:

Groundwater

COMPLETED IRP PHASE:

PA/SI

CURRENT IRP PHASE:

none

FUTURE IRP PHASE:

LTM

RFAAP-021 SWMU NO. 46
BURIAL PROPELLANTS

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM			39				

PROJECTED TOTAL: $39,000

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:
Metals,Organics, SVOC's, VOC's

MEDIA OF CONCERN:
Groundwater, Soil

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
LTM

RFAAP-022 SWMU NO. 57
200 AREA WASHRACK DISCHARGE POINT

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM							39

PROJECTED TOTAL: $39,000

IRP STATUS

RRSE RATING: Low Risk (3A)

CONTAMINANTS OF CONCERN:
Metals, Organics, VOC's, SVOC's

MEDIA OF CONCERN:
Groundwater, Surface Water, Soil

COMPLETED IRP PHASE:
PA/SI, RI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
LTM

RFAAP-023 SWMU NO. 43
SANITARY LANDFILL NO. 2

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							312
IRA							
RD							
RA(C)							
RA(O)							
LTM							766

PROJECTED TOTAL: $1,079,000

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:
VOC's SVOC's

MEDIA OF CONCERN:
Groundwater, Soil, Surface Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI, LTM

RFAAP-024 SWMU NO. 45
LANDFILL NO. 3

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS					611		
IRA							
RD						107	
RA(C)							2206
RA(O)							653
LTM							273

PROJECTED TOTAL: $3,850,000

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Metals, SVOC's

MEDIA OF CONCERN:
Groundwater, Surface Water, Soil

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI, RD, RA(C), RA(O),LTM

RFAAP-025 SWMU NO. 50
BURIAL SITE $CaSO_4$ NEAR S48, 49

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM							79

PROJECTED TOTAL: $79,000

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:
Flyash, Sulfur by-products

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
LTM

RFAAP-026 SWMU NO. 31
COAL ASH SETTLING LAGOON

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS	207		572				
IRA							
RD							
RA(C)							
RA(O)							
LTM							38

PROJECTED TOTAL: $1,023,000

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Explosives, Metals, Organics

MEDIA OF CONCERN:
Groundwater, Surface Water, Soil

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI, LTM

RFAAP-027 SWMU NO. 31
COAL ASH SETTLING LAGOON

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS						565	
IRA							
RD							
RA(C)							
RA(O)							
LTM							39

PROJECTED TOTAL: $604,000

IRP STATUS

RRSE RATING: Medium Risk 2A

CONTAMINANTS OF CONCERN:
Paint Waste, Solvents

MEDIA OF CONCERN:
Soil, Air, Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI, LTM

RFAAP-028 SWMU NO. 59
BOTTOM ASH PILE

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS				571			
IRA							
RD					86		
RA(C)							3453
RA(O)							
LTM							266

PROJECTED TOTAL: $4,376,000

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:
Explosives, Metals, VOC's, SVOC's

MEDIA OF CONCERN:
Groundwater, Soil, Surface Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), LTM

RFAAP-029 SWMU NO. 52
OLD SANITARY LANDFILL AREA H

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS			508				
IRA							
RD				37			
RA(C)					679		
RA(O)						5	159
LTM						19	244

PROJECTED TOTAL: $1,651,000

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Explosives, VOC's, SVOC's

MEDIA OF CONCERN:
Soil, Groundwater, Surface Water, Soil

COMPLETED IRP PHASE:
PA/SI, RI

CURRENT IRP PHASE:
RC with LTM

FUTURE IRP PHASE:
RC with LTM

RFAAP-030 SWMU NO. 30
AIR CURTAIN DESTRUCTION

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							460
IRA							
RD							144
RA(C)							5796
RA(O)							
LTM							270

PROJECTED TOTAL: $6,671,000

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Metals, VOC's, SVOC's

MEDIA OF CONCERN:
Groundwater, Soil, Surface Water

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI, RD, RA(C), LTM

RFAAP-031 SWMU Q
ABANDONED LAGOON

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							513
IRA							
RD							16
RA(C)							543
RA(O)							
LTM							267

PROJECTED TOTAL: $1,339,000

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), LTM

RFAAP-032 SWMU NO. 61, 75,76
OIL TANKS

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:
POL

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA

CURRENT IRP PHASE:
RC

FUTURE IRP PHASE:
RC

RFAAP-033 SWMU 68
CHROMIC ACID TANKS

IRP STATUS

RRSE RATING: High Risk 1A
CONTAMINANTS OF CONCERN:
Metals, SVOC's
MEDIA OF CONCERN:
Soil, Groundwater
COMPLETED IRP PHASE:
PA/SI, RI, IRA
CURRENT IRP PHASE:
RC
FUTURE IRP PHASE:
RC

RFAAP-035
SEWAGE LINES

IRP STATUS

RRSE RATING: High Risk 1A
CONTAMINANTS OF CONCERN:
Heavy Metals
MEDIA OF CONCERN:
Soil, Groundwater
COMPLETED IRP PHASE:
PA/SI
CURRENT IRP PHASE:
none
FUTURE IRP PHASE:
none

RFAAP-036 SWMU NO. 10
BIOPLANT BASINS

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI, RI

CURRENT IRP PHASE:
RC

FUTURE IRP PHASE:
RC

RFAAP-037 SWMU P
BATTERY STORAGE AREA

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS						531	
IRA							
RD							30
RA(C)							744
RA(O)							
LTM							267

PROJECTED TOTAL: $1,572,000

IRP STATUS

RRSE RATING: Low Risk 3A

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), LTM

RFAAP-038 SWMU O
FUEL OIL SPILL

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS					208		
IRA							
RD						68	
RA(C)							1034
RA(O)							
LTM							237

PROJECTED TOTAL: $1,546,000

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
RI/FS, RD, RA(C), LTM

RFAAP-039 HWMU NO. 16
HAZARDOUS WASTE LANDFILL

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM	68	122	122	122	122	122	2673

PROJECTED TOTAL: $3,351,000

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
RC with LTM

FUTURE IRP PHASE:
RC with LTM

RFAAP-040
FORMER LEAD FURNACE

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM						79	

PROJECTED TOTAL: $79,000

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
LTM

RFAAP-041 HWMU NO. 4
SURFACE IMPOUNDMENT #4

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM	68	122	122	122	122	122	2673

PROJECTED TOTAL: $3,351,000

IRP STATUS

RRSE RATING: High Risk 1B

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
RC with LTM

FUTURE IRP PHASE:
RC with LTM

RFAAP-042 HWMU NO. 5
SURFACE IMPOUNDMENT #5

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM	68	122	122	122	122	122	2673

PROJECTED TOTAL: $3,351,000

IRP STATUS

RRSE RATING: High Risk 1B

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI, IRA

CURRENT IRP PHASE:
RC with LTM

FUTURE IRP PHASE:
RC with LTM

RFAAP-043 HWMU #7
SURFACE IMPOUNDMENT #7

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS							
IRA							
RD							
RA(C)							
RA(O)							
LTM	68	122	122	122	122	122	2673

PROJECTED TOTAL: $3,351,000

IRP STATUS

RRSE RATING: High Risk 1B

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI, IRA (capping)

CURRENT IRP PHASE:
RC with LTM

FUTURE IRP PHASE:
RC withLTM

RFAAP-044
NEW RIVER PLANT

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS	923						
IRA							
RD							110
RA(C)							2895
RA(O)							
LTM							811

PROJECTED TOTAL: $4,739,000

IRP STATUS

RRSE RATING: High Risk 1B

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA/SI

CURRENT IRP PHASE:
RI

FUTURE IRP PHASE:
RD, RA, LTM

RFAAP-045
BLDG 4343

CONSTRAINED COST TO COMPLETE

PHASE	2000	2001	2002	2003	2004	2005	2006+
RI/FS				385			
IRA							
RD					33		
RA(C)						546	
RA(O)							
LTM							265

PROJECTED TOTAL: $1,228,000

IRP STATUS

RRSE RATING: High Risk 1A

CONTAMINANTS OF CONCERN:
Heavy Metals

MEDIA OF CONCERN:
Soil, Groundwater

COMPLETED IRP PHASE:
PA

CURRENT IRP PHASE:
none

FUTURE IRP PHASE:
IRA, RD, RA(C), LTM

SCHEDULE

SCHEDULE

PAST MILESTONES

1990
Verification Investigation Initiation

1992
Verification Investigation Completion

1994
Interim Remedial Action RFAAP-003(SWMU 69)
RCRA Facility Investigation Initiation, MAY

1995
Initiated Interim Remedial Design, FEB

RFAAP-007(SWMU 28)
RFAAP-23(SWMU43)
RFAAP-029(SWMU52)

1997
Completed RCRA Facility Investigation, MAR
Completed IRA at SWMU 43, JUL
Completed IRA at SWMU 68, AUG
Completed New River and Tributaries Study, DEC

1998
Completed Master Work Plan, APR
Completed Site Management Plan, MAY
Initiated Corrective Measures Studies for remaining SWMUs requiring Corrective Action, JUN

1999
Corrective Measures Study for RFAAP-014 (SWMU 54), JUN

PROJECTED MILESTONES

2000
Initiate Background Survey Investigation
Initiate Baseline Risk Assessments @ SWMUs 39, 48, 49, & 54.
Execute groundwater study IAW Work Plan Addendum #009.

2001
Initiate follow-up Investigations
Initiate monitoring of required SWMUs

2002
Complete follow-up Investigations

2003-2008
Complete RCRA Facility Investigations & Corrective Measures Studies for remaining SWMUs as required.

2013
Complete Corrective Measures Implementations for remaining SWMUs requiring Corrective Action

2025
PROJECTED COMPLETION DATE OF IRP

SCHEDULE

NO FURTHER ACTION SITES

The following sites currently require no further action (excluding LTM) under the ER,A program:

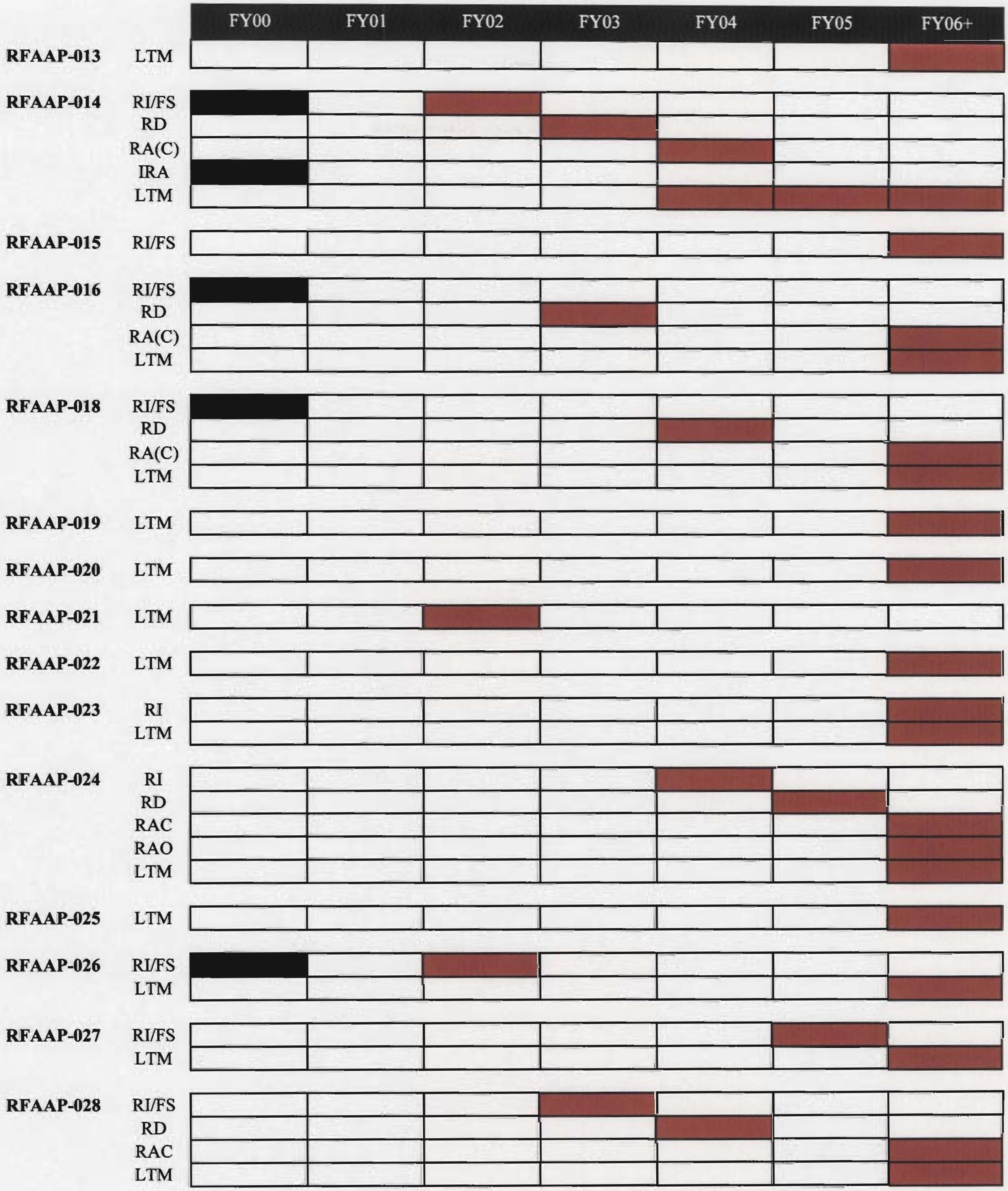
RFAAP-003
RFAAP-006
RFAAP-012
RFAAP-019
RFAAP-022
RFAAP-032
RFAAP-033
RFAAP-036
RFAAP-039 with LTM
RFAAP-041 with LTM
RFAAP-042 with LTM
RFAAP-043 with LTM

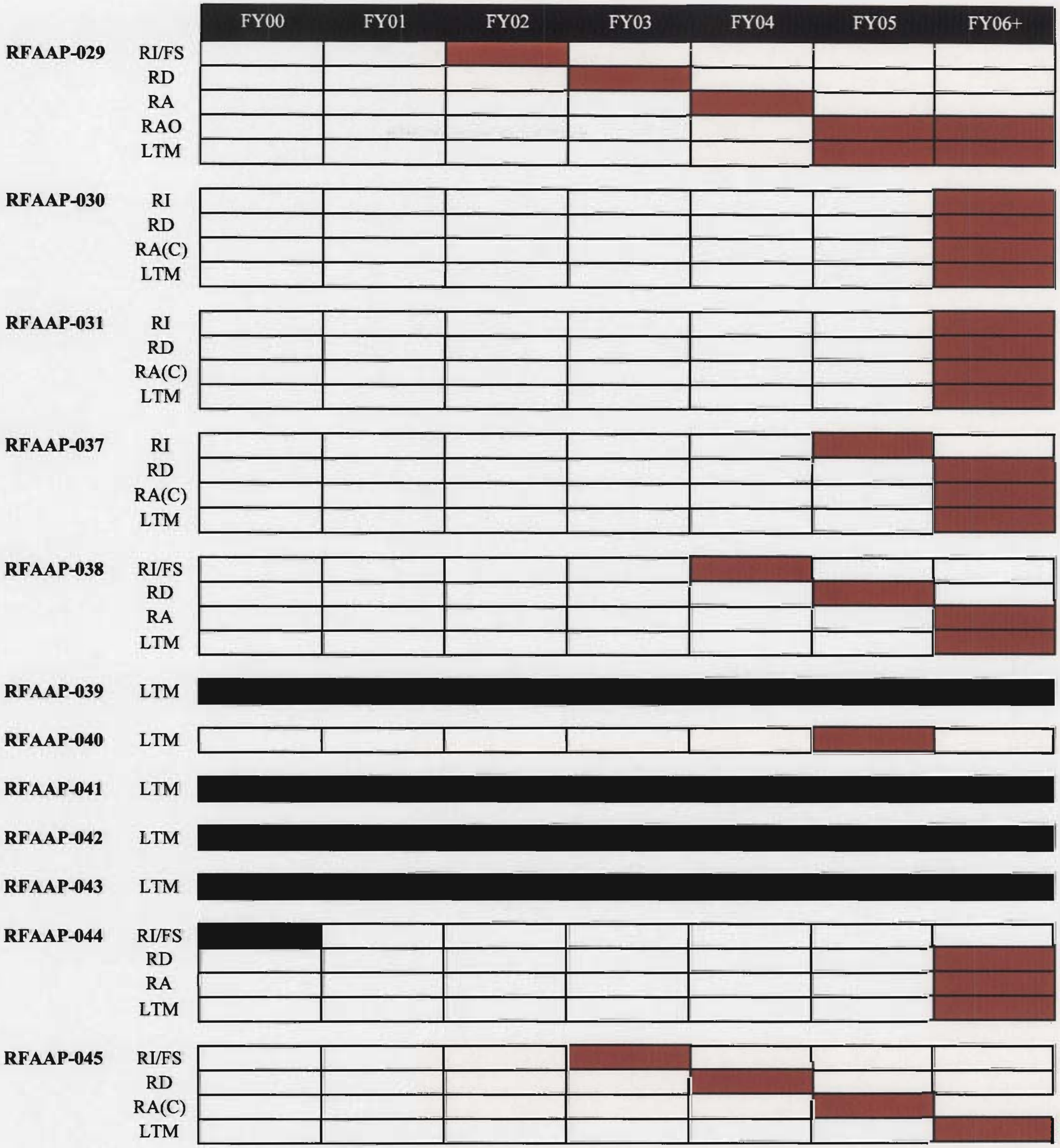
Radford Army Annunition Plant IRP Schedule

(Based on current funding constraints)

Completed Phase | Underway Phase | Future Phase

Site	Phase	FY00	FY01	FY02	FY03	FY04	FY05	FY06+
RFAAP-001	RI/FS						■	
	RD							■
	RA							■
	LTM							■
RFAAP-002	RI/FS							■
	RD							■
	RA(C)							■
	LTM							■
RFAAP-004	RI/FS							■
	RD							■
	RA(C)							■
	RA(O)							■
	LTM							■
RFAAP-005	RI/FS							■
	RD							■
	RA(C)							■
	LTM							■
RFAAP-007	RI/FS							■
	RA(O)							■
	LTM							■
RFAAP-008	RI/FS							■
	RD							■
	RA(C)							■
	RA(O)							■
	LTM							■
RFAAP-009	RI/FS					■		
	RD						■	
	RA(C)						■	
	RA(O)							■
	LTM							■
RFAAP-010	RI/FS							■
	RD							■
	RA(C)							■
	LTM							■
RFAAP-011	RI/FS							■
	RD							■
	RA(C)							■
	RA(O)							■
	LTM							■
RFAAP-012	RI/FS							■
	LTM							■


FY00
FY01
FY02
FY03
FY04
FY05
FY06+
RFAAP-013
LTM
RFAAP-014
RI/FS
RD
RA(C)
IRA
LTM
RFAAP-015
RI/FS
RFAAP-016
RI/FS
RD
RA(C)
LTM
RFAAP-018
RI/FS
RD
RA(C)
LTM
RFAAP-019
LTM
RFAAP-020
LTM
RFAAP-021
LTM
RFAAP-022
LTM
RFAAP-023
RI
LTM
RFAAP-024
RI
RD
RAC
RAO
LTM
RFAAP-025
LTM
RFAAP-026
RI/FS
LTM
RFAAP-027
RI/FS
LTM
RFAAP-028
RI/FS
RD
RAC
LTM


FY00
FY01
FY02
FY03
FY04
FY05
FY06+
RFAAP-029
RI/FS
RD
RA
RAO
LTM
RFAAP-030
RI
RD
RA(C)
LTM
RFAAP-031
RI
RD
RA(C)
LTM
RFAAP-037
RI
RD
RA(C)
LTM
RFAAP-038
RI/FS
RD
RA
LTM
RFAAP-039
LTM
RFAAP-040
LTM
RFAAP-041
LTM
RFAAP-042
LTM
RFAAP-043
LTM
RFAAP-044
RI/FS
RD
RA
LTM
RFAAP-045
RI/FS
RD
RA(C)
LTM

DEFENSE SITE ENVIRONMENTAL RESTORATION TRACKING SYSTEM

Site, 3. State Phase Summary Report 2/21/00

State: VA

Programs: BRAC I, BRAC II, BRAC III, BRAC IV, IRP

Subprograms: Compliance, Restoration, UXO

Installation count for Programs: 1

NPL Options: Delisted, No, Proposed, Yes

Installations count for Programs and NPL: 1

Site count for Programs and NPL: 44

					Phase / Status / Sites					
		PA						**SI**		
	C	**U**	**F**	**RC**		**C**	**U**	**F**	**RC**	
	44	0	0	1		42	0	0		
		RI / FS						**RD**		
	C	**U**	**F**	**RC**		**C**	**U**	**F**		
	10	18	14	10		0	0	26		
		RA(C)						**RA(O)**		
	C	**U**	**F**	**RC**		**C**	**U**	**F**	**RC**	
	1	0	27	1		0	0	10		
					LTM					
				C	**U**	**F**	**N**			
				0	4	28	12			
					Remedy / Status / Sites (Actions)					
					IRA					
		C			**U**			**F**		
	1	(1)			( )				( )	
					FRA					
	C				**U**			**F**		
	1	(1)			( )			27	(27)	
RIP Total:		0								
RC Total:		12								

Reporting Period End Date: 03/31/2000

DEFENSE SITE ENVIRONMENTAL RESTORATION TRACKING SYSTEM

Site, 9. RISK INSTALLATION ACTION PLAN REPORT 02/21/2000

Installation: RADFORD AAP
Major Command: AMC

SubCommand: IOC
Program Options: IRP, BRAC I, BRAC II, BRAC III, BRAC IV

Subprogram Options: Compliance, Restoration, UXO

Site		RRSE	Media Evaluated	Phase (s) Completed		Phase (s) Underway	Phase (s) Future	#IRA Completed		#IRA Underway	#IRA Future	LTM Status	RIP Date	RC Date
RAAP-001		1A	GW	PA			RAC					F		200809
				SI			RD							
							RI							
RAAP-002		1A	SL	PA			RAC					F		200909
				SI			RD							
							RI							
RAAP-003		1A	SH	PA								N		199408
			SL	RI										
			WH	SI										
RAAP-004		3A	GW	PA			RAC					F	201210	202710
				SI			RAO							
							RD							
							RI							
RAAP-005		1A	GW	PA		RI	RAC					F		200809
			SH	SI			RD							
			SL											
RAAP-006		2A	SL	PA								N		199210
				RI										
				SI										
RAAP-007		1A	GW	PA		RI	RAC					F	200610	202110
				SI			RAO							
RAAP-008		1A	GW	PA			RAC					F	200910	202410
			SH	SI			RAO							
			WH				RD							
							RI							
RAAP-009		1A	GW	PA			RAC					F	200610	202110
			SL	SI			RAO							
							RD							
							RI							

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Site		RRSE	Media Evaluated	Phase (s) Completed		Phase (s) Underway	Phase (s) Future	#IRA Completed		#IRA Underway	#IRA Future	LTM Status	RIP Date	RC Date
RAAP-010		1A	SH	PA		RI	RAC					F		200909
				SI			RD							
RAAP-011		1A	GW	PA			RAC					F	201010	202510
			SL	SI			RAO							
			WH				RD							
							RI							
RAAP-012		2A	GW	PA								N		199210
			SL	RI										
				SI										
RAAP-013		1A	GW	PA		RI	RAC					F		200709
			SL	SI			RD							
RAAP-014		1A	GW	PA		RI	RAC	1				F		200409
			SH	SI			RD							
			SL											
RAAP-015		3A	GW	PA			RAC					F		201409
				SI			RD							
							RI							
RAAP-016		1A	GW	PA		RI	RAC					F		200909
			SH	SI			RD							
			SL											
RAAP-017		3A	SH	PA			RAC					F	200910	202410
				SI			RAO							
							RD							
							RI							
RAAP-018		1A	GW	PA		RI	RAC					F		200709
			SL	SI			RD							
RAAP-019		3A	GW	PA								N		199210
				RI										
				SI										
RAAP-020		3A	SH	PA			RAC					F	200910	202410
				SI			RAO							
							RD							
							RI							
RAAP-021		3A	SL	PA			RI					N		200209
				SI										
RAAP-022		3A	SH	PA								F		199210
			WH	RI										
				SI										
RAAP-023		3A	SL	PA			RAC					F	201510	203010
				SI			RAO							
							RD							
							RI							

Site		RRSE	Media Evaluated	Phase (s) Completed		Phase (s) Underway	Phase (s) Future	#IRA Completed		#IRA Underway	#IRA Future	LTM Status	RIP Date	RC Date
RAAP-024		1A	GW	PA			RAC					F	200610	202110
				SI			RAO							
							RD							
							RI							
RAAP-025		3A	SL	PA		RI	RAC					F		200709
				SI			RD							
RAAP-026		1A	GW	PA		RI						N		200210
			SL	SI										
RAAP-027		2A	SL	PA		RI						N		200509
				SI										
RAAP-028		3A	SL	PA		RI	RAC					F		200709
				SI			RD							
RAAP-029		1A	GW	PA		RI	RAC					F	200410	201910
				SI			RAO							
							RD							
RAAP-030		1A	GW	PA		RI	RAC					F		200809
			SH	SI			RD							
			SL											
			WH											
RAAP-031		3A	SL	PA		RI	RAC					F		200909
				SI			RD							
RAAP-032		3A	SL	PA								N		198706
RAAP-033		1A	SL	PA								N		199804
				RI										
				SI										
RAAP-035		1A	SL	PA		RI						N		200212
				SI										
RAAP-036		1A	GW	PA								N		199812
			SH	RI										
			SL	SI										
			WH											
RAAP-037		3A	SL	PA			RAC					F		200709
				SI			RD							
							RI							
RAAP-038		1A	GW	PA			RAC					F		200609
				SI			RD							
							RI							
RAAP-039		1A	GW	PA								U		198812
			SL	RI										
				SI										
RAAP-040		1A	SL	PA		RI						N		200509
				SI										

			Media	Phase (s)		Phase (s)	Phase (s)	#IRA		#IRA	#IRA	LTM	RIP	RC
Site		RRSE	Evaluated	Completed		Underway	Future	Completed		Underway	Future	Status	Date	Date
RAAP-041		1B	GW	PA								U		198801
				RI										
				SI										
RAAP-042		1B	GW	PA								U		198810
				RI										
				SI										
RAAP-043		1B	GW	PA								U		198810
				RAC										
				SI										
RAAP-044		1B	SEF	PA		RI	RAC					F		200809
			SH	SI			RD							
			SL											
RAAP-045		1A	GW	PA		RI	RAC					F		200606
			SL				RD							
RRSE - Relative Risk Site Evaluation; Risk Category - 1=High, 2=Medium, 3=Low;														
Legal Agreement - A = with agreement, B = without agreement; C = Complete, U = Underway, F = Future, N = Not Applicable														
												Reporting Period End Date:	03/31/2000	

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REMEDIATION
ACTIVITIES

REM/IRA/RA ASSESSMENT

PAST REM/IRA/RA

- SWMU 69, Fininshing Pond Facility, interim removal action for removal of soils in pond highly contaminated with heavy metals form plating operation.
- SWMU 43, Old Sanitary Landfill, interim action to regrade the site to prevent ponding of storm water and improve site drainage.
- SWMU 68, Chromic Acid Tanks, interim removal action of soils thought to be similar to those at SWMU 69.
- Former Lead Furnace Area & NRU, Remove Contamination/Confirmatory Sampling

CURRENT REM/IRA/RA

- SWMUs 31,39,48,49,50,54,58,59,& NRU undergoing RFI/CMS.
- Monitoring of HWMUs 4,5,7,&16; SWMUs 28 & 52

FUTURE REM/IRA/RA

Potential Accelerated Actions:

- SWMU 48, Removal
- SWMU 39, Removal
- New River Unit, selected removal actions

Future REM/IRA/LTM Possible Opportunites:

- SWMU 13, New SOPs, Improve drainage, LTM
- SWMU 54, Removal & LTM
- SWMU 28, Capping
- Area O, Innovative mass removal in groundwater, LTM
- SWMU 51, Removal
- SWMU 26 - Monitoring
- New River Unit, Removal and LTM
- SWMU 39, Removal

COST ESTIMATES

PRIOR YEAR FUNDING

FY76	
INSTALLATION ASSESSMENT	$50.0 K
FY84	
INSTALLATION REASSESSMENT	$50.0 K
FY90	
VI/FI WORK PLANS	$270.7K
INSTALLATION SUPPORT	$29.2K
UNDERGROUND STORAGE TANKS (RFAAP)	$17.4K
	$317.3K
FY91	
VI/FI FIELDWORK AND REPORT, PHASE I	$1,570.9K
INSTALLATION SUPPORT	$36.3K
	$1,607.2K
FY92	
VI/FI PLANS, FIELDWORK, REPORT, PHASE II	$1,355.0K
SPLIT SAMPLES	$17.3K
	$1,372.3K
FY93	
INSTALLATION SUPPORT (UNIT 69 RA)	$184.0K
FY95	
CONDUCT RFIS AT SWMUS	$1,550.0K
CONDUCT VIS AT SWMU'S	$1,300.0K
	$2,850.0K
FY96	
ACID SEWER INVESTIGATION	$752.0K
CMS AT SWMU 54	$263.0K
PHASE II VI/RFI (INCLUDED S68 IRA)	$330.0K
IRA AT SWMU 43	$100.0K
	$1,445.0K
FY97	
MONITORING	$558.0K
RD ON SWMUS 28/52	$15.0K
	$573.0K

PRIOR YEAR FUNDING

FY98

RI/FS (SWMUs17,31,39,48,49,58 & NRU)	$1,804.2K
LTM	$160.0K
IRA (SWMU 54)	$1,804.5K
RD	$ 25.0K
	$3,793.7K

FY99

RFI/CMS (NRU& Bldg 4343)	$792.0K
RI/FS (Sewer Lines)	$360.7.0K
RFI/CMS (SWMU 48)	$915.3K
LTM (HWMUs 4,5,7,8,16)	$429.5
	$ 2,497.5K

TOTAL PRIOR YEAR FUNDS: $14,740.0K

RADFORD ARMY AMMUNITION PLANT - CONSTRAINED COST TO COMPLETE

DSERTS #	SITE TITLE	RRSE	PHASE	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15+	SITE TOTAL
RAAP-001	TNT WASTE ACID NEUTRALIZATION PITS	HIGH	RI						539										0	
			RD							41									0	
			RAC								1,148								0	
			LTM									42	57	19	9	9	9	9	112	1,992
RAAP-002	FLASH BURN PARTS AREA	HIGH	RI								314								0	
			RD									20							0	
			RAC										285						0	
			LTM											66	49	9	9	9	126	886
RAAP-004	FINISHING POND FACILITY, CHROMIC	LOW	RI											567					0	
			RD												104				0	
			RAC													2,287			0	
			RAO														19	37	1,020	
			LTM														40	22	288	4,385
RAAP-005	WASTE PROPELLANT BURNING GROUND	HIGH	RI							676									0	
			RD								373								0	
			RAC									14,939							0	
			LTM									21	44	53	53	53	53	53	489	16,805
RAAP-006	FORMER DRUM STORAGE AREA	HIGH	RAC							8									0	
			LTM								34								0	42
RAAP-007	CLOSED SANITARY LANDFILL	HIGH	RI							223									0	
			RAO								6	20	39	50	39	61	50	59	509	
			LTM								43	70	18	18	18	18	18	18	177	1,449
RAAP-008	CaSO4 TREATMENT DISPOSAL AREA	HIGH	RI								695								0	
			RD									167							0	
			RAC										2,212						0	
			RAO											5	25	49	72	49	790	
			LTM											53	83	10	10	10	160	4,390
RAAP-009	LANDFILL IN NITRO AREA	HIGH	RI					573											0	
			RD						37										0	
			RAC						674										0	
			RAO							4	4	4	4	4	4	4	4	4	26	
			LTM							41	65	16	16	16	16	16	16	16	147	1,717
RAAP-010	CaSO4 TREATMENT DISPOSAL AREA	HIGH	RI								892								0	
			RD									136							0	
			RAC										5,242						0	
			LTM											120	120	120	120	120	1,212	8,082
RAAP-011	RED WATER ASH BURIAL GROUND	HIGH	RI								505								0	
			RD									91							0	
			RAC										715						0	
			RAO											9	13	26	13	26	229	
			LTM											30	43	17	10	10	147	1,883
RAAP-012	ACID WASTEWATER LAGOON	HIGH	RI										204						0	
			LTM														39		0	243

RADFORD ARMY AMMUNITION PLANT - CONSTRAINED COST TO COMPLETE

DSERTS #	SITE TITLE	RRSE	PHASE	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15+	SITE TOTAL
RAAP-013	RED WATER ASH BURIAL	HIGH	LTM								79								0	79
RAAP-014	PROPELLANT BURNING ASH DISPOSAL AREA	HIGH	RI	150		608													0	
			RD				13												0	
			RAC					254											0	
			LTM					19	46	12	12	12	12	12	12	12	12	12	101	
			IRA	1,338															0	2,633
RAAP-015	FLY ASH LANDFILL #1	LOW	LTM								61	17	17	17	17	17	17	17	193	375
RAAP-016	WASTEWATER PONDS FROM PROPELLANT INCINERATOR	HIGH	RI	318															0	
			RD				46												0	
			RAC										1,855						0	
			LTM											54	85	11	11	11	159	2,549
RAAP-018	OILY WATER BURIAL AREA	HIGH	RI	318															0	
			RD					209											0	
			RAC								5,243								0	
			LTM									55	84	14	14	14	14	14	162	6,139
RAAP-019	INERT LANDFILL #1	LOW	LTM							39									0	39
RAAP-020	FLY ASH LANDFILL #2	LOW	LTM													68			0	68
RAAP-021	PROPELLANT BURIAL	LOW	LTM			39													0	39
RAAP-022	POND BY BUILDING 4931/4932	LOW	LTM												39				0	39
RAAP-023	SANITARY LANDFILL #2	LOW	RI													312			0	
			LTM															37	729	1,079
RAAP-024	LANDFILL #3	HIGH	RI					611											0	
			RD						107										0	
			RAC							2,206									0	
			RAO								13	23	50	30	50	55	30	50	353	
			LTM								48	65	9	9	9	9	9	9	107	3,850
RAAP-025	CaSO4 TREATMENT DISPOSAL AREA	LOW	LTM								79								0	79
RAAP-026	COAL ASH SETTLING POND	HIGH	RI	207		572													207	
			LTM							38									0	1,023
RAAP-027	RUBBLE PILE	MEDIUM	RI						565										0	
			LTM							39									0	604
RAAP-028	BOTTOM ASH PILE	LOW	RI				571												0	
			RD					86											0	
			RAC								3,453								0	
			LTM									43	70	9	9	9	9	9	109	4,376

RADFORD ARMY AMMUNITION PLANT - CONSTRAINED COST TO COMPLETE

DSERTS #	SITE TITLE	RRSE	PHASE	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15+	SITE TOTAL
RAAP-029	CLOSED SANITARY LANDFILL	HIGH	RI			508													0	
			RD				37												0	
			RAC					679											0	
			RAO						5	5	5	5	5	5	5	5	5	5	110	
			LTM						19	38	17	11	11	11	11	11	11	11	109	1,651
RAAP-030	AIRE CURTAIN DESTRUCTOR AND OPEN BURNING GROUND	HIGH	RI							460									0	
			RD								144								0	
			RAC									5,796							0	
			LTM										26	46	12	12	12	12	153	6,671
RAAP-031	CaSO4 TREATMENT DISPOSAL AREA	LOW	RI											513					0	
			RD												16				0	
			RAC												543				0	
			LTM												19	46	12	12	179	1,339
RAAP-037	BATTERY STORAGE AREA	LOW	RI						531										0	
			RD							30									0	
			RAC								744								0	
			LTM									26	45	11	11	11	11	11	140	1,572
RAAP-038	UNDERGROUND FUEL OIL SPILL	HIGH	RI					208											0	
			RD						68										0	
			RAC							1,034									0	
			LTM								21	33	15	10	10	10	10	10	119	1,546
RAAP-039	HAZARDOUS WASTE LANDFILL	HIGH	LTM	68	122	122	122	122	122	122	122	122	122	122	122	122	122	122	1,575	3,351
RAAP-040	FORMER LEAD FURNACE AREA	HIGH	LTM						79										0	79
RAAP-041	SURFACE IMPOUNDMENT #4	HIGH	LTM	68	122	122	122	122	122	122	122	122	122	122	122	122	122	122	1,575	3,351
RAAP-042	SURFACE IMPOUNDMENT #5	HIGH	LTM	68	122	122	122	122	122	122	122	122	122	122	122	122	122	122	1,575	3,351
RAAP-043	SURFACE IMPOUNDMENT #7	HIGH	LTM	68	122	122	122	122	122	122	122	122	122	122	122	122	122	122	1,575	3,351
RAAP-044	NEW RIVER PLANT	HIGH	RI	923															0	
			RD							110									0	
			RAC									2,895							0	
			LTM										41	41	41	41	41	41	566	4,739
RAAP-045	BUILDING 4343	HIGH	RI				385												0	
			RD					33											0	
			RAC						546										0	
			LTM							31	54	10	10	10	10	10	10	10	109	1,228
	FY TOTALS IN THOUSANDS OF DOLLARS			3,526	488	2,214	1,540	3,160	3,703	5,524	14,539	25,007	11,374	2,289	1,976	3,818	1,181	1,199	15,336	97,073

COMMUNITY INVOLVEMENT

A. Status of Community Interest

The surrounding community for Radford AAP included the counties of Montgomery (Pop. 73,913), Pulaski (Pop. 34,496), Floyd (Pop. 12,005), Giles (Pop. 16,366) and the City of Radford (Pop. 15,940).

In February 1995 and January 1998 we conducted surveys to determine if enough community interest existed to sustain a Restoration Advisory Board.

B. Determining Interest In Establishing a RAB

1. Efforts Taken To Determine Interest

(1) February 1995 and January 1998, RFAAP with the assistance of the US Army Environmental Center conducted community interviews with residents of the surrounding counties and city, and placed two newspaper advertisements soliciting community members to volunteer for RAB positions.
(2) June 1998, RFAAP held a public meeting to share information about the RFAAP cleanup program and about forming a RAB.
(3) August 1998, RFAAP held first RAB style meeting in which the Community Co-chair person was selected.
(4) September 1998, RFAAP conducted a plant tour for the RAB members.
(5) November 1998, RFAAP held the second RAB meeting with EPA attending for the first time.

2. Results of Efforts to Determine Interest in a RAB

Initially there was not enough public interest to form and sustain a RAB. During the summer of 1998 the situation changed for unknown reason/s and a RAB was formed in the late summer.

C. Conclusion

Since 1998, RAB meetings are scheduled every two months. Members were provided with copies of the IAP and other documents. Members have a general concern for current and past operations at the plant. Two plant tours have been provided.

D. Follow-up Procedures

RFAAP will continue the RAB meetings and explore other avenues (such as the internet) for community involvement.

DEFENSE SITE ENVIRONMENTAL RESTORATION TRACKING SYSTEM

Installation, 7. RAB REPORT 02/21/2000

Command: AMC **SubCommand:** IOC
Installation: RADFORD AAP

RAB Established Date: 199807 **Reason RAB Not Establish:**
RAB Adjourned Date: **Reason RAB Adjourned:**
TRC Date:

RAB Community Members: **Total RAB Community Members:** 7

Business Community
Local Residents

RAB Government Members: **Total RAB Government Members:** 7

Environmental Protection Agency
Local Government Officials
Other State Representatives

RAB Activities:

Advice On Scope/Sch Studies/Cleanup
Improved Base Credibility
Reviewed Plans And Technical Docs

RAB Advice

Remedy Selection
Site Priorities
Study Of Cleanup Schedule
Work Plan Priorities

TAPP Project Title: **TAPP Application Approval Date:**
TAPP Project Description:

Award Number	Purchase Order Award Date	Completion Date