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Acronyms and Abbreviations

ADT, Inc.	Aquifer Drilling & Testing, Inc.
amsl	above mean sea level
AOC	Area of Concern
ASP	Analytical Services Protocol
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
ATV	all terrain vehicle
bg	below grade
BS/BSD	blank spike/blank spike duplicate
°C	degrees Celsius
CAD	computer-aided design drawing
CH2M HILL	CH2M HILL, Inc.
COC	chain of custody
C.T. Male	C.T. Male Associates, P.C.
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethylene
1,2-DCE	1,2-dichloroethylene
DOE	Department of Energy
DQO	Data Quality Objective
EB	equipment blank
EM	electromagnetics
EPA	U.S. Environmental Protection Agency

EP Tox	Extraction Procedure Toxicity
eV	electron volt
°F	degrees Fahrenheit
FD	field duplicate
GE CR&D	General Electric Corporate Research and Development
gpm	gallons per minute
GPR	ground penetrating radar
HCl	hydrochloric acid
HNO_3	nitric acid
ICPS	Inductively Coupled Plasma Spectrometry
KAPL	Knolls Atomic Power Laboratory
LCS	Laboratory Control Sample
LDA	Land Area
LWA	Lower Level
μ	micron
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
MB	method blank
MDL	method detection limit
mg/L	milligrams per liter
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
NAD	North American Datum, 1927
NFG	National Functional Guidelines (EPA)
NGVD	National Geodetic Vertical Datum, 1929

NTU	nephelometric turbidity unit
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OVA	organic vapor analyzer
PAH	polynuclear aromatic hydrocarbon
PARCCS	precision, accuracy, representativeness, completeness, and comparability
PCE	tetrachloroethylene
pH	acidity
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
PQL	Practical Quantitation Limit
QAPjP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RL	reporting limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SDR	Sample Delivery Group
SNR	Schenectady Naval Reactors
SPDES	State Pollutant Discharge Elimination System

SPRU	Separations Process Research Unit
SU	Standard Units
SV	Sampling Visit
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TAGM	Technical Assistance Guidance Memorandum
TAL	Target Analyte List
TB	trip blank
TCE	trichloroethylene
TCL	target compound list
TOGS	Technical and Operational Guidance Series
USGS	U.S. Geological Survey
UCL95	95th Percentile Upper Confidence Limit
UPA	Upper Level
UTL	Upper Tolerance Limit
UTL95	95th Percentile Upper Tolerance Limit
VOC	volatile organic compound

Executive Summary

The Knolls Atomic Power Laboratory (KAPL) is working closely with the United States Department of Energy (DOE) Oakland Operations Office, Office of Naval Reactors, and the New York State Department of Environmental Conservation (NYSDEC), to evaluate if a hazardous constituent release to the environment has occurred related to operations of the Separations Process Research Unit (SPRU). In accordance with an approved Work Plan, a Resource Conservation and Recovery Act (RCRA) Sampling Visit (SV) was implemented for eight Solid Waste Management Units (SWMUs) and one area of concern (AOC).

The SWMUs and AOC are grouped into three geographic areas:

Upper Level SWMUs	H2 Processing Facility	SWMU-030
	H2 Tank Farm	SWMU-031
	Pipe Tunnels	SWMU-057
Lower Level SWMUs/AOC	K6 Storage Pad	SWMU-036
	Former K7 Storage Pad	SWMU-037
	Railroad Staging Area	SWMU-038
	K5 Retention Basin	SWMU-040
	Lower Level Parking Lot	AOC-003
Land Area SWMU	Former Slurry Drum Storage Area	SWMU-035

The following is a synopsis of the SPRU SV findings and recommended further action by geographic area:

At the Upper Level SWMUs, organic and inorganic releases were discovered. Trace levels of volatile organic compounds (VOCs) (e.g., total 1,2-dichloroethylene and trichloroethylene (TCE)) were detected in soil and groundwater along the southern and western sides of Building H2 and along the western side of the Pipe Tunnel. Metals elevated above background were detected in shallow soil at the southwestern corner of Building H2 and east of the Tank Farm, and were detected in deeper soils south of the Tank Farm. Dissolved antimony was also detected, although suspect, slightly above groundwater standards along the northwest portion of Building H2. These areas will require further investigation to determine the nature and extent of the releases.

At the Lower Level SWMUs/AOC, organic and inorganic releases to soil were discovered. Various metals elevated above background (primarily mercury) were detected along the northern half of the Parking Lot and the Railroad Staging Area. Trace levels of VOCs (tetrachloroethylene (PCE) and TCE) and elevated metals were detected at the southeast portion of the Railroad Staging Area. Both areas will require further investigation to determine the nature and extent of the releases.

Polynuclear aromatic hydrocarbons (PAHs) and various metals were detected along the entire extent of the former railroad bed. These PAHs and metals are attributed to railroad construction materials and operations, and not SPRU or KAPL waste management. Also, traces of gasoline components were evident throughout the Railroad Staging Area and are attributed to motor vehicle use. No further action is recommended for these constituents.

A trace of TCE was detected along the northeast corner of the K5 Retention Basin. Steep slope and shallow bedrock conditions surrounding the basin and its influent drain line inhibited completion of all planned SV work. Based on these factors, and the lack of VOC impacted groundwater in two downgradient monitoring wells, further characterization of the K5 Retention Basin is recommended upon its demolition by DOE – Oakland Operations Office (DOE-OAK).

At the Land Area SWMU, no hazardous constituent releases were discovered that are attributed to SPRU operations. Low levels of VOCs (PCE and TCE) and elevated metals were detected in shallow soils attributed to releases from SWMUs that are separate from SPRU, and will be subject to a future RCRA Facility Investigation of other SWMUs by KAPL.

Based on this SV, there is no imminent threat to human health or the environment associated with releases from the former SPRU operations.

1.0 Introduction

In accordance with Module III, Condition E.2 of the New York Code of Rules and Regulations (6 NYCRR) Part 373 Hazardous Waste Management Permit (Part 373 Permit) for the Knolls Atomic Power Laboratory (KAPL) - Knolls, Niskayuna, New York (New York State Department of Environmental Conservation [NYSDEC] Permit Number 4-4224-00024/00001), effective July 20, 1998, (Reference(1)), a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) Sampling Visit (SV) was implemented for eight Solid Waste Management Units (SWMUs) and one area of concern (AOC) that are associated with the historical Separations Process Research Unit (SPRU) operations. The SV was implemented in accordance with an SV Work Plan (Reference(2)) approved by NYSDEC (Reference(3)). The purpose of this SV was to assess whether a release of hazardous waste or hazardous constituents is occurring or has occurred within the investigation areas.

1.1 SV Overview

SPRU was operated from the late 1940s to the early 1950s at the Knolls Site in two Upper Level buildings (G2 and H2). The function of SPRU was to develop and refine a process for the extraction of useful radionuclides from irradiated nuclear fuel. The work was done on a laboratory scale and never on a production level. Test quantities of fuel were dissolved in acids and treated with various chemicals to separate the radionuclides. Wastes were managed in the Upper Level building (H2) tanks, in the Lower Level areas/structures, and in the undeveloped portion of the Knolls Site, the Land Area.

SPRU research was concluded in 1953. During the next several years, substantial effort was devoted to shipping the staged waste for off-site disposal. By the mid-1960s, most of the SPRU wastes had been removed from the Knolls Site.

The eight SWMUs and one AOC are related to the SPRU because they received waste materials associated with or generated at the SPRU. The SWMUs and AOC are identified below and are grouped in accordance with Knolls Site “geographical areas.”

Geographic Area	SWMU/AOC	Relationship to SPRU Process
Upper Level SWMUs	H2 Processing Facility (SWMU-030)	Waste and wastewater processing
	H2 Tank Farm (SWMU-031)	Process separations material and waste storage
	Pipe Tunnels (SWMU-057)	Waste transportation drain lines between Buildings G2/G1/E1 and H2
Lower Level SWMUs/AOC	K6 Storage Pad (SWMU-036)	Above-ground storage of containerized wastes
	Former K7 Storage Pad (SWMU-037)	Above-ground staging of solid containerized wastes
	Railroad Staging Area (SWMU-038)	Waste staging and railroad car loading operations
	K5 Retention Basin (SWMU-040)	Containment of non-hazardous process wastewater and laundry wastewater
	Lower Level Parking Lot (AOC-003)	Received fill material from the Railroad Staging Area, and K6 and K7 Storage Pads
Land Area SWMU	Former Slurry Drum Storage Area (SWMU-035)	Above-ground staging of slurry wastes

Note: Two other SWMUs associated with past SPRU operations, J4 Filter Bed (SWMU-041) and the former Laundry Drain System (SWMU-055), will be addressed under the Facility Areas SV and the Drain Evaluation SV, respectively, per References (4 and 5). *The existing remnant portion of the Laundry Drain Line that connects to* the K5 Retention Basin is part of this SV Report.

Within each SWMU or AOC, the objective of the SV sampling was to provide sufficient characterization data to evaluate whether a release of hazardous constituents from waste operations has occurred, to make preliminary determinations about the nature of the release, and to establish the need for further investigation and/or interim corrective measures.

2.0 Knolls Site Description

2.1 Facilities and Layout

As shown on Figure 2-1, the Knolls Site is located in the Town of Niskayuna, Schenectady County, New York, on the south bank of the Mohawk River. The Knolls Site consists of 170 acres, located mostly on a bluff approximately 115 to 120 feet above the Mohawk River surface. Along the northern margin of the Knolls Site, the land surface slopes steeply to a natural bench approximately 15 to 20 feet above the river surface. The Knolls Site, which fronts approximately 4,200 feet of the Mohawk River, is bounded 1) to the north by the Mohawk River; 2) to the east by a mixture of open land, parks, and the closed Town of Niskayuna municipal landfill; 3) to the south by a low-density suburban residential area; and 4) to the west by the General Electric Corporate Research and Development (GE CR&D) Center.

Construction of the Knolls Site began in 1948, and laboratory operations began in 1949. The principal function of the Knolls Site is research and development in the design and operation of Naval nuclear propulsion plants. Facilities include administrative offices, machine shops, a sewage pumping station, wastewater treatment facilities, a boiler house, oil storage facilities, cooling towers, waste storage facilities, and chemistry, physics, and metallurgical laboratories. The buildings and support facilities occupy approximately 60 acres of the property. The remainder of the Knolls Site (approximately 110 acres) consists of undeveloped woods and fields.

As shown on Figure 2-2, the three SV investigation areas are in separate and distinct geographic areas within the Knolls Site. The Upper Level SWMUs comprise an investigation area around Buildings H2 and G2 located in the northern portion of the bluff along the northwestern perimeter of the Knolls Site upper level facility area.

The Upper Level SWMU area is a developed area mostly covered by concrete and asphalt. he area surrounding Building H2 is covered by gravel overlying an impermeable geomembrane to the east, west, and north. The Lower Level SWMUs/AOC extends along the parking lot and old railroad spur within the bench between the Lower Level facility area and the hill slope rising up to the Knolls Site upper level. The eastern portion of the Lower Level SWMUs/AOC area is primarily a grassy surface with asphalt roadways bisecting the area along the east-west and north-south axes. The western portion of the Lower Level SWMUs/AOC area consists of an asphalt parking lot. The Land Area SWMU is located in the southeastern portion of the Knolls Site (upper level) and bounded by the East Boundary and Midline stream drainages. The outer perimeter of the Land Area is partially wooded along the eastern, northern, and western perimeter, with grass and brush comprising the non-wooded areas.

2.2 Geology

Most of the Knolls Site is located on the Upper Level bluff approximately 115 to 120 feet above the Mohawk River surface. Along the northern margin of the Knolls Site, the land surface slopes steeply to a natural bench comprising the Lower Level approximately 15 to 20 feet above the river surface.

The geology underlying the Knolls Site consists of unconsolidated overburden materials, overlying bedrock. Depth to bedrock at the Lower Level is approximately 5 to 20 feet below existing grade elevations and in the Upper Level at depths ranging from approximately 40 to 80 feet below existing grade elevations. Bedrock underlying the Knolls Site is mapped as the Upper-Middle Ordovician aged Schenectady Formation, which is composed of a series of alternating beds of graywacke, sandstone, siltstone, and shale about 2,000 feet thick, dipping gently to the west and southwest. The Schenectady Formation is underlain by the Canajoharie shale, which is a dark gray to black, thinly bedded fissile shale.

The unconsolidated materials at the Knolls Site consist mainly of glacial deposits. The till, which directly overlies the bedrock at most locations, consists of a grayish-blue, dense, compact till. This is known as the Mohawk Till, which is commonly referred to as the gray till. The gray till extends from the bedrock typically to within 10 to 15 feet of the ground surface, where the gray till transitions into a yellowish-brown till commonly referred to as the brown till. The uppermost portion of the brown till at the Knolls Site is commonly disturbed and in some instances contains anthropogenic materials (e.g., asphalt and concrete). Throughout this report, this interval is referred to as till-derived fill. The brown till originally was thought to be a separate depositional sequence from the gray till. However, evidence suggests that the brown till is the weathered surface of the gray till. Occasional lenses of graded material, usually fine sand, exist within the till. Overlying the till are thin glacial lake sequences (silts and clays) and discontinuous ice-contact deposits (sand and gravel).

2.3 General Hydrogeology

The groundwater resources at the Knolls Site are limited due to the low permeability of the bedrock and unconsolidated deposits. The predominant unconsolidated deposits are composed of brown and gray till with occasional lenses of graded material, usually fine sand, within the till. Overlying the till in some areas are thin glacial lake sequences (silts and clays) and discontinuous ice-contact deposits (sand and gravel). Thin layers of winnowed till or highly weathered bedrock are also found at the till/bedrock interface and in some instances provide a localized groundwater source. Consequently, there is no principal or primary bedrock or overburden aquifers underlying the Knolls Site for development as commercial or public water supplies.

The gray till is almost entirely impermeable except for the occasional lenses of fine sand, which are capable of transmitting small quantities of water. Based on drilling records, these lenses are small in both vertical and horizontal extent and are isolated from one another. The brown till also is relatively impermeable; however, water is capable of percolating through the brown till as indicated by perched water at the brown till/gray till contact. Groundwater present in the horizontal shales and sandstones of the Schenectady Formation is found within the bedrock fractures, joints, and bedding planes and within the upper portions of the bedrock at the interface with the unconsolidated deposits. These shales and sandstones are characteristically non-porous and impermeable, and form poor aquifers.

The overall site-wide direction of groundwater flow at the Knolls Site is believed to be generally northeast to the Mohawk River. Based on the relatively low permeability of the bedrock and till at the Knolls Site, groundwater movement, overall, is expected to be relatively slow. The movement of perched groundwater on the gray till will generally mirror the topography of the top of the till surface. The topography of the gray till is considered similar to the natural topography of the landscape where it has not been disturbed. In those areas where excavation of the gray till has occurred to facilitate the construction of site buildings, utilities, and other site facilities, variations in groundwater flow direction and velocities are likely to occur with groundwater preferentially flowing into and along the less compact and more permeable backfill material.

2.4 Climate and Surface Water

The climate in the region of the Knolls Site is primarily continental in character, but is subjected to some modification from the maritime climate that prevails in the extreme southeastern portion of New York State. Winters are usually cold and occasionally fairly severe. Maximum temperatures during colder winter months often are below freezing, and nighttime low temperatures frequently drop to 10 degrees Fahrenheit (°F) or lower. Sub-zero temperatures occur rather infrequently, about a dozen times a year. Snowfall in the area is quite variable, averaging approximately 65 inches a year. The mean annual precipitation for the region is approximately 36 inches per year, and winds are predominantly westerly to northwesterly.

The Knolls Site is located adjacent to the Mohawk River, which serves as the main watercourse for the Mohawk River Drainage Basin. The river flows eastward to where it joins the Hudson River in Cohoes, New York. Three streams drain directly to the Mohawk River from the Knolls Site. The East Boundary Stream is located on the Knolls Site between the closed Knolls and Niskayuna Landfills and receives drainage from the southeastern portion of the Land Area. The Midline Stream drains the central area of the Knolls Site and receives only runoff from the Knolls Site property, including most of the Land Area. The West Boundary Stream, which is located adjacent to the Knolls Site on GE CR&D Center property, receives some surface water runoff from the Knolls Site. Runoff from the southern and eastern area of the Upper Level SWMUs mostly enters on-site storm sewers for subsequent discharge to the Mohawk River. Runoff from the western and northern perimeter of the Upper Level flows over the bluff slope into drainage channels for discharge to the West Boundary Stream. Runoff from the Lower Level SWMUs/AOC also flows to the

Mohawk via storm sewers or, in the case of the northwestern parking lot, directly into the West Boundary Stream and the Mohawk River.

3.0 SWMUs/AOC Description and Background

The following sections provide a physical description and operational and waste management history of the SPRU SV SWMUs and AOC.

3.1 Upper Level SWMUs

3.1.1 H2 Processing Facility, SWMU-030

Physical. Building H2, located at the northwest end of the Knolls Site Upper Level (see Figure 2-2), was constructed in the late 1940s to house SPRU liquid waste processing equipment and storage tanks. The building resides on a 2 to 3 foot thick concrete foundation slab and is constructed of concrete walls more than 2 feet thick. Copper waterstops were installed at all construction joints. The building consists of approximately 27,900 square feet of floor space on three main floors (332, 319, and 308 foot levels; elevation above mean sea level [amsl]). Nearly 70 percent of this space is located below grade. The majority of liquid waste processing equipment is fabricated of stainless steel and resides on two floors at the 319 and 308 foot levels. Liquid waste processing area walls and ceilings were coated with a sealant or cocooning material, while the floor areas are generally lined with stainless-steel floor pans. Foundation footing drains are plumbed to a sump system located downslope of buildings (see Section 4.6).

Operational. During the early 1950s, Building H2 was used to process waste and wastewater from SPRU operations. Subsequently, the unit was, and continues to be, used to process laboratory (unrelated to SPRU) wastewater.

Chemical wastes were processed in Building H2 during the early 1950s. The chemical waste was transferred via stainless-steel drain lines to one of five stainless-steel neutralizers, where it was neutralized, distilled, and/or concentrated. The neutralizer bottoms were transferred to the H2 Tank Farm (SWMU-031) for storage, the organic distillate was collected and containerized, and excess water generated during concentrations was processed with other wastewaters prior to discharge.

SPRU wastewaters were accumulated in one of three stainless-steel 10,000-gallon storage tanks. Accumulated wastewater was transferred to one of two evaporators, where it was concentrated 400-fold. Distillate from the evaporators was collected in a receiver tank, where it was monitored and, if within acceptable Mohawk River Advisory Committee limits, discharged to the Mohawk River via the K5 Retention Basin and/or the stormwater drainage system. Evaporator bottoms, referred to as slurry waste, were dried in one of two drum dryers and containerized in 55-gallon drums. Containerized slurry waste was staged adjacent to Building H2 prior to being placed in storage at the Former Slurry Drum Storage Area (SWMU-035), the K6 Storage Pad (SWMU-036), or the Railroad Staging Area (SWMU-038).

From 1950 until 1964, the evaporative wastewater processing technique was used. Subsequent to 1964, wastewater was processed via filtration and ion exchange prior to discharge. Discharge of treated wastewater was ceased in 1977, when a water reuse system was installed. This system is still operational.

In addition to liquid waste processing, solid wastes were compacted in Building H2. The solid waste compaction process was begun in 1972, subsequent to the equipment being transferred from Building L7 to Building H2. The solid waste compaction operation in Building H2 was shut down in 2000.

Waste Type/Characteristics. During the early 1950s, more than 20,000 gallons of corrosive chemical waste containing heavy metals, methyl isobutyl ketone, and/or organic diluents and more than 9 million gallons of heavy metal containing wastewater were processed in Building H2.

Release Information. High water marks on walls in waste processing areas and radioactivity detected in adjacent soil and footing drains indicated a potential chemical constituent release from this unit.

3.1.2 H2 Tank Farm, SWMU-031

Physical. The subsurface H2 Tank Farm abuts Building H2 on its eastern side. One 5,000-gallon and six 10,000-gallon stainless steel storage tanks are located in seven underground concrete vaults. The vaults are in a row in a north-south direction on the east side of the H2 Processing Facility (SWMU-030) (see Figure 2-2). The floors and walls of these vaults are constructed of concrete that ranges from 2 to 8 feet thick. A waterproof sealant was applied to the vault floors and walls, and copper water-stops were installed during construction. An emulsified asphalt waterproof coating was applied to the exterior of the vault foundations. The vault ceilings are constructed of upright and inverted concrete "T" blocks covered with tarpaper, asphalt, and approximately 9 feet of fill. Sealed vault access-ways and tank vent lines penetrate the ground surface. Visual inspections of the tanks and vaults, in 1989 and 1998, showed that they were intact and in good condition. Groundwater seeps were observed in several vault ceilings.

Operational. Processed separations material and waste were accumulated within the various tanks until SPRU research was concluded in 1953. Some materials and waste remained in storage until the mid-1960s, when it was removed, processed via evaporation, and transported off-site for disposal. Subsequent to SPRU operations, several tanks were used to accumulate and store liquid waste from Knolls Site materials and chemistry laboratories. Prior to 1964, upset conditions were documented that resulted in tank contents being released to the ground surface via vents in the tank vaults. Affected soils were removed. During 1978, all tanks were drained and removed from service. Tank heels remain today.

Waste Type/Characteristics. Corrosive liquid wastes potentially containing methyl isobutyl ketone, organic diluents, and/or heavy metals were accumulated within these tanks. Approximately 2,100 total gallons of residue remains within the tanks (tank heels below the drain level). In 1990, total metals analysis was performed on residue in five of the storage tanks for Extraction Procedure Toxicity (EP Tox) metals. In 1998, total metals analysis for Target Analyte List (TAL) metals was performed on debris sampled from five of the tank vault floors. Elevated concentrations of eight metals were observed. The range of results from each analysis is presented below.

Metal	1990 Residue Sampling from Tanks 509A, -C, -D, -E and 578 Range (mg/kg)	1998 Debris Sampling from Tank Vaults 505, 509B, -C, –D and 578 Range (mg/kg)
Mercury[1]	217 – 2,810	4.93 – 81.5
Silver[1]	95 – 325	ND – 7.93
Arsenic[1]	135 – 247	2.02 – 57.6
Barium[1]	2220 – 68,600	34.3 – 317
Cadmium[1]	69 – 111	ND – 5.27
Chromium[1]	349 – 3920	26.6 – 543
Manganese	NA	202 – 829
Nickel	NA	33.8 – 402
Lead[1]	455 – 10,600	59.7 – 493
Selenium[1]	195 – 336	1.05 – 9.04
Zinc	NA	77.9 – 1,990

Notes: NA = Not Analyzed, ND = Not Detected, mg/kg = milligrams per kilogram

[1] 1998 TCLP metal analysis on water samples from tank vault 509E were all not detected and were either not detected or below reporting limits in tank vault 509A

Release Information. High water marks attributed to water seeping from the vault ceilings were observed on vault walls during the 1989 inspection. Radioactivity detected in footing drains indicates a potential chemical constituent release from this unit to the floors within the vaults, although a pathway to the environment is not known to exist.

3.1.3 Pipe Tunnels, SWMU-057

Physical. This unit consists of a tunnel located in and connecting the basements of Buildings G2 and H2 (see Figure 2-2). The tunnel is more than 5 feet wide and 8 feet high. Tunnel walls, floors, and ceilings are constructed of concrete more than 6 inches thick. A waterproof sealant was applied to the unit's floor and walls during construction. Copper water-stops and asphalt filler were also installed at all construction joints. With the exception of an expansion joint located at the north end of Building G2, the tunnel appeared intact and in good condition during a 1989 visual inspection. Groundwater intrusion was observed at this expansion joint.

Operational. The tunnel was constructed to house industrial and wastewater drain lines from operations in Buildings G2, G1, and E1. Wastewater accumulation was occasionally reported on the floor of this tunnel.

Waste Type/Characteristics. Wastewater potentially contained heavy metals.

Release Information. High water marks and stains were observed on tunnel walls and floors during a 1989 visual inspection. Radioactivity detected in the Building H2 footing drain indicates a potential chemical constituent release from this unit.

3.2 Lower Level SWMUs/AOC

3.2.1 K6 Storage Pad, SWMU-036

Physical. This unit, centrally located at the Knolls Site Lower Level (see Figure 2-2), is a 23-foot wide by 48-foot long, concrete shielded, concrete storage pad with 8 feet high walls. The inside of the concrete structure is partially divided into two storage cells of equal dimension. With the exception of the pad's southern wall, which is 8 inches thick, the shielding walls are more than 2.5 feet thick. An earthen embankment abuts the southern wall. This unit was fitted with a roof in 1987.

Operational. This unit was used from the late 1950s until the fall of 1968 to store containerized solid waste potentially containing hazardous constituents. The original K6 facility cells were unprotected and exposed to the environment. Floor drains located in both storage cells were used to drain the area of rainwater. A 4-inch diameter drainpipe extended approximately 115 feet east toward a 36-inch storm sewer. The line was plugged and blanked off in 1973. The concrete pad was subsequently removed. No evidence of a release was found when the drain line was blanked off.

Waste Type/Characteristics. Waste containerized in 55-gallon drums or casks generally included Building H2 slurry waste, filters, and equipment. Slurry waste potentially contained heavy metals.

Release Information. Radioactivity detected in soils indicated a potential chemical constituent release from this unit.

3.2.2 Former K7 Storage Pad, SWMU-037

Physical. This former unit, which consisted of a fenced concrete pad, was centrally located at the Knolls Site Lower Level, west of the K6 Storage Pad (SWMU-036) (see Figure 2-2). The fencing and concrete pad have been removed.

Operational. This unit was used during the 1960s to stage solid waste prior to off-site disposal. Wastes were generally containerized in 4-foot square wooden boxes.

Waste Type/Characteristics. Solid waste consisted of compacted paper, cardboard, and personal protective equipment (PPE) from Building L7. Employee interviews indicate hazardous waste or chemical constituents may have been managed at or in proximity to this unit.

Release Information. Radioactivity detected in adjacent soils indicates a potential chemical constituent release at this unit.

3.2.3 Railroad Staging Area, SWMU-038

Physical. This unit consists of the land area located adjacent to and south of the former railbed at the Knolls Site Lower Level (see Figure 2-2).

Operational. Four-foot square wooden boxes and 55-gallon drums of solid waste, including slurry wastes, were staged at this unit prior to off-site disposal. Waste staging operations commenced in the early 1950s and ceased in the late 1960s.

Waste Type/Characteristics. Slurry waste, potentially containing heavy metals, and solid waste were staged at this unit.

Release Information. Radioactivity detected in adjacent soil indicates a potential chemical constituent release from this unit.

3.2.4 K5 Retention Basin, SWMU-040

Physical. This unit is an in-ground, open topped, concrete basin located on the hillside between the Knolls Site Upper and Lower Levels (see Figure 2-2). The unit measures approximately 22 feet wide by 43 feet long by 11 feet deep and is constructed of 1 foot thick concrete walls. The unit is equally divided into two 30,000-gallon holding basins. Cracks have been observed in both basin floors. An influent drainage valve pit and an effluent drainage valve pit are located on the south and north sides of the building, respectively. Each valve pit is plumbed to both basins. The influent valve pit has a floor drain that drains to the hillside to the south-southeast. The effluent valve pit drains to the north into catch basin No. 26. Catch basin No. 26 also intercepts stormwater from the Upper Level area.

Operational. This unit was operational from 1950 until the late 1960s. Non-hazardous wastewater, potentially containing chemical constituents processed in Building H2, and laundry wastewater, were piped via an underground drain line to the retention basin prior to stormwater drain discharge. A roof was installed over the basin subsequent to its operational life.

Waste Type/Characteristics. Non-hazardous wastewater, potentially containing chemical constituents, and laundry wastewater, were temporarily held here.

Release Information. Basin overflows have been reported, and there is a potential for release attributed to basin integrity loss (i.e., cracks). Trace levels of barium (0.59 milligrams per liter [mg/L]) were detected in concrete samples collected during a 1993 tank cleanup effort. Radioactivity detected in adjacent soil indicated a potential chemical constituent release from this unit.

3.2.5 Lower Level Parking Lot, AOC-003

Physical. This AOC consists of the fill material located below and adjacent to the Lower Level Parking Lot (see Figure 2-2).

Operational. Fill material obtained from former SPRU waste management areas was used to expand the Lower Level Parking Lot in August 1962. Fill was obtained from the area between Storage Pads K6 and K7, as well as from the Railroad Staging Area.

Waste Type/Characteristics. Wastes staged in the areas where fill material was obtained included slurry waste. Slurry waste potentially contained heavy metals.

Release Information. Radioactivity detected in fill material indicated the occurrence of a potential chemical constituent release.

3.3 Land Area SWMU

3.3.1 Former Slurry Drum Storage Area, SWMU-035

Physical. This unit, located outside and east of the Knolls Site Upper Level developed area (see Figure 2-2), consisted of an approximately 900 square foot earthen bermed area. The earthen berm was bulldozed and graded in the mid-1950s. Localized undulating topography, attributed to former cleanup activities, indicates the former location of this SWMU. No visible evidence of the berm exists today.

Operational. During the early 1950s, slurry waste generated from wastewater processing activities in Building H2 was staged at this unit prior to off-site disposal. Cleanup efforts were initiated in the early 1960s and again in the late 1970s. During cleanup efforts, exposed ground areas of contamination were covered with asphalt-impregnated paper, and a layer of clean soil was placed on top of the asphalt paper. Approximately 1,000 cubic yards of soil were removed.

Waste Type/Characteristics. Slurry waste potentially contained heavy metals.

Release Information. Radioactivity detected in soil indicated a potential chemical constituent release from this unit.

4.0 Overview of Field Activities

4.1 Geophysical Investigation

Prior to drilling the soil borings required during this SV, a geophysical survey was conducted to identify potential subsurface features that could present a health and safety concern if encountered during the field investigation. Geophysical anomalies corresponding to subsurface features were identified and boring methods modified in areas where anomalies were present (i.e., hand augering replaced direct push sampling). Soil borings advanced within areas of geophysical anomalies are further discussed in Sections 6.2.7 and 7.2.4. The objective of the geophysical investigation was to evaluate the anomalies sufficiently to ensure safe subsurface sampling, but not necessarily to identify the specific source of the anomaly or its complete extent.

Electromagnetics (EM-61) and Ground Penetrating Radar (GPR) were used with varying levels of success in each of the geographical areas. Both methods were moderately successful throughout the Lower Level SWMUs/AOC area. GPR was not successful at either the Upper Level SWMU or the Land Area SWMU due to the high clay content of the soils and the required depth of penetration. Because a previous geophysical survey (Reference(6)) was performed over a large portion of the Land Area, EM-61 was used within the Land Area only to clear the immediate drilling location.

A more detailed discussion of the geophysical survey and a presentation of identified geophysical anomalies is provided in Appendix F.

4.2 Soil Sample Collection Procedures

Subsurface soil samples were collected at the Upper Level SWMUs, the Lower Level SWMUs/AOC, and the Land Area SWMU using either an auger drill rig or a direct push sampler. The drill rig and direct push soil borings were advanced by Aquifer Drilling & Testing, Inc. (ADT, Inc.), of Troy, New York. Hand augers were also used to collect subsurface soil samples at various shallow locations in the Lower Level SWMUs/AOC and in the Land Area SWMU. Hand auger borings were conducted by C.T. Male Associates, P.C. (C.T. Male) or CH2M HILL, Inc. (CH2M HILL). Specific soil sample collection procedures are summarized in the following subsections. Soil samples were collected in accordance with the SV Work Plan (Reference(2)). Modifications to the sampling procedures presented in Reference(2) are noted where applicable.

Soil sampling activities were performed by C.T. Male under the supervision of CH2M HILL or by CH2M HILL. During implementation of the work, field activities were documented in bound logbooks with consecutively numbered pages. Logbooks included field notes, boring logs, and soil sampling data sheets.

Area-specific summaries of the soil boring program are presented in Tables 4-1 through 4-3. Corresponding area-specific summaries of the soil samples are presented in Tables 4-4 through 4-6. Soil boring locations for each area are shown in Figures 4-1 through 4-3. The referenced tables and figures are located under corresponding tabs at the end of Section 4.0. Boring logs are presented in Appendix D.

4.2.1 Split-Barrel Sampling Using Drill Rig

Subsurface soil samples were collected using 3-inch diameter, 2-foot long split-barrel carbon steel samplers (split-spoons) equipped with new clean acetate liners. Continuous soil sampling was performed at the soil boring locations. A truck-mounted drill rig (CME-55 or Mobile Drill B-29) was used to advance the open hole of the split-barrel samplers through hollow-stem augers. A track-mounted all terrain vehicle (ATV) drill rig (CME LC-60) was used in areas with limited access. The split-barrel samplers were driven with a 140-pound hammer dropped from a 30-inch height via an automatic hammer in accordance with American Society for Testing and Materials (ASTM) D1586, *Standard Method for Penetration Test and Split-Barrel Sampling of Soils* (Reference(7)). The soil boring locations advanced with a drill rig are identified in Tables 4-1 through 4-3, as well as in the boring logs.

After extracting the split-barrel sampler, it was screened for total volatile organic compound (VOC) vapors using a MiniRae® photoionization detector (PID) that was calibrated daily. The split-barrel sampler was then placed on the sampling table on clean plastic sheeting. After removal from the split-barrel, the acetate liner was split open by two full-length cuts with a utility knife. The surface of the soil was immediately screened for total VOC vapors using the PID, and the reading was recorded on the boring log. The length of soil recovered was measured and recorded on the boring log.

If the PID reading was 2 ppm or more above background, a soil sample was collected for VOC analysis. Unless otherwise noted herein, at least one sample, biased toward depth or a saturated zone, from each soil boring location was analyzed for VOCs regardless of PID readings. Within each 2-foot sample interval, if VOC vapors were detected in a localized section of the soil core or if the soil was saturated at any point in the core, the VOC sample was collected primarily from that section. Otherwise, the VOC sample was collected from the full length of the recovered sample interval. At some soil boring locations a field decision was made to collect more than one VOC sample based on various reasons including moisture/saturation conditions, lithology changes, PID readings, and visual observations (see Tables 4-4 to 4-6).

VOC samples were collected by directly transferring a representative portion of the sample from the acetate liner into a pre-cleaned laboratory-supplied container using a field-cleaned stainless-steel scoopula and/or gloved hands (new clean nitrile gloves). Following the collection of a VOC sample, soils were classified in accordance with Section 4.2.4.

The remaining soil was then transferred into a field-cleaned stainless-steel bowl and homogenized. Vegetation, asphalt, construction materials, rocks, and twigs were removed from the soil sample when possible. The soil was placed in the center of the bowl and initially mixed and/or chopped with a field-cleaned stainless-steel scoopula and/or gloved hands (new clean nitrile gloves). The soil was then quartered and moved to a corner of the bowl. Each quarter was then mixed individually, moved back to the center of the bowl, and thoroughly mixed with the other quarters. The homogenized soil was then transferred into a pre-cleaned laboratory-supplied container for semivolatile organic compounds (SVOCs) and metals analyses.

The sample containers were properly labeled, packaged, and then placed into a cooler containing bagged ice and/or ice packs to chill the samples to 4 degrees Celsius (°C). Sample information was recorded in the field logbooks and a chain of custody (COC) record was completed.

Following sample collection and data recording, investigation-derived soil was managed in accordance with Reference(2) as described in Section 4.11. A new layer of clean plastic sheeting was placed on the sample preparation surface prior to each sample interval where samples were collected for laboratory analyses. At completion of each soil boring, the soil boring was abandoned (unless a monitoring well was required) by filling with remaining investigation-derived soil and/or filling with bentonite/cement mixture to the surface.

Field quality control (QC) samples including equipment blanks, field duplicates, matrix spike/matrix spike duplicates (MS/MSDs) and trip blanks were collected as described in Section 4.9.

Soil sample identification numbers were assigned using the following protocol. For normal samples (excluding QC samples) the sample ID was prefixed with a three character code identifying either the Lower Level (LWA), Upper Level (UPA) or Land Area (LDA); followed by a two-digit numeral indicating the SWMU/AOC number; followed by a three-digit numeral corresponding to the sample sequence for the designated SWMU/AOC. The following QC samples were identified by prefixes -- "FD" or "FDD" for field duplicates, "EB" or "EBD" for equipment blanks and TB or TBD for trip blanks -- followed by a number indicating the sequence in which the sample was taken. MS/MSDs were identified on the COC.

The following exceptions to this labeling protocol occurred during field execution:

- Sample identification numbers appended with "V" or "V2" were taken from a previously-sampled target interval at an alternate date or offset location and analyzed for VOCs.
- Sample identification numbers appended with "A" or "B" were taken from a previously-sampled target interval at an offset location.
- Samples prefixed with a B and then the soil boring location number were assigned by field samplers for soil boring locations B3101, B3102,B3537 and B4002. The last four digits correspond to the upper and lower depths of the sample interval in feet below grade (bg).
- Five MS/MSD sample identification numbers were appended with "MS/MSD".

4.2.2 Direct Push Sampling

Subsurface soil samples were also collected using direct push methods. Direct push sampling was performed using a vehicle-mounted (Geoprobe Model 5400) or ATV-mounted (Geoprobe Model 4220) percussion hammer unit. Soil samples were collected using 3-inch diameter, 2-foot long carbon steel split-barrel samplers equipped with new clean acetate liners. At a few soil boring locations, the soil samples were collected using 2-inch diameter, 4-foot long macrocore samplers equipped with new clean acetate liners. The soil boring locations advanced with a direct push sampler are identified in Tables 4-1 through 4-3, as well as in the boring logs (Appendix D). The specific sample collection method is identified in the boring logs.

To obtain soil samples, the direct push sampler was positioned at the sample location, and the split-barrel sampler or macrocore sampler was advanced to the target depth. After extracting the sampler, the split-barrel sampler or macrocore sampler was screened for total VOC vapors using a MiniRae® PID that was calibrated daily. The sampler was then placed on the sampling table on clean plastic sheeting, and the acetate liner was removed from the sampler. The length of soil recovered was measured and recorded on the boring log. The acetate liner was then split open by two full-length cuts with a utility knife. The surface of the soil was immediately screened for total VOC vapors using the PID, and the reading was recorded on the boring log. The PID readings were at background for all soil intervals at each direct push boring location, except for one boring location in the Lower Level (B3703) and three boring locations in the Land Area (B3532, B3555, B3556) as shown in the following table.

Sample collection, packaging, and handling procedures described in Section 4.2.1 were followed. At completion of each soil boring, the soil boring was abandoned by filling with remaining investigation-derived soil, followed by bentonite chips or pellets to the surface, if necessary.

Soil Boring ID	Location	Depth Interval (feet bg)	PID Reading (ppm)
B3703	Lower Level	Decomposed leaves at top of 0-2 foot core and surrounding soil boring	40-50
		0.5-2	0.4-0.7
B3532 (1)	Land Area	2-2.2	>999 (offscale)
B3555 (1)	Land Area	2-4	300-500
		4-6	20-50
B3556 (1)	Land Area	0-2	100
		2-4	40-100

bg = below ground
(1) Landfill debris (i.e., paper and office refuse), associated with the Former Landfill (SWMU-002), was encountered within or immediately below the sample interval PID readings.

4.2.3 Hand Auger Sampling

Hand augers were used to collect subsurface soil samples at shallow soil boring locations in the Lower Level and Land Area that were not accessible by the auger drill rig or direct push sampler, in conjunction with these sampling techniques, and from the test pit (T4001) excavated in the area of the remnant influent drain line at the K5 Retention Basin in the Lower Level. Hand auger samples were collected using a 2 or 3-inch diameter open bucket steel hand auger. In addition, several soil borings in the Upper Level were advanced with a post hole digger to 4 feet bg to check for utilities before continuing the boring with the drill rig, and one soil sample was collected at soil boring B3001 with the post hole digger. The soil boring locations advanced with a hand auger and post hole digger are identified in Tables 4-1 through 4-3, as well as in the boring logs.

Soil removed with the hand auger was transferred from the auger head to a stainless-steel bowl on the sampling table, which was covered with clean plastic sheeting. The surface of the soil in the bowl was screened for total VOC vapors using a MiniRae® PID that was calibrated daily, and the PID reading was recorded on the boring log. The PID readings were at background for all soil intervals at each hand auger boring location.

The sample collection, packaging, and handling procedures described in Section 4.2.1 were followed. At completion of each soil boring, the soil boring was abandoned by filling with remaining investigation-derived soil, followed by bentonite chips or pellets to the surface, if necessary.

4.2.4 Geologic Description

The soil samples obtained with split-barrel and macrocore samplers were inspected in the opened acetate liner. For the samples obtained with hand augers, the soil was inspected as it was removed from the hand auger and in the stainless-steel bowl. The physical description of the soil including grain size, color, odors, staining, moisture content and firmness, and the geologic description of the soil were recorded on the boring logs (see Appendix D). The Unified Soil Classification System was used to characterize the samples. The presence of any man-made materials (e.g., brick, slag, refuse) and PID readings were also noted.

4.2.5 Exceptions to SV Work Plan and Quality Assurance Project Plan (QAPjP) Requirements

A few procedural modifications to Reference(2) occurred during implementation of the soil sampling field activities. These minor changes did not affect the Data Quality Objectives (DQOs) of the SV. In general, the modifications consisted of the following:

- Three-inch diameter split-barrel samplers were used at times in place of 2-inch diameter samplers at the drill rig soil boring locations.
- An automatic hammer was used in place of a cathead at the drill rig soil boring locations to drive the split-barrel samplers in accordance with Reference(7).
- Acetate liners were placed inside the split-barrel samplers at the drill rig soil boring locations consistent with direct push technology.
- Three-inch diameter split-barrel samplers or macrocore samplers, equipped with an acetate liner instead of a polyvinyl chloride (PVC) liner, were used at the direct push soil boring locations.
- In addition to the stainless-steel scoopula, sample containers were often filled by hand (nitrile-gloved); and occasionally, the soil was homogenized by hand (nitrile-gloved) in addition to the stainless-steel scoopula.

- At a few locations, at least one soil sample was not analyzed for VOCs and/or the soil samples were not analyzed for SVOCs and metals.
- The soil samples for SVOCs and metals analyses were collected in the same sample container instead of separate containers, as approved by the analytical laboratory.

A complete listing of the modifications is presented in Table 4-7 along with an explanation of the rationale for the change.

4.3 Monitoring Well Installation Procedures

Three monitoring wells identified as MW-SV1 through MW-SV3 were installed in soil borings advanced with a drill rig in the Upper Level SWMUs (see Figure 4-1). During supplemental field work performed during June and July 2001, a permanent direct push monitoring well (MW-SV8) was constructed at soil boring location B3103. An additional direct push well was installed at location B3004, but was dry (see Figure 4-1). Four monitoring wells identified as MW-SV4 through MW-SV7 were installed in soil borings advanced with a drill rig in the Lower Level SWMUs/AOC (see Figure 4-2). The monitoring wells were installed by ADT, Inc., under the supervision of C.T. Male and CH2M HILL personnel between October 27, 2000, and December 6, 2000, and between June 15 and 19, 2001, during the supplemental field work. Development of the monitoring wells was performed by C.T. Male under the supervision of CH2M HILL personnel between December 14, 2000 and January 5, 2001, and on June 27, 2001. The monitoring wells were installed in accordance with Reference(2). Modifications to the monitoring well installation procedures and well development procedures presented in Reference(2) are noted where applicable.

During implementation of the work, field activities were documented in bound logbooks with consecutively numbered pages. Logbooks included field notes, monitoring well installation logs, and well development logs.

4.3.1 Monitoring Well Installation

As required by Reference(2) groundwater monitoring wells were installed in soil borings with saturated conditions. Well screens were installed above the impermeable till or bedrock that comprises the base of the unconfined surficial aquifer. The base of the well screen was as close to the contact of the underlying confining unit as possible. Over-drilling into the confining unit was done where necessary to provide sump space for containment of soil boring slough.

The monitoring wells were constructed with 1 or 2-inch diameter, 5 or 10-foot long, 0.010 factory-slotted Schedule 40 PVC screen and end caps, threaded flush with a 1 or 2-inch diameter Schedule 40 PVC riser pipe and vented cap. The monitoring wells installed with a direct push sampler are 1-inch diameter (MW-SV8, B3004) and the monitoring wells installed with a drill rig are 2-inch diameter (MW-SV1 to MW-SV7). The 5-foot screen length was used where the total well depth was less than 20 feet, and the 10-foot screen length was used where the total well depth was greater than 20 feet. The well screen and riser pipe were certified clean and wrapped by the manufacturer. It was therefore unnecessary to high-pressure steam-clean the well screen and riser pipe prior to installation.

The annular materials were emplaced as the drill casing was retracted. The primary filter pack consisted of a fine to medium #0 sand and generally extended 2 feet above the top of the screen. The secondary filter pack consisted of a very fine #00 sand and generally extended 0.5 to 1-foot above the primary filter pack. A seal (of at least 2 feet) of bentonite pellets or chips was placed above the secondary filter pack. The bentonite was hydrated with water when it was placed in an unsaturated interval. The monitoring wells were completed to grade with a flush-mounted well cover set in a cement/bentonite grout containing approximately 5 percent bentonite. A permanent reference mark was placed on the riser rim for water level and well depth measurements.

A monitoring well installation log, documenting well construction details, was completed for each well. A summary of the monitoring well installation details is presented in Tables 4-8 and 4-9. Monitoring well installation logs are presented in Appendix D.

A few procedural modifications to Reference(2) occurred during implementation of the field activities for the monitoring well installations. In general, the modifications consisted of the following:

- A 2-foot primary filter pack above the top of the well screen was not installed at each well.
- A 1 to 2-foot secondary filter pack above the primary filter pack was not installed at each well.
- A flush mount well cover was not installed at the temporary monitoring well installed at soil boring location B3004.

A complete listing of the modifications is presented in Table 4-10 along with an explanation of the rationale for the change.

4.3.2 Monitoring Well Development

Monitoring well development did not begin until at least 48 hours after the "SV" monitoring wells were installed. The headspace in each well was initially monitored for total VOCs using a MiniRae® PID that was calibrated daily. Background PID measurements ranged from 0.0 to 0.5 ppm. The water level and total well depth were then measured following the procedures described in Section 4.4.1, and the volume of standing groundwater in the well was calculated.

The monitoring wells, except MW-SV8, were developed by surging the well with a disposable bailer and then using a peristaltic pump and new disposable tubing to remove the water from the well. The water removed from the well was collected in a graduated container, and the volume was recorded. Monitoring well MW-SV8 was not developed due to insufficient water column height. The temporary well at soil boring B3004 was dry. The field parameters of pH, temperature, specific conductivity, and turbidity were measured at regular intervals after every one-half to three-quarters of a well volume was removed. Well development continued until the pH, temperature, and specific conductivity stabilized. Turbidity did not stabilize and was greater than 5 nephelometric turbidity units (NTUs) at all new SV monitoring well locations except for MW-SV3. Stabilization was defined in Reference(2) as a 10 percent or less variation for temperature, specific conductivity, and turbidity and for pH readings within 0.1 units between three consecutive readings.

Monitoring well development information was recorded on well development logs and in the field notes. A summary of monitoring well development data is presented in Tables 4-11 and 4-12.

A few procedural modifications to Reference(2) occurred during implementation of the monitoring well development field activities. In general, the modifications consisted of the following:

- Monitoring well MW-SV8 was not developed.
- An organic vapor analyzer (OVA) was utilized instead of a PID on one occasion to measure the monitoring well headspace for total VOCs prior to the start of the well development.
- Field parameters were not measured at monitoring wells MW-SV1, MW-SV2, and MW-SV8.
- MW-SV3 was the only well where development resulted in a stabilized turbidity and in a turbidity of less than 5 NTUs.

A complete listing of the modifications is presented in Table 4-13 along with an explanation of the rationale for the change.

4.4 Groundwater Sample Collection Procedures

Purging and groundwater sampling of new and existing monitoring wells were performed by C.T. Male or CH2M HILL personnel between December 13, 2000 and February 6, 2001, and between June 21 and July 5, 2001. The purging and sampling were performed in accordance with Reference(2). Modifications to the purging and sampling procedures presented in Reference(2) are noted where applicable.

During implementation of the work, field activities were documented in bound logbooks with consecutively numbered pages. Logbooks included field notes, as well as monitoring well purging and sampling logs.

4.4.1 Groundwater Level Measurements

The headspace in each well was initially monitored for total VOC vapors using a PID that was calibrated daily. The water level and total depth were then measured to the nearest 0.01 foot with a clean water level meter. After each measurement, the water level probe and cable were decontaminated with organic-free deionized water/distilled water or with an Alconox/water solution and thoroughly rinsed with organic-free deionized water/distilled water.

Water level measurements taken prior to groundwater sampling and to establish the potentiometric surface are presented in Tables 4-14 through 4-16.

4.4.2 Groundwater Purging

The purging, sampling, and monitoring equipment was set on a clean polyethylene sheet laid out around the well. The monitoring equipment was calibrated daily according to the manufacturer's specifications. The headspace PID reading and water level measurements were measured following the procedures described in Section 4.4.1. The monitoring well depth was not checked (if it had been previously measured/determined) to avoid disturbing sediment on the bottom of the well. The monitoring wells were purged with a disposable plastic bailer, a dedicated PVC bailer, a Geotech Geopump 2 peristaltic pump, or a Grundfos Rediflow 2 submersible pump. A listing of the monitoring wells purged and the purge method, as well as a summary of purge data are presented in Tables 4-17 through 4-19.

The sampling point for the pumps was generally the midpoint of the water column, but not less than 2 feet from the bottom of the well except where necessary. New disposable tubing was used for the pumps. The pump was set at the lowest setting and slowly increased until discharge occurred into a graduated container. The field parameters of pH, temperature, specific conductivity, and turbidity were measured at regular intervals, unless otherwise indicated, to determine when the well had stabilized. Stabilization was defined in Reference(2) as a 10 percent or less variation for temperature, specific conductivity, and turbidity (when turbidity was greater than 5 NTUs) and for pH readings within 0.1 unit between three consecutive readings. Generally, the purging continued until the field parameters stabilized or the well was purged dry or near dry. Turbidity only stabilized in some of the wells as discussed in Table 4-20. Some of the other field parameters (temperature, pH, specific conductivity) also did not stabilize in a few of the wells (see Table 4-20). Due to the slow recovery/recharge of some of the wells, there was insufficient water to continue purging until the field parameters stabilized.

Several wells in the Upper Level (MW-SV1, MW-SV8, H-21, and H-22) were not purged prior to sampling due to low water columns and slow recovery/recharge rates. In addition, some of the wells in the Upper Level had to be purged one or more days before sampling and allowed to recover in order to have sufficient water to collect the samples. Monitoring well MW-SV1 was purged dry on December 19, 2000. It had only recovered sufficiently to enable the VOCs sample to be collected on December 22, 2000. On December 28, 2000, an attempt to collect the SVOCs sample was made, but there was insufficient groundwater to fill the sample container. On January 10, 2001, there was sufficient groundwater to collect the SVOCs sample only. The metals sample was collected on February 8, 2001.

After well MW-SV1 was initially purged on December 19, 2000, it was not purged again because of the lack of sufficient groundwater, and the recovery/recharge was slow as evidenced by the inability to sample all required parameters on the same day. During resampling of cased borings H-21 and H-22 for filtered and unfiltered metals (see Section 4.4.3), there was insufficient groundwater to purge the cased borings and fill the sample containers. When these cased borings were initially purged on December 21, 2000, the water column height was approximately 15.5 feet at H-21 and 11 feet at H-22. When the cased borings were resampled for metals on January 9, 2001, the water column height was approximately 4.7 feet at H-21 and 1.5 feet at H-22. Because the cased borings had apparently not fully recovered from the December 21, 2000, purging, they were not purged again, so that sufficient groundwater would be available to fill the sample containers.

When a pump was used for the purging, a flow-through cell (YSI Model 6820/610-D or YSI Model 6920/650 MDS) was used for the field parameter measurements, with the turbidity sample collected prior to the flow-through cell. Once stabilization occurred, the sample was collected before it passed through the flow-through cell. When bailers were used, the groundwater was poured into a container designed to fit the field parameter meter

(YSI Model 6820/610-D or YSI Model 6920/650 MDS). The turbidity was measured with a separate turbidity meter (HF Scientific DRT-15CE or HACH 2100P).

A summary of the field parameter measurements collected at completion of the purging and before collecting the groundwater samples (if the purging and sampling were done on different days) is presented in Tables 4-21 through 4-23.

4.4.3 Groundwater Sample Collection

The monitoring wells sampled in the Upper Level included "SV" monitoring wells MW-SV1 to MW-SV3, and MW-SV8 and existing KAPL monitoring wells B-8, B-9, B-14 to B-16, B-26, H-20 to H-22, H-24, H-26, H-28, KH-15, KH-16, MW52-1, MW52-2, and MW52-4. The monitoring wells sampled in the Lower Level included "SV" monitoring wells MW-SV4 to MW-SV7 and existing KAPL monitoring wells KH-20 to KH-23. The monitoring wells sampled in the Land Area included existing KAPL monitoring wells KH-11, MW-3, NTH-1, NTH-1A, NTH-4, W-2 to W-4, and W-8.

The monitoring wells were sampled with a disposable plastic bailer, a Geotech Geopump 2 peristaltic pump with new disposable tubing, a Grundfos Rediflow 2 submersible pump with new disposable tubing, or a Waterra inertial pump with new disposable tubing. The samples were collected following purging or when sufficient groundwater had recharged into the well. Pre-cleaned sample containers with the required preservatives were supplied by the laboratory. The sample containers were filled in the following order: VOCs, SVOCs, total metals, and filtered metals. If the turbidity was greater than 5 NTUs, the samples were field filtered through a 0.45-micron (μ) filter into a nitric acid (HNO_3) preserved container. Due to insufficient preserved containers, the filtered sample from monitoring well MW52-2 collected on February 6, 2001, was placed into a non-preserved container that was subsequently preserved with HNO_3 at the laboratory.

The sample containers were properly labeled, packaged, and placed into a cooler containing bagged ice and/or ice packs to chill the samples to 4°C. Sample information was recorded in the field logbooks and a COC record was completed. Field QC samples, including field duplicates, MS/MSDs, equipment blanks, and trip blanks were collected as described in Section 4.9.

Groundwater sample identification numbers were assigned using the following protocol. For normal samples (excluding QC samples) the sample ID was prefixed with a three character code identifying either the Lower Level (LWA), Upper Level (UPA) or Land Area (LDA); followed by "GW" and a one- or two-digit number indicating the sequence the sample was taken in each area. Normal samples appended with an "M" were additional samples taken for metals analysis as discussed in the next paragraph. Field duplicates were prefixed with "FDGW" followed by a number indicating the sequence the field duplicate was taken. MS/MSDs were identified on the COC.

Cased borings/monitoring wells H-21, H-22, H-24, H-26, H-28, MW52-1, MW52-4, MW-SV2, MW-SV4, and MW-SV6 were sampled for filtered metals because the turbidity was greater than 5 NTUs, but inadvertently not sampled for the total metals as required by Reference(2). These wells were subsequently resampled for both filtered and total metals. During the initial sampling, some of the wells in the Upper Level were purged and then sampled the next day or later due to slow recharge which allowed the sediment in the water column time to settle. When the wells were resampled, the purging and sampling occurred in quick succession, which prevented the same degree of sediment settling from the water column. The wells generally had less water in them, which may have served to concentrate the sediment. As a result, some of the resampled monitoring wells (H-22, H-26, H-28, MW52-1, MW52-4) had a higher turbidity than when they were initially sampled. Both sets of data are discussed in the data interpretative sections of this report.

Monitoring well MW-SV8 was initially purged on June 27, 2001, but there was only sufficient sample volume to collect the VOCs sample. It was purged again on July 2, 2001, and the SVOCs and metals samples were collected. Due to discontinuous flow using the peristaltic pump during sampling for VOCs on June 27, 2001, the monitoring well was repurged and resampled for VOCs on July 5, 2001, using a Waterra inertial pump and tubing. The tubing was filled with slow movement of the inertial pump then raised to the surface and the water drained into the VOA vials through the pump's ball valve. Both sets of VOCs samples were analyzed.

A summary of the groundwater sampling data and laboratory analyses is presented in Tables 4-24 through 4-26.

4.4.4 Exceptions to SV Work Plan and QAPjP Requirements

A few procedural modifications to Reference(2) occurred during implementation of the monitoring well purging and sampling field activities. In general, the modifications consisted of the following:

- Monitoring well B3004 was not purged or sampled because it did not produce any water.
- A few monitoring wells were not purged prior to sampling (MW-SV1 during sampling for SVOCs and metals, and H-21 and H-22 during resampling for metals).
- The turbidity and some of the other field parameters had not stabilized at every monitoring well prior to collecting the groundwater samples.
- One filtered metals sample had to be preserved at the laboratory instead of in the field.

A complete listing of the modifications is presented in Table 4-20 along with an explanation of the rationale for the change.

4.5 Soil Gas Survey

Soil gas survey points were installed near monitoring well B-15 and along the hill slope southwest of Building H2 by C.T. Male and CH2M HILL personnel between November 20, 2000, and January 3, 2001. The soil gas survey was performed in accordance with Reference(2). Modifications to the soil gas survey procedures presented in Reference(2) are noted where applicable. The protocol for identifying gas sampling points and the measurements taken at each point was to use a prefix “GS30”, for gas survey at SWMU-030 (H2 Processing Facility), followed by a two-digit number identifying the sequence that the point was installed.

Soil gas samples were obtained from below grade locations using temporary soil gas survey points. Each temporary sampling point was constructed of an aluminum expendable shield point attached to a new dedicated section of polypropylene tubing, both of which were inserted into a round steel tube (0.5-inch outside diameter by 4 feet long). The shield point is patented and manufactured by KVA Analytical Systems of Falmouth, Massachusetts. The shield point is tiered such that the slotted intake portion rests inside the steel tube being protected from contact with soil, and the remaining part of the point is larger in diameter than the steel tube allowing the steel tube to drive the point to the desired depth. The steel tube was driven into the ground surface, using a small sledgehammer, 3 to 3.5 feet bg. When the desired depth was reached, the steel tube was then retracted 2 inches leaving the shield point in-place to expose the intake slots, thereby allowing a gas sample to be collected. The annulus between the steel tube and polypropylene tubing was sealed with an expandable/impervious polyurethane foam material.

Once the shield point was exposed, a PID equipped with an 11.7 electronvolt (eV) lamp was immediately attached so that the tubing/soil boring ambient air was evacuated by the internal pump of the PID. The PID was attached to the polypropylene tubing with flexible tubing to prevent ambient air infiltration. At each desired sampling point, an initial soil gas reading was collected when connected, and then 1-minute and 2-minute readings were collected. After the 2-minute reading was collected, the 11.7 eV lamp PID was removed and a second PID equipped with a 10.6 eV lamp was attached for comparison. A soil gas reading was recorded once the reading with the 10.6 eV lamp was sustained. Background readings were recorded from both PIDs prior to collection of the soil gas readings. The PIDs were also calibrated daily. After all of the soil gas readings were collected, the steel tubes were removed from the ground such that the expendable shield point and accompanying polypropylene tubing was left in-place.

During implementation of the work, field activities were documented in bound logbooks with consecutively numbered pages. The soil gas survey locations are shown on Figure 4-1. The soil gas sample location GS3001, in an area of asphalt pavement east of monitoring well B-15, could not be advanced because the pavement could not be penetrated with an electric drill equipped with a carbide drill bit. The location was offset less than 1.5 feet and a second attempt made, but the asphalt could not be penetrated. In addition, a few soil gas survey locations (GS3003 to GS3005, GS3007, and GS3013) could not be advanced to the target depth of 3 to 4 feet bg due to shallow refusal (i.e., gravel, cobbles). PID readings were not measured at soil gas sample locations GS3022 and GS3026 since the limits had already been defined by sample locations with undetected VOCs in soil gas.

A few procedural modifications to Reference(2) occurred during implementation of the soil gas survey field activities. In general, the modifications consisted of the following:

- The SV Work Plan QAPjP specified comparative evaluation of PID readings between a 10.2 and 11.7 eV lamp to determine if the 10.2 eV lamp, which is less sensitive to moisture, could be used. Evaluation of soil gas with an 11.7 eV lamp was required since the ionization potential for carbon tetrachloride (11.47 eV) exceeds the capability of a 10.2 or 10.6 eV lamps. Lamps with a 10.2 eV are not manufactured for the Mini-Rae PID instruments used during the SV fieldwork. Rae Systems Inc. has documented a maximum 5 percent variation between the response of 9.8 and 10.6 eV lamps over a relative humidity range of 25 percent to 90 percent at 25°C (Reference(8)). The variation between a 10.2 and 10.6 eV lamp is expected to be less and therefore use of the 10.6 eV lamp does not result in a significant difference in lamp response to humidity relative to the specified 10.2 eV lamp.

- Because the soil present in the area of investigation was relatively loose, a soil boring was not necessary to effectively install the temporary gas sampling point except for areas covered in asphalt. If present, asphalt was penetrated with an electric drill equipped with a carbide drill bit.

- The temporary soil gas point was constructed slightly differently: a steel rod, expendable shield point, and polypropylene tubing was pre-assembled above grade, driven to the desired depth, and the steel tube surrounding the sample tubing was retracted only enough to expose the screened shield point attached to the tubing below grade.

- The slightly different construction of the soil gas point eliminated the need for sealing the steel tube at grade level with bentonite clay as the annulus between the steel tube and polypropylene tubing was sealed at the top with an expandable/impervious polyurethane foam material to prevent ambient air infiltration.

- Polypropylene tubing was used in-place of polyethylene tubing due to availability and strength.

A complete listing of the modifications is presented in Table 4-27 along with an explanation of the rationale for the change.

4.6 H2 Hillside Sump Sampling

The H2 Hillside Sump captures groundwater intercepted by a drain system surrounding Building H2. The drain system consists of two sections each comprised of 6 inch vitrified tile pipe encased in a gravel backfill. The 302 foot above mean sea level (amsl) elevation section surrounds the perimeter of the Building H2, an area approximately 130 by 75 feet, and was installed as a drain at the base of the H2 foundation. The 318 foot amsl elevation section was installed along the top of the tank vault and serves to intercept infiltrating water and prevent it from saturating the area outside of the tank vault containment walls. No engineering drawings have been found that establish whether flow from the tank vault foundation drains enters the Building H2 drain system.

Each drain system enters the H2 Hillside Sump in separate drain lines. The 318 and 302 foot amsl sections enter the sump at heights of 6.3 feet and 4.3 feet above the bottom of the concrete sump, respectively. Flow from the 302 foot amsl section drops from the pipe about six inches into a metal bucket that overflows into the sump. At the time of sampling, water was not flowing from the 318 foot amsl section, but was flowing from the 302 foot amsl section at an estimated rate of 1 gallon per minute (gpm).

Due to the confined space, the sump was not entered for sampling. The sample was collected by placing a polyethylene tube directly into the bucket and pumping with a peristaltic pump. The tube was positioned approximately mid-way in the bucket. Conductivity, pH, and temperature were measured with an YSI Model 610 flow-through cell. Turbidity was measured with a HACH Model 2100P field turbidimeter. Conductivity, pH, and temperature stabilized (at less than 10 percent variation) within a few minutes with final measurements of 2.53 mS/cm, 8.04, and 7.42^0 C, respectively. Turbidity at the time of sampling was 1.63 NTU.

The sump was sampled for VOCs, SVOCs, and total (unfiltered) metals. Due to the low turbidity, a filtered (dissolved) sample was not collected. The sample identification number was HSGW1.

4.7 K5 Catch Basin Sediment Evaluation

The approximate location of catch basin No. 26 in the Lower Level was located from as-built drawings. Soil was removed with shovels from the hillside on December 1, 2000, to gain access to catch basin No. 26. The excavated soil was temporarily placed on plastic sheeting. A weathered piece of plywood was observed on top of the manhole grate during the excavation activities. Organic vapors were not detected by PID monitoring of the excavated manhole grate.

The base of the concrete structure was observed to be approximately 18 feet below the top of the structure. One effluent and two influent pipes were observed within the concrete structure. An influent pipe, approximately 3 inches in diameter with an invert (bottom most portion) approximately 6.5 feet below the top of the structure, was observed on the eastern wall of the structure. Water was not observed discharging from the pipe at the time of this evaluation. An influent pipe, approximately 24 inches in diameter with an invert approximately 7 feet below the top of the structure, was observed on the southern wall. A moderate flow of water was observed discharging into the catch basin structure from this pipe. A slightly larger effluent pipe was located near the base of the structure on its northern side. Water discharging from the southern influent pipe was falling to the bottom of the structure, where it then entered the effluent pipe. Scour marks were observed on the northern wall of the structure.

The bottom of the structure was “sounded” using Geoprobe tooling rods to assess the presence of sediment. No sediment was observed and, accordingly, a sample was not collected from catch basin No. 26 and the upgradient catch basin No. 5 (formerly labeled as No. 25). Existing utility mapping identifies the catch basin just upstream of catch basin No. 26 as No. 5, not No. 25 as previously stated in Reference(2).

4.8 Sampling Equipment Cleaning Procedures

To minimize the potential for cross-contamination between sample locations and intervals, standardized equipment cleaning procedures were followed during the soil sampling, groundwater sampling, and soil gas survey. The specific cleaning procedures for the sampling equipment are summarized as follows:

Larger equipment that came in contact with the soil being sampled was cleaned with a high-pressure high-temperature washer (steam cleaner) at the beginning of the project upon arrival to the Knolls Site, between investigation areas, and at completion before leaving the Knolls Site. Downhole equipment including drill rods and bits were decontaminated between soil borings. The equipment that underwent steam cleaning included drill rigs (truck or trailer mounted), augers, drill rods, and miscellaneous tools.

Reusable equipment used for soil, groundwater, and soil gas survey was cleaned prior to the initiation of the sampling program. Sampling equipment that came into contact with the soil and/or groundwater during sampling was cleaned between each sample location in accordance with Reference(2). The cleaning procedure was as follows:

1. Physical removal of any soil adhered to the sampling equipment, if necessary
2. Non-phosphate detergent (Alconox) and tap water scrub
3. Tap water rinse
4. Organic-free deionized water or distilled water rinse
5. Air dried, when practical, and then placed on and covered with aluminum foil, as applicable

During groundwater purging and sampling, disposable tubing and disposable or dedicated bailers were used thereby eliminating the necessity for those items to be decontaminated. When the Grundfos® submersible or Waterra pumps were used, they were decontaminated as described above.

New expendable shield points and new polypropylene tubing were used at each soil gas survey location thereby eliminating the necessity for those items to be decontaminated. As an added precaution, each sampling point was assembled and the PID was connected to evacuate and check the air within the polypropylene tubing for possible contamination. Reusable sampling equipment consisted of steel tubes that were cleaned prior to installation and at completion of the work.

4.9 Field Quality Control Samples and Collection Procedures

One equipment blank (EB), field duplicate (FD), and MS/MSD were collected for every 20 normal samples within each of the three investigation areas. A trip blank (TB) also accompanied shipment of soil and groundwater samples submitted to the laboratory for VOCs analyses. The QC samples were collected in the same sample containers and analyzed for the same parameters as the corresponding soil and groundwater samples. The QC sample containers were labeled, packaged, and placed in coolers in the same manner as described for the soil and groundwater samples in Sections 4.2 and 4.4. The QC sampling activities were documented in bound logbooks, and the samples were recorded on the COC record form.

The QC samples collected for the project are summarized in Tables 4-28 through 4-30. The procedures for collection of QC samples are discussed below:

Equipment Blanks. The soil sampling EBs were collected by pouring deionized, organic-free water through an acetate liner into a clean stainless-steel bowl containing a cleaned scoopula and shoe from a split-barrel sampler. The sample containers were then filled with the rinse water in order of decreasing volatility. The EB for groundwater sampling with the Grundfos® (submersible) pump was collected by placing the clean submersible pump in a tub of deionized, organic-free water and pumping the water through the tubing and the YSI Model 6820 or Model 6920 field parameter meter directly into the laboratory containers. The EB for groundwater sampling with the peristaltic pump was collected by pumping deionized, organic-free water through the new tubing directly into the laboratory containers. For the filtered metals analysis, the deionized, organic-free water was also pumped through a new filter (0.45 μ). The sample containers were filled in order of decreasing volatility.

Trip Blanks. TBs, which were prepared and supplied by the laboratory, consisted of two 40-milliliter (mL) vials of laboratory-supplied water preserved with hydrochloric acid (HCl). The TBs accompanied the samples through collection, packaging, and shipment to the laboratory. TBs were also recorded on the COC record form.

Field Duplicates. Soil FDs for VOCs analysis were collected from the same locations or intervals as the regular VOCs sample. The FD samples were collected by alternately placing an equal amount of soil from each location in the sample interval into the sample jar and the duplicate sample jar until both containers were full. To collect the SVOCs and metals FD samples, the regular sample container and the duplicate sample container were filled by scooping up small portions of the homogenized soil and alternately placing equal portions of soil into each container until full. Groundwater FD samples were collected by alternately placing equal aliquots of water from the sampling device into the sample containers and duplicate sample containers. The VOC sample containers were filled first, followed by the SVOC sample containers, and then the metals sample containers.

Matrix Spike/Matrix Spike Duplicates. The soil MS/MSD samples were collected in the same manner as the FD samples. The groundwater MS/MSD samples were collected by alternately placing equal aliquots of water from the sampling device into the sample containers and the MS/MSD sample containers. The VOC sample containers were filled first, followed by the SVOC sample containers, and then the metals sample containers.

A few procedural modifications to Reference(2) occurred during implementation of the field activities. In general the modifications consisted of the following:

- Field quality control samples were collected within each of the three investigation areas at an overall frequency required by the QAPjP (e.g., one MS/MSD for every 20 normal sample collected). However, the rate of collection for MS/MSD, FD, and EB quality control samples was not always consistent (e.g., one MS/MSD out of every 20th consecutive normal sample). As indicated in Appendix B, the global impact of the sample matrix is consistent and did not affect the usability of the data. The data support that MS/MSD accuracy and precision, surrogate recovery, and field duplicate precision did not influence the final numerical result. There is no impact on data quality resulting from varying rates of quality control sample collection.
- Two sets of sample containers were filled instead of three containers for the MS/MSD soil samples as approved by the analytical laboratory.

- The acetate liner and shoe from a split-barrel sampler were used in place of a split-barrel sampler for the collection of EBs.
- On two occasions, no TB accompanied the groundwater samples submitted to the laboratory for VOC analysis. VOCs were infrequently detected in TBs (see Appendix B, Table B-5) indicting VOC introduction through sample handling was minimal. Therefore, there is little impact on sample quality resulting from the missing trip blank data.

A complete listing of the modifications is presented in Table 4-31 along with an explanation of the rationale for the change.

4.10 Land Survey

The ground surface elevation and horizontal location of each soil boring and soil gas survey location advanced during the SV was surveyed by C.T. Male surveyors under the supervision of a New York State licensed surveyor. The new monitoring wells were located horizontally, and the vertical elevation of the flush mount cover and the top (reference point) of the PVC well riser pipe were measured. The vertical elevations were measured through differential leveling methods to the nearest 0.01 foot based on KAPL control monument No. 20 at elevation 252.619 feet. The vertical elevations are based on the National Geodetic Vertical Datum (NGVD), 1929. The horizontal locations are based on the New York State Plane Coordinate System, East Zone, North American Datum (NAD), 1927. A tabulated copy of the land survey results including location identification, horizontal coordinates (northing and easting), and vertical elevations are presented in Appendix E.

The soil boring locations, soil gas survey locations, and monitoring well locations were incorporated into a KAPL base map in accordance with the horizontal coordinates, and a computer-aided design drawing (CAD) was generated. The CAD base map drawings showing the soil boring, soil gas, and monitoring well locations in the Upper Level, Lower Level, and Land Area are presented as Figures 4-1 through 4-3.

4.11 Waste Management Activities

Investigation-derived wastes consisting of soil cuttings, decontamination water and groundwater purge water were managed in accordance with Section 6.0 of Reference(2). Soil cuttings were placed within the soil boring, with any remaining open soil boring filled with bentonite granules. Cuttings from soil borings completed as monitoring wells were placed on the ground surface within the general SWMU area, protected with a tarp over the winter, and seeded in the spring. Cuttings from soil borings along the pipe tunnel and adjacent to Building H2 were placed in the grassy area north of Building H2, which is the only area in the vicinity of Building H2 not covered by asphalt or geomembrane. Cuttings from monitoring wells installed in front of the K5 Retention Basin were stabilized along the north wall of the K5 Retention Basin and those from the front of the K6 Storage Pad were placed on the earthen floor of the K6 Storage Pad. No soil boring cuttings exhibited field evidence indicating the presence of hazardous constituents (e.g., staining, hazardous anthropogenic material, or PID readings).

Groundwater produced from purging and developing groundwater monitoring wells was dispensed on the ground surface near the wellhead. Decontamination water from field decontamination of downhole equipment was dispensed on the ground surface adjacent to the soil boring or well installation/sampling locations or disposed in accordance with KAPL's waste management procedures (Building H2 water treatment system via KAPL's State Pollutant Discharge Elimination System (SPDES) permit). No groundwater or decontamination water showed field evidence (e.g., sheen, odor, or PID readings) of contamination. Only non-phosphate (Alconox) detergent and water were used during the decontamination process.

However, groundwater from monitoring wells along the pipe tunnel and Building H2 and associated decontamination water was dispensed on the ground surface north of Building H2 due to the presence of impermeable asphalt or geomembrane in the vicinity of the wells.

PPE such as Tyvek coveralls and gloves were disposed of as nonhazardous waste in accordance with Knolls Site waste management procedures.

4.12 Analytical Methods

The analytical portion of the project was executed by laboratories that possessed a certification rendered by the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program. Lionville Laboratory, Inc., formerly RECRA Environmental Inc., (certification number 106529) was used for all samples collected through February, 2001. Due to sample throughput concerns during the supplemental sampling field work, samples collected during June and July, 2001, were analyzed by General Engineering Laboratory, Inc. (certification number 11501).

NYSDEC ASP Category B data deliverables were provided for the analyses. The appropriate quality assurance data validation summary report (Appendix A) accompanied each data package.

All laboratory analytical methods, including QA/QC procedures, conformed to the most current EPA SW-846 requirements. The laboratory analytical results were reported and documented in a manner conforming with SW-846 protocols and the NYSDEC Analytical Services Protocol (ASP) requirements. NYSDEC ASP approves Inductively Coupled Plasma Spectrometry (ICPS) for the determination of traditional graphite furnace elements such as arsenic, lead, selenium, and thallium. The laboratories did analyze these elements by method SW846 6010B. Method detection limits (MDLs) were well within the QAPjP requirements (see Appendix B).

Samples were analyzed for SVOCs (SW846 8270C), VOCs (SW846 8260B), and metals (SW846 6010B and the 7470/7471 for mercury) in accordance with the NYSDEC ASP guidance.

4.13 Data Validation Procedures

The purpose of the data quality evaluation process is to assess the effect of the overall analytical process on the usability of the data. The two major categories of data evaluation are laboratory performance and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements regarding whether the laboratory did, or did not, analyze the samples within the limits of the analytical method. Evaluation of matrix interferences is subtler and involves the analysis of several areas of results including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results.

Before the analytical results were released by the laboratory, both the sample and QC data were carefully reviewed to verify sample identity, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data were reduced and the resulting data were reviewed to ascertain whether they were within the laboratory-defined limits for accuracy and precision. Any non-conforming data were discussed in the data package cover letter and case narrative.

The hard copy data packages were reviewed by the project chemists applying the review criteria outlined in the U.S. Environmental Protection Agency (EPA) guidance documents *Contract Laboratory Program National Functional Guidelines for Organic Data Review (1999)* (Reference(9)) and *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (1994)* (Reference(10)). These documents, known collectively as the National Functional Guidelines (NFG), are specific to NYSDEC protocol for data validation. Areas of review (when applicable to the method) included holding time compliance, calibration verification, blank results, matrix spike precision and accuracy, method accuracy as demonstrated by Laboratory Control Samples (LCSs), field duplicate results, surrogate recoveries, internal standard performance, and interference checks. A data review worksheet was completed for each of these data packages, and any non-conformances were documented. Additionally, as per NFG, calculations were performed in order to verify laboratory reported results. This data review and validation process is independent of the laboratory's checks and focuses on the usability of the data to support the project data interpretation and decision-making processes.

Data that were not within the acceptance limits were appended with a qualifying flag that consists of a single or double letter abbreviation that qualifies the data. Although the qualifying flags are appended to data records during the database query process, they are also included in the final data summary tables deliverable so that the data will not be used indiscriminately. These also include secondary (two-digit “sub-qualifier”) flags that are entered into the comments field of the database. The secondary qualifiers provide the reasoning behind the assignment of a qualifier to the data. The following primary flags were used to qualify the data:

- U—Undetected. Analyte was analyzed for, but was not detected above the MDL.
- UJ—Detection limit estimated. Analyte was analyzed for, and qualified as not detected. The result is estimated.
- J—Estimated. The analyte was present, but the reported value may not be accurate or precise.
- R—Rejected. The data are unusable. (Note: Analyte/compound may or may not be present.)

Numerical sample results that are greater than the MDL but less than the laboratory reporting limit (RL) are qualified with a "J" for estimated, as required by NFG.

The entire database was queried for frequency of detection in blanks and samples, detailed listing of blank detects, MS/MSD results, field duplicate precision, surrogate recoveries, and preparation and analysis dates pertaining to holding times. The queries were then manipulated to calculate necessary statistics for global evaluation of the data. The results of the data quality evaluation of the SV data are presented and discussed in Appendix B. Overall, conclusions are summarized as follows:

- The laboratory analyzed the samples according to the EPA methods stated in Reference(2) as demonstrated by the deliverable summaries and analytical run sequences.
- The blank spike/blank spike duplicate (BS/BSD) accuracy and precision results indicate that the analytical methods were in control within the laboratory.
- Sample results for metals and organics above the MDL but less than the RL (i.e., "J" values) may be attributed to instrument noise and/or low-level contamination (sampling or laboratory) and not site-related activities and as such may be false positives.

- Concentrations of methylene chloride, methyl ethyl ketone, acetone, and the phthalates result from laboratory and field blank contamination and are not further evaluated as environmental contaminants.

- The semivolatile fraction realized some matrix interferences that yielded the majority of the rejected data in this sample set. Including all analyses, 84.8 percent of the data are usable. The laboratory reanalyzed most of the semivolatile fraction resulting in acceptable data. When the initially rejected data are replaced with acceptable reanalyzed data, the resulting percentage of usable data increases to 99.6 percent, exceeding the project completeness goal of 95 percent. Reanalysis of SVOC samples resulted in some qualified data, as discussed in Appendix B.

- Eighty-one antimony results were rejected due to low matrix spike recoveries (<30 percent). Antimony is a recognized poor performer in solid matrices utilizing standard EPA methodologies.

- Field duplicate results indicate good field sampling precision and homogeneity of the sample matrix.

Data quality findings specific to each geographic area are summarized in Sections 5.4, 6.4, and 7.4. Laboratory case narratives, analytical form 1s, and chains of custody are included as Appendix A.

5.0 Upper Level SWMUs

5.1 SV Characterization Objectives

Characterization objectives for soil, groundwater, and soil gas at the H2 Processing Facility (SWMU-030), the H2 Tank Farm (SWMU-031), and the Pipe Tunnels (SWMU-057) developed in the SV Work Plan (Reference(2)) are summarized and presented in Table 5-1. An evaluation of the field performance relative to the objectives is also presented in Table 5-1. SV Work Plan objectives were met with the exception of soil boring B3002, which encountered refusal prior to reaching the Building H2 foundation, and soil boring B5702 which encountered underground utilities at a shallow depth and was abandoned. During the supplement field work performed in June and July 2001, additional samples were taken at soil borings B3004 and B3103 to augment the original dataset. Groundwater samples were also collected from a monitoring well at B3103 (MW-SV8). A temporary well was installed at B3004, but was dry.

5.2 Geology

The subsurface conditions within the Upper Level were evaluated through the completion of: 1) 11 soil borings (see Table 4-1, Section 4.0) and five monitoring well installations completed at the H2 Processing Facility (SWMU-030), the H2 Tank Farm (SWMU-031), and the Pipe Tunnels (SWMU-057), undertaken as part of this SV (see Appendix D); and 2) existing boring logs for other soil borings and monitoring wells previously completed within the Upper Level.

The soil borings completed adjacent to Building H2 were used to prepare geologic cross sections A-A′, B-B′, and C-C′ as shown on Figure 5-1. Figures 5-2 through 5-4 provide the geologic cross sections for A-A′ running northeast to southwest, B-B′ running east to west, and C-C′ running northwest to southeast, respectively.

Soil borings B3001 and B3003 were used to construct cross section A-A′ as provided in Figure 5-2. Each of these soil borings was completed within 10 feet of the exterior wall of

Building H2. Beneath the asphalt pavement and sub-base sand and gravel is a till-derived fill that appears to have been used as backfill around the building's foundation wall. Till-derived fill is defined as a till that has been excavated, reworked and placed as a fill material. The composition of the till-derived fill is predominately a clay and silt material with varying percentages of sand and gravel. Soil boring B3001 was extended to a total depth of 27.4 feet bg. The till-derived fill at B3001 extended to a depth of approximately 24 feet bg above the native gray till. At soil boring B3003, till-derived fill was encountered to a depth of 24 feet bg, below which was a native gray till, and the boring was terminated at a depth of 27.8 feet bg.

Figure 5-3 presents cross section B-B′ across the Pipe Tunnel running between Buildings G2 and H2. The dimensions and depth of the tunnel were taken from historic construction drawings. Soil borings B5703 and B5704 were completed on the east and west sides of the tunnel, respectively, within 4 feet of the exterior wall of the tunnel. An additional boring was initially attempted approximately 3 feet west of B5704, but was terminated at a depth of 9 feet bg after encountering gray till at a depth of 5 feet bg. Soil borings B5703 and B5704 were terminated at depths of 18.4 and 16.2 feet bg, respectively, and till-derived fill was encountered within each boring to a depth of approximately 15 and 13 feet bg, respectively. Native gray till was encountered directly beneath the till-derived fill at each boring location.

According to construction drawings, the elevation of the bottom of the Pipe Tunnel footing at cross section B-B′ is 316 feet amsl. The elevation of the bottom of the footing at Building H2 is approximately 305 feet amsl, approximately 11 feet lower than the Pipe Tunnel. In review of construction drawings for the Pipe Tunnel and Building H2, the Pipe Tunnel footing slopes downward from 324 feet amsl at Building G2 to a point approximately 56 feet north of Building G2, where the bottom of the tunnel footing runs level to Building H2 (approximately 37 feet north) at an elevation of approximately 316 feet amsl. In review of the soil boring data adjacent to the Pipe Tunnel and adjacent to Building H2, it is expected that till-derived fill placed around the Pipe Tunnel is contiguous with the till-derived fill placed within the foundation excavation along the southeastern wall of Building H2. Based on the historical site photographs and building construction drawings, it is expected that the gray till surface beneath the Pipe Tunnel descends steeply downward to the base of the foundation excavation along the southern wall of Building H2, at a point between soil borings B5704 and B5701. Thus, a potential pathway exists for groundwater migrating adjacent to the Pipe Tunnel to intercept the Building H2 footing drain.

Figure 5-4 presents cross section C-C′. This cross section covers the southwest corner of Building H2 and depicts the subsurface conditions for soil borings B3002 and B3003. Soil boring B3002 was completed within 10 feet of the exterior wall of Building H2. Beneath the pavement and sub-base sand and gravel at B3002, till-derived fill was present to a depth approximately 21.5 feet bg. Gray till was present directly beneath the till-derived fill, and the boring was terminated at 22.2 feet bg.

On each end of the cross sections A-A′ and C-C′, the lateral contact between the till-derived fill and gray till is inferred based on historical photographs taken during the initial construction of Building H2.

Soil borings H-20, H-21, H-22, H-24, H-26, and H-28 were completed in 1973 along the western and northwestern sides of the exterior wall of Building H2. The boring logs for these soil borings identify soils composed of silt, sand, gravel, and clay from grade to depths of 20 to 26 feet bg. This soil was classified as fill and is likely to be till-derived fill. Gray till was present directly beneath the fill material, with the exception of soil boring H-26, where a 3-foot layer of brown gravel was present beneath the fill, on top of the gray till, between the depths of 20 and 23 feet bg.

5.3 Hydrogeology

5.3.1 General

Based on the water level data collected from the monitoring wells within the Upper Level as presented in Table 4-14 (Section 4.0), two distinct groundwater flow patterns exist within the area. One pattern is within the fill materials placed within the construction excavations for Building H2, the H2 Tank Farm, and the Pipe Tunnel, primarily contained and controlled by the limits of the excavations. The second flow pattern (water levels from existing KAPL monitoring wells) is considered not to be significantly influenced by building excavations. This area is located on the hillside slope and Lower Level Road, west of

Building H2. An overall water table contour map of the Upper Level is presented as Figures 5-5 and 5-6 for the dates of March 20, 2001 and June 26, 2001, respectively.

5.3.2 Building H2, Tank Farm, and Pipe Tunnel

Groundwater was measured on March 20 and June 26, 2001, in the monitoring wells (SV-1 through SV-3) adjacent to the Pipe Tunnel and Building H2 at depths of approximately 12 to 13 feet bg and 22 feet bg, respectively. In each instance and on both dates, the groundwater was found to be perched within the till-derived fill above the native gray till. The relative moisture content of the gray till below the fill/till interface at each of the soil borings was logged as damp and moist, a further indication that the groundwater present in the borings is perched above the gray till. At MW-SV8, completed south of the H2 Tank Farm, groundwater was also found to be perched within the till-derived fill above the native gray till at 27.9 feet bg on June 26, 2001.

Groundwater present within the till-derived fill used as backfill around Building H2 and the Pipe Tunnel is primarily contained laterally and vertically by the gray till in which the buildings and structures are constructed. These conduits within the gray till act as a preferred pathways for groundwater migration as the till-derived fill is generally more permeable than the native gray till. The slope of the gray till surface, as it was left following construction of Building H2, the Tank Farm, and the Pipe Tunnel, also controls in part the movement of groundwater perched on top of its surface.

In review of the March 20, 2001, water level data (Table 4-14, Section 4.0) collected from the SV monitoring wells and the "H" series cased borings, it appears that groundwater movement within the backfill around the Pipe Tunnel flows in a northerly direction toward the southern wall of Building H2. Upon intercepting the backfill around Building H2, the groundwater migrates to the west and to the southwest corner of Building H2. From this point, the groundwater migrates to the north along the western building wall to the northwest corner of Building H2. The groundwater elevation at cased boring H-22 (northwest corner of Building H2) was the lowest of each of the monitoring wells constructed adjacent to and around the exterior wall of Building H2. Water levels measured on March 20, 2001, within cased borings H-21, H-22, H-26, and MW52-1 were significantly lower (3.34 to 9.61 feet) than the initial water levels measured December 13 and 14, 2000, prior to purging (see Table 4-14, Section 4.0). Water levels shown on Table 4-14 (Section 4.0) and Figure 5-5 reveal that these cased borings and MW52-1 never fully recovered. Therefore, groundwater flow along the footing to the north of Building H2 and the Tank Farm is not indicative of water table elevations and can only be assumed to flow towards the northwest corner of Building H2 as indicated on Figure 5-5.

At the location of cased boring H-26, between the northwest corner of Building H2 (cased boring H-24) to approximately halfway along the northern wall of Building H2 (cased boring H-28), there appears to be a minor groundwater trough at the location of cased boring H-26. In accordance with the water level data from March 20, 2001, the water level at H-26 is approximately 1.5 feet lower than at H-24 to the west and H-28 to the east. A layer of gravel was noted in an existing boring log of H-26 at a depth of 20 to 23 feet bg.

The June 26, 2001, water level data collected from the monitoring wells installed adjacent to the Pipe Tunnel, Tank Farm (including MW-SV8), and Building H2 were used to determine the direction of groundwater flow within the fill used as backfill around these structures. As depicted in Figure 5-6, the movement of groundwater within the backfill is similar to that presented in Figure 5-5. However, between monitoring wells MW-SV3 and MW-SV8, it appears that flow is west to east. Also, the groundwater elevation at H-26 was approximately 1.6 feet higher than at H-24 and H-28, which contradicts the March 2001 water levels.

5.3.3 North of Building H2

The depth to groundwater within the monitoring wells installed outside of the excavated areas of Building H2 and the Pipe Tunnel ranged from approximately 3 to 7 feet bg. At the monitoring well locations situated at the same approximate elevation as Building H2 (B-8, B-9, and KH-16), the groundwater level was slightly above the fill/till interface. Groundwater flow within this grouping of monitoring wells is to the west and north based on the groundwater level data recorded on March 20, 2001 and June 26, 2001 (Table 4-14, Section 4.0). This flow pattern is similar to the ground surface topography of the area and may be primarily influenced by the topography of the fill/till interface.

5.3.4 Lower Level Road

The March 20, 2001, groundwater levels within the monitoring wells located along the eastern side of the Lower Level Road (KH-15, B-16, and B-26) were found within the native soils present at these boring/well locations at depths ranging from approximately 4 to 7 feet bg. The groundwater flow direction is westerly from Building H2 down the slope to the Lower Level Road. The groundwater flow direction skews to the northwest as it approaches the Lower Level Road cut. Water levels within monitoring wells KH-15, B-16, and B-26 were not recorded on June 26, 2001.

5.3.5 Bedrock

One bedrock monitoring well (MW52-2) is present within the Upper Level. According to the well log for MW52-2, bedrock was encountered at a depth of approximately 65 feet bg. The bedrock was then drilled out another 70 feet to a total depth of 136 feet bg. The water level within the well was recorded at a depth of approximately 95 feet bg. In accordance with this data, the groundwater within the bedrock is separate from the groundwater found both perched and within the native tills within the Upper Level. Because there is only one bedrock well in the vicinity of Building H2, the direction of groundwater movement within the bedrock is not defined.

5.4 SV Investigation Results

The following subsections discuss detected VOCs, SVOCs, and metals in soil and groundwater within the Upper Level. An evaluation of these constituents in both soil and groundwater is also provided. The term "elevated" concentration is used throughout this report. Elevated concentrations in soil are those that exceed background concentrations. Background concentrations for soil were established by:

- Any detected VOC concentration not associated with laboratory or field sampling contamination;
- Any detected SVOC concentration not associated with interferences (i.e., asphalt, construction materials, and laboratory contamination); and

- The calculated Upper Tolerance Limit (UTL) statistic for the SV metals that estimates site-specific background levels following the methodology discussed in Appendix G.

In addition, metals data were evaluated against background ranges obtained from the J7 Scrap and Salvage RCRA Facility Investigation (RFI) Draft Report (Reference(11)) and other published background ranges for the Albany area, New York State, and the northeastern and eastern United States (Reference(12). NYSDEC recommended soil cleanup objectives (Reference(13)) are used for comparison purposes, where applicable.

Groundwater VOC, SVOC, and metal results that are not associated with laboratory or field contamination are compared to NYSDEC ambient water quality standards for groundwater (Reference(14)) and are considered elevated if they exceed their respected standard or guidance value. Total (unfiltered) metal results are not representative of groundwater quality (particulate inclusion with greater than 5 NTUs), as previously established in the KAPL Annual Environmental Monitoring Report (Reference(15)). Therefore, the filtered (dissolved) results, when available, are compared to NYSDEC ambient water quality standards for groundwater.

5.4.1 Soil Gas Survey

Table 5-2 lists the VOC soil gas concentrations from 32 sample locations along the hillside adjacent to Building H2. Figure 5-7 identifies survey locations where sustained soil gas concentrations exceeded 2 ppm, as determined by field PID screening further discussed in Section 4.5.

A total of 32 soil gas survey locations were field screened between November 22 and 29, 2000 and January 3, 2001, by an 11.7 and/or 10.6 eV PID. Initial and sustained PID readings were recorded as maximum readings and stabilized readings after two minutes of purging, respectively. Sustained PID readings (greater than or equal to 1 ppm) were detected at five soil gas survey locations, of which three locations (GS3018, GS3019, and GS3020 at 3, 5, and 4.9 ppm, respectively) were greater than 2 ppm.

Twelve of these 32 soil gas survey locations were added to 1) completely bound locations that sustained PID readings greater than 2 ppm at GS3018, GS3019, and GS3020; 2) evaluate conditions downslope of a steep break along the hillside; and 3) evaluate conditions adjacent to the west side of Building H2 and below the geomembrane material covering this surface area.

Soil gas survey locations GS3018, GS3019, and GS3020 are co-located along the hillside west of Building H2, approximately 30 feet west of the fence line (see Figure 5-7). PID readings exceeding 2 ppm were bounded on all sides by non-detects or VOC concentrations less than 2 ppm. Sustained PID readings greater than 2 ppm at these three locations were not traced back towards Building H2. However, sustained PID readings may be a result from their screened elevations (measured from approximately 312 to 316 feet amsl) being closer to the vadose zone containing VOCs perched above the surface of the till along the southwestern side of Building H2.

Soil gas measurements obtained on January 3, 2001, used only a 10.6 eV lamp due to the lack of response of the 11.7 eV lamp. An initial elevated PID reading of 4.7 ppm was measured at GS0330, but almost immediately dropped off to less than 2 ppm and was interpreted as moisture condensation exacerbated by cold temperatures. Similarly, background PID readings were recorded at four of the five locations surveyed that day as indicated on Table 5-2.

5.4.2 VOCs in Upper Level Soil

A total of 21 soil samples and two duplicate samples were collected and analyzed for VOCs from 11 of the soil borings (see Table 4-4, Section 4.0). Eleven VOCs were detected in eight of the soil borings as summarized in Table 5-3 and are provided as a complete dataset in Appendix C. Figure 5-8 depicts VOCs that are not considered to be associated with laboratory or field sampling contamination and/or are potential release indicators as discussed below.

No PID readings were detected above background in any of the soil samples collected. VOCs were collected from the fill/till interface or the foundation drain materials from nine soil borings within the Upper Level. The remaining two soil borings (B3001 and B5703) were not sampled at the lowest interval for VOCs. Instead, the VOC sample from soil boring B3001 was collected from a moist to wet interval first encountered within a granular fill and till-derived fill (10 to 12 feet bg). Soil boring B5703 was collected approximately

3 feet above the fill/till interface within a moist soil interval. Re-drilling for an at-depth VOC sample at B5703 was not considered necessary since a monitoring well was installed at this soil boring location.

VOCs were detected in eight soil borings (B3001, B3003, B3004, B3101, B3103/B3103B, B5701, B5703, and B5704A/B5704). Three of these locations (B3001, B3101, and B5703) detected only acetone and/or methylene chloride, except for a trace level (1J µg/kg) of toluene in B3101 at 26 to 27.8 feet bg. No VOCs were detected above NYSDEC soil cleanup objectives. Acetone and methylene chloride were detected in various soil samples. As discussed in Appendix B, these VOCs are attributed to laboratory interferences and were also detected in a limited number of blanks (i.e., equipment, trip, and method). Chloroform was detected (1J µg/kg) in one sample B5704A (5 to 5.5 feet bg). Chloroform was also detected in various equipment field blanks and is attributable to the chlorinization by-product of municipal water.

The distribution of VOCs in soil is consistent with that expected from a release from the Pipe Tunnel near soil boring B5704, then subsequent transport by groundwater north along the Pipe Tunnel for entry into the Building H2 foundation near soil boring B5701. Based on observed groundwater gradients around Building H2 and the Pipe Tunnel (see Figures 5-5 and 5-6), groundwater flows from soil boring B5704 west toward soil boring B5701. Detected VOCs by SWMU area are discussed below.

H2 Processing Facility (SWMU-030)

Toluene, trichloroethylene (TCE), and total 1,2-dichloroethylene (1,2-DCE) were detected at B3003 (up to 4J µg/kg), southwest corner of Building H2, at 22 to 22.5 feet bg. TCE (9.1 µg/kg) was also detected along the western perimeter of Building H2 at B3004 (22.2 to 22.5 feet bg). Traces of acetone (up to 15J µg/kg) and methylene chloride (up to 46 µg/kg) were also detected in both soil borings.

Low levels of acetone (13 µg/kg) and methylene chloride (18J µg/kg) were detected in B3001, north of Building H2.

H2 Tank Farm (SWMU-031)

Low levels of carbon disulfide (1.4J µg/kg), ethylbenzene (0.41J µg/kg), and toluene (1J µg/kg) were detected at various depths in B3101 and B3103/B3103B located east and south of the Tank Farm, respectively. Carbon disulfide has been observed in field QC blanks, though not those associated with the H2 Tank Farm samples (Appendix B). Low levels of acetone (up to 23J µg/kg) and methylene chloride (up to 39 µg/kg) were detected at various depths in both soil borings.

Pipe Tunnels (SWMU-057)

The highest concentrations of TCE (270 µg/kg) and total 1,2-DCE (150 µg/kg) were detected at B5704 (southwest soil boring of the Pipe Tunnel) at 12.5 to 13 feet bg. TCE (7 µg/kg) was also detected at 6 to 6.3 feet bg within B5704. Traces of 1,1-dichloroethane (1,1-DCA) (2J µg/kg); 1,1-dichloroethylene (1,1-DCE) (5J µg/kg); and vinyl chloride (11J µg/kg) were also detected at 12.5 to 13 feet bg within B5704.

TCE and total 1,2-DCE were detected at B5701 (up to 11 µg/kg) at 22 to 22.5 feet bg, north of B5704.

Acetone (up to 5J µg/kg), chloroform (1J µg/kg), and methylene chloride (up to 17 µg/kg) were detected at various depths in three of the four soil borings.

5.4.3 SVOCs in Upper Level Soil

A total of 41 soil samples and two duplicate samples were collected from various intervals at 11 soil borings and analyzed for SVOCs (see Table 4-4). Up to 16 polynuclear aromatic hydrocarbons (PAHs) (8.2J to 110,000 µg/kg) were detected in all 11 soil borings. Low levels of phenol, 2-chlorophenol, 4-chloro-3-methylphenol, and bis(2-ethylhexyl)phthalate (up to 142J µg/kg) were also detected in six of the soil borings. Detected SVOCs are summarized in Table 5-4 and are provided as a complete dataset in Appendix C.

The discontinuous nature of the elevated PAHs and phenols is indicative of materials (i.e., surface asphalt and asphaltic water proofing on the exterior foundations of Building H2, the Tank Farm, and the Pipe Tunnel and expansion joints in the Pipe Tunnel) containing SVOCs mixed within the backfill excavations. Soil boring logs (Appendix D) indicate traces (<10 percent) of cinders, slag-like material, dark anthropogenic material (typically less than

0.25-inch diameter balls of hard carbon material with a charcoal streak), and organic material (leaves and roots) within fill material backfilling the Building H2, Tank Farm, and Pipe Tunnel construction excavations. Trace levels of detected phthalates, phenol, 2-chlorophenol, and 4-chloro-3-methylphenol are attributed to laboratory interferences as they were also detected in a limited number of blanks (i.e., equipment, trip, and method).

The location of elevated SVOCs do not correlate with detected VOCs. The presence of SVOCs in soil at the Upper Level SWMUs is not likely associated with a release. A summary of detected SVOCs by SWMU area is discussed below.

H2 Processing Facility (SWMU-030)

Up to 14 PAHs were detected at trace levels (18J to 84J μg/kg) in soil borings B3001 (10 to 12 feet bg) and B3002 (0 to 2 and 14 to 16 feet bg). Only 2-methylnaphthalene was detected at 19J μg/kg in B3001 (20 to 22 feet bg). No PAHs were detected in B3001 at the surface (1 to 2 feet bg) or the lowest sampling intervals in B3001 (25 to 26.2 feet bg) and in B3002 (20 to 20.4 feet bg).

Ten PAHs were detected (360J to 2,500 μg/kg) at soil boring location B3003 from 20 to 22 feet bg. Only traces of pyrene (260J μg/kg) and fluoranthene (190J μg/kg) were detected at a shallower depth of 10 to 12 feet bg. No PAHs were detected at the surface (0.1 to 2 feet bg) and at the lowest sampling interval (22 to 22.9 feet bg).

Fifteen PAHs were detected (10.7J to 740 μg/kg) at soil boring location B3004. Trace concentrations were detected throughout the boring with the higher concentrations in the lowest sampling interval (20 to 22 feet bg).

H2 Tank Farm (SWMU-031)

Up to 16 PAHs were detected at all three soil boring locations at the H2 Tank Farm. PAHs detected at soil boring location B3101 (1.33 to 2 feet bg) ranged from 790J to 35,000 μg/kg and at B3102 (0.16 to 2 feet bg) from 200J to 2,600J μg/kg. Traces of PAHs (up to 220J μg/kg) were detected at the lowest sampling interval in both soil borings.

PAHs detected from 10 to 12 feet bg at B3103 were elevated relative to the other two soil borings ranging from 1,060 to 110,000 μg/kg. PAH concentrations in the lowest sampling interval (28.5 to 29 feet bg) attenuate to trace levels (up to 13.2 μg/kg).

Pipe Tunnels (SWMU-057)

Up to 15 PAHs were detected at soil boring locations B5701 (270J to 6,800J μg/kg) and B5704 (29J to 510J) from 5 to 7 feet bg. Traces of PAHs (up to 250J μg/kg) were detected at 15 to 17 feet bg and 18 to 20 feet bg in B5701 and only phenol (42J μg/kg) was detected at depth (12.5 to 13 feet bg) in B5704. No PAHs were detected at depth (22 to 24 feet bg) in B5701. Up to 15 PAHs were detected (20J to 460 μg/kg) in soil boring locations B5702 and B5703 from 5 to 7 feet bg. No PAHs were detected at 10 to 12 feet bg and 15 to 15.8 feet bg in B5703.

5.4.4 Metals in Upper Level Soil

A total of 41 soil samples and two duplicate samples were collected from various intervals and analyzed for metals from 11 of the soil borings (see Table 4-4). Sixteen metals (aluminum, antimony, arsenic, barium, cadmium, calcium, total chromium, lead, magnesium, manganese, mercury, potassium, selenium, sodium, vanadium, and zinc) were detected at slightly elevated levels relative to their respective SV background values as discussed below. These metals are summarized in Table 5-5 and are provided in Appendix C. Figure 5-9 depicts metals elevated above the SV background UTL95 values (see Appendix G), J7 Scrap and Salvage site specific background ranges (Reference(11)) (see Table G-5 in Appendix G), and published background ranges (Reference(12)). Six of the non-hazardous metals (aluminum, calcium, magnesium, manganese, potassium, and sodium) are not depicted on Figure 5-9, because these metals are either within or below one or more of the applicable background ranges previously discussed or are attributed to road salt application and backfill mineralogy.

Calcium (up to 154,000 mg/kg), magnesium (up to 76,900 mg/kg), manganese (up to 955 mg/kg), potassium (up to 45,000 mg/kg), and/or sodium (up to 2,760 mg/kg) were detected at elevated levels in all of the eleven soil borings. These non-hazardous metals are largely attributed to road salt application and backfill mineralogy.

A summary of elevated metals above SV background by SWMU area is provided below.

H2 Processing Facility (SWMU-030)

The following metals are elevated in soil borings adjacent to the H2 Processing Facility:

- Arsenic was elevated (25.2 mg/kg) along with other elevated levels of calcium (129,000J mg/kg) and magnesium (61,000 mg/kg) at soil boring B3002 (0 to 2 feet bg) along the southwest side of Building H2. These metals attenuate with depth at the next deepest sample interval (14 to 16 feet bg). Arsenic exceeds all applicable background ranges as well as the NYSDEC soil cleanup objective.

  Total chromium (19.2 mg/kg) was also slightly elevated at B3002 (14 to 16 feet bg), which attenuates at depth (20 to 20.4 feet bg). Total chromium is below the J7 Scrap and Salvage RFI maximum value (25.7 mg/kg) and the Albany area background range (1.5 to 25 mg/kg).

- Slightly elevated antimony (0.78J mg/kg), mercury (0.14 mg/kg), vanadium (56.7 mg/kg), and the highest concentrations of calcium (154,000J mg/kg) and magnesium (76,900 mg/kg) were detected at soil boring B3003 (0 to 2 feet bg) along the southwest side of Building H2. Mercury and vanadium attenuate with depth at the next deepest sample interval (10 to 12 feet bg). Antimony remains elevated (0.46J mg/kg) at 22 to 22.9 feet bg. Both antimony concentrations exceed the J7 Scrap and Salvage RFI maximum background value (0.31J mg/kg). Mercury slightly exceeds the J7 Scrap and Salvage RFI maximum background value (0.13 mg/kg). Vanadium is below the J7 Scrap and Salvage RFI maximum background value (159 mg/kg) and the eastern United States background range (1 to 300 mg/kg).

- Slightly elevated lead (21.5J mg/kg) and cadmium (0.39J mg/kg) were detected at B3004 (0.5 to 2 feet bg). Lead attenuates with depth at the next deepest sample interval (10 to 12 feet bg) and cadmium attenuates at 20 to 22 feet bg. Lead is below the J7 Scrap and Salvage RFI maximum background value of 40.8 mg/kg and background range of northeastern soils (4 to 61 mg/kg). Cadmium is within the background range of northeastern soils (0.001 to 1 mg/kg).

Elevated levels of antimony, arsenic, and mercury exceed applicable background ranges at the southwest corner of Building H2 (B3002 and B3003), which likely indicates a hazardous constituent release from SPRU operations. However, antimony may be suspect due to matrix interference issues demonstrated in soil samples at the Tank Farm and the Pipe Tunnel.

H2 Tank Farm (SWMU-031)

The following metals are elevated in soil borings adjacent to the H2 Tank Farm:

- Antimony (0.4J mg/kg) was slightly elevated at the final depth of soil boring B3102 (8 to 8.8 feet bg) above the J7 Scrap and Salvage RFI maximum background value (0.31J mg/kg). However, antimony was not detected (<0.13J mg/kg) in the corresponding duplicate sample (FDD002) and therefore is likely a result of matrix interference and not a release indicator.

- Aluminum (up to 18,100J mg/kg) was detected at slightly elevated levels in two soil intervals (10 to 12 and 28.5 to 29 feet bg) at soil boring B3103/B3103B, south of the Tank Farm. Aluminum is below the J7 Scrap and Salvage RFI maximum value (19,799 mg/kg) and the Albany area background range (1,000 to 25,000 mg/kg).

- Cadmium (0.75 mg/kg), lead (45.7 mg/kg), mercury (0.31 mg/kg), and zinc (357J mg/kg) were elevated at soil boring B3101 (1.33 to 2 feet bg), immediately east of the Tank Farm. These metals attenuate with depth at the next sample interval (10 to 12 feet bg) and are laterally bounded by lower concentrations in one direction (west) by soil boring B3102.

  Cadmium and lead are above the J7 Scrap and Salvage maximum background values (<0.03 and 40.8 mg/kg, respectively), but are within the background ranges of the northeastern soils of 0.001 to 1 mg/kg and 4 to 61 mg/kg, respectively.

  Mercury and zinc are both above the J7 Scrap and Salvage RFI maximum values (0.13 mg/kg and 227 mg/kg, respectively), other published background ranges, and the NYSDEC soil cleanup objectives.

- Barium (up to 179 mg/kg), total chromium (up to 26.2 mg/kg), lead (20.7 mg/kg), mercury (0.15 mg/kg), selenium (up to 1.61 mg/kg), vanadium (up to 36.3J mg/kg), and zinc (97.1J mg/kg) were elevated at soil boring B3103 and its offset location B3103B, immediately south of the Tank Farm. With the exception of elevated levels of total chromium, selenium, and vanadium at 0.5 to 2 feet bg, elevated concentrations are deeper than 10 feet bg. Concentrations of barium (179 mg/kg), total chromium (26.2 mg/kg), selenium (0.772 mg/kg), and zinc (97.1J mg/kg) are elevated in the lowermost sampling interval (28.5 to 29 feet bg) collected from backfill materials at the base of the tank vault wall, near its foundation.

Barium is above the J7 Scrap and Salvage maximum background value (81.9J), but is within background ranges for the Albany area (250 to 350 mg/kg) and New York State (15 to 600 mg/kg).

Total chromium slightly exceeds the J7 Scrap and Salvage RFI maximum value (25.7 mg/kg) and Albany area background range (1.5 to 25 mg/kg), but is within the New York State soil range (1.5 to 40 mg/kg).

Lead is below the J7 Scrap and Salvage RFI maximum background value (40.8 mg/kg) and the background range of northeastern soils (4 to 61 mg/kg).

Mercury is above the J7 Scrap and Salvage RFI maximum value (0.13 mg/kg), other published background ranges, and the NYSDEC soil cleanup objective.

Selenium and zinc are below the J7 Scrap and Salvage RFI maximum background values of 1.8J mg/kg and 227 mg/kg, respectively.

Vanadium is below the J7 Scrap and Salvage RFI maximum background value of 159 mg/kg and the eastern United States background range (1 to 300 mg/kg).

Elevated metals detected in the surface soil of B3101 (mercury and zinc) and at deeper samples in B3103/B3103B (mercury) indicate a likely release of hazardous constituents from SPRU operations to the east and south portions of the Tank Farm, respectively. These same metals are also associated with the tank vault residue and debris as indicated by the analytical results discussed in Section 3.1.2.

Pipe Tunnels (SWMU-057)

The following metals are elevated in soil borings along the Pipe Tunnel:

- Antimony is slightly elevated (up to 0.38J mg/kg) in the duplicate sample (FDD001) from boring B5701 (15 to 17 feet bg), B5701 (18 to 20 feet bg), and B5703 (5 to 7 feet bg). Antimony concentrations at these soil borings are just above the SV and the J7 Scrap and Salvage RFI maximum background values (0.29 and 0.31J mg/kg, respectively). Antimony attenuates at the next sample intervals within borings B5701 (22 to 24 feet bg) and B5703 (10 to 12 feet bg). Because antimony (0.17J mg/kg) was not elevated in the corresponding original sample from B5701 (15 to 17 feet bg), variability of antimony is likely a result of matrix interference, and therefore elevated antimony is not a release indicator.

- Cadmium is slightly elevated (0.38 mg/kg) at B5701 (5 to 7 feet bg), but is within the background range of northeastern soils (0.001 to 1 mg/kg).

- Total chromium is slightly elevated (19.1 mg/kg) at B5701 (18 to 20 feet bg), but is below the J7 Scrap and Salvage RFI maximum value (25.7 mg/kg) and Albany area background range (1.5 to 25 mg/kg).

- Lead is slightly elevated (15.9 mg/kg) at B5701 (5 to 7 feet bg), but is well below the J7 Scrap and Salvage RFI maximum background value (40.8 mg/kg) and the background range of northeastern soils (4 to 61 mg/kg).

- Mercury is slightly elevated (0.11 mg/kg) at B5702 (5 to 5.6 feet bg), located near the northeast corner of the Pipe Tunnel, but is below the J7 Scrap and Salvage RFI maximum background value of 0.13 mg/kg.

- Selenium is slightly elevated (0.35 mg/kg) at B5701 (18 to 20 feet bg), but is well below the J7 Scrap and Salvage RFI maximum background value of 1.8 mg/kg.

- Zinc is elevated (112 and 123 mg/kg), but is well below the J7 Scrap and Salvage RFI maximum background value of 227 mg/kg.

Slightly elevated levels of the metals discussed above are all below other applicable background ranges or not confirmed in duplicate sample analyses and therefore do not indicate a release of metal constituents from SPRU operations at the Pipe Tunnel.

5.4.5 VOCs in Upper Level Groundwater

A total of 14 groundwater samples (MW-SV8 was sampled twice) plus two duplicate groundwater samples were collected and analyzed for VOCs from four newly installed monitoring wells (MW-SV1, MW-SV2, MW-SV3, and MW-SV8), three existing 1952 monitoring wells (MW52-1, MW52-2, and MW52-4), and six 1973 cased borings (H-20, H-21, H-22, H-24, H-26, and H-28). Up to six VOCs were detected in three of the monitoring wells/cased borings as discussed below and as summarized in Table 5-6 and depicted on Figure 5-10. Acetone, carbon disulfide, methyl ethyl ketone, and toluene were detected in trace concentrations (4.5J to 21 μg/L). As discussed in Appendix B, these compounds are also detected in a limited number of laboratory or field blanks so their isolated detection in the Upper Level groundwater samples does not likely indicate a release to the environment. No PID readings were detected above background in any of the monitoring wells or cased borings sampled. As described in Section 4.4.3, MW-SV8 was sampled twice; once with a peristaltic pump (sample UPAGW21), and since its low yield could not sustain uninterrupted discharge, again with an inertial pump (sample UPAGW21V2). Temporary well B3004 did not yield groundwater. Detected VOCs by SWMU are summarized below.

H2 Processing Facility (SWMU-030)

A trace of carbon disulfide (5J μg/L) in groundwater from cased boring H-28 was the only VOC detected. No VOCs were detected in the other five cased borings.

H2 Tank Farm (SWMU-031)

No VOCs were detected in monitoring wells MW52-1, MW52-2, and MW52-4. Low levels of acetone and traces of carbon disulfide, methyl ethyl ketone, and toluene detected in the sample (UPAGW21V2) collected from MW-SV8 using an inertial pump are most likely associated with laboratory or field handling of the samples. These compounds were also not detected in the first sample (UPAGW21) collected from MW-SV8 using a peristaltic pump.

Pipe Tunnels (SWMU-057)

VOCs (i.e., TCE and 1,2-DCE) were detected in two of the three newly installed monitoring wells (MW-SV1 and MW-SV3) at trace levels along the west side of the Pipe Tunnel. A trace of carbon disulfide (1J µg/L) was also detected at MW-SV1. The highest concentrations of TCE (18 µg/L) and 1,2-DCE (7 µg/L) were detected in monitoring well MW-SV3, adjacent to Building H2. Trace levels of TCE (2J µg/L) and 1,2 DCE (1J µg/L) were detected in MW-SV1. TCE and 1,2-DCE were also routinely detected in monitoring well B-15, located approximately 75 feet west of the tunnel, during the KAPL Annual Environmental Monitoring Program (Reference(15)). No VOCs were detected in MW-SV2.

5.4.6 SVOCs in Upper Level Groundwater

A total of 21 groundwater samples plus three duplicate samples were collected and analyzed for SVOCs from the same wells/cased borings sampled for VOCs above plus eight existing monitoring wells (B-8, B-9, B-14, B-15, B-16, B-26, KH-15, and KH-16). Up to nine SVOCs were detected in 11 of the monitoring wells/cased borings as discussed below and as summarized in Table 5-7. Trace levels of PAHs detected in wells at the Tank Farm are indicative of materials (i.e., asphaltic water proofing on the exterior foundation) containing PAHs mixed within the backfill material. Trace levels of benzyl alcohol and phthalates detected in nine groundwater samples are attributed to laboratory interferences and, in the case of phthalates, are also detected in a limited number of blanks (i.e., equipment, trip, and method).

Overall, the locations of detected SVOCs do not correlate with detected VOCs. The presence of SVOCs in groundwater at the Upper Level SWMUs is not likely associated with a release from SPRU operations. A summary of detected SVOCs is presented below.

Trace levels (up to 0.8J µg/L) of 2-methylnaphthalene (MW-SV1), phenanthrene (MW-SV1), benzyl alcohol (H-22), and di-n-butylphalate (H-24, MW52-2, and B-26) were detected in five of the 20 monitoring wells/cased borings sampled for SVOCs. Traces of bis (2-ethylhexyl) phthalate (up to 13J µg/L) were also detected in six additional monitoring wells/cased borings (H-26, MW52-4, MW-SV8, B-8, B-14, and B-15).

Trace levels (up to 0.7J µg/L) of benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3,-c,d)pyrene were also detected in MW52-4.

5.4.7 Metals in Upper Level Groundwater

A total of 19 groundwater plus three duplicate samples (including re-sampling for metals as discussed in Section 4.4.2) were collected and analyzed for dissolved (filtered if > 5 NTUs) and total metals from the four newly installed monitoring wells (MW-SV1, MW-SV2, MW-SV3, and MW-SV8), the three existing 1952 monitoring wells (MW52-1, MW52-2, and MW52-4), and the six 1973 cased borings (H-20, H-21, H-22, H-24, H-26, and H-28) as discussed below and summarized in Table 5-8.

Elevated dissolved metal concentrations of magnesium, manganese, and/or sodium were detected in most of the wells. These non-hazardous metals are largely attributed to road salt application and backfill mineralogy. Other dissolved metals were detected below water quality criteria (Reference(14)) except for the following:

- Dissolved iron was elevated in one monitoring well (860 µg/L in MW52-1).
- Estimated concentrations of dissolved antimony were slightly elevated in two cased borings adjacent to the northwest corner of Building H2 (H-28 at 4.3J µg/L and H-22 at 3.1J µg/L).
- A trace level of thallium was detected at 1 µg/L in a duplicate sample (FDGW11) of MW-SV3, but not from the associated corresponding sample. Neither sample was filtered since the groundwater turbidity was less than 5 NTUs.

These isolated detections of dissolved iron and thallium most likely result from construction materials or matrix interference and therefore do not indicate a release to groundwater from Building H2 SPRU operations.

In addition to slightly elevated dissolved antimony in H-22 and H-28, dissolved antimony was also detected in groundwater at lower concentrations in cased borings H-20 and H-21, along the west side of Building H2 (inferred to be downgradient of boring B3003 as shown on Figures 5-5 and 5-6). As discussed in Section 5.4.4., antimony was detected in soil at slightly elevated concentrations at boring B3003 at the southwest portion of Building H2.

Antomony detected in dissolved groundwater samples from H-20, H-21, H-22, and H-28 may indicate the transfer of antimony from soil to groundwater, but is suspect due to the possibility of matrix interference (demonstrated at the Pipe Tunnel and the Tank Farm), low yield of the cased borings, and the construction of the cased borings (i.e., an opened bottom 3-inch diameter PVC pipe backfilled with pea gravel).

Other unfiltered (total) metals were elevated in groundwater, but are associated with high turbidity in low yield wells. This is consistent with the KAPL Annual Environmental Monitoring Program.

5.4.8 Characterization of Hillside Sump Water

No VOCs or SVOCs were detected in the Hillside Sump water. Total (unfiltered) metals (i.e., magnesium and sodium) were elevated at 65,000 µg/L and 409,000 µg/L, respectively. All other metals were below water quality standards and are consistent with the KAPL Annual Environmental Monitoring Program.

6.0 Lower Level SWMUs/AOC

6.1 SV Characterization Objectives

Characterization objectives for surface and subsurface soil and groundwater at the Railroad Staging Area, K5 Retention Basin, the K6 and K7 Storage Pad SWMUs, and the Parking Lot AOC, as developed in the SV Work Plan (Reference(2)), are summarized and presented in Table 6-1. An evaluation of the field performance relative to the objectives is also presented in Table 6-1. Overall, SV Work Plan objectives were met, with the following exceptions:

- Some borings around the K5 Retention Basin did not reach the target depths due to shallow refusal.
- Two borings adjacent to the K5 Retention Basin influent drain line were not sampled due to failure to precisely locate the line with geophysical or drilling methods.

- Only one of two sampling trenches along the influent drain line planned during the supplemental field work was completed due to interferences with utilities.
- There are no upgradient groundwater monitoring wells at the K5 Retention Basin and K6 Storage Pad due to the unsaturated field conditions.

Upgradient groundwater monitoring wells will not be installed; however, there is little impact to the data interpretation since no elevated hazardous constituents were detected in downgradient wells. Additional drilling beneath the K5 Retention Basin and influent drain lines will be performed when the structure is decommissioned and demolished and access to the soil beneath the foundation and drain lines is possible.

6.2 Geology

6.2.1 General

The Lower Level features include the K6 Storage Pad (SWMU-036), the Former K7 Storage Pad (SWMU-037), the Railroad Staging Area (SWMU-038), the K5 Retention Basin (SWMU-040), and the Lower Level Parking Lot (AOC-003). The Lower Level, excluding the Lower Level Parking Lot, is generally characterized as a rectangular-shaped area approximately 1,200 feet long trending southeast/northwest and approximately 150 feet wide trending northeast/southwest. In the area of the K5 Retention Basin, this distance increases to approximately 200 feet.

The Lower Level Parking Lot area is contiguous to the northwestern end of the Lower Level, although physically separated by a chain link fence. It is a rectangular-shaped area approximately 400 feet long along its long axis, which trends south/north, and approximately 120 feet wide along its shorter east/west trending axis.

The subsurface conditions within the Lower Level (SWMUs-036, -037, -038, and -040) were evaluated through the completion of 77 shallow and 16 deep soil borings. The soil borings located in front of the K5 Retention Basin and the K6 Storage Pad (see Figure 6-2) were used to prepare the geologic cross section shown on Figure 6-3. The subsurface conditions within the Lower Level Parking Lot were evaluated through the completion of 12 shallow soil borings. The SV Work Plan planned target depths for each of the soil borings are presented in Table 4-2 (Section 4.0).

Fill materials were encountered at each of the soil boring locations. These fill materials, which are composed of three general types, are characterized as follows:

- **Railbed Ballast**. Composed of darkly colored crushed stone, ash, cinders, and coal.
- **Structural/Granular Fill**. Composed primarily of sand and gravel with lower percentages of finer silt and clay components or crushed stone.
- **Till-derived fill**. Composed primarily of silt and clay with lesser percentages of sand and gravel, or silt and clay with nearly equal percentages of sand and gravel.

Because the planned depth of many of the soil borings was 2 feet bg, the total depth of the fill at these shallow soil boring locations was not defined. For the soil boring locations planned to be terminated at 6 feet bg and deeper, the vertical limits of the fill were in many instances defined.

6.2.2 Railbed Ballast

Within the Lower Level, including the Lower Level Parking Lot, the extent of the railbed ballast was defined as shown on Figure 6-1. The distribution of the railbed ballast is most apparent in the northeastern portions of the Lower Level and coincides with the historical location of the railroad tracks in this area. However, there is an absence of railbed ballast at several boring locations where ballasts would be expected based on the historical location of the railroad tracks. These locations may represent areas where the railbed ballast was excavated as part of construction activities within the Lower Level. The railbed ballast is also present within the southern sections of the Lower Level Parking Lot area. The railbed ballast was not present at the existing ground surface. In most instances, the railbed ballast was found beneath either a thin (<6 inches) surficial layer of topsoil or asphalt pavement, or beneath a layer of structural sand and gravel fill or till-derived fill. Within the defined railbed ballast areas, the thickness of the ballast material varied from 2 inches to greater than approximately 6 feet. However, in most instances, the thickness of the railbed ballast ranged from approximately 9 inches to 2 feet. The depth to the top and bottom of the railbed ballast layer, where encountered, is listed adjacent to its respective soil boring number on Figure 6-1. The soil borings that revealed the thickest layers of railbed ballast were in the area of soil borings B3820 through B3823 east of the K5 Retention Basin, and soil borings B3801, B3803, B3816, B3825, B3848, and B3849, all within the northern portions of the Railroad Staging Area.

Within the former Railroad Staging Area, where the railbed ballast was not present, and beneath the ballast at some locations, fill materials were encountered to depths of approximately 1 foot to greater than 6 feet bg. The fill materials are composed primarily of sand and gravel with lesser percentages of clay and silt, or clay and silt with lesser percentages of sand and gravel. Because the majority of the soil borings were terminated at 2 or 6 feet bg, the vertical limits of the fill were not defined at some of the soil boring locations. The native soil beneath the ballast or other fill material is classified as a brown or dark gray/brown till composed of silt and clay with near equal percentages of sand and gravel.

6.2.3 K6 Storage Pad

Borings B3601 through B3607 were completed at the location of the K6 Storage Pad (SWMU-036). Fill materials were encountered in each of these soil borings from 0 to 8 feet bg. The fill materials present were classified as structural fill composed primarily of sand and gravel or till-derived fill composed of silt and clay with lesser percentages of sand and gravel. Native soil (till) composed of brown clay and silt with lesser percentages of sand and gravel were present beneath the fill materials to either drilling refusal, which was interpreted to be the top of bedrock, or directly over a thin layer (<1 foot) of sand and gravel or weathered bedrock with lesser percentages of silt and clay directly over bedrock. At four of the soil boring locations, plant roots and vegetative debris were noted at depths approximately 8 feet bg, which suggests this was the former natural grade prior to the construction of the K6 Storage Pad structure or that it was mixed in with the fill as it was being placed.

6.2.4 Former K7 Storage Pad

Borings B3701 through B3704 and B3855, completed in the area of the Former K7 Storage Pad (SWMU-037), revealed the presence of fill materials beneath the topsoil layer to total depths ranging from approximately 2 to 5.5 feet bg. Structural type fill composed of fine to coarse gravel with lesser percentages of silt, sand, and clay were present to depths of approximately 2 feet bg. Till-derived fill composed of brown clay with lesser percentages of silt, sand, and gravel was present beneath the structural fill materials. Native gray till composed of clay and silt with lesser percentages of sand and gravel was present beneath the structural fill and/or till-derived fill at each of the soil borings. Vegetative type material noted at soil boring B3855 at a depth of approximately 5.5 feet bg, may represent the former natural grade prior to the construction activities within the area, or may have been mixed in with the fill as it was placed within the construction area. Bedrock was not encountered at any of the soil boring locations.

6.2.5 K5 Retention Basin

The soil borings completed in the area of the K5 Retention Basin (SWMU-040) were numbered B4001 through B4014 (see Figure 6-1). Each of these soil borings (except B4013 and B4014) was completed within the former chain link fence surrounding the K5 Retention Basin. Five of these soil borings were planned and designated as the deep soil borings within the Lower Level. Soil composed mainly of till-derived fill was encountered within the soil borings to depths ranging from 1 to 11.5 feet bg (see Figure 6-3). Undisturbed till, composed of either gray or brown clay with lesser percentages of silt, sand, and gravel, was present beneath the fill soil at each of the soil boring locations excluding B4009 to B4012. At these locations, the fill soils extended to the depth of drilling refusal or bedrock. The undisturbed till beneath the fill soils extended to depths of 6 to 13 feet bg. On the basis of either hollow-stem auger or split-barrel penetration refusal, bedrock is considered to have been encountered at depths ranging from approximately 6 to 14 feet bg at each of the soil boring locations, excluding soil boring B4012. The bedrock fragments within the split-barrel samplers, where recovered, were composed of black shale.

6.2.6 Lower Level Parking Lot

The Lower Level Parking Lot (AOC-003) was investigated through the completion of 12 soil borings (B0301 through B0312). Each boring was advanced to a total depth of 6 feet bg. With the exception of borings B0301 and B0311, which were completed in grass areas adjacent to the parking lot, asphalt with a crushed stone sub-base was penetrated at each of the soil boring locations. Fill soil composed of structural fill and till-derived fill was encountered in each of the borings. Concrete fragments were noted within the upper 2 feet of soils at soil borings B0303 and B0305. Railbed ballast was noted within the upper 2 feet of soils at soil borings B0307, B0308, B0310, and B0312. Extension of railbed ballast into the southern section of the Lower Level Parking Lot area, where there is no evidence of a railbed, indicates possible disturbance and movement of soil out of the Railroad Staging Area. The fill materials were not fully penetrated at any of the soil boring locations.

6.2.7 Geophysical Survey Review

Figures 1, 2, and 3 in the Geophysical Investigation Report (Appendix F) appear to show good correlation between the geophysical anomaly findings and the soil boring data. Correlation appears to exist between the limits of the ballast defined by the soil boring data and the "Distinct Boundary Marking Change in Character of the Soil." Correlation is also apparent between the deep fill materials at K6 Storage Pad structure, and the fill area around the southern fence gate with the mapped "Anomalous Zone Containing Primarily Scattered EM Anomalies Representing Buried Objects or Disturbed Area." Good correlation is also apparent relative to the mapped location of the railbed ballast and fill materials within the Lower Level Parking Lot area. This correlation is based on the soil boring data and the "Distinct Boundary Marking Change in Character of Soil" and mapped "Anomalous Zone Containing Primarily Scattered EM Anomalies Representing Buried Objects or Disturbed Area" shown on Figure 9 (Appendix F).

The two areas of suspected buried debris and/or structures shown on Figure 1 (Appendix F) identified as "Anomalous Zone Containing Primarily Scattered EM Anomalies Representing Buried Objects or Disturbed Area" are located with the grid area generally defined as E440-E520 and N160-N200. The soil borings completed within this general grid area are B3850, B3851, B3866, and B3867. Based on the boring logs for these soil borings, fill materials composed of sand and gravel, crushed stone and till-derived fill were encountered. Anthropogenic materials, staining, or odors were not noted in the recovered soil samples; therefore, the anomaly is not related to buried debris.

Figure 2 from Appendix F identifies three main areas of suspected buried debris and/or structures. The first area is located east of the K7 Storage Pad within grids E840–E890 and N190-N230. Soil boring B3857 was completed within this grid and indicated fill materials present to a depth of at least 6 feet bg. The fill was classified from grade to 6 feet bg as till-derived fill with a layer of wood between the depth of 3.8 and 4.2 feet bg. The origin of the wood has not been defined, but is believed to have been part of the backfill material. No staining or odors were encountered.

The second area of suspected buried debris and/or structures is within the grid area of E930-E980 and N240-N270. Soil boring B3837 was completed in the vicinity of this anomaly, at which approximately 5.6 feet of fill was noted. The fill consisted primarily of till-derived fill; however, a 0.2-foot thick siltstone inclusion was found overlying a thin layer (less than 0.1 foot) of granular fill at the base of the fill directly above gray till. No anthropogenic material, odors, or stains were encountered.

The third area of suspected buried debris and/or structures is within the grid area of E1000-E1020 and N190-N250, north of the K5 Retention Basin. Soil boring B3859 was completed within the eastern portions of the anomaly. At this location, till-derived fill was present to a depth of 6 feet bg. The soil boring was terminated within the till-derived fill such that the vertical extent of the fill was not defined. No anthropogenic material, odors, or stains were encountered.

Figure 3 from Appendix F depicts an area of suspected buried debris and/or structures within the generalized grid area of E1150-E1230 and N230-N290. Soil borings B3818, B3819, and B3841 were advanced in this general grid area. Fill was encountered at B3818 to depths of at least 2 feet bg. At B3819, till-derived fill was encountered to a depth of 6 feet bg. At B3841, till-derived fill and granular fill were encountered to a depth of 4 feet bg. No anthropogenic material, odors, or stains were encountered.

6.3 Hydrogeology

The direction of groundwater flow within the Lower Level was evaluated on the basis of groundwater elevation data collected on March 20, 2001, from existing KAPL monitoring wells KH-20, KH-21, and KH-22 and from SV monitoring wells MW-SV4 through MW-SV7, as listed in Table 4-15 (Section 4.0). As presented in Figure 6-4, the overall direction of groundwater flow within the area is from the southwest to the northeast toward the Mohawk River. According to the boring logs for monitoring wells KH-21 and KH-22, both of these wells were constructed with the screened portion of the well sealed within the bedrock. SV monitoring wells MW-SV4 through MW-SV7 were installed downslope of the K5 Retention Basin and K6 Storage Pad. The bottom of the well screens for monitoring wells MW-SV4, MW-SV5, and MW-SV7 were set at the base of the soil borings, which in each instance was within the weathered portions of shale bedrock. A 5 foot section of well screen was used at each of these locations, which straddled the fill/till interface. The 5 foot section of well screen within MW-SV6 was installed approximately 1.8 feet above the top of bedrock and extended up to a point that straddled the fill/till interface.

The depth to groundwater relative to the ground surface at each of the "KH" designated monitoring wells was approximately 12 feet bg. Because the screened sections of monitoring wells KH-21 and KH-22 were sealed within the bedrock, they represent the groundwater level within the bedrock without being directly influenced by groundwater possibly present within the overburden till and fill. The depth to groundwater relative to ground surface at each of the SV designated monitoring wells was approximately 4 to 6 feet bg. Because the well screens for these wells were installed within either the upper weathered portion of the bedrock in the overburden or directly above the bedrock in the overburden, the water levels within the wells are considered to be representative of the groundwater levels within the overburden soils; however, the well levels may be partially influenced by the groundwater within the underlying bedrock.

The water table within the western section of the Lower Level is within the fill soils above the till interface. Because the permeability of the fill soils is greater than the native till, groundwater migration above the till/fill interface is primarily influenced and controlled by the topography of the fill/till interface and within lenses and pockets of fill soil possessing the higher permeability values. Distinct depressions filled with fill soils were identified within the areas of K5 Retention Basin and K6 Storage Pad. These depressions are likely related to the excavations for foundations and ancillary utilities associated with these structures. Groundwater flow within these isolated and localized depressions are expected to be radially inward to some extent during various times throughout the year. When the depressions become full, the groundwater is then expected to migrate in an easterly direction or in the direction of the slope of the fill/till interface.

6.4 SV Investigation Results

The following subsections discuss detected VOCs, SVOCs, and metals in soil and groundwater within the Lower Level. An evaluation of these constituents in both soil and groundwater is also provided. The term "elevated" concentration is used throughout this report. Elevated concentrations in soil are those that exceed background concentrations. Background concentrations in soil were established by:

- Any detected VOC concentration not associated with laboratory or field sampling contamination;
- Any detected SVOC concentration not associated with interferences (i.e., asphalt, construction materials, and laboratory contamination); and
- Calculating the UTL statistic for the SV metals dataset to obtain site-specific background levels following the methodology discussed in Appendix G.

In addition, metals data were evaluated against background ranges obtained from the J7 Scrap and Salvage RCRA Facility Investigation (RFI) Draft Report (Reference(11)) and other published background ranges for the Albany area, New York State, and the northeastern and eastern United States (Reference(12). NYSDEC recommended soil cleanup objectives (Reference(13)) are used for comparison purposes, where applicable.

Groundwater VOC, SVOC, and metal results that are not associated with laboratory or field contamination are compared to NYSDEC ambient water quality standards for groundwater (Reference(14)) and are considered elevated if they exceed their respective standard or guidance value. Total (unfiltered) metal results are not representative of groundwater quality (particulate inclusion with greater than 5 NTUs), as previously established in the KAPL Annual Environmental Monitoring Report (Reference(15)). Therefore, the filtered (dissolved) results, when available, are compared to NYSDEC ambient water quality standards for groundwater.

6.4.1 VOCs in Lower Level Soil

A total of 109 soil samples plus 14 duplicate samples were collected and analyzed for VOCs from 101 soil borings and one trench. Eleven VOCs (acetone, benzene, carbon disulfide, chlorobenzene, chloroform, methyl ethyl ketone, methylene chloride, TCE, tetrachloroethylene (PCE), toluene, and total xylenes) were detected in 59 soil borings and one trench as summarized in Table 6-2 and Figure 6-5. As discussed in Appendix B, acetone, methyl ethyl ketone, and methylene chloride detection can result from laboratory interferences and are also common laboratory and field contaminants. Detection of these VOCs in Lower Level soil samples does not indicate a hazardous constituent release and are not depicted on Figure 6-5. Other detected VOCs also found in a limited number of field and laboratory blanks included benzene, carbon disulfide, and chloroform are not depicted on Figure 6-5.

Sporatic low-level detections of PCE and TCE (up to 6 µg/kg) in soils indicate isolated releases of VOCs within the Lower Level. Other VOCs including toluene and xylene were identified in trace amounts, most likely from operation of motorized equipment in the Lower Level. No VOC concentrations exceeded NYSDEC recommended soil cleanup levels. A summary of detected VOCs by SWMU/AOC is discussed below:

Lower Level Parking Lot (AOC-003)

Trace detections of the gasoline constituent toluene (1J µg/kg) were found at two soil boring locations (B0301 and B0311 at 4 to 6 feet bg) along the perimeter of the Lower Level Parking Lot asphalt. These detections likely resulted from minor drips from vehicles and runoff from the asphalt roadway and parking lot.

K6 Storage Area (SWMU-036)

No VOCs were detected in soil borings at the K6 Storage Area.

K7 Storage Pad (SWMU-037)

Benzene (3J µg/kg) was detected at soil boring B3703 (4 to 6 feet bg). Trace levels (up to 3J mg/kg) of toluene and total xylenes were detected at B3703 (0.5 to 2 feet bg). Other soil borings (B3701, B3702, and B3855) also detected toluene at trace amounts (up to 2J mg/kg) from 4 to 6 feet bg. This area is located adjacent to an asphalt roadway and has been used on occasion for vehicle parking.

Railroad Staging Area (SWMU-038)

Trace levels of PCE were detected in soil borings B3844 (2J µg/kg from 0.08 to 2 feet bg) and B3864 (6 µg/kg for the original sample and its duplicate from 0.41 to 2 feet bg). TCE (4 to 6 µg/kg) was also detected in these same three samples. Both borings are co-located within the asphalt area of the Sewage Treatment Plant, near the location of the J4 sand filter bed that received soil from the Slurry Drum Storage Area. Samples from B3844 and B3864 were both collected within till-derived fill.

Traces of PCE (0.52J µg/kg) and TCE (3J µg/kg) were also detected at soil boring locations B3807 (4 to 4.5 feet bg) and B3848 (0.5 to 2 feet bg), respectively. Both borings are located in the northwestern portion of the Railroad Staging Area.

Traces of the gasoline constituent toluene (1J to 3J µg/kg) were detected in 15 soil boring locations concentrated primarily along the southwestern perimeter of the Railroad Staging Area. Eleven of the detections occurred within 0.16 to 2 feet bg; the remainder are in the lowest sampled interval from 4 to 6 feet bg. A trace of xylene (2J µg/kg), another gasoline constituent, detected at one soil boring (0.5 to 2 feet bg at B3848) is within this same area. The distribution of these gasoline constituents likely results from motorized equipment operation and parking in this area.

Single detections of chloroform (4J µg/kg) at soil boring B3864 (0.41 to 2 feet bg) and carbon disulfide (4J µg/kg) at soil boring B3865 (0.16 to 2 feet bg) are within the range detected in equipment blanks (1J to 4J µg/kg for chloroform; 1.1J to 15 µg/kg for carbon disulfide). These detections likely result from field sampling or laboratory sources. A trace of chlorobenzene (1J µg/kg) was located in the area containing traces of gasoline constituents.

K5 Retention Basin (SWMU-040)

Trace concentrations of toluene and TCE (2J µg/kg) were detected at soil boring B4005 (6 to 6.4 feet bg) at the interface of structural fill and gray till (6 to 6.4 feet bg). The soil boring is adjacent to the northeastern building foundation and was drilled to refusal in the gray till at a depth of 6.4 feet bg, just below the building foundation. Traces of anthropogenic material (wood) were noted in the structural fill. Toluene and TCE were not detected in groundwater from monitoring wells immediately downgradient from the K5 Retention Basin (see Section 6.4.4).

Chloroform was detected (15 µg/kg) in a soil sample from soil boring B4013, located downslope from the K5 Retention Basin, but was absent in the groundwater sample taken from monitoring well MW-SV6 completed in this same soil boring. Although chloroform was not associated with the equipment blank from this soil sample, it was detected in 21 equipment blanks (see Appendix B) taken throughout the SPRU SV sampling. This isolated detection is within five times the maximum chloroform equipment blank detected concentration (4J µg/L) and likely results from field sampling.

6.4.2 SVOCs in Lower Level Soil

A total of 250 soil samples and 14 duplicate samples were collected from various intervals at 103 soil borings and one trench and analyzed for SVOCs (see Table 4-5). Up to 17 PAHs were detected at concentrations up to 12,000 µg/kg (see Tables 6-3 and 6-4). Other detected SVOCs were 1,2,4-trichlorobenzene, 4-methylphenol (p-cresol), benzyl butyl phthalate, bis(2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octylphthalate, and phenol at concentrations up to 6,100 µg/kg. As discussed in Appendix B, phthalate compounds are detected in field and laboratory blanks and when reported are not the result of hazardous constituent releases.

As shown in Figure 6-6, SVOCs are widely occurring throughout the Lower Level. As described below, these SVOCs most likely result from railroad operations, vehicle emissions, or asphalt within the Lower Level rather than hazardous constituent releases from SPRU operations.

Lower Level Parking Lot (AOC-003)

PAH compounds were detected at three soil boring locations (B0304, B0307, and B0309) along the northwestern perimeter of the asphalt-covered parking area at estimated concentrations up to 2,100J µg/kg. These PAH detections could result from movement of soils from the Railroad Staging Area (see Section 3.2.5) during construction of the parking lot or from the parking lot asphalt.

An isolated occurrence of 1,2,4-trichlorobenzene was detected (350J µg/kg) at soil boring B0303 (0.25 to 2 feet bg), located in the northern portion of the parking lot. NYSDEC does not provide a soil cleanup criteria for 1,2,4-trichlorobenzene (Reference(13)). The compound is only found in low concentration in one other SPRU SV soil boring location (26J µg/kg at B3516 in the Land Area).

K6 Storage Area (SWMU-036)

PAH compounds were detected at two soil boring locations (B3602 and B3606) at the K6 Storage Area at estimated concentrations up to 50J µg/kg. Phenol was also detected at a single soil boring location (75J µg/kg at B3602), located within the railbed ballast material (see Figure 6-1). Phenol is a component of creosote, commonly used to treat railroad ties (Reference(16)).

K7 Storage Pad (SWMU-037)

Low-level detections of PAHs (19 to 34 µg/kg) were found at soil boring B3702, located at the base of the hill slope along the southern perimeter of the Lower Level.

Railroad Staging Area (SWMU-038)

PAH compounds were detected in 43 of the 69 soil borings within the Railroad Staging Area at concentrations up to 12,000 µg/kg. The highest concentrations of PAHs, primarily fluoranthene, pyrene, phenanthrene, benzo(a)anthracene, chrysene, acenaphthylene, naphthalene, and 2-methylnaphthalene, are located along the extent of the former railbed track. Comparison of the extent of PAHs identified on Figure 6-6 and the extent of the railbed ballast shown on Figure 6-1 demonstrates a correlation between the location of PAH detections and railbed ballast. PAHs are components of tar mixtures, preserved wood and partially burnt hydrocarbons and are often associated with the operation of railroads and track construction (Reference(16)). Characterization of samples from within the extent of railroad ballast indicated the presence of black carbonaceous materials. This material was eliminated from the field sample to the highest degree possible, but was not completely avoidable within the sample matrix. Asphalt roadways and walkways located throughout the Lower Level may also be contributing PAHs to surface soil.

Single detections of 4-methylphenol (57J µg/kg) at soil boring B3853 and phenol (29J µg/kg) at soil boring B3860 are located within or adjacent to the railbed ballast. Phenol and 4-methylphenol are components of creosote, commonly used to treat railroad ties (Reference(16)).

K5 Retention Basin (SWMU-040)

PAHs benzo(a)anthracene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene and pyrene were detected in concentrations up to 54 µg/kg in three soil borings and one trench. PAHs detected in the three soil borings surrounding the K5 Retention Basin are similar in concentration to those for the Railroad Staging Area and likely result from asphaltic materials used in the construction of the K5 Retention Basin. PAHs at trench T4001 located upgradient (uphill) of the K5 Retention Basin are between the surface and 1.5 feet bg and are therefore not associated with the influent drain pipe encountered at depth.

6.4.3 Metals in Lower Level Soil

A total of 250 soil samples and 14 duplicate samples were collected from various intervals and analyzed for metals from 103 soil borings and one trench in the Lower Level area (see Tables 6-5 and 6-6). Within these 264 samples analyzed from soil borings across the Lower Level, all 23 metals analyzed were elevated above their respective SV background values in the following decreasing order of frequency: sodium (99), lead (87), selenium (57), arsenic (53), total chromium (51), vanadium (51), magnesium (42), cobalt (42), potassium (37), zinc (32), manganese (30), copper (31), calcium (29), thallium (28), mercury (26), antimony (25), barium (24), cadmium (23), nickel (21), iron (20), aluminum (19), silver (13), and beryllium (1).

Calcium (up to 120,000 mg/kg), magnesium (up to 56,500 mg/kg), manganese (up to 1,820 mg/kg), and sodium (up to 1,350 mg/kg) were detected in soil borings throughout the

Lower Level. These non-hazardous metals are largely attributed to road salt application and soil mineralogy.

The following metals were detected in concentrations within the J7 Scrap and Salvage RFI maximum background value or published background ranges and therefore likely result from natural variability in fill materials:

- Aluminum (up to 17,800 mg/kg) is below the J7 Scrap and Salvage RFI maximum background concentration (19,700 mg/kg) and within the Albany area (1,000 to 25,000 mg/kg) background range.
- Barium (up to 212 mg/kg) is above the J7 Scrap and Salvage RFI maximum background value (81.9J mg/kg), but is within the background ranges for the Albany area (250 to 350 mg/kg) and eastern United States (15 to 600 mg/kg).
- Cobalt (up to 30.6 mg/kg) is above the J7 Scrap and Salvage RFI maximum background value (15.4 mg/kg), but is within the New York State background range (2.5 to 60 mg/kg).
- Iron (up to 49,500 mg/kg) is above the J7 Scrap and Salvage RFI maximum background value (38,300 mg/kg) and Albany area (150 to 5,000 mg/kg) background range, but is within the eastern United States (2,000 to 550,000 mg/kg) background range.
- Potassium (up to 3,020 mg/kg) is above the J7 Scrap and Salvage RFI maximum background value (1,870 mg/kg), but is within the Albany area (12,500 to 17,500 mg/kg) and New York State (8,500 to 43,000 mg/kg) background ranges.
- Selenium (up to 1.27 mg/kg) is below the J7 Scrap and Salvage RFI maximum background value (1.8J mg/kg) and within the eastern United States (<0.1 to 3.9 mg/kg) background range.

Since the SV background is based on an upper tolerance interval with a 95 percent confidence level, it is anticipated that up to 5 percent of the metal results will exceed the UTL95 statistic even in the case that there has been no hazardous constituent release. Therefore, metals detected in “elevated” concentrations at low frequency and in isolated locations are likely artifacts of the statistical methodology and/or matrix interference and therefore do not represent a hazardous constituent release.

A summary of all elevated metals by SWMU/AOC area is discussed in the following subsections. The distribution of metals above all applicable background ranges are presented in Figures 6-7 and 6-8.

K6 Storage Pad (SWMU-036)

Thirty five soil samples and two field duplicates were collected from seven soil borings within the K6 Storage Pad to a maximum depth of 14.8 feet bg. Elevated concentrations of the following metals are considered to result from expected statistical variations or matrix interference and therefore do not represent a release to the environment.

- Antimony was slightly elevated in four samples with the maximum estimated concentration (0.37J mg/kg) from the field duplicate (sample FDD003) collected from B3602 (14 to 14.8 feet bg). Antimony is not detected(<0.13J mg/kg) in the corresponding original sample (LWA36010). Other elevated antimony detections are estimated and only slightly above the SV background. The variability of antimony is likely a result of matrix interference, and therefore is not considered a release indicator. Antimony is not detected in the two downgradient monitoring wells (MW-SV4 and MW-SV5).
- The only elevated concentration of beryllium from Lower Level samples (1.4 mg/kg) is from 0 to 2 feet bg at soil boring B3602. Beryllium slightly exceeds the J7 Scrap and Salvage RFI maximum background value (0.89 mg/kg), but is within the background range for the eastern United States (0 to 1.75 mg/kg).

Elevated concentrations of the following six metals are not considered representative of a release to the environment when compared to other background values and criteria.

- Arsenic is elevated (up to 15.7 mg/kg) in six soil samples and one field duplicate at depths below 10 feet bg at six soil boring locations. Arsenic is below the J7 Scrap and Salvage RFI maximum background value (17.9 mg/kg), but is slightly outside the background range reported for New York State (3 to 12 mg/kg).

- Nine total chromium concentrations are only slightly elevated (18.9 to 22.7 mg/kg) above the SV background of 18.8 mg/kg. These concentrations are below the J7 Scrap and Salvage maximum background value (25.7 mg/kg).
- Lead is slightly elevated (up to 24.7 mg/kg) in 10 soil samples and one field duplicate from four soil boring locations. Lead is below the J7 Scrap and Salvage RFI maximum background value (40.8 mg/kg) and within the background range of northeastern soils (4 to 61 mg/kg).
- Thallium was detected at only two soil borings B0308 (2 to 4 feet bg) and B3604 (6 to 8 feet bg), once at a concentration of 0.38 mg/kg that is elevated relative to the SV background data, but is below the J7 Scrap and Salvage RFI maximum background value (0.42J mg/kg).
- Vanadium was elevated (26 to 51.6 mg/kg) in six soil samples and one field duplicate at four soil boring locations. However, the concentrations are below the J7 Scrap and Salvage RFI maximum background value (159 mg/kg) and the eastern United States background range (1 to 300 mg/kg).
- Zinc is slightly elevated (up to 109 mg/kg and no more than 31 percent over the SV background) in seven samples from five soil borings. Zinc is well below the J7 Scrap and Salvage RFI maximum background value (227 mg/kg).

Metal concentrations at the K6 Storage Pad do not indicate a hazardous constituent release from SPRU operations.

Former K7 Storage Pad (SWMU-037)

Twelve soil samples and one field duplicate were taken from four 6-foot deep soil borings at the Former K7 Storage Pad. Elevated concentrations of the following four metals result either from expected statistical variation or matrix interference, and are within other background ranges.

- Two cadmium concentrations are slightly elevated (0.36 and 0.55 mg/kg) to a depth of 2 feet bg in soil borings B3701 and B3704. Cadmium is above the J7 Scrap and Salvage RFI maximum background value (<0.03 mg/kg), but is within the background ranges of the northeastern soils (0.0001 to 1 mg/kg). These concentrations are bounded horizontally and vertically with cadmium concentrations below SV background.

- Lead is slightly elevated to a depth of 2 feet bg at soil boring B3701 (35.8 mg/kg) and B3704 (29.5 mg/kg), but at concentrations below the J7 Scrap and Salvage RFI maximum background value (40.8 mg/kg) and within the background range of northeastern soils (4 to 61 mg/kg). Both soil borings are along the paved Lower Level access roadway, so slightly elevated concentrations likely result from vehicle use.
- Thallium is slightly elevated (0.29 mg/kg) at B3704 (4 to 6 feet bg), but is below the J7 Scrap and Salvage RFI maximum background value (0.42J mg/kg).
- Vanadium is slightly elevated (up to 28.5 mg/kg) at B3701 (0.08 to 2 feet bg) and B3702 (0.5 to 2 feet bg), but is well below the J7 Scrap and Salvage maximum background value (159 mg/kg) and the eastern United States background range (1 to 300 mg/kg).

Zinc is elevated at soil boring B3701 from 0.18 to 2 feet bg (110 mg/kg) and 4 to 6 feet bg (270 mg/kg). Both concentrations exceed published background ranges for the eastern United States (9 to 50 mg/kg) and the Albany area (37 to 60 mg/kg), and the maximum exceeds the J7 Scrap and Salvage RFI maximum background value (227 mg/kg). Zinc is associated with process materials within the H2 Tank Vaults (see Section 3.1.2). Elevated zinc at soil boring B3701 is bounded horizontally by concentrations below the SV background in all sample intervals from surrounding soil borings B3702, B3854, B3853, B3704, B3832, and B3830. Soil boring B3701 was terminated 0.4 feet into low-permeability gray till. Elevated zinc at soil boring B3701 is isolated since the potential for vertical migration into the gray till is minimal.

Railroad Staging Area (SWMU-038)

A total of 130 soil samples and eight duplicate samples were collected from 69 soil borings located in a grid covering the expected extent of the Railroad Staging Area.

Elevated concentrations of metals discussed below are not considered indicative of a release to the environment since they are infrequently detected above SPRU SV background values and are below other applicable background ranges:

- Nickel is elevated (up to 47 mg/kg) in four samples and one duplicate sample within various sample intervals at five soil boring locations. Nickel (25 mg/kg) is not elevated in the original sample (LWA38147) associated with the duplicate (47 mg/kg in sample FD0004). Both concentrations are below the J7 Scrap and Salvage RFI maximum background value (57.3 mg/kg).
- Vanadium was elevated (25.9 to 42.8 mg/kg) in 25 samples at 20 soil boring locations, but at concentrations well below the J7 Scrap and Salvage RFI maximum background value (159 mg/kg) and eastern United States background range (1 to 300 mg/kg).
- Zinc was elevated (88.9 to 117 mg/kg) in six samples from various depths at four soil boring locations, but is below the J7 Scrap and Salvage maximum background value (227 mg/kg). The distribution of zinc is similar to that of calcium and magnesium.

Elevated concentrations of antimony, arsenic, copper, and lead are likely associated with the railroad tracks formerly located along the northeastern perimeter of the Railroad Staging Area or ballast materials that have been distributed throughout the Lower Level (see Figure 6-1). Copper and arsenic are known components of creosote used to preserve wood ties. Elevated concentrations of these metals likely result from weathering of railroad ties, or in the case of lead, operation of locomotives. For the most part, elevated antimony is consistent with that of arsenic and copper along the former railbed.

- Arsenic was elevated (up to 75 mg/kg) in 28 samples collected from various depths at 24 soil boring locations. Concentrations of 13 of the samples also exceed the J7 Scrap and Salvage RFI maximum background value (17.9 mg/kg). The highest concentrations of arsenic (32 to 75 mg/kg) are found from 0 to 2 feet bg at soil boring locations along the extent of the former railroad tracks.
- Copper was elevated (up to 79.7 mg/kg) in 18 samples primarily from 0 to 2 feet bg at 17 soil boring locations above the J7 Scrap and Salvage RFI maximum background value (44.4 mg/kg) and the Albany area background range (<1 to 15 mg/kg). The distribution of copper is very similar to that of arsenic with the highest concentrations located along the extent of the former railroad tracks.

- Lead was elevated (18.9 to 90.8 mg/kg) in 41 samples and one duplicate sample primarily from 0 to 2 feet bg at 38 soil boring locations. The highest levels of lead (87.3J and 90.8 mg/kg) were detected at B3801 (0.16 to 2 feet bg) and B3835 (4 to 6 feet bg), respectively. These two concentrations were both above the J7 Scrap and Salvage RFI maximum background value (40.8 mg/kg) and the background range of northeastern soils (4 to 61 mg/kg). The distribution of lead is very similar to that of copper and arsenic with the highest concentrations located along the extent of the former railroad tracks. Other elevated lead concentrations are along the Lower Level access road and likely result from vehicle use.
- Antimony was elevated (up to 1.3J mg/kg) in 18 samples primarily from 0 to 2 feet bg at 15 soil boring locations above the J7 Scrap and Salvage RFI maximum background value (0.31J mg/kg). All of the soil borings were located along or adjacent to the extent of the former railbed. All of the elevated antimony concentrations were estimated (J-qualified).

Elevated concentrations of silver, mercury, total chromium, and thallium may indicate a release to the environment from SPRU activities within the Railroad Staging Area (see Figure 6-8). Silver was elevated in the southeastern portion of the Railroad Staging Area at soil borings B3844, B3846, B3863, and B3864 (0.1J to 1.1 mg/kg) and in the central portion of the Railroad Staging Area at adjacent borings B3832 and B3833 (0.5 to 0.6 mg/kg, respectively). All elevated silver concentrations were within 2 feet bg except within the 4 to 6-foot bg interval at B3833 (0.6 mg/kg) and exceed all applicable background ranges and the NYSDEC soil cleanup objective (site background). Elevated silver in the southeast portion of the Railroad Staging Area could result from concentration of heavy metals in sewage sludge associated with the former sewage drying beds.

Elevated silver in central portion soil borings is bounded vertically and horizontally by soil samples of lowered concentrations. Silver is not bounded horizontally southwest of soil borings B3863 and B3864 or vertically at B3833 (terminated in till-derived fill). Silver detected at 0.1J mg/kg in the northwest corner of the Railroad Staging Area is also not bounded horizontally to the west. Silver was also elevated at concentrations of 0.1J and 0.28J mg/kg at soil borings B3848 and B3859, respectively, to a depth of 2 feet bg. Silver is bounded at vertically by lowered concentrations at both borings and horizontally, except to the southwest of B3859.

Mercury was elevated (0.1 to 2.5 mg/kg) to a depth of 2 feet bg at 13 soil boring locations across the Railroad Staging Area. The maximum concentrations occurred at soil borings B3803 (2.5 mg/kg), located in the northwestern corner of the gridded area, and B3856 (1 mg/kg), along the walkway. Mercury concentrations are above the J7 Scrap and Salvage RFI maximum background value (0.13 mg/kg) at six soil boring locations (B3803, B3818, B3825, B3852, B3856, and B3863). Most of the elevated mercury concentrations are not bounded by lower concentrations below background.

Total chromium is elevated in 18 samples and one duplicate sample from 14 soil boring locations. The two highest total chromium concentrations (26.2 and 45.6 mg/kg) were detected at B3859 (4 to 6 feet bg) and duplicate sample (FD0004) of B3864 (0.41 to 2 feet bg), respectively. Both exceed the J7 Scrap and Salvage RFI maximum background value (25.7 mg/kg) and are outside the Albany area background range (1.5 to 25 mg/kg), but are within the New York State soil range (1.5 to 40 mg/kg).

Thallium is elevated (up to 1.08J mg/kg) in 21 samples and one duplicate sample from various depths at 17 soil boring locations distributed throughout the Lower Level sampling grid. Five thallium concentrations exceed the maximum J7 Scrap and Salvage RFI background value of 0.42J mg/kg. The maximum thallium concentration was detected from 2 to 4 feet bg at soil boring B3859, located about 35 feet north of the K5 Retention Basin, coincident with the elevated chromium at 4 to 6 feet bg at the same soil boring location. Total chromium and thallium at soil boring B3859 could be associated with the K5 Retention Basin or former railbed materials (copper, arsenic). All elevated thallium concentrations are estimated (J-qualified), rendering their evaluation against background tenuous.

Lower Level Parking Lot (AOC-003)

A total of 36 samples and one duplicate sample were taken from 12 soil borings located in a grid covering the extent of the Lower Level Parking Lot (see Figure 4-2).

Elevated concentrations of metals discussed below are not considered indicative of a hazardous constituent release to the environment since they are infrequently detected at concentrations above all applicable background ranges:

- Total chromium was elevated at soil boring B0301 (28.1 mg/kg at 4 to 6 feet bg and 22.9 mg/kg at 2 to 4 feet bg). Only the maximum concentration exceeds both the J7 Scrap and Salvage RFI maximum background value (25.7 mg/kg), and Albany area background range (1.5 to 25 mg/kg), but is within the New York State soil range (1.5 to 40 mg/kg).
- Cobalt concentrations were elevated (14.7 to 30.6 mg/kg) in five samples taken from various depths at four soil boring locations throughout the parking lot. Cobalt in three samples exceeds the J7 Scrap and Salvage RFI maximum background value of 15.4 mg/kg, but is within the New York State background soil range (2.5 to 60 mg/kg).
- Nickel is elevated at two soil boring locations (up to 42.6 mg/kg) at concentrations below the J7 Scrap and Salvage RFI maximum background value (57.3 mg/kg).
- Thallium is elevated at one soil boring location (0.27 mg/kg) at a concentration less than the J7 Scrap and Salvage RFI maximum background value (0.42J mg/kg).
- One elevated concentration of vanadium (178 mg/kg) from 4 to 6 feet bg at soil boring location B0307 is above the J7 Scrap and Salvage maximum background value (159 mg/kg), but is within the range of the eastern United States background (1 to 300 mg/kg). Vanadium is slightly elevated (25.6 to 28.1 mg/kg) in soil borings B0301, B0302, B0306, and B0310.
- Zinc was elevated (83.2 to 154 mg/kg) within various depths at five soil boring locations, but below the J7 Scrap and Salvage RFI maximum background value (227 mg/kg).

Elevated concentrations of the following metals exceed all applicable background ranges and NYSDEC soil cleanup objectives.

- Antimony was slightly elevated (0.32J to 0.48J mg/kg) in three samples from two soil boring locations (B0302 and B0303) in the northwestern corner of the Lower Level Parking Lot.
- Arsenic was slightly elevated (8.9 to 23 mg/kg) in 10 samples taken from various depths at seven soil boring locations. The highest concentrations are located in the northern corner of the parking lot at soil boring B0301 (23 mg/kg at 2 to 4 feet bg and 21.3 mg/kg at 4 to 6 feet bg) and also exceed the J7 Scrap and Salvage RFI maximum background value (17.9 mg/kg) and the NYSDEC soil cleanup objective (7.5 mg/kg or site background).
- Cadmium was slightly elevated (0.31 to 1.2 mg/kg) at B0302 (0.33 to 2 feet bg) and B0303 (0.25 to 2 feet bg and 2 to 4 feet bg), but both attenuate at depth. These cadmium concentrations are above the J7 Scrap and Salvage RFI maximum background value (<0.03 mg/kg). The highest cadmium concentration of 1.2 mg/kg at B0303 (0.25 to 2 feet bg) is slightly above the background range of the northeastern soils (0.0001 to 1 mg/kg) and the NYSDEC soil cleanup objective (1 mg/kg or site background).
- Copper was elevated (40.9 to 111 mg/kg) in five samples collected from various intervals at four soil boring locations within the parking lot. Four samples exceed the maximum J7 Scrap and Salvage RFI background value of 44.4 mg/kg in soil borings B0301, B0303, and B0312. The highest concentrations occur in the northern portion at soil borings B0301 and B0303 and exceed the NYSDEC soil cleanup objective (25 mg/kg or site background).
- Lead was elevated (15.8 to 86.7 mg/kg) in 15 samples from 9 soil borings within the parking lot. Most of these elevated lead concentrations may result from vehicle use; however the maximum concentrations (47.1 to 86.7 mg/kg) were detected in all three samples taken to a depth of 6 feet bg at soil boring B0305, located in the northern portion of the parking lot. The highest concentration of lead (86.7 mg/kg) is above the J7 Scrap and Salvage RFI maximum background value (40.8 mg/kg) and the background range of northeastern soils (4 to 61 mg/kg).

- Mercury was elevated (0.1 to 6.9J mg/kg) in 11 samples from six soil borings clustered in the northern portion of the parking lot. The maximum concentration was detected from 2 to 4 feet bg at soil boring B0307 and mercury concentrations remained elevated between 4 and 6 feet bg (0.45 mg/kg). Nine samples exceed the J7 Scrap and Salvage RFI maximum background value (0.13 mg/kg).

- Silver was elevated (0.12J to 0.19J mg/kg) at soil boring locations B0301, B0303, and B0311, located along the perimeter of the parking lot. Silver concentrations attenuate to below detection limits in the lowest intervals of these soil borings. Elevated silver is above the SV background value (0.09 mg/kg) and the J7 Scrap and Salvage RFI maximum background value (<0.12 mg/kg) and therefore is above the NYSDEC soil cleanup objective (site background).

Although many of the metals discussed above are detected infrequently, together they indicate a pattern of elevated metal concentrations, primarily in the northern portion of the parking lot. Releases of mercury are established at soil concentrations up to 6.9J mg/kg. Metals have not been bounded vertically at all soil borings and are not bounded horizontally to the west and north of the parking lot. Arsenic and copper, and to a lesser degree antimony and lead, are coincidentally elevated similar to the former railbed. This supports the movement of soil from the Railroad Staging Area and association with the former railbed and locomotive operations.

K5 Retention Basin (SWMU-040)

A total of 37 soil samples plus two duplicate samples were collected from 11 soil borings and one trench at the K5 Retention Basin. Elevated concentrations of metals discussed below do not identify a hazardous constituent release since they are infrequently detected at concentrations above background ranges.

- Arsenic is slightly elevated (9 to 11.6 mg/kg) in nine samples from various depths at four soil boring locations; however, the concentrations are all below the J7 Scrap and Salvage RFI maximum background value (17.9 mg/kg) and are within the range for New York State (3 to 12 mg/kg).

- Total chromium is slightly elevated (19.2 to 24.6 mg/kg) in 17 samples from six soil borings and trench T4001; however, the maximum concentration is below the J7 Scrap and Salvage RFI maximum background value (25.7 mg/kg) and the Albany area background range (1.5 to 25 mg/kg).

- Lead is slightly elevated (15.9 to 34.9 mg/kg) in 17 samples at seven soil boring locations; however, the maximum concentration is less than the J7 Scrap and Salvage RFI maximum background value (40.8 mg/kg) and the background range of northeastern soils (4 to 61 mg/kg).

- Nickel is elevated (34.1J to 44.7J mg/kg) in eleven samples at three soil boring locations, but at concentrations below the J7 Scrap and Salvage RFI maximum background value (57.3 mg/kg).

- Vanadium is elevated in 11 samples (25.7 to 40.9 mg/kg) from six soil borings and one trench; however the maximum concentration is well below the J7 Scrap and Salvage RFI maximum background value (159 mg/kg) and the eastern United States background range (1 to 300 mg/kg).

- Cadmium is elevated in nine samples and one duplicate sample (0.32 to 0.89 mg/kg) from soil borings B4001 (4 to 6 feet bg), B4005 (0 to 2 and 4 to 6 feet bg), B4008 (2 to 4 feet bg), and B4013 (0 to 2 feet bg), and trench T4001 (0 to 1.5, 5 to 6, and 6 to 8 feet bg). These cadmium concentration are greater than the J7 Scrap and Salvage RFI maximum background value (<0.03 mg/kg), but are within the range for the eastern northeastern soils (0.0001 to 1 mg/kg). Since cadmium is elevated in samples collected ugradient (uphill) from the K5 Retention Basin and above the influent drain line (B4008, B4001, and the 5 to 6 feet bg interval from T4001) that are not likely affected by releases from the K5 Retention Basin, it not likely that they result from SPRU operations.

The following metals are elevated above all applicable background ranges in isolated occurrences.

- Copper is elevated (38.7 to 70.1J mg/kg) in eight samples from soil borings B4001, B4004, B4005, B4009, B4011, and B4013 located around the perimeter and downslope of the K5 Retention Basin structure. The two highest concentrations (48 and 70.1J mg/kg) exceed the maximum J7 Scrap and Salvage RFI background value (44.4 mg/kg). The samples were taken from various intervals to a depth of 13.9 feet bg. The highest concentration is from soil boring location B4009 located along the foundation where the influent drain line penetrates where the sample was taken below the drain line invert (2 to 3 feet bg).

- Zinc is elevated along the influent drain line, B4008 (102 mg/kg from 2 to 4 feet bg) and B4009 (142 mg/kg from 2 to 3 feet bg). Zinc is also elevated at the southeast corner of the K5 Retention Basin structure (109 mg/kg from 0 to 2 feet bg at soil boring B4005B) and to a depth of 2 feet bg at B4013 (257 mg/kg). The maximum concentration of zinc exceeds the J7 Scrap and Salvage RFI maximum background value of 227 mg/kg.

Elevated concentrations of copper and zinc occur sporadically in sample intervals throughout the soil borings. Because the maximum concentrations of copper and zinc are detected above all applicable background ranges at isolated locations (upgradient and downslope) without other elevated metals, these metals are likely associated with soil mineralogy and/or construction activities and therefore are not likely associated with SPRU operations.

6.4.4 VOCs in Lower Level Groundwater

VOC samples were collected from wells installed at the K6 Retention Basin (SWMU-036) and K5 Retention Basin (SWMU-035) to determine if a release occurred specifically from these SWMUs. As discussed in Section 4.2.5, lack of saturated conditions upgradient of both these SWMUs prevented installation of upgradient monitoring wells as specified in the SV Work Plan. Two downgradient monitoring wells were installed at each SWMU. Well construction information is presented in Table 4-9. Groundwater purging and sampling information along with field parameter data is presented in Tables 4-18 and 4-22.

Carbon disulfide was detected in trace (1J to 2J µg/L) concentrations in samples from monitoring wells MW-SV4 and MW-SV6. Since carbon disulfide was detected in analytical and equipment blanks (see Appendix B), laboratory or field contamination is the likely source of carbon disulfide.

Chloromethane was detected (16 µg/L) in the duplicate sample (FDGW14) from monitoring well MW-SV5. Since this detection was not confirmed by the corresponding original sample (LWAGW6) and chloromethane was detected in analytical and equipment blanks (see Appendix B), laboratory or field contamination is the likely source of chloromethane.

6.4.5 SVOCs in Lower Level Groundwater

Eight groundwater samples and two duplicate samples were collected from four existing and four newly installed groundwater monitoring wells (see Section 6.4.4) and analyzed for SVOCs.

Trace levels of phenol were detected in groundwater from MW-SV5 (2J µg/L) and KH-20 (8J µg/L). The phenol detection in MW-SV5 is also associated with a phenol detection (75J µg/kg) in a soil sample (2 to 4 feet bg) taken from the MW-SV5 soil boring (B3602). This soil sampling interval from the MW-SV5 soil boring was below an interval of railroad ballast (0.8 to 2 feet bg) containing dark slag-like material and gray mottling, suggesting the presence of organic matter. The soil boring log for existing monitoring well KH-20 shows the presence of fill material with dark brown top soil containing roots at a depth of 11.5 feet bg. Phenol in these wells and soil borings may result from natural degradation of organic matter or creosote associated with the railbed.

6.4.6 Metals in Lower Level Groundwater

Four groundwater samples and one duplicate sample were collected from four newly-installed groundwater monitoring wells located in the Lower Level, downgradient from the K6 Storage Area (SWMU-036) and the K5 Retention Basin (SWMU-040).

Iron, magnesium, manganese, and sodium are elevated above NYSDEC ambient water quality criteria in the soluble fraction of two or more of the four monitoring wells. The turbidity of the samples collected from these series of wells ranged from 3.78 NTUs at MW-SV4 to 262 NTUs at MW-SV7. Cobalt in the total sample from MW-SV6 is elevated when compared to the other samples. Cobalt is associated with natural particulates from one of the highest turbid samples, since it is not elevated within the filtered sample. No toxic metals in either total or filtered results are elevated or exceed NYSDEC ambient water quality standards.

7.0 Land Area SWMUs

7.1 SV Characterization Objectives

Characterization objectives for surface and subsurface soil and groundwater at the Former Slurry Drum Storage Area as developed in the SV Work Plan (Reference(2)) are summarized and presented in Table 7-1. An evaluation of the field performance relative to the objectives is also presented in Table 7-1. Overall, SV Work Plan objectives were met with the following exceptions:

- Five soil borings did not reach their target depth due to encountering office material refuse (paper, cardboard) not related to SPRU activities.
- A groundwater monitoring well was not installed due to the lack of saturated conditions in the Land Area.

7.2 Geology

7.2.1 General

The subsurface conditions within the Land Area SWMU are generally characterized as granular fill or till-derived fill overlying brown and gray till, or over bedrock. Within the Land Area a total of 58 soil borings were completed as part of this SV. All of the soil borings were terminated at depths less than 10 feet bg, with the exception of three that were terminated between 10 and 14 feet bg (Table 4-3, Section 4.0). Thirty-seven of the soil borings were terminated at the planned depth of 4 feet bg.

The soils above till were encountered at each of the soil boring locations and were composed of the following material types:

- Granular fill generally composed of sand with lesser percentages of silt and gravel or sand and gravel with lesser percentages of silt and clay.
- Till-derived fill composed of silt and clay with lesser percentages of sand and gravel.

Office refuse composed primarily of paper, cardboard, plastic cups and lids, binders, and pencil fragments was also encountered at five of the soil boring locations. In general, the depth to the top of the refuse from the existing grade ranged from 2 to 4 feet. At each soil boring location where the refuse was encountered, the vertical limits of the waste were not defined within the depths explored. At soil boring B3555, the refuse was still present to a depth of 9.3 feet bg.

7.2.2 Brown/Gray Till Interface

The interface between the brown and gray till was encountered at 11 of the soil borings at depths ranging from 1 inch bg at soil boring B3508 to 12 feet bg at soil boring B3538. The soil borings exhibiting the deepest depths to the gray till were encountered at the soil borings in the southwest corner of the Land Area. Geologic Cross Section Locations are shown on Figure 7-1, and presented as Figures 7-2, 7-3, and 7-4.

7.2.3 Landfill Debris

Landfill debris (i.e., paper and office refuse), associated with the Former Landfill (SWMU-022), was encountered at five shallow (1.7-3.5 feet bg) soil boring locations (B3531, B3532, B3547, B3555, and B3556) within the southwest corner of the Land Area approximately 200 feet east of the Salt Storage Shed and immediately north of the access road leading back to the closed landfill area. The approximate limit of the landfill debris is depicted on Figure 7-5. The vertical extent of the debris was not defined within the depths explored. At soil boring B3555, the debris was present at the final depth of approximately 9.3 feet bg. The material over the debris at each soil boring location was classified as till-derived fill.

7.2.4 Geophysical Survey Review

A previous geophysical survey (Reference(6)) was performed over the Land Area to identify potential burial areas. Therefore, a complete geophysical survey of the Land Area was not duplicated during the SPRU SV. Instead, isolated electromagnetic surveys using the EM-61 method were used to identify potential subsurface objects that could interfere with drilling. To establish that EM-61 would provide useful data in the Land Area, an EM-61 survey was performed within two small test areas (approximately 30 by 30 feet and 50 by 50 feet) as presented in Appendix F, Figures 14 through 16. A single electromagnetic anomaly was identified in one test survey (see Appendix F, Figure 14). This anomaly likely results from a small metallic object located in the vicinity of the Pyrophoric Area (SWMU-005).

Two soil borings, B3518 and B3519, were advanced using a hand auger due to the presence of electromagnetic anomalies identified during boring specific the EM-61 survey. No metallic objects or other anthropogenic material was observed in the two 4-foot borings (see Appendix D).

7.3 Hydrogeology

None of the soil borings completed during this investigation encountered soils that were saturated with water; therefore, no monitoring well was installed. Water levels from existing KAPL monitoring wells within the Land Area were recorded on several dates as presented in Table 4-16 (Section 4.0). The water levels from March 19, 2001, were used to develop groundwater contours within the monitoring well array in the Land Area. The groundwater contours and inferred direction of groundwater flow are presented as Figure 7-6.

When measured March 19, 2001, the depth to water within the existing monitoring wells ranged from less than 1 foot (artesian effect above grade in W-8) to 20 feet below the top of the well casings. These depths are shallower than the water levels collected from the monitoring wells in December 11, 2000 (see Table 4-16, Section 4.0).

Figure 7-6 shows a groundwater mound within the area of monitoring wells NTH-1 and NTH-4. Groundwater flow off the mound is inferred to be radially in all directions. The groundwater mound appears to be in part related to the fill/till topographic mound located approximately 150 feet southwest of the groundwater mound. A groundwater trough is apparent in between monitoring wells NTH-4 and MW-3, where the groundwater converges between monitoring wells W-2 and W-3. Groundwater flow within the trough appears to be northerly toward W-3, north of monitoring well W-2, and southerly toward monitoring well W-8, south of W-2.

The approximate 1 foot of elevation difference between monitoring wells NTH-1 and NTH-1A is because monitoring well NTH-1 is a bedrock well with its screened interval sealed off from the groundwater within the overburden soils. The groundwater elevation difference also suggests that there is a slight downward hydraulic gradient (downward movement of groundwater from overburden to bedrock) between the groundwater within the overburden and the underlying bedrock with the till acting as an effective confining layer.

7.4 SV Investigation Results

The following subsections discuss detected VOCs, SVOCs, and metals in soil and SVOCs within groundwater at the Land Area. An evaluation of these constituents in both soil and groundwater is also provided. The term "elevated" concentration is used throughout this report. Elevated concentrations in soil are those that exceed background concentrations. Background concentrations in soil were established by:

- Any detected VOC concentration not associated with laboratory or field sampling contamination;
- Any detected SVOC concentration not associated with interferences (i.e., asphalt, construction materials, and laboratory contamination); and
- Calculating the UTL statistic for the SV metals dataset to obtain site-specific background levels following the methodology discussed in Appendix G.

In addition, metals data were evaluated against background ranges obtained from the J7 Scrap and Salvage RFI Draft Report (Reference(11)), and other published background ranges for the Albany area, New York State, and the northeastern and eastern United States (Reference(12)). NYSDEC recommended soil cleanup objectives (Reference(13)) are used for comparison purposes, where applicable.

Groundwater SVOC results that are not associated with laboratory or field contamination are compared to NYSDEC ambient water quality standards for groundwater (Reference(14)) and are considered elevated if they exceed their respective standard or guidance value.

7.4.1 VOCs in Land Area Soil

Fifty-eight soil samples plus seven duplicate samples were collected from 55 soil borings in the Land Area and analyzed for VOCs. Concentrations of VOCs detected in surface and subsurface soils are listed and compared to NYSDEC soil cleanup objectives in Table 7-2. Detected VOCs within the Former Slurry Drum Storage Area (SWMU-035) are summarized as follows:

- PCE was detected in six samples from six soil borings at concentrations ranging from 1J to 180 μg/kg.
- TCE was detected in four samples from four soil borings at concentrations ranging from 2J to 130 μg/kg.
- Total 1,2-DCE was detected in four samples and one duplicate from four soil borings at concentrations ranging from 2J to 17 μg/kg.
- Methyl ethyl ketone was detected in two samples from two soil borings at concentrations of 16 and 180J μg/kg.
- The following gasoline constituents were detected in up to 12 samples and 2 duplicates from 13 soil boring locations: 1) ethylbenzene at concentrations ranging from 2J to 100 μg/kg, 2) toluene at concentrations ranging from 1J to 63 μg/kg, and 3) total xylenes at concentrations ranging from 1J to 700 μg/kg.
- Trace levels of 2-hexanone (detected once at 2J mg/kg) and carbon disulfide (detected twice at 2J and 2.9J mg/kg) are attributed to laboratory or field sampling contamination.
- Common laboratory contaminants of acetone and methylene chloride were detected at concentrations up to 110J μg/kg (in eight samples from seven soil borings) and up to 45J μg/kg (in 20 samples and one field duplicate from 20 soil borings), respectively.

No VOC concentrations exceeded NYSDEC recommended soil cleanup objectives.

As shown in Figure 7-7, VOCs were detected in soil within two distinct locations. A cluster of soil borings (B3507, B3516, B3517, B3518, B3519, and B3528) located in the northwestern quadrant of the sampling grid encountered the highest concentrations of PCE (180 μg/kg at

B3518) and TCE (130 µg/kg at B3519) in the near surface (2 to 4 foot) interval. These soil borings are located near the head of the Mid-Line Stream drainage. Traces (less than 3J µg/kg) of toluene were also observed within this area (see Figure 7-7). Samples were all collected from either till-derived fill or brown till. In accordance with the SV Work Plan objective of evaluating near-surface soil characteristics associated with SPRU operations, soil borings in this area were not drilled deeper than 4 feet and did not encounter the low-permeability gray till. Therefore, the vertical extent of the VOCs within fill and brown till has not been identified. None of the soil borings encountered significant soil moisture or saturated groundwater conditions.

Figure 7-7 also shows a second cluster of soil borings (B3531, B3532, B3533, B3554, B3555, and B3556) located in the southwest portion of the study area that encountered elevated levels of VOCs within the upper 2 foot interval to depths of 6 feet. As discussed in Section 7.2.3, these borings are located within or adjacent to an area where buried refuse (e.g., office supplies and paper) was observed. This material is likely associated with the Former Landfill (SWMU-002) rather than SPRU activities in the Land Area, further sampling into the refuse was not necessary to meet the SPRU SV objective. The sample from 4 to 5 feet bg at soil boring B3555 was composed of refuse material, which detected elevated concentrations of methyl ethyl ketone (180J µg/kg), PCE (120J µg/kg), total xylenes (700 µg/kg), ethylbenzene (110 µg/kg), and toluene (23J µg/kg). TCE and total 1,2-DCE were also detected at concentrations of less than 5J µg/kg. With the exception of trace concentrations of carbon disulfide and chlorobenzene at soil boring B3531, these same VOCs are detected in samples from other soil borings located near soil boring B3555, with the highest concentrations associated with sampling intervals below 4 feet bg. Therefore, the soil VOC concentrations in this area are likely associated with VOCs within the refuse that are transported upward via vapor transport or intermittent saturated groundwater conditions.

The earthen berm that initially contained the Former Slurry Drum Storage Area (see Section 3.3.1) was located approximately in the area bounded by soil borings B3538, B3541, B3552, and B3548. VOCs detected in the northwestern quadrant of the study area are not evident in soil within the suspected extent of the Former Slurry Drum Storage Area. Their presence may be related to earthen berm grading activity, overland flow of ponded water within the Former Slurry Drum Storage Area, and infiltration as it flowed toward the Mid Line Stream drainage. However, the lack of this VOC signature within soils beneath the suspected extent of the Former Slurry Drum Storage Area suggests an alternative, potentially non-SPRU-related source. As further discussed in Section 7.4.4, groundwater in downgradient monitoring well W-3 has historically been impacted by VOCs (1,2-DCE). These data suggest that the low levels of PCE and TCE found in soil within the Land Area, or another undetermined source to the west of the Land Area sampling grid, may be degrading and migrating to groundwater.

7.4.2 SVOCs in Land Area Soil

Twenty-three SVOC compounds, including 16 PAH compounds, were detected in 31 samples including two duplicates from 23 soil borings within the Land Area (see Table 7-3). The following PAHs were detected: 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, and pyrene. PAH concentrations ranged from 18J to 6,800 μg/kg (see Figure 7-8).

PAHs are more frequently detected in soil borings along the southern portion of the Land Area (see Figure 7-8). The highest concentrations of PAH compounds (between 1,000J and 6,800 μg/kg) were observed at soil boring locations B3543 (0 to 2 feet bg), B3554 (4 to 6 ft bg), B3555 (0.16 to 2 and 4 to 5 feet bg), and B3556 (0.16 to 2 feet bg).

The 4 to 5 foot interval sample from soil boring B3555 is comprised of refuse material. The sample from the 0.16 to 2 foot interval of adjacent soil boring B3556 is just above refuse observed at 2.8 feet bg. Both soil borings contain 2-methylnaphthalene and naphthalene in about the same proportions, with concentrations higher at soil boring B3555.

4-Methylphenol (23J and 40J mg/kg in the original and corresponding duplicate samples) and naphthalene (330J μg/kg) between 2 and 4 feet bg at soil borings B3533 and B3556, respectively, are likewise associated with non-SPRU-related activities. Phenol was detected at soil boring B3539, within the extent of the Former Slurry Drum Storage Area. PAH compounds in the uppermost sampling interval (0 to 2 feet bg) are associated with the non-

SPRU disposal area (soil borings B3532, B3547, and B3555), are within the extent of the Former Slurry Drum Storage Area (soil borings B3543 and B3551), or within the area where the Former Slurry Drum Storage Area earthen berm was bulldozed (e.g., soil boring B3527). PAHs were detected within the 2 to 4 feet interval at one isolated location (B3509), located along the eastern portion of the Mid-Line Stream drainage. However, the detection was in a duplicate sample and not in the original corresponding sample. For almost all samples, the relative proportion of the individual PAH compounds is similar with fluoranthene, pyrene and, to a lesser extent, phenanthrene concentrations dominant.

Materials potentially containing PAHs (e.g., asphalt or coal slag indicative of railroad operations) were not as widely observed in soil borings in the Land Area as they were in Upper and Lower Level soil borings, but they were identified. Asphalt was found between 0 and 0.3 foot bg at soil boring B3535 and slag was noted to a depth of 0.8 foot at soil boring B3557. As discussed in Section 3.3.1, asphalt-impregnated paper historically was used to cover soil during soil excavation operations in the Land Area. Detected PAHs in the Land Area likely result from excavation-related activities rather than releases to the environment from SPRU-related waste management activities. Detections in duplicate samples and not the associated original samples indicate heterogeneity and the presence of particles containing PAHs in the matrix. Some detected PAHs are located above or adjacent to non-SPRU disposal operations.

Excluding phthalate compounds associated with laboratory contamination (see Appendix B), other detected SVOCs are 4-methylphenol, phenol, and 1,2,4-trichlorobenzene at concentrations (19J to 40J µg/kg) below the NYSDEC soil cleanup objectives. These SVOCs were detected at three separate soil boring locations across the Land Area (see Figure 7-8). These isolate occurrences, together with a lack of other SVOCs, and the trace estimated values render these results suspect and not indicative of a release.

7.4.3 Metals in Land Area Soil

A total of 125 soil samples and seven duplicate samples were collected from 55 soil borings within the area potentially impacted by activity at the Former Slurry Drum Storage Area (SWMU-035). Each of the 23 metals were elevated in at least one sample; however, for each metal the number of elevated concentrations was infrequent (from 2 to 11) relative to the total number of samples collected (132). Since the SV background is based on an upper tolerance interval with a 95 percent confidence level, it is statistically anticipated that metal concentrations in up to five percent of the Land Area samples could incorrectly be interpreted as being above background (i.e., a Type-II statistical error). Therefore, assuming there has been no release of metals from the Former Slurry Drum Storage Area, about six samples would be expected, on average, to be elevated in the Land Area. The metal-specific evaluation provided in the following paragraphs considers co-location of elevated metals and the degree to which background values are exceeded to determine whether elevated metal concentrations are likely statistical variations or if they have resulted from a hazardous constituent release.

The following elevated metal concentrations either result from expected statistical variations, matrix interferences, or are not significant when compared to other background ranges.

- Aluminum is elevated (15,300 to 19,900 mg/kg) in six soil borings at concentrations below the J7 Scrap and Salvage RFI maximum background value (19,700 mg/kg), and within the background ranges reported for the Albany area (1,000 to 25,000 mg/kg).
- Antimony is slightly above the SV background value (0.29 mg/kg) and the J7 Scrap and Salvage RFI maximum background value (0.31J mg/kg) in soil borings B3543 and B3552 at concentrations of 0.36J and 0.32J mg/kg, respectively. Antimony was detected in 44 of the Land Area soil samples at estimated concentrations ranging from 0.13J to 0.36J mg/kg. Considering the widespread range of antimony detection and the potential for matrix interference (see Section 5.4.4), these elevated levels likely result from expected statistical variation or matrix interference and do not indicate a release from SPRU operations.
- Arsenic is slightly elevated (8.9 to 9.2 mg/kg) in four soil boring locations above the SPRU SV background value of 8.8 mg/kg. Arsenic was detected at a maximum concentration of 13.7 mg/kg at B3534 (0.33 to 2 feet bg) located within the southern portion of the Land Area. All but the maximum arsenic value is within the background ranges reported for New York State (3 to 12 mg/kg) and all are below the J7 Scrap and Salvage RFI maximum background value (17.9 mg/kg).

- Barium is elevated in nine samples from nine soil boring locations. The highest concentrations at B3536 and B3518 (up to 139 and 176 mg/kg, respectively) are above the J7 Scrap and Salvage RFI maximum background value (81.9J mg/kg), but are well within the Albany area (250 to 350 mg/kg) background range.

- Beryllium slightly exceeds the SPRU SV background value of 1.1 mg/kg in two samples each at 1.2 mg/kg. Both concentrations are within the New York State background range (up to 1.75 mg/kg) and are slightly above both the Albany area background range (up to 0.9 mg/kg) and the J7 Scrap and Salvage RFI maximum background value (0.89 mg/kg).

- Cadmium is elevated in six samples (up to 0.67 mg/kg) from soil boring locations B3519, B3531, B3534, B3548, and B3532. The maximum concentrations are only slightly above the SV background (0.3 mg/kg) and the J7 Scrap and Salvage RFI maximum background value (<0.03 mg/kg), but are within the northeastern soils background range (0.001 to 1 mg/kg).

- Total chromium (up to 21.7 mg/kg) is slightly elevated within various intervals at eight soil boring locations. All concentrations are below the J7 Scrap and Salvage RFI maximum background value (25.7 mg/kg) and are within the Albany area background range (1.5 to 25 mg/kg).

- Calcium is elevated in four samples at concentrations up to 125,000 mg/kg. The highest concentration was detected at soil boring location B3517 (0 to 2 feet bg) along with elevated concentrations of magnesium, as discussed below. These and other elevated concentrations (from 32,300 to 65,700 mg/kg) likely result from variations in soil mineralogy or construction debris (concrete).

- Cobalt concentrations are slightly elevated (up to 20 mg/kg) within various intervals at seven soil boring locations. However, these concentrations only slightly exceed the SPRU SV background value (14.4 mg/kg) and the J7 Scrap and Salvage RFI maximum background value (15.4 mg/kg), but are within the New York State background range (2.5 to 60 mg/kg).

- Iron is slightly elevated in the uppermost sampling interval (0 to 2 feet bg) at soil borings B3536 (38,700 mg/kg) and B3522 (42,500 mg/kg). These concentrations are above the J7 Scrap and Salvage RFI maximum background value (38,300 mg/kg), but are well within the iron background range (2,000 to 550,000 mg/kg) for the eastern United States.

- Magnesium is elevated in ten soil borings at concentrations up to 62,600 mg/kg. The highest elevated concentrations are in the lowest sampling intervals at soil borings B3554 (25,400 mg/kg from 4 and 6 feet bg) and B3517 (62,600 mg/kg from 2 and 4 feet bg). These concentrations exceed the SV background and maximum J7 Scrap and Salvage background value by over a factor of 5. The soil borings were located in the southern and northwestern portions of the Land Area, respectively. Other elevated magnesium concentrations from 9,460 to 11,000 mg/kg are sufficiently close to the SV background value (9,362 mg/kg) and likely result from natural variability in soil mineralogy.

- Manganese concentrations are slightly elevated (up to 904 mg/kg) at six soil boring locations throughout the Land Area above the J7 Scrap and Salvage RFI maximum background value (764 mg/kg), but are well within the range for the eastern United States (50 to 5,000 mg/kg).

- Potassium is slightly elevated (1,940 to 2,260 mg/kg) above the maximum SV and J7 Scrap and Salvage RFI background values (up to 1,870 mg/kg) from soil borings located throughout the Land Area. These concentrations are well within the range reported for the Albany area (12,500 to 17,500 mg/kg).

- Selenium was slightly elevated (up to 0.39 mg/kg) in various intervals from six soil boring locations. Selenium concentrations are below the J7 Scrap and Salvage RFI maximum background value (1.8J mg/kg) and are within the background range for the eastern United States (0.1 to 3.9 mg/kg).

- Thallium is elevated (up to 0.3 mg/kg) in three soil borings. The maximum thallium concentration is below the J7 Scrap and Salvage RFI maximum background value (0.42J mg/kg).

- Vanadium is elevated (up to 0.3 mg/kg) in nine soil borings. The maximum vanadium concentration is below the J7 Scrap and Salvage RFI maximum background value (159 mg/kg) and is within the background range for the eastern United States (1to 300 mg/kg)..

- Zinc was elevated at soil boring B3531 (124 mg/kg from 0.16 to 2 feet bg and 108 mg/kg from 2 to 3 feet bg) and B3556 (103 mg/kg from 2 to 3.16 feet bg). These concentrations are below the J7 Scrap and Salvage RFI maximum background value (227 mg/kg).

The following metals are elevated above background ranges and, in some cases, applicable NYSDEC soil cleanup objectives. As discussed below, the clustered locations of these metals may indicate a hazardous constituent release.

- Copper is elevated at B3519 (50.3 mg/kg from 0.5 to 2 feet bg) and B3543 (109 mg/kg from 0 to 2 feet bg). Both concentrations exceed the J7 Scrap and Salvage maximum background value (44.4 mg/kg). Copper attenuates to concentrations that are below the SV or the J7 Scrap and Salvage RFI background values in the underlying 2 to 4 foot bg sampling intervals. Copper is slightly elevated at soil boring B3536 (41.6 mg/kg), but is below other applicable background ranges.

- Lead is elevated in nine soil borings throughout the Land Area. The maximum concentration (189J mg/kg) from the bottom-most sampling interval of B3555 (4 to 5 feet bg) exceeds all background ranges. The next highest lead concentration (58.6 mg/kg) from soil boring B3531 (2 to 3 feet bg) is slightly elevated above the maximum J7 Scrap and Salvage RFI maximum background value (40.8 mg/kg) and is within the background range of northeastern soils (4 to 61 mg/kg). The remaining elevated lead concentrations are below the J7 Scrap and Salvage RFI maximum background value.

- Mercury is elevated at soil boring locations B3518 (0.32 mg/kg from 0.5 to 2 feet bg), B3531 (0.21 mg/kg from 2 to 3 ft bg), and B3556 (0.25 mg/kg from 0.16 to 2 feet bg), and B3527 (0.1 mg/kg from 0.83 to 1.66 feet bg). Concentrations at borings B3518, B3531, and B3556 exceed the J7 Scrap and Salvage RFI maximum background value (0.13 mg/kg). Concentrations at boring B3527 just exceed the SV background and not the J7 Scrap and

Salvage RFI maximum background value. Borings B3531 and B3556 are adjacent to each other in the southwestern corner of the Land Area.

- Nickel is elevated at soil borings B3543 (132 mg/kg from 0 to 2 feet bg) and B3554 (89 mg/kg from 4 to 6 feet bg) at concentrations that exceed the J7 Scrap and Salvage RFI maximum background value (57.3 mg/kg). Both soil borings are located in the southern portion of the Land Area.
- Silver is elevated in seven samples (0.13J to 0.6 mg/kg) in various intervals from five soil borings located primarily in the southern portion of the Land Area sampling grid. However, the maximum silver concentration of 0.6 mg/kg is located at soil boring location B3518 (0.5 to 2 feet bg), along the west-central edge of the sampling grid. Silver concentrations are elevated to a depth of 4 feet bg at soil boring B3543 (0.54J to 0.59 mg/kg) and attenuate to non-detect levels at 4 to 6 feet bg. Silver is also slightly elevated at soil boring location B3531 to its maximum depth of 3 feet bg (0.13J and 0.15J mg/kg).

Elevated concentrations of copper, lead, mercury, nickel, and silver indicate two potential areas of impact. Figure 7-9 identifies soil boring locations in the southern portion of the Land Area that contain elevated levels of one or more of these metals. The horizontal extent of elevated mercury and lead has not been established to the southwest portion of the study area. The vertical extent of lead has also not been established since the maximum concentrations occur in the lowest interval of soil borings B3531 and B3555, both terminated above buried materials. The extent of nickel is bounded horizontally at both soil borings B3543 and B3554, vertically at B3543, but not vertically at B3554.

The vertical extent of metals in the southern portion of the Land Area in soil borings that encountered buried materials (B3531, B3532, B3547, B3555, and B3556) was not completely determined due to the termination of the borings above the buried material. Elevated metals in this area may be associated with landfilling of materials not related to SPRU. The southern portion of the Land Area is also associated with an area of possible buried metal objects identified in a previous geophysical survey (Reference(6), Figure 7).

The area surrounding soil boring locations B3518 and B3519 comprises the other area of potential metals impact. Elevated concentrations of copper, mercury, and silver in the uppermost sampling intervals are bounded by lowered concentrations in the underlying (2 to 4 feet bg) interval. Both soil borings are located along the western edge of the Land Area sampling grid so they are not bounded to the west. Soil boring B3518 is near an area of possible buried metal objects identified during a previous geophysical survey (Reference(6), Figure 7).

Chemical Characterization of Land Area Groundwater

The scope of the groundwater investigation performed within this SV sampling effort was to sample and analyze wells within and surrounding the Land Area for SVOCs to complement the existing metals and VOC database. As presented in Table 7-1, installation of additional groundwater monitoring wells was not performed due to the lack of saturated conditions within the fill or brown till overlying the gray till.

A trace of phenanthrene was detected in one monitoring well (NTH-1) at a concentration of 0.6J μg/L, well below the NYSDEC ambient groundwater quality standard of 50 μg/L. As shown in Figure 7-6, NTH-1 is an upgradient well unaffected by the Land Area SWMUs. No other SVOCs were detected in any of the monitoring wells. No SVOC release to groundwater is indicated by these results.

8.0 Conclusions

Based on this SV, there is no imminent threat to human health or the environment associated with releases from the former SPRU operations. The following observations and conclusions can be made regarding the release of hazardous constituents to the environment by SPRU operations.

8.1 Upper Level SWMUs

8.1.1 H2 Processing Facility (SWMU-030)

Surface soil near the southwest corner of Building H2 has elevated antimony, arsenic, and mercury concentrations. Antimony was also detected, although suspect, above the NYSDEC ambient water quality criteria (Reference(14)) in dissolved groundwater samples collected along the northwest portion of Building H2. Although soil along the foundation of Building H2 (west and south side) is impacted by VOCs (TCE and total 1,2-DCE), the concentrations are well below the NYSDEC recommended soil cleanup objectives (Reference(13)). Groundwater along the southern perimeter of Building H2 contains VOCs (TCE and total 1,2-DCE) above the NYSDEC ambient water quality criteria.

8.1.2 H2 Tank Farm (SWMU-031)

Mercury and zinc are elevated above background or NYSDEC recommended soil cleanup objectives in surface soil in the east-central portion of the H2 Tank Farm. Mercury is also elevated above background or NYSDEC recommended soil cleanup objectives in soil at the base of the tank farm vault foundation. These metals are consistent with hazardous constituents managed by SPRU operations.

8.1.3 Pipe Tunnels (SWMU-057)

VOCs below NYSDEC recommended soil cleanup objectives were detected within soil along the western foundation of the Pipe Tunnel. Groundwater also contains traces of VOCs (1,1-DCA; 1,1-DCE; total 1,2-DCE; TCE, and vinyl chloride), west of the Pipe Tunnel. Only TCE exceeds the NYSDEC ambient water quality criteria in one well.

8.2 Lower Level SWMUs/AOC

8.2.1 K6 and K7 Storage Pads (SWMUs-036 and –037)

Except for an isolated detection of elevated zinc above background in one soil boring at the K7 Storage Pad (SWMU-037), no hazardous constituent releases were discovered that are associated with the K6 Storage Pad (SWMU-036) and the Former K7 Storage Pad (SWMU-037).

8.2.2 Railroad Staging Area (SWMU-038)

Concentrations of silver, mercury, total chromium, and thallium detected in shallow soil above background indicate hazardous constituent releases in the southeastern, central, and northern portions of the Railroad Staging Area. These metals are also above the NYSDEC recommended soil cleanup objectives. Traces of VOCs were detected below NYSDEC recommended soil cleanup objectives in the northwestern and southeastern portions of the Railroad Staging Area. Traces of gasoline constituents were evident throughout the Railroad Staging Area and are likely associated with motor vehicle use, not waste management or product spills from SPRU operations. Elevated metals and VOCs in the southeastern portion of the Railroad Staging Area may have resulted from operations at the former Sewage Treatment Plant, and may not be related to SPRU.

Antimony, copper, arsenic, lead, and PAH compounds are elevated throughout the extent of the former Railbed area. These PAHs and metals are attributed to railroad construction materials and operations, and not SPRU or KAPL waste management.

8.2.3 K5 Retention Basin (SWMU-040)

A trace detection of TCE in soil at the northeast corner of the K5 Retention Basin suggests a potential release of VOCs from the building's foundation at a concentration well below NYSDEC recommended soil cleanup objective. Slightly elevated concentrations of copper and zinc in the soils surrounding the K5 Retention Basin are likely associated with soil mineralogy and/or construction activity, therefore are not likely a release indicator from waste management or product spills from SPRU operations.

8.2.4 Lower Level Parking Lot (AOC-003)

Concentrations of antimony, arsenic, cadmium, copper, lead, mercury, and silver are above background or NYSDEC recommended soil cleanup objectives in soil borings primarily in the northern portion of the parking lot. Concentrations of mercury (up to 6.9 mg/kg) significantly exceed the NYSDEC soil cleanup objective. Metal concentrations indicate a likely hazardous constituent release from SPRU operations. Traces of gasoline constituents in parking lot soil are likely associated with vehicle use, not waste management or product spills from SPRU operations.

Overall, concentrations of chemical constituents in groundwater at the Lower Level SWMUs/AOC are consistent with natural conditions; therefore, no release of hazardous constituents was determined in groundwater at the Lower Level.

8.3 Land Area SWMU

8.3.1 Former Slurry Drum Storage Area (SWMU-035)

VOCs including PCE, TCE, and 1,2-DCE were detected in soil in the west-central and southwestern portions of the Land Area sampling grid. Detections in the west-central area are near monitoring well W-3, which historically contains 1,2-DCE in groundwater, and indicate potential migration of VOCs from soil to groundwater. This area is also within the vicinity of the former Pyrophoric Area (SWMU-005), where activities unrelated to SPRU may have released VOCs. Neither the source nor the extent of the VOCs in the west-central area has been established. VOCs in the southwestern portion of the Land Area are likely associated with trash and refuse disposal at the Former Landfill (SWMU-002), and not related to SPRU operations.

Copper, lead, mercury, nickel, and silver in soil were observed to exceed background or NYSDEC soil cleanup objectives. There are few adjacent soil borings with consistently elevated metals concentrations. Specific areas of potential release are not well defined; however, elevated metals do occur in the southwestern portion of the Land Area and at a grouping of soil borings located in the west-central portion of the Land Area sampling grid, defined by elevated copper, mercury, and silver. Both areas of elevated metals are associated with VOCs.

9.0 Recommendations

Additional characterization is recommended for the three SPRU SV geographic areas as described below.

9.1 Upper Level SWMUs

The extent of the VOC impact to soil and groundwater at the Pipe Tunnels (SWMU-057) and H2 Processing Facility (SWMU-030) require further evaluation to determine the extent of VOCs at the Pipe Tunnel and to confirm whether there is an additional release from the foundation of Building H2. The extent of metals in near-surface soil at the southwestern corner of Building H2 and along the southern and eastern perimeter of the H2 Tank Farm (SWMU-031) requires further investigation. Potential transfer of metals (antimony) from soil to groundwater along the western side of Building H2 also requires further evaluation.

9.2 Lower Level SWMUs/AOC

The extent of elevated metals, primarily mercury, in soil within the northern portion of the Railroad Staging Area (SWMU-038) and the Lower Level Parking Lot (AOC-003) requires further evaluation. Low levels of VOCs and elevated metals located in the southeast portion of the Railroad Staging Area also require further evaluation. These areas will require further investigation to determine the nature and extent of the releases.

Except for an isolated detection of zinc above background in one soil boring, no hazardous constituent releases were discovered that are associated with the K6 Storage Pad (SWMU-036) and the Former K7 Storage Pad (SWMU-037). No further action is recommended for these two SWMUs.

Evaluation of the nature and extent of a trace level of TCE detected at the northeast corner of the K5 Retention Basin (SWMU-040) should be performed during decommissioning and demolition of the structure, due to current access limitations. The low concentrations do not warrant immediate action and there is no evidence of migration from SWMU-040 in two downgradient monitoring wells. Additional sampling performed along the influent drain line to the K5 Retention Basin did not indicate a hazardous constituent release; however, sampling at a planned second trench could not be done due to underground utility interferences and topography. Sampling along the influent drain line should be performed during the demolition of the K5 Retention Basin to confirm the absence of a hazardous constituent release.

PAH compounds and various metals (antimony, arsenic, copper, and lead) were detected along the entire extent of the former railbed within the Railroad Staging Area (SWMU-038). These PAHs and metals are attributed to railroad construction materials and operations, and not SPRU or KAPL waste management. Also, traces of gasoline components were evident throughout the Railroad Staging Area and are attributed to motor vehicle use. No further action is recommended for these constituents.

9.3 Land Area SWMU

At the Land Area, no hazardous constituent releases were discovered that are attributed to SPRU. Low levels of VOCs (PCE and TCE) and elevated metals detected in shallow soils are attributed to releases from SWMUs that are separate from SPRU and will be subject to a future RFI by KAPL within the Pyrophoric Area (SWMU-005) and the Former Landfill (SWMU-002). Hence, no further action is recommended for SWMU-035.

10.0 References

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2) KAPL. 2000. *RCRA Facility Assessment Sampling Visit for Separation Process Research Unit SWMUs/AOC – Work Plan*. April 2000.

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