U.S. ARMY ENGINEER DIVISION
HUNTSVILLE, ALABAMA

REMEDIAL INVESTIGATION REPORT AT THE ASH LANDFILL SITE

JUNE 1994

REMEDIAL INVESTIGATION REPORT
ASH LANDFILL
SENECA ARMY DEPOT
ROMULUS, NEW YORK

Prepared For:

Seneca Army Depot
Romulus, New York

Prepared By:

Engineering-Science, Inc.
Prudential Center
Boston, Massachusetts

720447-01024 July, 1994

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LIST OF ACRONYMS

AET	Actual Evapotranspiration
AMC	U.S. Army Material Command
AQCR	Genesee-Finger Air Quality Control Region
1,2-DCA	1,2-Dichloroethane
1,2,-DCE	1,2-Dichloroethylene (total)
2,4,5-TP	Silvex
ASTM	American Society for Testing and Materials
bls	below land surface
B	Boring
BDL	Below Detection Limit
BOD	Biological Oxygen Demand
BRA	Baseline Risk Assessment
BRAC	Base Realignment and Closure
C	Carcinogenic Risk
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic feet per second
CI	Chloride
CLP	Contract Laboratory Program
cm	Centimeters
cm/sec	Centimeters per second
COD	Chemical Oxygen Demand
CRAVE	USEPA Carcinogen Risk Assessment Verification Endeavor
CV	Coefficient of Variance
DCE	Dichloroethylene
DOT	Department of Transporation
DWQS	Drinking Water Quality Standard
EIS	Environmental Impact Statement
EM	Electromagnetic
EPA	Environmental Protection Agency
EPC	Explsive Point Concentration
ERA	Ecological Risk Assessment
ES	Engineering-Science, Inc.

LIST OF ACRONYMS
(Con.t)

ESE	Environmental Science and Engineering
EPT	Ephemeroptera, Plecoptera, Tricopteraft
FDA	Food and Drug Administration
FS	Feasibility Study
ft	Feet
ft/day	Feet per day
ft/ft	Feet per foot
ft/sec	Feet per second
ft/yr	Feet per year
GAE	Geophysical anomaly excavations
GC	Gas chromatograph
GC/MS	Gas chromatograph/Mass spectrum
gpm	Gallons per minute
GPR	Ground penetrating radar
GSSI	Geophysical Survey Systems, Inc.
I	Infiltration
ICF	ICF Technology, Incorporated
LOT	Limit of Tolerance
L/min	Liters per minute
m	meter
MCPP	4-Chloro-2-Methylphenoxy-2-propionic acid
mg/kg	Milligrams per kilogram
mg/L	Micrograms per liter
mg/m_3	milligrams/cubic meter
MHz	Megahertz
mi	Mile
mL	Milliliter
mmhos/m	Millimhos per meter
mmHg	Millimeters Mercury
MRD	Missouri River Division

LIST OF ACRONYMS
(Con.t)

m/s	meter per second
MSL	Mean sea level
MW	Monitor Well
NBS	National Bureau of Standards
Nc	Hazard Quotient
NO_2/N	Nitrite-Nitrogen
NO_3/N	Nitrate-Nitrogen
NPL	National Priority List
NTU	Nephelometric turbidity units
NYSDEC	New York State Department of Environmental Conservation
OVM	Organic Vapor Meter
PAH	Polynuclear aromatic hydrocarbons
PCB	Plychlorinated Biphenyls
PERC	Percolation
PET	Potential Evapo Transpiration
PID	Photoionization detector
ppm	parts per million
ppmv	Part Per MIllion Per Volume
PR	Percent Recovery
PSCR	Preliminary Site Characterization Report
Psi	Pounds per square inch
PT	Monitoring Well
PVC	Polyvinyl Chloride
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RF	Response Factor
RfC	Reference Concentration
RfD	Reference Dose

LIST OF ACRONYMS

(Con.t)

RI	Remedial Investigation
RME	Reasonable Maximum
RPD	Relative Percent Difference
RQD	Rock Quality Designation
SARA	Superfund Amendments and Reauthorization Act
SCS	Soil Conservation Service
SDG	Sample Delivery Group
SEAD	Seneca Army Depot (old name)
SEDA	Seneca Army Depot
Sec	Seconds
SIR	Subsurface Interface
SO_4	Sulfate
SOP	Standard Operating Procedurs
SQL	Sample Quantitator Limits
ST	Soil Moisture
SVOCs	Semi-Volatile Organic Compounds
SW	Sediment and surface water sample station
SWMU	Solid Waste Management Unit
T1,2-DCE	trans-1,2-Dichloroethylene
TAGM	New York State Chemical And Administrative Guidance Memorandum
TAL	Target analyte list
TCE	Trichloroethylene
TCL	Target compound list
TES	Target Environmental Services, Inc.
TIC	Tentatively Identified Compound
TKN	Total Kjeldah/Nitrogen
TOC	Total Organic Carbon
TOX	Total Organic Halogens
TP	Test Pit
TS	Total Solids

LIST OF ACRONYMS
(Con.t)

ug/g	Micrograms per gram
ug/wp	Micrograms per wipe
ug/kg	Micrograms per kilogram
UCL	Upper Confidence Limit
USACE	United States Army Corps of Engineers
USAEHA	United States Army Environmental Hygiene Agency
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USCS	Unified Soil Classification System
USGS	United States Geological Survey
VC	Vinyl Chloride
VLF-EM	Very Low Frequency Electromagnetic
VOA	Volatile organic analyte
VOC	Volatile Organic Compound
Vs	Volt Second

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

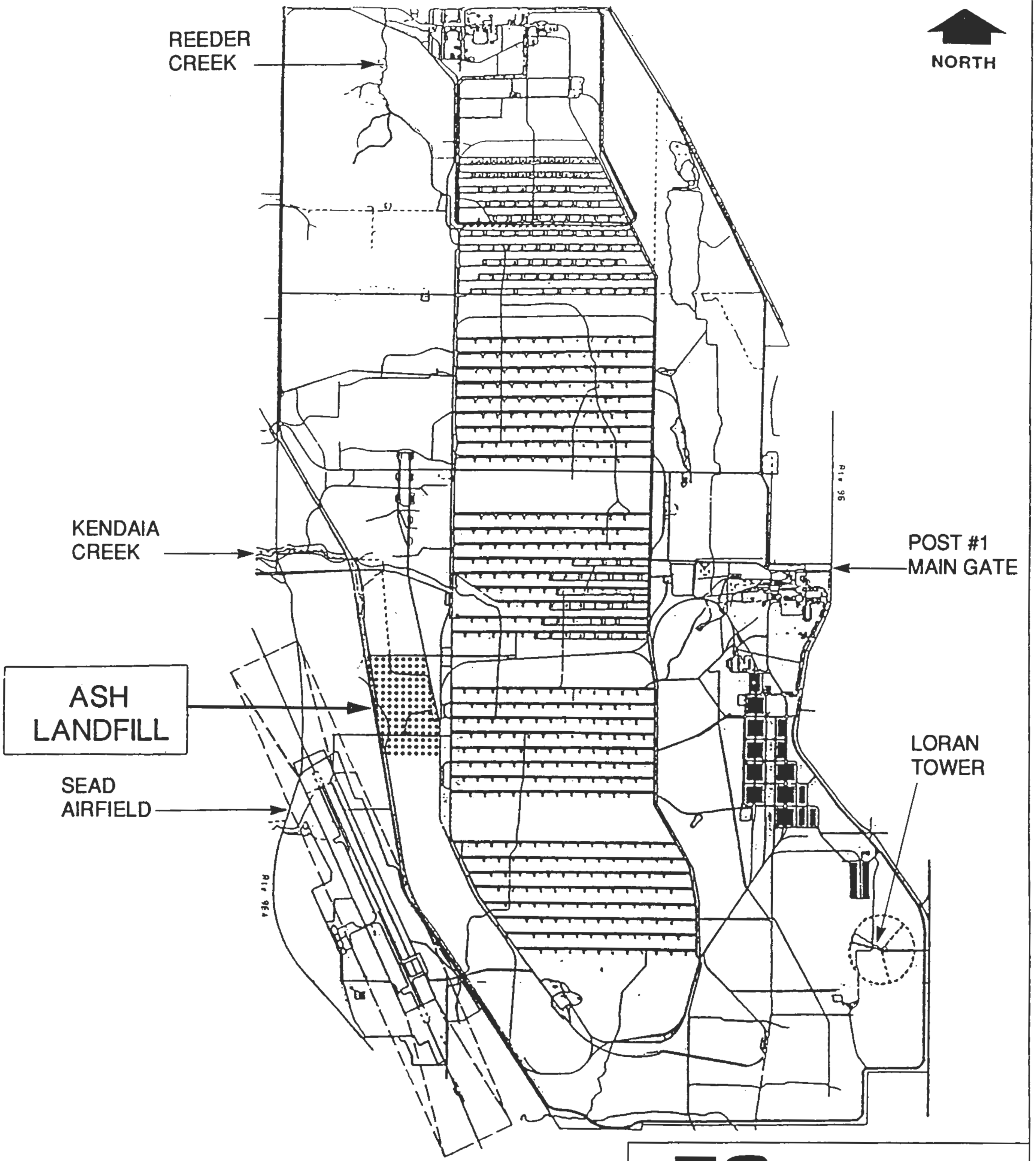
This report describes the Remedial Investigation (RI) activities at the Seneca Army Depot Activity (SEDA) Ash Landfill site. Engineering-Science, Inc. (ES) has been retained by the United States Army Corps of Engineers (USACE) as part of their remedial response activities under the Comprehensive Environmental Responsibility, Compensation and Liability Act (CERCLA) to perform these activities. The purpose of this report is to discuss the physical characteristics of the site, present and interpret the analytical results from the investigation programs, identify sources of the potential contamination at the site and estimate the risk to human health and the environment. The Ash Landfill is included on the federal facilities National Priorities List (NPL) and has been listed since July 13, 1989.

1.2 SITE BACKGROUND

1.2.1 Site Description

SEDA is an active military facility constructed in 1941. The site is located approximately 40 miles (mi) south of Lake Ontario, near Romulus, New York (Figure 1-1). The facility is located in an uplands area, at an elevation of approximately 600 feet Mean Sea Level (MSL), that forms a divide separating two of the New York Finger Lakes, Cayuga Lake on the east and Seneca Lake on the west. Sparsely populated farmland covers most of the surrounding area. New York State Highways 96 and 96A adjoin SEDA on the east and west boundaries, respectively. Since its inception in 1941 SEDA's primary mission has been the receipt, storage, maintenance, and supply of military items. The Ash Landfill site encompasses approximately 130 acres of the 10,587 - acre SEDA. Figure 1-2 presents a plan view of SEDA and identifies the location of the Ash Landfill site.

The Ash Landfill site consists of and abandoned incinerator building and stack (Building 2207), a former cooling pond, an ash landfill, and a nearby Non-Combustible Fill Landfill (Figure 1-3). The site is bounded on the north by Cemetary Road, on the east by a SEDA railroad line, on the south by undeveloped SEDA land, and on the west by the depot's boundary. Beyond the depot's western boundary are farmland and residences on Smith Farm Road and along Route 96A. Sampson State Park on the shore of Seneca Lake is located immediately to the west of Route 96A.



Source: Seneca Army Depot

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SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

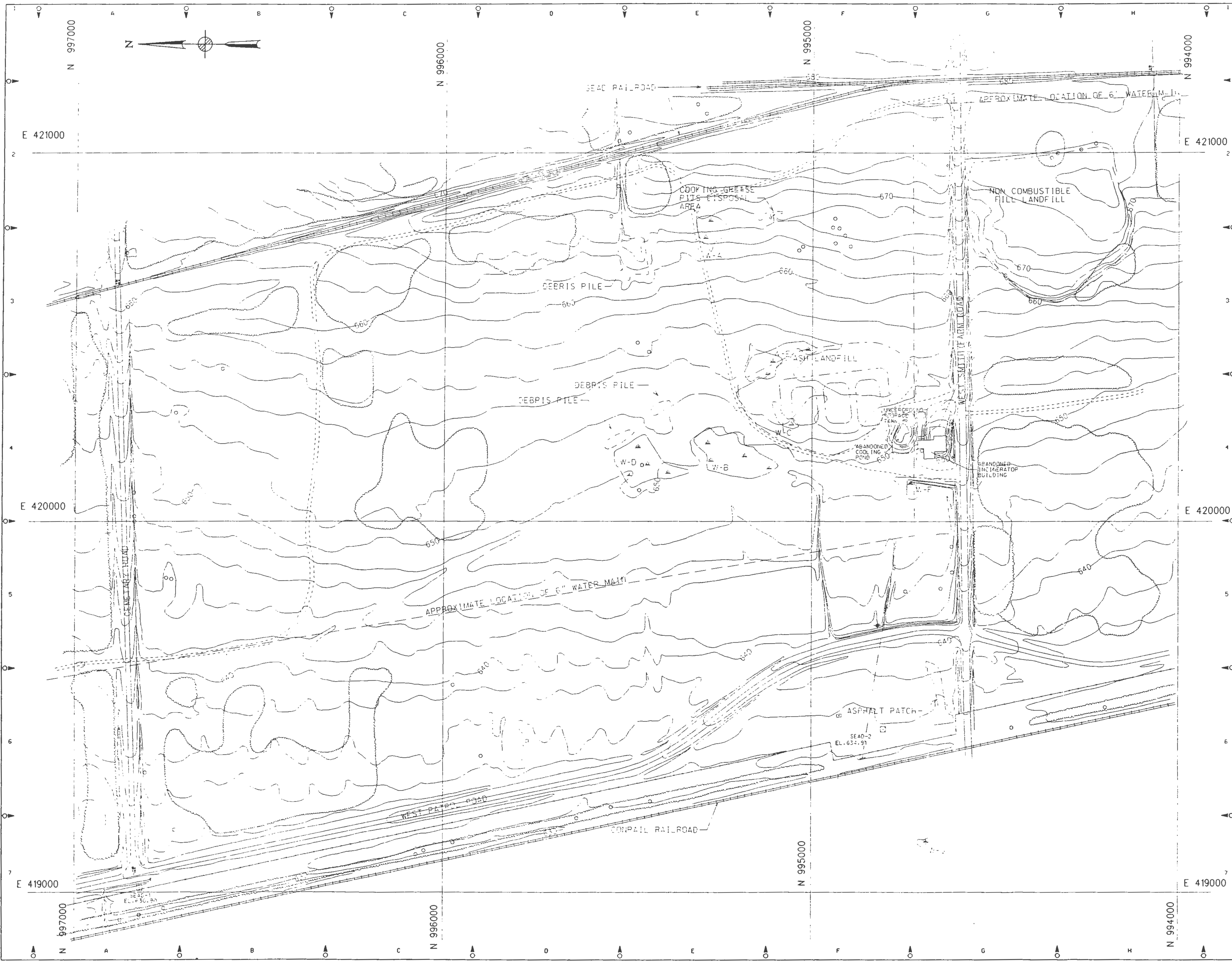
DEPT. ENVIRONMENTAL ENGINEERING

NO 720447-03000

FIGURE 1-2

SENECA ARMY DEPOT MAP

SCALE 1" = 4000' (APPROXIMATE)



/usr/sd3/environ/miso/senp2x28.dgn

20-OCT-1993 09:00

REV	DATE	DESCRIPTION
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A.KAELIN
CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAELIN
RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER
MGR. OF ENGR. J.P.CHAPUCK
PROJECT MANAGER M.N.DUCHESNEAU
MGR. OF PROJECTS J.P.CHAPUCK
IN CHARGE W.D.PATTERSON

DRAWN | CHECKED | DES.SUPV. | RESP.ENGR. | CH.DISC.ENG. | PROJ. MGR.

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ASH LANDFILL

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NO. 720447-03000

FIGURE 1-3
ASH LANDFILL
SITE MAP

SCALE 1" = 250'

ES S DWG. NO. 720447-03000-1-1
REV B

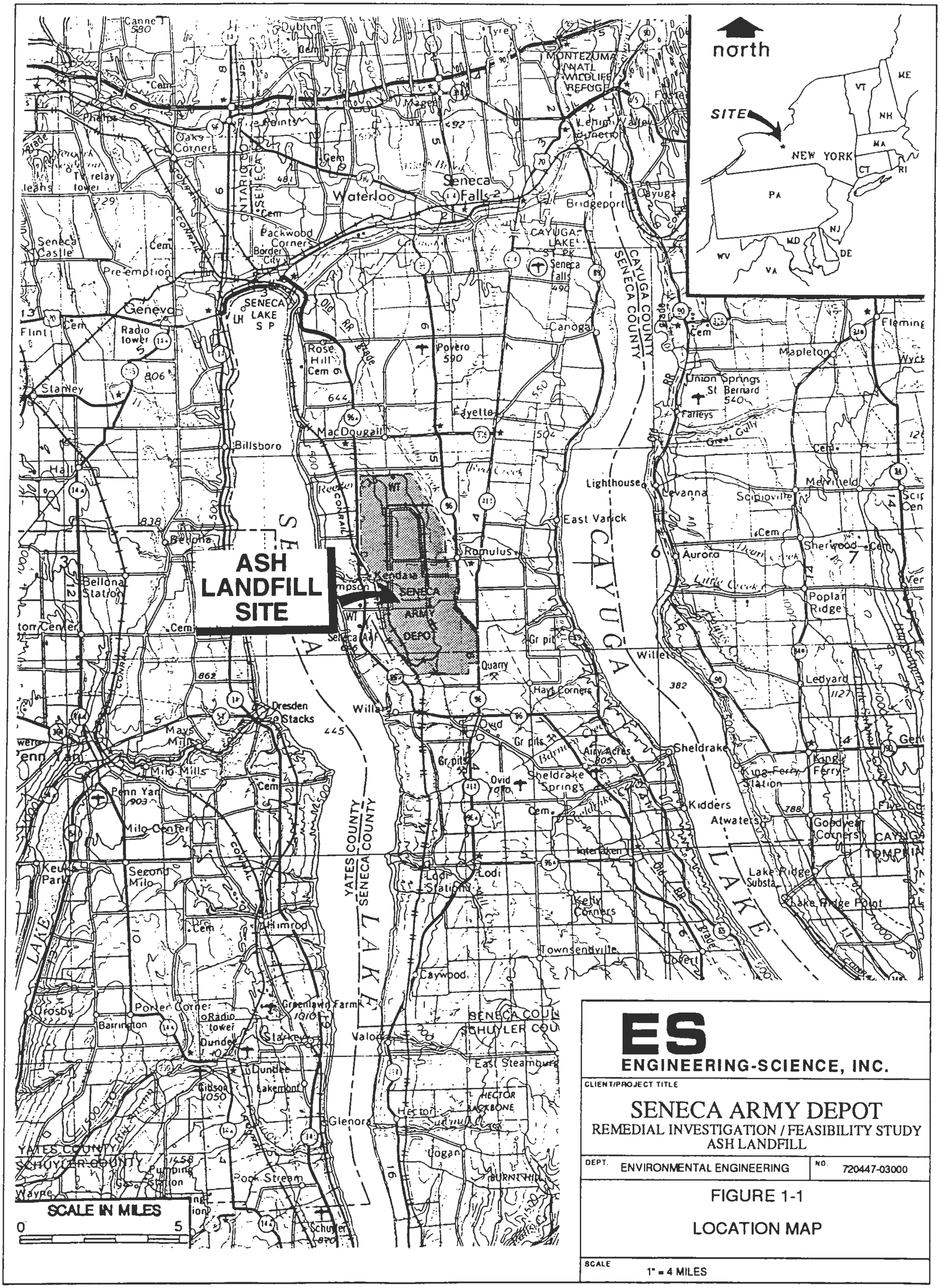

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FIGURE 1-1

LOCATION MAP

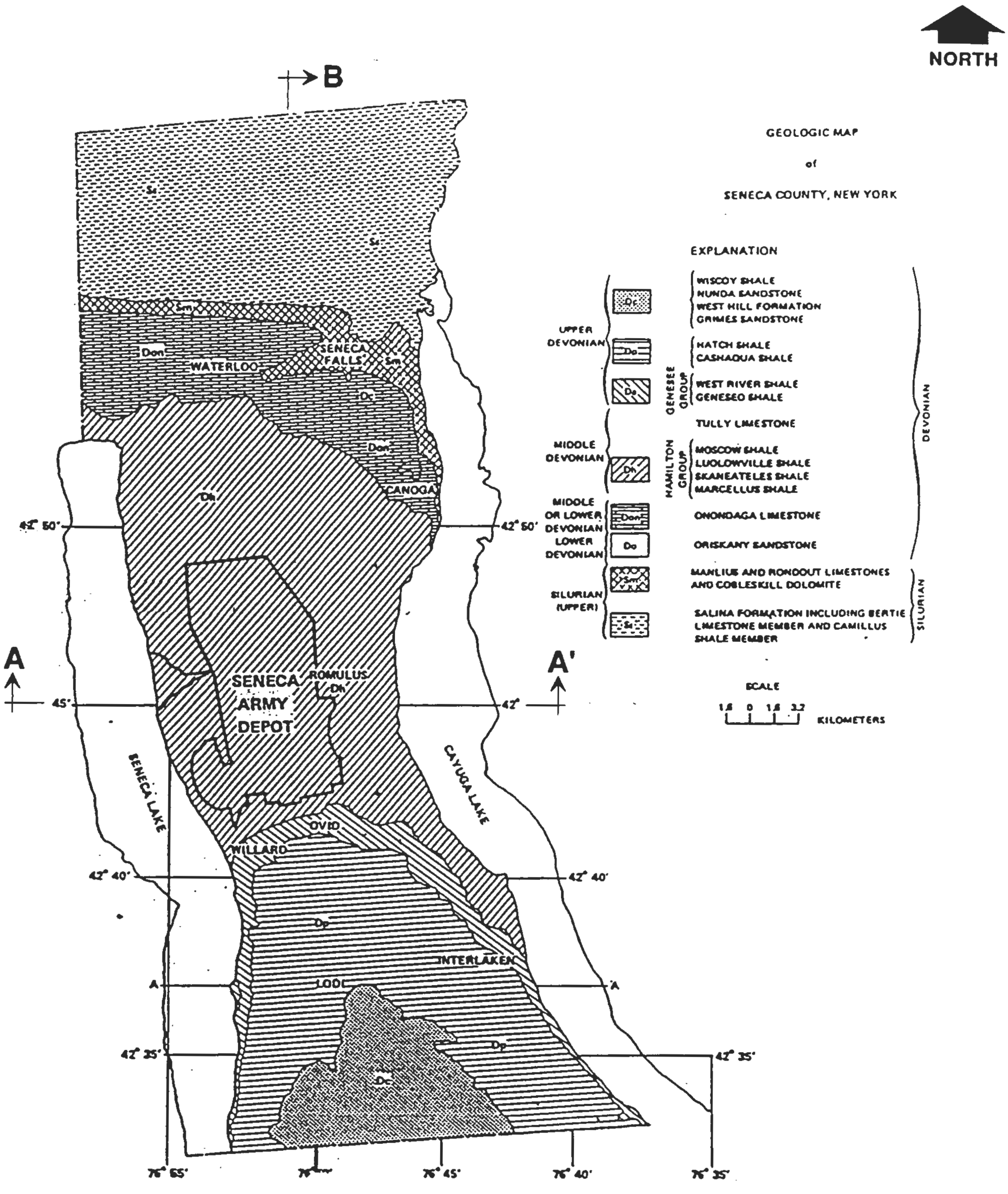
SCALE 1" = 4 MILES

The Ash Landfill was previously used by the Army for disposal of ash generated from the incineration of solid waste (trash) produced at the depot. The Non-Combustible Fill Landfill is located east of the incinerator building on the south side of West Smith Farm Road. This landfill was the repository of materials that could not be burned in the incinerator.

1.2.1.1 Regional Geologic Setting

The Finger Lakes uplands area is underlain by a broad north-to-south trending series of rock terraces mantled by glacial till. As part of the Appalachian Plateau, the region is underlain by a tectonically undisturbed sequence of Paleozoic rocks consisting of shales, sandstones, conglomerates, limestones and dolostones. Figure 1-4 shows the regional geology of Seneca County. In the vicinity of SEDA, Devonian age (385 million years bp) rocks of the Hamilton group are monoclinally folded and dip gently to the south (Figure 1-5). No evidence of faulting or folding is present. The Hamilton Group is a sequence of limestones, calcareous shales, siltstones, and sandstones. These rocks were deposited in a shallow inland sea at the north end of the Appalachian Basin (Gray, 1991). Terrigenous sediments from topographic highs associated with the Acadian landmass of Western New England, eastern New York and Pennsylvania were transported to the west across a marine shelf (Gray, 1991). These sediments were deposited in a northeast-southwest trending trough whose central axis was near what is now the Finger Lakes (Gray, 1991).

The Hamilton Group, 600 to 1500 feet thick, is divided into four formations. They are, from oldest to youngest, the Marcellus, Skaneateles, Ludlowville, and Moscow formations. The western portion of SEDA is generally located in the Ludlowville Formation while the eastern portion is located in the younger Moscow Formation. The Ludlowville and Moscow formations are characterized by gray, calcareous shales and mudstones and thin limestones with numerous zones of abundant invertebrate fossils that form geographically widespread encrinites, coral-rich layers, and complex shell beds. The Ludlowville Formation is known to contain brachiopods, bivalves, trilobites, corals and bryozoans (Gray, 1991). In contrast, the lower two formations (Skaneateles and Marcellus) consist largely of black and dark gray sparsely fossiliferous shales (Brett et al., 1991). Locally, the shale is soft, gray, and fissile. Figure 1-6 displays the stratigraphic section of Paleozoic rocks of Central New York. The shale is extensively jointed and weathered at the contact with overlying tills. Joint spacings are 1 inch to 4 feet in surface exposures. Prominent joint directions are N 60° E, N 30° W, and N 20° E, with the joints being primarily vertical. Corings performed on the upper 5 to 8 feet of the bedrock revealed low Rock Quality Designations (RQD's), i.e., less than 5



SOURCE: The Groundwater Resources of Seneca County, New York: Mozola, A.J., Bulletin GW-26, Albany, NY, 1951

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ASH LANDFILL

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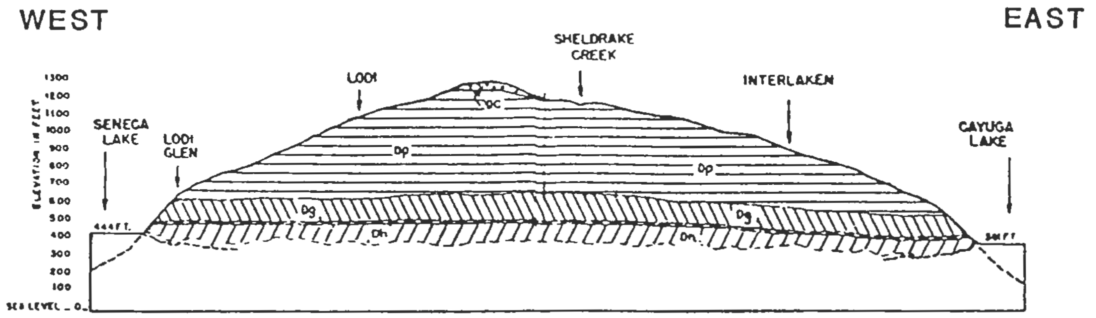
FIGURE 1-4

GEOLOGIC MAP OF SENECA COUNTY

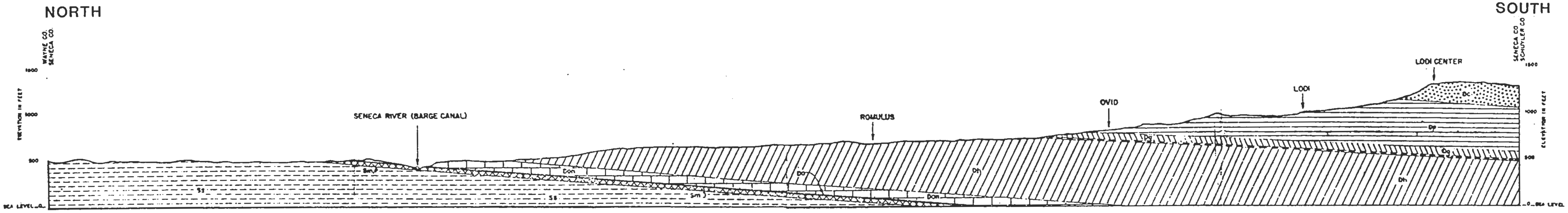
SCALE

UNITED STATES GEOLOGICAL SURVEY

GEOLOGIC SECTIONS ACROSS SENECA COUNTY, NEW YORK



EAST-WEST SECTION ALONG LINE A-A' SHOWN ON FIGURE I-4



NORTH-SOUTH SECTION ALONG LONGITUDE 76°50' LINE B-B' ON FIGURE I-5

EXPLANATION

WISCOY SHALE
NUNDA SANDSTONE
WEST HILL FORMATION
GRIMES SANDSTONE

HATCH SHALE
CASHAQUA SHALE

WEST RIVER SHALE
GENESEO SHALE

DEVONIAN

MIDDLE DEVONIAN
TULLY LIMESTONE
Dh — HAMILTON GROUP: MOSCOW SHALE, LUDLOWVILLE SHALE, SKANEATELES SHALE, MARCELLUS SHALE

MIDDLE OR LOWER DEVONIAN
Don — ONONDAGA LIMESTONE

LOWER DEVONIAN
Do — ORISKANY SANDSTONE

DEVONIAN

SILURIAN (UPPER)
Sm — MANLIUS AND RONDOUT LIMESTONES AND COBLESKILL DOLOMITE
Ss — SALINA FORMATION INCLUDING BERTIE LIMESTONE MEMBER AND CAMILLUS SHALE MEMBER

SILURIAN

SOURCE: The Groundwater Resources of Seneca County, New York: Mozola, A.J., Bulletin GW-26, Albany, NY, 1951

SCALE
1 0 1 2 3 MILES

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FIGURE 1-5
REGIONAL GEOLOGIC CROSS SECTIONS
SCALE 1" = 12,000' APPROXIMATE

MESOZOIC

Lower Cretaceous

MESOZOIC INTRUSIVES

Kimberlite and alnoite dikes and diatremes

PALEOZOIC

Upper Devonian

CONNEAUT GROUP
600-1000 ft. (180-300 m.)

Germania Formation—shale, sandstone; Whitesville Formation—shale, sandstone; Hinsdale Sandstone; Wellsville Formation—shale, sandstone; Cuba Sandstone.

CANADAWAY GROUP
800-1200 ft. (240-370 m.)

Machias Formation—shale, siltstone; Rushford Sandstone; Caneadea, Canisteo, and Hume Shales; Canaseraga Sandstone; South Wales and Dunkirk Shales; In Pennsylvania: Towanda Formation—shale, sandstone.

JAVA GROUP
300-700 ft. (90-210 m.)

Wiscoy Formation—sandstone, shale; Hanover and Pioe Creek Shales.

WEST FALLS GROUP
1100-1600 ft. (340-490 m.)

Nunda Formation—sandstone, shale.

West Hill and Gardeau Formations—shale, siltstone;

Roricks Glen Shale; upper Beers Hill Shale; Grimes Siltstone.

lower Beers Hill Shale; Dunn Hill, Millport, and Moreland Shales.

Nunda Formation—sandstone, shale; West Hill Formation—shale, siltstone; Corning Shale.

"New Milford" Formation—sandstone, shale.

Gardeau Formation—shale,. siltstone; Roricks Glen Shale.

Slide Mountain Formation—sandstone, shale, conglomerate.

Beers Hill Shale; Grimes Siltstone; Dunn Hill, Millport, and Moreland Shales

SONYEA GROUP
200-1000 ft. (60-300 m.)

In west: Cashaqua and Middlesex Shales.

In east: Rye Point Shale; Rock Stream ("Enfield") Siltstone; Pulteney, Sawmill Creek, Johns Creek, and Montour Shales.

GENESEE GROUP AND TULLY LIMESTONE
200-1000 ft. (60-300 m.)

West River Shale; Genundewa Limestone; Penn Yan and Geneseo Shales; all except Geneseo replaced eastwardly by Ithaca Formation—shale, siltstone and Sherburne Siltstone.

Middle Devonian

Oneonta Formation—shale, sandstone.

Unadilla Formation—shale, siltstone.

Tully Limestone.

HAMILTON GROUP
600-1500 ft. (180-460 m.)

Moscow Formation—In west: Windom and Kashong Shales, Menteth Limestone Members; In east: Cooperstown Shale Member, Portland Point Limestone Member.

Ludlowville Formation—In west: Deep Run Shale, Tichenor Limestone, Wanakah and Ledyard Shale Members, Centerfield Limestone Member. In east: King Ferry Shale and other members, Stone Mill Sandstone Member.

Skaneateles Formation—In west: Levanna Shale and Stafford Limestone Members; In east: Butternut, Pompey, and Delphi Station Shale Members, Mottville Sandstone Member.

Marcellus Formation—In west: Oakta Creek Shale Member; In east: Cardiff and Chittenango Shale Members, Cherry Valley Limestone and Union Springs Shale Members.

Panther Mountain Formation—shale, siltstone, sandstone.

ONONDAGA LIMESTONE AND ORISKANY SANOSTONE
75-150 ft. (23-45 m.)

Onondaga Limestone—Seneca, Morehouse (cherty) and Nedrow Limestone Members, Edgecliff cherty Limestone Member, local bioherms.

Oriskany Sandstone.

Lower Devonian

HELDERBERG GROUP
0-200 ft. (0-60 m.)

Coeymans and Manlius Limestones; Rondout Dolostone.

Upper Silurian

AKRON DOLOSTONE, COBLESKILL LIMESTONE, AND SALINA GROUP
700-1000 ft. (210-300 m.)

Akron Dolostone; Bertie Formation—dolostone, shale.

Camillus and Syracuse Formations—shale, dolostone, gypsum, salt.

Cobleskill Limestone; Bertie and Camillus Formations—dolostone, shale.

Syracuse Formation—dolostone, shale, gypsum, salt.

Vernon Formation—shale, dolostone.

LOCKPORT GROUP
80-175 ft. (25-55 m.)

Oak Orchard and Penfield Dolostones, both replaced eastwardly by Sconondoa Formation—limestone, dolostune.

CLINTON GROUP
150-325 ft. (40~~-100 m.)~~

Decew Dolostone; Rochester Shale.

Lower Silurian

Irondequoit Limestone; Williamson Shale; Wolcott Furnace Hematite; Wolcott Limestone; Sodus Shale; Bear Creek Shale; Wallington Limestone; Furnaceville Hematite; Maplewood Shale; Kodak Sandstone.

Herkimer Sandstone; Kirkland Hematite; Willowvale Shale; Westmoreland Hematite; Sauquoit Formation—sandstone, shale; Oneida Conglomerate.

MEDINA GROUP AND QUEENSTON FORMATION
0-900 ft. (0-270 m.)

Medina Group: Grimbsy Formation—sandstone, shale.

Queenston Formation—shale, siltstone.

Upper Ordovician

Undifferentiated Medina Group and Queenston Formation.

LORRAINE GROUP
700-900 ft. (210-270 m.)

Oswego Sandstone.

Pulaski and Whetstone Gulf Formations—siltstone, shale.

Middle Ordovician

TRENTON GROUP
100-300 ft. (30-90 m.)

Utica Shale.

Hamilton group	Moscow shale	43±	Lower two-thirds of section is a fossiliferous, soft gray calcareous shale; upper third highly friable but less calcareous and fossiliferous. Staining by iron oxide very common. Concretions present in greater abundance in lower beds, but irregular calcareous masses occur throughout section. Joints parallel, tightly sealed, trending N.65°E. and N.25°-30°W.
	Ludlowville shale	43±	Lower beds are thinly laminated, light-colored, fossiliferous, shaly passage beds; overlain by hard calcareous black shales 13 to 30 centimeters thick and rich in corals and brachiopods; hard layers responsible for falls and cascades. Middle beds are less fossiliferous, soft gray arenaceous shales, rich in concretions, calcareous lenses, and occasional thin sandstone layers. Upper beds (Tichenor limestone member) are thin, irregularly bedded gray shales becoming light blue gray upon exposure, calcareous, coarsely textured, and fossiliferous. Joints parallel 5 to 50 centimeters apart, well developed but tight.
	Skaneateles shale	56±	Basal beds composed of dark fissile shale. Upper shale more calcareous, grayish to bluish impure limestone layers. Joint pattern N.75°E. and N.30°W.; diagonal joints N.50°E. Joints sealed, parallel and spaced 15 centimeters to 1.2 meters apart.
	Marcellus shale	15	Black, slatelike, bituminous shale with occasional limestone layers in sequence, and containing zones rich in iron sulfides or calcareous concretions, often with septarian structures; very fissile, iron-stained and gray when weathered. Joint pattern N.25°W., N.65°E., 2.5 centimeters to 1.2 meters apart.

SOURCE: The Groundwater Resources of Seneca County, New York: Mozola, A.J., Bulletin GW-26, Albany, NY, 1951

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REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT ENVIRONMENTAL ENGINEERING
NO 720447-03000

FIGURE 1-6
BEDROCK STRATIGRAPHIC COLUMN

SCALE

percent with almost 100 percent recovery (Metcalf & Eddy, 1989), suggesting a high degree of weathering.

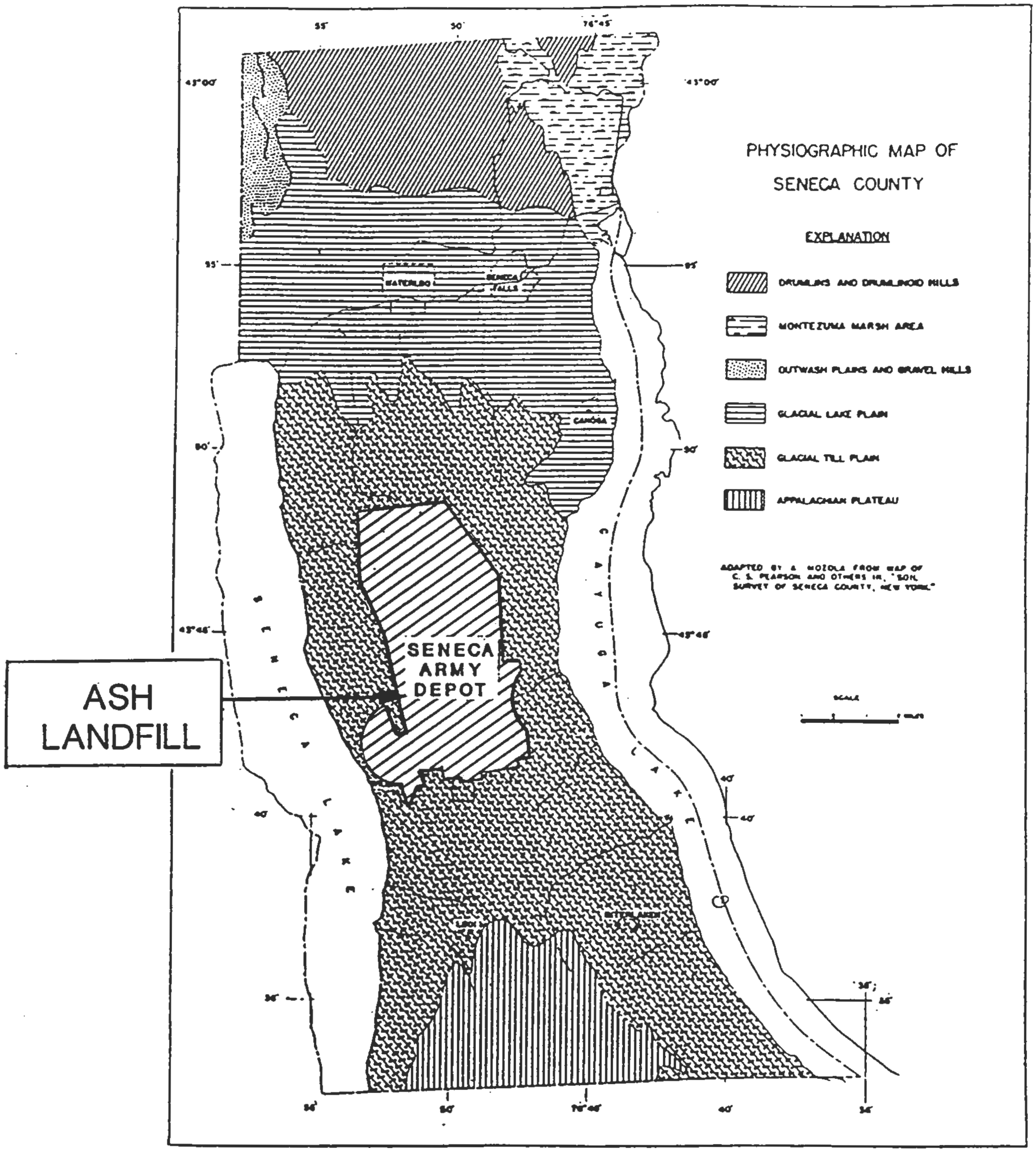
Pleistocene age (Wisconsin event, 20,000 bp) glacial till deposits overlie the shales. Figure 1-7, the physiography of Seneca County, presents an overview of the subsurface sediments present in the area. The site is shown on Figure 1-7 as lying on the western edge of a large glacial till plain between Seneca Lake and Cayuga Lake. The till matrix, the result of glaciation, varies locally but generally consists of horizons of unsorted silt, clay, sand, and gravel. The soils at the site contain varying amounts of inorganic clays, inorganic silts, and silty sands. In the central and eastern portions of SEDA the till is thin and bedrock is exposed or within 3 feet of the surface in some locations. Thickness of the glacial till deposits at SEDA generally ranges from 1 to 15 feet.

Darien silt-loam soils, 0 to 18 inches thick, have developed over Wisconsonian age glacial tills. These soils are developed on glacial till where they overlie the shale. In general, the topographic relief associated with these soils is 3 to 8 percent. Figure 1-8 presents the U.S. Department of Agriculture General Soil map for Seneca County. Figure 1-9 presents the surficial soil map for the area surrounding the Ash Landfill site.

Regional background elemental concentrations for soils from the Finger Lakes area of New York State are not available. However, elemental concentrations for soils from the eastern United States and in particular, New York State are available. Table 1-1 cites data on the eastern United States from a United States Geological Survey (USGS) professional paper (Shacklette and Boerngen, 1984) and data on the New York State soils from New York State Department of Environmental Conservation (NYSDEC) report.

1.2.1.2 Regional Hydrogeologic Setting

Regionally, four distinct hydrologic units have been identified within Seneca County (Mozola A.J., 1951). These include two distinct shale formations, a series of limestone units, and unconsolidated beds of Pleistocene glacial drift. Overall, the groundwater in the county is very hard, and therefore, the quality is minimally acceptable for use as potable water. Figure 1-10 shows the distribution of known private wells near the western perimeter of SEDA based on information obtained from the Town of Romulus. There are no public supply wells with a one-mile radius of the site. Approximately 95 percent of the wells in the county are used for domestic or farm supply and the average daily withdrawal is approximately



SOURCE: The Groundwater
Resources of Seneca County,
New York: Mozola, A.J.,
Bulletin GW-26, Albany, NY, 1951

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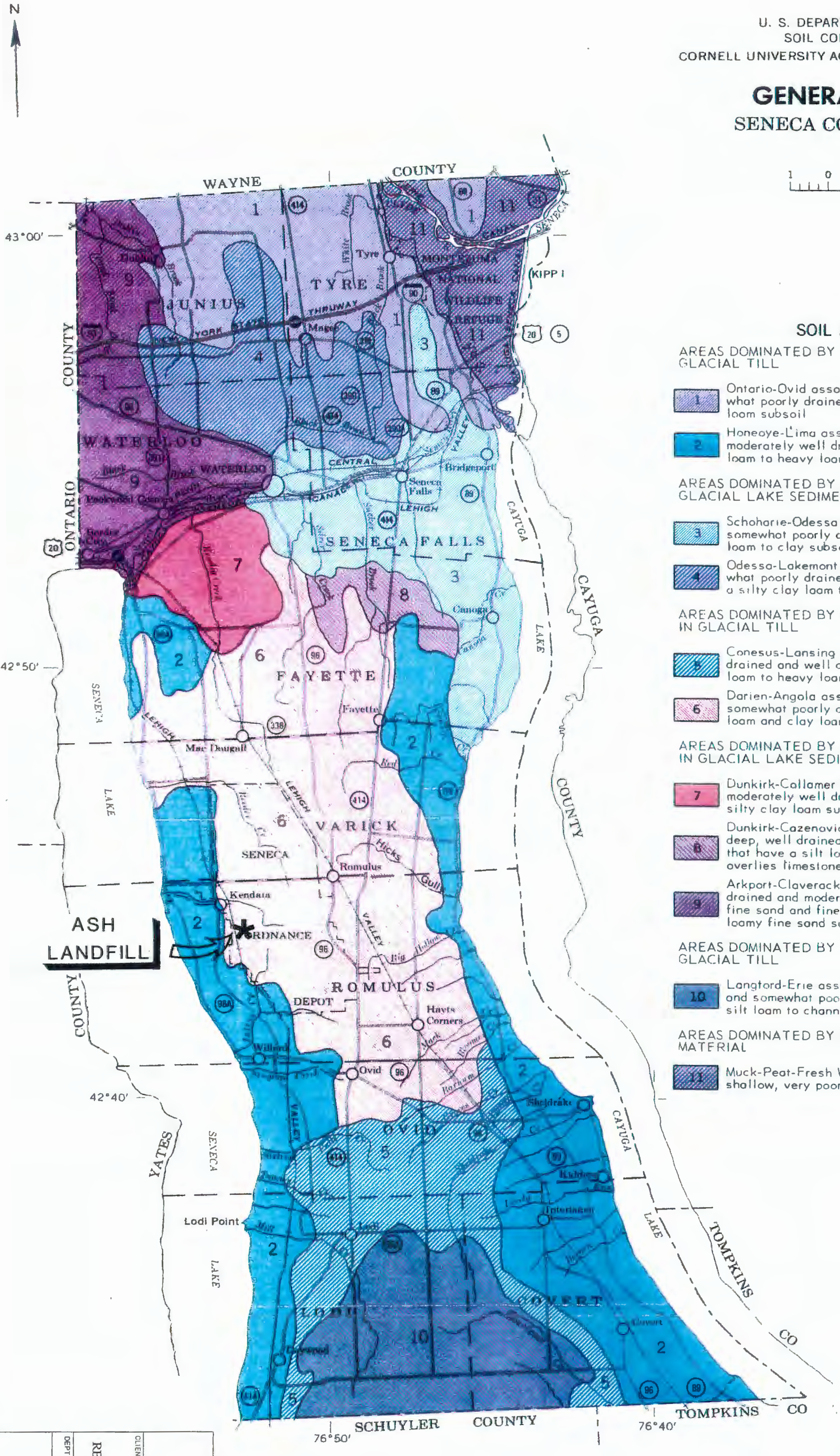
DEPT. ENVIRONMENTAL ENGINEERING	NO. 720447-03000
FIGURE 1-7 PHYSIOGRAPHIC MAP OF SENECA COUNTY	
SCALE 1' = 5 MILES	

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

SENECA COUNTY, NEW YORK

Scale 1 : 190,080



SOIL ASSOCIATIONS

AREAS DOMINATED BY HIGH-LIME SOILS DEVELOPED IN GLACIAL TILL

1	Ontario-Ovid association: Deep, well-drained to somewhat poorly drained soils that have a loam to silty clay loam subsoil
2	Honeoye-Lima association: Deep, well drained and moderately well drained soils that have a heavy silt loam to heavy loam subsoil

AREAS DOMINATED BY HIGH-LIME SOILS DEVELOPED IN GLACIAL LAKE SEDIMENTS

3	Schoharie-Odessa association: Deep, well-drained to somewhat poorly drained soils that have a silty clay loam to clay subsoil
4	Odessa-Lakemont association: Deep, dominantly somewhat poorly drained and poorly drained soils that have a silty clay loam to silty clay subsoil

AREAS DOMINATED BY MEDIUM-LIME SOILS DEVELOPED IN GLACIAL TILL

5	Conesus-Lansing association: Deep, moderately well drained and well drained soils that have a heavy silt loam to heavy loam subsoil
6	Darien-Angola association: Deep and moderately deep, somewhat poorly drained soils that have a silty clay loam and clay loam subsoil

AREAS DOMINATED BY MEDIUM-LIME SOILS DEVELOPED IN GLACIAL LAKE SEDIMENTS

7	Dunkirk-Collamer association. Deep, well drained and moderately well drained soils that have a silt loam to silty clay loam subsoil
8	Dunkirk-Cazenovia association: Moderately deep and deep, well drained and moderately well drained soils that have a silt loam to silty clay loam subsoil that overlies limestone
9	Arkport-Claverack association: Deep, dominantly well drained and moderately well drained soils that are loamy fine sand and fine sandy loam throughout or that have a loamy fine sand subsoil over silty clay or clay

AREAS DOMINATED BY LOW-LIME SOILS DEVELOPED IN GLACIAL TILL

10	Langford-Erie association: Deep, moderately well drained and somewhat poorly drained soils that have a channery silt loam to channery loam fragipan

AREAS DOMINATED BY SOILS DEVELOPED IN ORGANIC MATERIAL

11	Muck-Peat-Fresh Water Marsh association Deep to shallow, very poorly drained organic soils

February 1971

NOTE—
This map is intended for general planning. Each delineation may contain soils having ratings different from those shown on the map. Use detailed soil maps for operational planning.

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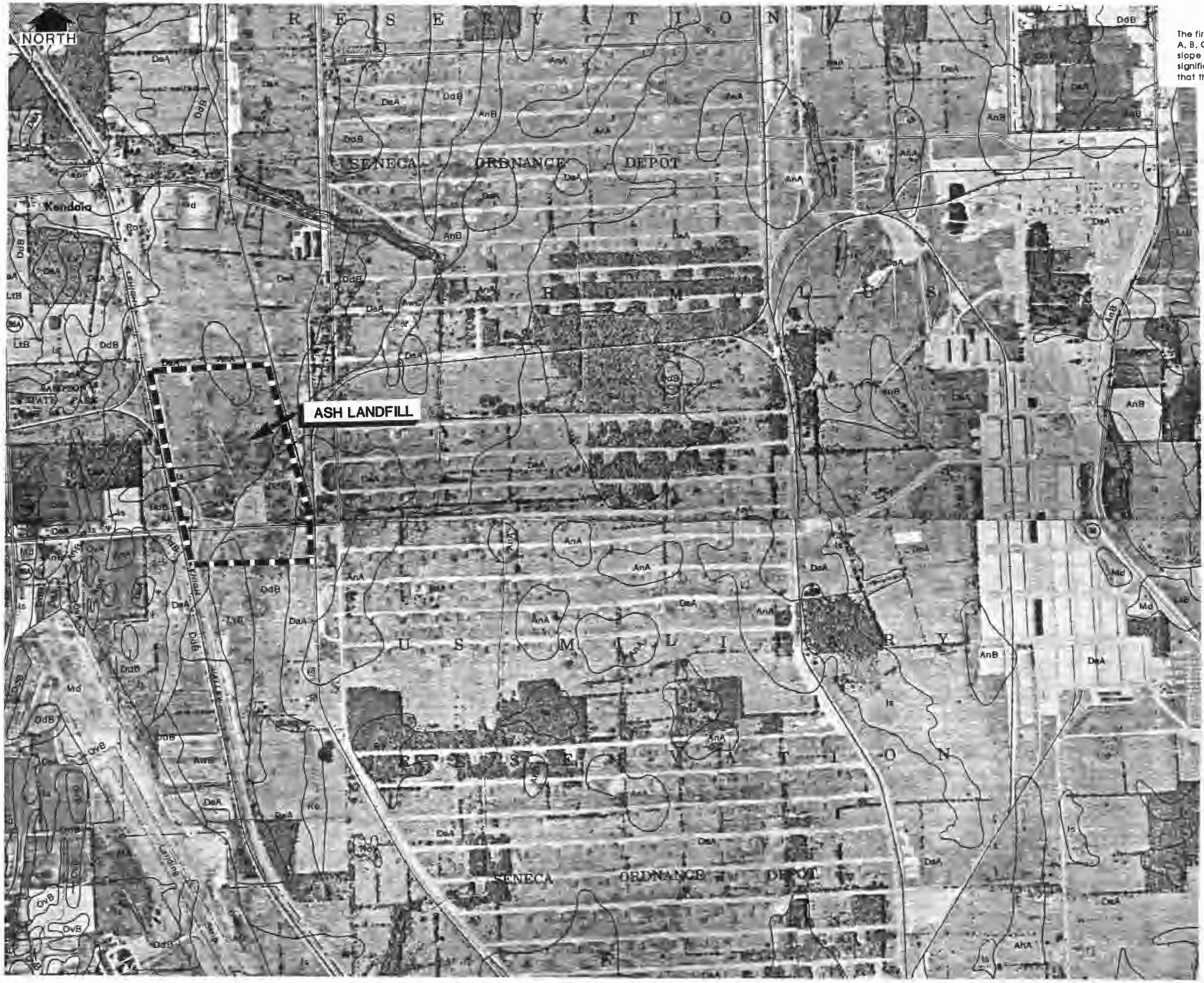
NO. 720447-03000

FIGURE 1-8
GENERAL SOIL MAP
SENECA COUNTY, NEW YORK

SCALE 1" = 3 MILES



SOIL LEGEND

The first letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, and F, is a general guide to the slope class. Symbols without a slope letter are those miscellaneous land types or soils where slope is not significant to use and management. A final number, 3, in the symbol shows that the soil is eroded.

SYMBOL	NAME
Ac	Alden mucky silt loam
Ad	Alden mucky silt loam, till substratum
Al	Alluvial land
AnA	Angola silt loam, 0 to 3 percent slopes
AnB	Angola silt loam, 3 to 8 percent slopes
AoA	Appleton gravelly silt loam, 0 to 3 percent slopes
AoB	Appleton gravelly silt loam, 3 to 8 percent slopes
ApA	Appleton silt loam, 0 to 3 percent slopes
ApB	Appleton silt loam, 3 to 8 percent slopes
ArB	Arkport loamy fine sand, 1 to 6 percent slopes
ArC	Arkport loamy fine sand, 6 to 12 percent slopes
ArD	Arkport loamy fine sand, 12 to 20 percent slopes
AuD	Arnot channery silt loam, 15 to 25 percent slopes
AwB	Aurora silt loam, 3 to 8 percent slopes
AwC	Aurora silt loam, 8 to 15 percent slopes
AwD	Aurora silt loam, 15 to 25 percent slopes
AzF	Aurora and Farmington soils, 25 to 75 percent slopes
Ca	Canandaigua silt loam
CeB	Cazenovia silt loam, 3 to 8 percent slopes
CeB3	Cazenovia silt loam, 3 to 8 percent slopes, eroded
CeC	Cazenovia silt loam, 8 to 15 percent slopes
CeC3	Cazenovia silt loam, 8 to 15 percent slopes, eroded
ChD	Cazenovia soils, 15 to 25 percent slopes
ChE	Cazenovia soils, 25 to 40 percent slopes
CkA	Claverack loamy fine sand, 0 to 2 percent slopes
CkB	Claverack loamy fine sand, 2 to 6 percent slopes
ClA	Collamer silt loam, 0 to 2 percent slopes
ClB	Collamer silt loam, 2 to 6 percent slopes
ClC	Collamer silt loam, 6 to 12 percent slopes
CoA	Collamer silt loam, moderately shallow variant, 0 to 2 percent slopes
CoB	Collamer silt loam, moderately shallow variant, 2 to 6 percent slopes
CsA	Conesus gravelly silt loam, 0 to 3 percent slopes
CsB	Conesus gravelly silt loam, 3 to 8 percent slopes
Cu	Cosad loamy fine sand
DaA	Darien silt loam, 0 to 3 percent slopes
DdB	Darien-Danley-Cazenovia silt looms, 3 to 8 percent slopes
DuB	Dunkirk silt loam, 1 to 6 percent slopes
DuC3	Dunkirk silt loam, 6 to 12 percent slopes, eroded
DuD	Dunkirk silt loam, 12 to 20 percent slopes
DwB	Dunkirk silt loam, limestone substratum, 1 to 6 percent slopes

SOURCE: U.S. Department of Agriculture Soil Survey, Seneca County, New York, April, 1992

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FIGURE 1-9

SURFICIAL SOIL MAP FOR ASH LANDFILL

SCALE 1" = 1300' APPROXIMATE

TABLE 1 – 1

BACKGROUND CONCENTRATIONS OF ELEMENTS IN SOILS OF THE EASTERN UNITED STATES WITH SPECIFIC DATA FOR NEW YORK STATE

SENECA ARMY DEPOT
ASH LANDFILL

ELEMENT	CONCENTRATION RANGE (mg/kg)	GEOGRAPHIC LOCATION
Aluminum	7,000 – 100,000	Eastern U.S. (2)
	1,000 – 25,000	Albany Area (1)
Arsenic	< 0.1 – 73	Eastern U.S. (2)
	3 – 12	New York State (1)
	< 0.1 – 6.5	Albany Area (1)
Barium	10 – 1,500	Eastern U.S. (2)
	15 – 600	New York State (1)
	250 –350	Albany Area (1)
Beryllium	1 – 7	Eastern U.S. (2)
	0 – 1.75	New York State (1)
	0 – 0.9	Albany Area (1)
Cadmium	Not Available	Eastern U.S. (2)
	0.0001 – 1.0	No Region Specified (1)
Calcium	100 – 280,000	Eastern U.S. (2)
	130 – 35,000	New York State (1)
	150 – 5,000	Albany Area (1)
	2,900 – 6,500	Albany Area (1)
Chromium	1 – 1,000	Eastern U.S. (2)
	1.5 – 40	New York State (1)
	1.5 – 25	Albany Area (1)
Cobalt	< 0.3 – 70	Eastern U.S. (2)
	2.5 – 60	New York State (1)
	2.5 – 6	Albany Area (1)
Copper	< 1 – 700	Eastern U.S. (2)
	< 1 – 15	Albany Area (1)
Iron	100 – 100,000	Eastern U.S. (2)
	17,000 – 25,000	Albany Area (1)
Lead	> 10 – 300	Eastern U.S. (2)
	1 – 12.5	Albany Area (1)
Magnesium	50 – 50,000	Eastern U.S. (2)
	2,500 – 6,000	New York State (1)
	1,700 – 4,000	Albany Area (1)
Manganese	> 2 – 7,000	Eastern U.S. (2)
	50 – 5,000	New York State (1)
	400 – 600	Albany Area (1)
Mercury	0.01 – 3.4	Eastern U.S. (2)
	0.042 – 0.066	Albany Area (1)

TABLE 1 – 1

BACKGROUND CONCENTRATIONS OF ELEMENTS IN SOILS OF THE EASTERN UNITED STATES WITH SPECIFIC DATA FOR NEW YORK STATE

SENECA ARMY DEPOT
ASH LANDFILL

ELEMENT	CONCENTRATION RANGE (mg/kg)	GEOGRAPHIC LOCATION
Nickel	< 5 – 700 19.5 (mean)	Eastern U.S. (2) New York State (1) (no range available)
Potassium	50 – 37,000 47.5 – 117.5	Eastern U.S. (2) New York State (1)
Selenium	> 0.1 – 3.9 Not Available	Eastern U.S. (2) No New York State Data Given (1)
Sodium	500 – 50,000 Not Available	Eastern U.S. (2) No New York State Data Given (1)
Vanadium	> 7 – 300 Not Available	Eastern U.S. (2) No New York State Data Given (1)
Zinc	> 5 – 2,900 37 – 60	Eastern U.S. (2) Albany Area (1)

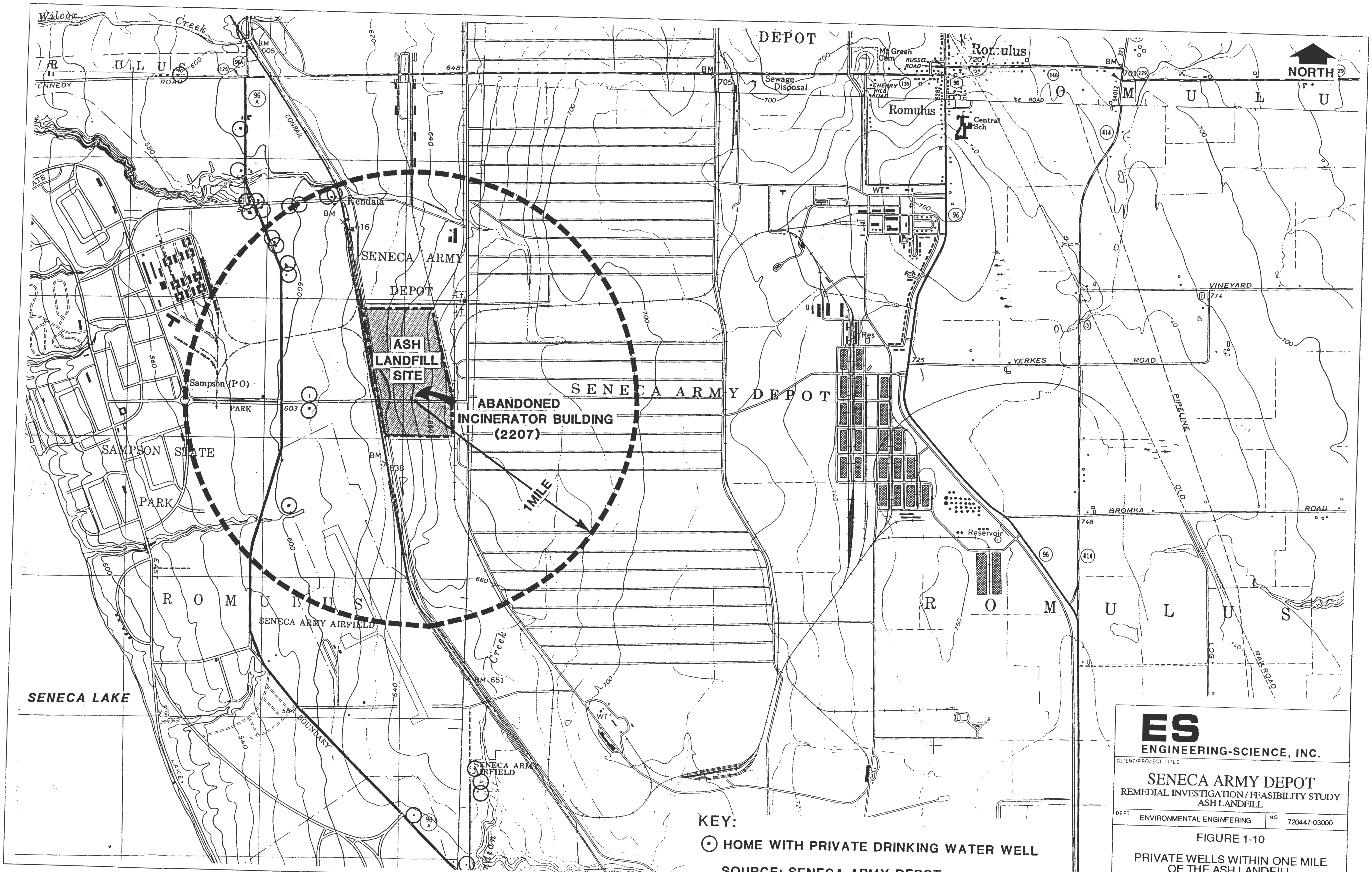
Notes:

1. (1) Source: McGovern, Carol E., Background Concentrations of 20 Elements in Soils with Special Regard for New York State, Wildlife Resources Center, New York Department of Environmental Conservation, Delmar, New York 12054, No Date.
2. (2) Source: Shacklette, H.T. and Boerngen, J.G., 1984, Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, U.S.G.S. Prof Paper 1270, Washington.
3. The data are for areas where surficial materials are thought to be uncontaminated, undisturbed, or areas far from pollution sources.

500 gallons, an average rate of 0.35 gallons per minute (gpm). About five percent of the wells in the county are used for commercial, industrial, or municipal purposes. Seneca Falls and Waterloo, the two largest communities in the county, are in the hydrogeologic region which is most favorable for the development of a groundwater supply. However, because the hardness of the groundwater is objectionable to the industrial and commercial establishments operating within the villages, both villages utilize surface water (Cayuga Lake and Seneca River, respectively) as their municipal supplies. The villages of Ovid and Interlaken, both of which are without substantial industrial establishments, utilize groundwater as their public water supplies. Ovid obtains its supply from two shallow gravel-packed wells, and Interlaken is served by a developed seepage-spring area.

Regionally, the water table aquifer of the unconsolidated surficial glacial deposits of the region would be expected to flow in a direction consistent with the ground surface elevations. Geologic cross-sections from Seneca Lake and Cayuga Lake have been constructed by the State of New York, (Mozola, 1951, and Crain, 1974). This information suggests that a groundwater divide exists approximately half way between the two finger lakes. SEDA is located on the western slope of this divide and therefore regional surficial groundwater flow is expected to be westward toward Seneca Lake.

A substantial amount of information concerning the hydrogeology in the area has been compiled by the State of New York, (Mozola, 1951). These reports have been reviewed in order to better understand the hydrogeology of the area surrounding SEDA. The data indicates that within a four (4) mile radius of the site a number of wells exist from which geologic and hydrogeologic information has been obtained. This information includes: 1) the depth; 2) the yield; and 3) the geological strata the wells were drilled through. Although the information was compiled in the 1950s, these data are useful in providing an understanding and characterization of the aquifers present within the area surrounding SEDA. A review of this information suggests that three geologic units have been used to produce water for both domestic and agricultural purposes. These units include: 1) a bedrock aquifer, which in this area is predominantly shale; 2) an overburden aquifer, which includes Pleistocene deposits (glacial till); and 3) a deep aquifer present within beds of limestone the underlying shale. The occurrence of water derived from limestone is considered to be unusual for this area and is more commonplace to the north of this area. The limestone aquifer in this area is between 100 and 700 feet deep. As of 1957, twenty-five wells utilized water from the shale aquifer, six wells tapped the overburden aquifer, and one used the deep limestone as a source of water.



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NO 720447-03000

FIGURE 1-10

PRIVATE WELLS WITHIN ONE MILE OF THE ASH LANDFILL

SCALE 1" = 2,000'

For the six wells that utilized groundwater extracted from the overburden, the average yield was approximately 7.5 gpm. The average depth of these wells was thirty-six feet. The geologic material which comprises this aquifer is generally Pleistocene till, with the exception of one well located northeast of the site. This well penetrates an outwash sand and gravel deposit. The yields from the five overburden wells ranged from 4 to 15 gpm. The well located in the outwash sand and gravel deposit, drilled to 60 feet, yielded only 5 gpm. A 20-foot hand dug well, located southeasterly of the outwash well, yielded 10 gpm.

The geologic information reviewed indicates that the upper portions of the shale formation would be expected to yield small, yet adequate, supplies of water, for domestic use. For mid-Devonian shales such as those of Hamilton group, the average yields, (which are less than 15 gpm), are consistent with what would be expected for shales (LaSala, 1968). The deeper portions of the bedrock, (at depths greater than 235 feet) have provided yields up to 150 gpm. At these depths the high well yields may be attributed to the effect of solutioning on the Onondaga limestone, which is at the base of the Hamilton Group. Based on well yield data, the degree of solutioning is affected by the type and thickness of overlying material (Mozola, 1951). Solution effects on limestones (and on shales which contain gypsum) in the Erie-Niagara have been reported by LaSala (1968). This source of water is considered to comprise a separate source of groundwater for the area. Very few wells in the region adjacent to SEDA utilize the limestone as a source of water, which may be due to the drilling depths required to intercept this water.

The geologic study of the area by Mozola determined three reasons for the lack of hydrologic interconnection between the groundwater near the surface and the deeper aquifers. First, the shales in this region are relatively impermeable, i.e., absorbing, transmitting, and yielding water very slowly. Joints and other openings in the shales are generally very narrow or are filled with fine silt and clay. This impermeability tends to inhibit downward seepage of water from the surficial deposits. Second, the slope of the bedrock and the land surfaces toward the Finger Lakes favors rapid drainage of surface water. Third, the overlying glacial drift is considered too thin to hold large quantities of water for gradual recharge of the bedrock.

1.2.1.3 Local Hydrogeology

Characterization of the local hydrogeology is based upon slug test information obtained from previous site investigations. USATHAMA (1989) conducted single-well aquifer tests (slug tests) in the landfill area to estimate the hydraulic conductivity of the water-bearing materials underlying the site. The slug test is applicable for fully or partially penetrating well in unconfined aquifers. The slug tests were performed on five shallow groundwater monitor wells (PT-11, PT-12, PT-15, PT-21 and PT-23) screened in the overburden and upper (weathered) portion of the bedrock. Slug test data were analyzed according to the method developed by Bouwer and Rice (1976). The hydraulic conductivity values generated from the slug test analysis were used in conjunction with an estimate of soil porosity and the calculated groundwater flow gradient to develop an estimate for the average groundwater flow rate at the site. Excluding PT-21, which had an extremely low hydraulic conductivity value of 5.87 x 10^{-11} centimeters per second (cm/sec) [1.66 x 10^{-7} feet per day (ft/day)], the average hydraulic conductivity, as determined by the slug test analysis, was 2.06 x 10^{-4} cm/sec (0.587 ft/day). The typical range of glacial tills described by Freeze and Cherry (1979) is between 1 x 10^{-4} cm/sec (3 x 10^{-1} ft/day) and 1 x 10^{-10} cm/sec (3 x 10^{-7} ft/day).

The groundwater flow gradient in the area was calculated using the distance between PT-17 and PT-18 (680 feet), located along the general direction of maximum gradient. The change in piezometric head between the two wells, as measured by ICF Technology, Inc. (ICF) on October 24, 1988, was 14.8 feet. Thus, the gradient obtained for the area of interest was 2.2 x 10^{-2} feet per foot (ft/ft). The effective porosity of the aquifer was estimated to be 11 percent from typical values for silty clays and shale bedrock. The average linear velocity of groundwater flow, calculated by ICF using Darcy's law, between PT-17 and PT-18 is 2.2 x 10^{-7} ft/sec, 1.19 x 10^{-2} ft/day or, 6.9 feet per year (ft/yr) based on a hydraulic conductivity of 3.3 x 10^{-5} cm/sec (9.33 x 10^{-2} ft/day).

Data from quarterly groundwater sampling and previous field investigations indicate that the saturated thickness of the till/weathered shale overburden aquifer is variable, generally ranging between 1 and 8.5 feet, however, some locations on-site dry up completely. From two years of data, the effect on the water table elevations is likely a seasonal phenomenon. The overburden aquifer is thickest during the spring recharge months and thinnest during the summer and early fall. During late fall and early winter, the saturated thickness increases. This cycle of aquifer thickness appears to be consistent with what would be expected from an understanding of the hydrologic cycle.

1.2.2 Site History

SEDA was constructed in 1941 and has been owned by the United States Government and operated by the Department of the Army since this time. Prior to construction of the depot, the site was used for farming. From 1941 to 1974, uncontaminated trash was burned in a series of burn pits near the abandoned incinerator building (Building 2207). According to a U.S. Army Environmental Hygiene Agency (USAEHA) Interim Final Report, Groundwater Contamination Survey No. 38-26-0868-88 (July 1987), during approximately this same period of time (1941 until the late 1950's or early 1960's) the ash from the refuse burning pits was buried in the landfill.

The incinerator building was built in 1974. Between 1974 and 1979, materials intended for disposal were transported to the incinerator. The incinerator was a multiple chamber, batch-fed 2,000 pound per hour capacity unit which burned rubbish and garbage. The incinerator unit contained an automatic ram-type feeder, a refractory lined furnace with secondary combustion and settling chamber, a reciprocating stoker, a residue conveyor for ash removal, combustion air fans, a wet gas scrubber, an induced draft fan, and a refractory-lined stack (USAEHA, 1975). Nearly all of the approximately 18 tons of refuse generated per week on the depot were incinerated. The source for the refuse was domestic waste from depot activities and family housing. Large items which could not be burned were disposed of at the Non-Combustible Fill Landfill.

Ashes and other residues from the incinerator were temporarily disposed of in an unlined cooling pond immediately north of the incinerator building. The cooling pond consisted of an unlined depression approximately 50 feet in diameter and approximately 6 to 8 feet deep. When the pond filled (approximately every 18 months), the fly ash and residues were removed, transported, and buried in the adjacent landfill east of the cooling pond. The refuse was dumped in piles and occasionally spread and compacted. No daily or final cover was applied. The active area of the Ash Landfill extended at least 500 feet north at the incinerator building, near a bend in a dirt road, based on an undated aerial photograph of the incinerator during operation. Parallel grooves at the northernmost extent of the filled area are visible in the aerial view of the incinerator and adjacent fill area during active operation and indicate that the fill was spread using a bulldozer or similar equipment. The incinerator was destroyed by a fire on May 8, 1979, and the landfill was subsequently closed. The landfill was apparently covered with native soils of various thicknesses but has not been closed with an engineered cover or cap.

A grease pit disposal area near the eastern boundary of the site was used for disposal of cooking grease. Evidence of burning of debris during the operation of the incinerator is evidenced by the areas of blackened soil, charred debris and areas of stressed or dead vegetation.

The approximately 2-acre Non-Combustible Fill Landfill southeast of the incinerator building (immediately south of the SEDA railroad line) was used as a disposal site for non-combustible materials including construction debris from 1969 until 1977.

1.2.3 Previous Investigations

A substantial volume of data is available for the Ash Landfill site. Soil sampling, monitoring well installation groundwater sampling, and surface water sediment sampling have all been performed under various investigative programs conducted at the Ash Landfill. Information is available on the overburden conditions and the direction of groundwater flow at the site with a level of detail sufficient to initially characterize the physical setting of the Ash Landfill.

The following reports have provided data on the Ash Landfill:

1. Army Pollution Abatement Program Study No. D-1031-W Landfill Leachate Study No. 81-26-8020-81, 1979, conducted by USAEHA.
2. Installation Assessment of Seneca Army Depot Report No. 157, 1980, conducted by USATHAMA.
3. Interim Final Report Groundwater Contamination Survey No. 35-26-0868-88, Evaluation of Solid Waste Units, 1987, conducted by USAEHA.
4. Geohydraulic Study No. 38-26-0313-88, 1987, conducted by USAEHA.
5. Remedial Investigation Feasibility Study, 1989, conducted by USATHAMA/ICF, Inc. Site Investigation, 1989, conducted by Hunter/Environmental Science and Engineering (ESE).
6. Quarterly Groundwater Monitoring (1987-1993).

All previous investigations of the Ash Landfill site are summarized in chronological order in Table 1-2. The complete list of references is given in the Reference section of this document. The results of these various investigations are briefly summarized below.

1.2.3.1 Army Pollution Program Study (USAEHA 1979)

In 1979, a landfill leachate study (No. D-1031-W) was conducted by the USAEHA (1979) to determine the extent of leachate production and contamination caused by activities at the ash landfill site. The study included installation and sampling of monitoring wells. Six borings were advanced around the Ash Landfill site for the purpose of installing monitoring wells. The wells installed were PT-10, PT-11, PT-12, PT-13, PT-14, and PT-15 (wells PT-13 and PT-14 no longer exist on the site). No soil analyses were performed during the installation of these wells. The direction of groundwater flow was determined to be to the southwest, toward Seneca Lake. The six wells were sampled and analyzed for pH, conductivity, alkalinity, hardness, color, sulfate (SO_4), chloride (Cl), total solids (TS), nitrite-nitrogen (NO_2/N), nitrate-nitrogen (NO_3/N), total Kjeldahl nitrogen (TKN), eleven metals, chemical oxygen demand (COD), total organic carbon (TOC), and biological oxygen demand (BOD). Wells PT-11 and PT-12, located near the two disposal areas (i.e., the Ash Landfill and the Non-Combustible Fill Landfill), were found to contain elevated sulfates and chlorides. The study concluded that groundwater samples from wells adjacent to the two disposal areas show evidence of leachate. Maximum contaminant levels for drinking water supplies as defined in the New York State Sanitary code were exceeded for sulfate and color. It was also concluded that these contaminants affect aesthetic quality, but did not represent a health hazard. Maximum contaminant levels were not exceeded for wells downgradient from these wells. Recommendations were made to establish a monitoring program for leachate.

1.2.3.2 Installation Assessment Report (USATHAMA 1980)

Areas of known or suspected waste disposal at SEDA were delineated in an Installation Assessment (1980) performed by USATHAMA. The investigation included a records search and interviews with current and former SEDA employees. The report identified the Ash Landfill site as having potential for contaminant migration.

TABLE 1 – 2

SUMMARY OF PREVIOUS SAMPLING AND SITE INVESTIGATIONS

SENECA ARMY DEPOT
ASH LANDFILL

DATE	REPORT	AGENCY/ CONSULTANT	PROGRAM DESCRIPTION
July – August 1979	Army Pollution Abatement Program Study No. D–1031–W Landfill Leachate Study No. 81–26–8020–81	USAEHA	Groundwater contamination study. Installation of wells PT–10, PT–11, PT–12, PT–13, PT–14, PT–15.
January 1980	Installation Assessment of Seneca Army Depot Report No. 157	USATHAMA	Initial installation assessment recognized former incinerator and ash landfill as having potential for ground contamination.
1986	Groundwater Monitoring Results for Seneca Army Depot	USAEHA	Sampling of wells on ash landfill site.
July 1987	Interim Final Report Groundwater Contamination Survey No. 35–26–0568–88 Evaluation of Soild Waste Management Units	USAEHA	Identifies, describes, and evaluates solid waste management units of Seneca Army Depot, including the ash landfill.
August 1987	Groundwater Sampling	Galson Laboratories	Sampling of wells PT–12, PT–14, PT–15, Farm House Deep, Farm House Shallow, and Barn wells.
September 1987	Groundwater Monitoring Well Installation	Paratt Wolff, Inc.	Installation of wells PT–16 and PT–17.
October 1987	Geohydrologic Study No. 38–26–0313–88	USAEHA	Installation of wells PT–18, PT–19, PT–20, PT–22, PT–23, PT–24, PT–25, PT–26.
November 1987	Groundwater Sampling	Galson Laboratories	Sampling of Farm House Deep Farm House Shallow, and Barn wells at Shaw residence.
March 1988	Groundwater Sampling	Galson Laboratories	Sampling of wells PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–19, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.
April 1988	Groundwater Sampling	Galson Laboratories	Sampling of wells PT–10, PT–11, PT–12, PT–15, PT–16, and PT–17.

TABLE 1 – 2

SUMMARY OF PREVIOUS SAMPLING AND SITE INVESTIGATIONS

SENECA ARMY DEPOT
ASH LANDFILL

DATE	REPORT	AGENCY/ CONSULTANT	PROGRAM DESCRIPTION
August 1988	Update of the Initial Installation Assessment of the Seneca Army Depot	USATHAMA	Summarizes groundwater studies at the Ash Landfill Site. Continued groundwater monitoring is planned.
October 1988	Groundwater Sampling	CS Environmental Laboratory, Inc.	Sampling of Farm House Deep, Farm House Shallow, and Barn wells.
November 1988	Groundwater Sampling	CS Environmental Laboratory, Inc.	Sampling of Farm House Deep, Farm House Shallow, and Barn wells.
1988	Site Investigation	ICF, Inc.	Geophysical survey (EM and GPR) of the landfill and the burning pit areas.
January 1989	Groundwater Sampling	CS Environmental Laboratory, Inc.	Sampling of Farm House Deep, Farm House Shallow, and Barn wells.
March 1989	Groundwater sampling	Galson Laboratories	Sampling of wells PT–12 and PT–17.
September 1989	Groundwater sampling	Galson Laboratories	Sampling of wells PT–10, PT–11, PT–12, PT–15, PT–16, and PT–17.
September 1989	Groundwater sampling	Galson Laboratories	Sampling of wells PT–12 and PT–17.
November 1989	Geohydrologic Study No. 38–26–K928–90	USAEHA	Installation of 7 additional monitoring wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, and MW–33.
March 1989	Remedial Investigation Feasibilty Study	USATHAMA/ICF, Inc.	The Site Investigation included a soil gas survey by Target, EM, and GPR surveys, soil samples, slug testing, and groundwater samples from 10 existing wells.
1989	Site Investigation	Hunter/ESE	Geophysical survey (EM and GPR) of the northern portion of the landfill site.

TABLE 1 – 2

SUMMARY OF PREVIOUS SAMPLING AND SITE INVESTIGATIONS

SENECA ARMY DEPOT
ASH LANDFILL

DATE	REPORT	AGENCY/ CONSULTANT	PROGRAM DESCRIPTION
January 1990	Groundwater Sampling	National Environmental Testing, Inc.	Sampling of wells PT–26, MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, Farm House Deep, Farm House Shallow, and Barn Wells.
March & April 1990	Groundwater Sampling	National Environmental Testing, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.
June 1990	Groundwater Sampling	National Environmental Testing, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.
September 1990	Groundwater Sampling	National Environmental Testing, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.
December 1990	Groundwater Sampling	National Environmental Testing, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.

TABLE 1 – 2

SUMMARY OF PREVIOUS SAMPLING AND SITE INVESTIGATIONS

SENECA ARMY DEPOT
ASH LANDFILL

DATE	REPORT	AGENCY/ CONSULTANT	PROGRAM DESCRIPTION
March 1991	Groundwater Sampling	National Environmental Testing, Inc.	Sampling of wells MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–12, PT–17, PT–18, PT–20, PT–21, PT–22, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.
May 1991	RI/FS Work Plan	ESE	
June 1991	Groundwater Analysis	National Environmental Testing, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.
September 1991	Groundwater Analysis	National Environmental Testing, Inc.	Sampling of wells MW–27, MW–28, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, and Farm House Deep, Farm House Shallow, and Barn wells.
December 1991	Groundwater Analysis	National Environmental Testing, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.
March 1992	Groundwater Analysis	National Environmental Testing, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.

TABLE 1 – 2

SUMMARY OF PREVIOUS SAMPLING AND SITE INVESTIGATIONS

SENECA ARMY DEPOT
ASH LANDFILL

DATE	REPORT	AGENCY/ CONSULTANT	PROGRAM DESCRIPTION
June 1992	Groundwater Analysis	National Environmental Testing, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.
December 1992	Groundwater Analysis	National Environmental Testing, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.
January 1993	Groundwater Analysis	Aquatec, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.
April 1993	Groundwater Analysis	Aquatec, Inc.	Sampling of wells MW–27, MW–28, MW–29, MW–30, MW–31, MW–32, MW–33, PT–10, PT–11, PT–12, PT–15, PT–16, PT–17, PT–18, PT–20, PT–21, PT–22, PT–23, PT–24, PT–25, PT–26, Farm House Deep, Farm House Shallow, and Barn wells.

Between 1980 and 1987 USAEHA installed five additional groundwater monitoring wells in the area of the Ash Landfill. The wells were installed to investigate the possibility of leachate entering the groundwater. It was reported that several indicator parameters (i.e., sulfate, chloride, specific conductance) were found in the groundwater samples collected from these wells indicating that the landfill had impacted the groundwater quality. Groundwater monitoring results (1986) submitted by USAEHA found that total organic halogens (TOX) were present in a downgradient well on the Ash Landfill site.

1.2.3.3 Evaluation of Solid Waste Management Units (SWMUs) (USAEHA 1987a)

In July 1987, a Groundwater Contamination Survey (No. 38-26-0868-88), was conducted by USAEHA to identify, describe, and evaluate solid waste management units at SEDA. The Ash Landfill site was identified in this report as having a potential for impacting groundwater. Three SWMUs, (1) SEAD-3, Incinerator Cooling Water Pond; 2) SEAD-6, Abandoned Ash Landfill; and, 3) SEAD-14, Refuse Burning Pits were identified as being related to an off-depot contamination plume.

Groundwater samples collected from wells PT-12 and PT-14 in March 1987 contained trichloroethene and 1,2-dichloroethene. Additional samples collected during this study contained elevated concentrations of trichloroethylene, and trans-1,2-dichloroethylene, and lower concentrations of chloroform, 1,2-dichloroethane, and vinyl chloride. It was speculated that these compounds were probably not due to the Ash Landfill contents but more likely associated with the refuse burning pits. Groundwater samples from three off-site wells located less than a quarter mile downgradient from the contaminated monitoring wells did not contain volatile organic compounds.

1.2.3.4 Quarterly Groundwater Monitoring (1987-1991)

Quarterly Groundwater Monitoring has been performed from 1987 to present. Two monitoring wells (PT-16 and PT-17) were installed at the Ash Landfill site in September 1987 by Paratt Wolff, Inc. in order to replace the two wells (PT-13 and PT-14), that were destroyed. Additional monitoring wells (PT-18, PT-19, PT-20, PT-21, PT-22, PT-23, PT-24, PT-25, and PT-26) were installed during a geohydrologic study (No. 38-26-0313-88) conducted by USAEHA in October 1987. The study concluded that a plume with two main constituents, trichloroethylene and 1,2-dichloroethylene, was present. Less prominent compounds such as chloroform, 1,2-dichloroethane, and vinyl chloride were also detected.

Subsequent groundwater sampling events from January 1990 through July 1993 have confirmed the presence of these volatile organic compounds in the selected wells on the Ash Landfill site. Monitoring Wells PT-10 through PT-12, PT-15 through PT-18, PT-20 through PT-26 and MW-27 through MW-33 were included in the sampling program (Table 1-2). The prominent volatile organic compounds detected in wells on-site include trichloroethylene, tetrachloroethene, trans-1,2-dichloroethylene, vinyl chloride, 1,2-dichloroethane, and chloroform. Less common compounds are 1,1,1-trichloroethane, 1,1-dichloroethane and chloromethane. Wells PT-18 and PT-12 were the most severely impacted. Historical concentrations of trichloroethylene indicate considerable variation in the concentration of this compound in selected wells on-site (Figure 1-11). Generally trichloroethylene appears to be the predominant compound in the wells where volatiles were detected.

1.2.3.5 Geohydrologic Study (USAEHA 1987b)

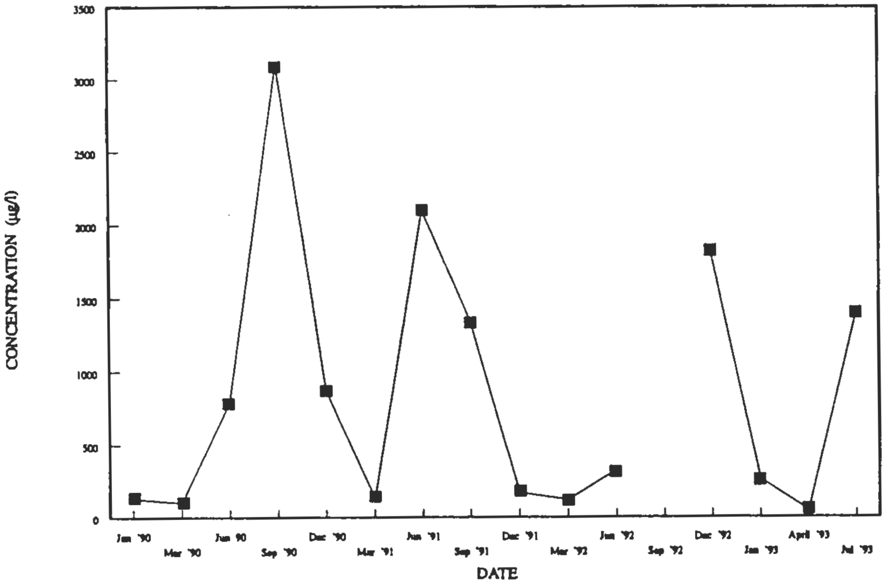
In 1987, USAEHA, conducted a geohydrologic study. Analytical results of soil samples from eleven soil borings (BH-16, BH-17, BH-18, BH-19, BH-21, BH-24, BH-25, BH-27, BH-28, BH-29, and BH-30) during the USAEHA October 1987 study indicated that volatile organic compounds were present in the samples. Several volatile organic compounds were detected in these samples including trichloroethylene, 1-2-dichloroethylene and vinyl chloride. The highest concentration of volatile organics was detected in BH-29, approximately 300 feet north of the incinerator building.

1.2.3.6 RI/FS (USATHAMA - 1989)

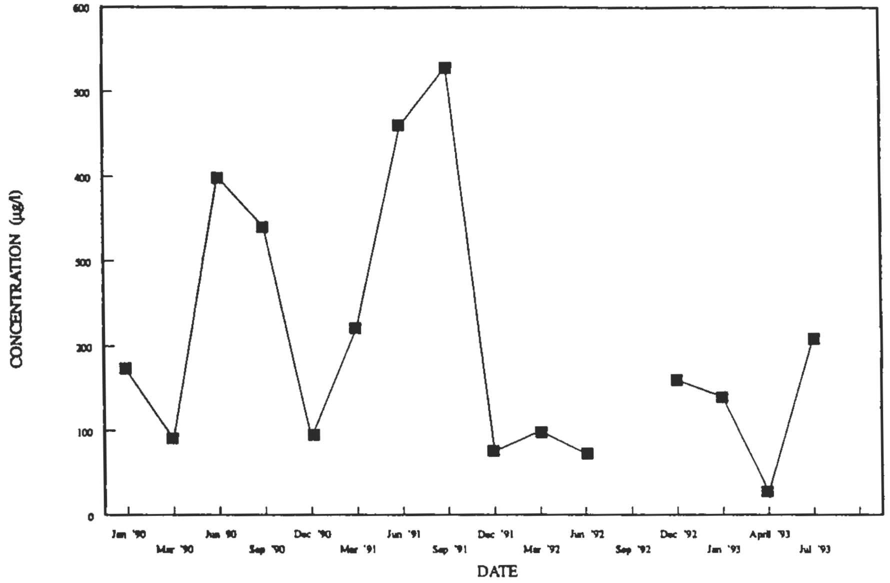
ICF undertook a site investigation of the landfill area for USATHAMA from September 1988 to February 1989. The scope of the site investigation included:

1. Soil sampling within the landfill area for volatile and metals analyses;
2. Groundwater sampling from 10 existing wells for volatile and metals analyses;
3. Surface water sampling;
4. Slug testing on several of the existing wells;
5. A soil-gas investigation; and
6. Terrain conductivity surveys using low-frequency electromagnetic (EM) induction and ground-penetrating radar (GPR).

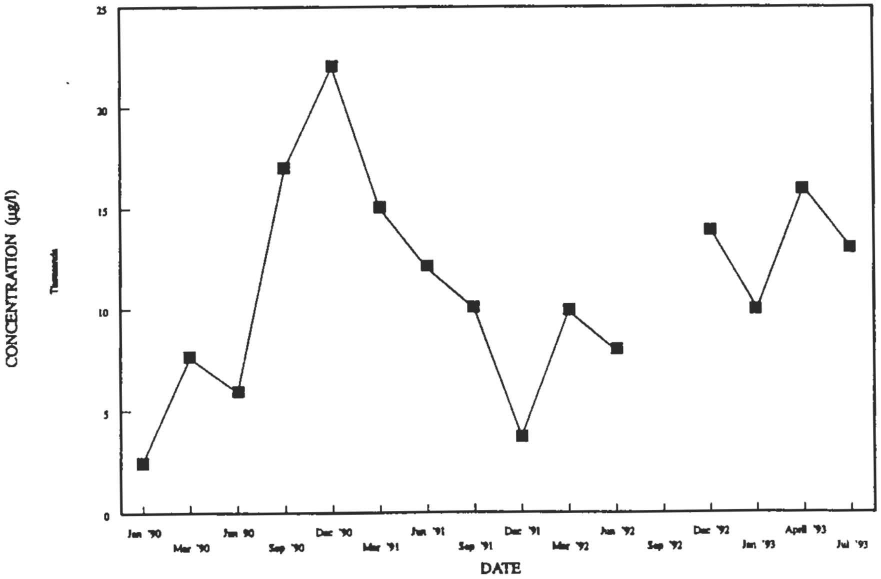
TCE CONCENTRATIONS IN PT-12



TCE CONCENTRATIONS IN PT-17



TCE CONCENTRATIONS IN PT-18



ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

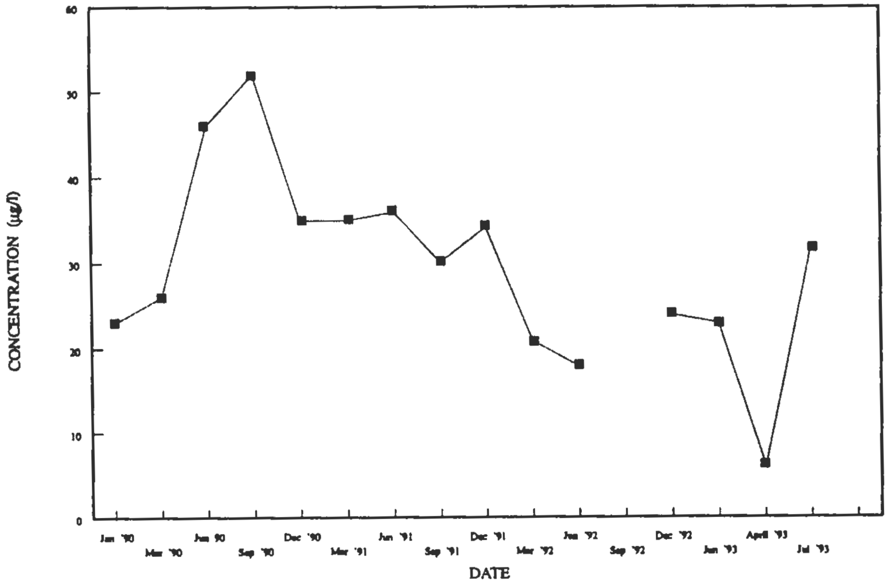
DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-01000

FIGURE 1-11

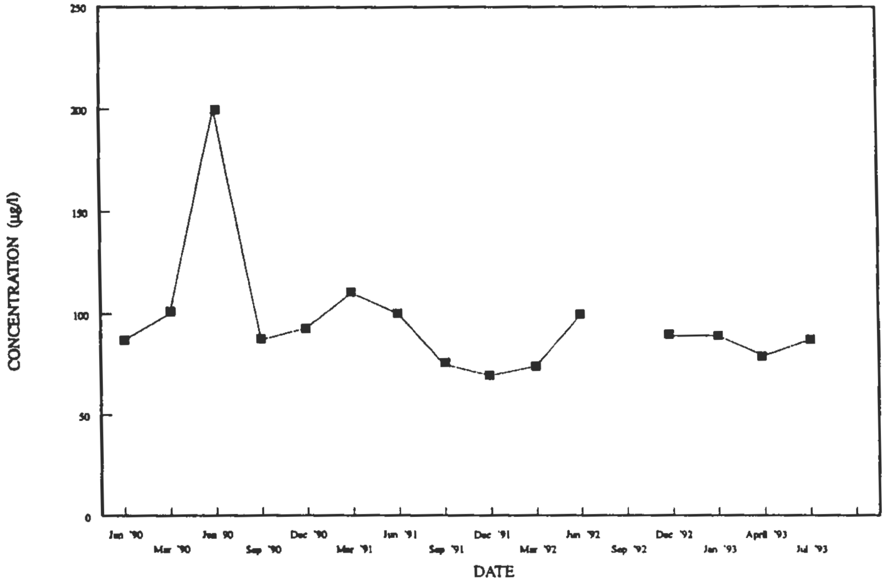
HISTORICAL CONCENTRATIONS OF TCE IN GROUND WATER

SCALE

TCE CONCENTRATIONS IN PT-20



TCE CONCENTRATIONS IN PT-22



TCE CONCENTRATIONS IN PT-23

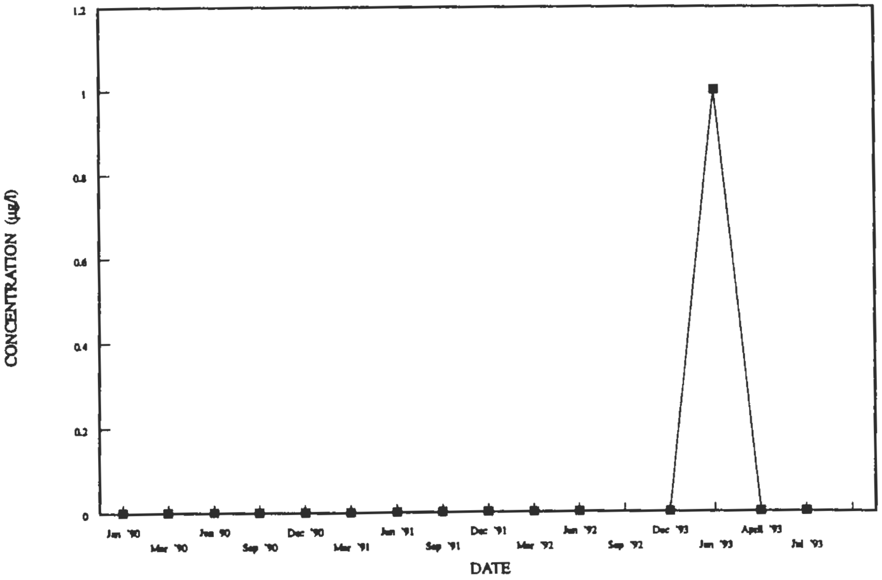


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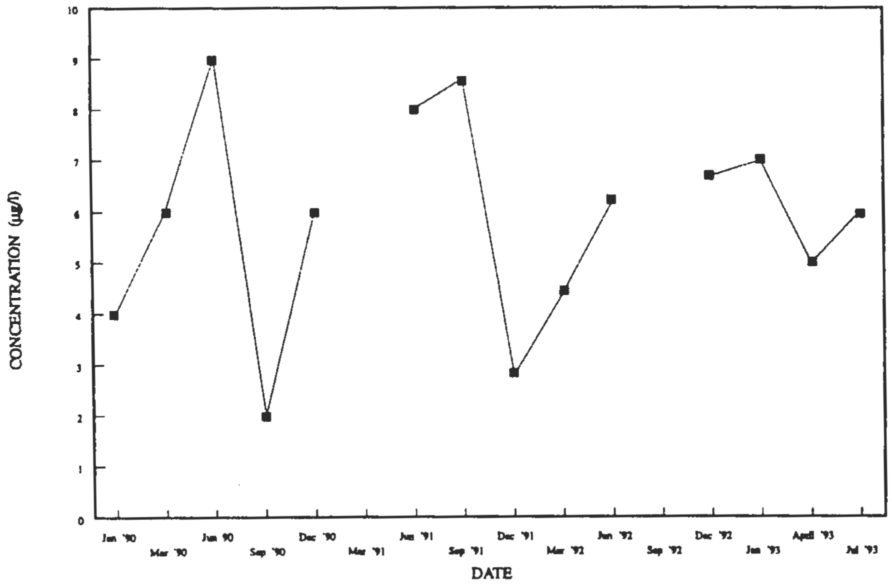
FIGURE 1-11 CONT.

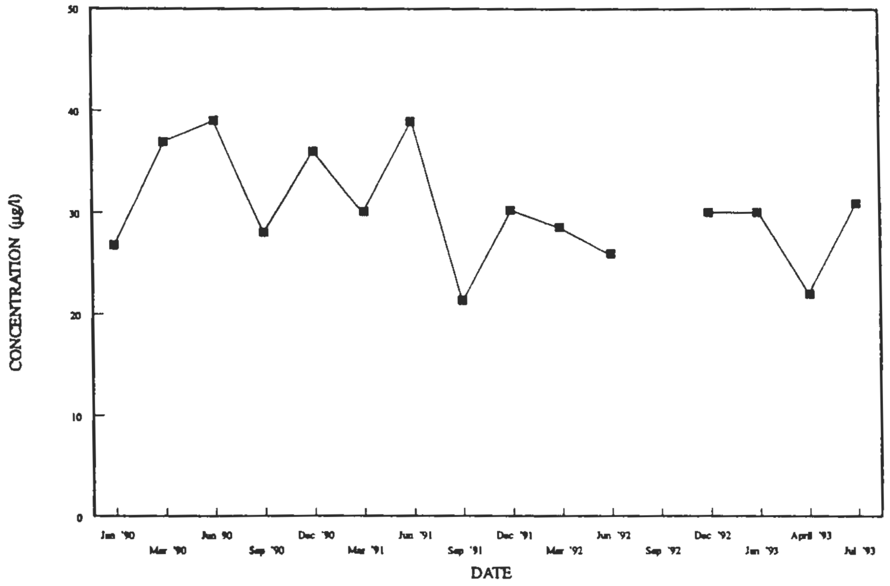
HISTORICAL CONCENTRATIONS OF TCE
IN GROUND WATER

SCALE

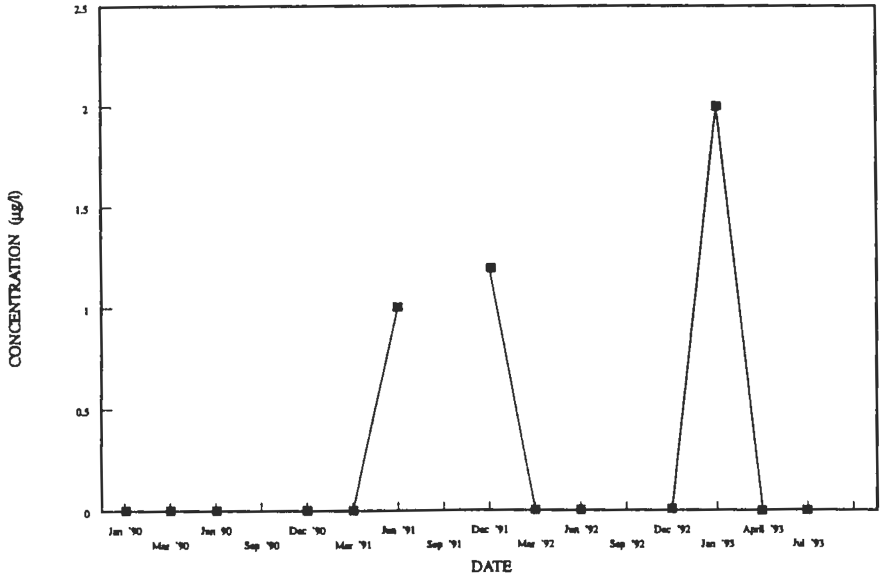
TCE CONCENTRATIONS IN PT-24



TCE CONCENTRATIONS IN MW-28



TCE CONCENTRATIONS IN MW-29



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ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO 720447-01000

FIGURE 1-11 CONT.

HISTORICAL CONCENTRATIONS OF TCE IN GROUND WATER

SCALE

The results of the investigation indicated that the landfill contained fill materials and numerous buried metal objects. Relatively high levels of volatile chlorinated compounds such as trichloroethylene (TCE), trans-1,2-dichloroethylene (DCE), and chloroform were detected in the soils. Low to moderate metals concentrations were detected in the soils. Groundwater within the landfill contains volatile chlorinated hydrocarbons at levels that appear to have caused the formation of a downgradient plume extending to the western limits of SEDA property. The groundwater was investigated only in the shallow aquifer extending down to competent bedrock at a depth of approximately 10 feet. The results of the investigation also indicated the potential presence of additional source areas to the north of the projected limits of the landfill.

Soil

Soil samples were collected from seven borings (SS-01 through SS-07) and analyzed for volatiles and metals. Samples were taken at approximately 2 to 3 ft-below land surface. Low concentrations of 1,2-dichloroethlene were detected in one of the soil samples, however, not all samples were analyzed for the volatile organics shown to be of concern in the past. The concentrations of metals found in the soil samples suggested the metal content of the Ash Landfill area was above background levels. Four samples were collected from the Ash Landfill area: SS-02, SS-03, SS-04, and SS-05. These samples contained concentrations of zinc (ranging from 33,000 μg/g in SS-05 to 350 μg/g in SS-03), lead (ranging from 620 μg/g in SS-05 to 240 μg/g in SS-02), copper (ranging from 230 μg/g in SS-05 to 68 μg/g in SS-03), chromium (ranging from 41 μg/g in SS-05 to 25 μg/g in SS-02), and cadmium (ranging from 13 μg/g in SS-02 to 2.3 μg/g in SS-04). These concentrations were all above the background levels indicated from SS-01.

Groundwater

Analytical results from November 1988 indicated that chlorinated volatile organic compounds were present on-site. As a result of the sampling, trichloroethylene, was determined to have migrated to the western boundary of the depot at concentrations of 2.4 micrograms per Liter (μg/L) and 4.0 μg/L in wells PT-15 and PT-24, respectively. Concentrations of trichloroethylene decreased significantly in nearby downgradient wells, especially PT-20.

Surface Water

Surface water samples were collected from locations near the Ash Landfill area, including off depot sampling locations. These locations were selected along drainage ditches that flow downgradient from the landfill. Surface seeps downgradient of the site were also sampled. Volatiles (trans-1,2-dichloroethylene and trichloroethylene) and metals (zinc, lead, chromium, cadmium, barium, and copper) were detected in the surface water samples. The concentrations of trans-1,2-dichloroethylene detected ranged from 110 μg/L at surface water sample SW-32 (taken in the drainage ditch approximately 100 feet west of the incinerator building) to 3.01 μg/L at SW-2 (taken in the drainage ditch approximately 800 feet west of the SEDA boundary fence). Concentrations of trichloroethylene detected ranged from 50 μg/L at SW-32 to 12.3 μg/L at SW-4, located in the surface water seep area, approximately 700 feet west of the SEDA boundary fence.

Most samples analyzed for metals were collected off depot. Only one on depot sample was analyzed for metals. Surface water sample SW-10, collected just east of the SEDA boundary fence, had concentrations of metals above detection limits: 23.6 μg/L of zinc and 24.9 μg/L of barium.

Surface water analyses indicate that impacts may extend offpost in surface drainage systems and surface water seeps. The offdepot surface water impacts was believed to be due to groundwater seepage to the surface and not as a direct result of surface water flow.

Soil Gas

Target Environmental Services, Inc. (TES), under supervision of ICF, conducted a soil gas survey at SEDA in October and November 1988. The primary objective of the soil gas survey was to provide indications of likely source locations within the landfill area and to correlate the geophysical survey data. This information was used to determine the best locations for subsequent soil sampling. Secondary objectives of the survey were to investigate downgradient contaminant migration patterns in relation to existing monitor well locations and to determine whether the underground diesel fuel tank adjacent to the incinerator building was leaking.

Soil gas sampling was performed across the survey grid established at the onset of the field investigation. Initially, approximately 80 samples were collected from points spanning the entire grid, with greater focus on the suspected areas of the landfill. Samples were collected from the following areas:

1. The underground diesel fuel tank and in the vicinity of boring hole BH-29, where free-floating material had been reported (USAEHA, 1987b, Geohydrologic Study No. 38-26-0313-88);
2. The grease pits east of the landfill area; and
3. Within the former cooling pond.

The soil gas grid and sampling locations were extended farther to the north than originally planned because the geophysical survey detected buried metal in that direction and because of positive soil gas results along the north side of the landfill. The grid was also expanded to the west because volatile constituents were previously detected in groundwater samples taken near the western SEDA boundary. Soil gas provided a screening technique to determine whether the apparent contamination was localized or was associated with groundwater contamination from the landfill. The density of sampling in the downgradient (western) direction was increased to encompass all 100-foot grid points west of the landfill.

Soil gas sample analysis on a portable gas chromatograph revealed elevated hydrocarbon concentrations primarily in the central portion of the survey area. The highest total volatiles levels were detected north of the incinerator building, at station K-6. A compound with an elution time near that of toluene accounts for essentially all of the remaining volatiles measured on the site, outside of the K-6 area. The local anomaly at K-6 reflected the occurrence of a nonstandardized light (volatile) hydrocarbon. Low concentrations of trichloroethylene and trans-1,2-dichloroethylene were measured on the western half of the site, coinciding with the points of highest total volatiles concentrations. Soil gas samples from locations K-6 and K-8, were sent to the TES laboratory for overnight analysis. Gas chromatography (GC) analysis indicated the presence of typical diesel fuel or kerosene constituents and a wide variety of volatile chlorinated species in these samples. Eight other locations directly surrounding this area were then sampled. These samples showed significantly reduced photoionization detector (PID) readings and levels of volatiles in the field GC analysis, indicating that the incident involved a localized source of contaminants.

Geophysics

A geophysical survey was completed at the site in October and November 1988 with the following objectives:

1. To detect and delineate the presence and/or absence of buried metal within the landfill, grease pit, and Ash Landfill areas;
2. To determine if the buried metal could be drums or other likely contaminant sources;
3. In conjuction with the soil gas survey, to determine the location and extent of contamination sources and migration pathways; and
4. To scan areas selected for the soil gas survey for buried metal (e.g., drums) and utilities, so that the soil gas probe would not encounter such items.

To meet these objectives, the EM induction technique, commonly referred to as terrain conductivity, and GPR were used. The EM survey, completed with the Geonics EM-31DL Terrain Conductivity Meter, was used for the majority of the surveillance and locating efforts and for surveying of all gridded portions of the site. GPR was used at selected locations to determine whether buried metal targets would yield container-like signatures and to provide better depth discrimination needed to clear areas for the soil gas survey. Field measurements were made along a survey grid on 50-foot centers in the landfill, ash pit, and grease pit portions of the site and on 100-foot centers in the portion of the site downgradient from the landfill. EM measurements were made every 20 feet along each 50-foot and 100-foot survey line in the north-south and east-west directions.

EM anomalies, indicating buried metal, occurred on the northernmost original survey line. Therefore, the survey grid was extended along the northern end of the landfill by 100 feet. To establish continuity between the two areas, the survey lines were also extended from the grease pit area into the landfill and ash pit gridded areas. EM readings were taken in the north-south direction. EM readings ranged from 0 to 120 millimhos per meter (mmhos/m) and were contoured with 20-mmhos/m increments. This contour map indicated a buried water line, located in the area trending from east to west past the incinerator building. The contours also identified the northern extent of the landfill, outside of the survey area. The grease pit area, located in the eastern portion of the plot did not exhibit significant changes in conductivity readings; therefore, it probably did not contain buried metal or other landfilled materials similar to those observed adjacent to the incinerator.

A map, based on the interpretation of the EM data, shows where buried metal is believed to be located (ICF, 1989). Although the form of individual objects could not be determined from the data, it appears that buried metal is scattered throughout the landfill area, generally being concentrated along the J, K, L, and M survey lines. Further information on the identity of the buried metal was provided by interpretation of the GPR survey data. Generally, the GPR survey confirmed the existence of buried metal in areas identified by the EM survey. The GPR data provide a variety of signatures and particular patterns characteristic of typical landfilled and buried objects. In some areas, GPR signatures indicated the possible presence of buried drums. However, these signatures could also be produced by cylindrical objects other than drums, such as pipes, cables, or sections of culvert. Correlation of the GPR target locations with the metal signatures from the EM surveys shows that the objects are most likely metallic.

1.2.3.7 Site Investigation Report (Detection Sciences - 1990)

Detection Sciences, Inc., under the supervision of ESE, completed a geophysical survey at the site in October 1989. In the previous geophysical survey conducted by ICF in October and November 1988, which encompassed the Ash Landfill area and burning pits, geophysical anomalies were observed along the northern boundary of the survey grid. Based on these results, it was necessary to extend the investigation further north to delineate these anomalies. The ESE geophysical survey overlapped the 1988 ICF survey by two east-west trending survey lines. Originally, the ESE grid was designed to extend the ICF grid by 360 feet to the north before the site was cleared of brush and small trees in preparation for the geophysical survey. After the proposed grid area was cleared, an ash pile was identified on the surface east of the original grid. The grid was then extended to the east to include this area by shortening the northern reach to 310 feet.

As reported by Detection Sciences, Inc., the GPR signatures within the burial/debris areas were remarkably homogeneous, indicating that the various anomalies contained relatively similar mixes of metals and nonmetals. In general, a busy radar signature indicates the burial of solid waste materials. No radar signatures indicating the presence of intact drums were observed. The ability of GPR to identify drums is based on buried targets having the size, shape, and characteristics of a buried drum (Detection Sciences, Inc., 1990). To the radar, a crushed drum is simply a piece of scrap metal and is not identifiable as a drum. In general, the radar (GPR) contour map indicates what appears to be normal soil horizons, or background conditions, over the majority of the survey lines. Several small ash mounds were observed during the investigation. The geophysical data collected indicated that the surface piles did not contain buried debris and did not penetrate the surface.

1.3 OFF-SITE WELL INVENTORY

Eleven private homes with private drinking water wells were identified within a one-mile radius of the Ash Landfill (Figure 1-10). The wells are west and north of the site. The nearest location with wells is a house located approximately 2,400 feet west of the Ash Landfill on West Smith Farm Road. Other off-site wells are located along 96A.

1.4 REPORT ORGANIZATION

The remaining sections of this report are organized to describe the investigation programs, the results of the data collected during the RI and to identify the magnitude and extent of contamination. Section 2.0 (Study Area Investigation) presents a description of the important site features, characteristics, sources of contamination and discusses the investigation programs (i.e., geophysical, surface water and sediment, soils, groundwater, and ecological) performed during the RI. Section 3.0 discusses the results of the investigation programs, specifically, surface features, ecology, surface water hydrology and sediments, geology and hydrogeology. The nature and extent of contamination on and off-site is discussed in Section 4.0. Section 5.0 (Contaminant Fate and Transport) provides a discussion of the mechanisms involved in the weathering and transport of constituants found at the site. Section 6.0 (Baseline Risk Assessment) evaluates the risk to human health and the environment. Section 7 (Summary and Conclusions) presents a summary discussion of the results and a brief conclusion. Appendices are included in separate volumes and contain the data on which the text and conclusions are based.

2.0 STUDY AREA INVESTIGATION

2.1 INTRODUCTION

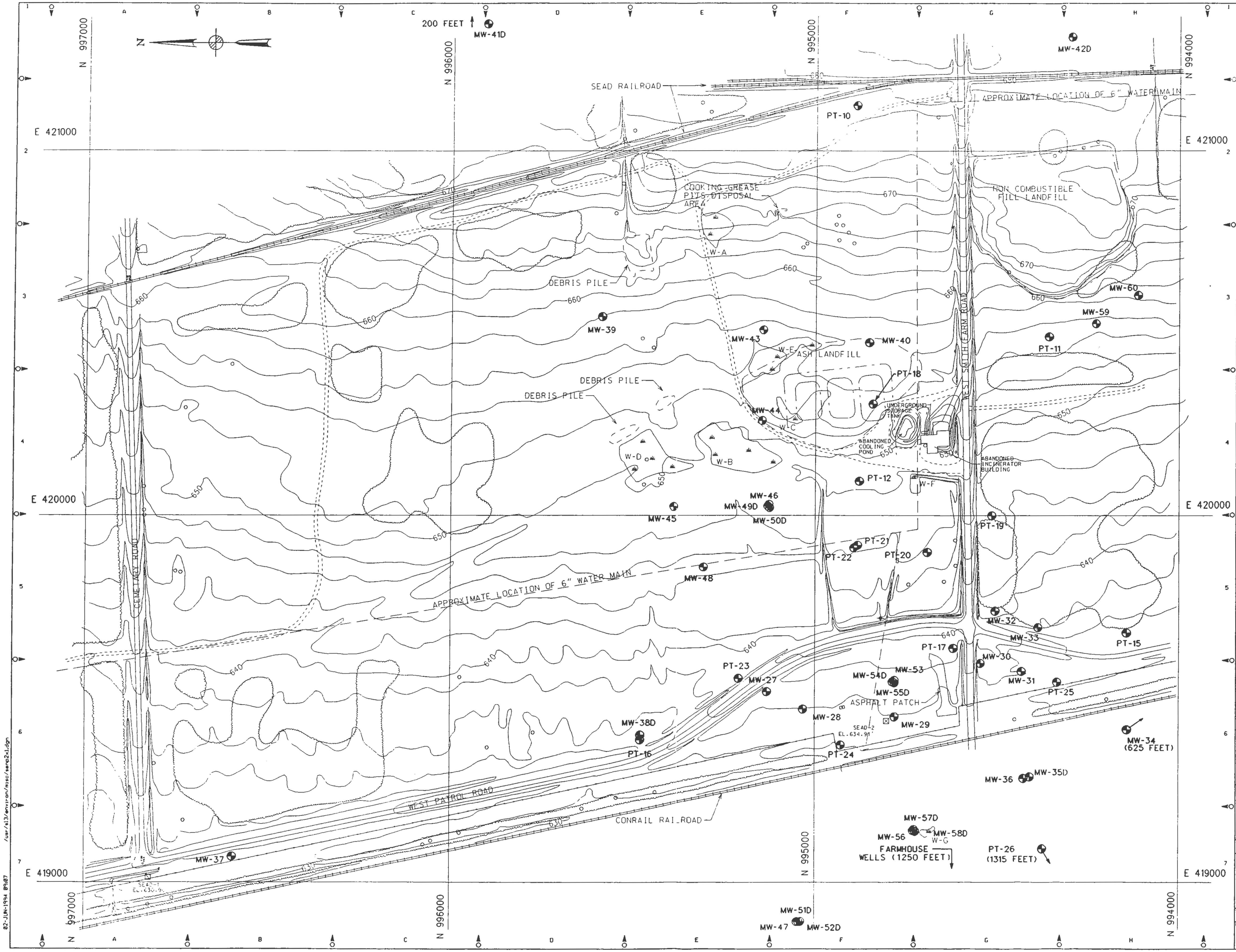
Previous studies conducted at the Ash Landfill served as the basis for planning the current investigation. The initial phase of the planning process involved the development of a conceptual understanding of site conditions. The focus of this investigation was to refine the present understanding of the site. This CERCLA investigation combined the existing database with additional hydrologic, geologic and ecological information required to provide a comprehensive CERCLA investigation report. This additional information was acquired through the implementation of numerous focused tasks described in the Ash Landfill workplan. The field work for the RI was conducted in two phase (Phase I and II) with a Preliminary Site Characterization Report (PSCR) being prepared after the completion of the Phase I work. The PSCR provided the basis for the Phase II field work to complete the RI. The following sections describe, in detail, the Phase I and II work completed by ES to further characterize the environmental setting of the site.

The Ash Landfill workplan was approved by U.S. Environmental Protection Agency (EPA), Region II and NYSDEC, on November 7, 1991. The additional Phase II field tasks, as incorporated into the workplan, were approved by EPA Region II and NYSDEC, on November 25, 1992. The workplan described the following Phase I and Phase II field tasks:

1. Geophysical Investigations (Phase I and II)
2. Soil Gas Survey (Phase I)
3. Soil Headspace Survey (Phase II)
4. Soil Sampling (Phase I and II)
5. Photo Linement/Fracture Trace Analysis (Phase II)
6. Groundwater Investigation (Phase I and II)
7. Surface Water/Sediment and Spring Investigations (Phase I and II)
8. Incinerator Dust Wipe Sampling (Phase I)
9. Ecological Investigation (Phase I)

2.2 SITE SURVEY PROGRAM

The site survey program was conducted in Phase I and consisted of field reconnaissance, ground control and aerial photogrammetry. A reconnaissance of the site was performed to



LEGEND:

PAVED ROAD
DIRT ROAD
650 GROUND CONTOUR AND ELEVATION
TREE
W-E WETLAND & DESIGNATION
APPROXIMATE EXTENT OF FILL
OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
APPROXIMATE EXTENT OF DEBRIS PILE
BRUSH
CHAIN LINK FENCE
UTILITY POLE
APPROXIMATE LOCATION OF FIRE HYDRANT
FUEL OR UNDERGROUND STORAGE TANK
SEAD-1 EL.630.90' SURVEY MONUMENT
PT-22 MW-37. MONITORING WELL AND DESIGNATION

REV	DATE	DESCRIPTION
C	6/3/94	DRAFT-FINAL RI REPORT
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN · CHECKED · DES.SUPV. · RESP.ENGR. · CH.DISC.ENG. · PROJ. MGR. · NF

DRAWN BY G.A.KAELIN
CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAELIN
RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER
MGR. OF ENGR. J.P.CHAPLICK
PROJECT MANAGER M.N.DUCHESNEAU
MGR. OF PROJECTS J.P.CHAPLICK
IN CHARGE W.D.PATTERSON

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO.

FIGURE 2-1
ASH LANDFILL AREA
SITE PLAN

SCALE 1" = 250'

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locate general site features and confirm the presence of significant features (i.e., incinerator building, cooling pond, filled areas, possible solvent dumping areas, debris pits, monitoring wells, access roads) identified in the workplan. Also, sampling locations were identified and marked during this initial survey.

The site and surrounding area was photographed from the air on December 12, 1991 for the purpose of constructing a photogrammetric site plan with 2 foot contour intervals. This photogrammetric map was used as the basis for the site base map. The photographs were also utilized for the ecological survey to identify significant vegatative types. Site survey information was gathered from 16 photographs at a scale of 1" - 500' taken from two east-west trending flight lines (lines 3 and 4). The lines extended from the area of North-South Baseline Road west to the eastern edge of Seneca Lake at Sampson State Park. Ground control was performed during the months of November and December of 1991, and January and February of 1992. All sampling locations and monitoring wells were located and surveyed. The top of the polyvinyl chloride (PVC) riser pipe, protective steel casing and the ground surface elevation at each well location were also surveyed. Each location was referenced to the New York State Plane Coordinate System. Figure 2-1 presents the Ash Landfill Area Site Plan.

2.3 CHARACTERIZATION OF SOURCE AREAS

Known and potential source areas were characterized from information gathered during past site investigation programs. Nine potential source areas were identified in the ESE workplan 1991. Refer to Figure 2-1 for the approximate locations of these areas. These areas are as follows:

1. Three possible solvent dump sites located approximately 200 feet west of the Ash Landfill;
2. Suspected buried debris piles north of the Ash Landfill. The three debris piles are defined by blackened areas with only a slight topographic relief.
3. Grease pits northeast of the Ash Landfill, used for the disposal of used kitchen grease. The grease pit disposal area is located near the eastern boundary of the site. Evidence of burning debris during the operation of the incinerator is shown by the area of blackened soil, charred debris, and areas of stressed or dead vegetation.
4. The Ash Landfill extending north and east of the incinerator building, used for disposal of incinerator ash between 1974 and 1979. The Ash Landfill is defined by a low vegetated topographic high and is composed of dark brown to black ash that

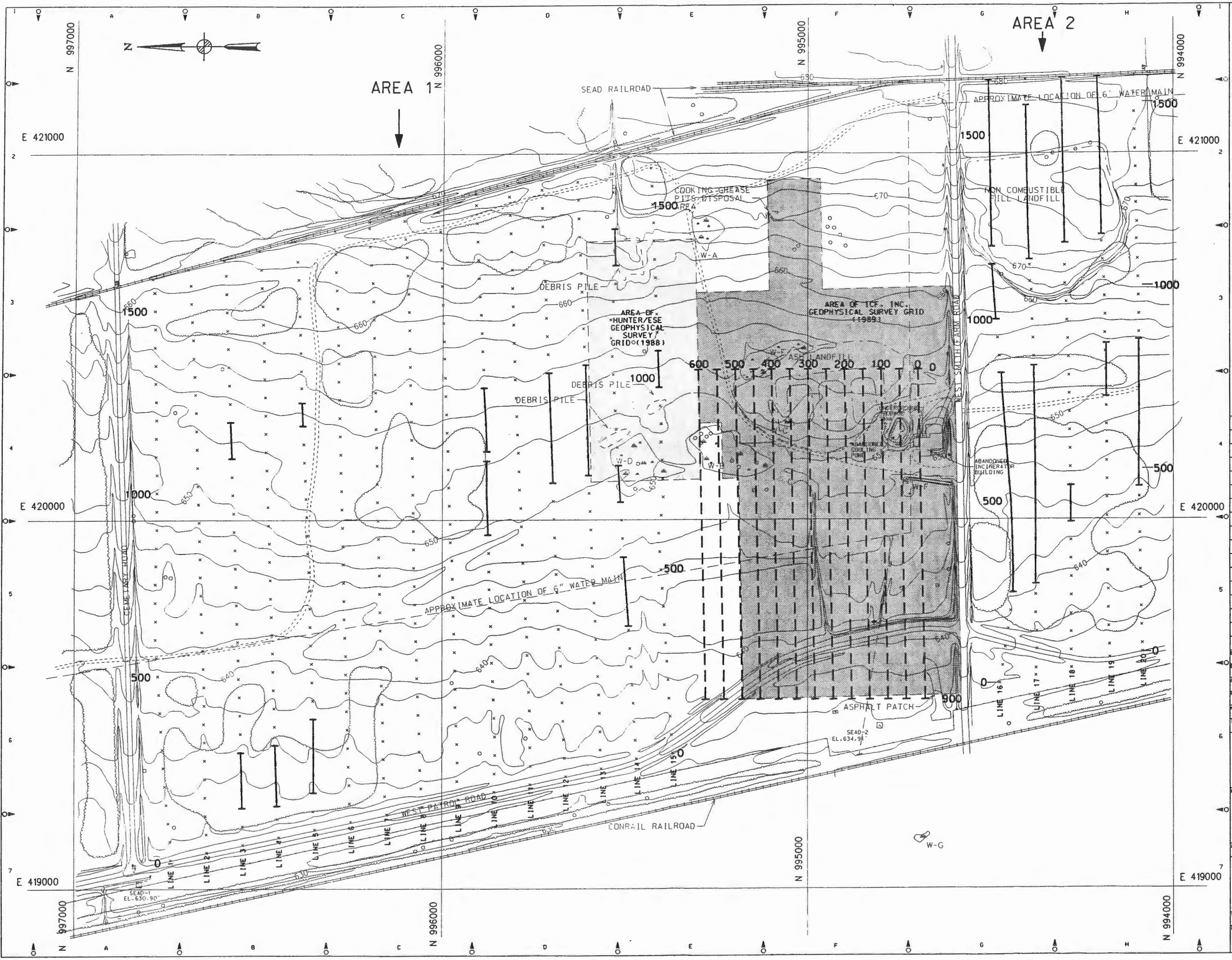
was spread over an approximately 300 x 500 foot area. The fill is up to 4 feet thick. The active area of the Ash Landfill extended at least 500 feet north of the incinerator building, near a bend in a dirt road. The landfill was apparently covered with native soils of various thicknesses but has not been closed with an engineered cover or cap.

5. An abandoned Non-Combustible Fill Landfill southeast of the Ash Landfill and incinerator area on the south side of West Smith Farm Road. The Non-Combustible Fill Landfill is approximately 2 acres in area. This roughly rectangular, wedge-shaped fill area thickens to the west where it reaches a maximum total relief of approximately 14 feet. The top surface of the filled area is covered with low grassy vegetation.
6. Burning pits north and west of the incinerator building, and within the Ash Landfill area, that were used to burn uncontaminated trash from 1941 to 1974. Figure 3-1 is a 1968 aerial photograph showing the burn pits.
7. A cooling pond, adjacent to the incinerator building, used for cooling fly ash and residues from the incinerator. The cooling pond consisted of an unlined depression approximately 50 feet in diamter and 6 to 8 feet deep. Ashes and other residues from the incinerator were temporarily disposed of in the pond. It is located 10 feet from the northeastern corner of the incinerator building.
8. A diesel fuel underground storage tank located adjacent to the northeast corner of the incinerator building.
9. The former incinerator (Building 2207), used to incinerate trash between 1974 and 1979. The abandoned incinerator is situated on a small artificially constructed mound and is located near West Smith Farm Road.

2.4 GEOPHYSICAL INVESTIGATION

The geophysical investigation was designed to accomplish several objectives during the course of the Phase I and II fieldwork. The objective of the Phase I geophysical program was to further delineate any additional possible sources of contamination (i.e.,geophysical anomalies) outside of the areas already investigated by ICF (USATHAMA 1989) and Detection Sciences (1990). In some instances this survey overlapped areas previously investigated.

During Phase I two geophysical surveys were performed by Blasland & Bouck Engineers, P.C. for ES, at the Ash Landfill area in October 1991. Appendix B contains the Geophysical Report by Blashland and Bouck Engineers. The geophysical surveys, consisting of an EM-31 terrain conductivity survey and a GPR survey, were conducted to identify anomalous areas and provide characterization to the nature of these anomalies. The areas investigated using these geophysical methods are shown on Figure 2-2. Area 1, located north of the limits of



LEGEND:

	PAVED ROAD
	DIRT ROAD
650	GROUND CONTOUR AND ELEVATION
○	TREE
W-B	WETLAND & DESIGNATION
	APPROXIMATE EXTENT OF FILL
	OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
	APPROXIMATE EXTENT OF DEBRIS PILE
	BRUSH
	CHAIN LINK FENCE
◊	UTILITY POLE
✦	APPROXIMATE LOCATION OF FIRE HYDRANT
	FUEL OR UNDERGROUND STORAGE TANK
☒ SEAD-1 EL.630.90'	SURVEY MONUMENT
500 ×	LOCATION OF GEOPHYSICAL SURVEY POINT WITH DISTANCE EAST OF 0-POINT.
LINE 1	BLASLAND & BOUCK ENGINEERS, P.C., GEOPHYSICAL SURVEY LINE. × INDICATES EM-31 SURVEY POINT.
I	LOCATION OF BLASLAND & BOUCK ENGINEERS, P.C. GROUND PENETRATING RADAR SURVEY.
600	PHASE 2- VERY LOW FREQUENCY ELECTROMAGNETIC SURVEY LINES AND LINE NUMBER

REV	DATE	DESCRIPTION
B	10/93	PREDRAFT PHASE II RI/FS
A	1/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A. KAELIN	CHECKED BY M.E. BAKER
DESIGN SUPV. G.A. KAELIN	RESP. ENGR. M.N. DUCHESNEAU
CHIEF DISC. ENGR. M.E. BAKER	MGR. OF ENGR. J.P. CHAPLICK
PROJECT MANAGER M.N. DUCHESNEAU	
MGR. OF PROJECTS J.P. CHAPLICK	
IN CHARGE W.D. PATTERSON	

DRAWN CHECKED DES.SUPV. RESP.ENGR. CH.DISC.ENG. PROJ. MGR.

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 2-2
LOCATION OF
GEOPHYSICAL SURVEYS

SCALE 1" = 250'

ES'S DWG. NO. 720447-03000-2-1
REV B

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19-OCT-1993 16:10

the abandoned Ash Landfill, consists of a rectangular area with approximately 1,500 feet north-south and 1,600 foot east-west dimensions. Area 2, located south of the limits of the abandoned Ash Landfill and West Smith Farm Road, has a 500 foot north-south dimension and a 1,650 foot west-east dimension.

During Phase II ES conducted a Very Low Frequency Electromagnetic (VLF-EM) survey. The objective of this survey was to identify potential subsurface fractures in the shale and their vertical orientation. Any such fractures would likely have a direct impact on the groundwater flow regime and thus potential contaminant migration in the consolidated shale. Twelve west to east survey profiles were run to the north of the West Smith Farm Road were run.

2.4.1 EM-31 Survey

For Area 1, 15 geophysical survey lines were established every 100 feet along West Patrol Road, beginning 100 feet south of Cemetery Road (Figure 2-2). Endpoints for these 15 geophysical lines were established along the railroad bed located approximately 1,600 feet east of West Patrol Road. The geophysical survey lines were numbered 1 through 15, from north to south respectively. For Area 2, five geophysical survey lines were established in a similar fashion, beginning 100 feet south of the West Smith Farm Road. Endpoints for these five geophysical lines were established along the railroad bed located approximately 1,600 feet east of West Patrol Road. These geophysical lines were numbered 16 through 20, from north to south. The survey lines were established and cleared of vegetation to permit access. The 20 geophysical survey lines were cleared of standing vegetation to ground level by SEDA personnel from the Roads and Grounds Department.

EM Data measurements were collected every 50 feet along each survey line using a Geonics model EM-31 terrain conductivity meter. A digital data logger, Model DL55, was used to record readings. The following instrument functional checks and calibration were performed daily: Internal battery condition, Instrument zero reading, Instrument phasing and Instrument sensitivity. Instrument sensitivity was performed in an area considered to represent background site conditions. This area is located east and upgradient of the eastern limit of the abandoned Ash Landfill, about 20 feet south of monitoring well PT-10.

The EM survey of Area 1 was performed on October 14 and 16, 1991. A total of 23,650 lineal feet of EM survey was completed with 473 measurements collected for each of the quadrature-phase and in-phase components. The EM survey of Area 2 was performed on October 17, 1991. A total of 8,050 lineal feet of EM survey was completed with 161 measurements collected for each of the quadrature-phase and in-phase components.

2.4.2 GPR Survey

Anomalies defined by the EM-31 survey line plots were investigated using a Geophysical Survey Systems, Inc. (GSSI) subsurface interfacing radar (SIR), System-3, consisting of a PR-8300 profiling recorder and a 300 megahertz (MHz) transducer. Equipment calibration was performed prior to GPR profiling across potential anomaly areas and was completed in the same area as the EM-31 calibration. GPR equipment calibration included the following: Adjustment of range setting, Adjustment of high and low pass filters, Setting of the transmitting rate, Number of scans per second and print polarity, and Adjustment of range gains. Routine adjustments and maintenance of the profiling recorder were completed in accordance with the manufacturer's operation manual for the SIR System-3.

GPR profiles were performed by hand-pulling the 300 HMz transducer over the anomaly location. Horizontal control was accomplished by measuring with an engineer's tape between marked station locations and encoding the data with a station reference mark every 10 feet along each profile. The graphical output from the profiling recorder was continuously reviewed by the survey personnel to adjust equipment settings, if necessary, to maximize the resolution of subsurface anomalies. Each profile was annotated in the field with the profile line number, station interval, and anomaly location.

2.4.3 Very Low Frequency Electromagnetic (VLF-EM)

During Phase II, ES conducted a VLF-EM survey to help delineate the possible presence and location of fractures within the bedrock. The results of this investigation, in conjunction with the results of the photo lineament study described in Section 2.8, were used to locate one Phase II downgradient bedrock monitoring well cluster. The VLF-EM survey was conducted in January of 1993. Thirteen east-west trending transects were laid out and surveyed as shown in Figure 2-2. The survey area was selected to provide maximum coverage of the area hydraulically downgradient of the Ash Landfill. Survey transects were 900 feet long spaced at 100 foot intervals and VLF-EM measurements were made at 20 foot intervals along each transect.

The VLF-EM data were collected using a Gronics VLF-EM Wadi System. Initial field testing at the site with the Wadi unit indicated that the Annapolis, MD transmitting station provided the best source strength for the survey. Both the real and imaginary components of the induced VLF field were measured and stored electronically. The data collection was completed over a two day period. A total of 624 geophysical measurements were made. No problems were encountered in the field with either the geophysical equipment or with the VLF-EM transmitter signal strength. The results of the VLF-EM survey are discussed in Section 3.6.5.

2.5 SOIL GAS SURVEY INVESTIGATION

2.5.1 Introduction

A soil gas sampling and analysis program was performed from November 14, 1991 thru November 22, 1991 at the Ash Landfill as part of the Phase I fieldwork. The objectives of this program were to detect the presence of source materials which could be contributing to the impacts observed in several groundwater monitoring wells; confirm the results from a previous soil gas survey performed in 1987; provide a basis for locating additional confirmatory soil borings; and eliminate or confirm previously identified geophysical anomalies as locations of possible leaking drums. Areas which were identified as a geophysical anomoly and confirmed as a soil gas anomoly were then subjected to test pitting in order to confirm or deny the presence of leaking buried drums. The soil gas investigation results were also used to locate additional borings. Results from the soil gas investigation were compared to and supplemented by the results of the previous soil gas survey conducted by Target Environmental Services, Inc. (USATHAMA, 1989).

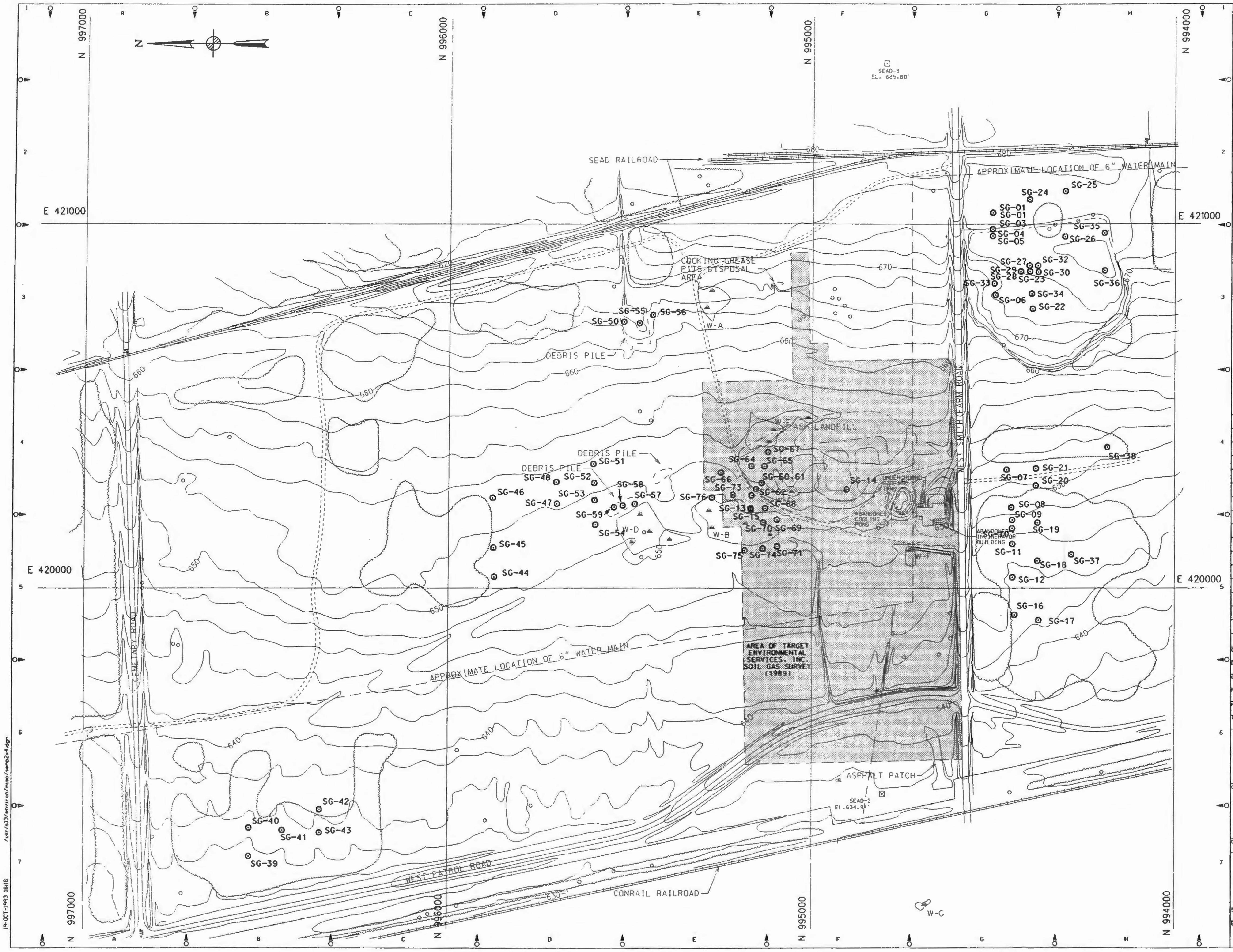
The presence of contaminants in the soil gas provides a strong indication that there is a source of volatile organics either in the soil near the probe or in the groundwater below the probe. The soil gas analysis is performed in the field with a portable gas chromatograph so that sample loss does not occur due to shipment off-site. The analytical results are available immediately and can be used to help direct the investigation regarding the location and density of soil gas samples. The analysis of site soil gas is used as a screening tool for rapidly identifying contaminant source soils and, in some cases, can delineate groundwater contamination plumes. In soils above groundwater contamination plumes, the expected soil gas concentrations are much less than those concentrations for source soils. This soil gas program was designed to identify volatile organic concentrations that indicate the presence of source materials (i.e., soils containing solvents). These soils constitute a continual sink for groundwater impacts. However, the boundary between soil gas concentrations representing source soils and soil gas concentrations resulting from a groundwater plume are not well defined. Follow-up soil sampling was used to determine the boundary.

2.5.2 Soil Gas Sampling Methods and Materials

The soil gas sampling method involved extracting a small representative sample of soil gas through a hollow steel probe driven a few feet into the ground. The extracted gas was then analyzed for the presence of expected volatile contaminants. A total of 76 soil gas samples were analyzed as part of this investigation (see Figure 2-3 for locations). Soil gas samples were collected through a hollow steel drilling rod that was driven approximately 48 inches into the vadose zone using a drilling rig (Table 2-1). Soil gas sampling was conducted at locations that were identified by geophysical techniques as anomalies. The remaining sample locations were chosen based on the suspected presence of source areas through past soil and groundwater analytical data and visual evidence of stressed vegetation or surface debris. The intent of the soil gas program was to obtain information confirming the presence of volatile organic compounds in the areas of geophysical anomalies and suspected source areas of groundwater contamination. All locations of soil gas samples were marked with a yellow flag.

These locations were surveyed and plotted on a site map by a New York State registered land surveyor.

A 1.75 inch, outer diameter, steam-cleaned, hardened hollow carbon steel BW drilling rod fitted with a penetrometer point on the tip was driven below the ground surface using a drilling rig equipped with standard equipment. The rod was driven by an assembly consisting of a 140-pound weight, a driving head, and a guide permitting a free fall of 30 inches. Blow counts for each 6-inch penetration were recorded for each location. The blow counts provide an indication of the relative density of the material. Rod refusal was defined when more than 100 blows were applied for six inches of penetration (Table 2-1).



LEGEND:

- PAVED ROAD
- DIRT ROAD
- GROUND CONTOUR AND ELEVATION
- TREE
- WETLAND & DESIGNATION
- APPROXIMATE EXTENT OF FILL
- OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
- APPROXIMATE EXTENT OF DEBRIS PILE
- BRUSH
- CHAIN LINK FENCE
- UTILITY POLE
- APPROXIMATE LOCATION OF FIRE HYDRANT
- FUEL OR UNDERGROUND STORAGE TANK
- SURVEY MONUMENT (SEAD-1 EL.630.90')
- LOCATION OF SOIL GAS SAMPLE AND DESIGNATION (SG-37)

REV	DATE	DESCRIPTION
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B	10/93	PREDRAFT PHASE II RI/FS
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MGR. OF PROJECTS J.P.CHAPLICK	
IN CHARGE W.D.PATTERSON	

DRAWN | CHECKED | DES.SUPV. | RESP.ENGR. | CH.DISC.ENG. | PROJ. MGR. | | MF

ES

ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 2-3
LOCATION OF
SOIL GAS SAMPLES

SCALE 1" = 250'

ES DWG. NO. 720447-03000-2-5
REV B

TABLE 2–1

SOIL GAS PROGRAM SUMMARY
PHASE I

SENECA ARMY DEPOT
ASH LANDFILL

LOCATION	DATE	SAMPLE DEPTH	BLOWS PER 6 INCHES
SG–01	11/15/91	48 inches	1–2–3–7–15–15–14–16
SG–02	11/15/91	(Duplicate of SG–01)	–
SG–03	11/15/91	48 inches	1–3–9–13–9–13–23–39
SG–04	11/15/91	48 inches	4–4–5–6–13–15–11–11
SG–05	11/15/91	(Duplicate of SG–04)	–
SG–06	11/15/91	48 inches	1–3–3–8–18–16–12–14
SG–07	11/15/91	48 inches	2–2–2–6–21–37–55–94
SG–08	11/18/91	48 inches	2–4–11–15–28–50–52–130
SG–09	11/18/91	48 inches	2–4–4–22–44–40–34–34
SG–10	11/18/91	48 inches	2–2–3–10–39–31–53–53
SG–11	11/18/91	37 inches	2–2–3–11–22–70–100/.1'
SG–12	11/18/91	30 inches	2–3–7–17–27–100/.4'
SG–13	11/18/91	48 inches	4–6–5–4–3–3–4–4
SG–14	11/18/91	48 inches	6–8–7–5–10–12–11–9
SG–15	11/19/91	48 inches	5–8–7–5–4–4–5–8
SG–16	11/19/91	42 inches	2–2–7–13–21–41–100
SG–17	11/19/91	40 inches	2–2–3–6–8–20–40–100/.3'
SG–18	11/19/91	36 inches	2–2–2–3–12–50–100/.3'
SG–19	11/19/91	40 inches	2–2–2–3–9–36–100/.4'
SG–20	11/19/91	38 inches	2–2–3–7–19–65–100/.2'
SG–21	11/19/91	36 inches	2–2–5–25–41–91–100/.1'
SG–22	11/19/91	48 inches	2–3–2–3–6–8–15–9
SG–23	11/19/91	48 inches	3–3–7–11–11–18–18–57
SG–24	11/19/91	48 inches	2–2–3–6–17–23–30–27
SG–25	11/19/91	48 inches	2–2–4–9–11–16–27–34
SG–26	11/19/91	48 inches	3–6–5–2–1–1–1–1
SG–27	11/19/91	48 inches	8–38–26–9–6–5–3–4
SG–28	11/19/91	48 inches	2–3–7–13–16–10–4–7
SG–29	11/19/91	(Duplicate of SG–28)	–
SG–30	11/19/91	48 inches	2–4–7–13–12–9–6–6
SG–31	11/20/91	(Rod Blank)	–
SG–32	11/20/91	48 inches	4–13–22–13–10–3–4–3
SG–33	11/20/91	48 inches	3–3–2–5–6–6–6–10
SG–34	11/20/91	48 inches	3–7–13–12–8–8–6–4
SG–35	11/20/91	48 inches	5–8–7–6–5–4–3–4
SG–36	11/20/91	48 inches	2–3–4–3–3–2–5–10
SG–37	11/20/91	48 inches	1–2–2–8–28–37–64–64
SG–38	11/20/91	45 inches	1–2–4–8–21–42–74–100/.3'
SG–39	11/20/91	48 inches	1–2–2–3–8–22–20–14
SG–40	11/20/91	38 inches	1–3–2–10–26–74–100/.2'
SG–41	11/20/91	45 inches	2–2–4–8–17–31–58–100/.3'
SG–42	11/20/91	42 inches	2–2–2–3–12–36–115
SG–43	11/20/91	48 inches	1–2–3–2–5–11–16–20
SG–44	11/20/91	48 inches	2–2–3–9–31–53–43–71
SG–45	11/21/91	40 inches	2–2–2–3–9–40–100/.4'
SG–46	11/21/91	39 inches	2–1–26–27–42–65–100/.3'
SG–47	11/21/91	38 inches	2–2–2–3–12–47–100/.2'
SG–48	11/21/91	48 inches	2–1–2–2–10–18–38–42
SG–49	11/21/91	(Rod Blank)	–
SG–50	11/21/91	48 inches	1–1–2–3–3–2–2–1

TABLE 2–1

SOIL GAS PROGRAM SUMMARY
PHASE I

SENECA ARMY DEPOT
ASH LANDFILL

LOCATION	DATE	SAMPLE DEPTH	BLOWS PER 6 INCHES
SG–51	11/21/91	44 inches	1–3–2–9–19–24–85–100/.2'
SG–52	11/21/91	38 inches	1–2–2–4–7–7–11–12
SG–53	11/21/91	48 inches	1–1–2–3–4–5–8–10
SG–54	11/21/91	48 inches	1–2–2–6–13–19–30–52
SG–55	11/21/91	48 inches	1–2–2–4–5–2–2–2
SG–56	11/21/91	38 inches	2–2–5–11–24–52–100/.2'
SG–57	11/21/91	48 inches	1–2–3–5–8–13–19–16
SG–58	11/21/91	48 inches	2–1–2–2–6–12–14–21
SG–59	11/21/91	48 inches	1–2–1–4–17–29–29–34
SG–60	11/21/91	48 inches	2–6–9–10–9–7–5–3
SG–61	11/21/91	(Reanalysis of SG–60)	–
SG–62	11/21/91	48 inches	5–13–23–16–13–12–7–3
SG–63	11/21/91	48 inches	7–12–18–12–10–4–4–5
SG–64	11/21/91	48 inches	4–7–8–7–9–6–3–19
SG–65	11/21/91	48 inches	3–5–7–6–4–5–6–12
SG–66	11/21/91	48 inches	2–4–5–5–7–5–4–2
SG–67	11/21/91	48 inches	1–2–2–3–23–50–66–23
SG–68	11/22/91	48 inches	4–4–3–3–5–7–11–9
SG–69	11/22/91	48 inches	2–5–7–3–1–5–10–14
SG–70	11/22/91	48 inches	2–2–3–3–2–2–3–6
SG–71	11/22/91	48 inches	1–2–4–5–6–8–8–9
SG–72	11/22/91	(Rod Blank)	–
SG–73	11/22/91	48 inches	3–3–3–3–11–29–44–61
SG–74	11/22/91	48 inches	2–2–3–6–18–34–35–36
SG–75	11/22/91	48 inches	2–2–3–8–8–11–17–29
SG–76	11/22/91	48 inches	1–2–3–7–9–9–11–18

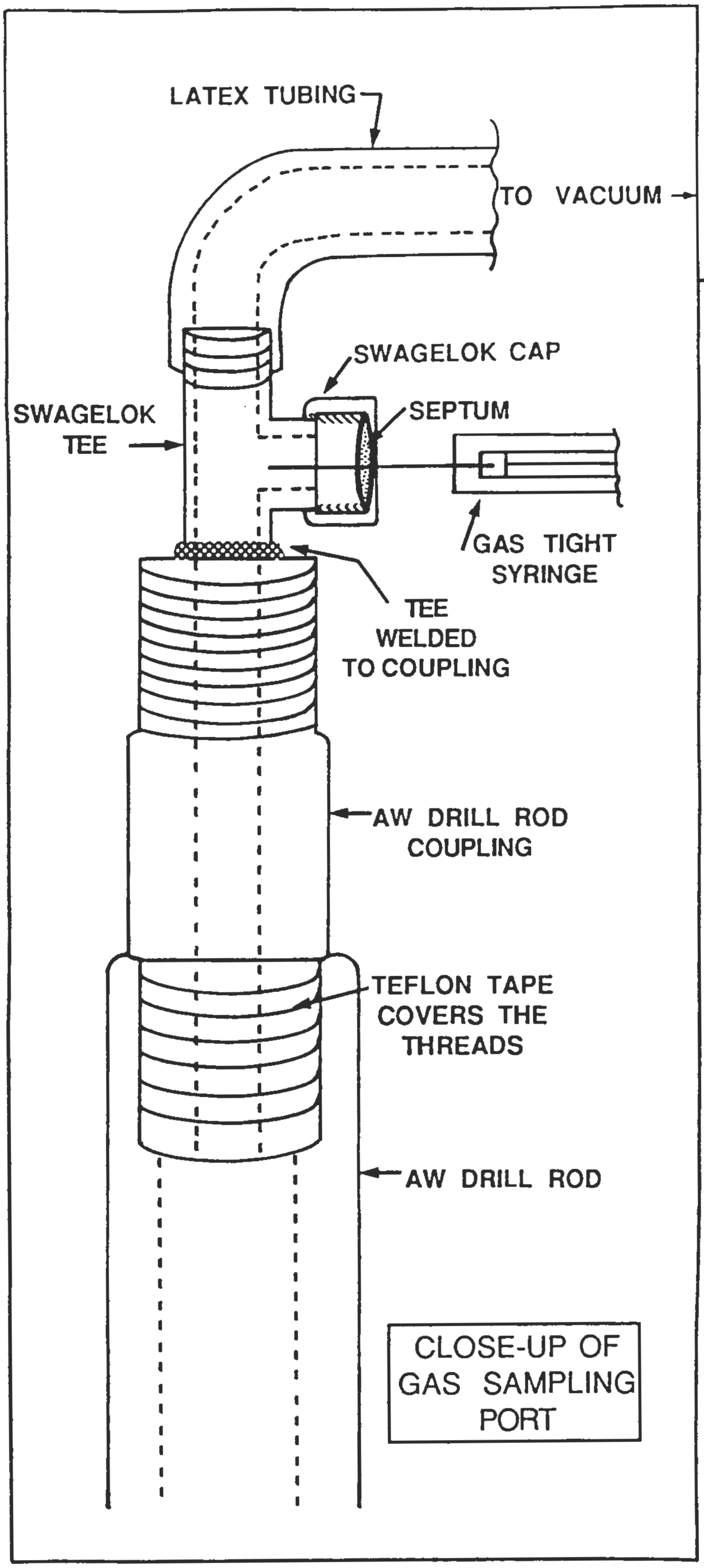
Once the desired depth of penetration was reached, the drilling rod was withdrawn approximately 6 inches, allowing the penetrometer point to dislodge from the rod, creating a void space through which soil gas was extracted. A metal rod was inserted into the hollow drilling rod to ensure that the penetrometer point had been dislodged. If not, the point was knocked out with the metal rod. Bentonite was packed at the ground surface around the probe to prevent influx of atmospheric air into the sample probe. The hollow drilling rod exposed above the land surface was fitted with a coupling containing evacuation and sampling ports. Teflon tape was used on the threads connecting the coupling to the hollow drilling rod to prevent infiltration of surface gases into the sampling ports. One-half inch latex laboratory tubing connected the evacuation port to the intake of a SKC Aircheck Sampler pump (Model 224-PCXR7). The sampling port was fitted with a septum. A new septum was used at each sampling location.

The probe was purged by creating a slight negative pressure with an SKC air sampling pump through the evacuation line for at least 5 minutes to ensure that the gases flowing through the hollow drilling rod were representative of soil gases. The gases were purged at a rate of approximately 3 liters per minute. The effluent gas was monitored continuously with an Organic Vapor Meter (OVM) Model 580B. The soil gas sample was collected from the probe immediately if the effluent monitoring indicated an increase in the concentration of volatiles after 5 minutes of purging. Gas samples were collected to coincide, as much as possible, with the highest concentration of gas measured by the OVM. Approximately 3 ml of soil gas was extracted through the sampling port using a Hamilton gas tight sampling syringe. The syringe was immediately transported to the temporary soil gas laboratory. Figure 2-4 illustrates the gas collection probe.

Following the collection of soil gas sample, the drilling rod was removed from the ground using the drilling rig or by hand. The probe hole was backfilled with bentonite. Penetrometer points were decontaminated prior to use and drilling rods were steam cleaned after each use. Other sampling equipment (e.g.,drill couplings, sampling syringes, tubing, etc) was decontaminated after each use according to the decontamination procedures outlined in the Quality Assurance Project Plan. All syringes were decontaminated and blanked prior to field use.

2.5.3 Analytical Support

Soil samples were analyzed in the field using a Photovac 10S50 portable gas chromatograph



CLOSE-UP OF GAS SAMPLING PORT

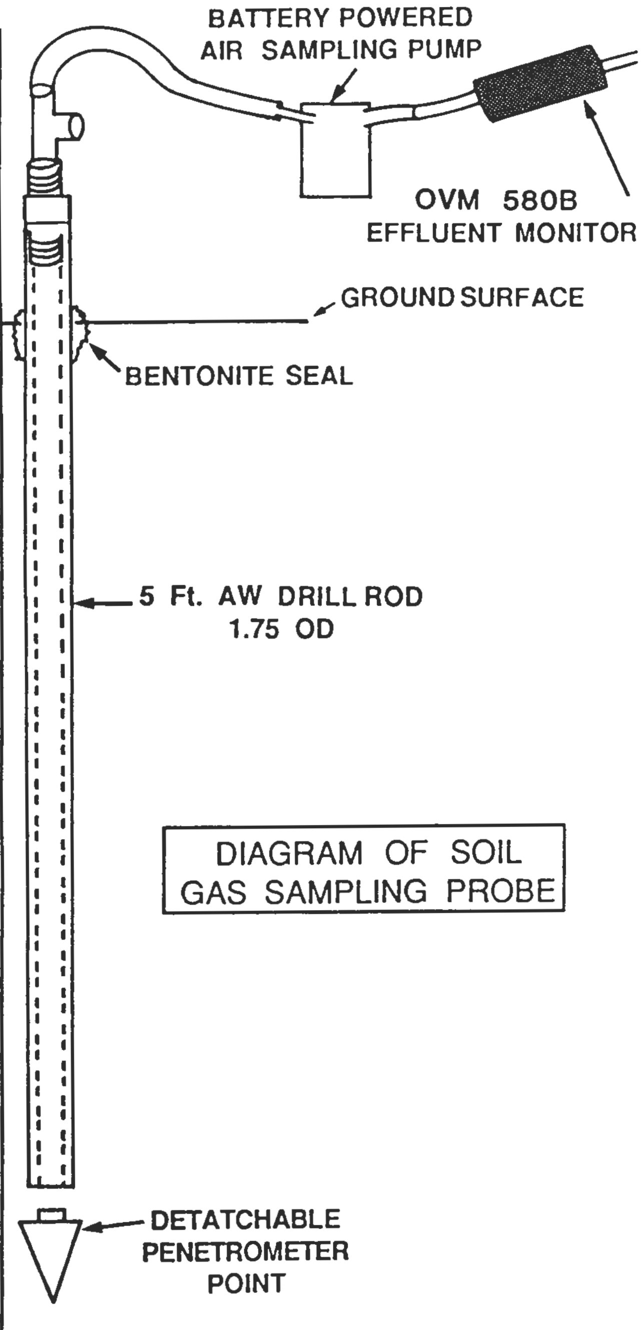


DIAGRAM OF SOIL GAS SAMPLING PROBE

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 2-4

SOIL GAS SAMPLING PROBE

SCALE NTS

to facilitate real time data acquisition. Various amounts of gas soil samples ranging between 0.25 and 5.0 mls, were injected into the portable gas chromatograph. The amount injected was determined depending on the results of the continuous monitoring with the OVM. High OVM readings, meant that less sample was required to be injected so that the detector response was within the calibration range of the instrument. The temporary soil gas laboratory was established in the on-site field trailer. A simplified explanation of the analytical procedure is provided in the following paragraphs.

The gas chromatograph instrument separates compounds in a chromatographic column (selected on a site-specific basis) and detects and quantifies the compounds using a detector. After a sample is introduced to the chromatograph, it is carried by a carrier gas through the column. Different compounds pass through the column at different rates, resulting in a characteristic "retention time" for each compound. By comparison with standards, this retention time can be used to identify compounds. The detector responds to the presence of compounds by producing a difference in current from a reference current. The magnitude of this current difference can be used, when compared to standards, to determine concentrations of compounds present in the sample.

The analytical system utilized for this program was the portable Photovac 10S50 gas chromatograph. This instrument is equipped with a heated capillary column and an on-board peak integrator. The detector for this instrument is the PID. The PID is ideal for detecting volatile organic compounds that contain aromatic rings and unsaturated double bonds. Both groundwater and previous soil gas sampling have indicated the presence of trichloroethylene, 1,2-Dichloroethylene and small amounts of benzene, toluene and xylene.

Quantitative analysis of soil gas requires quantitative gas standards. The gas standards used for this project were prepared by National Specialty Gases and is certified by National Specialty Gases to be traceable to the National Bureau of Standards (NBS). The gas standard mixture included trichloroethylene, 1,2-Dichloroethylene, benzene, toluene, and xylene, each at concentrations of approximately 100 parts per million per volume (ppmv). This standard mixture was certified by the manufacturer and a certificate of analysis accompanied the gas standard. This certificate of analysis is presented in Appendix E. The field calibration standard was prepared from this certified gas standard. Dilutions were made from this standard by injecting a known volume of calibration gas into a clean glass sampling bulb of known volume. The analytical instrument was calibrated each day prior to the analysis of a sample.

2.5.4 Data Interpretation

Data interpretation is an important element of the soil gas analysis. The acquired vapor phase concentrations are evaluated to determine the relationship between soil gas and source soils. The interpretation of the soil gas data involved identification of each organic compound by retention time comparison with gas standards. Quantitation of gas concentrations was obtained as the product of the Response Factor (RF) and the obtained detector response for each compound. RF's were obtained from the calibration curves as the slope of the straight line when the integrated area under the curve, expressed in Volt-sec (Vs), was plotted against the concentration of the gas injected. The calibration curves were prepared assuming the injected volume was constant at one milliliter. If necessary, based upon the OVM readings obtained during sample collection, the volume injected was adjusted to assure that the detector response would not exceed the upper calibration range. The final concentration of the collected sample was determined by applying either a dilution factor or a concentration factor, depending upon the volume injected. For example, if 0.5 milliLiter (mL) was injected the obtained concentration was multiplied by 2. The prepared calibration curves and best fit line statistical analyses are presented in Appendix E. Since toluene or xylene was not observed in any soil gas samples these curves were not prepared.

2.6 SOIL HEADSPACE INVESTIGATION

2.6.1 Introduction

A soil headspace survey was conducted from April 19, 1993 through April 23, 1993 at the Ash Landfill as part of the Phase II fieldwork. The objectives of the program were to fully define two previously defined soil gas "hot spots" near the "bend in the road" that are contributing to the impacts of Volatile Organic Compounds (VOCs) in several groundwater monitoring wells; and provide a basis for locating Phase II soil borings in and around the Ash Landfill.

While the original plan in Phase II was to conduct the investigation using soil gas methods as in Phase I, heavy seasonal precipitation resulted in a rise in the shallow aquifer water table and saturation of the near surface soils and precluded the collection of soil gas from the site. After gaining approval from EPA and NYSDEC the plan to investigate this area of the site involved the analysis of soil headspace instead of soil gas. This method provides equally useful data to allow for relative comparison of volatiles present at the sample locations and thus further delineate of the soil gas "hot spots".

2.6.2 Soil Headspace Sampling Methods and Materials

The distribution of sampling points was established so that the objectives of the investigation were met. Specifically, radiating arrays of sampling points were established so that their centerpoints were at two locations corresponding to the previously defined soil gas "hot spots" (Figure 2-5). The arrays were comprised of 77 sampling points (Table 2-2). The first array, centered at SG-0, was comprised of 47 sampling points located along 8 major azimuths and the second array, centered at SG-00, was comprised of 28 sampling points located along 5 major azimuths. Two sampling points were also conducted near PT-18.

A total of 95 soil samples were collected from 2-4 feet below the ground surface using split-spoon sampling. Two-inch split spoons were driven using a 140 pound hammer mounted on a mobile B-9 drilling rig. The soil in each 2-4 foot split spoon was screened immediately upon opening the spoon. The sample for the analysis was collected from the location in the spoon which exhibited the highest concentration of volatiles based on screening with the organic vapor meter and transferred to a 40 mL amber glass vial. In order to maintain comparability between soil headspace results an approximately equal volume of soil (about 30 to 40 grams) was collected in each 40 mL amber glass vial with a Teflon septum. Following collection of the soil headspace sample, the hole created by the split-spoon samplers was backfilled with bentonite. The split-spoons and sampling equipment were decontaminated after each use according to the decontamination procedures outlined in the Quality Assurance Project Plan in the workplan. All syringes were decontaminated and blanked prior to use in the field.

Headspace analyses of the samples were performed in a similar manner to the soil gas analyses in Phase I using a Photovac 10S50 portable gas chromatograph (Section 2.5.4). To allow for peak identification during the chromatography a gas standard was used. The standard, obtained from Canan Scientific of Atlanta, GA, was composed of 4 chlorinated compounds (vinyl chloride, 1,1-dichloroethylene, cis-1-2-dichloroethylene, and trichloroethylene) each at a concentration of approximately 100 ppm.

The approach to interpreting the chromatography was based on a relative comparison of the response to trichloroethylene, the compound believed to be most related to source areas in the Ash Landfill. Because the exact volume of the soil was not known only magnitudes of relative soil contamination by volatiles could be established. Results of the soil headspace are discussed in Section 4.0.

TABLE 2 – 2

SOIL HEADSPACE USING GAS CHROMATOGRAPHY
PHASE II

SENECA ARMY DEPOT
ASH LANDFILL

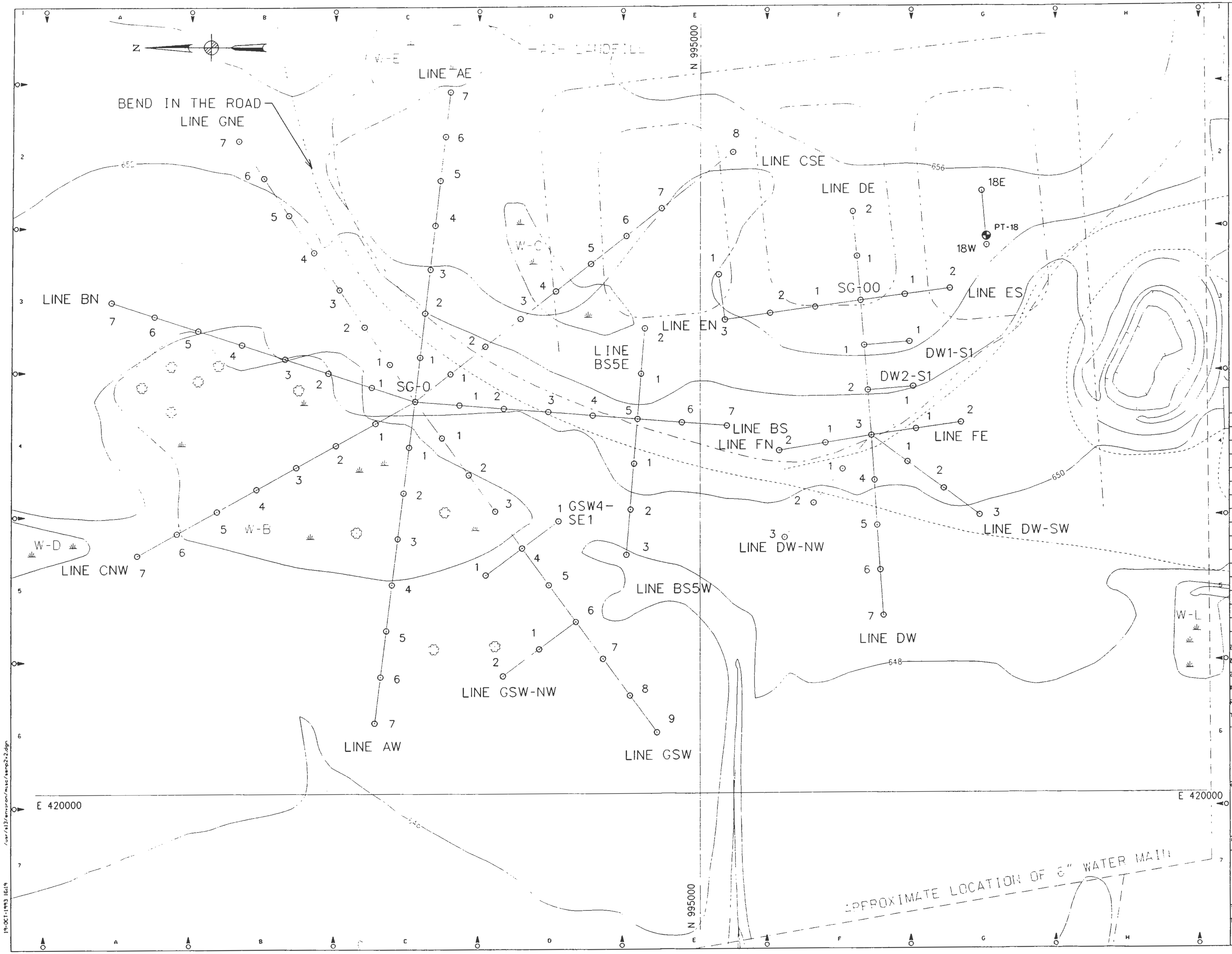
HEADSPACE POINT	DATE	DEPTH
SG–00	04/21/93	2 – 4'
DE–1	04/21/93	2 – 4'
DE–2	04/21/93	2 – 4'
DW–1	04/21/93	2 – 4'
DW–1	04/21/93	2 – 4'
DW–2	04/21/93	2 – 4'
DW–2	04/21/93	2 – 4'
DW–3	04/21/93	2 – 4'
DW–4	04/21/93	2 – 4'
DW–5	04/21/93	2 – 4'
DW–6	04/23/93	2 – 4'
DW–7	04/26/93	2 – 4'
DW–1–S1	04/26/93	2 – 4'
DW–1–S1	04/26/93	2 – 4'
DW–2–S1	04/26/93	2 – 4'
DW–3–SW1	04/26/93	2 – 4'
DW–3–SW2	04/26/93	2 – 4'
DW–3–SW3	04/26/93	2 – 4'
DW–3–NW1	04/26/93	2 – 4'
DW–3–NW2	04/26/93	2 – 4'
EN–1	04/21/93	2 – 4'
EN–2	04/21/93	2 – 4'
EN–3	04/26/93	2 – 4'
EN–3–E1	04/26/93	2 – 4'
ES–1	04/21/93	2 – 4'
ES–2	04/21/93	2 – 4'
FN–1	04/21/93	2 – 4'
FN–2	04/21/93	2 – 4'
FS–1	04/21/93	2 – 4'
FS–2	04/21/93	2 – 4'
GNE–1	04/23/93	2 – 4'
GNE–2	04/22/93	2 – 4'
GNE–3	04/22/93	2 – 4'
GNE–4	04/22/93	2 – 4'
GNE–5	04/22/93	2 – 4'
GNE–6	04/22/93	2 – 4'
GNE–7	04/22/93	2 – 4'
GSW–1	04/22/93	2 – 4'
GSW–2	04/22/93	2 – 4'
GSW–3	04/22/93	2 – 4'
GSW–4	04/22/93	2 – 4'
GSW–4	04/22/93	2 – 4'
GSW–5	04/22/93	2 – 4'
GSW–6	04/22/93	2 – 4'
GSW–7	04/22/93	2 – 4'
GSW–8	04/23/93	2 – 4'
GSW–4–SE1	04/27/93	2 – 4'
GSW–4–NW1	04/27/93	2 – 4'
GSW–6–NW1	04/27/93	2 – 4'
GSW–6–NW2	04/27/93	2 – 4'
GSW–9	04/27/93	2 – 4'
18E	04/23/93	2 – 4'
18W	04/23/93	2 – 4'
SG–0	04/20/93	2 – 4'
SG–0	04/20/93	2 – 4'

TABLE 2 – 2

SOIL HEADSPACE USING GAS CHROMATOGRAPHY
PHASE II

SENECA ARMY DEPOT
ASH LANDFILL

HEADSPACE POINT	DATE	DEPTH
AE–1	04/21/93	2 – 4'
AE–1	04/21/93	2 – 4'
AE–2	04/21/93	2 – 4'
AE–3	04/21/93	2 – 4'
AE–3	04/21/93	2 – 4'
AE–4	04/21/93	2 – 4'
AE–5	04/21/93	2 – 4'
AE–6	04/21/93	2 – 4'
AE–7	04/21/93	2 – 4'
AW–1	04/22/93	2 – 4'
AW–2	04/22/93	2 – 4'
AW–3	04/22/93	2 – 4'
AW–4	04/22/93	2 – 4'
AW–5	04/22/93	2 – 4'
AW–6	04/22/93	2 – 4'
AW–7	04/22/93	2 – 4'
BS–1	04/20/93	2 – 4'
BS–2	04/20/93	2 – 4'
BS–2	04/20/93	2 – 4'
BS–3	04/21/93	2 – 4'
BS–3	04/21/93	2 – 4'
BS–4	04/21/93	2 – 4'
BS–5	04/21/93	2 – 4'
BS–5	04/21/93	2 – 4'
BS–6	04/21/93	2 – 4'
BS–7	04/21/93	2 – 4'
BS–5E–1	04/23/93	2 – 4'
BS–5E–2	04/23/93	2 – 4'
BS–5W–1	04/22/93	2 – 4'
BS–5W–2	04/22/93	2 – 4'
BS–5W–3	04/22/93	2 – 4'
BN–1	04/21/93	2 – 4'
BN–2	04/21/93	2 – 4'
BN–3	04/21/93	2 – 4'
BN–4	04/21/93	2 – 4'
BN–5	04/21/93	2 – 4'
BN–6	04/21/93	2 – 4'
BN–7	04/21/93	2 – 4'
CSE–1	04/20/93	2 – 4'
CSE–2	04/20/93	2 – 4'
CSE–3	04/20/93	2 – 4'
CSE–4	04/20/93	2 – 4'
CSE–5	04/20/93	2 – 4'
CSE–6	04/20/93	2 – 4'
CSE–7	04/20/93	2 – 4'
CSE–8	04/23/93	2 – 4'
CNW–1	04/22/93	2 – 4'
CNW–1	04/22/93	2 – 4'
CNW–2	04/22/93	2 – 4'
CNW–3	04/22/93	2 – 4'
CNW–4	04/22/93	2 – 4'
CNW–5	04/21/93	2 – 4'
CNW–6	04/21/93	2 – 4'
CNW–7	04/21/93	2 – 4'



REV	DATE	DESCRIPTION
A	10/93	PREDRAFT PHASE II RI/FS

DRAWN BY G.A.KAELIN
CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAELIN
RESP. ENGR. M.N.DUCHESNEAU
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MGR. OF ENGR. J.P.CHAPLUCK
PROJECT MANAGER M.N.DUCHESNEAU
MGR. OF PROJECTS J.P.CHAPLUCK
IN CHARGE W.D.PATTERSON

DRAWN | CHECKED | DES.SUPV. | RESP.ENGR. | CH.DISC.ENG. | PROJ. MGR. | MF

ES

ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 2-5
LOCATION OF
SOIL HEADSPACE POINTS

SCALE 1'' = 50'

ES'S DWG. NO. 720447-03000-2-6
REV A

2.7 SOILS INVESTIGATION PROGRAM

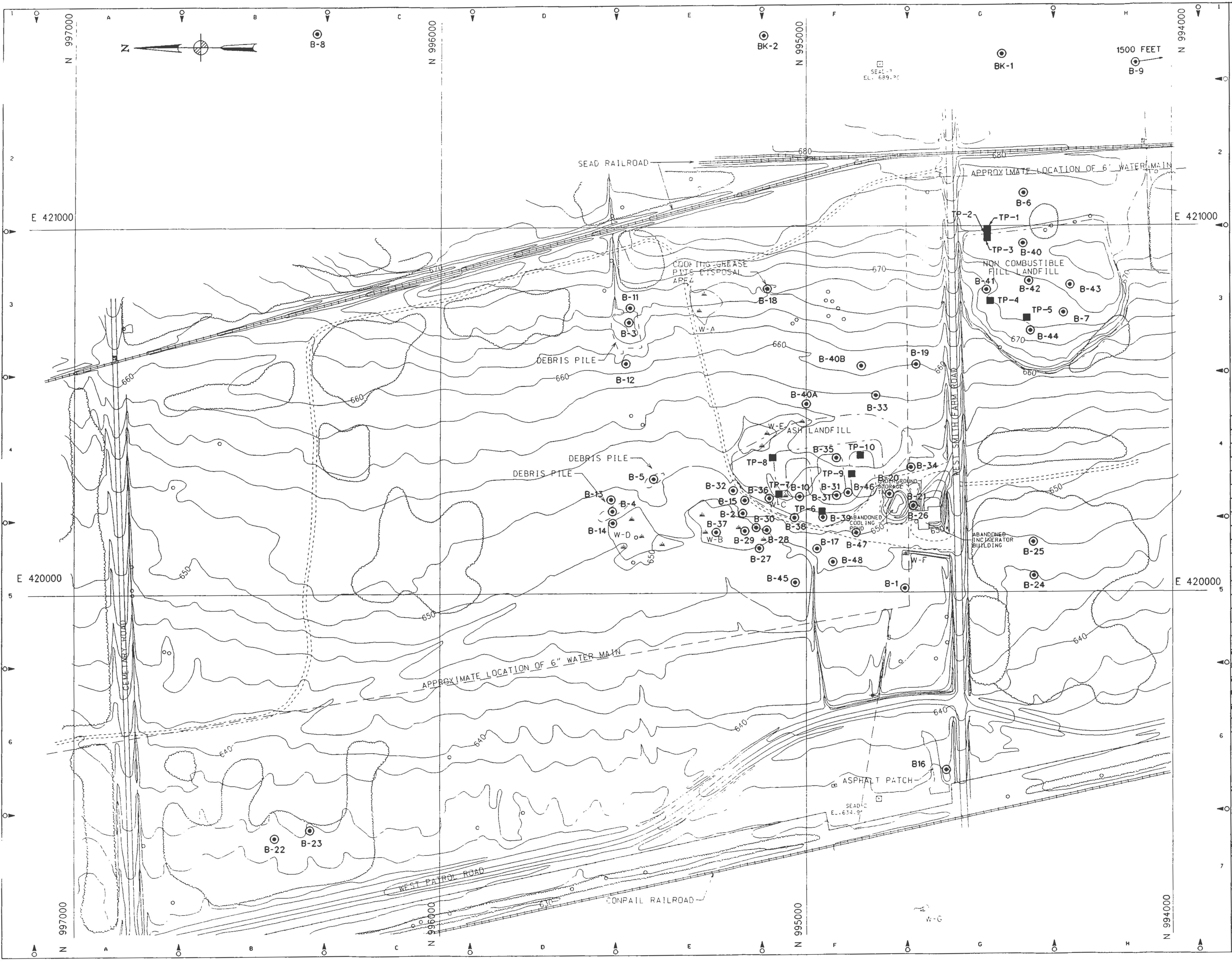
2.7.1 Introduction

In accordance with the pre-approved workplan, a comprehensive soils investigation program was completed at the Ash Landfill. The Phase I program consisted of 30 soil borings and 5 test pits. The Phase II program consisted of 18 soil borings and 10 test pits. The location of the various borings and test pits are shown on Figure 2-6. The individual boring logs and test pit logs are included within Appendix C and Appendix D respectively. The objective of the soil investigation programs was to determine the nature and concentrations of contaminants in the overburden soils and fill. Empire Soils Investigation, Inc. of Groton, New York performed the drilling and test pitting in Phase I. The Phase II drilling and test pitting were performed by American Auger and Ditching of Constancia, New York.

2.7.2 Soil Borings

During Phase I a total of 32 soil borings (B) were installed at the site (Figure 2-6). Sixteen (16) of these were installed in locations previously identified as possible source areas or for geographic coverage as designated in the workplan. These borings were performed in the following locations:

1. One within each of the three possible solvent dumps west of the former ash landfill (B1-91, B2-91 and B17-91);
2. One within each of the three debris piles north of the former ash landfill (B3-91, B4-91 and B5-91);
3. One within the cooking grease pit/disposal area in the northeastern portion of the former ash landfill (B18-91);
4. Two within the former construction debris disposal area southeast of the former ash landfill area (B6-91, B7-91);
5. One within the suspected burning pits in the southern portion of the former ash landfill area (B19-91);
6. One near the former cooling pond at the northeast corner of the former incinerator building (B20-91);



LEGEND:

PAVED ROAD
DIRT ROAD
GROUND CONTOUR AND ELEVATION
TREE
WETLAND & DESIGNATION
APPROXIMATE EXTENT OF FILL
OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
APPROXIMATE EXTENT OF DEBRIS PILE
BRUSH
CHAIN LINK FENCE
UTILITY POLE
APPROXIMATE LOCATION OF FIRE HYDRANT
FUEL OR UNDERGROUND STORAGE TANK
SURVEY MONUMENT
BORING & DESIGNATION
TEST PIT & DESIGNATION

REV	DATE	DESCRIPTION
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A.KAEUN
CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAEUN
RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER
MGR. OF ENGR. J.P.CHAPLICK
PROJECT MANAGER M.N.DUCHESNEAU
MGR. OF PROJECTS J.P.CHAPLICK
IN CHARGE W.D.PATTERSON

DRAWN | CHECKED | DES.SUPV. | RESP.ENGR. | CH.DISC.ENG. | PROJ. MGR. | MF

ES

ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO.

FIGURE 2-6
LOCATION OF SOIL BORINGS AND TEST PITS

SCALE 1" = 250'

ES'S DWG. NO. 720447-03000-2-4
REV B

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08-JUL-1994 15:53

7. One near of the underground diesel storage tank on the northeast side of the former incinerator building (B21-91, B26-91-follow-up boring in the same location samples from B-26-91 were analyzed for TPH only);
8. One at the approximate location of existing soil boring BH-29 to investigate further the diesel-like material reportedly encountered at this location (ICF), 1989) (B10-91);
9. One located south of existing soil boring SS-06 (B16-91) and,
10. Two background soil borings northeast and southeast of the site (B8-91 and B9-91). These two borings were located upgradient of the site with respect to both surface water flow and the groundwater flow. These borings were located in areas not subject to site activities.

The other 16 Phase I borings were installed in selected areas of the site based on the results of the geophysics and soil gas surveys (Figure 2-6). These borings were performed in the following locations:

1. Five near B2-91 at the bend in the unpaved road at the northern tip of the Ash Landfill (B15-91, B27-91 through B30-91);
2. Two near B3-91 (B11-91 and B12-91);
3. Two near B4-91 (B13-91 and B14-91);
4. One on geophysical line 4 (B22-91);
5. One on geophysical line 5 (B23-91);
6. Two along geophysical line 17 (B24-91 and B25-91);
7. One near the highest soil gas reading obtained in the Target (1989) soil gas survey (B31-91); and
8. Two additional borings (B40A-91 and B40B-91) were performed as potential, but abandoned, locations for monitoring well MW-40. These were abandoned because of a lack of water in the borehole.

Phase I soil borings were performed using an Acker F-800 drilling rig equipped with 4.25-inch I.D. hollow stem augers. All borings were advanced to refusal on compentent bedrock. During drilling, soil samples were collected continuously at 2-foot intervals using a decontaminated 2 or 1.5 foot split spoon sampler according to the method described in ASTM-D 1586-84. This technique involved driving a decontaminated split spoon sampler 2 feet into undisturbed soil with a rig-mounted 140 lb hammer. A larger diameter (3") 1.5' split spoon sampler was used to obtain a large amount of soil for duplicates and QC samples or when sample recoveries were low with a 2" spoon. Once the sample was collected the augers were advanced to the top of the next sample interval. Samples were collected until spoon refusal on competant shale was encountered. Borings logs are included in Appendix C.

During Phase I up to four soil samples were collected for level IV anlayses within each boring. Samples were collected from the surface (0-2'), at an intermediate zone (3-4'), from the top of the water table to one foot above the water table, and from the weathered shale zone at the interval from the competent shale unit to two feet above the competent shale unit, except where geologic or water table conditions prevented the collection of these samples (Table 2-3).

In Phase II, a total of eighteen soil borings were advanced at the Ash Landfill (Figure 2-6). These borings were performed in the following locations:

1. Five within the Non-Combustible Fill Landfill (B40, B41, B42, B43 and B44) based on Phase I soil gas results;
2. Nine at the "hot spot" near the "bend in the road" (B32, B35, B37, B38, B39, B45, B46, B47 and B48) based on Phase I soil and soil gas results and on Phase II soil headspace results;
3. Two associated with defining the southern and eastern extent of the Ash Landfill (B33, and B34); and
4. Two background borings (BK-1 and BK-2) performed east of the SEDA railroad. These borings are in the same general vicinity as the Phase I background borings (B8 and B9) and were selected using the same rationale.

Phase II soil borings were obtained using a Mobile B-9 drilling rig equipped with 4 1/4-inch I.D. hollow stem augers. All other sampling equipment and methods were the same as described for Phase I soil borings. Four samples for laboratory analysis were obtained from each Phase II soil boring using a split-spoon sampler. In each boring, discrete samples were collected from the surface [0 to 2 ft.- below land surface (bls)], at an intermediate zone (3 to 4 ft-bls), from the top of the water table to 1 ft above the water table, and from the weathered shale zone at the interval from the competent shale unit to 2 ft above the competent shale unit. In some instances geologic conditions prevented collection of all of the samples at each location.

All soil samples were screened for VOCs with an OVM 580B immediatley upon opening of the split spoon. Samples were also screened for radiation with a Dosimeter Mini Con Rad Detector. A designated downwind monitoring station was chosen for each boring location

TABLE 2 – 3

SOIL BORINGS AND SAMPLING SUMMARY
PHASES I & II

SENECA ARMY DEPOT
ASH LANDFILL

BORING	PHASE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE METHOD
B1–91	I	S1030–1	0–2'	GS
	I	S1030–2	2–4'	SS
	I	S1030–3	4–6'	SS
	I	No Recovery	6–8'	SS
B2–91	I	S1031–4	0–2'	GS
	I	S1031–5	2–4'	SS
	I	No Sample Taken	4–6'	–
	I	S1031–6	6–8'	SS
	I	S1031–7	8–10'	SS
B3–91	I	S1031–8	0–2'	GS
	I	S1031–9	2–4'	SS
	I	S1031–10	4–6'	SS
	I	S1031–11	6–8'	GS
B4–91	I	S1101–12	0–2'	GS
	I	S1101–13	2–4'	SS
	I	S1101–14	4–6'	SS
	I	No Recovery	6–8'	SS
B5–91	I	S1101–15	0–2'	SS
	I	S1101–16	2–4'	SS
	I	S1101–17	4–6'	SS
	I	No Sample Taken	6–8'	–
	I	S1101–18	8–10'	SS
B6–91	I	S1104–19	0–2'	SS
	I	S1104–20	2–4'	SS
B7–91	I	S1104–21	0–2'	GS
	I	S1104–22	2–4'	SS
	I	No Sample Taken	4–6'	–
	I	No Sample Taken	6–8'	–
	I	No Sample Taken	8–10'	–
	I	S1104–23	10–12'	SS
	I	No Recovery	12–14'	SS
B8–91	I	S1105–24	0–2'	GS
	I	S1105–25	2–4'	SS
	I	S1105–26*	2–4'	SS
	I	No Sample Taken	4–6'	–
	I	S1105–27	6–8'	SS
B9–91	I	S1105–28	0–2'	GS
	I	S1105–29	2–4'	SS
	I	No Sample Taken	4–6'	SS
	I	S1105–30	6–8'	SS
	I	No Sample Taken	8–10'	GS
	I	No Sample Taken	10–12'	SS
	I	No Sample Taken	12–14'	SS
	I	No Recovery	14–16'	SS
B10–91	I	S1106–31	0–2'	SS
	I	S1106–32	2–4'	SS
	I	S1106–33*	2–4'	SS
	I	No Sample Taken	4–6'	SS
	I	S1106–34	6–8'	SS
	I	No Recovery	8–10'	SS
B11–91	I	S1106–36	0–2'	GS
	I	S1106–37	2–4'	SS
	I	No Sample Taken	4–6'	SS
	I	S1106–38	6–8'	SS
B12–91	I	S1107–39	0–2'	GS
	I	S1107–40	2–4'	SS
	I	No Sample Taken	4–6'	SS
	I	S1107–41	6–8'	SS
B13–91	I	S1107–42	0–2'	GS
	I	S1107–43	2–4'	SS
	I	No Sample Taken	4–6'	SS
	I	S1107–44	6–8'	SS

TABLE 2 – 3

SOIL BORINGS AND SAMPLING SUMMARY
PHASES I & II

SENECA ARMY DEPOT
ASH LANDFILL

BORING	PHASE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE METHOD
B14–91	I	S1108–45	0–2'	GS
	I	S1108–46	2–4'	SS
	I	S1108–47*	2–4'	SS
	I	S1108–48	4–6'	SS
	I	No Recovery	6–8'	SS
B15–91	I	S1108–49	0–2'	GS
	I	S1108–50	2–4'	SS
	I	S1108–51*	2–4'	SS
	I	No Sample Taken	4–6'	SS
	I	S1108–52	6–8'	SS
	I	No Recovery	8–10'	SS
B16–91	I	S1112–53	0–2'	GS
	I	S1112–54	2–4'	SS
	I	No Sample Taken	4–6'	SS
	I	S1112–55	6–8'	SS
B17–91	I	S1113–56	0–2'	GS
	I	S1113–57	2–4'	SS
	I	S1113–58	4–6'	SS
	I	S1113–59	6–8'	SS
B18–91	I	S1113–60	0–2'	GS
	I	S1113–61	2–4'	SS
	I	S1113–62	4–6'	SS
B19–91	I	S1113–63	0–2'	GS
	I	S1113–64	2–4'	SS
	I	S1113–65	4–6'	SS
B20–91	I	S1114–66	0–2'	GS
	I	S1114–67	2–4'	SS
	I	S1114–68	4–6'	SS
	I	No Recovery	6–8'	SS
	I	No Recovery	8–10'	SS
B21–91	I	S1114–69	0–2'	GS
	I	S1114–70	2–4'	SS
	I	S1114–71*	2–4'	SS
	I	S1114–72	4–6'	SS
B22–91	I	S1202–73	0–2'	GS
	I	S1202–74	2–4'	SS
	I	S1202–75	2–4'	SS
B23–91	I	S1202–76	0–2'	GS
	I	S1202–77	2–4'	SS
	I	S1202–78	4–6'	SS
	I	No Recovery	6–8'	SS
B24–91	I	S1202–79	0–2'	GS
	I	S1202–80	2–4'	SS
	I	S1202–81	4–6'	SS
B25–91	I	S1203–82	0–2'	GS
	I	S1203–83	2–4'	SS
	I	S1203–84	4–6'	SS
B26–91	I	No Sample Taken	0–2'	GS
(TRPH analysis only)	I	S1203–85	2–4'	SS
B27–91	I	S1204–86^	0–2'	GS
	I	S1204–87^	2–4'	SS
B28–91	I	S1204–88^	0–2'	GS
	I	S1204–89	2–4'	SS
	I	S1204–89A*	2–4'	SS
	I	S1204–90^	4–6'	SS
B29–91	I	S1204–91	0–2'	GS
	I	S1204–91A*	0–2'	GS
	I	S1204–92	2–4'	SS
	I	S1204–93	4–6'	SS
	I	S1204–93A*	4–6'	SS

TABLE 2 – 3

SOIL BORINGS AND SAMPLING SUMMARY
PHASES I & II

SENECA ARMY DEPOT
ASH LANDFILL

BORING	PHASE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE METHOD
B30–91	I	S1204–94	0–2'	GS
	I	S1204–94A*	0–2'	GS
	I	S1204–95	2–4'	SS
	I	S1204–96	4–6'	SS
	I	S1204–96A*	4–6'	SS
B31–91	I	S1205–97	0–2'	GS
	I	S1205–97A*	0–2'	GS
	I	S1205–98^	2–4'	SS
	I	S1205–99	4–6'	SS
	I	S1205–100	6–8'	SS
B32	II	B32–1	0–2'	GS
	II	B32–2	2–4'	SS
	II	B32–3	4–6'	SS
	II	B32–4	6–7.9'	SS
B33	II	B33–1	0–2'	GS
	II	B33–2	2–3.5'	SS
B34	II	B34–1	0–2'	GS
	II	B34–2	2–2.75'	SS
B35	II	B35–1	0–2'	GS
	II	B35–2	2–4'	SS
	II	B35–3	4–6'	SS
B36	II	B36–1	0–2'	SS
	II	B36–2	2–4'	SS
	II	B36–3	4–6'	SS
	II	B36–4	6–7.9'	SS
	II	B36–6*	4–6'	SS
B37	II	B37–1	0–2'	SS
	II	B37–2^	2–4'	SS
	II	B37–3	4–5.5'	SS
	II	B37–6*	4–5.5'	SS
B38	II	B38–1	0–2'	SS
	II	B38–S^	2–4'	SS
	II	B38–3	4–6'	SS
	II	B38–4	6–8'	SS
	II	B38–6*	4–6'	SS
B39	II	B39–1	0–2'	GS
	II	B39–2	2–4'	SS
	II	B39–3	4–6'	SS
	II	B39–4	6–6.5'	SS
B40	II	B40–1	0–2'	GS
	II	B40–2	2–4'	SS
	II	B40–4	6–8'	SS
	II	B40–5	9.5–10.5'	SS
B41	II	B41–1	0–2'	GS
	II	B41–2	2–4'	SS
	II	B41–3	5.5–6.5'	SS
	II	B41–4	6.5–8.0'	SS
B42	II	B42–1	0–2'	SS
	II	B42–2	2–4'	SS
	II	B42–3	4–6'	SS
	II	B42–4	6–7.2'	SS
B43	II	B43–1	0–2'	SS
	II	B43–2	2–4'	SS
	II	B43–3	4–6'	SS
	II	B43–4	8–10'	SS
B44A	II	B44A–3	8–10'	SS
B44B	II	BB4B–1	0–2'	SS
	II	B44B–2	2–4'	SS
	II	B44B–3	8–10'	SS
	II	B44B–4	12–13.5'	SS

TABLE 2 – 3

SOIL BORINGS AND SAMPLING SUMMARY
PHASES I & II

SENECA ARMY DEPOT
ASH LANDFILL

BORING	PHASE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE METHOD
B45	II	B45–1	0–2'	SS
	II	B45–2 ^	2–4'	SS
	II	B45–3	4–6'	SS
	II	B45–6*	4–6'	SS
B46	II	B46–1	0–2'	SS
	II	B46–2	2–4'	SS
	II	B46–3	4–6'	SS
	II	B46–4	6–7.1'	SS
B47	II	B47–1	0–2'	SS
	II	B47–2	2–4'	SS
	II	B–47–3	4–5.3'	SS
B48	II	B48–1	0–2'	SS
	II	B48–2 ^	0–4'	SS
	II	B48–3	4–6'	SS
	II	B48–6*	4–6'	SS
BK1	II	BK1–1	0–2'	SS
BK2	II	BK2–2	0–2'	SS

NOTES:
1) SS = Split spoon
2) GS = Ground scrape
3) * = Lab Duplicate
4) ^ = Missouri River Division
5) No Sample Taken indicates that no sample was collected for laboratory analysis.
However, a sample was collected for stratigraphic information.

and monitored for volatile organics with an OVM and test and dust and particulates using a MIE Model PDM-3 Miniature Real-Time Aerosol meter (Miniram). A miniram was also positioned on or near the drilling rig. The OVM was programmed to register real time and maximum readings of volatile organics. These meters were checked before drilling and approximately every 15 minutes during drilling.

Upon completion of sampling during Phases I and II all borings were grouted to the surface and the soil brought to the surface by the augers was containerized in DOT-approved 55-gallon drums. When filled, the drums were transported to the temporary drum storage area immediately west of the abandoned cooling pond. The drilling rig, augers and split spoons were steam cleaned between borings at the decontamination pad using potable water from the Depot.

2.7.3 Test Pits (Geophysical Anomally Excavations)

Test pits (TP) were excavated in both Phases I and II of the investigation. During Phase I, test pits were excavated in locations where GPR characterization of EM-31 anomalies indicated a possible drum signature. A total of five excavations were performed along lines 16 and 17 on the Non-Combustible Fill Landfill (Figure 2-6). Excavations were performed at 374 feet, 1252 feet, 1432 and 1446 feet and 1482 feet along line 16 and at 1188 on line 17. Phase I test pits were excavated to up to five feet deep using a backhoe (Table 2-4). Upon completion all excavated material was returned to the pit and covered. Personnel conducting test pitting activities were outfitted in Level B equipment because of the possible presence of chlorinated volatile organic compounds detected in the soil gas investigation. Test pit logs are included in Appendix D.

During Phase II, a total of ten test pits were excavated (see Figure 2-6). Five test pits (TP-1 thru TP-5) were excavated at the Non-Combustible Fill Landfill in the same locations as the five test pits in Phase I to determine if the EM-31 and GPR anomalies were being caused by objects buried deeper than 5 feet below the ground surface, the maximum depth excavated to in Phase I. Test pits TP-6 thru TP-10 were excavated in locations where GPR characterization of EM-31 anomalies identified in the USATHAMA (1989) RI/FS indicate possible pipe or drum signature. Although a significant number of possible drain or pipe signatures were identified, only a representative number (5) were chosen to investigate using test pits. The locations were chosen by reviewing the possible drum or pipe signatures on the georadar profiles and identifying the five most representative signatures. There was also some

TABLE 2 – 4

CROSS–SECTIONAL SOIL SAMPLING OF GPR GEOPHYSICAL ANOMALIES

SENECA ARMY DEPOT
ASH LANDFILL

TEST PIT NUMBER	PHASE	TEST PIT DEPTH
TP–1	I	5'
TP–2	I	5'
TP–3	I	5'
TP–4	I	5'
TP–5	I	5'
TP–1	II	10'
TP–2	II	6.8'
TP–3	II	10'
TP–4	II	10'
TP–5	II	14.5'
TP–6	II	8'
TP–7	II	9'
TP–8	II	6.6'
TP–9	II	6'
TP–10	II	6'

Notes:
The geophysical anomaly excavations consisted of cross–sectional excavations at the location of the identified anomaly.

consideration given to geographic location in making these determinations. The locations of the additional (TP-6 thru TP-10) five test pits are shown on Figure 2-6 and an explanation of their coordinates relative to grid lines and reference points is given below (Exhibit: Radar

Survey Line Location, Seneca Army Depot, USATHAMA, 1989). Test pit TP-6 was excavated between grid nodes J5 and J6 100 feet east of the railroad spike and 368 feet north of the centerline of West Smith Farm Road. Test pit TP-7 was excavated between nodes K3 and K4; 150 east of the railroad spike and 485 feet north of the centerline of West Smith Farm Road. Test pit TP-8 was excavated at node M3, 250 feet east of the railroad spike and 400 feet north of the centerline of West Smith Farm Road. Test pit TP-9 was excavated between nodes L7 and L8, 200 feet east of the railroad spike and 285 feet north of the centerline of West Smith Farm Road. Lastly, test pit TP-10 was excavated between nodes M7 and M8, 250 feet east of the railroad spike and 260 feet north of the centerline of West Smith Farm Road.

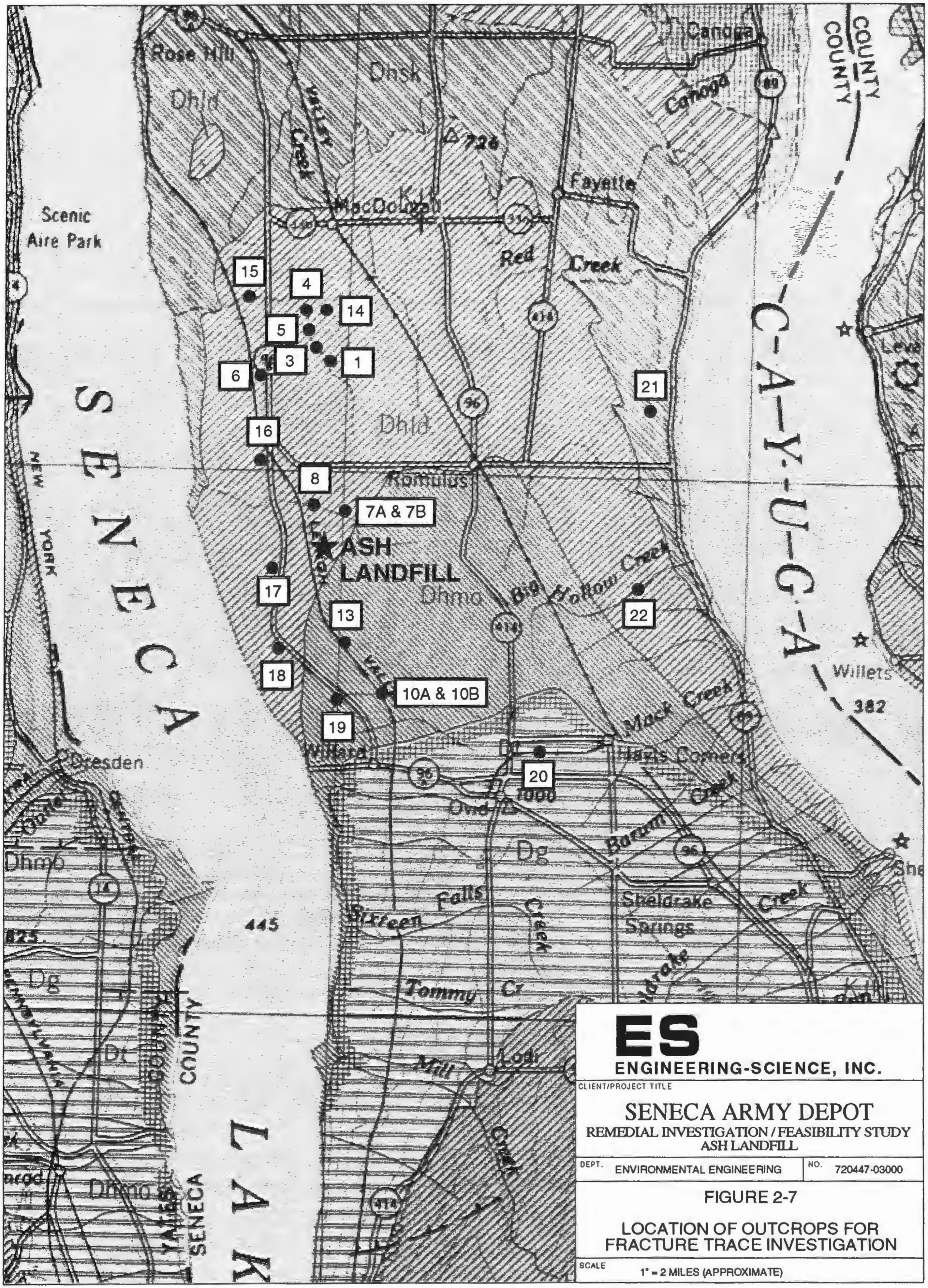
Phase II test pits were excavated to up to ten feet deep using a backhoe. Upon completion all excavated material was returned to the pit and covered. Personnel conducting test pitting activities were outfitted in Level B equipment because of the possible presence of chlorinated volatile organic compounds detected in the soil gas investigation. Test pit logs are included in Appendix D.

2.8 PHOTO LINEAMENT AND FRACTURE TRACE STUDY

A photo-lineament and fracture trace analysis was performed during the Phase II investigations to provide site specific information on the strike and dip of the fractures within the bedrock. The purpose of the photo-lineament and fracture trace analysis was to determine the direction and presence of bedrock fractures as they pertain to controlling groundwater flow direction. This reconnaissance technique was a precursor to bedrock well installation and provided the basis for locating one of the four well clusters. The photo-lineament analysis provided a visual observation, based upon linear fractures identified from multiple air-photo platforms, of the locations and orientation of suspected bedrock fractures. The fracture trace analysis provided ground-based verification of mapped photo-lineaments and the collection and analysis of fracture strike and dip data from geologic outcrops surrounding the site.

The photo-lineament analyses was conducted by identifying and measuring major liner features from a minimum of three air-photo platforms that cover the study area. The determination of the various platforms to use were based upon scale imagery, times of the year of photos, and angle of illumination. Stero pairs of air-photos were analyzed and the photo-lineaments were characterized by length and suspected strength of expression. On each platform linear features were characterized as strong, moderate, or subtle in expression. Upon completion of the photo interpretation the lineament data were digitized and overlaid on the site base map. The lineament data were analyzed and plotted in several forms including histograms and frequency diagrams. The data were filtered on the basis of lineament orientations and length. The lineament data from the different platforms were also analyzed to identify coincident lineaments. Lineaments that are identified on multiple platforms have the highest probability of being "real" and representing fracture trends within the bedrock that may control groundwater flow. The lineaments identified through this process were compared with documented regional structures, faults, and strike and dip data.

To study bedrock fractures, outcrops were identified within the study area using air photographs, topographic maps, existing bedrock geologic quadrangle maps and field investigations. The outcrop stations were selected based on their proximity to the site, quality of exposure, and geographic coverage. The locations of the outcrops used for the fracture trace analysis are shown in Figure 2-7. During the field investigation fracture orientations (strike and dip) were recorded at each outcrop location. In addition to orientation, the morphology, spacing, and length of each joint, fault or bedding plane was recorded. In order to delineate the most important fracture sets, the data were filtered on the basis of joint orientation, dip angle, size, roughness, and planarity. Filtered data were also plotted as poles or great circles (planes) on a steronet, in histogram form, and as a rose diagram. Rose diagrams are the most helpful aid in visualizing the orientation of fracture sets. Upon completion of the geologic field work a composite base map was developed that shows the above discussed lineament data, the outcrop locations, and a rose diagram of measured fracture orientations for each outcrop location. The superposition of these two data sets provided for a rapid evaluation of the lineament azimuth data with actual fracture trends measured in the field. These data were also compared with regional strike and dip data to identify potential preferential flow pathways for groundwater within the bedrock.



ES

ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE	
SENECA ARMY DEPOT REMEDIAL INVESTIGATION / FEASIBILITY STUDY ASH LANDFILL	
DEPT. ENVIRONMENTAL ENGINEERING	NO. 720447-03000
FIGURE 2-7 LOCATION OF OUTCROPS FOR FRACTURE TRACE INVESTIGATION	
SCALE 1" = 2 MILES (APPROXIMATE)	

2.9 GROUNDWATER INVESTIGATION

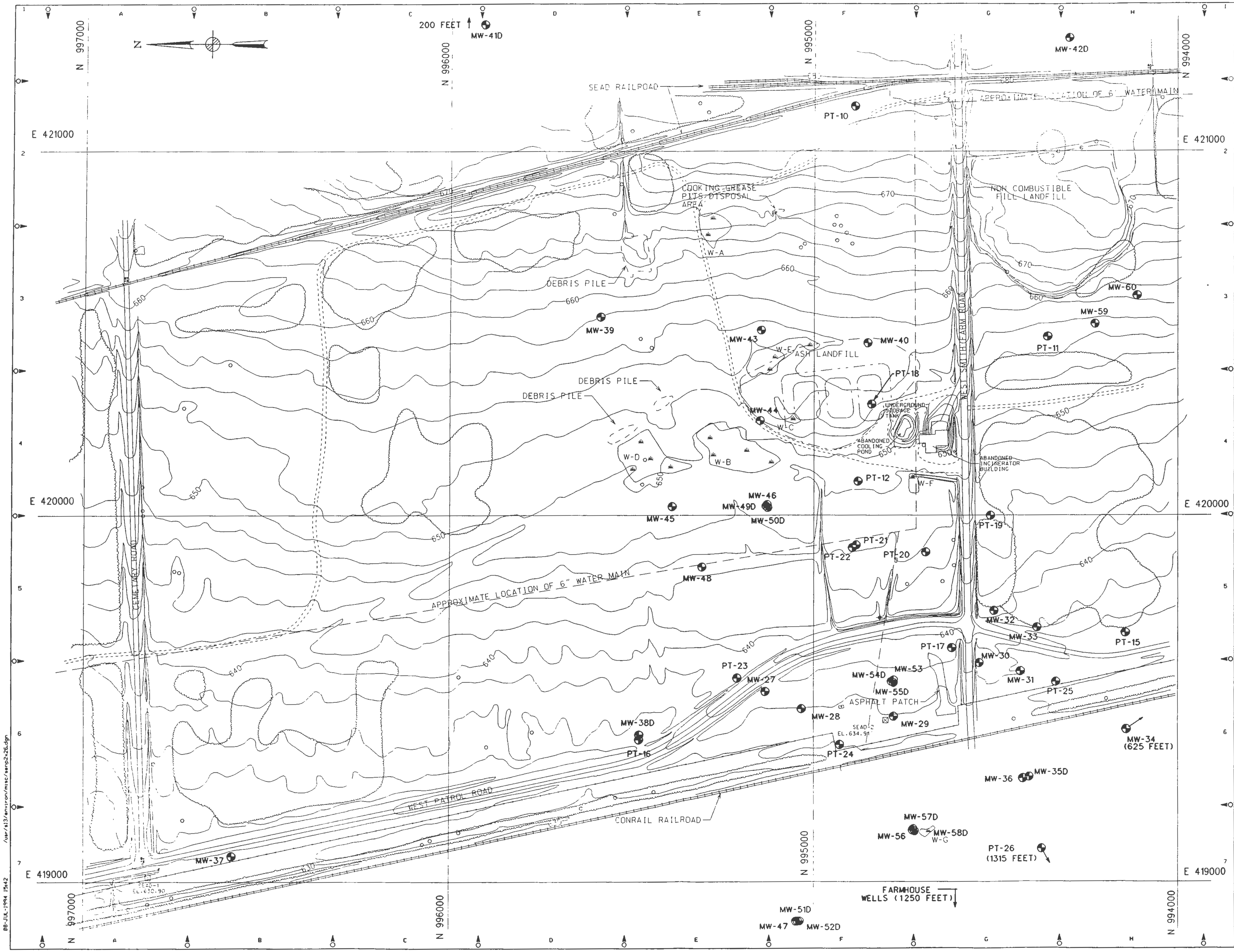
2.9.1 Introduction

The groundwater investigation program was designed to provide additional information on the concentrations and distributions of selected constituents in the shallow and deep aquifers. Two phases of monitoring well (MW) installation and aquifer testing were performed. In Phase I nine monitoring wells were installed; five shallow wells screened in the till/weathered shale aquifer and four deep wells screened in the competent shale aquifer (Figure 2-8). In Phase II sixteen monitoring wells were installed; eight shallow wells screened in the till/weathered shale, four shallow bedrock wells screened in the 0 to 20 foot zone of the competent shale and four deep bedrock wells screened in the 20 to 40 foot zone of the competent shale. In addition, all existing wells and wells installed during Phases I and II were sampled for water quality analyses. Physical characteristics of the till/weathered shale and competent shale aquifers and their general groundwater flow conditions were investigated through historical and current, measurements of depth to water, packer tests, slug tests and vertical connection tests.

2.9.2 Monitoring Well Installation

In Phase I shallow monitoring wells were located in upgradient and downgradient locations relative to areas of known impacts to groundwater to determine the extent of the impacts. Wells MW-34, MW-36, and MW-37 were installed along the western boundary of the site to monitor the downgradient and lateral extent of the known volatile organics plume (Figure 2-8). Two shallow wells (MW-39 and MW-40) were installed in upgradient locations to monitor the eastern extent of impacted groundwater. Four deep competent bedrock monitoring wells (MW-35D, MW-38D, MW-41D and MW-42D) were also installed in upgradient and downgradient locations on the site. Monitoring well construction details for all wells at the Ash Landfill are presented in Table 2-5.

The shallow wells were installed in borings drilled with an Acker F800 hollow stem auger rig using 4.25-inch hollow stem augers. The borings were advanced to auger refusal, which for the purposes of this investigation defines the contact between weathered shale and competent shale. During drilling, split spoon samples were collected continuously until spoon refusal using the method outlined in American Society for Testing and Materials (ASTM)-D 1580-84 to allow characterization of the geology at the well location. Monitoring wells were



LEGEND:

PAVED ROAD
DIRT ROAD
650 GROUND CONTOUR AND ELEVATION
○ TREE
W-E WETLAND & DESIGNATION
APPROXIMATE EXTENT OF FILL
OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
APPROXIMATE EXTENT OF DEBRIS PILE
BRUSH
CHAIN LINK FENCE
UTILITY POLE
APPROXIMATE LOCATION OF FIRE HYDRANT
FUEL OR UNDERGROUND STORAGE TANK
☒ SEAD-1 EL.630.90' SURVEY MONUMENT
PT-22 MW-37 MONITORING WELL AND DESIGNATION

REV	DATE	DESCRIPTION
B	10/93	PREDRAFT PHASE II RI/FS
A	7/26/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A.KAELIN
CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAELIN
RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER
MGR. OF ENGR. J.P.CHAPLICK
PROJECT MANAGER M.N.DUCHESNEAU
MGR. OF PROJECTS J.P.CHAPLICK
IN CHARGE W.D.PATTERSON

DRAWN CHECKED DES.SUPV. RESP.ENGR. CH.DISC.ENG. PROJ. MGR. MF

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO.

FIGURE 2-8
LOCATION OF
MONITORING WELLS

SCALE 1" = 250'
ES'S DWG. NO. 720447-03000-2-7
REV B

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TABLE 2 – 5

MONITORING WELL CONSTRUCTION DETAILS

SENECA ARMY DEPOT
ASH LANDFILL

Well Number	Well Type (T / WS = Till / Weathered Shale; S = Shale)	Depth of Well Relative to Ground Surface (ft)	Depth of Well Relative to Top of PVC (ft)	Diameter of Boring/Core (in)	Diameter of Well (in)	Well Screen Length (ft)	Screened Interval Relative to Ground Surface (ft)	Well Screen Slot Size (in)	Thickness of Bentonite Seal (ft)	Height of PVC Well Stickup (ft)	Elevation of Top of PVC Well (MSL) (ft)	Well Casing Material	Well Screen Material
1 PT–10	S	42.5	46.36	NA	2	NA	NA	NA	NA	3.80	681.60	PVC	PVC
2 PT–11	T / WS or S	15.7	19.55	NA	2	NA	NA	NA	NA	3.85	658.45	PVC	PVC
3 PT–12	T / WS	10.1	13.38	NA	2	NA	NA	NA	NA	3.25	652.15	PVC	PVC
4 PT–13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5 PT–14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6 PT–15	T / WS or S	15.4	19.50	NA	2	NA	NA	NA	NA	3.56	637.86	PVC	PVC
7 PT–16	T / WS	9.1	11.04	10.5	2	5.0	4.0 – 9.0	0.010	NA	1.85	637.65	PVC	PVC
8 PT–17	T / WS	9.8	11.65	10.5	2	5.0	4.0 – 9.0	0.010	NA	1.80	640.20	PVC	PVC
9 PT–18	T / WS	9.3	11.70	10.5	2	5.0	4.0 – 9.0	0.010	3.8	2.36	656.86	PVC	PVC
10 PT–19	T / WS	10.6	11.70	10.5	2	5.0	4.0 – 9.0	0.010	4.0	1.64	645.44	PVC	PVC
11 PT–20	T / WS	9.4	11.80	10.5	2	5.0	3.8–8.8	0.010	3.0	2.34	647.54	PVC	PVC
12 PT–21	T / WS or S	17.7	19.46	10.5	2	5.0	12.5–17.5	0.010	10.5	1.74	647.94	PVC	PVC
13 PT–22	T / WS	9.1	11.81	10.5	2	5.0	4.0–9.0	0.010	3.9	2.64	648.74	PVC	PVC
14 PT–23	T / WS	9.7	12.08	10.5	2	5.0	4.0–9.0	0.010	4.0	2.34	641.64	PVC	PVC
15 PT–24	T / WS	9.4	11.88	10.5	2	5.0	4.0–9.0	0.010	3.0	2.43	636.43	PVC	PVC
16 PT–25	T / WS	9.5	12.03	8.5	2	5.0	4.0–9.0	0.010	4.0	2.45	637.15	PVC	PVC
17 PT–26	T / WS	11.4	14.00	8.5	2	5.0	6.0–11.0	0.010	4.8	2.54	614.64	PVC	PVC
18 MW–27	T / WS	8.3	10.54	8.5	2	5.0	3.0–8.0	0.010	3.0	2.18	639.28	PVC	PVC
19 MW–28	T / WS	8.6	10.39	8.5	2	5.0	3.1–8.1	0.010	3.1	1.72	637.22	PVC	PVC
20 MW–29	T / WS	9.0	10.54	8.5	2	5.0	3.6–8.6	0.010	3.6	1.48	637.28	PVC	PVC
21 MW–30	T / WS	7.3	10.52	8.5	2	5.0	2.0–7.0	0.010	2.0	3.16	640.26	PVC	PVC
22 MW–31	T / WS	9.4	10.34	8.5	2	5.0	4.2–9.2	0.010	4.2	0.85	636.65	PVC	PVC
23 MW–32	T / WS	8.6	10.37	8.5	2	5.0	3.7–8.7	0.010	3.7	1.41	641.71	PVC	PVC
24 MW–33	T / WS	8.7	10.39	8.5	2	5.0	3.5–8.5	0.010	3.5	1.62	639.52	PVC	PVC
25 MW–34	T / WS	16.2	18.15	8.5	2	10.0	6.5–16.1	0.010	4.5	1.89	632.89	PVC	PVC
26 MW–35D	S	54.3	56.64	5.5	2	25.0	29.0–54.00	0.010	3.2	2.30	631.90	PVC	PVC
27 MW–36	T / WS	14.9	16.58	8.5	2	10.0	4.7–14.7	0.010	2.1	1.63	631.73	PVC	PVC

TABLE 2 – 5

MONITORING WELL CONSTRUCTION DETAILS

SENECA ARMY DEPOT
ASH LANDFILL

	Well Number	Well Type (T / WS = Till / Weathered Shale; S = Shale)	Depth of Well Relative to Ground Surface (ft)	Depth of Well Relative to Top of PVC (ft)	Diameter of Boring/Core (in)	Diameter of Well (in)	Well Screen Length (ft)	Screened Interval Relative to Ground Surface (ft)	Well Screen Slot Size (in)	Thickness of Bentonite Seal (ft)	Height of PVC Well Stickup (ft)	Elevation of Top of PVC Well (MSL) (ft)	Well Casing Material	Well Screen Material
28	MW–37	T / WS	11.7	13.62	8.5	2	5.0	6.7–11.7	0.010	3.0	1.89	632.89	PVC	PVC
29	MW–38D	S	29.7	32.24	5.5	2	20.0	9.7–29.7	0.010	1.8	2.53	637.93	PVC	PVC
30	MW–39	T / WS	9.9	11.89	8.5	2	5.0	4.54–9.54	0.010	3.8	1.96	659.76	PVC	PVC
31	MW–40	T / WS	12.3	14.71	8.5	2	7.0	5.2–12.2	0.010	3.2	2.32	659.32	PVC	PVC
32	MW–41D	S	44.6	47.02	5.5	2	30.0	14.5–44.5	0.010	2.7	2.42	694.02	PVC	PVC
33	MW–42D	S	45.0	47.38	5.5	2	20.0	24.7–44.7	0.010	2.9	2.34	683.04	PVC	PVC
34	MW–43	T / WS	5.5	7.47	8.5	2	2.0	2.9–4.9	0.010	1.4	2.13	657.73	PVC	PVC
35	MW–44	T / WS	8.7	10.78	8.5	2	4.0	3.3–7.3	0.010	1.0	1.85	653.85	PVC	PVC
36	MW–45	T / WS	6.2	8.34	8.5	2	4.0	2.0–6.0	0.010	0.5	2.30	650.90	PVC	PVC
37	MW–46	T / WS	9.0	11.45	8.5	2	5.0	3.5–8.5	0.010	0.5	2.31	650.41	PVC	PVC
38	MW–47	T / WS	5.8	8.56	8.5	2	1.5	3.5–5.0	0.010	1.3	2.76	628.06	PVC	PVC
39	MW–48	T / WS	9.0	11.50	8.5	2	5.0	3.5–8.5	0.010	0.5	2.32	648.32	PVC	PVC
40	MW–49D	S	35.2	37.54	3.75	2	19.0	15.5–34.5	0.010	4.5	2.30	650.50	PVC	PVC
41	MW–50D	S	57.8	59.66	3.75	2	19.4	37.8–57.2	0.010	36.0	1.88	649.88	PVC	PVC
42	MW–51D	S	33.2	36.87	3.75	2	19.0	13.3–32.3	0.010	5.5	2.64	628.24	PVC	PVC
43	MW–52D	S	56.7	59.36	3.75	2	19.4	36.7–56.07	0.010	35.0	1.05	626.35	PVC	PVC
44	MW–53	T / WS	7.9	10.35	8.5	2	4.0	4.0–7.8	0.010	1.0	2.41	639.41	PVC	PVC
45	MW–54D	S	32.6	34.99	3.75	2	19.0	13.3–32.3	0.010	5.0	2.21	639.11	PVC	PVC
46	MW–55D	S	55.9	58.18	3.75	2	19.4	35.9–55.3	0.010	33.0	2.36	639.16	PVC	PVC
47	MW–56	T / WS	4.2	6.88	8.5	2	2.0	2.2–3.7	0.010	1.1	2.61	630.51	PVC	PVC
48	MW–57D	S	33.0	35.09	3.75	2	19.0	13.3–32.3	0.010	5.0	1.82	629.82	PVC	PVC
49	MW–58D	S	55.3	57.29	3.75	2	19.4	35.29–54.65	0.010	33.3	1.99	629.69	PVC	PVC
50	MW–59	T / WS	8.5	9.1	8.5	2	4.0	3.4–7.35	0.010	1.0	1.79	656.83	PVC	PVC
51	MW–60	T / WS	8.5	9.5	8.5	2	4.0	3.4–7.35	0.010	1.0	2.88	660.15	PVC	PVC

Notes:

1. Wells PT–10 through PT–17 were installed by Parratt – Wolff, Inc. under the supervision of USAEHA.
2. Wells MW–13 and MW–14 were destroyed sometime prior to 1991.
3. Well types for PT–11, PT–15 and PT–21 are not certain.
4. Well types for wells PT–10 through PT–15 are derived from boring log information.
5. Wells MW–18 through MW–33 were installed under the supervision of USAEHA.
6. Well MW–34 through MW–42D, MW–59, and MW–60 were installed by Empire Soils Investigations, Inc. under the supervision of Engineering–Science, Inc.
7. Wells MW–43 through MW–49D, MW–51D, MW–53, MW–54D, MW–56, and MW–57D were installed by American Auger & Ditching Co., Inc.
8. Wells MW–50D, MW–52D, MW–55D, and MW–58D were installed by Maher Environmental.

constructed of 2-inch I.D. schedule 40 Polyvinyl Chloride (PVC) with a well screen slot size of 0.010. A sand pack was placed around and extended a few feet above the well screen above which a bentonite seal was placed. In some instances the bentonite extended to the surface as there was no vertical space available for a cement/bentonite grout. A 4" by 4" steel protective casing with a looking cap was installed at the surface and held in place with a 2' by 2' cement pad. The end of PVC riser was equipped with an expandable well cap. In addition all soil samples were screened with an OVM 580B for volatile organics and a Dosimeter Mini Con Rad Detector for radiation. The shallow monitoring well construction details are presented in Appendix F.

The deep wells were installed using an Acker drilling rig equipped with 6.25 inch hollow stem augers and 7-5/8-inch air rotary bit. The Phase I deep wells were double cased. At each well location 6-inch inner diameter PVC surface casing was set approximately 5 feet into the competent shale using hollow stem auger and air rotary techniques. The annular space between the casing and borehole was grouted and allowed to set a minimum of 48 hours before drilling was resumed. In all locations groundwater was encountered within 100 feet below the land surface, although during drilling it was very difficult to determine the exact location of the water table for setting the well screen. Weak zones noted during drilling were interpreted to be the locations of fractures, and thus avenues for groundwater movement; well screens were set to intersect these fracture zones. The monitoring wells were constructed in a similar manner to the shallow wells with the exception of the 6-inch PVC outer casing discussed above. In these deep wells there was adequate vertical space above the bentonite seal to place grout. At least 20 feet of well screen was installed and at least 20 feet competent bedrock was penetrated at each well location. The deep monitoring well construction details are provided in Appendix F.

In Phase II individual shallow till/weathered shale wells and monitoring well clusters (consisting of a till/weathered shale well, a shallow bedrock well and a deep bedrock well) were installed to fully define the horizontal and vertical extent of the plume of volatile organic compounds in the groundwater. At the well clusters, the depths of the two shallower wells were predetermined by the workplan and the depth of the third well was determined through constant head hydraulic conductivity testing. The clusters were installed in a triangular fashion with the shallow till/weathered shale well as the most upgradient and the two competent bedrock wells on the downgradient corners of the triangle to prevent any possible interference of the till/weathered shale well by the deeper competent shale wells. In total, 18 wells were installed during this phase, six individual till/weathered shale wells and four well clusters.

Four of the individual wells were installed within and near the "bend in the road" at the Ash Landfill. Well MW-44 was installed immediately west of the area that was determined to contain the highest concentration of volatile organic compounds using soil gas, soil headspace, and soil analyses.· This well is designed to monitor the highest concentrations of volatiles in groundwater on-site. Wells MW-43 and MW-45 were installed to the east and northwest of the Ash Landfill, respectively, to bound the plume of volatiles. MW-48 was installed immediately west of the 6-inch water main that traverses the site to investigate the possibility that volatile organics may have preferentially migrated north in coarse-grained fill along the water main. Two of the individual wells (MW-59 and MW-60) were installed downgradient of the Non-Combustible Fill Landfill to provide a total of three downgradient wells (with PT-11).

The well clusters were installed in downgradient locations relative to the Ash Landfill. Well clusters were purposely not installed in the source area to prevent any possible means for cross-contamination of aquifers. Three of the four well clusters [(MW-46, MW-49D and MW-50D), (MW-47, MW-51D and MW-52D), and (MW-56, MW-57D and MW-58D)] were located based on knowledge of the plume configuration after Phase I. A single well cluster (MW-53, MW-54D and MW-55D) was located using photolineament and fracture trace analysis described in Section 2.8.

Well cluster (MW-46, MW-49D and MW-50D) was installed approximately 250 feet west of MW-44 to monitor the horizontal and vertical extent of the plume downgradient from a source area. Well MW-46 was installed in the till/weathered shale aquifer. Well MW-49D was installed in 0 to 20 feet of the competent shale and MW-50D in 20-40 feet of the competent shale. Constant head packer testing in the 20- to 40 zone of the competent shale yield a hydraulic conductivity greater than 1.0 x 10^{-6} cm/sec (the lowest acceptable limit) and this the third well (MW-50D) was screened in this interval. Procedures for the packer testing are more thoroughly discussed in Section 2.9.5.1.and the results are discussed in Section 3.7.3.3.

Well clusters MW-47, MW-51D and MW-52D and MW-56, MW-57D and MW-58D were installed to define the eastern of extent of the volatiles plume. The former cluster is located along the western perimeter of a cultivated field approximately 500 feet from the Depot boundary and the latter at the southern end of the cultivated field approximately 250 feet west of the Depot boundary. At each of these two clusters one well (MW-47 and MW-56) was installed in the till/weathered shale and one was installed in the 0 to 20 foot zone of the competent shale (MW-51D and MW-57D). At the cluster at the southern end of the field the constant head packer test yielded a conductivity greater than 1.0×10^{-6} cm/sec for the 20 to 40-foot zone and so the well was set there. At the other cluster, no significant flows were measured in the 20-40 foot, 40-60 foot and 60-80 foot test zones in the competent shale during the constant head packer testing. Therefore, it was decided to grout up the corehole to 40 feet in the competent shale and set the well from 20-40 feet so that the analytical data from this location could be used as a basis of comparison among the other deep competent shale wells. Also if any volatiles had penetrated through the till/weathered shale-competent shale contact, they would first be detected in the upper portions of the shale aquifer.

The fourth well cluster (MW-53, MW-54D, and MW-55D) was installed at the downgradient end of the volatile plume approximately 140 feet west of West Patrol Road. This location of this cluster was chosen based on a photolineament and fracture trace results for the Ash Landfill specifically. The location is near the intersection of several linear trends that correspond to azimuths of fractures measured at local outcrops. Detailed procedures of the photolineament and fracture trace investigations are discussed in Section 2.8. Results for these investigations are discussed in Section 3.5.7. One well (MW-53 was installed in the till/weathered shale aquifer and another MW-54D was installed in the 0 to 20 foot zone of the competent shale. Again, results of the packer testing in the 20-40 foot zone yielded a conductivity greater than 1.0×10^{-6} cm/sec and the well (MW-55D) was set in this zone.

In Phase II, the shallow wells were installed in borings drilled with a Mobile B-9 drilling rig using 4.25-inch hollow stem augers. The borings were advanced to auger refusal. During drilling, split spoon samples were collected continuously until spoon refusal using the method outlined in ASTM-D 1580-84 to allow characterization of the geology at the well location. In addition all soil samples were screened with an OVM 580B for volatiles organics and a Dosimeter Mini Con Rad Detector for radiation. The shallow monitoring wells were constructed in a similar fashion to those installed during Phase I. Well construction details are presented in Appendix F.

The shallow bedrock wells were installed using Mobile B-9 drilling rig equipped with 6 1/4-inch hollow stem augers, a 5 7/8-inch roller bit, and HQ size coring equipment. The Phase II shallow bedrock wells were double cased. At each location a 4-inch steel casing was installed approximately 3-4 feet into the competent shale using hollow stem augers and a roller bit. The 4-inch steel casing was installed with a 2 foot bentonite seal at its base and the annular space between the 4-inch casing and the borehole was grouted to the surface and allowed to set for a minimum of 48 hours. Next, an HQ size coring bit and core barrel were used to advance the hole from 0 to 20 feet into competent shale. During coring potable demonstrated analyte-free water was pumped into the corehole to serve as a lubricant and also to remove the fine rock flour and shale chips from the hole. The water was recirculated into the hole after passing through a steel bath with several baffles to contain most of the rock flour and shale chips, preventing them from being reintroduced into the corehole. The monitoring wells were installed in the 0 to 20 foot zone using similar techniques to those described previously for Phase I bedrock wells.

The deep bedrock wells were installed using a Gus Peach Manufacturing Co. GP-660C all terrain vehicle drilling rig equipped with 8.25 inch hollow stem augers, 5-1/2-inch roller bit and HQ size rock coring equipment. The Phase II deep wells were triple cased. At each well location 6-inch inner diameter steel surface casing was set approximately 3-4 feet into the competent shale using hollow stem auger techniques. The 6-inch steel casing was installed with a 2-foot bentonite seal at its base and the annular space between the casing and borehole was grouted and allowed to set a minimum of 48 hours before drilling was resumed. Next, a 5 1/2-inch roller bit was used to penetrate the 0-20 foot zone of the competent shale, a zone already screened by the shallow deep bedrock wells previously described. A 4-inch steel casing was installed in this hole with a 2-foot bentonite seal at the base and the annular space between the 4-inch and 6-inch steel casings was grouted to the ground surface. The grout was allowed to set for 48 hours before the next drilling phase. The next phase of drilling involved a combination of rock coring and constant head packer testing in 20 feet intervals of shale. Each 20 foot interval below the 4-inch steel casing was cored in 5-foot intervals using an HQ size drill bit and core barrel. During coring the well was lubricated with water as previously described for the shallow bedrock wells. When the 20 foot interval had been cored the conductivity of the interval was determined using a constant head packer test. If the test showed the interval met the minimum acceptable conductivity, a well was installed at this depth. Details on the specific depths for the deep wells were previously discussed in this section.

All existing and shallow and deep monitoring wells installed during Phases I and II were provided with an expandable locking well cap, a locking steel protective casing and concrete pad. All water used in the drilling process for both Phases I and II was containerized in 55-

gallon drums. Following well installation the elevations of the well protective casing, PVC riser, and ground surface were surveyed. The existing wells were also re-surveyed for these data.

During drilling for Phases I and II a designated downwind monitoring station was chosen for each well location and monitored for volatile organics with an OVM and test and dust and particulates using a MIE Model PDM-3 Miniature Real-Time Aerosol meter (Miniram). A miniram was also positioned on or near the drilling rig. The OVM was programmed to register real time and maximum readings of volatile organics. These meters were checked before drilling and approximately every 15 minutes during drilling.

2.9.3 Monitoring Well Development

Subsequent to the well installations, each monitoring well was developed to insure that a proper hydraulic connection existed between the borehole and the surrounding aquifer. The well development details for the Phase I and II wells are summarized in Table 2-6. No information was available regarding the development of wells installed prior to this RI/FS investigation.

The collection of representative groundwater samples is partially dependent upon the turbidity of the sample. Guidance provided by NYSDEC indicates that a valid sample is considered to be one that has a turbidity of less than 50 Nephelometric Turbidity Units (NTUs). Turbidity was measured in the field with a Hach portable field turbidimeter with full scale ranges of 1.0, 10 and 100 NTUs. The procedure used to develop the Phase I wells consisted of surging the water in the borehole with a bailer to loosen fine-grained materials present within the well screen and surrounding sand pack. The turbid water was then removed from each well using a gasoline powered pump or bailer and stored on-site in 55 gallon drums for later disposal. The well development was continued until the turbidity of the water from each of the monitoring wells had stabilized or dropped below the 50 NTU value. As seen in Table 2-6, the turbidity of most samples did not drop below 100 NTUs during the well development. This was due to the clay rich, fine-grained nature of the till and weathered shale.

The development procedure was modified for the wells installed during Phase II to reduce the turbidity of the water in the wells. For development of these wells, only light surging with a bailer for a 2 to 5 minutes was performed and the water in the well was removed using a peristaltic pump at a rate of between 1.5 and 3 liters per minute. The light surging was performed to remove any silt and clay "skin" that may have formed on the borehole wall during drilling. The relatively low flow rate water removal was performed to develop the well and surrounding formation by removing some silt and clay, while not creating an influx of large amounts of silt and clay, which are major components of the till. Final turbidity values for these wells are shown in Table 2-6. Turbidity was measured in the field with a Engineered Systems Model 800 portable field analyzer with full scale ranges of 20 and 200 NTUs. A number of these wells were able to achieve turbidities of less than 50 NTUs.

2.9.4 Groundwater Sampling

All existing and monitoring wells installed during Phases I and II were sampled for this investigation. In total, four sampling events were performed at the Ash Landfill. Privately owned wells at the farmhouse on West Smith Farm Road were also sampled during three quarterly sampling events of the Ash Landfill. The monitoring wells were sampled to evaluate the presence and extent of organic chemical constituents present within the groundwater. The first round, which included 29 wells, was performed upon completion of the Phase I field work and data from this sampling was presented in the PSCR. The second round of sampling, which included 35 wells, was performed upon the completion of the Phase II field work. The third round (Phase IIA) which included 14 wells was conducted in November 1993. The fourth round (Phase IIB) was from wells PT-11, MW-59 and MW-60 was conducted in April 1994. Information for both Phases of sampling is presented in Table 2-7.

For Phase I groundwater sampling, the wells were purged of at least three well volumes using a decontaminated Teflon bailer until indicator parameters (pH, temperature and specific conductance) were observed to vary by less than 10 percent and the turbidity was less than 50 NTUs. While stabilization of indicator parameters was achieved, water samples with turbidities less than 50 NTUs were rarely obtained. If during the purging process the well went to near dryness, purging was stopped and the well was allowed to recover to 80 percent of the original water column before additional water was removed. If the well went to near dryness again, purging was stopped. Sampling occurred within three hours of purging for high yield wells. For low yield wells groundwater was removed from the well as available to fill the appropriate sample containers. Samples were collected using a decontaminated Teflon bailer. The samples were collected in the following order: volatiles, semivolatiles, pesticides and PCBs, explosives, metals, and cyanide. In Phase I, if the turbidity for a well was greater than 50 NTUs, both total and dissolved (filtered) metals were collected.

TABLE 2 – 6

MONITORING WELL DEVELOPMENT INFORMATION

SENECA ARMY DEPOT
ASH LANDFILL

MONITORING WELL	INSTALLATION DATE	DEVELOPMENT METHOD	INDICATORS				GALLONS REMOVED	BORING WELL VOLUMES REMOVED
			TEMPERATURE (°C)	pH (standard units)	CONDUCTIVITY (µmhos/cm)	TURBIDITY (NTUs)		
PT–10	NA	NA	NA	NA	NA	NA	NA	NA
PT–11	NA	NA	NA	NA	NA	NA	NA	NA
PT–12	NA	NA	NA	NA	NA	NA	NA	NA
PT–13	NA	NA	NA	NA	NA	NA	NA	NA
PT–14	NA	NA	NA	NA	NA	NA	NA	NA
PT–15	NA	NA	NA	NA	NA	NA	NA	NA
PT–16	NA	NA	NA	NA	NA	NA	NA	NA
PT–17	NA	NA	NA	NA	NA	NA	NA	NA
PT–18	NA	NA	NA	NA	NA	NA	NA	NA
PT–19	NA	NA	NA	NA	NA	NA	NA	NA
PT–20	NA	NA	NA	NA	NA	NA	NA	NA
PT–21	NA	NA	NA	NA	NA	NA	NA	NA
PT–22	NA	NA	NA	NA	NA	NA	NA	NA
PT–23	NA	NA	NA	NA	NA	NA	NA	NA
PT–24	NA	NA	NA	NA	NA	NA	NA	NA
PT–25	NA	NA	NA	NA	NA	NA	NA	NA
PT–26	NA	NA	NA	NA	NA	NA	NA	NA
MW–27	NA	NA	NA	NA	NA	NA	NA	NA
MW–28	NA	NA	NA	NA	NA	NA	NA	NA
MW–29	NA	NA	NA	NA	NA	NA	NA	NA
MW–30	NA	NA	NA	NA	NA	NA	NA	NA
MW–31	NA	NA	NA	NA	NA	NA	NA	NA
MW–32	NA	NA	NA	NA	NA	NA	NA	NA
MW–33	NA	NA	NA	NA	NA	NA	NA	NA
MW–34	10/24/91	Teflon Bailer	10.1 / 9.5	7.67 / 7.86	485 / 455	>100 / >100	80	5
MW–35D	11/5/91	Teflon Bailer	9.1 / 9.0	8.21 / 8.18	320 / 340	>100 / >100	35	5
MW–36	10/30/91	Teflon Bailer	–	7.81 / 7.72	455 / 500	>100 / >100	30	5
MW–37	10/25/91	Teflon Bailer	9.1 / 9.2	7.56 / 7.67	420 / 430	>100 / >100	85	5
MW–38D	11/6/91	Teflon Bailer	8.8 / 8.5	7.7 / 7.9	395 / 370	>100 / 65	110	5
MW–39	10/28/91	Teflon Bailer	6.5 / 8.2	7.67 / 7.5	320 / 490	>100 / 95	70	5
MW–40	10/28/91	Teflon Bailer	10.2 / 10.3	7.69 / 7.83	455 / 435	>100 / >100	60	5
MW–41D	11/6/91	Teflon Bailer	7.8 / 7.6	7.65 / 7.67	435 / 435	>100 / 90	50	5
MW–42D	11/7/91	Teflon Bailer	9.6 / 8.0	8.1 / 7.96	300 / 420	>100 / 15	50	5
MW–43	5/3/93	Surge & Pump	14.1 / 13.7 / 13.8	7.26 / 7.21 / 7.24	700 / 700 / 700	0.9	14	5
MW–44	5/3/93	Surge & Pump	13.7 / 13.0 / 13.0	7.26 / 7.26 / 6.83	1200 / 1200 / 1200	40	29.5	5

TABLE 2 – 6

MONITORING WELL DEVELOPMENT INFORMATION

SENECA ARMY DEPOT
ASH LANDFILL

MONITORING WELL	INSTALLATION DATE	DEVELOPMENT METHOD	INDICATORS				GALLONS REMOVED	BORING WELL VOLUMES REMOVED
			TEMPERATURE (°C)	pH (standard units)	CONDUCTIVITY (µmhos/cm)	TURBIDITY (NTUs)		
MW–45	5/4/93	Surge & Pump	13.2 / 13.5 / 13.1	7.12 / 7.82 / 7.09	650 / 610 / 640	NA	15.6	5
MW–46	5/5/93	Surge & Pump	11.5 / 11.3 / 11.2	7.0 / 7.45 / 7.48	610 / 620 / 610	60	26	5
MW–47	5/11/93	Surge & Pump	13.3 / 13.2 / 13.0	7.13 / 7.28 / 7.51	600 / 600 / 590	38	5	5
MW–48	5/4/93	Surge & Pump	11.8 / 11.7 / 11.6	7.66 / 7.50 / 7.16	580 / 580 / 580	3.8	27	5
MW–49D	5/5/93	Surge & Pump	10.2 / 9.6 / 9.5	7.56 / 7.63 / 7.76	575 / 575 / 575	1800	40.5	5
MW–50D	6/3/93	Surge & Pump	11.4 / 10.6 / 10.8	8.41 / 8.02 / 8.00	500 / 500 / 500	N/A	58.5	5
MW–51D	5/10/93	Surge & Pump	9.9 / 10.1 / 10.0	7.18 / 7.33 / 7.27	560 / 595 / 540	21	37.7	5
MW–52D	6/8/96	Surge & Pump	9.8 / 11.1 / 11.2	8.83 / 8.83 / 8.72	490 / 490 / 500	N/A	56	5
MW–53	5/6/93	Surge & Pump	11.4 / 12.3 / 12.1	7.10 / 7.09 / 7.29	650 / 640 / 650	50	21.8	5
MW–54D	5/6/93	Surge & Pump	10.6 / 10.5 / 10.8	7.79 / 8.18 / 7.87	530 / 510 / 550	80	36.0	5
MW–55D	5/12/93	Surge & Pump	11.4 / 11.7 / 11.6	8.68 / 9.0 / 8.70	550 / 500 / 500	760	53.25	5
MW–56	5/11/93	Surge & Pump	15.3 / 14.8 / 14.5	6.93 / 6.90 / 6.82	600 / 600 / 600	N/A	4.15	5
MW–57D	5/18/93	Surge & Pump	11.2 / 11.8 / 11.7	8.87 / 8.92 / 8.90	600 / 600 / 600	110	40	5
MW–58D	6/4/93	Surge & Pump	11.4 / 11.5 / 11.5	9.07 / 9.04 / 9.04	600 / 600 / 600	4200	56.25	5
MW–59	3/29/84	Surge & Pump	5.0 / 5.0 / 5.2	7.10 / 7.03 / 7.02	790 / 780 / 750	0.71	26.5	4
MW–60	3/20/94	Surge & Pump	5.2 / 6.0 / 6.0	7.20 / 7.28 / 7.24	320 / 320 / 300	2.91	27.5	4

TABLE 2 – 7

MONITORING WELL FIELD SAMPLING INFORMATION

SENECA ARMY DEPOT
ASH LANDFILL

MONITORING WELL	DATE	INDICATORS				GALLONS REMOVED (gal)	STANDING WATER VOLUME (gal)	WELL VOLUMES REMOVED
		TEMPERATURE (°C)	pH (standard units)	CONDUCTIVITY (µmhos/cm)	TURBIDITY (NTUs)			
PT–10	01/08/92	9.0 / 8.6	7.4 / 7.5	570 / 590	NA	20.00	6.73	2.97
PT–11	01/14/92	9.1	7.2	980	NA	2.50	2.56	0.98
PT–12	01/17/92	6.5	7.2	600	NA	7.20	1.40	5.14
PT–15	01/09/92	7.4	7.3	349	NA	7.50	2.53	2.96
PT–16	01/08/92	6.1 / 6.4	6.8 / 6.9	355 / 352	NA	5.0	1.39	3.60
PT–17	01/16/92	6.3 / 6.5	7.1 / 7.1	433 / 441	NA	16.30	1.27	12.83
PT–18	01/09/92	8.2 / 8.6	6.8 / 6.9	1230 / 1190	NA	7.50	1.00	7.50
PT–19	01/17/92	6.3 / 6.2	7.0 / 7.0	510 / 510	NA	10.20	1.36	7.50
PT–20	01/17/92	6.9 / 6.8	7.2 / 7.0	500 / 500	NA	13.5	1.14	11.84
PT–21	01/17/92	6.4	7.4	690	NA	12.00	2.34	5.13
PT–22	01/09/92	7.1 / 7.0	7.1 / 7.3	620 / 610	NA	8.50	1.18	7.20
PT–23	01/14/92	8.5	7.3	391	NA	1.70	1.32	1.29
PT–24	01/14/92	7.5 / 7.4	6.9 / 7.1	428 / 428	NA	4.50	1.26	3.57
PT–25	01/15/92	6.5 / 6.6	7.1 / 7.0	300 / 307	NA	4.00	1.35	2.96
PT–26	01/17/92	6.7 / 7.5	7.6 / 7.6	510 / 510	NA	5.00	1.73	2.89
MW–27	01/15/92	5.9	7.5	413	NA	1.50	35.00	0.04
MW–28	01/15/92	5.8 / 5.9	7.6 / 7.6	381 / 386	NA	5.00	0.94	5.32
MW–29	01/15/92	5.1 / 6.3	7.0 / 7.1	439 / 462	NA	2.00	0.66	3.03
MW–30	01/16/92	3.9 / 4.2	7.1 / 7.2	384 / 387	NA	12.30	1.10	11.18
MW–31	01/16/92	6.9 / 7.0	7.3 / 7.4	348 / 355	NA	7.00	1.26	5.56
MW–32	01/16/92	5.2 / 5.8	7.0 / 7.0	400 / 409	NA	11.5	1.05	10.95
MW–33	01/16/92	5.2 / 5.7	7.0 / 7.0	347 / 350	NA	12.30	1.10	11.18
MW–34	01/10/92	8.5 / 8.7 / 9.2	7.6 / 7.5 / 7.6	412 / 470 / 480	NA	34.70	2.57	13.50
MW–35D	01/14/92	8.8	8.5	409	NA	21.00	9.22	2.28
MW–36	01/14/92	7.3 / 7.7	7.0 / 7.1	490 / 496	NA	7.00	2.43	2.88
MW–37	01/10/92	7.3 / 7.3	6.7 / 6.8	420 / 428	NA	5.25	1.77	2.97
MW–38D	01/08/92	9.5 / 9.9	7.3 / 7.5	373 / 378	NA	15.00	4.90	3.06
MW–39	01/14/93	7.5 / 6.9	7.1 / 7.2	361 / 359	NA	5.00	1.71	2.92
MW–40	01/09/93	8.3 / 8.8	7.3 / 7.4	386 / 399	NA	7.00	1.92	3.65
MW–41D	01/13/93	9.8 / 10.2	7.2 / 7.4	490 / 460	NA	20.00	6.75	2.96
MW–42D	01/13/93	9.3	7.0	409	NA	16.00	7.60	2.11

TABLE 2 – 7

MONITORING WELL FIELD SAMPLING INFORMATION

SENECA ARMY DEPOT
ASH LANDFILL

MONITORING WELL	DATE	INDICATORS				GALLONS REMOVED (gal)	STANDING WATER VOLUME (gal)	WELL VOLUMES REMOVED
		TEMPERATURE (°C)	pH (standard units)	CONDUCTIVITY (µmhos/cm)	TURBIDITY (NTUs)			
PT–10	06/21/93	10.2 / 10.2 / 10.4	8.14 / 7.90 / 7.91	580 / 580 / 560	10.4	15.00	6.00	2.50
PT–11	07/09/93	11.9 / 12.6	7.31 / 7.17	800 / 800	102	2.40	1.86	1.29
PT–12	07/13/93	13.3	7.38 / 7.16	1520 / 1580	165	9.50	0.64	14.84
PT–15	06/22/93	11.4 / 11.2	7.98 / 7.81	380 / 390	1.3	3.25	1.76	1.85
PT–16	07/02/93	12.8 / 13.2 / 13.3	7.66 / 7.14 / 7.26	440 / 400 / 450	4.5	3.00	1.0	3.00
PT–17	07/11/93	13.4 / 12.9 / 13.0	7.15 / 7.26 / 7.32	550 / 540 / 530	4.1	1.80	0.57	3.16
PT–18	07/13/93	13.5 / 13.1 / 12.7	7.36 / 7.11 / 7.05	1100 / 1080 / 1100	8.4	1.80	0.60	3.00
PT–19	06/28/93	12.7 / 11.5 / 12.5	7.97 / 7.58 / 8.00	500 / 500 / 525	23	2.16	0.72	3.00
PT–20	07/10/93	13.0 / 12.5 / 12.2	6.92 / 7.17 / 7.14	660 / 650 / 675	70.5	1.38	0.5	3.00
PT–21	07/10/93	11.4 / 11.5	8.14 / 7.80	620 / 620	NA	5.40	1.80	3.00
PT–22	07/10/93	12.9	7.57	840	47.2	1.23	0.41	3.00
PT–23	06/22/93	11.8 / 10.9 / 10.9	7.69 / 7.52 / 7.54	440 / 435 / 430	NA	3.00	0.75	4.00
PT–24	07/09/93	13.3 / 13.9 / 13.7	7.53 / 7.70 / 7.54	510 / 500 / 500	12.8	3.00	1.00	3.00
PT–25	06/28/93	13.3 / 13.3 / 12.7	7.41 / 7.02 / 7.09	490 / 490 / 490	127	1.92	0.64	3.00
PT–26	07/01/93	11.5 / 11.4 / 11.1	8.13 / 7.84 / 7.70	520 / 520 / 523	1700	3.03	1.01	3.00
MW–27	06/29/93	13.4 / 12.7 / 13.0	7.66 / 7.18 / 7.20	590 / 600 / 600	NA	1.77	0.59	3.00
MW–28	07/09/93	13.8 / 14.4 / 14.3	7.59 / 7.32 / 7.52	500 / 490 / 500	76.2	2.10	0.70	3.00
MW–29	07/07/93	14.0 / 14.0 / 13.5	7.72 / 7.78 / 7.63	610 / 590 / 580	176	1.41	0.47	3.00
MW–30	06/29/93	14.4	7.81	600	NA	0.30	0.10	3.00
MW–31	06/29/93	13.2 / 13.0 / 12.7	6.9 / 6.97 / 6.94	550 / 500 / 500	191	1.50	0.50	3.00
MW–32	07/07/93	14.4	6.85	550	NA	0.75	0.3	3.00
MW–33	07/07/93	13.3 / 18.5	7.18 / 7.16	575 / 620	NA	0.42	0.14	3.00
MW–34	06/23/93	11.1 / 11.2 / 10.9	7.83 / 7.31 / 7.24	430 / 525 / 510	24.2	5.70	1.90	3.00
MW–35D	07/01/93	11.4 / 11.4 / 11.5	7.44 / 8.41 / 9.04	400 / 450 / 475	11.1	25.5	8.50	3.00
MW–36	07/01/93	11.2 / 12.0 / 12.7	7.49 / 7.49 / 7.45	520 / 525 / 525	42	5.82	1.94	3.00
MW–37	06/22/93	13.2 / 13.5 / 13.4	7.02 / 6.93 / 7.02	525 / 525 / 500	93	4.20	1.43	2.94
MW–38D	07/02/93	10.4 / 10.1 / 9.9	7.56 / 7.73 / 7.57	350 / 375 / 375	13.2	13.05	4.35	3.00
MW–39	06/21/93	10.8 / 11.2 / 11.3	7.75 / 7.63 / 7.61	420 / 430 / 440	2.0	4.20	1.40	3.00
MW–40	06/29/93	12.0 / 12.1 / 11.8	8.8 / 8.08 / 7.88	425 / 440 / 450	41	3.96	1.32	3.00
MW–41D	06/20/93	10.1 / 10.0 / 10.5	7.65 / 7.41 / 7.65	500 / 500 / 520	2.1	18.00	6.30	2.86
MW–42D	06/21/93	10.1 / 10.4	8.16 / 7.88	430 / 420	11.6	13.45	6.75	1.99

TABLE 2 – 7

MONITORING WELL FIELD SAMPLING INFORMATION

SENECA ARMY DEPOT
ASH LANDFILL

MONITORING WELL	DATE	INDICATORS				GALLONS REMOVED (gal)	STANDING WATER VOLUME (gal)	WELL VOLUMES REMOVED
		TEMPERATURE (°C)	pH (standard units)	CONDUCTIVITY (µmhos/cm)	TURBIDITY (NTUs)			
MW–43	06/28/93	15.7 / 15.6 / 15.1	7.6 / 7.31 / 7.30	625 / 625 / 625	1520	1.20	0.39	3.08
MW–44	07/14/93	15.8 / 16.9 / 16.5	7.12 / 6.93 / 6.87	1150 / 1150 / 1120	100	0.58	1.74	0.33
MW–45	07/14/93	18.4 / 17.4 / 16.7	7.42 / 7.2 / 7.15	550 / 500 / 540	54	1.05	0.35	3.00
MW–46	07/12/93	15.4 / 15.6 / 15.3/	7.10 / 7.20 / 7.11 /	620 / 620 / 620 / 600	1031	2.13	0.71	3.00
MW–47	07/08/93	16.7 / 16.0 / 15.8	7.40 / 7.31 / 7.33	510 / 500 / 490	192	0.90	0.30	3.00
MW–48	07/13/93	14.4 / 16.3 / 16.2	6.74 / 7.03 / 7.06	550 / 570 / 560	63	1.11	0.37	3.00
MW–49D	07/12/93	11.1 / 11.4 / 11.2	7.47 / 7.38 / 7.42	490 / 480	11	13.50	4.50	3.00
MW–50D	07/12/93	11.4 / 13.8	7.6 / 8.0	350 / 400	16.8	26.10	8.70	3.00
MW–51D	07/08/93	11.2 / 12.3 / 11.4	7.48 / 7.68 / 7.46	460 / 480 / 450	5.7	14.35	4.45	3.22
MW–52D	06/30/93	10.9 / 11.5	9.03 / 8.82	400 / 395	700	26.70	8.90	3.00
MW–53	07/11/93	15.7 / 14.3 / 13.9	7.20 / 7.32 / 7.34	650 / 620 / 600	40	0.72	0.24	3.00
MW–54D	07/11/93	11.0 / 11.4 / 11.2	8.54 / 8.08 / 8.06	430 / 430 / 390	17.6	12.60	4.20	3.00
MW–55D	07/14/93	12.0 / 12.2 / 13.0	8.73 / 9.13 / 8.71	400 / 400 / 420	23.1	7.70	150.00	0.05
MW–56	06/30/92	18.4 / 17.6 / 16.9	7.58 / 7.49 / 7.46	530 / 510 / 500	18800	1.50	0.50	3.00
MW–57D	06/30/93	11.2 / 11.6 / 11.6	8.90 / 8.80 / 9.50	425 / 420 / 425	790	14.52	4.84	3.00
MW–58D	07/08/93	12.4 / 11.8 / 12.0	9.34 / 9.29 / 9.28	480 / 490 / 480	103	25.32	8.44	3.00

TABLE 2 – 7

MONITORING WELL FIELD SAMPLING INFORMATION

SENECA ARMY DEPOT
ASH LANDFILL

MONITORING WELL	DATE	INDICATORS				GALLONS REMOVED (gal)	STANDING WATER VOLUME (gal)	WELL VOLUMES REMOVED
		TEMPERATURE (°C)	pH (standard units)	CONDUCTIVITY (μmhos/cm)	TURBIDITY (NTUs)			
MW–43	11/06/93	9.5/9.5/10.0	6.30/6.48/6.50	495/510/500	125	1.00	0.33	3.00
MW–45	11/06/93	10.5/10.5/11.0	6.70/6.60/6.80	470/480/485	31.4	1.20	0.39	3.00
MW–47	11/07/93	10.0/9.0	6.84/6.77	480/500	51.8	0.40	0.20	2.00
MW–48	11/05/93	12.5/12.5/13.0	6.50/6.98/6.95	510/500/500	753	2.50	0.83	3.00
MW–49D	11/06/93	10.0/10.0/10.0	7.02/6.82/6.82	400/425/420	21.7	14.25	4.75	3.00
MW–50D	11/06/93	10.0/9.5	7.29/7.26	350/355	11.0	14.00	8.50	1.65
MW–51D	11/07/93	11.0/11.5/12.0	6.92/6.72/6.76	440/480/470	10.6	14.40	4.80	3.00
MW–52D	11/07/93	10.0/11.0	7.56/7.60	425/490	410	11.10	8.60	1.29
MW–53	11/05/93	13.0/13.0	6.78/6.78	575/575	78.8	0.56	0.28	2.00
MW–54D	11/05/93	12.0/12.0/12.0	7.83/7.75/7.58	400/410/430	7.63	12.00	4.00	3.00
MW–55D	11/05/93	11.2/11.1/11.75	7.89/8.89/8.85	380/391/385	200	23.00	8.00	2.88
MW–56	11/07/93	11.0/11.0/11.5	6.83/6.97/6.83	440/450/450	44.8	1.50	0.50	3.00
MW–57D	11/07/93	9.5/10.0/10.0	8.45/8.40/8.42	460/430/430	359	10.60	5.2	3.00
MW–58D	11/07/93	9.5/10.0/10.0	8.69/8.90/8.80	430/430/430	> 1000	25.50	8.5	3.00
PT–11	04/18/94	7.0/7.5	7.37/7.40	610/630	34	2.50	2.45	1.02
MW–59	04/11/94	5.25/5.75/6.0	6.87/7.00/7.02	850/850/860	8.40	4.50	1.34	3.00
MW–60	04/11/94	5.5/5.8/5.7	7.38/7.35/7.34	370/355/352	2.20	4.20	1.4	3.00

Notes:
1) NA = Not Available

To lower the turbidity of the groundwater samples in Phase II the sampling procedure was modified. Because it was suspected that the high turbidities were due to the turbulent and silt-producing surge of the Teflon bailer, a low flow purging method was developed. The sampling order was also modified so that metals were collected earlier then in the Phase I program. Obtaining water samples for metals that are truly representative of the aquifer was a primary goal of the modified sampling procedure.

The modified groundwater sampling procedure used during Phase II (Phase IIA and Phase IIB) is described below. The wells were purged prior to sampling using a peristaltic pump with a dedicated Teflon tube that extended to the bottom of the well. The purging process began with the open-end of the tube at the bottom of the well screen (or at least 6 inches from the bottom of the well). The purging flow rate was between 1.5 and 2 liter per minute (L/min) and the water was purged into a graduated 5-gallon bucket. During the purging process the water level in the well was monitored with an electronic water level meter. After approximately one well volume was removed, the time, flow rate, depth to the bottom of the opening of the Teflon tube and the total volume of water removed was recorded on the sampling data sheet. Measurements of indicator parameters (temperature, specific conductance and pH) were also made this time. For wells which were not purged to near dryness after one well volume was removed, the Teflon tube was slowly raised to point between the top of the well screen and the water surface. After two well volumes had been removed the indicator parameters were measured and recorded. Purging of the well continued until three well volumes were removed. After purging the third well volume the indicator parameters were recorded for the last time. If required, additional temperature, specific conductance, and pH measurements were made until they stabilized (two successive measurements varied by less than 10 percent). Moving the location of the tube from the screened interval to a point near the top of the water surface during purging ensured the removal of any stagnant water from the well prior to sampling. After removal of three well volumes the well was allowed to sit for 2½ hours prior to sampling at which time the water level was measured in the well. If the well had recovered to 95 percent of the original static level, then sampling of the well was performed. If the 95 percent recovery was not achieved after 3 hours, then the recovery requirement for the well was reduced to 85 percent prior to sampling.

For wells that were very slow to recharge, purging of groundwater at the 1.5 to 2 L/min flowrate continued until the well was drained to near dryness (i.e., when the water level was at 1 foot above the bottom of the well). Again the purging process began with the open end of the Teflon tube at the bottom of the well screen or at least 6 inches from the bottom of the well. The time, flow rate, depth to the bottom of the open tube, and total volume of water removed after purging the well to near dryness were recorded. Temperature, specific conductance and pH were also recorded for these wells. At this time the well was considered to have been purged enough to ensure that the subsequent water samples collected from the well were representative of water from the aquifer. Once pumped to near dryness the well was allowed to recover to 85 percent of the original static level prior to sampling. If, however, the well did not recharge to 85 percent after six hours, the well was sampled anyway.

Prior to sampling the well, the depth to water was measured to verify that the water level met recovery requirement. Wells that did not meet the 95 percent recovery requirement after 3 hours were considered to be slow recharging wells and the recovery goal was reduced to 85 percent of the original static water level prior to sampling. If the well did not recharge to within 85 percent of the original static level after 6 hours, then the well was sampled as water was available for each parameter.

Prior to collecting the sample, the Teflon purging tube was removed from the well using a pair of latex gloves and placed into a clean plastic bag during sampling. To sample, the bailer was lowered into the well at a rate of 1/2-inch per second to minimize the disturbance of water and silt in the well. When the bailer was filled with water it was removed at a rate of 1/2-inch per second and the appropriate sample containers were filled. If during the sampling process the well was bailed to near dryness (i.e., two to three feet of water in the bottom of the well) sampling was stopped until the well recharged to 85 percent of the original static level. If it did not recharge to 85 percent after 6 hours, sampling was continued as water was available for each parameter. When sampling was complete, the dedicated Teflon tubing was returned to the well.

Monitoring wells at the Ash Landfill were sampled for the following parameters:

1. Target Compound List (TCL) for Volatile Organic Analytes (VOA by NYSDEC CLP)-Phase I only. For Phase II, wells in which volatile organic compounds were detected in Phase I were analyzed for TCL volatile organics by NYSDEC CLP methodology again in Phase II. Those wells in which no volatiles were detected in Phase I were analyzed by EPA Method 524.2 because of its lower detection limits; For Phase IIA, the wells which were analyzed in Phase II only, and had no volatiles

detected using the NYSDEC CLP VOA Method were analyzed using EPA 524.2. Phase IIB wells were also analyzed using EPA 524.2.

2. Target Compound List (TCL) for Acid, and Base/Neutral semivolatiles, Pesticides and Polychlorinated Biphenyls (AB/Ns, Pesticides and PCBs);
3. Target Analyte List (TAL) (Metals) for Phase I both total and dissolved metals samples were collected. In Phase II only total metals samples were collected; and
4. Method 8150 (Herbicides).

The sampling order for Phase II was as follows: 1) volatile organic compounds, 2) semivolatile organic compounds, 3) total metals (prepreserved), 4) herbicides, 5) pesticides and PCBs, and 6) cyanide. For Phase IIA, only volatile organic samples were collected. The results of the testing are discussed in detail in Section 4 of this report.

Three rounds of water level measurements were completed for monitoring wells PT-10 through MW-41D during Phase I. Two additional rounds were conducted for wells PT-10 through MW-58D for Phase II. The water level data have been used to determine the direction of groundwater flow within the till/weathered shale aquifer, and evaluate the relationship between the till/weathered shale and competent shale aquifers. These data are presented and discussed in detail in Section 3.

2.9.5 Aquifer Testing

2.9.5.1 Hydraulic Conductivity Testing Using Constant Head Packer Testing

The in-situ hydraulic conducitivity of the deep competent shale coreholes was determined using constant head packer testing. The testing was performed to evaluate the conductivity of the shale for the purposes of determining screen placement in the deep competent shale aquifer. Hydraulic conductivities determined in Phase I for competent shale wells ranged between 1.9×10^{-7} cm/sec and 4.7×10^{-5} cm/sec. For the purposes of this investigation an acceptable lower conductivity limit of 1.0×10^{-6} cm/sec for placing a well screen was chosen.

Prior to performing the packer testing, a 20-foot section interval of shale that had been cored was cleaned. The cleaning procedure involved flushing potable, demonstrated analyte-free water through the hole to remove all chips of shale and the rock flour that accumulated in the hole during coring. The flushing was performed until water discharging from the top of the well head was clear. This procedure was usually performed for about 20 to 30 minutes depending on how much rock flour and chips had accumulated in the corehole.

To perform the test a Bimbar 1 single inflatable packer and transducer were lowered into the corehole via a 1-inch I.D. steel pipe and set so that the bottom 20 feet was isolated from the open corehole above. The packer was connected via a packer air line to a regulated bottle of compressed air at the surface. Pressure tubing connected the transducer to a data logger at the surface where a direct reading of the pressure in the interval could be read. Both the packer inflation line and transducer line were taped to the 1-inch steel piping to prevent them from becoming snared during placement of the packer. The data logger was connected to a portable computer which ran the software.

A 500 gallon tank of potable, demonstrated analyte-free water was connected via a pump, regulator and flow meter to the 1-inch steel injection pipe that extended through the center of the packer into the interval to be tested. This equipment provided the ability to regulate and monitor the water being injected into the interval during the test. The water head above the test interval was determined using both the transducer and an electronic water level meter. This water head, in addition to other considerations, was used to determine the minimum inflation pressure applied to the packers for the test. Next the packers were inflated to determine the water head for the test interval. The packers were then deflated and water was flushed through the system to remove any entrapped air. When the system was flushed the packer was inflated to the pre-determined inflation pressure. Next the pressure within the enclosed system was monitored to verify that the seal between the packer and the corehole wall was adequate; it remained steady in all instances indicating a sealed system.

The test was performed by applying the selected pressures at the test interval and monitoring the flowrate and pressure in the test interval. A five step pressure test was performed at each interval consisting of three increasing steps to the maximum pressure and then two decreasing steps to the starting pressure. The cycling allows for a more detailed evaluation of the test results such that it is possible to determine at what pressures the following may occur 1) laminar flow, 2) turbulent flow, 3) dilation of fractures, 4) washouts, 5) void filling, or 6) hydraulic fracturing. During each test water was pumped into the test interval at the required pressure until the flow rate became stable; they usually stabilized within 5 minutes. Flow rates were maintained during three 5-minute intervals during which 30-second readings of flow were recorded. During the test small adjustments were made to the flow rate (i.e., injection pressure) to hold the downhole pressure in the test interval constant. The test was completed after the 5-cycles were performed. A Blue and White flow meter with a flow range between 0.010 and 0.25 gals/min was used to regulate and monitor the flow into the test zone. Generally, the flows were for the tests at the lower end of the flow range.

2.9.5.2 Hydraulic Conductivity Testing Using Rising Head Slug Tests

The in-situ hydraulic conductivity in the Phase I and Phase II monitoring wells was determined using rising head slug tests. The slug test parameters and related information are shown in Table 2-8. Several of the wells did not contain enough water to conduct the slug test namely MW-43, MW-44, MW-45, MW-46, MW-47 and MW-53. The rising head test requires the instantaneous removal of a specific volume from the well resulting in the lowering of the water table in the well. Subsequent to the removal of the volume, rising water levels are recorded for data reduction and used to calculate the hydraulic conductivity.

The slug test procedure used is described below. Prior to the beginning the test water level in the well was measured using an electronic water level meter. Then an In-Situ, Inc. model PTX-161 pressure transducer rated to 10 pounds per square inch (psi) was lowered into the well to an appropriate depth so that when the slug was lowered into the well it would not come in contact with the transducer. At least one foot was allowed between the bottom of the well and the transducer. Next, either a 3-foot or 5-foot long stainless steel slug with a 2.66-inch diameter was lowered into the well using clean nylon rope so that the top of the slug was just below the static water level previously measured in the well. The hollow stainless steel slug contained machined ends onto which stainless screw caps with o-ring gaskets fit. The slug was filled with potable water for the test. In some instances a thinner, solid 2-foot long slug had to be used for the slug test when the 5-foot slug became repeatedly snagged on the transducer cable, thereby disrupting the test. After the slug was lowered into the well, the water level in the well was allowed to equilibrate. Water levels were measured until they stabilized to within 0.01 feet for 5 minutes by monitoring the transducer. In most cases the stabilized water level at the end of the test was nearly equal to the original static water level.

After stabilization of the water level, the slug was removed and data logger was started simultaneously to begin the slug test. A 2-channel Hermit model 1000C data logger was used to record the slug test data. The data logger was configured for logarithmic data collection so that early changes in the water level were recorded. After 10 minutes of data collection

TABLE 2 - 8

DATA FOR SLUG TEST HYDRAULIC CONDUCTIVITY DETERMINATIONS

SENECA ARMY DEPOT
ASH LANDFILL

Well Number	Well Type ¹	Depth to Bottom of Aquifier		Well Point TOC (ft)	Screen Length (ft)	Static Water Level TOC (ft)	Static Height of Water Column (ft)	Initial Draw-down Relative to TOC (ft)	Displacement Relative to Static (ft)	Radius of Well Casing (ft)	Radius of Well Boring (ft)	Saturated Thickness of Aquifier (ft)	Screened Interval TOC (ft)	Slug Dimensions		Comments
		BGS (ft)	TOC (ft)											Length (ft)	Diameter (in)	
1 PT-10	S	375.0	375.0	46.36	NA	NA	NA	NA	NA	0.084	NA	NA	NA	NA	NA	No slug test was previously performed.
2 PT-11	T / WS or S	15.7	19.5	19.55	NA	NA	NA	NA	NA	0.084	NA	NA	NA	NA	NA	A slug test was previously performed.
3 PT-12	T / WS	13.0	16.2	13.38	NA	NA	NA	NA	NA	0.084	NA	NA	NA	NA	NA	A slug test was previously performed.
4 PT-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	The well no longer exists.
5 PT-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	The well no longer exists.
6 PT-15	S	15.4	19.5	19.50	NA	NA	NA	NA	NA	0.084	NA	NA	NA	NA	NA	A slug test was previously performed.
7 PT-16	T / WS	11.0	12.8	11.40	5.0	NA	NA	NA	NA	0.084	0.437	NA	5.85-10.85	NA	NA	No slug test was previously performed.
8 PT-17	T / WS	11.0	12.8	11.65	5.0	NA	NA	NA	NA	0.084	0.437	NA	5.80-10.80	NA	NA	No slug test was previously performed.
9 PT-18	T / WS	9.3	11.7	11.70	5.0	NA	NA	NA	NA	0.084	0.437	NA	6.36-11.36	NA	NA	No slug test was previously performed.
10 PT-19	T / WS	10.6	12.2	11.70	5.0	NA	NA	NA	NA	0.084	0.437	NA	5.64-10.64	NA	NA	No slug test was previously performed.
11 PT-20	T / WS	10.0	12.3	11.80	5.0	NA	NA	NA	NA	0.084	0.437	NA	6.14-11.14	NA	NA	No slug test was previously performed.
12 PT-21	S	17.7	19.4	19.46	5.0	NA	NA	NA	NA	0.084	0.437	NA	14.49-19.49	NA	NA	A slug test was previously performed.
13 PT-22	T / WS	9.1	11.7	11.81	5.0	NA	NA	NA	NA	0.084	0.437	NA	6.64-11.64	NA	NA	No slug test was previously performed.
14 PT-23	T / WS	10.5	12.8	12.08	5.0	NA	NA	NA	NA	0.084	0.437	NA	6.34-11.34	NA	NA	A slug test was previously performed.
15 PT-24	T / WS	10.0	12.4	11.88	5.0	NA	NA	NA	NA	0.084	0.437	NA	6.43-11.43	NA	NA	No slug test was previously performed.
16 PT-25	T / WS	10.0	12.4	12.03	5.0	NA	NA	NA	NA	0.084	0.354	NA	6.45-11.45	NA	NA	No slug test was previously performed.
17 PT-26	T / WS	12.0	14.5	14.00	5.0	NA	NA	NA	NA	0.084	0.354	NA	8.54-13.54	NA	NA	No slug test was previously performed.
18 MW-27	T / WS	8.3	10.5	10.54	5.0	NA	NA	NA	NA	0.084	0.354	NA	5.18-10.18	NA	NA	No slug test was previously performed.
19 MW-28	T / WS	8.6	10.3	10.39	5.0	NA	NA	NA	NA	0.084	0.354	NA	4.82-9.82	NA	NA	No slug test was previously performed.
20 MW-29	T / WS	9.0	10.5	10.54	5.0	NA	NA	NA	NA	0.084	0.354	NA	5.08-10.08	NA	NA	No slug test was previously performed.
21 MW-30	T / WS	7.3	10.5	10.52	5.0	NA	NA	NA	NA	0.084	0.354	NA	5.16-10.16	NA	NA	No slug test was previously performed.
22 MW-31	T / WS	9.4	10.3	10.34	5.0	NA	NA	NA	NA	0.084	0.354	NA	5.05-10.05	NA	NA	No slug test was previously performed.
23 MW-32	T / WS	9.0	10.4	10.37	5.0	NA	NA	NA	NA	0.084	0.354	NA	5.11-10.11	NA	NA	No slug test was previously performed.
24 MW-33	T / WS	8.7	10.3	10.39	5.0	NA	NA	NA	NA	0.084	0.354	NA	5.12-10.12	NA	NA	No slug test was previously performed.
25 MW-34	T / WS	16.5	18.3	18.15	10.0	3.92	12.28	5.78	1.865	0.084	0.354	12.43	8.39-18.39	5.38	1.66	A slug test was performed.
26 MW-35D	S	375.0	377.3	56.64	25.0	2.88	53.76	5.02	2.137	0.084	0.229	374.42	31.30-56.30	5.38	1.66	A slug test was performed.
27 MW-36	T / WS	14.8	16.5	16.58	10.0	2.82	13.76	4.91	2.094	0.084	0.354	13.76	6.33-16.33	5.38	1.66	A slug test was performed.

TABLE 2 - 8

DATA FOR SLUG TEST HYDRAULIC CONDUCTIVITY DETERMINATIONS

SENECA ARMY DEPOT
ASH LANDFILL

Well Number	Well Type ¹	Depth to Bottom of Aquifier		Well Point TOC (ft)	Screen Length (ft)	Static Water Level TOC (ft)	Static Height of Water Column (ft)	Initial Draw-down Relative to TOC (ft)	Displacement Relative to Static (ft)	Radius of Well Casing (ft)	Radius of Well Boring (ft)	Saturated Thickness of Aquifier (ft)	Screened Interval TOC (ft)	Slug Dimensions		Comments
		BGS (ft)	TOC (ft)											Length (ft)	Diameter (in)	
28 MW-37	T / WS	11.7	13.6	13.62	5.0	3.18	10.44	6.66	3.484	0.084	0.354	10.44	8.59 - 13.59	NA	NA	A slug test was performed.
29 MW-38D	S	375.0	377.5	32.24	20.0	4.02	28.22	7.57	3.555	0.084	0.229	373.51	12.23 - 32.23	NA	NA	A slug test was performed.
30 MW-39	T / WS	11.5	13.4	11.89	5.0	2.12	9.77	4.30	2.184	0.084	0.354	11.28	8.46 - 13.46	5.0	1.66	A slug test was performed.
31 MW-40	T / WS	12.2	14.7	14.71	7.0	4.15	8.15	6.08	1.931	0.084	0.354	8.15	7.52 - 14.52	5.0	1.66	A slug test was performed.
32 MW-41D	S	375.0	377.4	47.02	30.0	7.52	39.50	9.30	1.780	0.084	0.229	369.90	16.92 - 46.92	5.0	1.66	A slug test was performed.
33 MW-42D	S	375.0	377.3	47.38	20.0	3.58	43.80	6.83	3.254	0.084	0.229	373.76	27.04 - 47.04	2.86	1.66	A slug test was performed.
34 MW-43	T / WS	5.0	7.4	7.47	2.0	6.07	1.40	NA	NA	0.084	0.354	1.40	5.03 - 7.03	NA	NA	Not enough water to perform slug test.
35 MW-44	T / WS	8.0	10.7	10.78	4.0	7.26	3.52	NA	NA	0.084	0.354	3.52	5.15 - 9.15	NA	NA	Not enough water to perform slug test.
36 MW-45	T / WS	6.0	8.3	8.34	4.0	6.52	1.82	NA	NA	0.084	0.354	1.82	4.30 - 8.30	NA	NA	Not enough water to perform slug test.
37 MW-46	T / WS	9.0	11.4	11.45	5.0	7.57	3.88	NA	NA	0.084	0.354	3.88	5.81 - 10.81	NA	NA	Not enough water to perform slug test.
38 MW-47	T / WS	6.0	8.7	8.56	1.5	7.22	1.34	NA	NA	0.084	0.354	1.34	6.26 - 7.76	NA	NA	Not enough water to perform slug test.
39 MW-48	T / WS	9.0	11.5	11.50	5.0	7.06	4.44	10.31	3.257	0.084	0.354	4.44	5.82 - 10.82	2.86	1.66	A slug test was performed.
40 MW-49D	S	375.0	377.3	37.54	19.0	7.76	29.78	11.54	3.786	0.084	0.156	369.54	17.80 - 36.80	5.0	1.66	A slug test was performed.
41 MW-50D	S	375.0	376.8	59.66	19.4	8.18	51.48	12.57	4.390	0.084	0.156	368.87	39.68 - 59.08	5.0	1.66	A slug test was performed.
42 MW-51D	S	375.0	377.6	36.87	19.0	7.39	29.48	12.08	4.690	0.084	0.156	370.25	15.94 - 34.94	5.0	1.66	A slug test was performed.
43 MW-52D	S	375.0	376.05	59.36	19.4	8.25	51.11	12.60	4.349	0.084	0.156	367.87	37.75 - 57.15	5.0	1.66	A slug test was performed.
44 MW-53	T / WS	7.9	10.3	10.35	4.0	9.45	0.90	NA	NA	0.084	0.354	0.90	6.41 - 10.41	NA	NA	Not enough water to perform slug test.
45 MW-54D	S	375.0	377.21	34.99	19.0	9.07	25.92	11.33	2.261	0.084	0.156	368.14	15.51 - 34.51	5.0	1.66	A slug test was performed.
46 MW-55D	S	375.0	377.36	58.18	19.4	9.39	48.79	13.61	4.222	0.084	0.156	367.97	38.26 - 57.66	5.0	1.66	A slug test was performed.
47 MW-56	T / WS	4.2	6.8	6.88	1.5	4.88	2.00	NA	NA	0.084	0.354	2.00	4.81 - 6.31	NA	NA	Not enough water to perform slug test.
48 MW-57D	S	375.0	376.82	35.09	19.0	4.35	30.74	8.77	4.424	0.084	0.156	372.47	15.12 - 34.12	5.0	1.66	A slug test was performed.
49 MW-58D	S	375.0	376.99	57.29	19.4	4.26	53.03	7.93	3.618	0.084	0.156	372.73	37.28 - 56.68	5.0	1.66	A slug test was performed.
50 MW-59	T / WS	9.1	10.7	8.5	3.95	NA	NA	NA	NA	0.084	0.354	NA	3.4 - 7.35	NA	NA	No slug test performed.
51 MW-60	T / WS	9.1	10.1	8.5	3.95	NA	NA	NA	NA	0.084	0.354	NA	3.4 - 7.35	NA	NA	No slug test performed.

<u>Notes:</u>
1) ¹ S = Shale; T / WS = Till / Weathered Shale.
2) NA = Not Available.

the water level was monitored with the data logger to determine if it had stabilized. When the water level stabilized to within 0.02 feet over a 5-minute time period the test was stopped. The test data was downloaded to a portable computer in the field and reviewed to evaluate whether the data was acceptable.

The slug test information for each monitoring well was reduced using the procedure described by Bouwer and Rice (1976). Normalized recovery rates were plotted against time on a semi-logarithmic plot and the hydraulic conductivity was determined by the computer program AQTESOLV Version 1.1 Release 4. Prior to running the program the time and water level data were imported into an AQTESOLV data file. Next, input data required for analyzing the slug test were entered. The input data consisted of the following: 1) initial drawdown in test well; 2) internal radius of the test well casing; 3) effective radius of the test well; 4) saturated aquifer thickness under static conditions; 5) length of the test well screen; and 6) height of water column in test well under static conditions. The input data for the slug tests are included in Table 2-8. Once the data were plotted, the hydraulic conductivity was determined using the automatic estimating and interactive on-screen curve matching capabilities of the program to match the straight line portion of the drawdown (displacement) curve; the straight line portion is the valid part of the readings (Bouwer and Rice, 1976). The raw rising head slug test data as well as the results of the hydraulic conductivity determinations using AQTESOLV are included in Appendix G.

2.9.5.3 Vertical Connection Testing

To assess the degree of vertical connection between the shallow till/weathered shale aquifer and the deep competent shale aquifer, vertical connection tests were performed at two paired well locations (PT-18 and MW-38D, MW-36 and MW-35D) and four well clusters composed of three wells each (MW-46, MW-49D, MW-50D), (MW-47, MW-51D, MW-52D), (MW-53, MW-54D, MW55D), (MW-56, MW-57D, MW-58D). The tests were performed to determine if the contact between the till/weathered shale and competent shale could be considered a lower impermeable boundary for the shallow groundwater flow systems at the Ash Landfill. Such an impermeable boundary would be an important influence on the possible spread of volatiles and other constituents.

At well pairs one vertical connection test was performed by bailing water from the deeper of the two wells being tested and monitoring the resulting change in the water level in the shallower well. A transducer was lowered into the shallow well to monitor the water level changes. At well clusters two vertical connection tests were performed. One was performed by bailing water from the shallow competent shale well and measuring the change in the water level in the till/weathered shale well. The second test was performed by bailing the deep competent shale well and measuring the resulting water level change in both the till/weathered shale well and the shallow competent shale well. In this way, the degree of connection within the competent shale aquifer could also be assessed. For the latter test, a transducer was lowered into each of the two shallower wells and connected to a Hermit 1000c 2- channel data logger.

The method for preparing the data logger and transducer was similar to that used for the slug tests except a linear scale was programmed into the data logger, as a logarithmic scale was not necessary for this test. The transducer and cable were decontaminated between each test. All water bailed from the wells during these tests was containerized.

2.10 SURFACE WATER, SEDIMENT AND SPRING INVESTIGATION

2.10.1 Introduction

The objective of the surface water investigation at the Ash Landfill was to determine the nature and extent of impacts to the on-site and off-site surface waters. The results from the Phase I and II surface water and sediment sampling program were also used to determine the potential exposure levels for the risk assessment. In addition, potential spring locations were investigated during Phases I and II.

In accordance with the Ash Landfill workplan, seven locations were surveyed for the collection of surface water and sediment samples at the Ash Landfill for Phase I and six locations were surveyed for Phase II. Details on sample collection from these locations are given below. The sampling program for surface water and sediment is summarized in Tables 2-9 and 2-10, respectively. Sample locations are shown on Figures 2-9 and 12-11. The Phase I work was completed by ES during November and December 1991 and the Phase II work was completed during December and June 1992.

2.10.2 Chemical Sampling of Surface Water and Sediment

For Phase I, surface water and/or sediment samples were collected at three stations representative of wetlands and areas of standing water on or near the Ash Landfill site

(Figure 2-9). Two of these stations (SW-100 and SW-200) were to the north of the incinerator and the third (SW-600) was to the west, off Depot property in an area where a mound of soil was causing surface water to accumulate behind it. The area surrounding this location is an actively farmed hayfield with no evidence of seeps. In addition, four stations in drainage swales on and downgradient of the Ash Landfill site (SW-300, SW-400, SW-700, and SW-900) were sampled to provide an indication of the degree of surface transport of constituents from the Ash Landfill site. A fifth drainage swale station (SW-901) was established beyond the probable influence of contamination from the Ash Landfill site and served as a reference location. One station (SW-800) was also established in nearby Kendaia Creek, downstream of the confluence of a drainage swale that collects stormwater from the Ash Landfill site (Figure 2-11).

During Phase II, six additional surface water and/or sediment samples were collected from the wetlands in and around the Ash Landfill. Sediment samples were collected from wetlands W-A, W-B, W-C, W-D, W-E and W-F. Surface water samples were only collected from wetlands W-D and W-E only because of the dry conditions at the other locations. These samples were collected to determine if the Ash Landfill has had any impact on the nearby wetlands. Another station was established at an upstream reference area (SW-801) on Kendaia Creek where surface water and sediment samples were collected.

As a rule, surface water samples were collected first, however, if standing water was not present at the time of sampling, only sediment samples were collected. Surface water samples were collected on the site by directly filling the appropriate sample containers (Table 2-9). When the water depth was relatively shallow, sample containers were filled by bailing water into sample containers with a decontaminated glass beaker. Demonstrated anlayte-free water was used for decontamination of sampling equipment. Preservation of samples, if required, was performed after the samples were collected. Temperature, conductivity and pH of surface water, when present, were measured directly in the field with calibrated meters. Temperature and pH were measured with an Orion pH meter, Model 230A, and conductivity was measured with a YSI Model 33 conductivity meter. Sediment samples were collected by scooping sediment into a decontaminated stainless steel bowl with a decontaminated trowel (Table 2-10). VOA samples were taken first, prior to any mixing of the sediments. Then, the bowl was refilled with additional sediment, if required, thoroughly mixed and the appropriate sample containers filled with sediment. Samples were then placed in coolers containing refrigerants.

TABLE 2-9

SURFACE WATER SAMPLING SUMMARY
PHASES I & II

SENECA ARMY DEPOT
ASH LANDFILL

SURFACE WATER SAMPLE LOCATION	PHASE	MATRIX	SAMPLE NUMBER	SAMPLE DEPTH
SW – 100	I	WATER	W1012–119	4"
SW – 100	I	WATER	W1012–119M ^	4"
SW – 300	I	WATER	W1511–79	1/2"
SW – 400	I	WATER	W1511–80	1"
SW – 800	I	WATER	W1611–83	6"
SW – 800	I	WATER	W1911–83A	6"
SW – 800	I	WATER	W1911–84A*	6"
SW – 801	II	WATER	SW – 801	6"
SW – 901	I	WATER	W1511–76	2"
SW–WA	II	DRY	–	–
SW–WB	II	DRY	–	–
SW–WC	II	DRY	–	–
SW–WD	II	WATER	SW–WD* ^	0–6"
SW–WE	II	WATER	SW–WDE	0–6"
SW–WF	II	DRY	–	–

Notes:

1) Sample numbers contain a "W" for water, the day and month (i.e., 1211), followed by a number which is characteristic to each sample.
2) Sample numbers for Phase II samples are simply the sample location with a surface water identifier (SW).
3) All samples were analyzed for the following: pH, temperature, conductivity (field), volatile organics, semivolatile organics, pesticides/PCBs, metals, and cyanide (laboratory), herbicides.
4) * = lab duplicate
5) ^ = Missouri River Division

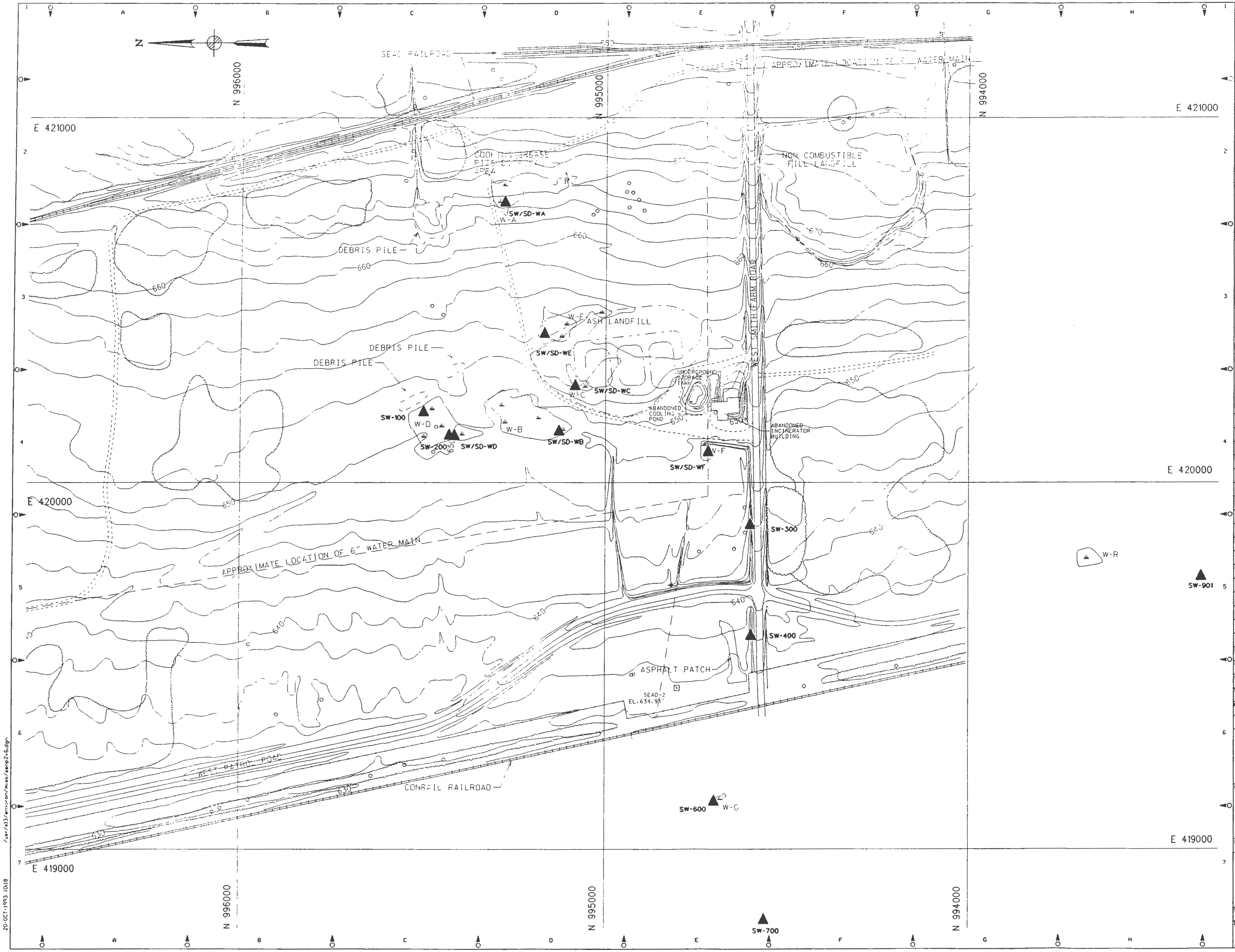
TABLE 2-10

SEDIMENT SAMPLING SUMMARY
PHASES I & II

SENECA ARMY DEPOT
ASH LANDFILL

SAMPLE LOCATION	PHASE	MATRIX	SAMPLE NUMBER	SAMPLE DEPTH
SW – 100	I	SEDIMENT	S1511–78	3"
SW – 100	I	SEDIMENT	S1012–119	4"
SW – 100	I	SEDIMENT	S1012–119M^	4"
SW – 200	I	SEDIMENT	S1511–77	3"
SW – 300	I	SEDIMENT	S1511–79	3"
SW – 400	I	SEDIMENT	S1511–80	3"
SW – 600	I	SEDIMENT	S1611–85	1"
SW – 600	I	SEDIMENT	S1611–86	1"
SW – 700	I	SEDIMENT	S2011–88	1"
SW – 800	I	SEDIMENT	S1611–83	6"
SW – 800	I	SEDIMENT	S1611–84*	6"
SW – 801	II	SEDIMENT	SW – 801	6"
SW – 900	I	SEDIMENT	S2011–87	1"
SD–WA	II	SEDIMENT	SD–WA	6"
SD–WB	II	SEDIMENT	SD–WB	6"
SD–WC	II	SEDIMENT	SD–WC	6"
SD–WD	II	SEDIMENT	SD–WD*^	6"
SD–WE	II	SEDIMENT	SD–WE	6"
SD–WF	II	SEDIMENT	SD–WF	6"

Notes:
1) Sample numbers contain an "S" for sediment, the day and month (i.e., 1211), followed by a number which is characteristic to each sample.
2) For Phase II samples, the sample number contains the sample location with a sediment identifier (SD).
3) All samples were chemically analyzed for the following: volatile organics, semivolatile organics, pesticides/PCBs, heavy metals, and herbicides.
4) * = lab duplicate
5) ^ = Missouri River Division



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20-OCT-1993 10:18

LEGEND:

- PAVED ROAD
- DIRT ROAD
- GROUND CONTOUR AND ELEVATION (650)
- TREE
- WETLAND & DESIGNATION (W-B)
- APPROXIMATE EXTENT OF FILL
- OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
- APPROXIMATE EXTENT OF DEBRIS PILE
- BRUSH
- CHAIN LINK FENCE
- UTILITY POLE
- APPROXIMATE LOCATION OF FIRE HYDRANT
- FUEL OR UNDERGROUND STORAGE TANK
- SURVEY MONUMENT (SEAD-1 EL.630.90')
- LOCATION OF SURFACE WATER AND SEDIMENT SAMPLE AND DESIGNATION (SW-100, SW/SD-WA)

NOTES:

1. FOR SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS OUTSIDE OF THIS SITE PLAN SEE FIGURE 2-2.

REV	DATE	DESCRIPTION
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A.KAELIN	CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAELIN	RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER	MGR. OF ENGR. J.P.CHAPLICK
PROJECT MANAGER M.N.DUCHESNEAU	
MGR. OF PROJECTS J.P.CHAPLICK	
IN CHARGE W.D.PATTERSON	

DRAWN | CHECKED | DES.SUPV. | RESP.ENGR. | CH.DISC.ENG. | PROJ. MGR. | MF

ES

ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY

ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING

NO. 720447-03000

FIGURE 2-9
LOCATION OF
SURFACE WATER AND
SEDIMENT SAMPLES

SCALE 1" = 250'

ES'S DWG. NO. 720447-03000-2-3

REV B

Stream velocity in Kendaia Creek was measured by clamping the sensor of a Marsh McBirney flowmeter onto a calibrated rod, positioning it so that it was measuring the velocity at approximately 60 percent of the water column depth (e.g., if the stream was one foot deep, velocity would be measured 0.6 feet from the bottom) and recording the value to the nearest hundredth of a foot per second. Velocity measurements were typically taken at 0.2 to 0.4 ft. intervals across the stream, using a transect measuring tape clamped to a heading and tailpin for reference. Distance between measurements was smaller (0.2 ft.) at higher velocity points in the stream. These measurements enabled the stream discharge to be calculated.

2.10.3 Spring Survey

During Phase I, a survey to identify the presence of springs within a one mile radius of the Ash Landfill site was performed by reviewing available mapping and field checking suspected spring locations. Map bases reviewed include 1 inch = 2000 feet USGS topographic maps (Dresden and Ovid quadrangles), Soil Conservation Service mapping for Seneca County (SCS 1972) and a 1 inch = 1200 feet topographic map of the site and surrounding area (5 foot contour interval) prepared by another consultant (Figure 1.1-2, ESE 1991). Potential spring locations were identified as areas near the headwaters of perennial streams, upgradient locations along defined channels (breaks in topography) and "seeps" identified during previous evaluations of this site. Locations of potential springs were marked on a map and investigated in the field. During Phase II, the potential spring locations were visited to determine if surface water was available for sampling and chemical analysis.

2.11 INCINERATOR DUST WIPE SAMPLING PROGRAM

During Phase I, dust was sampled from two furnaces within the Ash Landfill incinerator building (2207) using the cotton swab technique as specified by EPA Region II. The samples were collected from walls and ledges within two refractory-lined chambers in the building as these areas have a high likelihood of containing the parameters of interest and they were also accessible by the sampling team. Sample DW1206-1 was collected from the northernmost furnace and sample DW1206-2 was collected from a furnace located approximately 30 feet to the south. Moistened cotton swabs prepared according to the standard operating procedure developed by EPA Region II for taking dust wipe samples and contained in the appropriate sample jars were used. The prepared swabs for heavy metals were retrieved from the sample container, wiped over a one square foot wall and ledge surface using latex gloves and immediately replaced in the sample container. The swabs for acid/base neutral compounds, pesticides, and PCBs were treated in a similar fashion except these were wiped over a two foot square foot surface. All swabs were noticeably covered with dust and dirt after sample collection.

2.12 ECOLOGICAL INVESTIGATION

2.12.1 Introduction

An important component in establishing the environmental risk associated with a hazardous waste site is to identify the potential impacts to the on-site and off-site aquatic and terrestrial communities. The overall objective of this program was to characterize the existing aquatic and terrestrial biotic environment on and near the Ash Landfill Site.

The aquatic biotic assessment focused on Kendaia Creek, which is the only perennial body of water situated near the Ash Landfill Site. It lies 2,500 feet north of Cemetary Road. The measurement endpoints of the aquatic assessment are primarily community oriented and include determining the species composition, relative abundance, species richness and guild (food web) structure of the benthic macroinvertebrates and fish that are found in the creek. At an individual level, any suspected overt symptomology, such as tumors or other abnormalities, that could indicate adverse effects of contaminants were also quantified. These measurement endpoints enabled the derivation of the Phase I assessment endpoints used to identify potential aquatic receptors, exposure pathways, and characterize the existing aquatic community. Judgements regarding Kendaia Creek's value as a sport or recreational resource were made and potential interactions with downstream aquatic communities or terrestrial communities were identified.

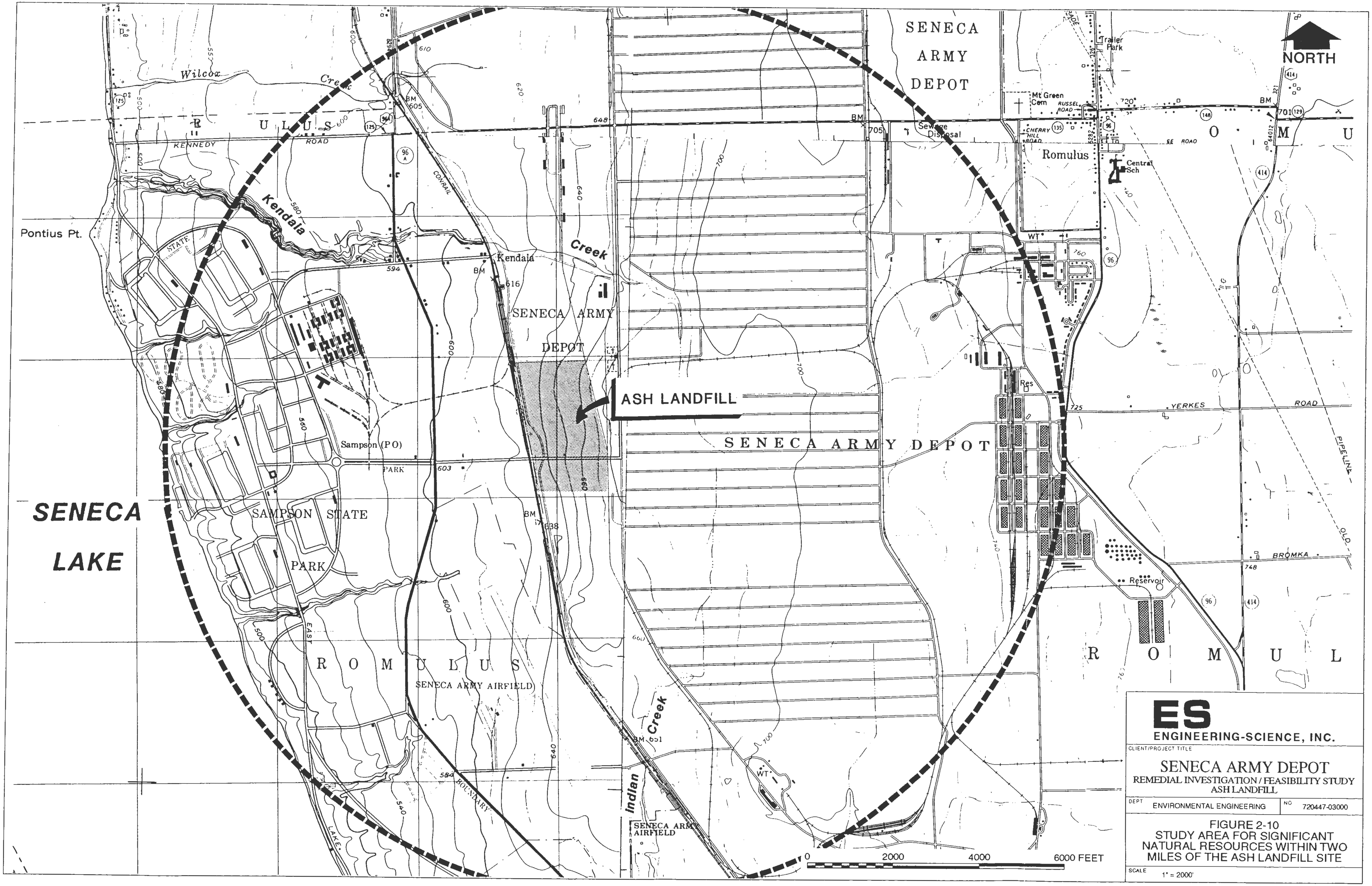
The measurement endpoints for the terrestrial biotic assessment are also primarily at the community level, focusing on determining the species composition, relative abundance and species richness of the terrestrial floral and faunal communities inhabiting the Ash Landfill Site and adjacent areas. The measurement endpoints are, as well, at the individual level where any overt symptomology, such as plant leaf chlorosis (yellowing) or reduced plant growth, was qualitatively assessed. These measurement endpoints enabled the derivation of the Phase I assessment endpoints that were used to characterize and evaluate the existing terrestrial biotic community and identify potential terrestrial biotic receptors and interactions with terrestrial communities adjacent to the Ash Landfill Site.

2.12.2. Study Areas

2.12.2.1 Aquatic Study Area

The only water body in proximity to the Ash Landfill Site that flows on a year round basis is Kendaia Creek which is approximately 4500 feet north of the abandoned incinerator building (Figure 2-10). Near the Ash Landfill Site, this stream is quite small, ranging in width from 3 to 10 feet with typical maximum depths ranging from 1 to 7 inches. Discharge measured during mid-November was only 0.3 cubic feet per second (cfs). Judging from the water surface elevation relative to the stream banks at the time of measurement, this discharge is fairly typical of normal conditions in this segment of Kendaia Creek. The substrate is composed predominantly of gravel-and cobble-sized particles. There are some reaches where the stream flows directly over bedrock. Silt and some sand are typically imbedded in the interstitial spaces of the gravel and cobbles. Flow characteristics of the stream include approximately equal amounts of pool and riffle. The applicable State water quality standard given to Kendaia Creek in its entirety is Class D. Kendaia Creek discharges into Seneca Lake, approximately 2 miles downstream of the fence line of the Seneca Army Depot, at a portion designated as AA(T). The state water index number for Kendaia Creek is ONT 66-12-P369-9. Conversations with local residents indicated rainbow smelt migrate from Seneca Lake into the lower reaches of Kendaia Creek to spawn. The NYSDEC Regional Fish Manager (Region 8) and his staff have no data regarding the aquatic community of Kendaia Creek and are not aware of any significant resources associated with this stream.

The only known actively managed fishery within two miles of the Ash Landfill Site is Seneca Lake. Seneca Lake supports a significant fishery for both coldwater and warmwater species. The New York State Department of Environmental Conservation enforces special fishing regulations for the Finger Lakes, of which Seneca Lake is one. These regulations pertain to lake trout, landlocked salmon, rainbow trout, largemouth and smallmouth bass, northern pike and walleye (NYSDEC undated). There are no other known significant aquatic resources, including wild and scenic rivers, within the two miles of the Ash Landfill Site.



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ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT ENVIRONMENTAL ENGINEERING
NO 720447-03000

FIGURE 2-10
STUDY AREA FOR SIGNIFICANT NATURAL RESOURCES WITHIN TWO MILES OF THE ASH LANDFILL SITE

SCALE 1" = 2000'

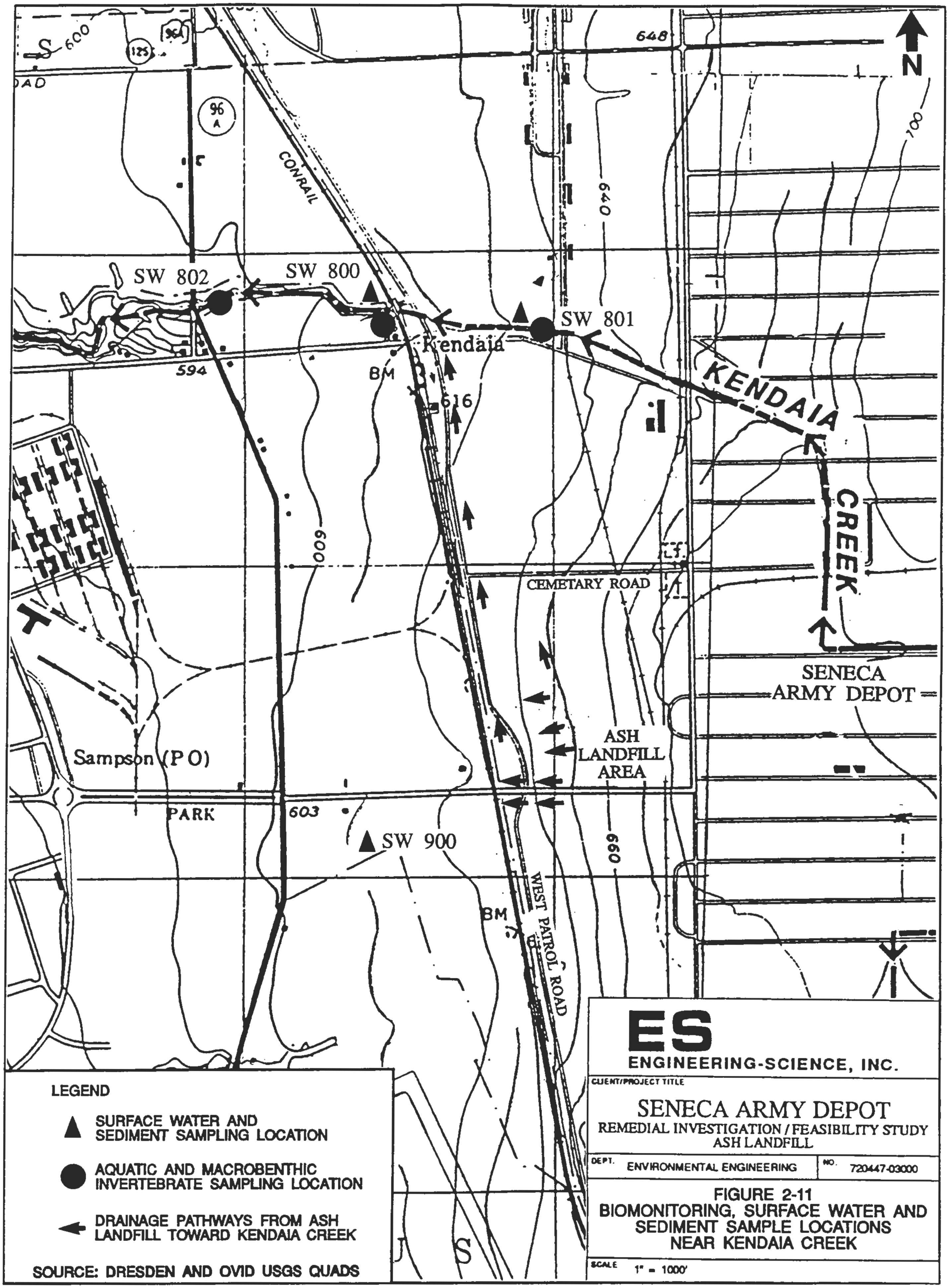
The aquatic biotic sampling location within Kendaia Creek most likely to receive surface water runoff from areas influenced by the Ash Landfill Site, Station SW-800, was immediately downstream of the confluence of a drainage ditch with the Creek near a CONRAIL railroad bridge (Figure 2-11). This station location corresponded with a sediment and water quality sampling point. This enabled direct correlations to be made between the aquatic community and chemical constituents of the sediment and water. A downstream biotic sampling station (SW-802) was established upstream of State Route 96A to characterize Kendaia Creek before it cascades over a falls created by a box culvert at this highway (Figure 2-11). This cascade represents an impassable barrier to upstream movement of most fish under normal circumstances. Station SW-801 was established as a reference station approximately 2000 feet upstream of Station SW-800 at a location beyond the probable influence of the Ash Landfill Site (Figure 2-11). Sediment samples and water quality samples were not collected at these two stations.

There were no aquatic plants observed in Kendaia Creek. However, an accurate assessment of the presence or absence of plants could not be made due to normal seasonal die-off.

2.12.2.2 Terrestrial Study Area

The terrestrial biotic assessment involved two general study areas. Within the broadest study area, which included the Ash Landfill Site and an area 2 miles from the site perimeter, significant resources such as NYSDEC significant habitats, habitats supporting endangered, threatened and rare species, species of concern, and state regulated wetlands, were identified (Figure 2-10). Also assessed for the 2-mile study area was the terrestrial resources used by humans (for hunting, agriculture, forestry, etc.) that would potentially be affected by Ash Landfill contaminants.

Within the smaller study area, which included the site and an area 0.5 mile from the site perimeter, the major vegetative communities (cover types), wildlife species associated with each cover type, and the value of the habitats (cover types) to the associated wildlife were identified (Figure 2-12). Observations for signs of overt symptomology (stressed or altered terrestrial biota) were conducted in the 0.5 mile study area. Most (70 percent) of this study area is within the depot, including the Depot airfield. The remaining portion is private farmland on the western side.



SOURCE: DRESDEN AND OVID USGS QUADS

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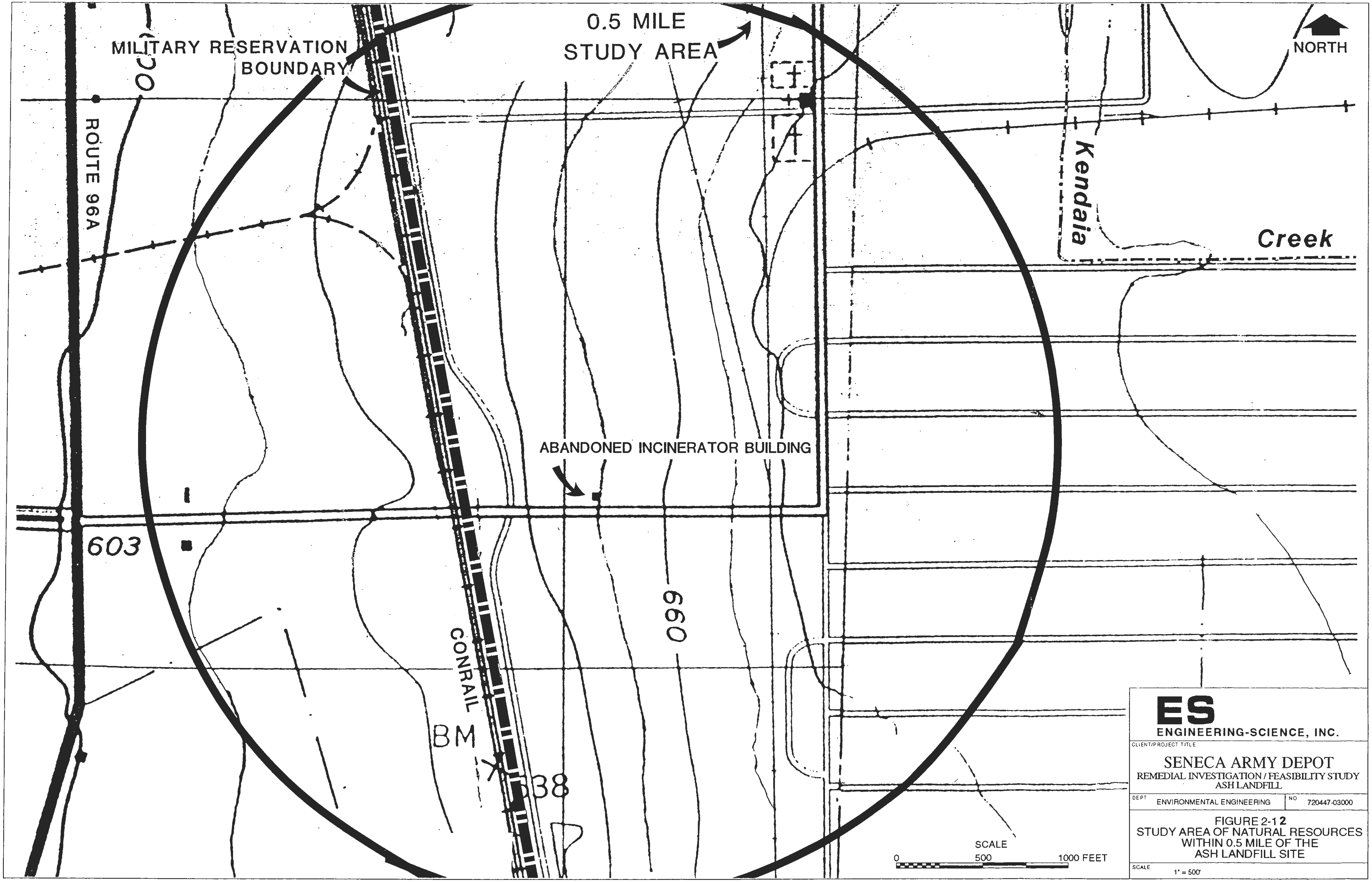
CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING NO. 720447-03000

FIGURE 2-11
BIOMONITORING, SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS NEAR KENDAIA CREEK

SCALE 1" = 1000'



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NO 720447-03000

FIGURE 2-12
STUDY AREA OF NATURAL RESOURCES
WITHIN 0.5 MILE OF THE
ASH LANDFILL SITE

SCALE 1" = 500'

2.12.3 Assessment Methods

2.12.3.1 Benthic Invertebrate Sampling

An optimum technique for collecting benthic macroinvertebrates in a stream such as Kendaia Creek is the Surber sampler. This devise is designed to provide quantitative samples in shallow streams where the substrate is predominantly sand, gravel and cobble. Other devises, such as the Ponar grab, cannot effectively sample such streams because the grab sampler cannot close completely when rocks become lodged in the jaws. This allows a portion of the sample to be lost, making quantification of results impossible. The Surber sampler must be used in a portion of the stream where the current is sufficient to carry invertebrates dislodged from the area being sampled into the sampler - usually at least 0.16 feet per second. Therefore, when interpreting the results of macroinvertebrate samples collected with the Surber sampler, it is important to realize that this devise must be used in riffle areas and that the benthic community in pools may be different than that which is represented by these collections. This difference is not believed to be substantial in Kendaia Creek, since the pools are relatively shallow (generally less than a foot deep) with similar substrate to the riffle areas.

The Surber sampler used for sampling Kendaia Creek is designed to sample a one square foot portion of stream bottom. The mesh of the net is 1mm square, therefore, some smaller organisms may have passed through the mesh, although many were still collected. Temperature, pH, dissolved oxygen and conductivity were measured with calibrated meters. Temperature and pH were measured with an Orion pH meter, Model 230A, dissolved oxygen was measured with a YSI Model 57 DO meter, and conductivity was measured with a YSI Model 33 conductivity meter.

Samples were collected by choosing a sampling site that was representative of the stream reach. Depth of water at the sampling site did not exceed one foot. When the site was selected, the sampler was placed flat on the stream bed in such a manner that a minimum of flow was allowed to wash under the sampler. Large rocks within the confines of the sampler were manually lifted from the substrate and scrubbed at the mouth of the sampler to dislodge attached or clinging invertebrates that were then carried downstream into the net by the current. If only a portion of a rock was within the one square foot area, only the portion within the sampling area was scrubbed. When all rocks within the sampling area were scraped, any silt, sand or gravel within the sampling area was disturbed to a depth of approximately four inches by hand or with a probe (such as a stick) to dislodge burrowing invertebrates and allow them to wash back into the net. After all materials within the sampling area were thoroughly disturbed, the net was quickly lifted out of the water and any debris or organisms adhering to the side of the net were rinsed into the bottom of the net. The net was then carefully inverted and the sample placed into a jar. Subsequent replicates were taken upstream of the previous sample to avoid the possibility of disturbances to the stream bed by sampling personnel influencing the sampling results. Samples were preserved in 70 percent ethanol and returned to the laboratory for sorting and identification. Samples were sorted in the laboratory under magnification provided by a dissecting microscope. All invertebrates were placed in vials and identified to the lowest practicable taxon by an aquatic ecologist.

2.12.3.2 Fish Sampling

All fish were collected by electroshocking. Electroshocking was accomplished by using a Coffelt BP-2 backpack electroshocker. This unit is most effective when the conductivity of the water does not exceed 500 to 600 micromhos/cm. The conductivity in Kendaia Creek during the fish sampling survey ranged from 550 to 575 micromhos/cm, which is within but near the upper limit of the effective range for this gear. Temperature, pH, dissolved oxygen and conductivity were measured with the same instruments used during benthic sampling.

Electroshocking samples were collected by beginning at the downstream segment of the station and proceeding upstream for a distance of approximately 150 ft. A supplemental collection (collection "B") along a 75 foot section the stream was made at Station SW-800 to allow the sampling of a higher gradient section of the stream, omitted from the primary sampling effort. Both pool and riffle habitat were sampled at all stations. The dip net/electrodes of the electroshocker were swept back and forth across the entire stream, with one crew member occasionally releasing the deadman's switch to interrupt the current field. This "pulsing" procedure reduced the tendency for fish to sense the field at a distance and flee. Stunned fish were netted and placed in a bucket of ambient water for later processing.

Processing of fish collected by electroshocking consisted primarily of identification and enumeration. An indication of the size range of fish in each collection was obtained by measuring at least the smallest and largest individual of each species. If field identification of a specimen was uncertain, which was the case with certain small minnows, voucher specimens were preserved in formalin and returned to the laboratory for confirmation of the identification. In addition, any individuals with overt symptomology (such as tumors) were preserved for documentation purposes. All other specimens collected were returned alive to the stream at the location that they were collected.

2.12.3.3 Terrestrial Assessment Methods

The presence of significant terrestrial biotic resources within the 2-mile study area was determined by contacting the NYSDEC Information Services for locations of Significant Habitats, rare, threatened and endangered species and species of concern. New York State regulated wetland maps were reviewed for the location of these significant wetland resources in the study area. The location of all significant resources occurring in the study area were mapped at a scale of 1" = 2000'. Information on the hunting, agricultural and forestry use of the terrestrial resources in the study area was obtained from the Seneca Army Depot, local residents, field reconnaissances and review of current (1991) aerial photography (scale 1" - 500').

The current aerial photography was reviewed to delineate the major upland and wetland vegetative cover types in the 0.5 mile study area. These major cover types were mapped at a scale of 1" = 1000'. Existing wetland mapping (NYSDEC Regulated and U.S. Fish and Wildlife Service) were reviewed for freshwater wetland locations. Field surveys were performed on foot to confirm or revise the cover type identification and boundaries and determine plant species composition, relative abundance, and density. Existing information was reviewed to confirm species presence (Cowardin 1965, Seneca Army Depot 1992). Freshwater wetlands on the Ash Landfill site were identified and delineated using the Unified Federal Routine Method (Federal Interagency Committee for Wetland Delineation 1989). These wetlands were surveyed and mapped at a scale of 1" = 500'.

Wildlife species, including amphibians, reptiles, birds and mammals, expected to inhabit the study areas' identified cover types, were determined primarily from existing information obtained from the Seneca Army Depot and the nearby Montezuma National Wildlife Refuge (U.S. Fish and Wildlife Service 1990, 1991a, 1991b). In addition, all wildlife observed during the course of the late fall ecological and surface water/sediment field programs were recorded to species, when possible. A small mammal live trapping program was conducted in the major habitats of the Ash Landfill and reference areas. A line of Sherman live traps, baited with peanut butter and oatmeal, was set out in a specific cover type at around dusk and checked the next morning. Any captured animals were identified to species then released. The habitat value of the cover types to wildlife was assessed during these field surveys. Any signs of wildlife and vegetation stress or alterations observed during the above surveys were also noted.

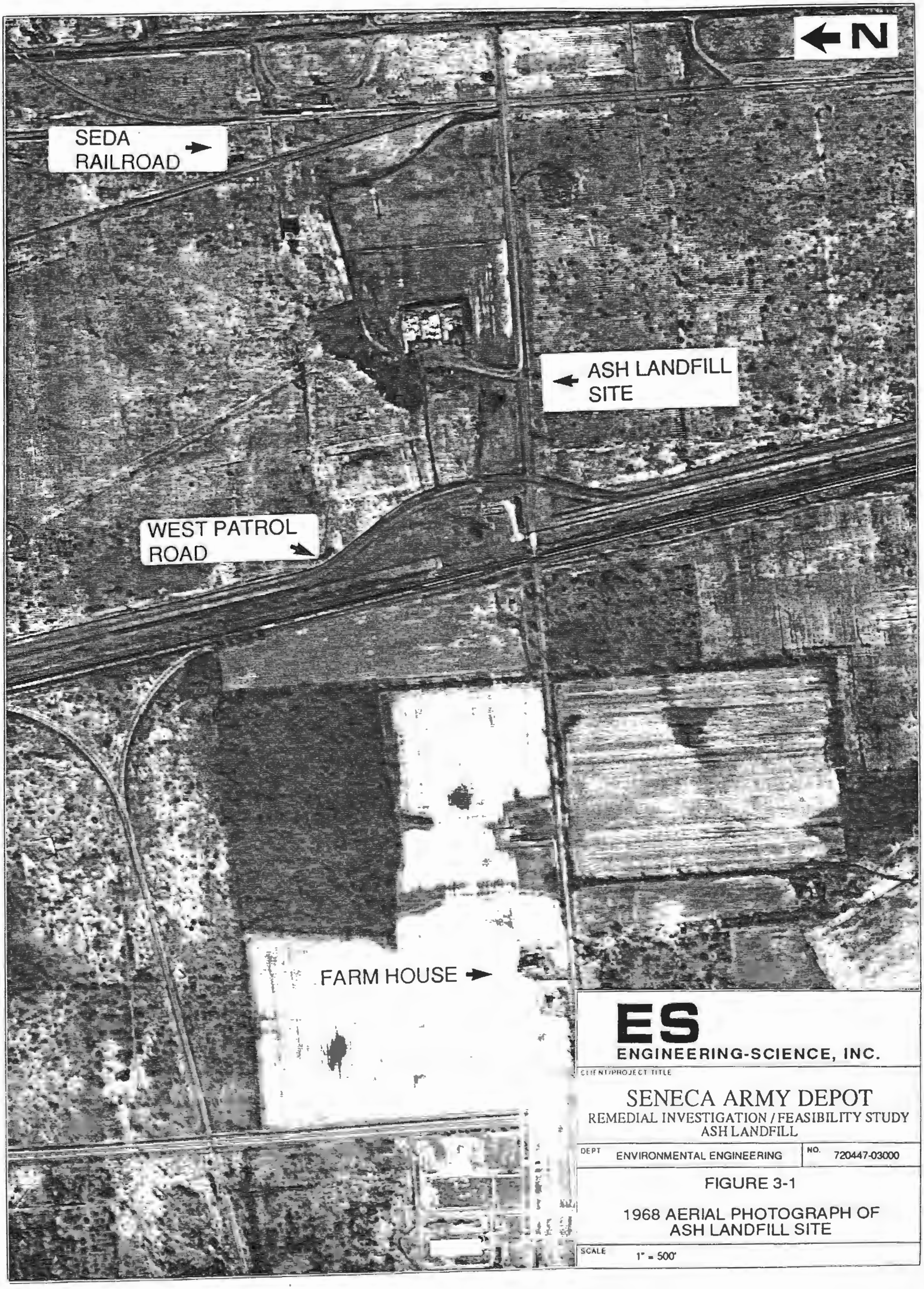
3.0 DETAILED SITE DESCRIPTION

3.1 INTRODUCTION

The Ash Landfill site area is located in the southwest section of SEDA. It encompasses approximately 130-acres and is composed mostly of undeveloped land with a few areas that contain man-made features or structures related to past site activities. The site is bounded on the north by Cemetery Road, on the east by the Seneca Army Depot Railroad line, on the south by open grassland and brush, and on the west by the boundary of the depot (Figure 2-1). Undeveloped areas are present mostly in the northern and extreme southwestern portions of the site. The area to the north of the ash landfill and debris piles is comprised mostly of low grasses with areas of dense brush and a few trees. South of West Smith Farm Road dense brush with some small open grassy areas dominate.

From 1941 to 1974, uncontaminated trash was burned in a series of burn pits near the incinerator building. A 1968 aerial photograph showing these burnpits is presented in Figure 3-1. Between 1974 and 1979 rubbish and garbage was burned in the incinerator. Ashes from the incinerator were temporarily stored in an unlined cooling pond. When the pond filled the ashes were buried in the adjacent Ash Landfill. Large items that could not be burned were disposed of in the Non-Combustible Fill Landfill.

Major features on the site are the abandoned incinerator building (Building 2207), a cooling pond, the Ash Landfill, and the Non-Combustible Fill Landfill. The abandoned and somewhat dilapidated incinerator building is situated on a small artificially constructed mound and is accessed via a paved driveway off of West Smith Farm Road. A garage-type entrance is located on the east side of the building. Doors are on the other three sides of the building. An underground fuel oil storage tank is located immediately adjacent to the northeastern corner of the incinerator building. An approximately 70-foot diameter abandoned cooling pond is located 10 feet from the northeastern corner of the incinerator building. The Ash Landfill is located slightly north of this point. The approximately 500 x 300 foot kidney-shaped Ash Landfill is defined by a 3 to 4 foot rise in topography (Figure 2-1). It is mostly vegetated with low grass, however, there are areas void of any vegetative cover near the bend in the road. The Non-Combustible Fill Landfill is located across West Smith Farm Road from the incinerator. This roughly rectangular, wedge-shaped fill area thickens to the west where it reaches a maximum total relief of approximately 14 feet. The top surface of the filled area is covered with low grassy vegetation.



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REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 3-1

1968 AERIAL PHOTOGRAPH OF ASH LANDFILL SITE

SCALE 1" = 500'

There are several minor features located at the Ash Landfill site. There is an asphalt patch area approximately 25 feet wide by 200 feet long near the boundary gate along West Smith Farm Road. The former use of this patched area is not known. There are three identified debris piles located in the central and east-central section of the site. There is a cooking grease pit disposal area in the east-central section of the site adjacent to the railroad line.

Utilities on the site include a water main and overhead utilities for phone and electricity. A 6-inch diameter underground water main traverses the central portion of the site from Cemetery Road to a location west of the incinerator building, where it branches to the west toward a fire hydrant and to the east running parallel to West Smith Farm Road. Approximately 50 feet from the Seneca Army Depot railroad tracks the water main turns to the south (at a fire hydrant) where it crosses West Smith Farm Road and exits the site. In addition, there is a water gate immediately west of the cooling pond which is supplied with water.

Access to SEDA is controlled by fencing and security patrols around the entire depot. Access to the Ash Landfill is provided along West Smith Farm Road, West Patrol Road and Cemetery Road. An unpaved road originates on the southern edge of West Smith Farm Road and leads into grassy fields and brush to the south. Another unpaved road originates in two locations east and west of the incinerator building. This road leads north along the western edge of the ash landfill where it bends to the east and loops toward the Seneca Army Depot railroad tracks eventually branching to the north and south. The northern branch returns to the central portion of the site and exits the site near the intersection of Cemetery Road and the 6-inch underground water main. The southern branch leads to West Smith Farm Road.

3.2 TOPOGRAPHY

SEDA lies on the western side of a series of north to south trending rock terraces that separate Cayuga Lake on the east and Seneca Lake on the west. The rock terraces range in elevation from 490 feet above MSL in northern Seneca County to as much as 1,600 feet above MSL at the southern end of the lakes. Elevations on SEDA range from 450 feet above MSL on the western boundary to 760 feet above MSL in the southeast corner. The Depot's land surface generally slopes to the west and north.

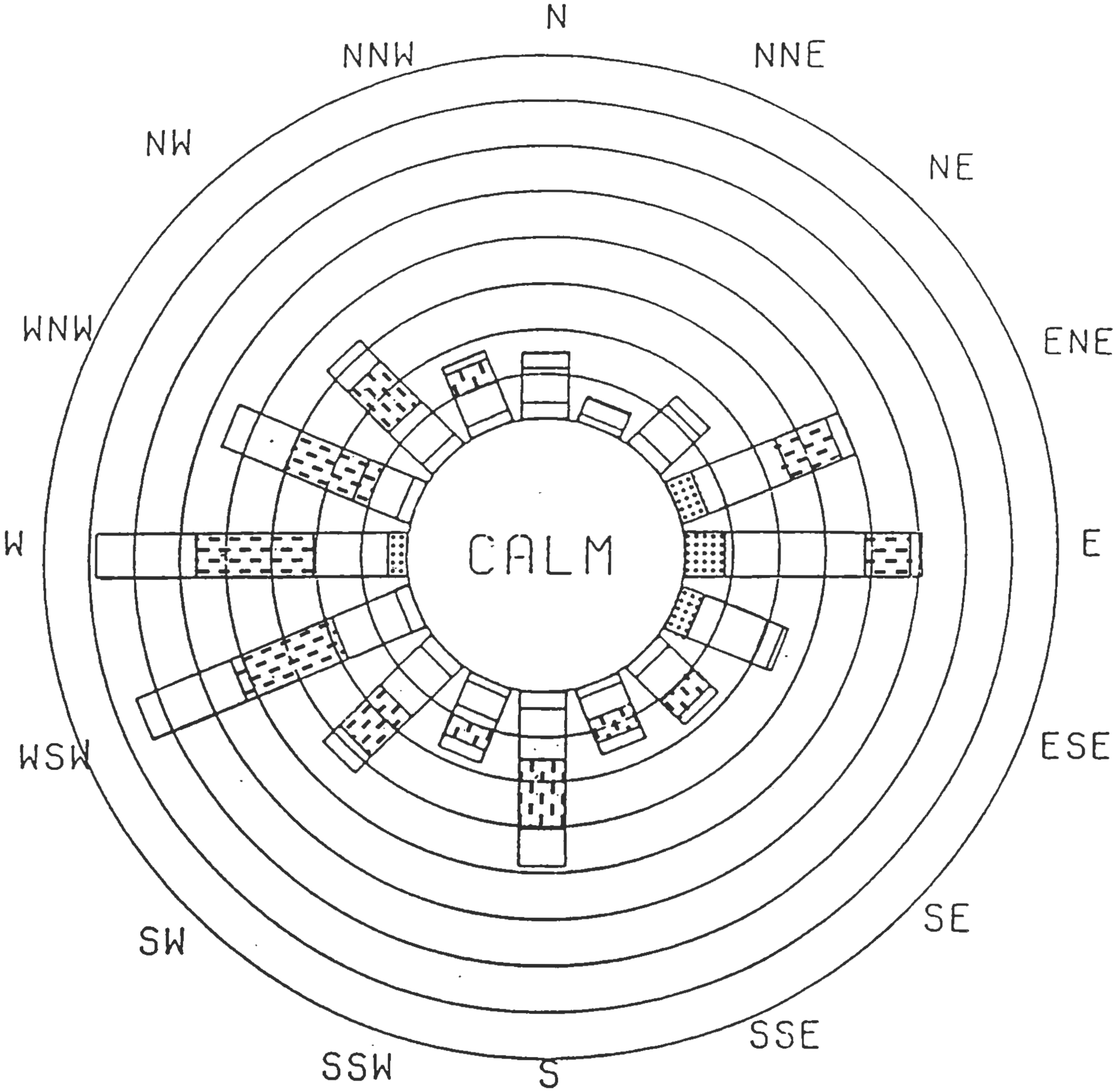
The Ash Landfill site is located on gently sloping terrain along the western boundary of SEDA, immediately west of the magazine area. The majority of the site, which slopes downward to the west-southwest, is vegetated with grasses and occasional brush thickets (Figure 2-1). Elevations range from 680 feet above MSL near the intersection of the railroad tracks and West Smith Farm Road to 630 to 635 feet along the fenced boundary line. Surface runoff from the area is collected in drainage ditches along the east-west roadway (West Smith Farm Road) and the north-south roadway (West Patrol Road).

3.3 CLIMATE

Table 3-1 summarizes climatological data for the SEDA area. The nearest source of climatological data is the Aurora Research Farm in Aurora, New York which is approximately ten miles east of SEDA on the east side of Cayuga Lake. This research Farm is administered by the Northeast Regional Climate Center located at Cornell University in Ithaca, New York. Only precipitation and temperature measurements are available from this location. The other data reported in Table 3-1 were taken either from isopleth drawings from a climatic atlas, or from data collected at Syracuse, New York, which is 40 miles northeast of SEDA. Meteorological data collected from 1965 to 1974 at Hancock International Airport in Syracuse, New York, were used to prepare the wind rose presented in Figure 3-2.

A cool climate exists at SEDA with temperatures ranging from an average of 23°F in January to 69°F in July. Marked temperature differences are found between daytime highs and nighttime lows during the summer and portions of spring and autumn. Precipitation is unusually well-distributed, averaging approximately 3 inches per month. This precipitation is derived principally from cyclonic storms which pass from the interior of the country through the St. Lawrence Valley. Lakes Seneca, Cayuga, and Ontario provide a significant amount of the winter precipitation and moderate the local climate. The annual average snowfall is approximately 100 inches. Wind velocities are moderate, but during the winter months, there are numerous days with sufficient winds to cause blowing and drifting snow. The most frequently occurring wind directions are westerly and west-southwesterly.

Daily precipitation data measured at the Aurora Research Farm in Aurora, New York for the period (1957-1991) were obtained from the Northeast Regional Climate Center at Cornell University. This station is located approximately 10 miles east of the depot. The average monthly precipitation during this 35-year period of record is summarized in Figure 3-3. The maximum 24-hour precipitation measured at this station during this period was 3.9 inches on September 26, 1975. Values of 35 inches mean annual pan evaporation and 28 inches for annual lake evaporation were already reported in Table 3-1. An independent value of 27



Installation:
Seneca Army Depot, NY
Location of Data:
Syracuse, NY
Source:
US Army Environmental
Hygiene Agency

NOTE : EACH DIVISION IS 2% OF TOTAL TIME .

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FIGURE 3-2

WIND ROSE, SYRACUSE, N.Y.

SCALE

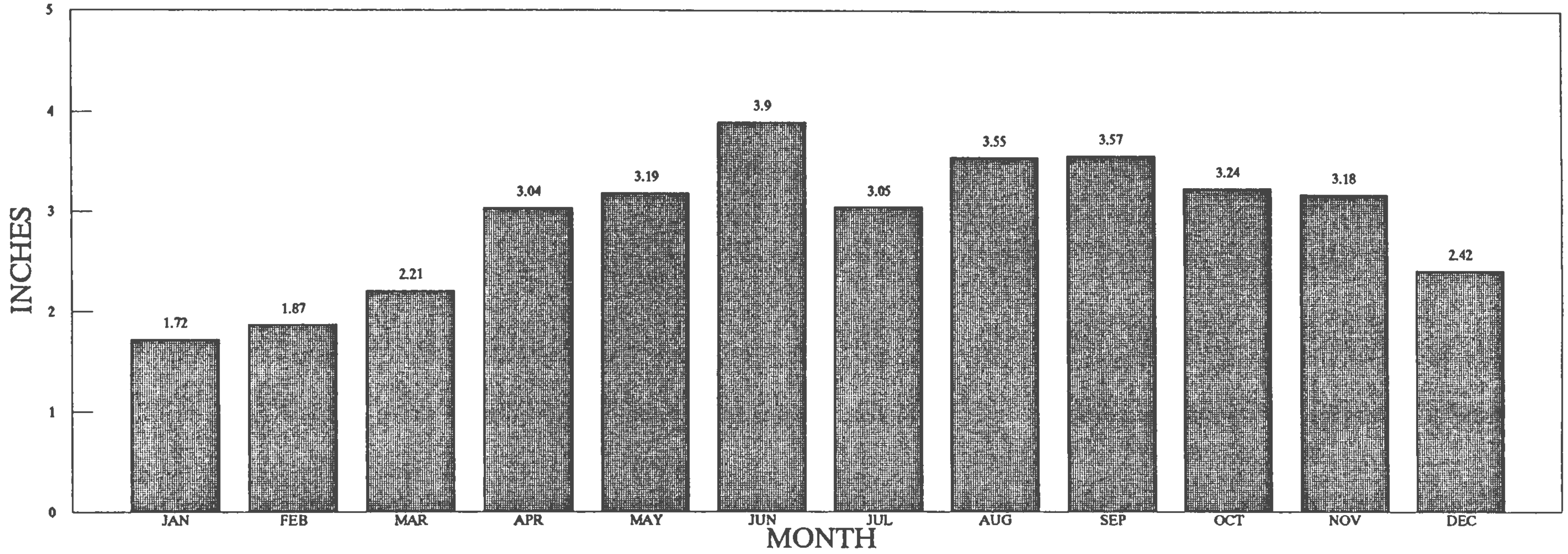

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FIGURE 3-3
AVERAGE MONTHLY PRECIPITATION IN
PROXIMITY OF SENECA ARMY DEPOT
(1958-1991)

SCALE

TABLE 3 – 1

CLIMATOLOGICAL DATA FOR SENECA ARMY DEPOT

SENECA ARMY DEPOT
ASH LANDFILL

MONTH	TEMPERATURE[1] (°F)			PRECIP[1] (in)	RH[3] (%)	SUN–	MEAN NUMBER OF DAYS[4]		
	MAX	MIN	MEAN	MEAN	MEAN	SHINE[3] (%)	CLEAR	PTLY. CLDY.	CLOUDY
JAN	30.9	14.0	22.5	1.88	70	35	3	7	21
FEB	32.4	14.1	23.3	2.16	70	50	3	6	19
MAR	40.6	23.4	32.0	2.45	70	50	4	7	20
APR	54.9	34.7	44.8	2.86	70	50	6	7	17
MAY	66.1	42.9	54.5	3.17	70	50	6	10	15
JUN	76.1	53.1	64.6	3.70	70	60	8	10	12
JUL	80.7	57.2	69.0	3.46	70	60	8	13	10
AUG	78.8	55.2	67.0	3.18	70	60	8	11	12
SEP	72.1	49.1	60.7	2.95	70	60	7	11	12
OCT	61.2	39.5	50.3	2.80	70	50	7	8	16
NOV	47.1	31.4	39.3	3.15	70	30	2	6	22
DEC	35.1	20.4	27.8	2.57	70	30	2	5	24
ANNUAL	56.3	36.3	46.3	34.33	70	50	64	101	200

PERIOD	MIXING HEIGHT[2] (m)	WIND SPEED[2] (m/s)
Morning (Annual)	650	6
Morning (Winter)	900	8
Morning (Spring)	700	6
Morning (Summer)	500	5
Morning (Autumn)	600	5
Afternoon (Annual)	1400	7
Afternoon (Winter)	900	8
Afternoon (Spring)	1600	8
Afternoon (Summer)	1800	7
Afternoon (Autumn)	1300	7

Mean Annual Pan Evaporation[3] (in) : 35
Mean Annual Lake Evaporation[3] (in) : 28
Number of episodes lasting more than 2 days (No. of episode–days)[2] :
  Mixing Height < 500 m, wind speed < 2 m/s : 0 (0)
  Mixing Height < 1000 m, wind speed < 2 m/s : 0 (0)
Number of episodes lasting more than 5 days (No. of episode–days)[2] :
  Mixing Height < 500 m, wind speed < 4 m/s : 0 (0)

Notes:

[1] Climate of New York Climatography of the United States No. 60. National Oceanic and Atmospheric Administration, June 1982. Data for Ithaca Cornell University, NY.

[2] Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution throughout the Contiguous United States. George C. Holzworth, Jan. 1972.

[3] Climate Atlas of the United States. U.S. Department of Commerce, 1983.

[4] Climate of New York Climatography of the United States No. 60. National Oceanic and Atmospheric Administration, June 1982. Data for Syracuse, NY.

inches for mean annual evaporation from open water surfaces was estimated from an isoplethed figure in "Water Atlas of the United States" (Water Information Center, 1973).

In general, climatological conditions that tend to promote good dispersions are high ambient temperatures, high wind speeds, low precipitation amounts, and a preponderance of clear skies. As Table 3-1 shows, temperatures tend to be highest from June through September.

Precipitation and relative humidity tend to be rather high throughout the year. The months with the most amount of sunshine are June through September. Mixing heights tend to be lowest in the summer and during the morning hours. Wind speeds also tend to be lower during the morning, which suggests that dispersion will often be reduced at those times, particularly during the summer. However, no episode-days are expected to occur with low mixing heights (less than 500 m) and light wind speeds (less than or equal to 2 m/s). Information on the frequency of inversion episodes for a number of National Weather Service stations is summarized in "Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States" (George C. Holzworth, US EPA, 1972). The closest stations at which inversion information is available are Albany, New York and Buffalo, New York. The Buffalo station is nearer to SEDA but almost certainly exhibits influences from Lake Erie. These influences would not be expected to be as noticeable at SEDA.

SEDA is located in the Genesee-Finger Lakes Air Quality Control Region (AQCR). The AQCR is designated as "non-attainment" for ozone and "attainment" or "unclassified" for all other criteria pollutants. Data for existing air quality in the immediate area surrounding the SEDA, however, can not be obtained since the nearest state air quality stations are 40 to 50 miles away from the depot (Rochester of Monroe County or Syracuse of Onondaga County). A review of the data for Rochester, which is in the same AQCR as SEDA, indicates that all monitored pollutants (sulfur dioxide, particulates, carbon monoxide, lead, ozone) are below state and federal limits, with the exception of ozone. In 1987, the maximum ozone concentration observed in Rochester was 0.127 ppm. However, this value may not be representative of the SEDA area which is in a more rural area.

3.4 SURFACE WATER

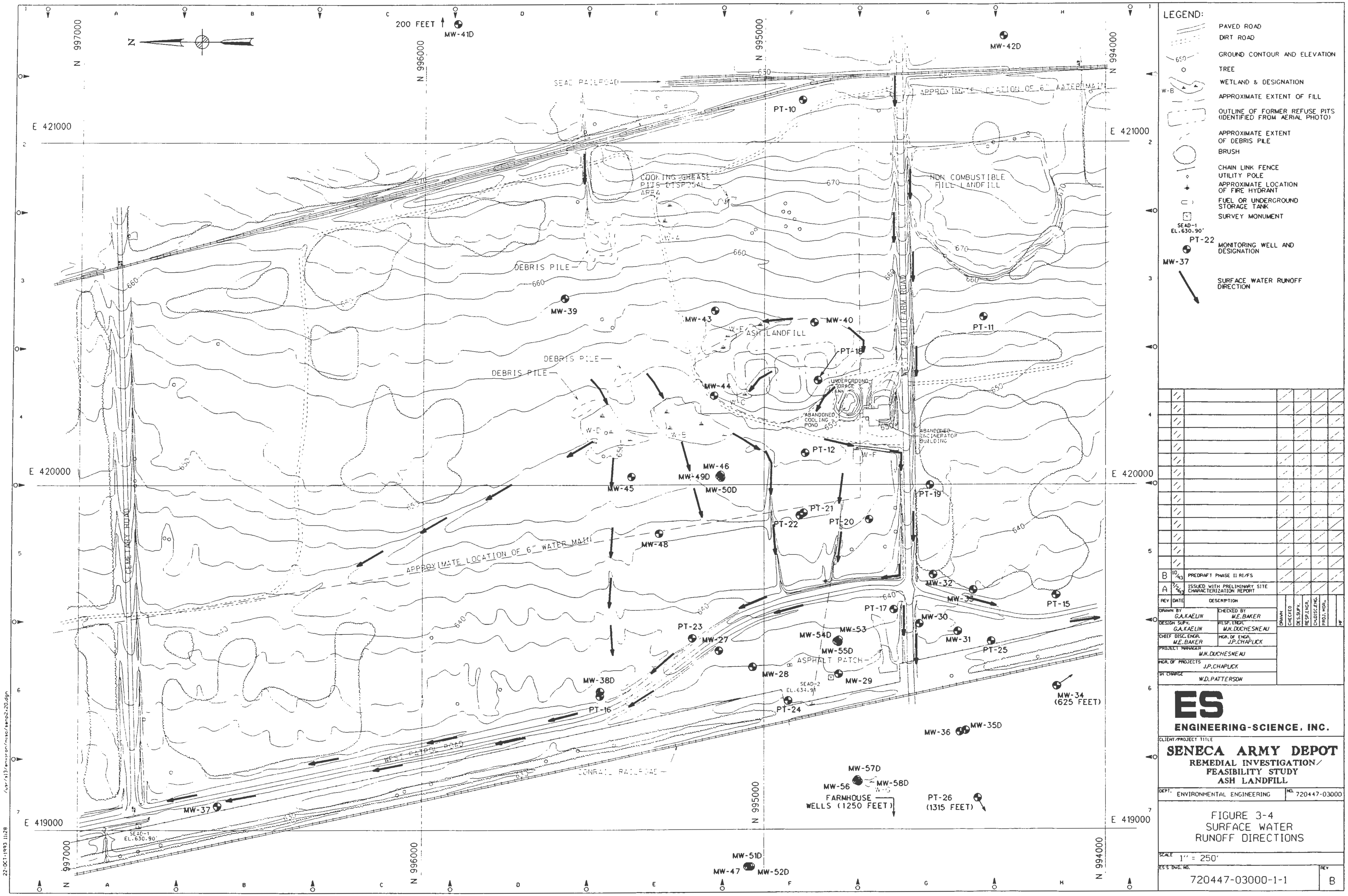
3.4.1 Surface Water

Surface water drains into several wetland areas on-site. Based on topographic expression, several of these wetland areas (W-B, W-D, W-E, and W-F) drain primarily into two small, but well developed, drainage swales south of the Ash Landfill and incinerator building (Figure 3-4). Farther north, less well developed swales drain areas in an near wetlands W-B and W-E. These ditches direct surface water flow westward into a drainage ditch along West Patrol Road. Some surface water drainage occurs along the periphery of the Ash Landfill which is represented by a low, kidney-shaped topographic high. Surface water, when present, drains to the north on both sides of West Patrol Road. Wetland W-F also drains west along West Smith Farm Road to the ditch along West Patrol Road. Drainage along West Patrol Road (between West Smith Farm Road and Cemetery Road) is to the northwest based on topography. Drainage on both sides of West Smith Farm Road and Cemetery Road is to the west. North and east of the site is Kendaia Creek which drains upland areas east of the Ash Landfill site and also is believed to receive surface water drainage from the Ash Landfill via the drainage ditches on both sides of West Patrol Road. Kendaia Creek passes approximately 4,000 feet north of the Ash Landfill and eventually drains into Seneca Lake. (Figure 2-11 shows Kendaia Creek and the drainage pathways).

Precipitation data from the nearest monitoring station (Aurora Research Farm), was reviewed to gain a perspective on the seasonal variations in rainfall that would directly impact surface water flow. This data indicates that, historically, June has the greatest amount of rainfall, 3.9 inches, and the winter months (January and February) generally have had the least amount of rainfall (Figure 3-3).

3.4.2 Spring Survey

Suspected spring locations within a one mile radius of the Ash Landfill were determined in the field for Phase I between October 29 and November 1, 1992 (Figure 3-5). There was no rainfall during this period and previous to this time conditions were described as "dry"by local residents; there was also no snow cover. These conditions minimized the potential that any observed water flows during this investigation were due to surface run-off. The most likely locations of springs within the study area were the headwaters of Kendaia and Indian Creeks. Field observations, however, indicated that the origins of both streams were to the west of the study area. Potential springs associated with a small unnamed stream that originates near the



REV	DATE	DESCRIPTION
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A.KAELIN	CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAELIN	RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER	MGR. OF ENGR. J.P.CHAPLICK
PROJECT MANAGER M.N.DUCHESNEAU	
MGR. OF PROJECTS J.P.CHAPLICK	
IN CHARGE W.D.PATTERSON	

DRAWN CHECKED DES.SUPV. RESP.ENGR. CH.DISC.ENG. PROJ. MGR. MF

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REMEDIAL INVESTIGATION/ FEASIBILITY STUDY ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING

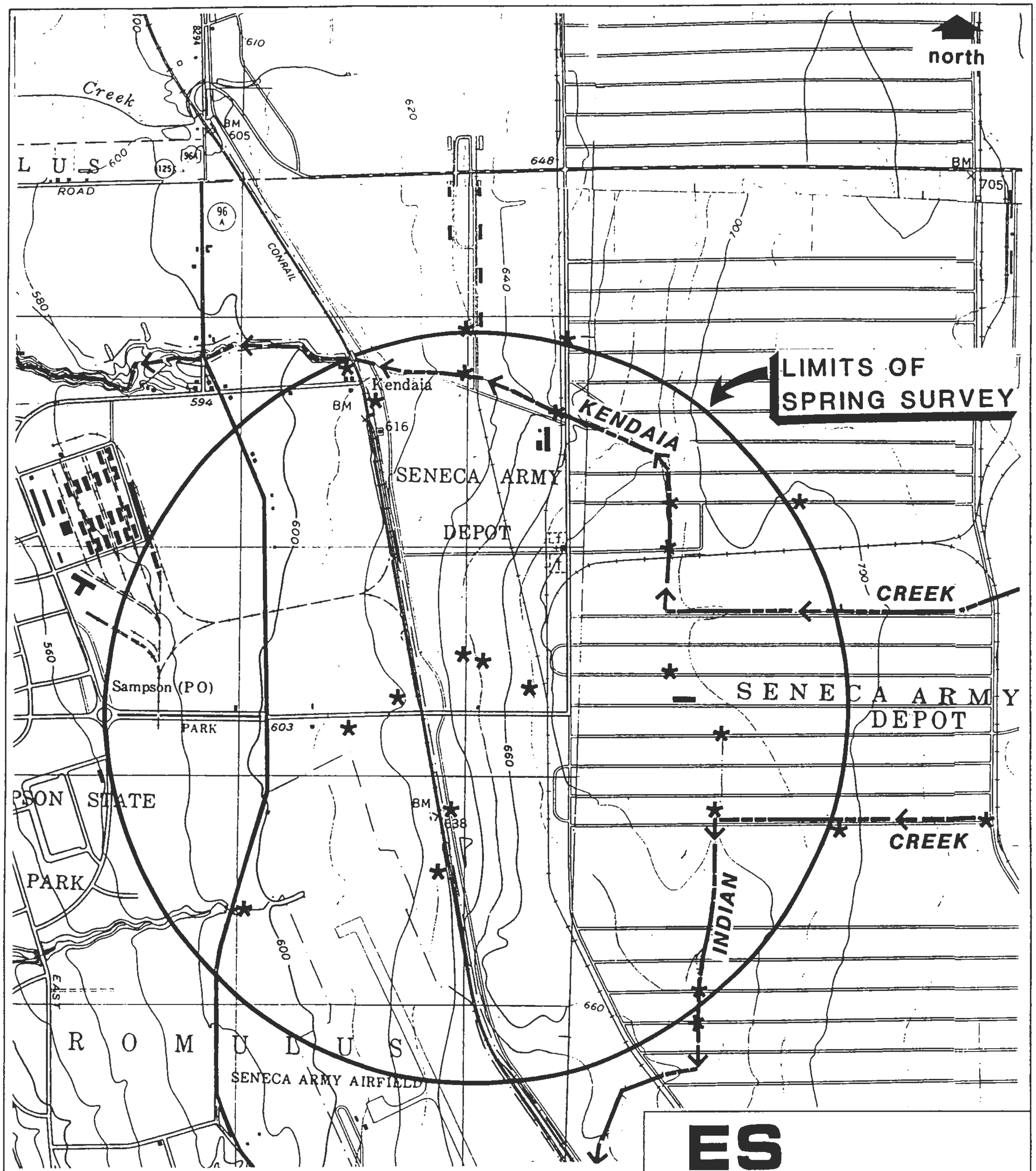
NO. 720447-03000

FIGURE 3-4
SURFACE WATER
RUNOFF DIRECTIONS

SCALE 1" = 250'

E.S DWG. NO. 720447-03000-1-1

REV B



LEGEND

★ FIELD INVESTIGATION POINTS

SOURCE
DRESDEN AND OVID USGS QUADS

SCALE
0 2000 4000 FEET

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REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

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FIGURE 3-5
SUSPECTED SPRING LOCATIONS
WITHIN ONE MILE OF THE
ASH LANDFILL SITE

SCALE 1" = 2000'

Seneca Army Airfield and passes through Sampson State Park could not be definitively identified due to extensive culverting of the stream under the landing strip. Three locations upgradient of the Airfield were observed and found to be dry. These locations were man-made drainage ditches that drain into the culvert system associated with the landing strip. Field observations made at potential seeps within wetlands in proximity to and downgradient of the Ash Landfill site found no evidence of springs within these wetlands. It appeared that low spots with poorly drained soils enabled surface run-off to collect and form hydric conditions that are conducive to wetland formation. In Phase II the suspected spring locations were again investigated for possible surface water sampling and no evidence of springs was observed. In summary, no evidence of springs was observed within a one mile radius of the Ash Landfill during the Phase I and II field work.

3.5 SITE GEOLOGY

3.5.1 Introduction

The site geology is characterized by gray Devonian shale with a thin weathered zone where it contacts the overlying mantle of Pleistocene glacial till. This stratigraphy is consistent over the entire site and in the site vicinity. Some areas on site have been used as dumping areas for artificial fill which, when present, occurs above the till.

3.5.2 Glacial Till

The predominant surficial geologic unit present at the site is dense glacial till. The till is distributed across the entire site and ranges from in thickness from less than 2 to as much as 11 feet although it is generally only a few feet thick. The thickest section of glacial till was encountered in well MW-36 while the thinnest till section was found at MW-28 and MW-29. The till is generally characterized by brown to gray-brown silt, clay and fine sand with few fine to coarse gravel-sized inclusions of weathered shale. Larger diameter weathered shale clasts (as large as 6-inches in diameter) are more prevalent in basal portions of the till and are probably ripped-up clasts removed by the active glacier. The general Unified Soil Classification System description of the till on-site is as follows: Clay-silt, brown; slightly plastic, small percentage of fine to medium sand, small percentage of fine to coarse gravel-sized gray shale clasts, dense and mostly dry in place, till, (ML). Grain size analyses performed by Metcalf & Eddy (1989) on glacial till samples collected during the installation of monitoring wells on another portion of SEDA show a wide distribution of sediments sizes. These tills have a high percentage of silt and clay with trace amounts of fine gravel. The porosities of five gray-brown silty clay (i.e., till) samples ranged from 34.0 percent to 44.2 percent with an average of 37.3 percent (USAEHA Hazardous Waste Study No. 37-26-0479-85). The minimum, maximum and average background concentrations of selected inorganic constituents in the till located on SEDA are shown in Table 3-2.

Darian silt-loam soils, 0 to 18 inches thick, are developed over the till on-site, however, in some locations, till is exposed at the surface. The surficial soils are somewhat poorly drained and have a silt clay loam and clay subsoil. In general, the topographic relief associated with these soils is 3-8%.

3.5.3 Weathered Shale

A zone of gray weathered shale of variable thickness was encountered below the till in almost all locations drilled on-site. This zone is characterized by fissile shale with a large amount of brown interstitial silt and clay. To assist in visualizing the extent and thickness of the weathered shale, an isopach map of the weathered shale was constructed from soil boring and monitoring well installation logs (Figure 3-6). Data on the upper boundary of the weathered shale was recorded in split spoon samples, whereas the base of the weathered shale was, for the purposes of this investigation, defined at the refusal depth with the augers or where augering became very difficult and slow. The isopach map shows only the general thicknesses of weathered shale because the method to define the base of the weathered shale was based on differing interpretations of refusal depth by drillers and drilling supervisors. The isopach map for the weathered shale indicates that thickness varies throughout the site (Figure 3-6), with the greatest thickness (approximately 12 feet) occurring approximately 260 feet west of the incinerator building and the least thick area (less than 1 foot) occurring approximately 400 feet north of the incinerator building. Differential weathering through geologic time is likely responsible for the variable thicknesses. An elongate, northwest-southeast oriented zone of increased thickness of weathered shale (greater than 5 feet) occurs south of the Ash Landfill incinerator building and includes the thickest portion of the weathered shale, near PT-20. Generally, thicknesses of weathered shale are less than 3 feet east of this zone and less than 5 feet west of this zone. No outcrops of weathered or competent shale are exposed at the Ash Landfill.

TABLE 3–2

AVERAGE AND INDIVIDUAL BACKGROUND CONCENTRATIONS OF SELECTED HEAVY METALS IN SITE SOILS

SENECA ARMY DEPOT
ASH LANDFILL

INORGANICS	MINIMUM	MAXIMUM	AVERAGE	STANDARD DEVIATION	95TH PERCENT UCL
Metals					
Aluminum	7160	20500	15796	3771	17503
Antimony	2.9	6.8	4.62	1.20	5.16
Arsenic	2.7	9.7	5.08	1.87	5.93
Barium	39.9	159	86.92	32.89	101.81
Beryllium	0.52	1.4	0.89	0.23	0.99
Cadmium	0.15	2.9	1.26	1.10	1.76
Calcium	1370	104000	30082	36991	46825
Chromium	11.2	30.1	24.05	5.56	26.57
Cobalt	8.1	20.4	13.75	3.36	15.27
Copper	16.2	32.7	21.89	4.82	24.07
Iron	17300	38600	29887	6210	32698
Lead	5.4	19.1	12.18	4.06	14.02
Magnesium	3850	17000	7555.33	3348.83	9071.08
Manganese	426	2380	855.40	464.80	1065.78
Mercury	0.015	0.13	0.06	0.03	0.07
Nickel	19	49.3	36.63	10.35	41.31
Potassium	975	2110	1371.67	348.81	1529.55
Selenium	0.085	0.94	0.23	0.26	0.35
Silver	0.155	0.87	0.46	0.28	0.59
Sodium	31.3	116	63.30	28.92	76.39
Thallium	0.17	0.335	0.24	0.04	0.26
Vanadium	12.9	32.2	23.17	5.12	25.49
Zinc	53.1	126	80.48	19.13	89.14
Cyanide	0.27	0.41	0.33	0.04	0.35

Notes:

1) All results are expressed in mg/kg.
2) All detects (no qualifier or J qualifier) were taken at full value.
All non–detects (U or UJ qualifier) were taken at half value.
3) 15 Background soil samples colleced from Phase I and II RI/FS investigations at the Ash Landfill (9 samples) and the Open Burning Grounds (6 samples).

TABLE 3–2

AVERAGE AND INDIVIDUAL BACKGROUND CONCENTRATIONS OF SELECTED HEAVY METALS IN SITE SOILS

SENECA ARMY DEPOT
ASH LANDFILL

INORGANICS	B8–91 0–2	B8–91 2–4	B8–91 2–4	B8–91 6–8	B9–91 0–2
Metals	(ASH)	(ASH)	(ASH)	(ASH)	(ASH)
Aluminum	19200	20500	17700	12700	14800
Antimony	5.15	4.4	4.1	4.2	4.95
Arsenic	5.1	6.1	6	4.2	4.3
Barium	136	98.9	86.7	56.2	101
Beryllium	1.4	1.2	1	0.78	1.1
Cadmium	2.6	2.9	2.4	1.9	2.3
Calcium	5390	4870	3560	85900	45600
Chromium	27.4	30.1	26.9	19.8	22.5
Cobalt	13.8	18.4	14	14.2	13.7
Copper	22.3	27.6	26	16.2	22.6
Iron	37200	36100	32500	27400	31000
Lead	14.5	11.4	13.6	10.1	10.8
Magnesium	5850	7300	6490	6720	8860
Manganese	1130	956	832	926	903
Mercury	0.09	0.06	0.06	0.05	0.08
Nickel	42.3	48.7	44.4	30.4	38.4
Potassium	1910	2110	1760	1430	1320
Selenium	0.085	0.105	0.1	0.305	0.105
Silver	0.8	0.65	0.6	0.65	0.75
Sodium	39.6	33.75	31.3	75.3	84.2
Thallium	0.235	0.29	0.285	0.17	0.295
Vanadium	32.2	25.4	26.4	15.7	19.7
Zinc	85.1	94.2	85	75	126
Cyanide	0.3	0.315	0.335	0.29	0.35

Notes:
1) All results are expressed in mg/kg.
2) All detects (no qualifier or J qualifier) were taken at full value.
All non–detects (U or UJ qualifier) were taken at half value.
3) 15 Background soil samples colleced from Phase I and II RI/FS investigations at the Ash Landfill (9 samples) and the Open Burning Grounds (6 samples).

TABLE 3–2

AVERAGE AND INDIVIDUAL BACKGROUND CONCENTRATIONS OF SELECTED HEAVY METALS IN SITE SOILS

SENECA ARMY DEPOT
ASH LANDFILL

INORGANICS	B9–91 2–4	B9–91 6–8	BK–1 0–2	BK–2 0–2	MW–34 0–2
Metals	(ASH)	(ASH)	(ASH)	(ASH)	(OB)
Aluminum	8880	7160	19400	14400	16100
Antimony	4.95	3.5	3.95	3.6	5.7
Arsenic	3.8	4.4	3	2.7	3.15
Barium	110	39.9	159	106	67.5
Beryllium	0.76	0.52	1.1	0.81	0.86
Cadmium	1.7	1.5	0.225	0.205	2.3
Calcium	104000	101000	4590	22500	28600
Chromium	13.8	11.2	30	22.3	26.6
Cobalt	10.7	8.1	14.4	12.3	17
Copper	21.6	19.3	26.9	18.8	32.7
Iron	19600	17300	38600	26600	35000
Lead	10.1	7.8	15.8	18.9	11.9
Magnesium	17000	12600	5980	7910	6850
Manganese	532	514	2380	800	803
Mercury	0.04	0.05	0.13	0.11	R
Nickel	23.8	19	47.7	31	49.3
Potassium	1080	1050	1720	1210	1290
Selenium	0.325	0.105	0.73	0.94	0.09
Silver	0.75	0.55	0.235	0.215	0.87
Sodium	112	116	49.1	61.1	55.2
Thallium	0.18	0.3	0.21	0.19	0.255
Vanadium	19.5	12.9	28	22.4	22.3
Zinc	84.3	74.8	98.6	63.7	95.7
Cyanide	0.315	0.31	0.285	0.305	0.27

Notes:
1) All results are expressed in mg/kg.
2) All detects (no qualifier or J qualifier) were taken at full value.
All non–detects (U or UJ qualifier) were taken at half value.
3) 15 Background soil samples colleced from Phase I and II RI/FS investigations at the Ash Landfill (9 samples) and the Open Burning Grounds (6 samples).
4) R = Rejected data

TABLE 3–2

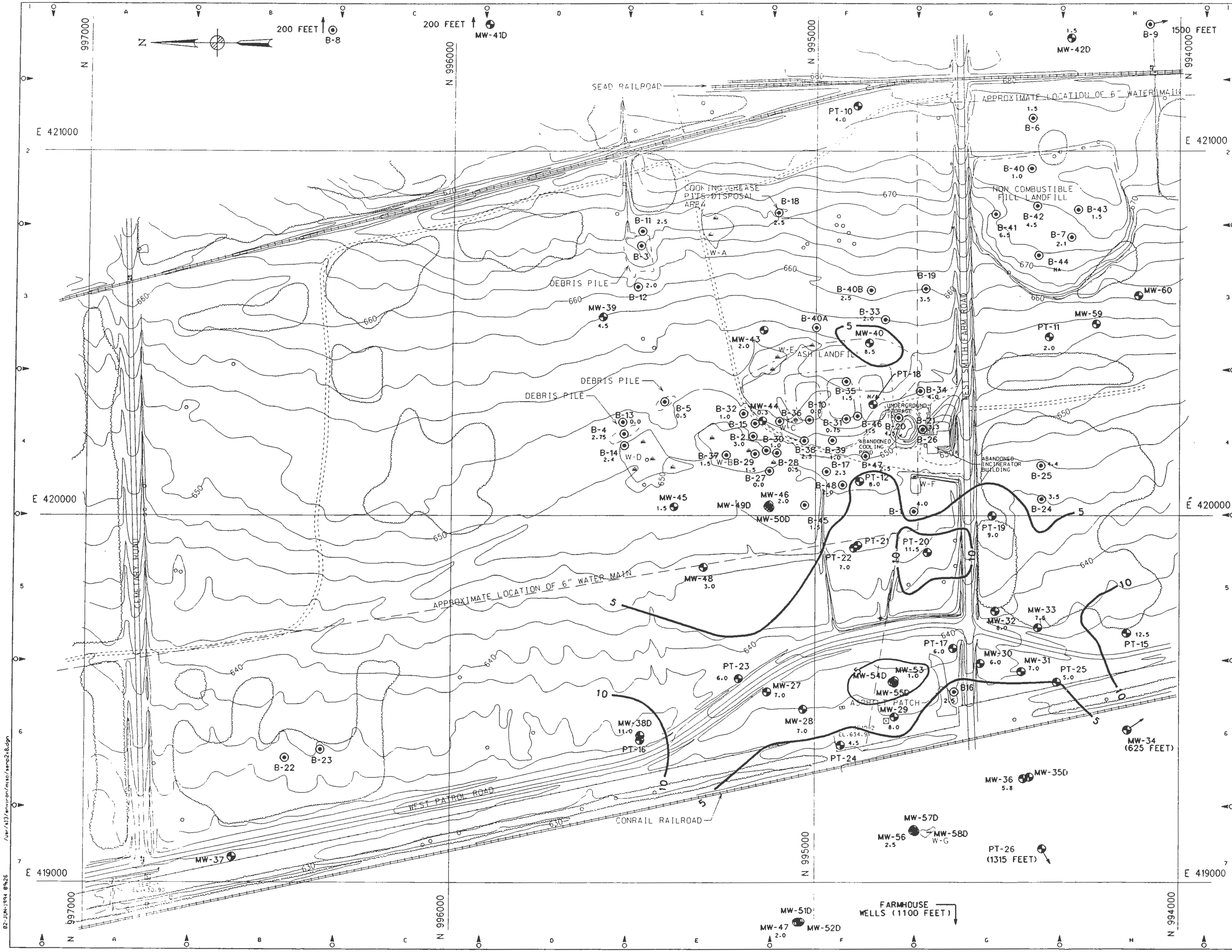
AVERAGE AND INDIVIDUAL BACKGROUND CONCENTRATIONS OF SELECTED HEAVY METALS IN SITE SOILS

SENECA ARMY DEPOT
ASH LANDFILL

INORGANICS	GB35–1 0–2	GB35–2 2–4	GB35–6 0–2	GB36–1 0–2	GB36–2 2–4
Metals	(OB)	(OB)	(OB)	(OB)	(OB)
Aluminum	18000	17600	16200	18100	16200
Antimony	2.9	6.8	6.3	5.9	2.9
Arsenic	6.2	7.7	5.3	4.6	9.7
Barium	93.6	61.7	61.7	74.8	50.8
Beryllium	0.85	0.74	0.77	0.77	0.65
Cadmium	0.165	0.155	0.175	0.15	0.165
Calcium	1590	17700	1370	1660	22900
Chromium	23.5	29.3	25.1	24.8	27.4
Cobalt	9.4	16.3	10.3	20.4	13.2
Copper	17.5	24.5	17.2	17.7	17.5
Iron	25200	34200	30800	26100	30700
Lead	14.4	5.4	19.1	12.7	6.2
Magnesium	3850	7790	4490	4490	7150
Manganese	701	646	775	426	507
Mercury	0.06	0.015	0.07	0.02	0.02
Nickel	26.3	48.7	28.3	28.3	42.8
Potassium	1110	1110	975	1400	1100
Selenium	0.115	0.115	0.105	0.1	0.09
Silver	0.17	0.16	0.18	0.155	0.17
Sodium	35.6	77.5	34.6	46.6	97.6
Thallium	0.275	0.27	0.25	0.23	0.215
Vanadium	27.1	22.3	26.1	27.8	19.7
Zinc	55	83.4	53.1	59.2	74.1
Cyanide	0.39	0.355	0.41	0.35	0.34

Notes:

1) All results are expressed in mg/kg.
2) All detects (no qualifier or J qualifier) were taken at full value.
All non–detects (U or UJ qualifier) were taken at half value.
3) 15 Background soil samples colleced from Phase I and II RI/FS investigations at the Ash Landfill (9 samples) and the Open Burning Grounds (6 samples).



LEGEND:

	PAVED ROAD
	DIRT ROAD
650	GROUND CONTOUR AND ELEVATION
○	TREE
W-B	WETLAND & DESIGNATION
	APPROXIMATE EXTENT OF FILL
	OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
	APPROXIMATE EXTENT OF DEBRIS PILE
	BRUSH
	CHAIN LINK FENCE
◦	UTILITY POLE
✦	APPROXIMATE LOCATION OF FIRE HYDRANT
⊂⊃	FUEL OR UNDERGROUND STORAGE TANK
⊠ SEAD-1 EL.630.90'	SURVEY MONUMENT
10	ISOPACH OF WEATHERED SHALE & THICKNESS IN FEET (DASHED WHERE INFERRED)
B-18 12.1 ⊙	SOIL BORING, DESIGNATION & THICKNESS OF WEATHERED SHALE ISOPACH IN FEET
PT-24 4.5 ⊕ MW-28 7.0	MONITORING WELL, DESIGNATION & THICKNESS OF WEATHERED SHALE ISOPACH IN FEET

REV	DATE	DESCRIPTION
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C	6/3/94	DRAFT-FINAL RI REPORT
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A.KAEUN	CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAEUN	RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER	MGR. OF ENGR. J.P.CHAPUCK
PROJECT MANAGER M.N.DUCHESNEAU	
MGR. OF PROJECTS J.P.CHAPUCK	
IN CHARGE W.D.PATTERSON	

DRAWN CHECKED DES.SUPV. RESP.ENGR. CH.DISC.ENG. PROJ. MGR. MF

ES

ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING NO.

FIGURE 3-6 WEATHERED SHALE ISOPACH MAP

SCALE 1" = 250'

ES'S DWG. NO. 720447-03000-3-2

REV C

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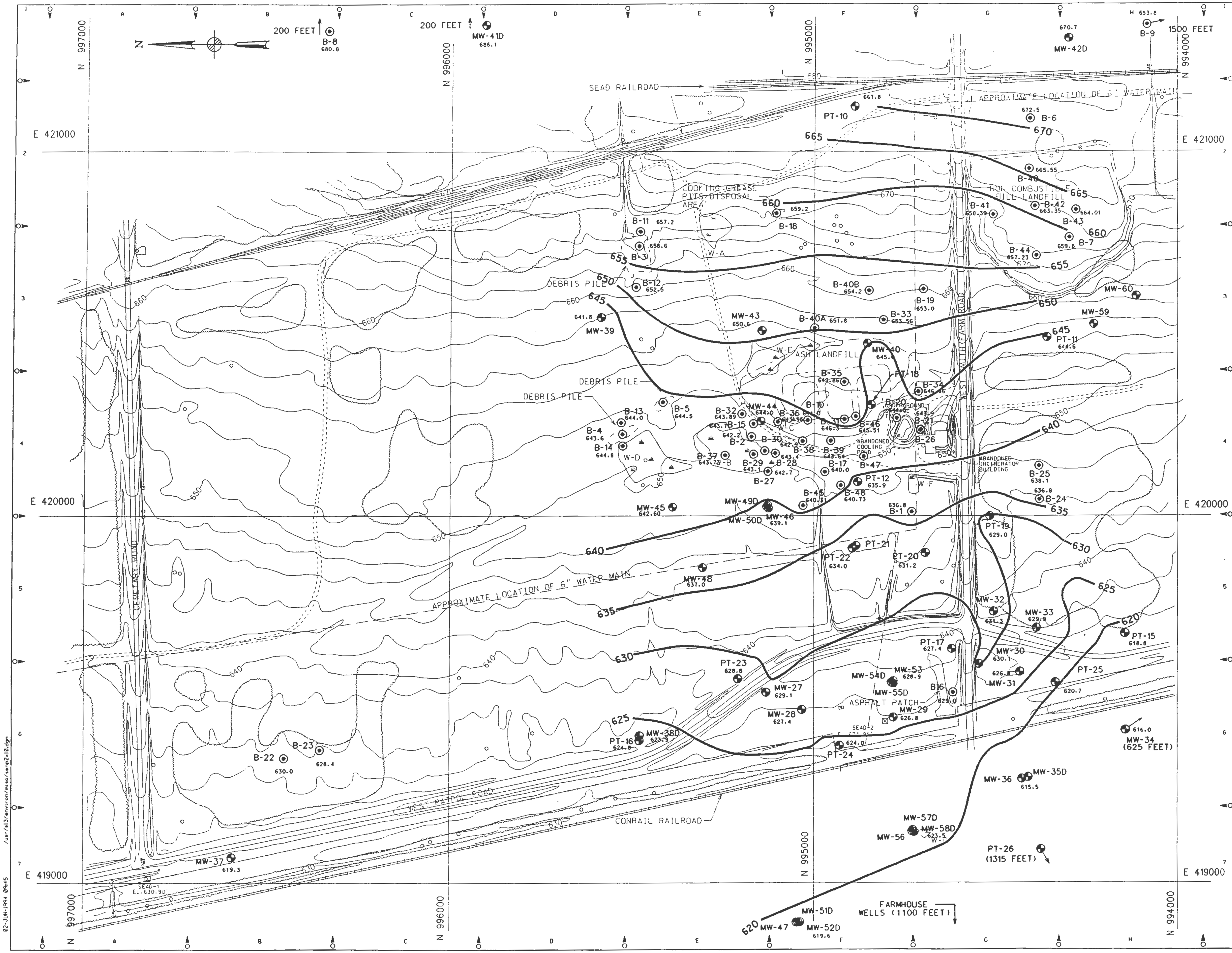
3.5.4 Competent Shale

The bedrock underlying the site is composed of the Ludlowville Formation of the Devonian age Hamilton Group. Merin (1992) also cites three prominent vertical joint directions of northeast, north-northwest, and east-northeast in outcrops of the Genesse Formation 30 miles southeast of the Ash Landfill site near Ithaca, New York. Three predominant joint directions, N60°E, N30°W, and N20°E are present within this unit (Mozola, 1952). These joints are primarily vertical. The Hamilton Group is a gray-black, calcareous shale that is fissile and exhibits parting (or separation) along bedding planes.

Gray competent shale was encountered between 6 and 14 feet below the land surface in all existing and newly performed borings on the site and in off-site surrounding areas. A competent shale topographic map (Figure 3-7) shows that topography slopes consistently to the west from an elevation of 720 feet in the eastern portion of the site to 614 feet in the western portion of the site. Bedrock topographic gradients are steepest in the eastern portion of the site (as is land surface topography) and in the southwestern portion of the site where they shift slightly to the southwest. A low ridge which protrudes from the area of PT-20 to MW-32 and MW-30 is a small anomaly in the bedrock topography. Based upon the available data, the competent bedrock surface flattens out under a cultivated field west of the Conrail railroad tracks.

The bedrock topographic map was developed based upon hollow stem auger refusal depths, blow counts from the soil borings and monitoring wells, and upon visual observations of the drilling supervisors. Boring and well log information from all of the available boring and well logs were used. In some instances, the determination of the elevation of the competent bedrock surface is subjective although generally, blow counts increase from 20 to 30 per 6 inches to over 100 blows per 6 inches when competent bedrock was encountered. In all instances, auger refusal was considered to be the top of the competent shale.

The characteristics of the competent shale were observed in a total of 236 feet of core collected during packer testing and monitoring well installation. Major characteristics of the bedrock cores include bedding plane fractures, breccia zones, tectonic joints, fossil beds, and minor deposits of iron sulfides. Bedding plan fractures were present throughout the competent shale although they were more well developed and more closely spaced near the top of the competent shale where they were observed to have a spacing of approximately 0.5 inches in the rock cores. Bedding plane fractures also tended to be filled with silt and clay



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LEGEND:

	PAVED ROAD
	DIRT ROAD
650	GROUND CONTOUR AND ELEVATION
○	TREE
W-B	WETLAND & DESIGNATION
	APPROXIMATE EXTENT OF FILL
	OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
	APPROXIMATE EXTENT OF DEBRIS PILE
	BRUSH
	CHAIN LINK FENCE
◊	UTILITY POLE
✦	APPROXIMATE LOCATION OF FIRE HYDRANT
⊂ ⊃	FUEL OR UNDERGROUND STORAGE TANK
☒ SEAD-1 EL.630.90'	SURVEY MONUMENT
B-19 653.0 ◉	SOIL BORING, DESIGNATION AND TOP OF BEDROCK ELEVATION
PT-24 624.0 ⊕ MW-28 627.4	MONITORING WELL DESIGNATION AND TOP OF BEDROCK ELEVATION
620	SHALE DEPTH CONTOUR

REV	DATE	DESCRIPTION
C	6/3/94	DRAFT-FINAL RI REPORT
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN | CHECKED | DES.SUPV. | RESP.ENGR. | CH.DISC.ENG. | PROJ. MGR. | | MF

DRAWN BY G.A.KAEUN	CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAEUN	RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER	MGR. OF ENGR. J.P.CHAPLICK

PROJECT MANAGER M.N.DUCHESNEAU

MGR. OF PROJECTS J.P.CHAPLICK

IN CHARGE W.D.PATTERSON

ES

ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING

NO.

FIGURE 3-7
COMPETENT SHALE
TOPOGRAPHY MAP

SCALE 1'' = 250'

ES'S DWG. NO. 720447-03000-3-1

REV C

near the top of the shale. Well defined bedding plane fractures were also noted by Merin (1992) in cores from well cemented, gray, thin-bedded siltstones of the Genessee Formation near Ithaca, New York. Generally, the fracture frequency decreased with depth as evidenced by the increase in RQDs. RQDs are the total length of recovered core sections over 4" in length expressed as a percentage of the interval cored. These data are summarized in Table 3-3. The core recoveries are influenced by the number of bedding plane fractures and tectonic fractures in the shale. Merin (1992) also noted that bedding plane fracture frequency decreased with depth in Devonian siltstones near Ithaca, New York.

Breccia zones are present in several of the cores at varying depths. These zones range from 3 to 12 inches thick and are composed of angular shale fragments in a fine silt and clay matrix. The upper and low contacts of these zones are generally sharp. The breccia is believed to have been formed during small tectonic movements along preexisting bedding plane fractures. No breccia zones were observed along any other type of fracture (e.g., vertical fracture or low angle fracture) except for bedding plane fractures. Brecciated zones were identified in cores for monitoring wells MW-49D (4"-thick zone at 24 feet), MW-50D (12"-thick zone at 41 feet), MW-52D (3"-thick zone at 40 feet), MW-54D (8" thick zone at 30 feet), MW-55D (3"-thick zone at 50 feet), and MW-55D (3" thick zone at 20 feet).

Joint fractures were very common in the competent shale. They were observed in most cores at a variety of angles (between 5° and 90°) although most tended to be between 30° and 60°. Below the top of the competent shale fractures were less than a millimeter thick. They were generally free of silt or clay except in the upper few feet of the shale where they were filled with silt and clay. In some instances, the fractures were filled with a secondary calcium carbonate mineral. The spacing between the joints was usually 4-5 inches in the 0 to 20-foot upper zone of the competent shale; joints spacings below 20 feet were variable but were generally greater than 4-5 inches. The orientation of the joints in space could not be determined because the drilling program did not require the collection of oriented cores.

Thin fossil beds were present at many locations in the shale. The beds ranged in thickness from less than 1 inch to 3 inches. Occasionally only a single fossil was seen in the shale and not associated with an accumulation bed. The fossil beds provide planes of weakness in the shale and were almost always associated with bedding plane fractures. They tended to be composed of the fossil types described in Section 2.0.

TABLE 3 – 3

RQDs IN COMPETENT SHALE

SENECA ARMY DEPOT
ASH LANDFILL

WELL	DEPTH RANGE	AVERAGE DEPTH	RQD %
MW–49D	FROM: 11.0 TO: 14.3	12.6	28
	FROM: 14.3 TO: 15.5	14.9	60
	FROM: 15.5 TO: 18.5	17.0	66
	FROM: 18.5 TO: 20.5	19.5	85
	FROM: 20.5 TO: 24.5	22.5	75
	FROM: 24.5 TO: 25.5	25.0	60
	FROM: 25.5 TO: 30.5	28.0	80
	FROM: 30.5 TO: 35.5	33.0	75
MW–50D	FROM: 35.5 TO: 40.2	37.9	79
	FROM: 40.2 TO: 45.5	42.9	67
	FROM: 45.5 TO: 50.5	48.0	76
	FROM: 50.5 TO: 54.9	52.7	98
	FROM: 54.9 TO: 58.5	56.7	99
MW–51D	FROM: 7.5 TO: 10.0	8.8	40
	FROM: 10.0 TO: 15.0	12.5	50
	FROM: 15.0 TO: 16.5	15.8	66
	FROM: 16.5 TO: 19.5	18.0	NA
	FROM: 19.5 TO: 24.3	21.9	10
	FROM: 24.3 TO: 29.3	26.8	43
	FROM: 29.3 TO: 34.3	31.8	29
MW–52D	FROM: 34.3 TO: 40.4	37.4	NA
	FROM: 40.5 TO: 45.5	43.0	NA
	FROM: 45.5 TO: 48.5	47.0	87
	FROM: 48.5 TO: 57.5	53.0	NA
	FROM: 57.5 TO: 65.5	61.5	NA
	FROM: 65.5 TO: 75.5	70.5	NA
	FROM: 75.5 TO: 80.5	78.0	94
	FROM: 80.5 TO: 84.5	82.5	NA
	FROM: 84.5 TO: 89.2	86.9	52
	FROM: 90.0 TO: 94.5	92.3	92
	FROM: 95.0 TO: 100.0	97.5	95
MW–54D	FROM: 8.0 TO: 10.5	9.3	0
	FROM: 10.5 TO: 15.5	13.0	74
	FROM: 15.5 TO: 20.5	18.0	85
	FROM: 20.5 TO: 22.5	21.5	25
	FROM: 22.5 TO: 25.5	24.0	72
	FROM: 25.5 TO: 30.5	28.0	58
	FROM: 30.5 TO: 33.0	31.8	76
MW–55D	FROM: 33.0 TO: 34.8	33.9	31
	FROM: 34.8 TO: 40.0	37.4	16
	FROM: 40.0 TO: 44.8	42.4	44
	FROM: 44.8 TO: 50.0	47.4	37
	FROM: 50.0 TO: 53.0	51.5	50
MW–57D	FROM: 8.0 TO: 10.5	9.3	0
	FROM: 10.5 TO: 15.5	13.0	15
	FROM: 15.5 TO: 20.5	18.0	86
	FROM: 20.5 TO: 25.5	23.0	22
	FROM: 25.5 TO: 30.5	28.0	69
	FROM: 30.5 TO: 33.0	31.8	100
MW–58D	FROM: 33.0 TO: 35.0	34.0	88
	FROM: 35.0 TO: 39.8	37.4	86
	FROM: 39.8 TO: 44.6	42.2	44
	FROM: 44.6 TO: 49.8	47.2	46
	FROM: 49.8 TO: 56.0	52.9	75

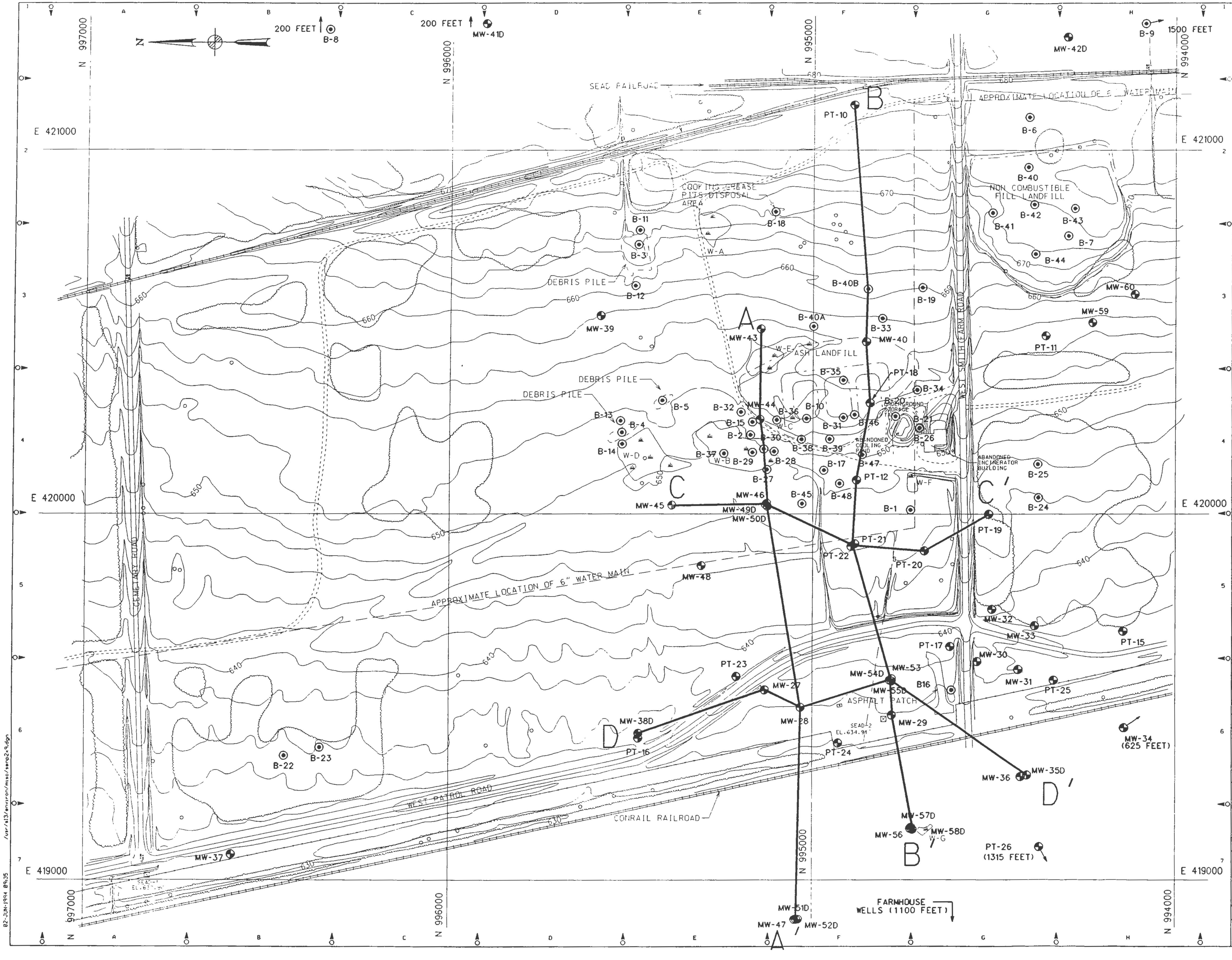
Iron sulfides were present throughout the cores; however, they were more abundant below 80 feet. Evidence for this is available only from the core for MW-52 which penetrated to 100 feet below the land surface.

3.5.5 Site Stratigraphy

Four geologic cross-sections were constructed for the site. The locations of these sections are shown in Figure 3-8. East-west cross-sections A-A′ and B-B′ and north-south cross-sections C-C′ and D-D′ show the consistent till, weathered shale, competent shale stratigraphy beneath the site based on data from borings and monitoring wells (Figures 3-9 through 3-12). All cross-sections illustrate the variable thicknesses of the weathered shale and the till, which appears to thicken in the western portion of the site. The Ash Landfill, up to 4 feet-thick, is shown on sections A-A′ and B-B′. The sections were drawn to provide a somewhat detailed view of the subsurface stratigraphy by intersecting as many data points (i.e., soil borings or monitoring wells) as possible while maintaining a uniform direction for the cross-section. The scale of the sections did not permit identification of a soil horizon.

3.5.6 Filled Areas

Three types of filled areas were identified on the site. These are the Ash Landfill, the non-combustible fill landfill, and debris piles. The Ash Landfill and non-combustible fill landfill are clearly defined, contiguous features whereas the debris piles are smaller and less pronounced. The Ash Landfill is defined by a low vegetated topographic high and is composed of dark brown to black ash that was spread over an approximately 300 x 500 foot area during operation of the incinerator. The ash is up to 4 feet thick. The extent of the Ash Landfill was identified by numerous borings. The non-combustible fill landfill is defined by a wedge-shaped feature that thickens to the west. It is located southeast of the Ash Landfill across West Smith Farm Road. This area contains mostly construction debris. It is well defined by the topographic expression of the fill which has a total relief of about 14 feet at the western toe. The three debris piles are defined by blackened areas with only a slight topographic relief. These areas are composed of ash, and pieces of burned wood and debris. Based on topographic expression, fill may also exist in other areas of the site such as beneath the southeastern portion of the incinerator building and as a component on the cooling pad walls.



/usr/al3/environ/misc/seng2x9.dgn

02-JUN-1994 09:35

LEGEND:

	PAVED ROAD
	DIRT ROAD
650	GROUND CONTOUR AND ELEVATION
	TREE
W-E	WETLAND & DESIGNATION
	APPROXIMATE EXTENT OF FILL
	OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
	APPROXIMATE EXTENT OF DEBRIS PILE
	BRUSH
	CHAIN LINK FENCE
◇	UTILITY POLE
✦	APPROXIMATE LOCATION OF FIRE HYDRANT
	FUEL OR UNDERGROUND STORAGE TANK
☒ SEAD-1 EL.630.90'	SURVEY MONUMENT
C'	LOCATION OF SITE CROSS SECTION AND DESIGNATION
B-43 ⊙	SOIL BORING & DESIGNATION
PT-22 ● MW-37	MONITORING WELL AND DESIGNATION

REV	DATE	DESCRIPTION
	/ /	
	/ /	
	/ /	
	/ /	
	/ /	
	/ /	
	/ /	
	/ /	
	/ /	
	/ /	
	/ /	
	/ /	
	/ /	
C	6/3/94	DRAFT-FINAL RI REPORT
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN
CHECKED
DES.SUPV.
RESP.ENGR.
CH.DISC.ENG.
PROJ. MGR.
MF

DRAWN BY G.A.KAELIN	CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAELIN	RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER	MGR. OF ENGR. J.P.CHAPLICK

PROJECT MANAGER M.N.DUCHESNEAU
MGR. OF PROJECTS J.P.CHAPLICK
IN CHARGE W.D.PATTERSON

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY ASH LANDFILL

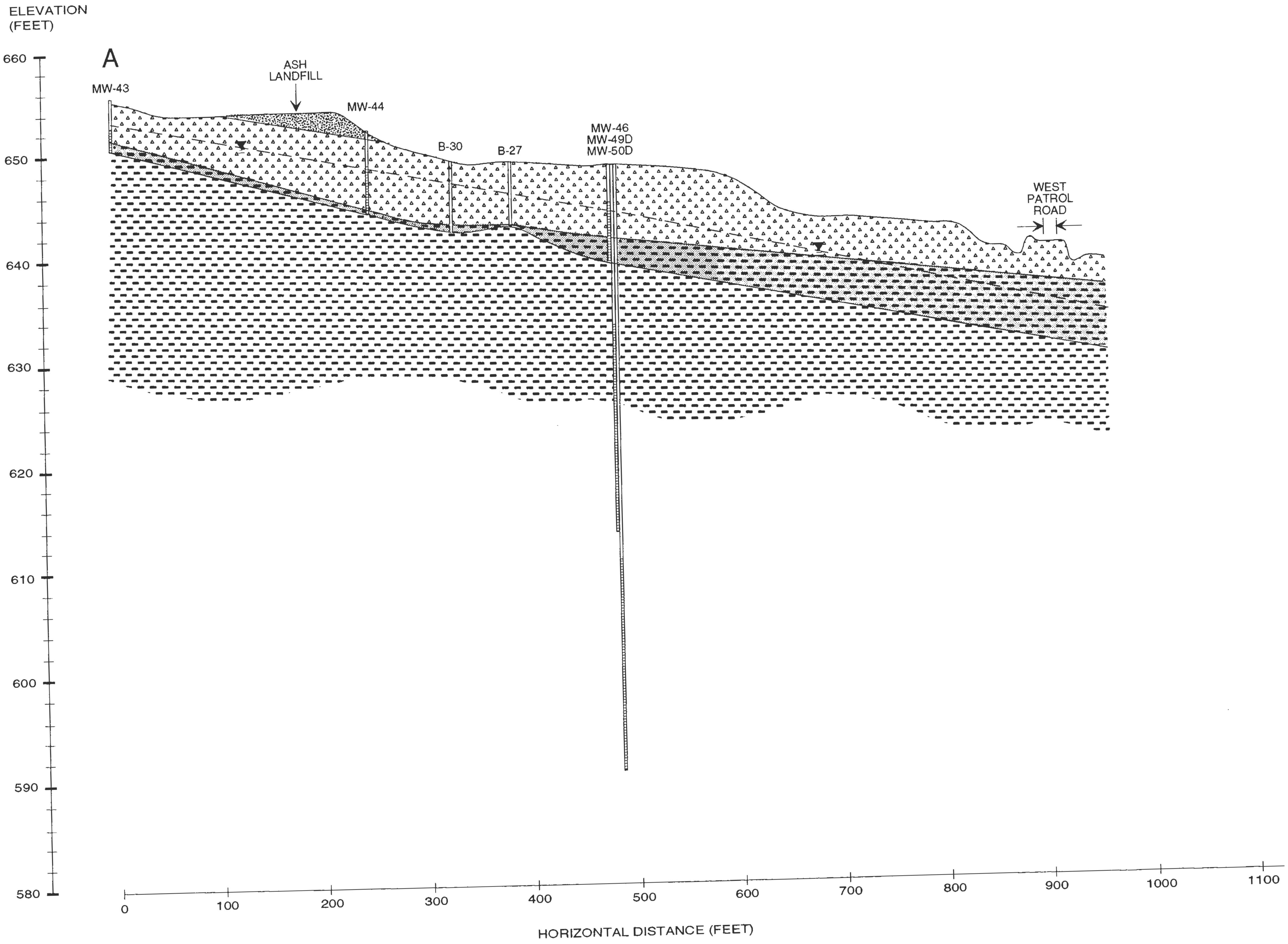
DEPT. ENVIRONMENTAL ENGINEERING
NO.

FIGURE 3-8
LOCATIONS
GEOLOGIC CROSS SECTIONS

SCALE 1" = 250'

ES'S DWG. NO. 720447-03000-3-3
REV C

CROSS SECTION A - A'



NOTES:

1. Lithologic units are based on descriptions supplied by Engineering-Science, Inc. Interpretations are based on extrapolations between widely spaced boreholes, actual conditions may vary.

2. Groundwater table based on depth to water measurements made in June 1993.

MW-44

Monitoring Well Designation with Screened Interval

LEGEND:

▨	FILL
△	TILL
▨	WEATHERED SHALE
▭	COMPETENT SHALE
— ▼ —	GROUNDWATER TABLE

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

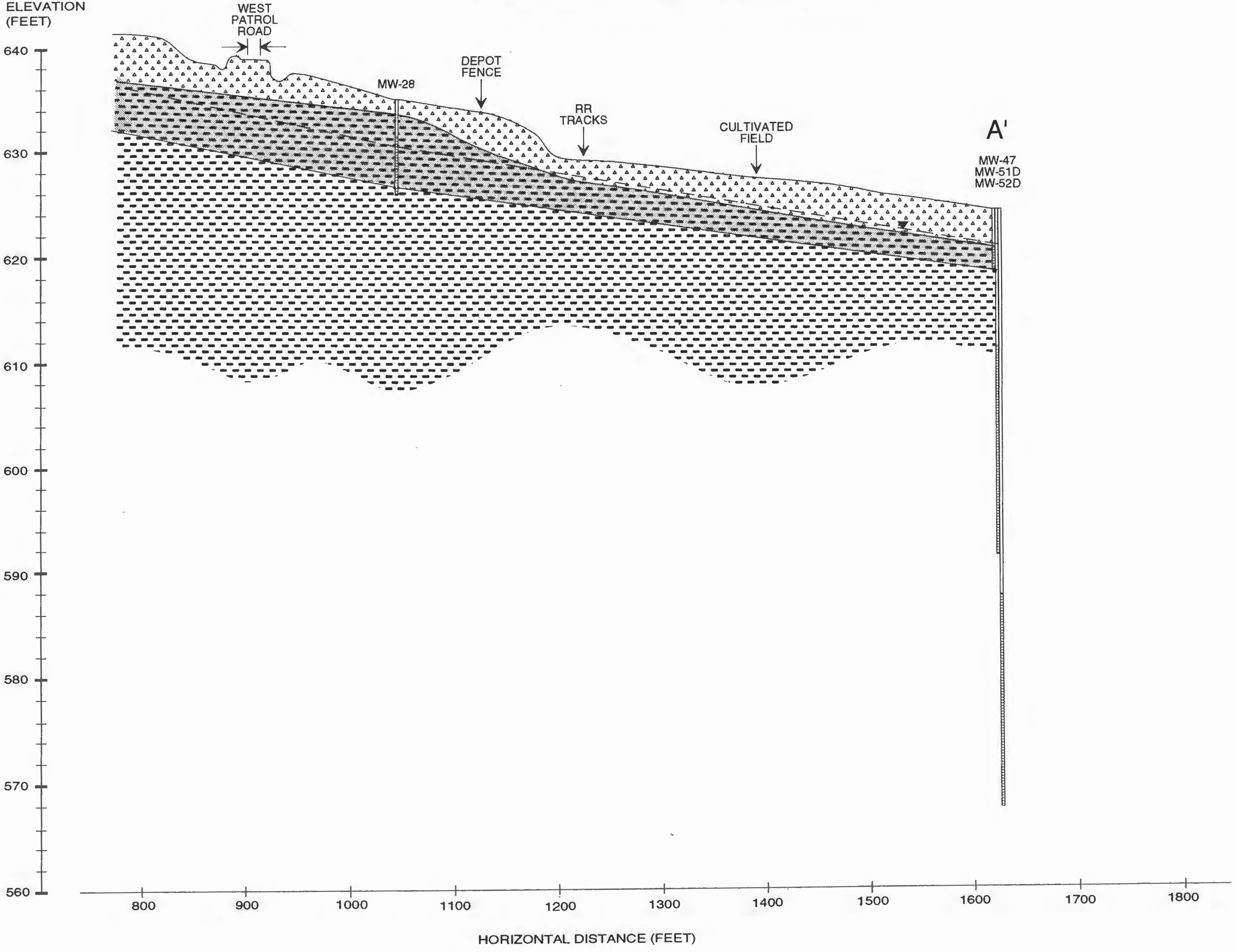
DEPT. ENVIRONMENTAL ENGINEERING
NO 720447-03000

FIGURE 3-9

CROSS-SECTION A - A'

SCALE HORIZONTAL : 1" = 100' VERTICAL 1" = 10'

CROSS SECTION A - A' (Continued)



NOTES:

1. Lithologic units are based on descriptions supplied by Engineering-Science, Inc. Interpretations are based on extrapolations between widely spaced boreholes, actual conditions may vary.
2. Groundwater table based on depth to water measurements made in June 1993.

MW-44

Monitoring Well Designation with Screened Interval

LEGEND:

▩ FILL

▨ TILL

▦ WEATHERED SHALE

▤ COMPETENT SHALE

— ▼ — GROUNDWATER TABLE

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

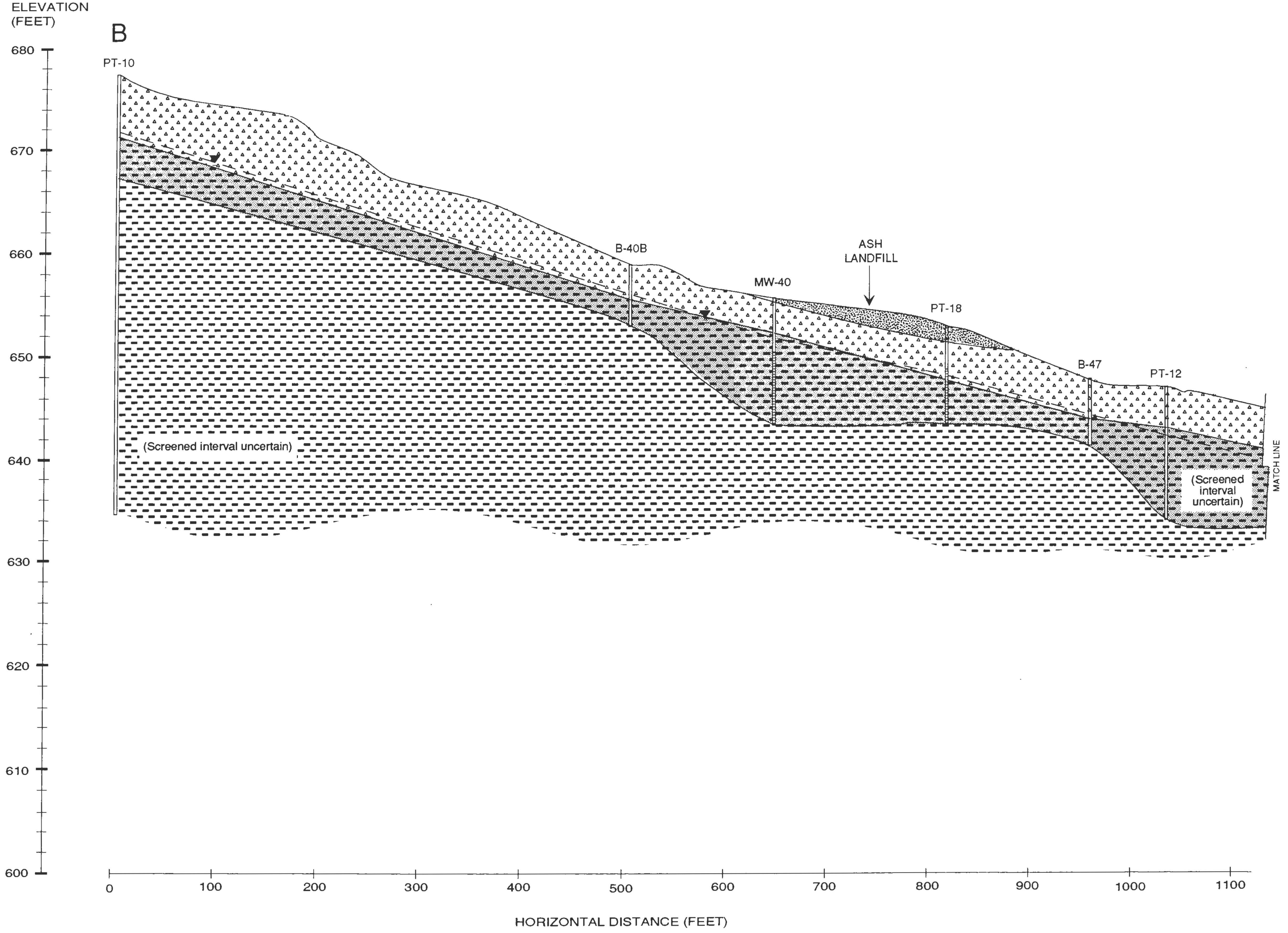
DEPT. ENVIRONMENTAL ENGINEERING | NO. 720447-03000

FIGURE 3-9

CROSS-SECTION A - A' (Continued)

SCALE HORIZONTAL : 1" = 100' VERTICAL 1" = 10'

CROSS SECTION B - B'



NOTES:

1. Lithologic units are based on descriptions supplied by Engineering-Science, Inc. Interpretations are based on extrapolations between widely spaced boreholes, actual conditions may vary.

2. Groundwater table based on depth to water measurements made in June 1993.

MW-44

Monitoring Well Designation with Screened Interval

LEGEND:

▨ FILL

▨ TILL

▨ WEATHERED SHALE

▨ COMPETENT SHALE

— ▼ — GROUNDWATER TABLE

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

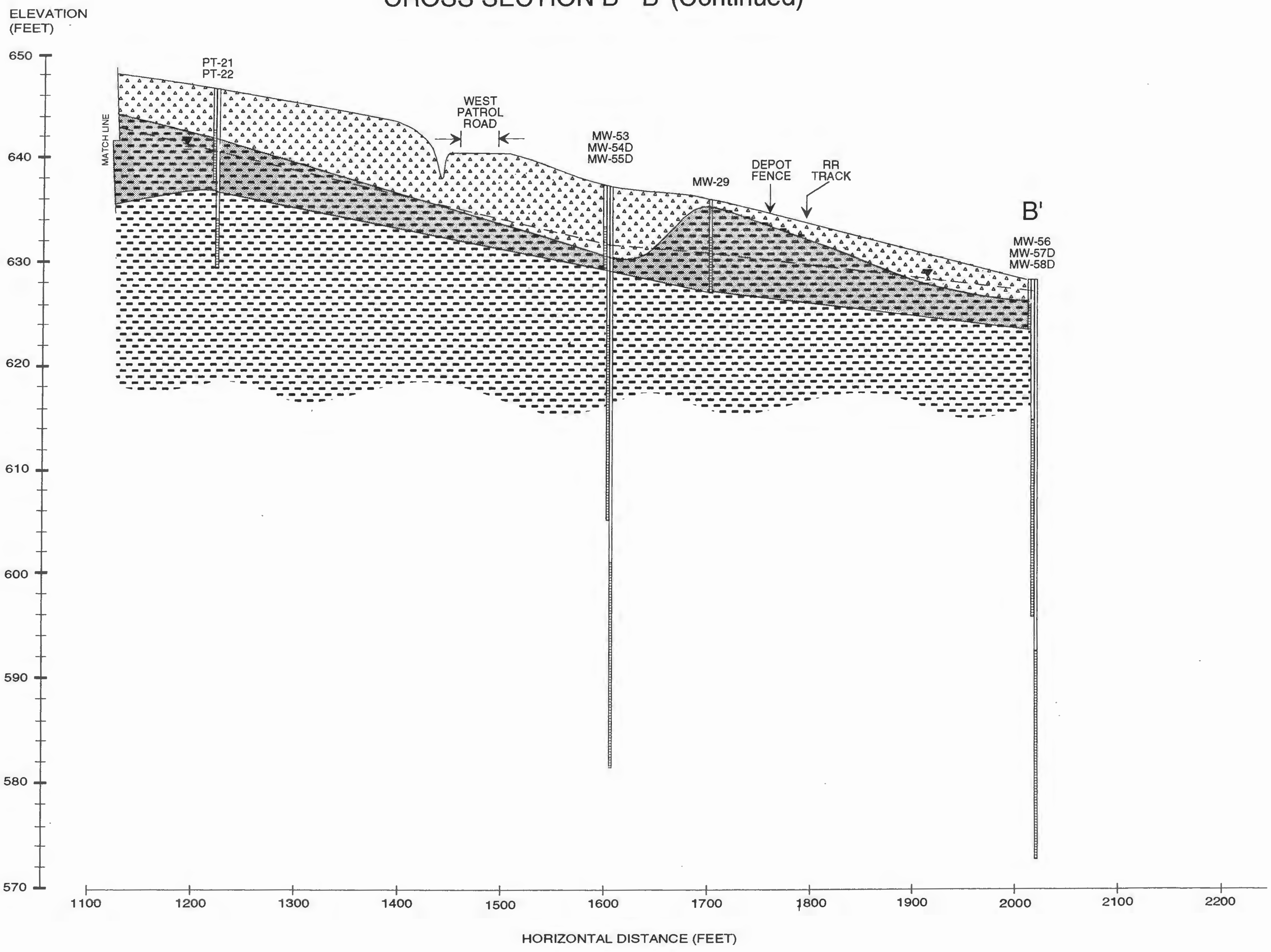
DEPT. ENVIRONMENTAL ENGINEERING | NO 720447-03000

FIGURE 3-10

CROSS-SECTION B - B'

SCALE HORIZONTAL : 1" = 100' VERTICAL 1" = 10'

CROSS SECTION B - B' (Continued)



NOTES:

1. Lithologic units are based on descriptions supplied by Engineering-Science, Inc. Interpretations are based on extrapolations between widely spaced boreholes, actual conditions may vary.
2. Groundwater table based on depth to water measurements made in June 1993.

MW-44

Monitoring Well Designation with Screened Interval

LEGEND:

- ▨ FILL
- △ TILL
- ▤ WEATHERED SHALE
- ▭ COMPETENT SHALE
- — ▼ — GROUNDWATER TABLE

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

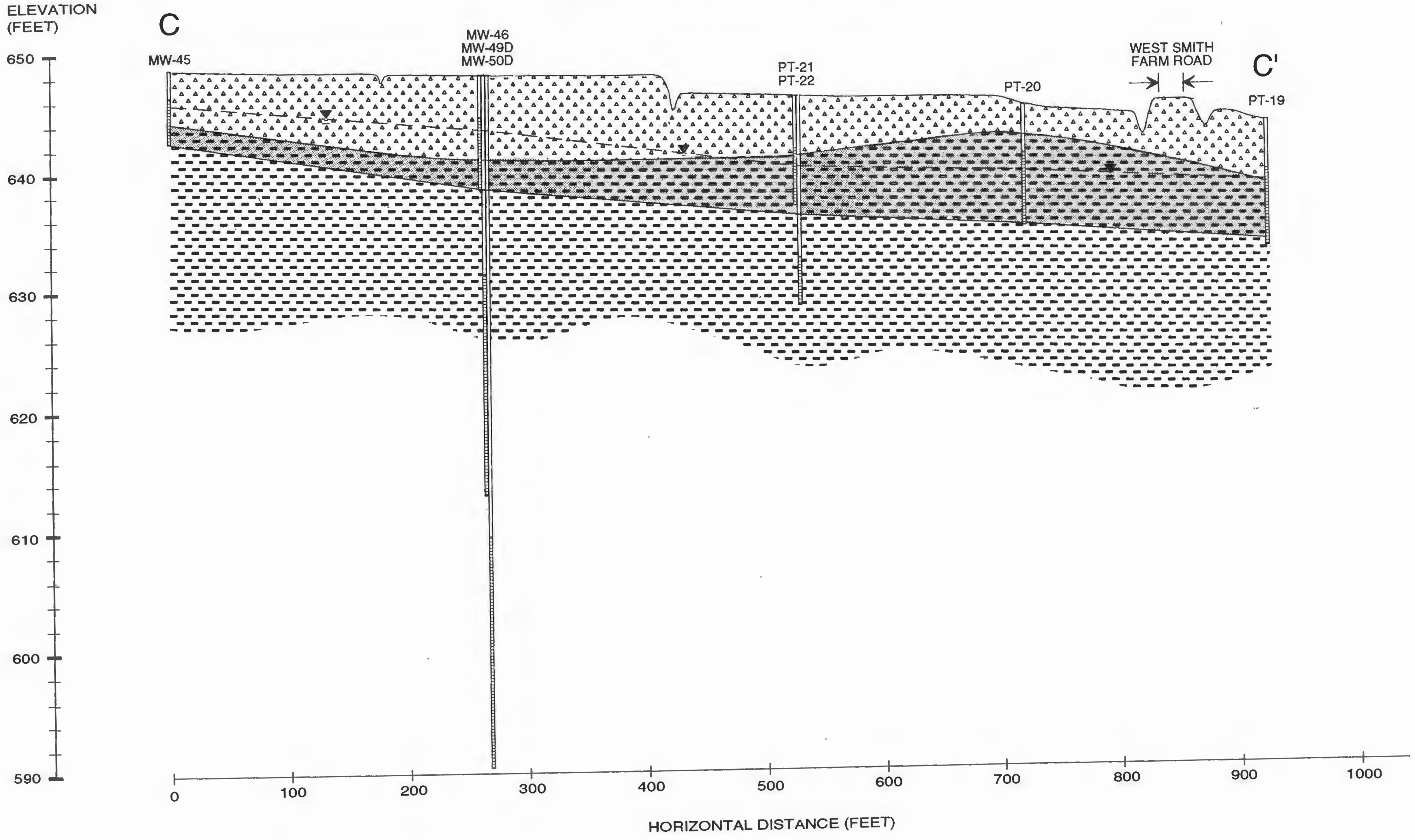
DEPT. ENVIRONMENTAL ENGINEERING	NO. 720447-03000

FIGURE 3-10

CROSS-SECTION B - B' (Continued)

SCALE HORIZONTAL : 1" = 100' VERTICAL 1" = 10'

CROSS SECTION C - C'



NOTES:

1. Lithologic units are based on descriptions supplied by Engineering-Science, Inc. Interpretations are based on extrapolations between widely spaced boreholes, actual conditions may vary.
2. Groundwater table based on depth to water measurements made in June 1993.

MW-44

Monitoring Well Designation with Screened Interval

LEGEND:

▩ FILL

▨ TILL

▦ WEATHERED SHALE

▤ COMPETENT SHALE

— ▼ — GROUNDWATER TABLE

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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

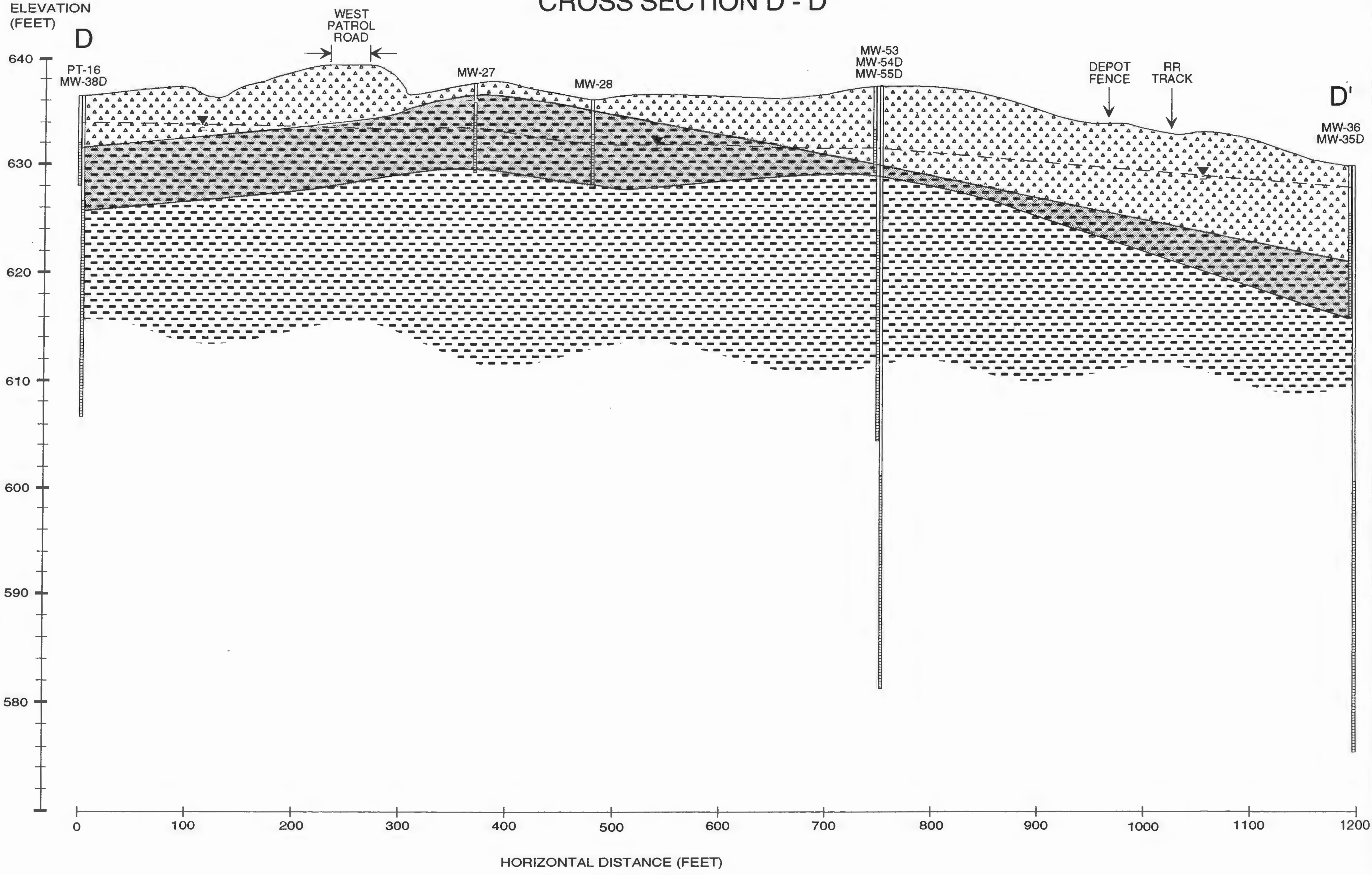
DEPT ENVIRONMENTAL ENGINEERING NO 720447-03000

FIGURE 3-11

CROSS-SECTION C- C'

SCALE HORIZONTAL : 1" = 100' VERTICAL 1" = 10'

CROSS SECTION D - D'



NOTES:

1. Lithologic units are based on descriptions supplied by Engineering-Science, Inc. Interpretations are based on extrapolations between widely spaced boreholes, actual conditions may vary.

2. Groundwater table based on depth to water measurements made in June 1993.

MW-44

Monitoring Well Designation with Screened Interval

LEGEND:

▨ FILL

▨ TILL

▨ WEATHERED SHALE

▨ COMPETENT SHALE

— ▼ — GROUNDWATER TABLE

ES

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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING | NO 720447-03000

FIGURE 3-12

CROSS-SECTION D - D'

SCALE HORIZONTAL : 1" = 100' VERTICAL 1" = 10'

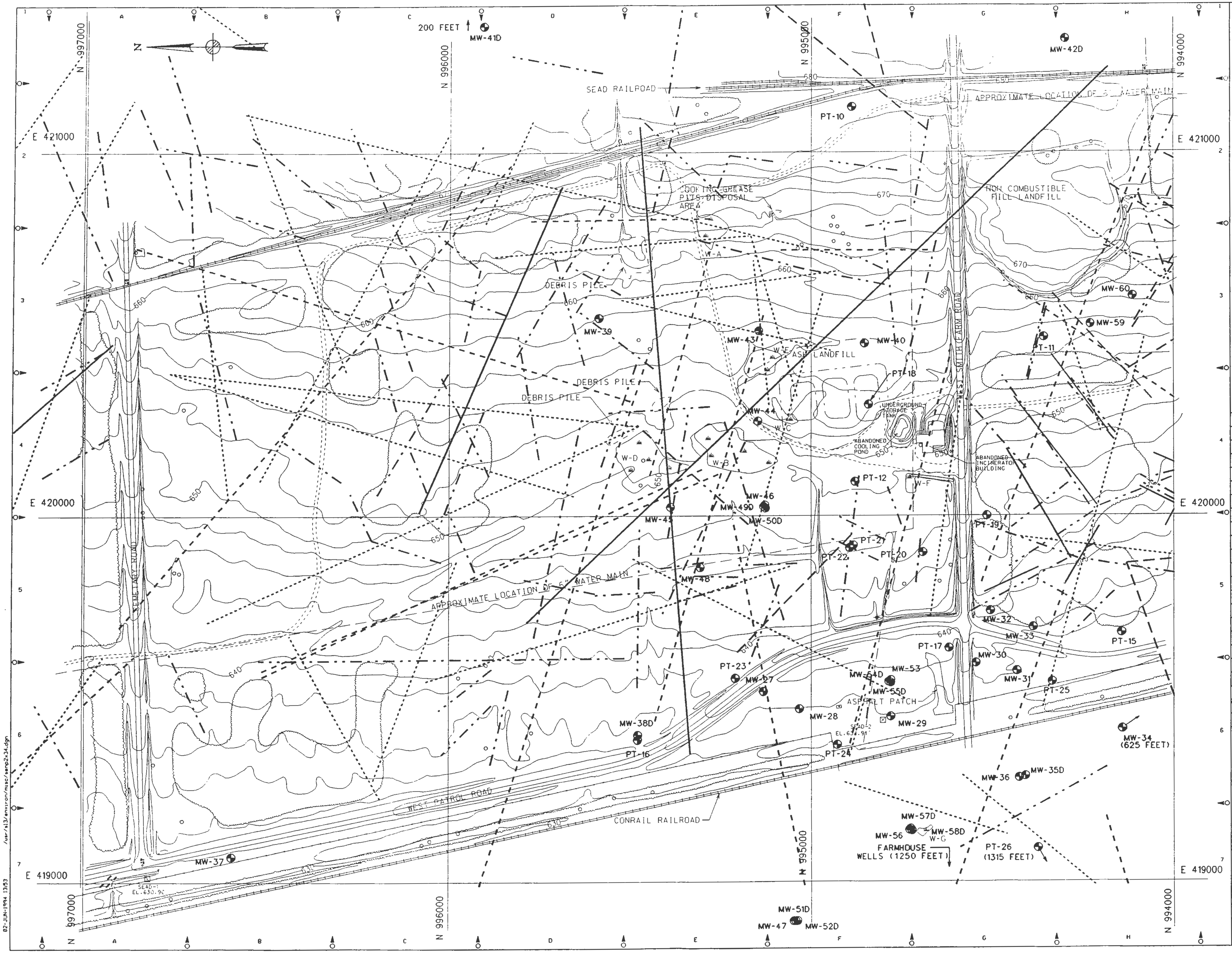
3.5.7 Photo Lineament and Fracture Trace Study

As described in Section 2.8, a photo lineament and bedrock fracture trace investigation was performed to delineate any areas downgradient of the Ash Landfill where a significant fractured bedrock aquifer might be identified. The analysis of the photo lineament and bedrock fracture trace data together provide information on the predominant fractures in bedrock that exist on a regional and local scale in the vicinity of the Ash Landfill site. Generally, the orientation of lineaments identified during the air photo interpretation was corroborated by the bedrock fracture trace measurements made at various outcrop locations within the study area.

The results of the photo lineament and bedrock fracture trace investigation are summarized in maps, histograms and rose diagrams. The air photo lineaments identified during the analysis of all three platforms are shown in Figure 3-13. Within this figure the photo lineaments identified on the various platforms are differentiated by line type. Figure 3-14 shows a histogram and rose diagram for the photo lineaments shown in Figure 3-13. Figure 3-15 presents a histogram and rose diagram of the bedrock fracture trace measurements made at all outcrop locations. These data together provided the basis upon which the location of monitoring well cluster MW-53, MW-54D and MW-55D was chosen.

The histogram and rose diagram shown in Figure 3-14 indicate a large degree of scatter within these data. A major peak is present at approximately 300 degrees. These northwest trending photo lineaments are obvious in Figure 3-13 where they represent some of the longer lineaments and have been identified on all platforms. While the histogram and rose diagram data suggest a single major peak along the northwest trend, an analysis of the photo lineaments shown in Figure 3-13 suggest two photo lineament sets prevalent along the north-northwest and west-northwest directions. A subtle trend of east-northeast (150 degrees) also appears to be present within these data.

The fracture trace histogram and rose diagram data for all outcrop locations shown in Figure 3-15 indicate two predominant fracture directions are present within the bedrock. The major fracture orientation has been identified at approximately 75 degrees or east-northeast. A second more subtle orientation has been identified at approximately 150 degrees or south-southeast. As could be expected, the bedrock fracture trace data show a much more distinct, readily identifiable fracture orientation for the bedrocks that indicates the major fracturing is present along the east-northeast direction with a conjugate fracture set present approximately



LEGEND:

- PAVED ROAD
- DIRT ROAD
- GROUND CONTOUR AND ELEVATION
- TREE
- WETLAND & DESIGNATION
- APPROXIMATE EXTENT OF FILL
- OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
- APPROXIMATE EXTENT OF DEBRIS PILE
- BRUSH
- CHAIN LINK FENCE
- UTILITY POLE
- APPROXIMATE LOCATION OF FIRE HYDRANT
- FUEL OR UNDERGROUND STORAGE TANK
- SURVEY MONUMENT (SEAD-1 EL. 630.90')
- MONITORING WELL AND DESIGNATION (PT-22, MW-37)
- PLATFORM A
- PLATFORM B
- PLATFORM C

REV	DATE	DESCRIPTION
C	6/3/94	DRAFT-FINAL RI REPORT
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN | CHECKED | DES.SUPV. | RESP.ENGR. | CH.DISC.ENG. | PROJ. MGR. | MF

DRAWN BY G.A.KAELIN
CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAELIN
RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER
MGR. OF ENGR. J.P.CHAPLUCK
PROJECT MANAGER M.N.DUCHESNEAU
MGR. OF PROJECTS J.P.CHAPLUCK
IN CHARGE W.D.PATTERSON

ES

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CLIENT/PROJECT TITLE

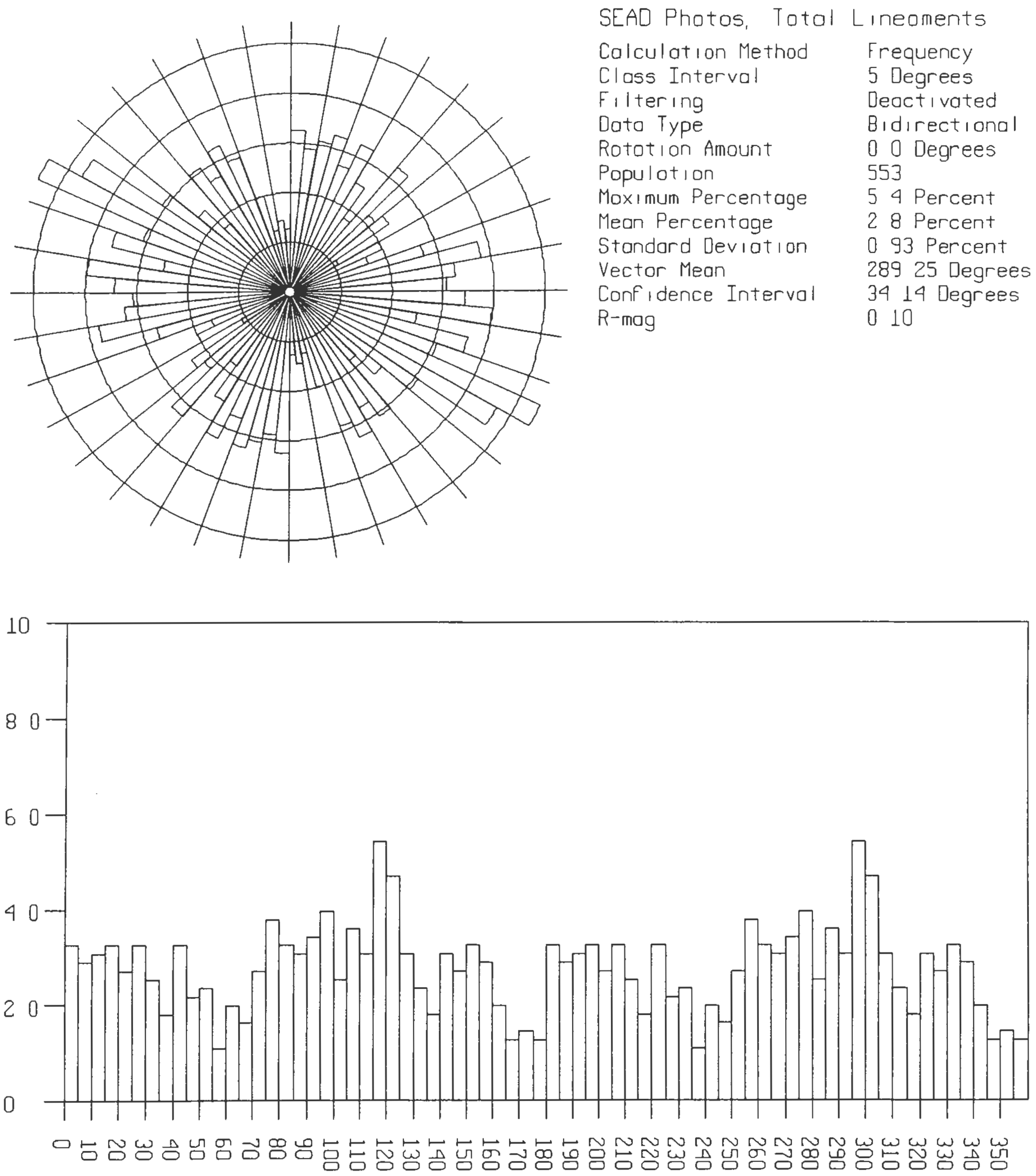
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO.

FIGURE 3-13
LINEAMENTS ON AND IN THE VICINITY OF THE ASH LANDFILL

SCALE 1" = 250'

ES'S DWG. NO. 720447-03000-1-1
REV C



Calculation Method	Frequency
Class Interval	5 Degrees
Filtering	Deactivated
Data Type	Bidirectional
Rotation Amount	0 0 Degrees
Population	553
Maximum Percentage	5 4 Percent
Mean Percentage	2 8 Percent
Standard Deviation	0 93 Percent
Vector Mean	289 25 Degrees
Confidence Interval	34 14 Degrees
R-mag	0 10

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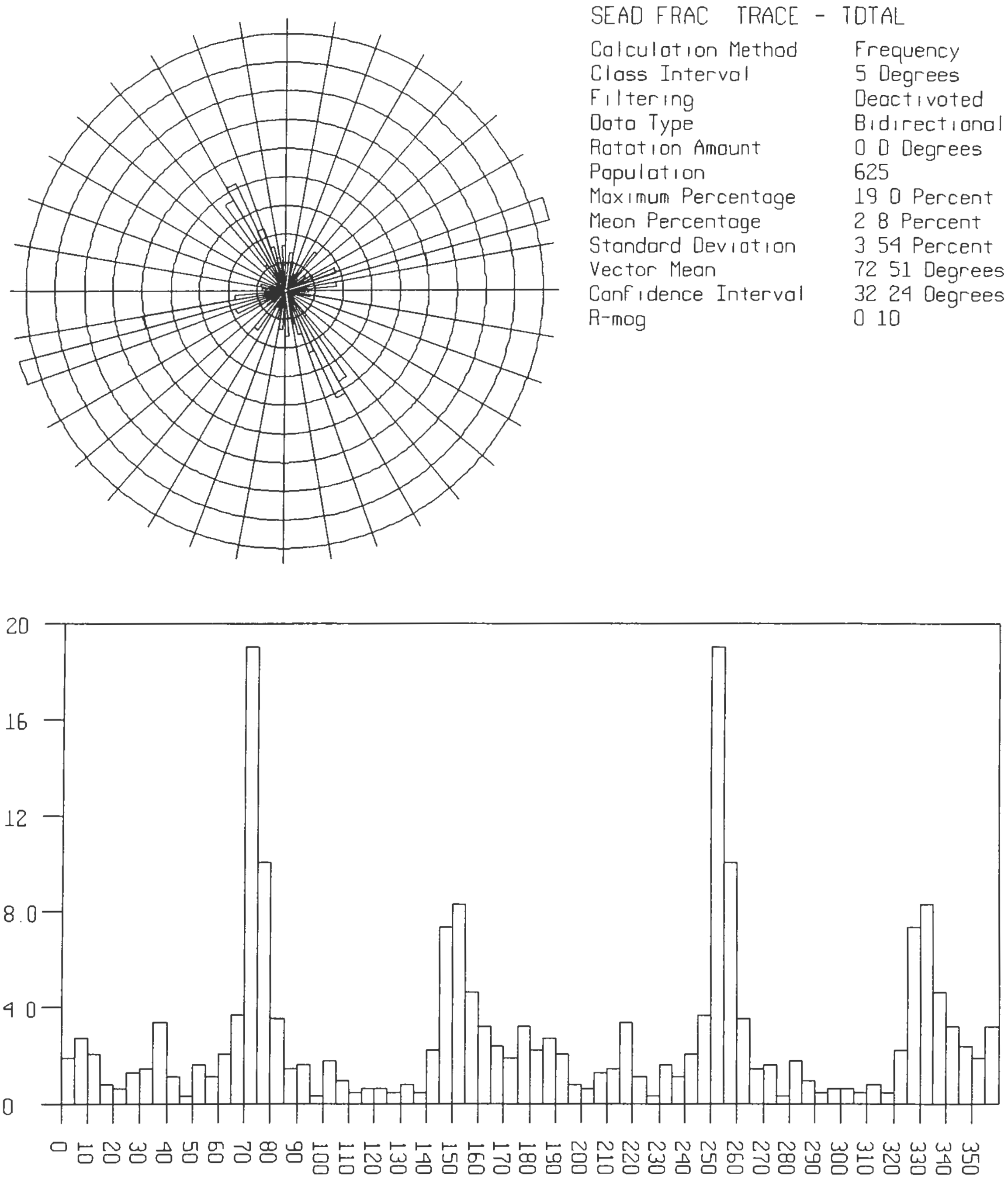
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING	NO. 720447-01000

FIGURE 3-14
PHOTOLINEAMENT HISTOGRAM AND ROSE DIAGRAM FOR PLATFORMS A, B, AND C

SCALE



SEAD FRAC TRACE - TOTAL

Calculation Method	Frequency
Class Interval	5 Degrees
Filtering	Deactivated
Data Type	Bidirectional
Rotation Amount	0.0 Degrees
Population	625
Maximum Percentage	19.0 Percent
Mean Percentage	2.8 Percent
Standard Deviation	3.54 Percent
Vector Mean	72.51 Degrees
Confidence Interval	32.24 Degrees
R-mag	0.10

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REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT ENVIRONMENTAL ENGINEERING
NO. 720447-01000

FIGURE 3-15

FRACTURE TRACE HISTOGRAMAND ROSE DIAGRAM FOR ALL OUTCROP LOCATIONS

SCALE

perpendicular to this along the east-southeast direction. Due to the wide scatter present within the photo lineament data, there is little direct correlation between these two data sets. Thus while the fracture trace data show two fracture sets, the regional scale air photo interpretation shows few readily observable photo lineaments that correlate with the outcrop data. This is not unexpected given the generally uniformed nature of the bedrock at the site.

The location of monitoring well cluster MW-53, MW-54D, and MW-55D was chosen based upon an analysis of both the geologic and geophysical data. A downgradient location was identified where photo lineaments with a north-northeast and west-northwest direction intersected. It was believed that this location might represent an area of increased permeability within the bedrock. This location also represents the only downgradient location where a significant photo lineament intersection was identified.

3.6 GEOPHYSICS

3.6.1 Introduction

Three separate geophysical investigations were performed during the Ash Landfill Remedial Investigation. During Phase I an EM-31 survey was performed to help identify any additional areas at the site where waste disposal may have occurred. To support this investigation, follow-up radar survey was conducted to further evaluate the possible sources of the EM-31 anomalies. During Phase II, a VLF-EM survey was conducted within the area surrounding, and downgradient of the Ash Landfill. The objective of this survey was to identify areas where bedrock fractures may exist thereby locally increasing the permeability of the competent shale bedrock. The results of these various investigations are summarized in detail below.

3.6.2 EM-31 Survey

The EM-31 terrain conductivity survey identified anomalies within both Area 1 and Area 2 at the Ash Landfill site. Anomalies defined by elevated conductivity and in-phase measurements were identified by plots of the conductivity and in-phase data collected along survey lines. Survey line plots of measured conductivity and in-phase readings show good correlation along each survey line profile (Appendix B). Anomalies are indicated by the unusually high or low conductivity and/or in-phase measurements. Conductivity anomalies were considered to represent readings above or below the typical background measurements ranging from 10.5 to 13.5 milli siemens/meter. In-phase anomalies were compared to conductivity anomalies to determine potential locations for buried metallic material along each survey line.

A summary of EM-31 anomaly locations along survey lines are presented on Table 3-4. The EM-31 survey data was also used to prepare conductivity and in-phase contour maps for the two areas investigated at the Ash Landfill. The contoured conductivity data and the contoured in-phase data are presented in Appendix B. The contoured conductivity data clearly shows anomalies in both Areas 1 and 2. In Area 1, several anomalies were distinguishable. The linear north-south trending anomaly at station 550 east of West Patrol Road was caused by the 6-inch water main. Several smaller conductivity anomalies are present on survey lines 3, 4, 5, 10, 13, 14, and 15. In Area 2, several anomalies were evident in both the eastern and western sections. The linear north-south trending anomaly at station 1650 was again caused by the 6-inch water main. The two large anomalies present along survey lines 17, 18, and 19 from stations 1150 to 1450 were caused by the non-combustible fill landfill. Several small conductivity anomalies were also present along survey lines 16, 17, and 18 from stations 450 to 650. The nature of these anomalies were further characterized by GPR profiling.

3.6.3 Ground Penetrating Radar (GPR) Survey

GPR was performed at anomalies identified by the conductivity survey. GPR traverses across EM-31 anomalies were performed to determine the nature (i.e., potential type and length) of these anomalies. The objective of this survey was to identify the presence of buried drums. Table 3-5 summarizes the results of the GPR anomaly review and characterization. About 78 percent of the anomalies defined by GPR, and summarized on Table 3-5, were characteristic of fill areas containing small debris. Nine anomalies had GPR signatures similar to signatures produced by an underground pipe or buried drum. These included anomalies located on survey lines 5, 13, 16, 17, and 18 (see Table 3-4 for anomaly locations along survey lines).

The GPR profiles for the nine anomalies containing possible pipe or drum signatures are presented in Appendix B. The profiles show the characteristic hyperbolic signature typical of a buried cylindrical object. A second characteristic of these signatures is the image duplication or echo, downward through the profile caused by a resonance feature associated with metallic objects. The presence of these two characteristics were evaluated to determine the likelihood of an anomaly containing a buried pipe or drum. Anomalies present on the graphic profiles in Appendix B were considered to have these characteristics and have been

TABLE 3-4
SUMMARY OF EM-31 ANOMALY LOCATIONS

SENECA ARMY DEPOT
ASH LANDFILL

EM-31		GPR	
LINE	ANOMALY LOCATION (ft)	LINE	AREA COVERED (ft)
3	100-250	3	100-250
3	500-600	3	*
3	1,050-1,150	3	1,050-1,150
4	90-250	4	90-250
4	550-600	4	*
5	100-300	5	100-300
5	550-60	5	*
5	1,100-1,170	5	1,100-1,170
6	550-600	6	*
7	550-600	7	*
8	550-600	8	*
9	550-600	9	*
10	500-600	10	*
10	700-900	10	700-900
10	930-1,100	10	930-1,100
11	500-550	11	*
12	500-550	12	*
12	800-1,100	12	800-1,100
13	500,550	13	*
13	800-1,100	13	800-1,100
14	360-550	14	360-550
14	700-800	14	700-800

TABLE 3-4
(Continued)

SENECA ARMY DEPOT
ASH LANDFILL

EM-31		GPR	
14	1,350-1,450	14	1,350-1,450
15	450-500	15	*
15	750-950	15	750-950
15	1,000-1,100	15	1,000-1,100
16	250-850	16	250-850
16	1,100-1,150	16	1,000-1,150
16	1,200-1,650	16	1,200-1,650
17	250-850	17	250-850
17	1,130-1,1550	17	1,130-1,550
18	400-500	18	400-500
18	1,150-1,600	18	1,150-1,600
19	700-850	19	700-850
19	1,150-1,635	19	1,150-1,635
20	450-850	20	450-850

NOTES:

* Anomaly location represents a buried pipeline (6-inch water main).
No GPR profile performed

TABLE 3-5
GPR CHARACTERIZATION OF EM-31 ANOMALY LOCATIONS

SENECA ARMY DEPOT
ASH LANDFILL

LINE	ANOMALY LOCATION (ft)	CHARACTERIZATION
3	100-200	Fill Area - Small Debris
3	200-250	Fill Area - Small Debris
4	150-250	Fill Area - Small Debris
5	150-200	Fill Area - Small Debris
5	200-250	Fill Area - (1) Possible Pipe or Drum Signature
10	760-780	Fill Area - Small Debris
10	840-860	Fill Area - Small Debris
10	980-1,000	Fill Area - Small Debris
12	910-960	Fill Area - Small Debris
12	980-1,000	Fill Area - Small Debris
13	830-890	Fill Area - Small Debris
13	905-925	Fill Area - Small Debris (1) Possible Pipe Signature
13	945-975	Fill Area - Small Debris (1) Possible Pipe Signature
13	1,000-1,020	Fill Area - Small Debris
14	1,350-1380	Fill Area - Small Debris
16	350-400	Fill Area with (1) Possible Pipe/Drum @ 374
16	460-500	Fill Area - Small Debris
16	580-590	Fill Area - Small Debris
16	600-625	Fill Area - Small Debris
16	625-640	Fill Area - Small Debris
16	665	Fill Area - Small Debris

TABLE 3-5
(Continued)

SENECA ARMY DEPOT
ASH LANDFILL

LINE	ANOMALY LOCATION (ft)	CHARACTERIZATION
16	740-780	Fill Area - Small Debris
16	1,200-1,270	Fill Area - (1) Possible Drum @1,252
16	1,350-1,500	(2) Possible Drums @ 1,432&1,446
16	1,350-1,500	(1) Possible Drums @ 1,482
17	300-370	(4) Small Fill Area - Small Debris
17	500-515	Small Fill Area @ 510
17	590-640	Fill Area - Small Debris
17	690-720	Fill Area - Small Debris
17	740-760	Fill Area - Small Debris
17	1,180-1,210	Fill Area - Fill Area with (1) Possible Drum @ 1,188
17	1,270-1,300	Fill Area - Small Debris
17	1,460-1,520	Fill Area - Possible Concrete Debris
18	440-450	Small Fill Area - Debris
18	1,250-1,290	Fill Area with Possible Concrete with Rebar
18	1,350-1,380	Fill Area - Small Debris
18	1,480-1,510	Fill Area with (2) Possible Pipes
19	750-800	Fill Area - Small Debris
19	1,240-1,25	Fill Area - Small Debris
19	1,830-1,350	Fill Area - Small Debris

annotated to show the location and station of the anomaly. Geophysical anomalies were further investigated during the soil gas and soil boring and test pit programs.

3.6.4 Geophysical Anomaly Excavation (GAE) and Cross Sectional Sampling

Test pits were excavated in both Phase I and Phase II of the investigation. In Phase I, a total of five excavations up to five feet deep were dug with a backhoe. The purpose of the excavations was to investigate GPR anomalies that were thought to indicate a buried pipe or drum. During Phase II, 10 test pits were excavated. The first five were at the same locations as the five test pits excavated during Phase I. The Phase II test pits were excavated to 10 feet deep, to determine if any objects were buried deeper than 5 feet. Various metal and wooden objects were found within the test pits. The objects included concrete posts, steel plates, pieces of pipe, railroad ties, etc. However no buried drums were found in the areas investigated. Table 3-6 presents the results of the cross sectional soil sampling of the identified GPR Geophysical Anomalies.

3.6.5 Very Low Frequency-Electromagnetic (VLF-EM) Survey

A VLF-EM survey was conducted during Phase II to delineate the possible presence and location of fractures present within the bedrock. The extent of the VLF-EM survey grid is shown in Figure 2-2. The real and imaginary components of the VLF-EM data were plotted in profile fashion for the 13 transects surveyed. These plots formed the basis of the VLF-EM data interpretation. An interpretation was made of these data to provide some additional insight into the possible presence of fractures present within the bedrock.

Three areas of VLF-EM anomalies were identified. These areas are shown in Figure 3-16. The first major anomalous area of VLF-EM response was located west of the Ash Landfill where a significant VLF-EM anomaly was found coincident with the SEAD 6-inch buried water main. The second area was located just to the north and west of the Ash Landfill where the VLF-EM data show several anomalies that are thought to be associated with both buried refuse or with variations in near surface materials. A third area of anomalous VLF-EM responses was located along the western portion of transect 200. This feature is also thought to be associated with near surface features due to its sharp response and extremely short wavelength. Based upon this interpretation, No anomalous features, thought to be associated with fractures within the bedrock, were identified with the data.

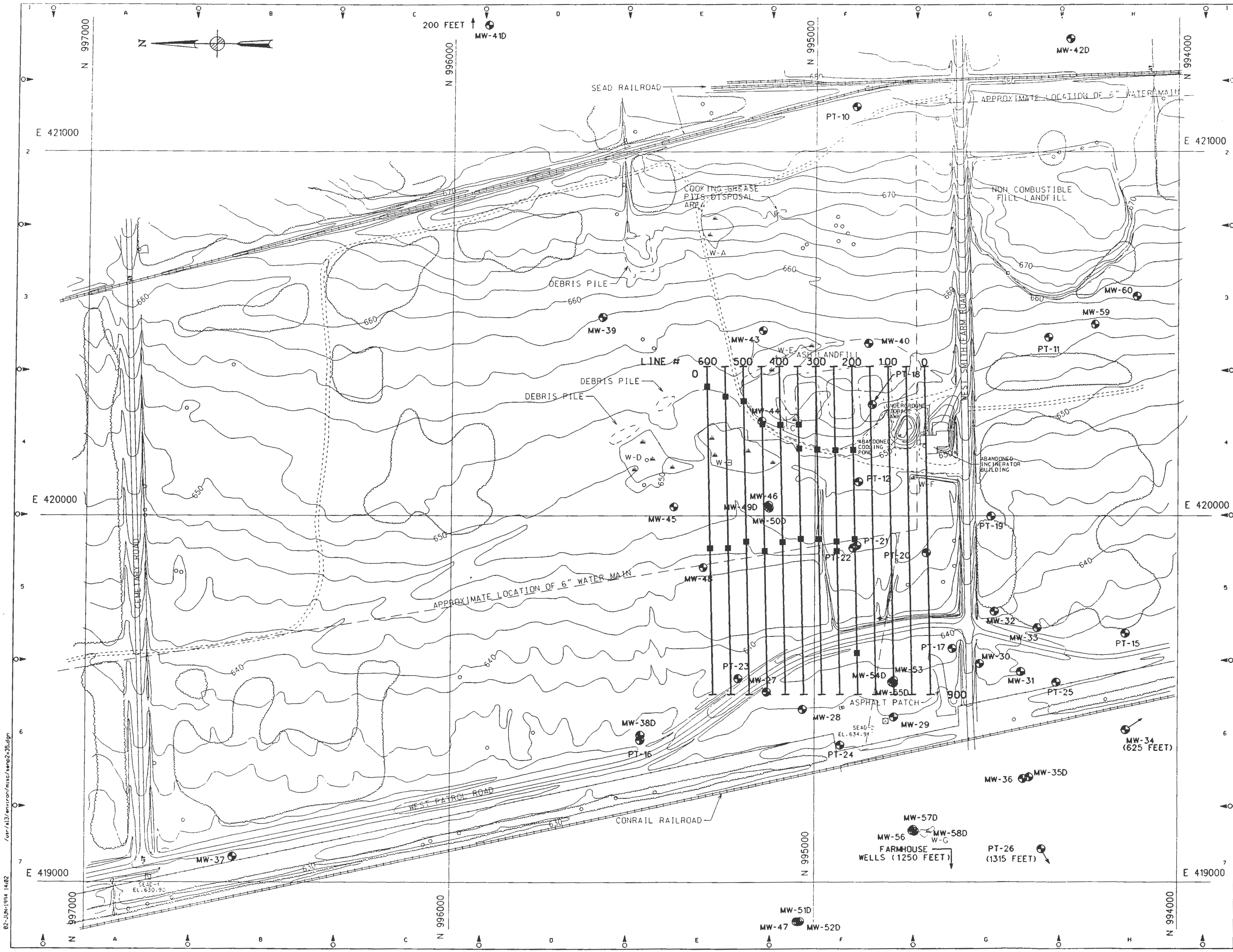
TABLE 3 – 6

CROSS–SECTIONAL SOIL SAMPLING RESULTS OF GPR GEOPHYSICAL ANOMALIES

SENECA ARMY DEPOT
ASH LANDFILL

TEST PIT NUMBER	PHASE	SAMPLE DEPTH	SAMPLE RESULTS
TP–1	I	5'	NO OBJECTS FOUND.
TP–2	I	5'	0 to 1' – SINGLE PIECE OF STEEL PLATE 1' X 11'.
TP–3	I	5'	NO OBJECTS FOUND.
TP–4	I	5'	0 to 2' – 2 CONCRETE FOOTINGS WITH STEEL FENCE POSTS THEREIN.
TP–5	I	5'	0 to 2' – 2 CONCRETE FOOTINGS WITH STEEL FENCE POSTS THEREIN. 2' to 3' – 1 REINFORCED CONCRETE PIE 16" ID.
TP–1	II	10'	NO OBJECTS FOUND.
TP–2	II	6.8'	STEEL PLATE 14"X14"X1/8". COMPETENT ROCK AT 6.8'.
TP–3	II	10'	NO OBJECTS FOUND.
TP–4	II	10'	2 CONCRETE FOOTINGS WITH STEEL FENCE POST THEREIN. SCRAPWOOD NAILS.
TP–5	II	14'–6"	2 CONCRETE FOOTINS WITH STEEL FENCE POSTS/IRON PIPING/ ELECTRICAL CABLE/WOODPOSTS.
TP–6	II	8'	0 to 2' – STEEL CYLINDER, MISC. HOUSEHOLD REFUSE. 2' to 4' – STEEL CABLE.
TP–7	II	9'	0 to 2' – LONG PIECES OF CORRUGATED METAL PIPE – 4', ASPHALT PIECES. 2' to 4' – AUTOTIRE MUNICIPAL REFUSE POCKET OF ASH. 4' to 7' – OILSHEEN.
TP–8	II	6.6"	2' to 4' – RAILROAD TIE, 16" CMV. 2" – I BEAM X 5' LONG.
TP–9	II	6'	0.5' to 1.5' – IRON PIPE FRAGMENT. 1.5' to 2' – PAINT CAN. 2' to 3' – LUMBER 2X6 ELECTRIC BRAKER.
TP–10	II	6'	0 to 1' – 12 OZ CAN, METAL STRAP 1'to 4' – MISC GARBAGE, OIL CAN, 3 GAL MILK PAIL, AUTOPARTS

Notes:
1) The geophysical anomaly excavations consisted of cross–sectional excavations at the location of the identified GPR anomaly.
2) GAE = Geophysical Anomaly Excavation
3) The test pit number also serves as the soil sample designation.



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REV	DATE	DESCRIPTION
C	6/3/94	DRAFT-FINAL RI REPORT
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A.KAELIN	CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAELIN	RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER	MGR. OF ENGR. J.P.CHAPLICK

PROJECT MANAGER M.N.DUCHESNEAU

MGR. OF PROJECTS J.P.CHAPLICK

IN CHARGE W.D.PATTERSON

DRAWN CHECKED DES.SUPV. RESP.ENGR. CH.DISC.ENG. PROJ. MGR. MF

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ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING NO.

FIGURE 3-16
VLF-EM ANOMALY
LOCATIONS

SCALE 1'' = 250'

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3.7 HYDROGEOLOGY

3.7.1 Introduction

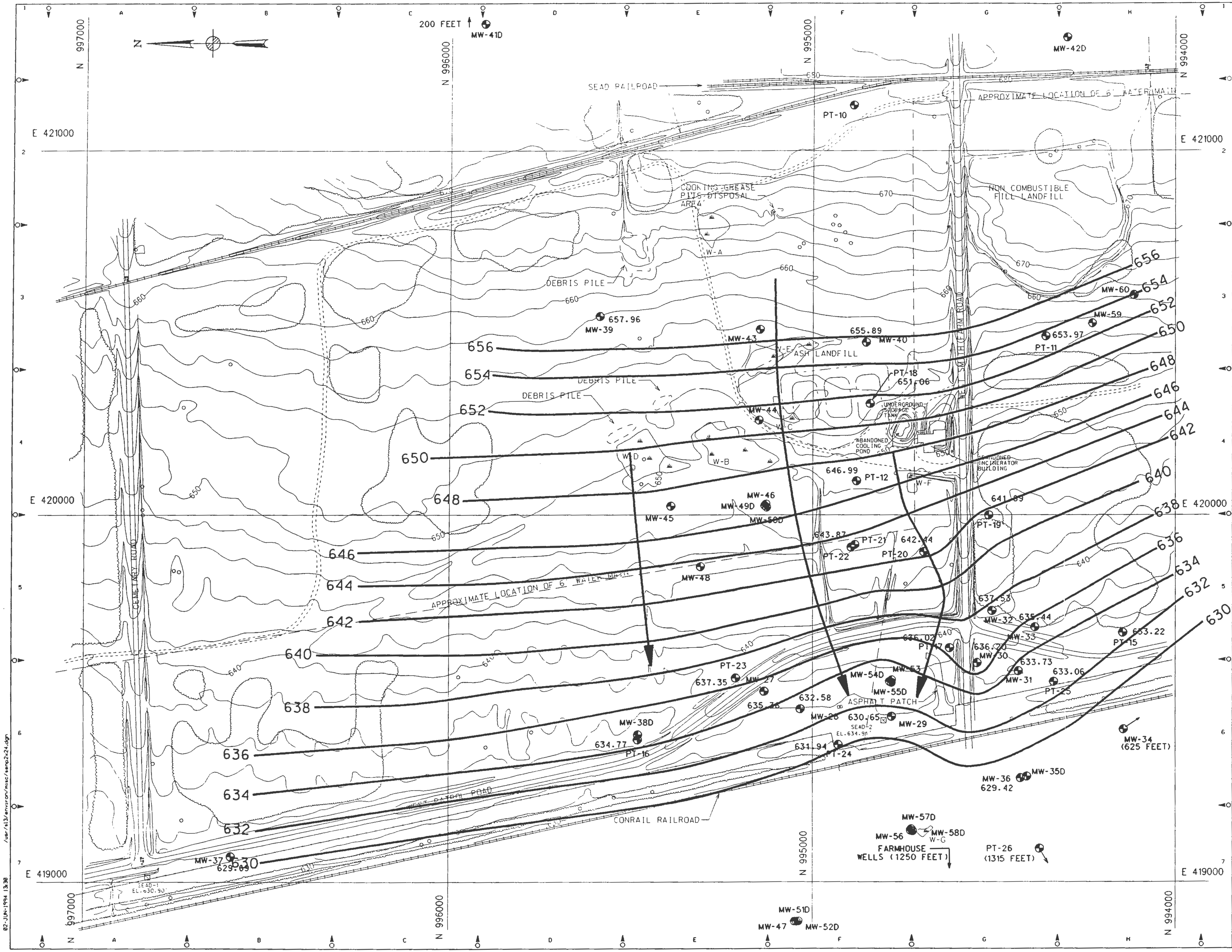
The hydrogeologic properties of the site were characterized in accordance with the investigation programs described in Section 2.0. This section presents the results of the investigation of the till/weathered shale and competent shale aquifers. It addresses topics such as groundwater flow directions, hydraulic conductivities, velocity of groundwater, vertical gradients, and vertical connection tests between the shallow and deep aquifers.

3.7.2 Groundwater Flow Directions

3.7.2.1 Till/Weathered Shale Aquifer

Groundwater contour maps with 2-foot contour intervals were constructed for both Phase I and Phase II using depth to groundwater measurements in the till/weathered shale aquifer. Table 3-7 summarizes the water level measurements in all wells at the Ash Landfill for both Phases I and II. A groundwater contour map for Phase I was constructed based on depth to water measurements made on January 7, 1992 (Figure 3-17). The map indicates that the general direction of groundwater flow in the shallow aquifer was to the west toward Seneca Lake, similar to the surface topography. The aquifer surface elevations were approximately 655 feet above MSL in the eastern portion of the site and 630 feet above MSL in the western portion of the site. Generally groundwater flow contours indicate that there is a consistent gradient over the entire site. In the area of the Ash Landfill and incinerator building groundwater contours were regular and evenly spaced. In the western portion of the site near the intersection of West Smith Farm Road and West Patrol Road, the contours showed a distinct shift (or divide) in the flow direction of groundwater. Specifically, the groundwater flow shifts from a southwesterly direction to a westerly and west-northwesterly direction. The groundwater gradient between wells PT-18 and PT-17 was calculated to be 2.13×10^{-2} feet per foot based on depth to water measurements made on January 7, 1992. The site wide hydraulic gradient (between wells MW-40 and MW-56) was calculated to be 1.95×10^{-2} feet per foot using measurements taken in June 1993.

For comparison purposes, a second groundwater contour map for Phase II was constructed based on depth to water measurements made on June 14, 1993 (Figure 3-18). In general, the groundwater surface elevations were 2 to 3 feet lower in this set of measurements than in the



LEGEND:

═	PAVED ROAD
┄	DIRT ROAD
650	GROUND CONTOUR AND ELEVATION
○	TREE
W-B	WETLAND & DESIGNATION
┄	APPROXIMATE EXTENT OF FILL
┄	OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
┄	APPROXIMATE EXTENT OF DEBRIS PILE
○	BRUSH
─	CHAIN LINK FENCE
◊	UTILITY POLE
✦	APPROXIMATE LOCATION OF FIRE HYDRANT
⊂⊃	FUEL OR UNDERGROUND STORAGE TANK
☒ SEAD-1 EL. 630.90'	SURVEY MONUMENT
PT-22 ⊕ MW-37	MONITORING WELL AND DESIGNATION & GW ELEVATION DATA COLLECTED ON JANUARY 7, 1992
650	GROUND WATER CONTOUR BASED ON PHASE 1 REMEDIAL INVESTIGATION RESULTS ARROWS INDICATE DIRECTIONS OF FLOW. DATA COLLECTED 1/7/92

REV	DATE	DESCRIPTION
C	6/3/94	DRAFT-FINAL RI REPORT
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A.KAELIN	CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAELIN	RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER	MGR. OF ENGR. J.P.CHAPLICK
PROJECT MANAGER M.N.DUCHESNEAU	
MGR. OF PROJECTS J.P.CHAPLICK	
IN CHARGE W.D.PATTERSON	

DRAWN CHECKED DES.SUPV. RESP.ENGR. CH.DISC.ENG. PROJ. MGR. MF

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CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING NO.

FIGURE 3-17
GROUND WATER ELEVATIONS AND TOPOGRAPHY MAP FOR THE TILL/ WEATHERED SHALE AQUIFER
PHASE I

SCALE 1" = 250'

ES'S DWG. NO. 720447-03000-1-1 REV C

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TABLE 3 - 7

MONITORING WELL WATER LEVEL SUMMARY

SENECA ARMY DEPOT
· ASH LANDFILL

MONITORING WELL NUMBER		TYPE OF MONITORING WELL (S[1] or T / WS[2])	PHASE I					PHASE II				PHASE IIA		
			1-7-92 DEPTH TO GROUNDWATER WATER TOC (ft)	1-24-92 DEPTH TO GROUNDWATER WATER TOC (ft)	2-4-92 DEPTH TO GROUNDWATER WATER TOC (ft)	TOP OF PVC CASING ELEVATION (MSL)[3]	GROUNDWATER ELEVATION BASED ON 1-7-92 DATA (MSL)[3]	4-13-93 DEPTH TO GROUNDWATER WATER TOC (ft)	6-14-93 DEPTH TO GROUNDWATER WATER TOC (ft)	TOP OF PVC CASING ELEVATION (MSL)[3]	GROUNDWATER ELEVATION BASED ON 6-14-93 DATA (MSL)[3]	11/93 DEPTH TO GROUNDWATER WATER TOC (ft)	TOP OF PVC CASING ELEVATION (MSL)[3]	GROUNDWATER ELEVATION BASED ON 11/93 DATA (MSL)[3]
1	PT-10	S	6.77	6.00	6.66	681.60	674.83	5.45	9.60	681.52	671.92	NA	681.52	681.52
2	PT-11	T / WS or S	4.48	6.46	5.34	658.45	653.97	4.24	6.51	658.22	651.71	NA	658.22	658.22
3	PT-12	T / WS	5.16	5.74	5.74	652.15	646.99	4.83	8.03	651.94	643.91	NA	651.94	651.94
4	PT-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5	PT-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6	PT-15	T / WS or S	4.64	19.44	5.34	637.86	633.22	3.96	8.41	637.76	629.35	NA	637.76	637.76
7	PT-16	T / WS	2.88	3.24	3.3	637.65	634.77	2.78	4.70	637.51	632.81	NA	637.51	637.51
8	PT-17	T / WS	4.18	4.62	4.74	640.20	636.02	4.23	7.62	640.14	632.52	NA	640.14	640.14
9	PT-18	T / WS	5.80	6.38	6.49	656.86	651.06	4.81	7.33	656.68	649.35	NA	656.68	656.68
10	PT-19	T / WS	3.55	3.62	3.78	645.44	641.89	NA	6.65	645.26	638.61	NA	645.26	645.26
11	PT-20	T / WS	5.10	5.59	6.22	647.54	642.44	4.84	7.58	647.28	639.70	NA	647.28	647.28
12	PT-21	T / WS or S	5.68	16.69	12.14	647.94	642.26	4.09	8.15	647.73	639.58	NA	647.73	647.73
13	PT-22	T / WS	4.87	5.59	5.79	648.74	643.87	5.29	8.57	648.61	640.04	NA	648.61	648.61
14	PT-23	T / WS	4.29	4.68	4.70	641.64	637.35	4.37	7.21	641.58	634.37	NA	641.58	641.58
15	PT-24	T / WS	4.49	4.69	4.70	636.43	631.94	4.30	5.21	636.40	631.19	NA	636.40	636.40
16	PT-25	T / WS	4.09	4.48	4.66	637.13	633.04	3.44	6.96	637.09	630.13	NA	637.09	637.09
17	PT-26	T / WS	3.64	4.48	4.42	614.64	610.80	2.86	6.85	614.64	607.79	NA	614.64	614.64
18	MW-27	T / WS	3.92	4.15	5.08	639.28	635.36	4.63	6.75	639.32	632.57	NA	639.32	639.32
19	MW-28	T / WS	4.64	4.82	4.90	637.22	632.58	4.70	5.77	637.21	631.44	NA	637.21	637.21
20	MW-29	T / WS	6.63	6.84	6.88	637.28	630.65	5.51	6.83	637.31	630.48	NA	637.31	637.31
21	MW-30	T / WS	4.06	5.66	6.01	640.26	636.20	4.16	8.83	640.32	631.49	NA	640.32	640.32
22	MW-31	T / WS	2.92	3.52	3.72	636.65	633.73	2.28	6.13	636.70	630.57	NA	636.70	636.70
23	MW-32	T / WS	4.18	4.54	4.99	641.71	637.53	3.97	7.96	641.68	633.72	NA	641.68	641.68
24	MW-33	T / WS	4.08	4.08	4.36	639.45	635.37	3.76	8.64	639.56	630.92	NA	639.56	639.56
25	MW-34	T / WS	3.00	3.92	4.18	632.89	629.89	2.77	5.84	632.89	627.05	NA	632.89	632.89
26	MW-35D	S	2.42	2.88	2.94	631.90	629.48	2.19	3.81	631.82	628.01	NA	631.82	631.82
27	MW-36	T / WS	2.31	2.82	2.99	631.73	629.42	2.33	3.90	631.79	627.89	NA	631.79	631.79

TABLE 3 – 7

MONITORING WELL WATER LEVEL SUMMARY

SENECA ARMY DEPOT
ASH LANDFILL

		PHASE I					PHASE II				PHASE IIA		
MONITORING WELL NUMBER	TYPE OF MONITORING WELL (S[1] or T / WS[2])	1–7–92 DEPTH TO GROUNDWATER WATER TOC (ft)	1–24–92 DEPTH TO GROUNDWATER WATER TOC (ft)	2–4–92 DEPTH TO GROUNDWATER WATER TOC (ft)	TOP OF PVC CASING ELEVATION (MSL)[3]	GROUNDWATER ELEVATION BASED ON 1–7–92 DATA (MSL)[3]	4–13–93 DEPTH TO GROUNDWATER WATER TOC (ft)	6–14–93 DEPTH TO GROUNDWATER WATER TOC (ft)	TOP OF PVC CASING ELEVATION (MSL)[3]	GROUNDWATER ELEVATION BASED ON 6–14–93 DATA (MSL)[3]	11/93 DEPTH TO GROUNDWATER WATER TOC (ft)	TOP OF PVC CASING ELEVATION (MSL)[3]	GROUNDWATER ELEVATION BASED ON 11/93 DATA (MSL)[3]
28 MW–37	T / WS	3.20	3.18	3.16	632.89	629.69	2.31	4.49	632.89	628.40	NA	632.89	632.89
29 MW–38D	S	3.44	4.02	4.08	637.93	634.49	3.38	5.23	637.90	632.67	NA	637.90	637.90
30 MW–39	T / WS	1.80	2.12	FROZEN	659.76	657.96	2.19	3.05	659.54	656.49	NA	659.54	659.54
31 MW–40	T / WS	3.43	3.98	4.15	659.32	655.89	3.13	6.30	659.30	653.00	NA	659.30	659.30
32 MW–41D	S	7.32	9.52	7.11	694.02	686.70	6.06	8.28	694.02	685.74	NA	694.02	694.02
33 MW–42D	S	2.67	3.58	3.61	683.04	680.37	2.38	5.70	683.04	677.34	NA	683.04	683.04
34 MW–43	T / WS	NA	NA	NA	NA	NA	NA	4.58	657.73	653.15	5.44	657.73	652.29
35 MW–44	T / WS	NA	NA	NA	NA	NA	NA	5.49	653.85	648.36	7.14	653.85	646.71
36 MW–45	T / WS	NA	NA	NA	NA	NA	NA	5.04	650.90	645.86	5.96	650.90	644.94
37 MW–46	T / WS	NA	NA	NA	NA	NA	NA	6.64	650.41	643.77	8.04	650.41	642.37
38 MW–47	T / WS	NA	NA	NA	NA	NA	NA	5.25	628.06	622.81	7.24	628.06	620.82
39 MW–48	T / WS	NA	NA	NA	NA	NA	NA	5.80	648.32	642.52	6.39	648.32	641.93
40 MW–49D	S	NA	NA	NA	NA	NA	NA	5.83	650.50	644.67	8.36	650.50	642.14
41 MW–50D	S	NA	NA	NA	NA	NA	NA	5.71	649.88	644.17	7.37	649.88	642.51
42 MW–51D	S	NA	NA	NA	NA	NA	NA	5.43	628.24	622.81	7.08	628.24	621.16
43 MW–52D	S	NA	NA	NA	NA	NA	NA	3.64	626.35	622.71	6.66	626.35	619.69
44 MW–53	T / WS	NA	NA	NA	NA	NA	NA	8.14	639.41	631.27	9.5	639.41	629.91
45 MW–54D	S	NA	NA	NA	NA	NA	NA	7.95	639.11	631.16	10.18	639.11	628.93
46 MW–55D	S	NA	NA	NA	NA	NA	NA	9.20	639.16	629.96	8.92	639.16	630.24
47 MW–56	T / WS	NA	NA	NA	NA	NA	NA	3.61	630.51	626.90	3.54	630.51	626.97
48 MW–57D	S	NA	NA	NA	NA	NA	NA	3.13	629.82	626.69	3.16	629.82	626.66
49 MW–58D	S	NA	NA	NA	NA	NA	NA	3.40	629.69	626.29	5.94	629.69	623.75
50 MW–59	T / WS	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.75	656.83	655.08
51 MW–60	T / WS	NA	NA	NA	NA	NA	NA	.NA	NA	NA	2.18	660.15	657.97

Notes:
1) S = Shale
2) T / WS = Till / Weathered Shale
3) MSL = Mean Sea Level
4) NA = Not Available
5) Water level data for MW–59 and MW–60 collected 4/11/94.

January 7, 1992 measurement. The groundwater flow directions were similar to those observed in Phase I. The groundwater gradients were similar for both sets of measurements.

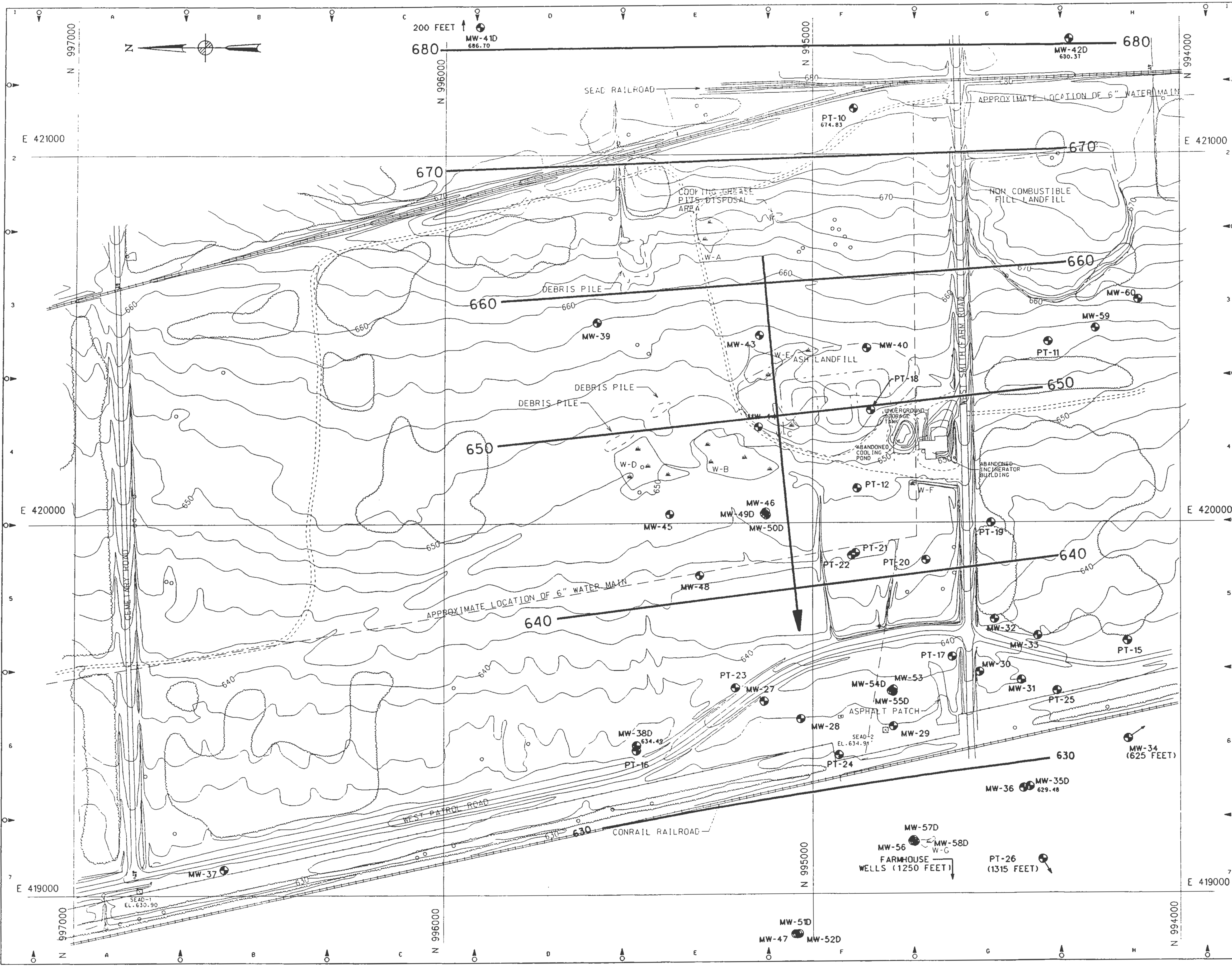
3.7.2.2 Competent Shale Aquifer

Groundwater contour maps were constructed for Phase I and Phase II depth to groundwater measurements in the competent shale aquifer (Figures 3-19 and 3-20). While the control on these maps is not as good as for the till/weathered shale aquifer due to a greater spacing between competent shale wells, they do provide useful information regarding general flow directions within the competent shale. Figure 3-19 depicts the groundwater flow direction in the competent shale aquifer based on data collected from 5 wells during Phase I. This map shows that the groundwater flows in a west-southwesterly direction.

The contours for the Phase II data (Figure 3-20) portray a similar groundwater flow direction for the site. Generally, both maps show a slight flattening of the water table to the west. The gradient betweens wells PT-10 and MW-36 was calculated to be 2.5×10^{-2} feet per foot for the January 7, 1992 data. A similar gradient was calculated for the June 14, 1993 data.

The physical characteristics of the competent shale aquifer that affect the flow of groundwater were investigated by reviewing a report prepared by Mozola (1951) and reviewing the core data collected during the Phase II monitoring well installation. Mozola (1951) described two distinct sets of joints in the area. The main set, termed dip joints, appear to be in the form of two conjugate shear planes that intersect to form acute angles ranging from 10° to 30°. The mean direction of the dip joints ranges from North 15° to 30° East to North 30° to 45° West. Strike joints at right angles to the dip joints trend from North 50° East to North 70° East and are spaced from 1 inch to 4 feet apart. The dip of the joint planes ranges from 46° to nearly vertical. In addition Mozola (1951) found that, most of the joints in the beds of the shale are filled with clay or fine silt which may inhibit groundwater flow.

The flow of groundwater in the competent shale is believed to be influenced primarily by the joints and bedding plane fractures that were observed in the cores. No other flow pathways were observed in the core samples. This view was put forth by Mozola (1951) for rocks of the Hamilton Group and more recently by Merin (1992) for Devonian siltstones near Ithaca, New York. Brecciated zones in the shale may have once transported significantly greater amounts of water than the unbreciated shale, however, today they are not believed to be major transport pathways because they are filled tightly with a fine silt and clay matrix.



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LEGEND:

═	PAVED ROAD
╌	DIRT ROAD
650	GROUND CONTOUR AND ELEVATION
○	TREE
W-B	WETLAND & DESIGNATION
╌	APPROXIMATE EXTENT OF FILL
▭	OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
╌	APPROXIMATE EXTENT OF DEBRIS PILE
○	BRUSH
─	CHAIN LINK FENCE
◦	UTILITY POLE
✦	APPROXIMATE LOCATION OF FIRE HYDRANT
⊂⊃	FUEL OR UNDERGROUND STORAGE TANK
☒ SEAD-1 EL.630.90'	SURVEY MONUMENT
PT-22 ● MW-37 615.5	MONITORING WELL AND DESIGNATION & GW ELEVATION DATA COLLECTED ON JANUARY 7, 1992
┼650	GROUND WATER CONTOUR BASED ON PHASE I REMEDIAL INVESTIGATIONS RESULTS. ARROW INDICATES DIRECTION OF FLOW. DATA COLLECTED ON 1/7/93.

REV	DATE	DESCRIPTION
C	6/3/94	DRAFT-FINAL RI REPORT
B	10/4/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A.KAEUN
CHECKED BY M.E.BAKER
DESIGN SUPV. G.A.KAEUN
RESP. ENGR. M.N.DUCHESNEAU
CHIEF DISC. ENGR. M.E.BAKER
MGR. OF ENGR. J.P.CHAPLICK
PROJECT MANAGER M.N.DUCHESNEAU
MGR. OF PROJECTS J.P.CHAPLICK
IN CHARGE W.D.PATTERSON

DRAWN | CHECKED | DES.SUPV. | RESP.ENGR. | CH.DISC.ENG. | PROJ. MGR. | | MF

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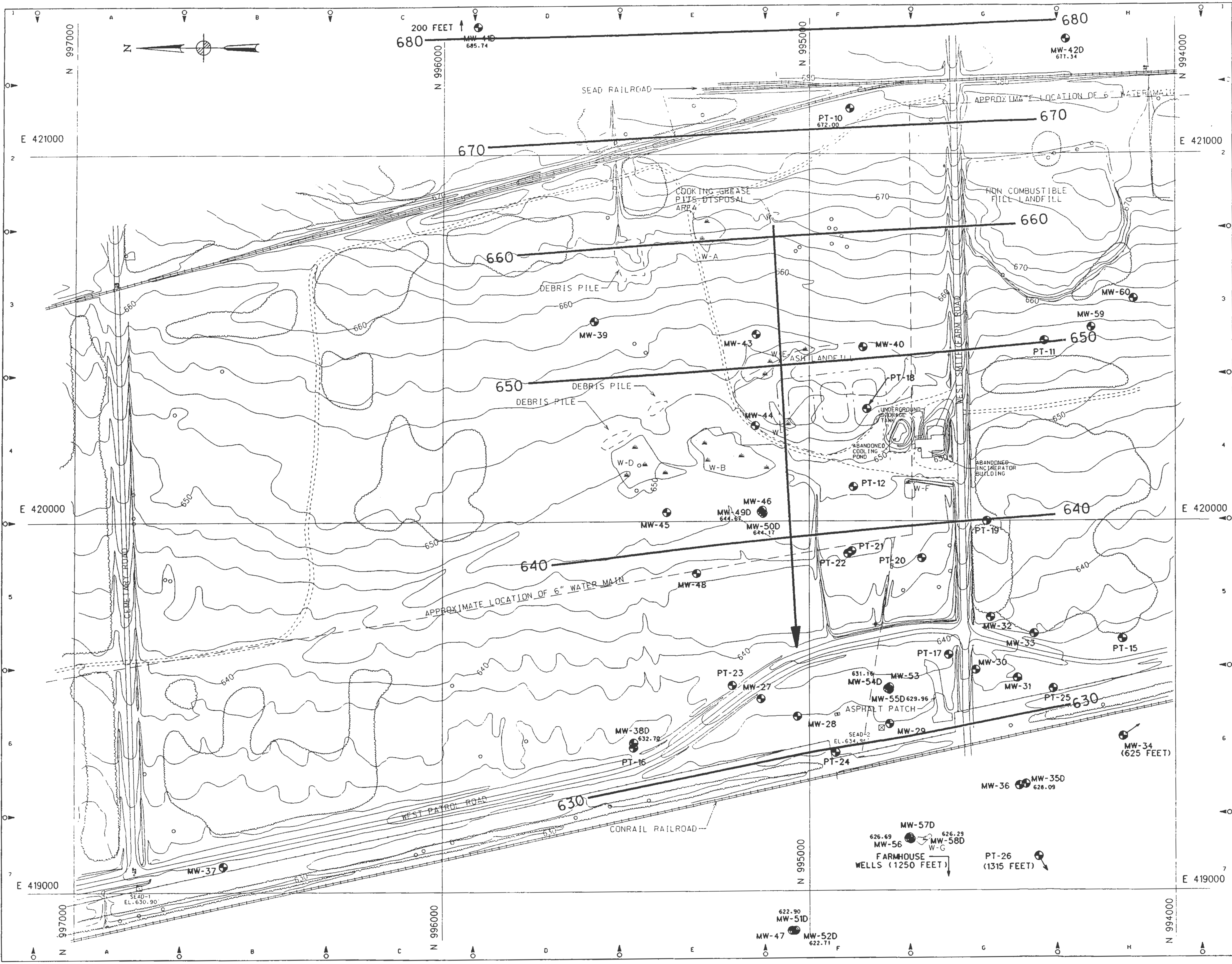
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO.

FIGURE 3-19
GROUNDWATER ELEVATIONS AND TOPOGRAPHY MAP FOR THE COMPETENT SHALE AQUIFER PHASE I

SCALE 1" = 250'

ES'S DWG. NO. 720447-03000-1-1
REV. C



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02-JUN-1994 10:31

LEGEND:

	PAVED ROAD
	DIRT ROAD
650	GROUND CONTOUR AND ELEVATION
○	TREE
W-B	WETLAND & DESIGNATION
	APPROXIMATE EXTENT OF FILL
	OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
	APPROXIMATE EXTENT OF DEBRIS PILE
	BRUSH
	CHAIN LINK FENCE
◇	UTILITY POLE
✦	APPROXIMATE LOCATION OF FIRE HYDRANT
⊂ ⊃	FUEL OR UNDERGROUND STORAGE TANK
☒ SEAD-1 EL.630.90'	SURVEY MONUMENT
PT-22 ● MW-37 615.5	MONITORING WELL AND DESIGNATION & GW ELEVATION DATA COLLECTED ON JUNE 14, 1993
640	GROUND WATER CONTOUR BASED ON PHASE II REMEDIAL INVESTIGATION RESULTS. ARROW INDICATES DIRECTION OF FLOW. DATA COLLECTED ON 6/14/93.

REV	DATE	DESCRIPTION
C	6/3/94	DRAFT-FINAL RI REPORT
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN · CHECKED · DES.SUPV. · RESP.ENGR. · CH.DISC.ENG. · PROJ. MGR. · MF

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ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING NO.

FIGURE 3-20
GROUNDWATER ELEVATIONS AND TOPOGRAPHY MAP FOR THE COMPETENT SHALE AQUIFER PHASE II

SCALE 1" = 250'

ES'S DWG. NO. 720447-03000-1-1 REV C

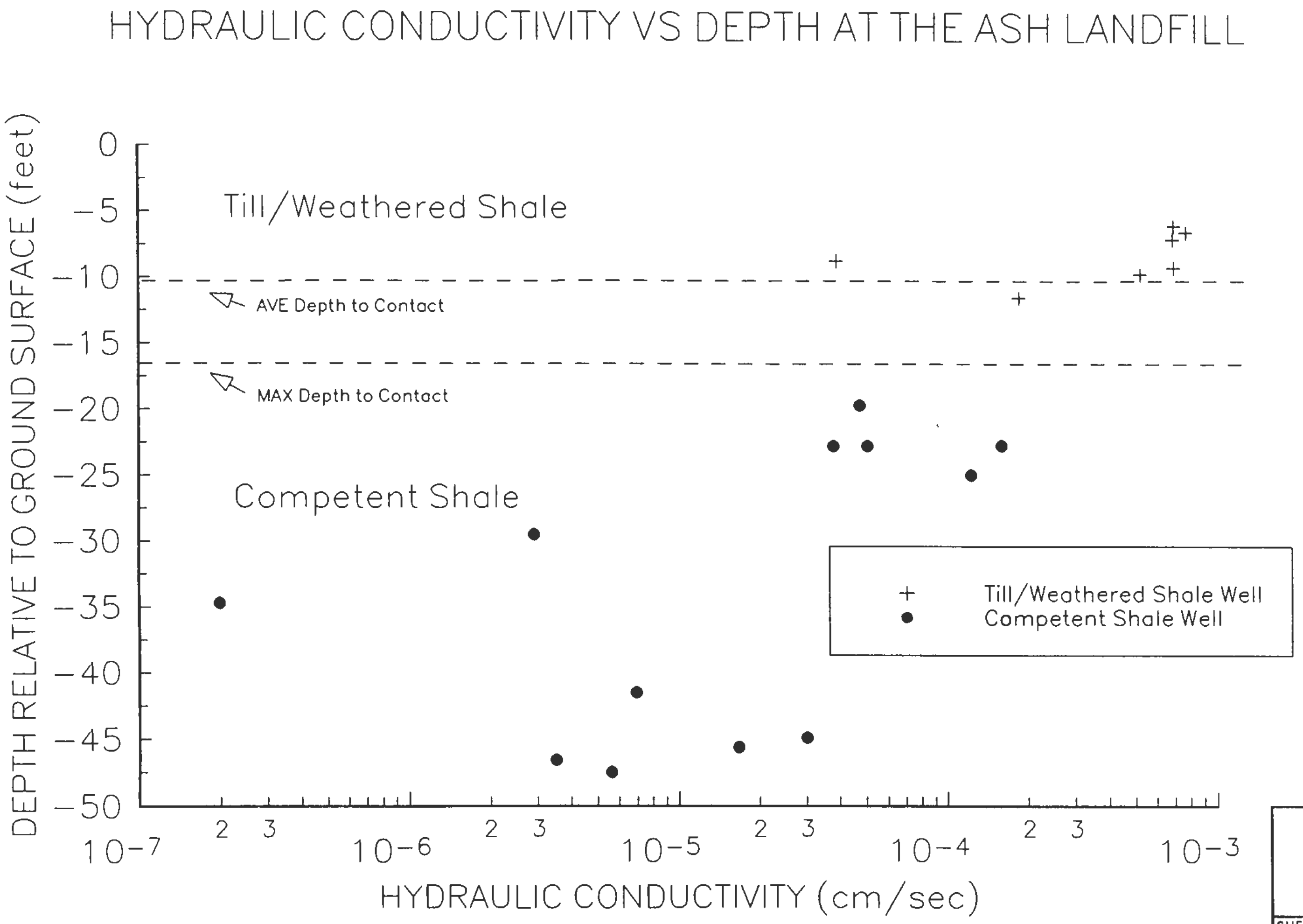
In Merin's (1992) conceptual model of groundwater flow, a network of horizontal and vertical bedding plane fractures and joints exists in the subsurface. Groundwater moves through vertical and horizontal planes of porosity (i.e., fractures) each of which is a fraction of a millimeter thick and extends several inches to tens of feet in length. Based on the physical characteristics of the competent shale observed in this investigation, this model is believed to apply to the shale at the Ash Landfill site.

3.7.3 Hydraulic Conductivities

3.7.3.1 Introduction

Hydraulic conductivities were determined for 23 wells on site of which 8 are till/weathered shale wells and 14 are competent shale wells (Appendix G). One well PT-11 may be screened in both the till/weathered shale and competent shale, however, the exact screen interval for this well is not known. The hydraulic conductivities for five of the wells (PT-11, PT-12, PT-15, PT-21 and PT-23) were determined by ICF Corporation as part of a previous RI/FS report prepared for USATHAMA (March, 1989). ES performed slug testing and hydraulic conductivity measurements on the other 18 wells during Phase I and Phase II fieldwork. Hydraulic conductivities for all 23 wells were calculated using the method described by Bouwer and Rice (1976). Table 3-8 presents the hydraulic conductivity data for monitoring wells at the Ash Landfill that were evaluated using the rising head slug test. Hydraulic conductivities on the site range from 7.8×10^{-4} to 1.9×10^{-7} cm/sec with one anomalous value of 5.8×10^{-11} cm/sec. The distribution of hydraulic conductivity values as a function of depth below the ground surface is shown on Figure 3-21. For perspective, average (10.2 feet) and maximum (16.5 feet) depths to the contact of the till/weathered shale and competent shale aquifers are indicated as dashed lines on this figure. In most instances the conductivity values for the till/weathered shale aquifer are greater than for the competent shale aquifer. Within the competent shale aquifer, conductivity values generally decrease with depth (Figure 3-21), a phenomenon which can be attributed to an increase in mechanical stresses causing fractures to close (deMarsily, 1986 and consistent with the RQD data). Merin (1992) noted a similar trend in fractured Devonian silstones near Ithaca, New York and attributed it to the fact that shallower wells intercepted more highly fractured rock in contrast to the deeper wells.

The determination of the hydraulic conductivity in a monitoring well requires that the aquifer thickness be known. The saturated thickness of the till/weathered shale aquifer was calculated using water level data and information from blow counts and soil boring refusal depths. None



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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING	NO. 720447-03000

FIGURE 3-21

HYDRAULIC CONDUCTIVITY VS.
DEPTH AT THE ASH LANDFILL

SCALE

of the bedrock cores are believed to have penetrated the entire thickness of the competent shale aquifer, so the saturated thickness of this aquifer was obtained from published literature. The Geologic Map of New York (1978) indicates that the Ash Landfill site is near the top of the Ludlowville Formation. Mozola (1951) cites thicknesses for the shale formations (Moscow, Ludlowville, Skaneateles, and Marcellus) which comprise the Hamilton Group. Specifically, the thicknesses of the Ludlowville, and the two stratigraphically lower formations, the Skaneateles and Marcellus, are 140± feet, 185± feet and 50 feet, respectively, In addition, Mozola (1951) lists all of these formations as having the same water bearing properties and thus are interpreted to comprise a single aquifer system. Therefore, the total thickness of competent shale aquifer at the Ash Landfill site is 375 feet for the purposes of calculating hydraulic conductivity values for wells screened in the shale. The Onondaga limestone occurs stratigraphically below the Marcellus Formation.

3.7.3.2 Till/Weathered Shale Aquifer

The hydraulic conductivity of the till/weathered shale aquifer was determined using rising head slug tests. Hydraulic conductivity values for the shallow till/weathered shale aquifer range from 3.9×10^{-5} cm/sec to 5.3×10^{-4} cm/sec and averaged 4.6×10^{-4} cm/sec (Table 3-8). Published hydraulic conductivity values for till or representative materials are: 1) 0.49 m/day (5.67×10^{-4} cm/sec) for a repacked predominantly sandy till (Todd 1980), and 2) from 10^{-2} to 10^{-3} m/day (10^{-5} to 10^{-6} cm/sec) for representative materials of silt, sand, and mixtures of sand, silt, and clay (Todd 1980). No published hydraulic conductivity values for weathered shale were identified.

3.7.3.3 Competent Shale Aquifer

The hydraulic conductivities for the competent shale aquifer were determined using rising head slug tests in the monitoring wells and packer testing in open core holes during the drilling of the deep competent shale wells. Hydraulic conductivity values for the competent shale aquifer as determined by slug testing ranged from 1.9×10^{-7} to 1.2×10^{-4} and averaged 3.7×10^{-5} cm/sec (Table 3-8). Hydraulic conductivities for the shale as determined by packer testing (Figure 3-22) during the coring showed some variability from conductivities determined by slug testing (Appendix G). For one well, MW-50D, the slug testing and constant head packer testing hydraulic conductivities showed good agreement with values of 5.6×10^{-6} cm/sec and 1.17×10^{-6} cm/sec, respectively. Results from three other wells (MW-52D, MW-55D and MW-58D) showed that the conductivity calculated for the packer testing was lower than that for slug

TABLE 3 – 8

HYDRAULIC CONDUCTIVITY VALUES FOR RISING HEAD SLUG TESTS

SENECA ARMY DEPOT
ASH LANDFILL

MONITORING WELL	TYPE OF MONITORING WELL	STATUS	HYDRAULIC CONDUCTIVITY BOUWER AND RICE (1976) (cm/sec)	(ft/min)
PT – 10	SHALE	No test was performed.	NA	NA
PT – 11*	TILL W. SHALE OR SHALE	A test was performed.	6.550E–05	1.289E–04
PT – 12	TILL/WEATHERED SHALE	A test was performed.	3.090E–05	6.083E–05
PT – 15	TILL W. SHALE OR SHALE	A test was performed.	1.300E–06	2.559E–06
PT – 16	TILL/WEATHERED SHALE	No test was performed.	NA	NA
PT – 17	TILL/WEATHERED SHALE	No test was performed.	NA	NA
PT – 18	TILL/WEATHERED SHALE	No test was performed.	NA	NA
PT – 19	TILL/WEATHERED SHALE	No test was performed.	NA	NA
PT – 20	TILL/WEATHERED SHALE	No test was performed.	NA	NA
PT – 21*	TILL W. SHALE OR SHALE	A test was performed.	5.870E–11	1.156E–10
PT – 22	TILL/WEATHERED SHALE	No test was performed.	NA	NA
PT – 23	TILL/WEATHERED SHALE	A test was performed.	7.800E–04	1.535E–03
PT – 24	TILL/WEATHERED SHALE	No test was performed.	NA	NA
PT – 25	TILL/WEATHERED SHALE	No test was performed.	NA	NA
PT – 26	TILL/WEATHERED SHALE	No test was performed.	NA	NA
MW – 27	TILL/WEATHERED SHALE	No test was performed.	NA	NA
MW – 28	TILL/WEATHERED SHALE	No test was performed.	NA	NA
MW – 29	TILL/WEATHERED SHALE	No test was performed.	NA	NA
MW – 30	TILL/WEATHERED SHALE	No test was performed.	NA	NA
MW – 31	TILL/WEATHERED SHALE	No test was performed.	NA	NA
MW – 32	TILL/WEATHERED SHALE	No test was performed.	NA	NA
MW – 33	TILL/WEATHERED SHALE	No test was performed.	NA	NA
MW – 34	TILL/WEATHERED SHALE	No test was performed.	NA	NA
MW – 34	TILL/WEATHERED SHALE	A test was performed.	1.847E–04	3.636E–04
MW – 35D	SHALE	A test was performed.	6.934E–06	1.365E–05
MW – 36	TILL/WEATHERED SHALE	A test was performed.	5.258E–04	1.035E–03
MW – 37	TILL/WEATHERED SHALE	A test was performed.	7.066E–04	1.391E–03
MW – 38D	SHALE	A test was performed.	4.719E–05	9.290E–05
MW – 39	TILL/WEATHERED SHALE	A test was performed.	6.939E–04	1.366E–03
MW – 40	TILL/WEATHERED SHALE	A test was performed.	3.871E–05	7.620E–05
MW – 41D	SHALE	A test was performed.	2.905E–06	5.719E–06
MW – 42D	SHALE	A test was performed.	1.981E–07	3.900E–07
MW – 48	TILL/WEATHERED SHALE	A test was performed.	7.031E–04	1.384E–03
MW – 48*	TILL/WEATHERED SHALE	A test was performed.	4.486E–03	8.830E–03
MW – 49D	SHALE	A test was performed.	1.222E–04	2.405E–04
MW – 50D	SHALE	A test was performed.	5.639E–06	1.110E–05
MW – 51D	SHALE	A test was performed.	1.595E–04	3.140E–04
MW – 52D	SHALE	A test was performed.	3.505E–06	6.899E–06
MW – 54D	SHALE	A test was performed.	5.044E–05	9.930E–05
MW – 55D	SHALE	A test was performed.	1.671E–05	3.290E–05
MW – 57D	SHALE	A test was performed.	3.786E–05	7.453E–05
MW – 58D	SHALE	A test was performed.	3.004E–05	5.914E–05
MW – 59	TILL/WEATHERED SHALE	No test was performed.	NA	NA
MW – 60	TILL/WEATHERED SHALE	No test was performed.	NA	NA
AVERAGE:				
COMPETENT SHALE			3.726E–05	7.272E–05
TILL / WEATHERED SHALE			4.580E–04	5.350E–04

Notes:
1) NA = Not Available
2) * Not included in the averages.
3) Hydraulic conductivity determinations for PT–11, PT–12, PT–15, PT–21, and PT–23 were made by ICF Corporation

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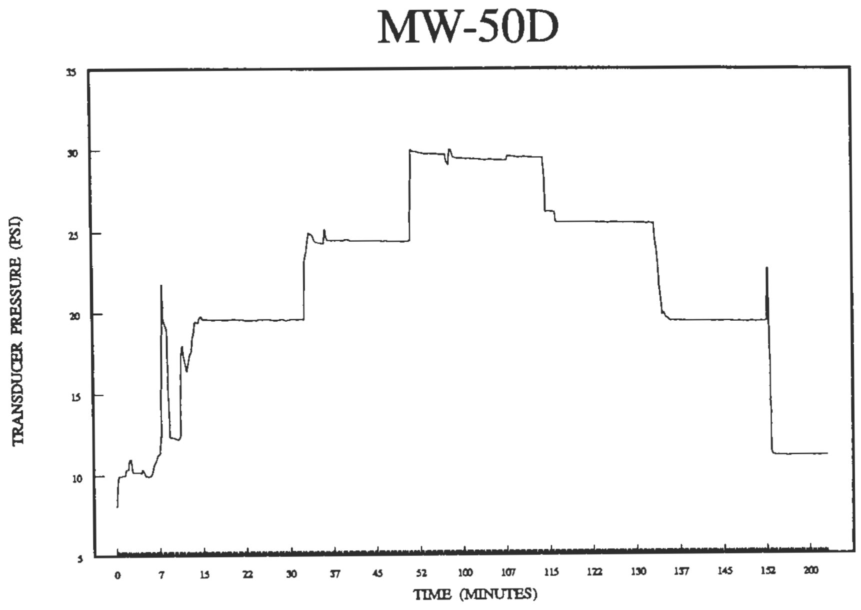

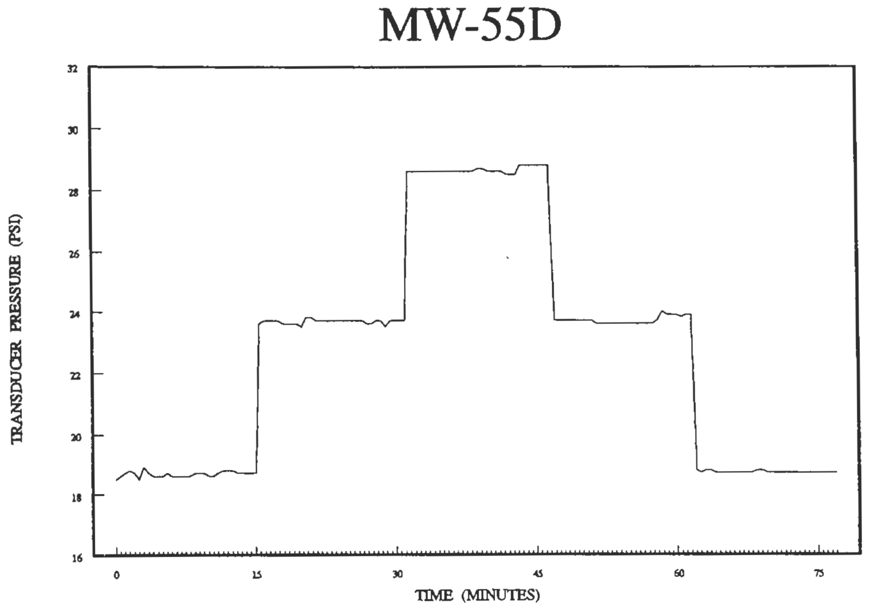

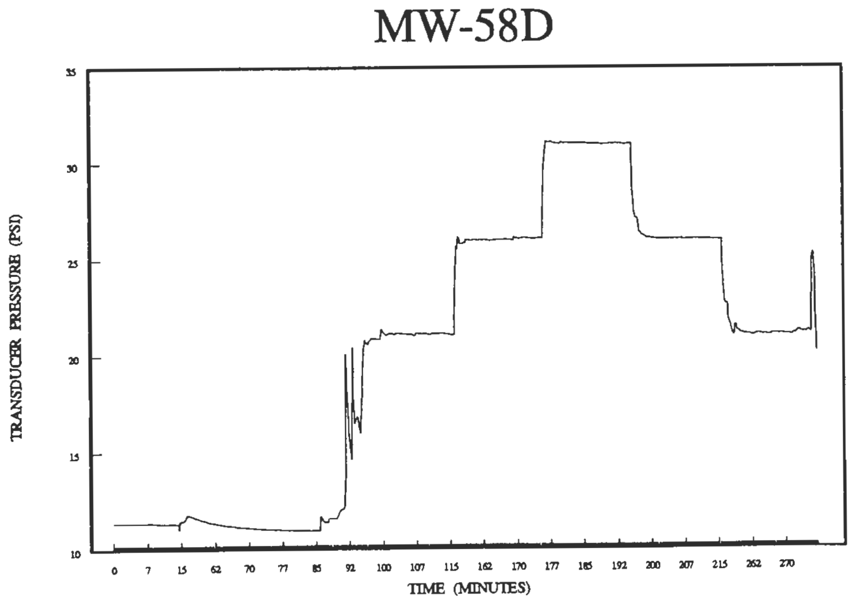

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REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING	NO. 720447-03000

FIGURE 3-22

PACKER TEST TRANSDUCER READINGS
FOR DEEP SHALE CORE HOLES

SCALE

testing. For MW-55D slug and packer testing hydraulic conductivities were 1.6×10^{-5} cm/sec and 4.16×10^{-6} cm/sec, respectively. For MW-58D slug and packer testing conductivities were 3.0×10^{-5} cm/sec and 4.55×10^{-6} cm/sec, respectively. For MW-52D a conductivity of 3.5×10^{-6} cm/sec was determined using slug testing. A packer test conductivity could not be calculated for MW-52D because no flow into the packered zone was measured. A possible explanation for the lower conductivities determined during the constant head packer testing is that the fractures in the core hole contained very fine shale particles (i.e., rock flour) generated during the coring process, even though the coreholes were flushed clean prior to the test. The slug tests were performed in the monitoring wells after well development had taken place. In developing the wells the fine rock flour may have been removed from the fractures resulting in higher conductivities for the shale during slug testing of some of the wells.The hydraulic conductivity data for individual packer tests indicate a pattern whereby the value for the peak pressure (test 3) is greater than for the low pressure tests, and the two low pressures produced approximately equal values (Appendix G). According to Houlsby (1976), a pattern such as this infers the occurrence of temporary dilatency of the rock mass. The high value at the peak pressure applied to the zone is interpreted as the result of fissures or fractures opening (temporarily) or materials being compressed by the test water (Houlsby, 1976). Therefore, the representative hydraulic conductivity is that obtained from the lowest pressure measurements (Houlsby, 1976). In this investigation, the conductivity for the shale was determined by averaging the values obtained at the lowest pressure.

3.7.4 Velocity of Groundwater

3.7.4.1 Introduction

Using Darcy's Law, the average linear velocity of groundwater in both the shallow till/weathered shale and deep competent shale aquifers was calculated. The velocity estimates were calculated using average site hydraulic conductivities, effective porosity estimates, and on-site groundwater gradients. A porosity estimate for weathered fissile shale with large amounts of silt in the interstices could not be located in the literature. Therefore, a till porosity of 15% to 20% was used in the calculations which assumes the till and silty weathered shale porosity are similar. Competent shale was reported to have an effective porosity of 6.75% (Todd 1980).

3.7.4.2 Till/Weathered Shale Aquifer

The average linear velocity of groundwater in the till/weathered shale was calculated using the method described by Darcy's Law based on: 1) an average hydraulic conductivity of 4.5×10^{-4} cm/sec (0.77 ft/day), 2) an estimated effective porosity of 15% (0.15) to 20% (0.20), and 3) a groundwater gradient of 1.95×10^{-2} ft/ft. Total porosities for till samples from another location at SEDA ranged from 34.0% to 44.2% with an average of 37.3%. Therefore, an effective porosity of 15% to 20% was reasonable. The Darcy equation for the average linear velocity (V) of groundwater flow (Freeze and Cherry 1979) is:

$$V = \frac{K \frac{dh}{dL}}{n}$$

where K is the hydraulic conductivity, n is the estimated effective porosity and dh/dL is the hydraulic gradient. Substituting the above-referenced values into this equation yields an average linear velocity of 7.5×10^{-2} feet/day or 27.4 feet/year at 20% effective porosity and 1.0×10^{-1} feet/day or 36.5 feet/year at 15% effective porosity. The actual velocity on-site may be locally influenced by more permeable zones possibly associated with utility lines or differences in the actual porosity of the till/weathered shale.

3.7.4.3 Competent Shale Aquifer

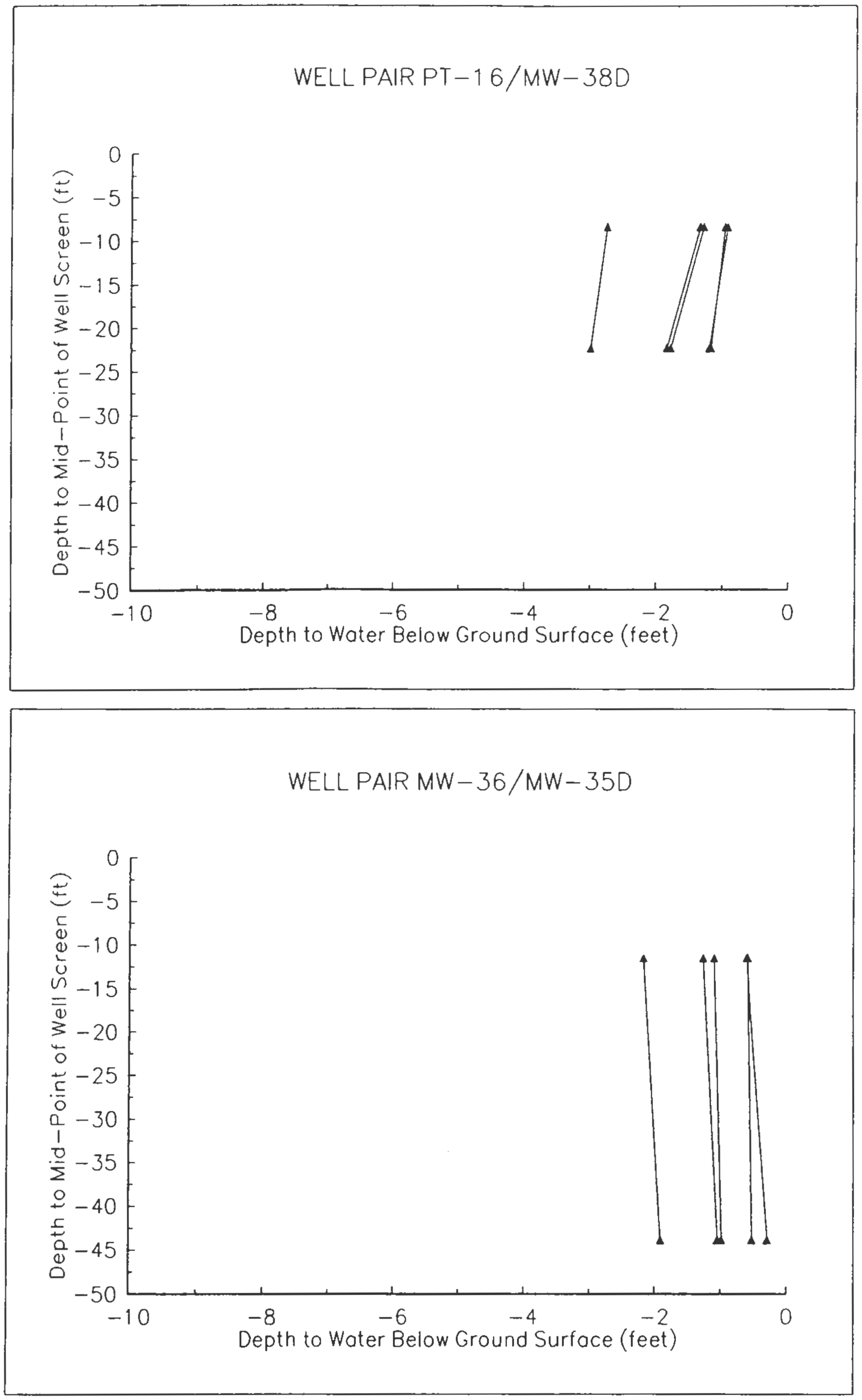
The average linear velocity of groundwater in the competent shale was calculated using the method described by Darcy's Law, based on: 1) an average hydraulic conductivity of 3.73×10^{-5} cm/sec (0.06 ft/day), 2) an estimated effective porosity of 6.75% (0.0675), and 3) a groundwater gradient of 2.5×10^{-2} ft/ft. The effective porosity for the shale was derived from a total porosity value cited by deMarsily (1986). Specifically, deMarsily cites a total porosity for shale of up to 7.5%. A plot of total and effective porosity for various materials shows that the effective porosity is approximately 90% of the total porosity for materials with a blocky nature (i.e., fractured shale). Using this visual relationship between total and effective porosities depicted by deMarsily, 90% of the total porosity (7.5%) is 6.75%. Therefore, substituting the above-referenced values into the Darcy equation in Section 3.7.4.1 yields an average linear velocity of 2×10^{-2} ft/day or 7.3 ft/year for the shale.

3.7.5 Vertical Hydraulic Heads and Gradients

Vertical hydraulic head profiles for the two well pairs (PT-16/MW-38D and MW36/MW-35D) and four well clusters (MW-46/MW-49D/MW-50D, MW-47/MW-51D/MW-52D, MW-53/MW-54D/MW-55D, and MW-56/MW-57D/MW-58D) show variable fluctuations in water levels (Figure 3-23). While the number of vertical data points is limited, the profiles do show a rudimentary view of vertical flow. For the well pairs five data sets are available. For the well clusters only one data set is available. Vertical gradients were calculated at both the well pairs and the well clusters on the Ash Landfill site (Table 3-9). For reference when viewing the profiles, the depth to the mid-point of the screens is provided on Table 3-9).

At well pair PT-16/MW-38D the data show a consistent downward flow direction and gradient between approximately 7 and 22 feet below the land surface. The data are from five separate dates representing three seasons, Winter, Spring, and Summer. The vertical gradient at this location ranges between 0.02 and 0.04, with an average of 0.028 (Table 3-9). At well pair MW-36/MW-35D the data show a consistent but upward flow direction and small gradient between approximately 12 and 44 feet below the land surface. Again, the data are from five separate dates representing three seasons, Winter, Spring, and Summer. The vertical gradient at this location ranges between -0.01 and -0.002, with an average of -0.007 (Table 3-9). Any changes in the direction and magnitude of the vertical gradient between approximately 12 and 44 feet can not be determined using the available data.

Well cluster MW-46/MW-49D/MW-50D exhibits a variable flow direction and gradient with depth. From approximately 6 to 27 feet an upward gradient (-0.05) exists, however, below this depth the gradient reverses and becomes downward at a magnitude of 0.02. The vertical hydraulic head profile for well cluster MW-47/MW-51D/MW-52D shows that there is generally no significant flow or gradient as all three wells exhibit the same water table elevation between approximately 6 and 50 feet. At well cluster MW-53/MW-54D/MW-55D the profile indicates that there is a very small downward gradient of 0.01 between approximately 8 and 25 feet. Below 25 feet, down to a depth of approximately 47 feet, the downward gradient becomes stronger at 0.05. Well cluster MW-56/MW-57D/MW-58D exhibits a small but uniform downward gradient (between 0.01 and 0.02) from approximately 5 to 50 feet below the ground surface.



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REMEDIAL INVESTIGATION / FEASIBILITY STUDY
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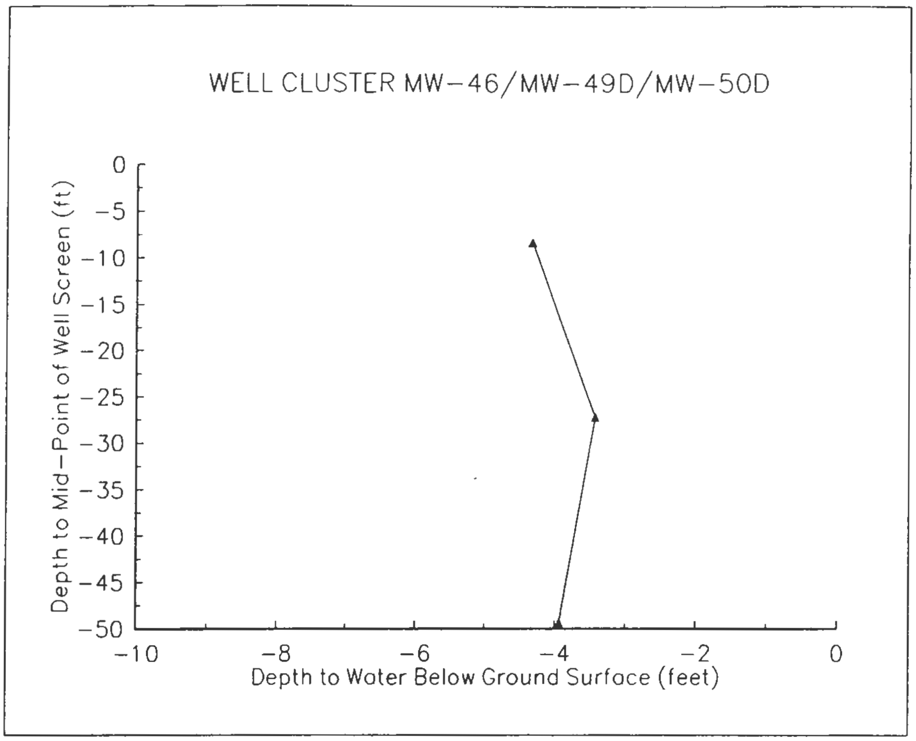
NO 720447-03000

FIGURE 3-23

VERTICAL HYDRAULIC HEAD PROFILES

SCALE



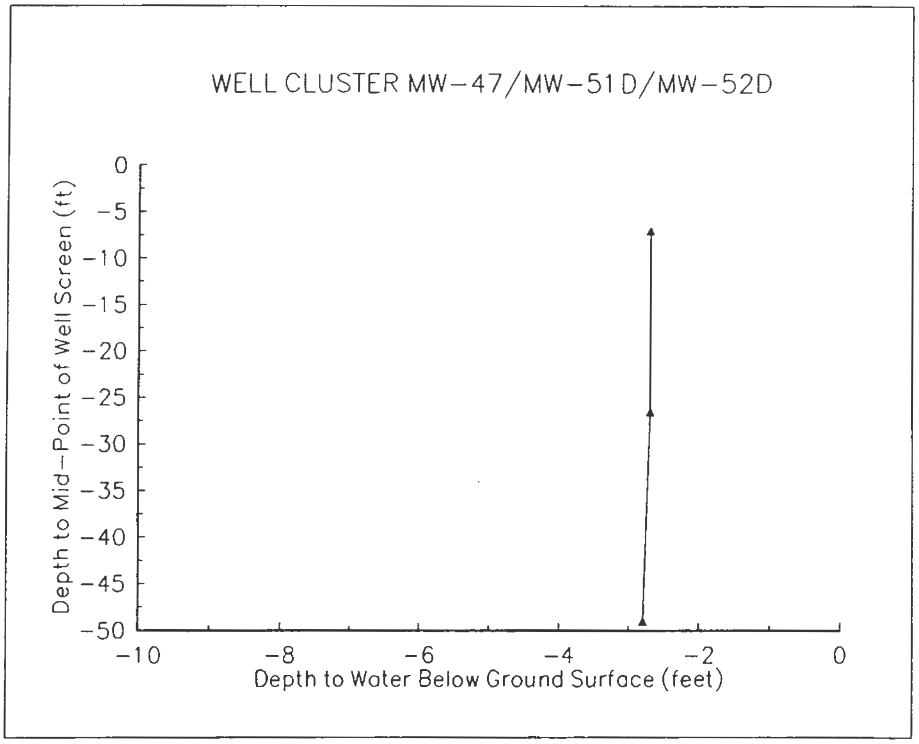


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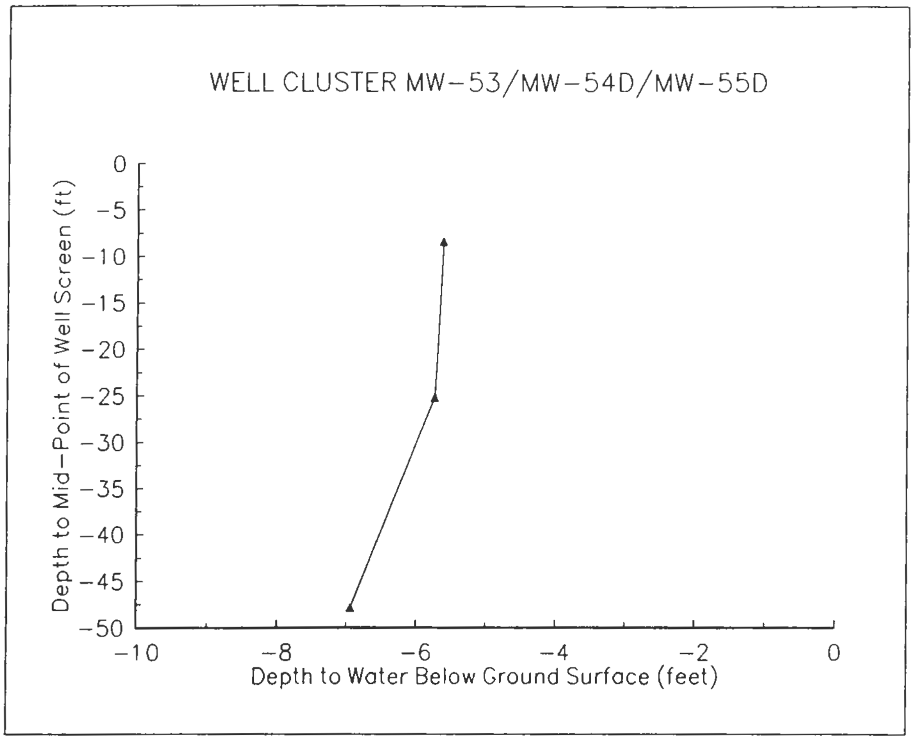
FIGURE 3-23 CONTINUED

VERTICAL HYDRAULIC HEAD PROFILES

SCALE



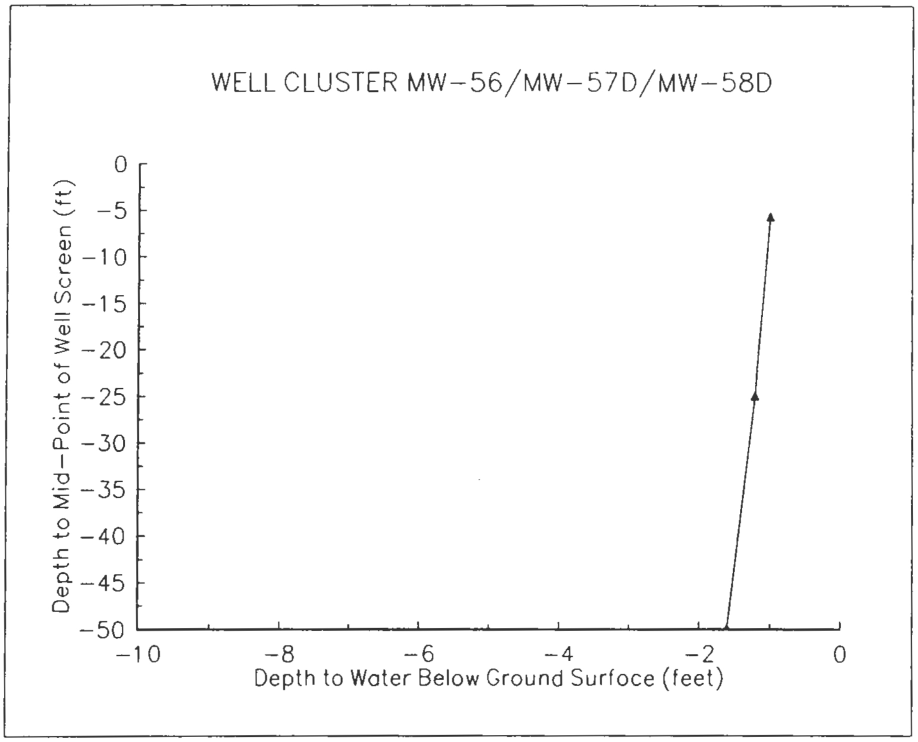


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FIGURE 3-23 CONTINUED

VERTICAL HYDRAULIC HEAD PROFILES

SCALE

TABLE 3 – 9

VERTICAL GRADIENTS IN PAIRED MONITORING WELLS

SENECA ARMY DEPOT
ASH LANDFILL

						PHASE I						PHASE II			
MONITORING WELL NUMBER	WELL TYPE	ELEVATION OF TOP OF PVC CASING (ft)	SCREENED INTERVAL REL. TO TOC (ft)	MID-POINT OF SCREEN REL. TO TOC (ft)	ELEVATION OF MID-POINT OF SCREEN (ft)	ELEVATION 07-JAN-92 (ft)	VERTICAL GRADIENT	ELEVATION 24-JAN-92 (ft)	VERTICAL GRADIENT	ELEVATION 04-FEB-92 (ft)	VERTICAL GRADIENT	ELEVATION 13-APR-93 (ft)	VERTICAL GRADIENT	ELEVATION 14-JUNE-93 (ft)	VERTICAL GRADIENT
PT-16	T/WS	637.65	5.94–10.94	8.44	629.21	634.77	0.02	634.41	0.04	634.35	0.04	634.73	0.02	632.95	0.02
MW-38D	CS	637.93	12.24–32.24	22.24	615.69	634.49		633.91		633.85		634.52		632.70	
MW-36	T/WS	631.73	6.38–16.38	11.38	620.35	629.42	–0.002	628.91	–0.003	628.74	–0.01	629.46	–0.01	627.83	–0.01
MW-35D	CS	631.90	31.34–56.34	43.84	588.06	629.48		629.02		628.96		629.63		628.09	
MW-46	T/WS	650.41	5.95–10.95	8.45	641.96	NA	NA	NA	NA	NA	NA	NA	NA	643.77	–0.05
MW-49D	CS	650.50	17.84–36.84	27.34	623.16	NA		NA		NA		NA		644.67	
MW-46	T/WS	650.41	5.95–10.95	8.45	641.96	NA	NA	NA	NA	NA	NA	NA	NA	643.77	–0.01
MW-50D	CS	649.88	39.66–59.06	49.36	600.52	NA		NA		NA		NA		644.17	
MW-49D	CS	650.50	17.84–36.84	27.34	622.54	NA	NA	NA	NA	NA	NA	NA	NA	644.67	0.02
MW-50D	CS	649.88	39.66–59.06	49.36	601.14	NA		NA		NA		NA		644.17	
MW-47	T/WS	628.06	6.26–7.76	7.01	621.05	NA	NA	NA	NA	NA	NA	NA	NA	622.81	0.00
MW-51D	CS	628.24	16.97–35.97	26.47	601.77	NA		NA		NA		NA		622.81	
MW-47	T/WS	628.06	6.26–7.76	7.01	619.34	NA	NA	NA	NA	NA	NA	NA	NA	622.81	0.00
MW-52D	CS	626.35	39.36–58.73	49.05	579.01	NA		NA		NA		NA		622.71	
MW-51D	CS	628.24	16.97–35.97	26.47	601.77	NA	NA	NA	NA	NA	NA	NA	NA	622.81	0.00
MW-52D	CS	626.35	39.36–58.73	49.05	577.30	NA		NA		NA		NA		622.71	
MW-53	T/WS	639.41	6.45–10.45	8.45	630.66	NA	NA	NA	NA	NA	NA	NA	NA	631.27	0.01
MW-54D	CS	639.11	15.69–34.69	25.19	614.22	NA		NA		NA		NA		631.16	
MW-53	T/WS	639.41	6.45–10.45	8.45	630.96	NA	NA	NA	NA	NA	NA	NA	NA	631.27	0.03
MW-55D	CS	639.16	38.18–57.58	47.88	591.28	NA		NA		NA		NA		629.96	
MW-54D	CS	639.11	15.69–34.69	25.19	613.97	NA	NA	NA	NA	NA	NA	NA	NA	631.16	0.05
MW-55D	CS	639.16	38.18–57.58	47.88	591.23	NA		NA		NA		NA		629.96	
MW-56	T/WS	630.51	4.88–6.38	5.63	624.88	NA	NA	NA	NA	NA	NA	NA	NA	626.9	0.01
MW-57D	CS	629.82	15.39–34.39	24.89	604.93	NA		NA		NA		NA		626.69	
MW-56	T/WS	630.51	4.88–6.38	5.63	624.06	NA	NA	NA	NA	NA	NA	NA	NA	626.9	0.02
MW-58D	CS	629.69	37.28–56.64	46.96	583.55	NA		NA		NA		NA		626.29	
MW-57D	CS	629.82	15.39–34.39	24.89	604.80	NA	NA	NA	NA	NA	NA	NA	NA	626.69	0.02
MW-58D	CS	629.69	37.28–56.64	46.96	582.86	NA		NA		NA		NA		626.29	

Notes:
1) Vertical gradients are shown as two significant digits only.
2) NA = Not Available

Generally, there is no consistent trend in any of the vertical hydraulic head profiles at the Ash Landfill site. Each location tends to have individual flow characteristics. However, the profiles for the two well clusters located in and near the cultivated field immediately west of the site are very similar.

3.7.6 Vertical Connection Between Till/Weathered Shale and Competent Shale Aquifers

3.7.6.1 Introduction

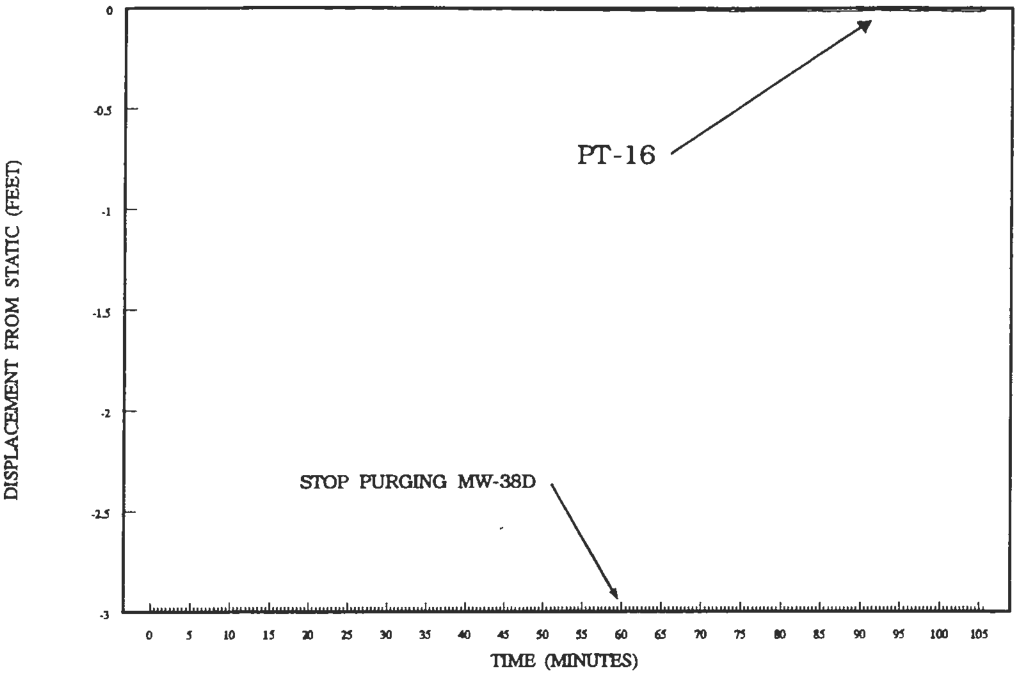
Vertical connection tests were performed on two paired wells (PT-16 and MW-38D, MW-36 and MW-35D), and four well clusters [(MW-46, MW-49D, and MW-50D), (MW-47, MW-51D, and MW-52D), (MW-53, MW-54D, and MW-55D), and (MW-56, MW-57D, and MW-58D)] to determine the degree of connection between the till/weathered shale and competent shale aquifers. Specifically, the tests were performed to determine whether the contact between the till/weathered shale and competent shale could be considered a lower impermeable boundary for the shallow groundwater flow systems at the Ash Landfill. Such an impermeable boundary would prove to be an important influence on the possible spread of volatiles and other constituents.

The water table displacements for each of the vertical connection tests are presented in graphs shown in Figure 3-24. In all instances the well numbers not containing a "D" are till/weathered shale wells and well numbers containing a "D" are competent shale wells. Purging of the deeper well began at zero minutes for all tests. The time at which purging was stopped is also indicated for the test. For comparison purposes, all test results are plotted on the same vertical scale. Most of the tests were not run until full recovery had occurred in the wells being tested due to the length of time expected for this to occur. It is noteworthy, that during the vertical connection test artificial gradients are created between separate aquifers or within a single aquifer and only the interconnection between the screened intervals in the wells was evaluated. The tests do not imply direction of groundwater movement under static conditions. All vertical connection data are included in Appendix H.

3.7.6.2 Paired Wells

A vertical connection test was performed on paired wells PT-16 and MW-38D. Well PT-16 exhibited a very small, although constant displacement throughout the time MW-38D was

DISPLACEMENT IN PT-16



DISPLACEMENT IN MW-36

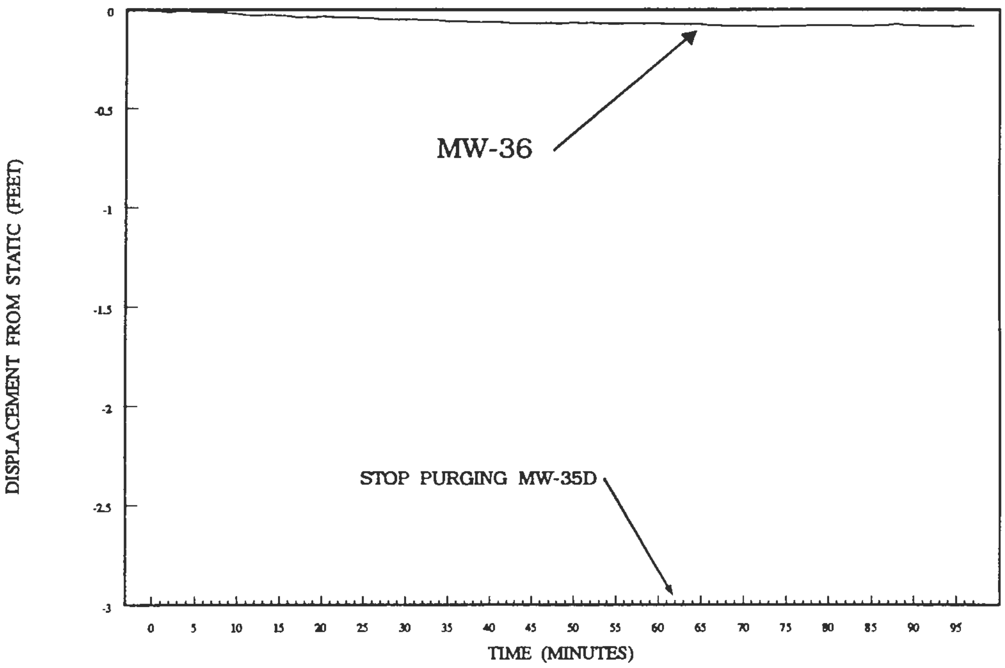


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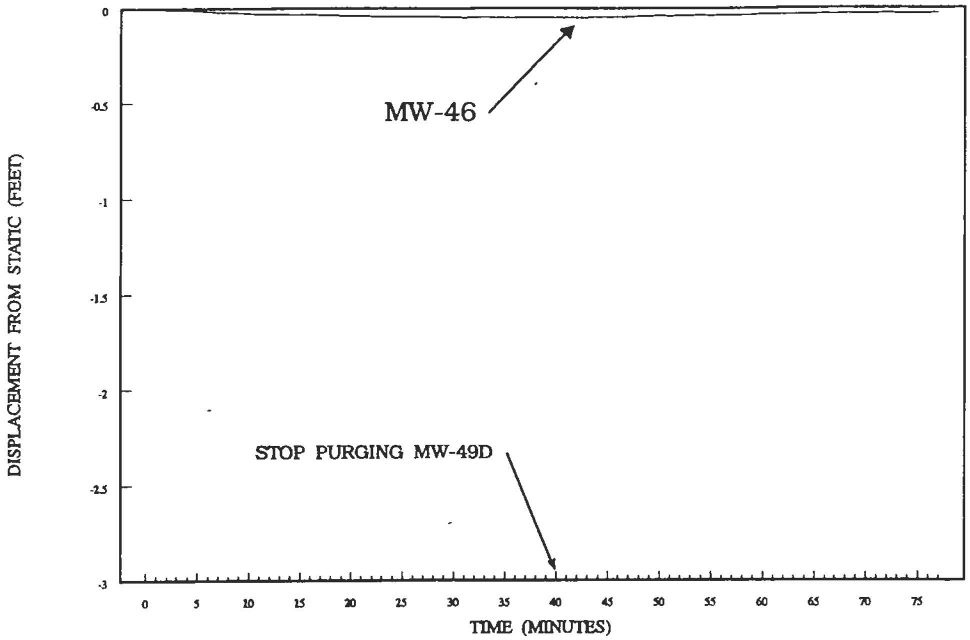
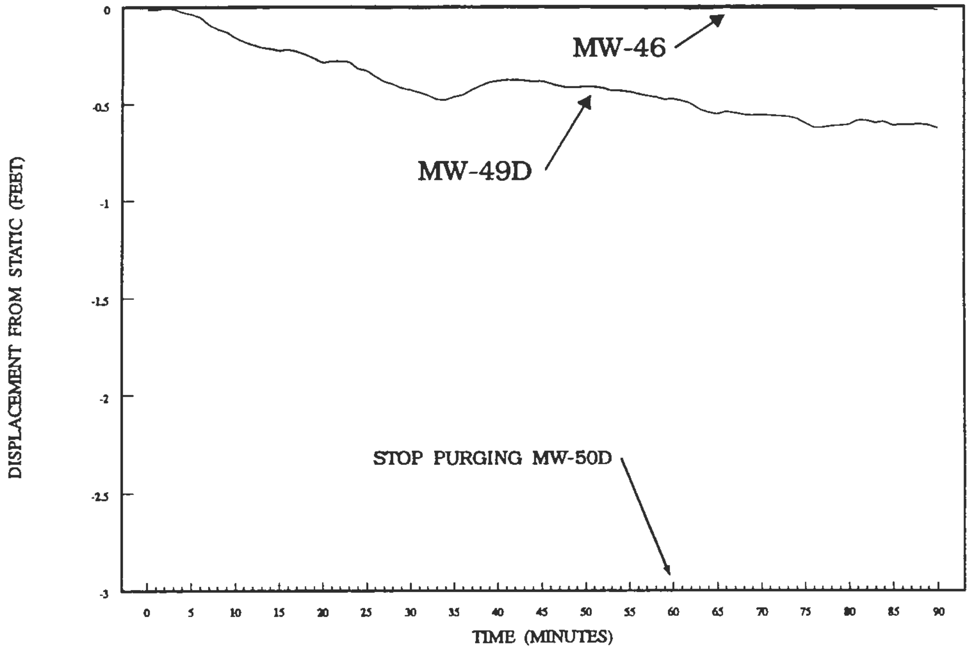
FIGURE 3-24

VERTICAL CONNECTION TESTS

SCALE



DISPLACEMENT IN MW-46



DISPLACEMENT IN MW-46 AND MW-49D

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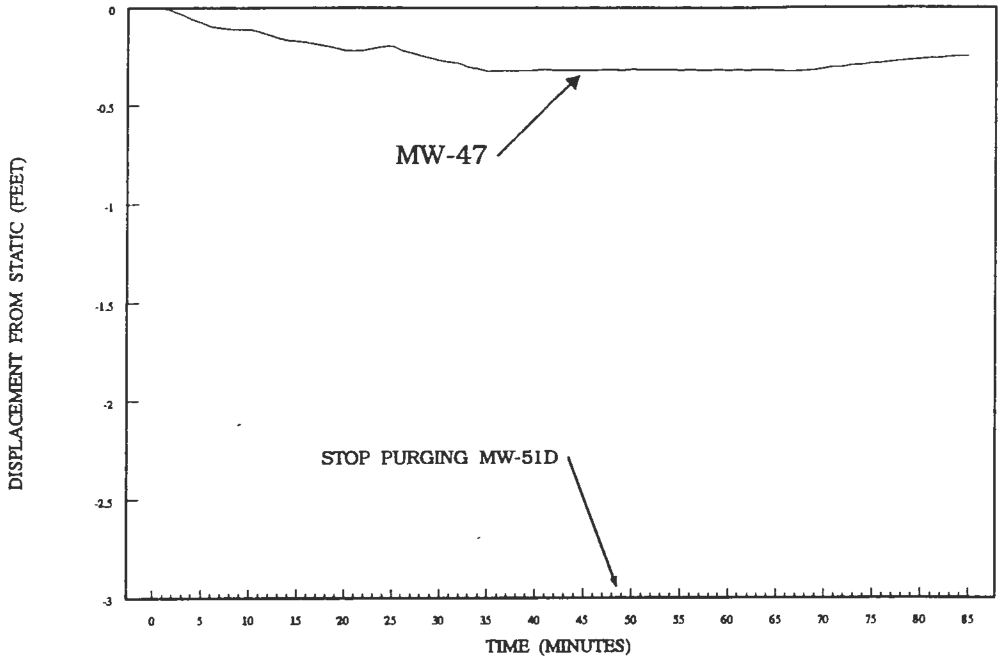
FIGURE 3-24 CONTINUED

VERTICAL CONNECTION TESTS

SCALE

DISPLACEMENT IN MW-47



DISPLACEMENT IN MW-47 AND MW-51D

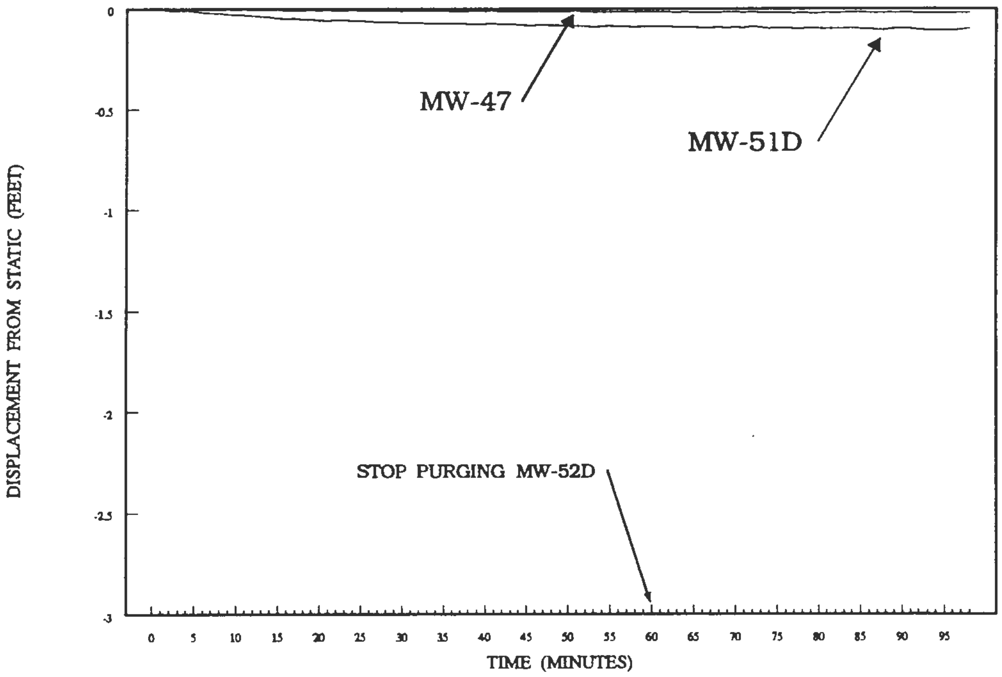


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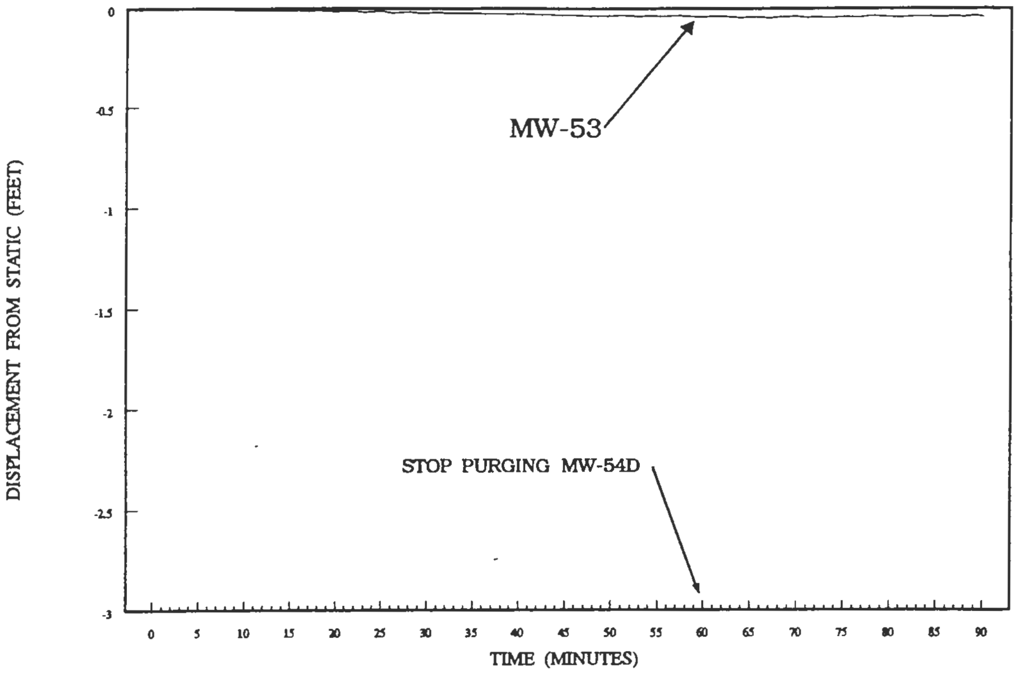
FIGURE 3-24 CONTINUED

VERTICAL CONNECTION TESTS

SCALE

DISPLACEMENT IN MW-53



DISPLACEMENT IN MW-53 AND MW-54D

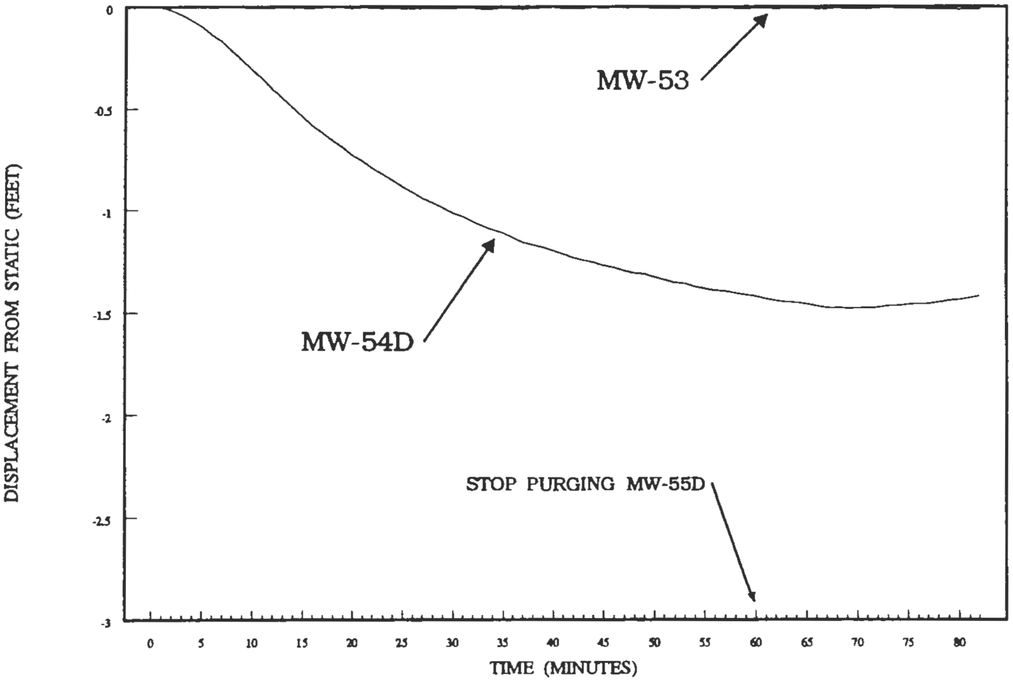


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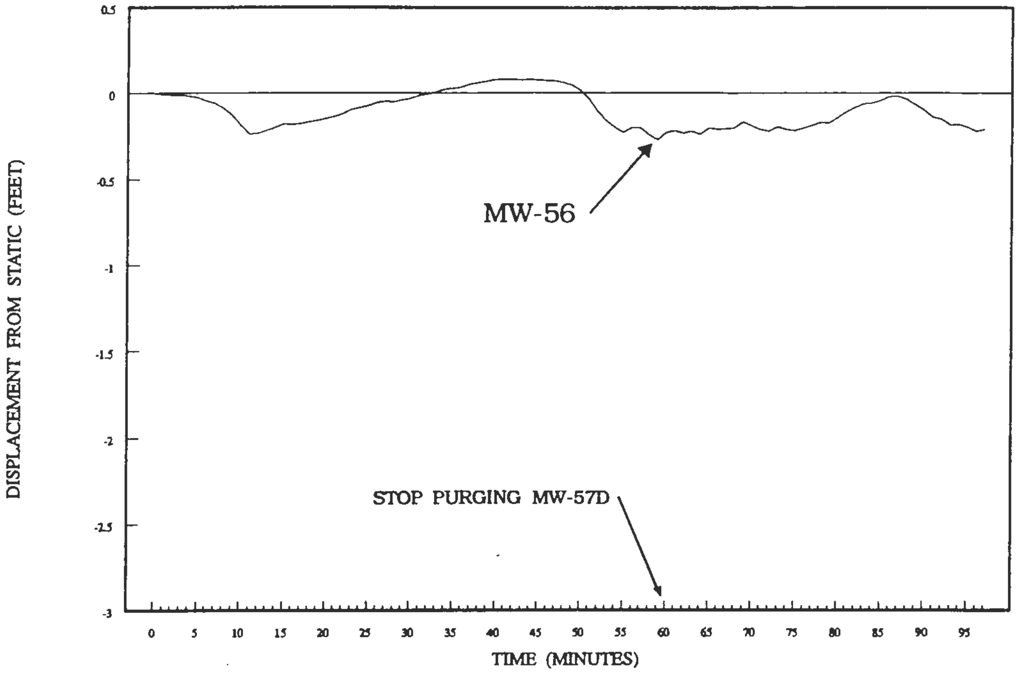
FIGURE 3-24 CONTINUED

VERTICAL CONNECTION TESTS

SCALE

DISPLACEMENT IN MW-56



DISPLACEMENT IN MW-56 AND MW-57D

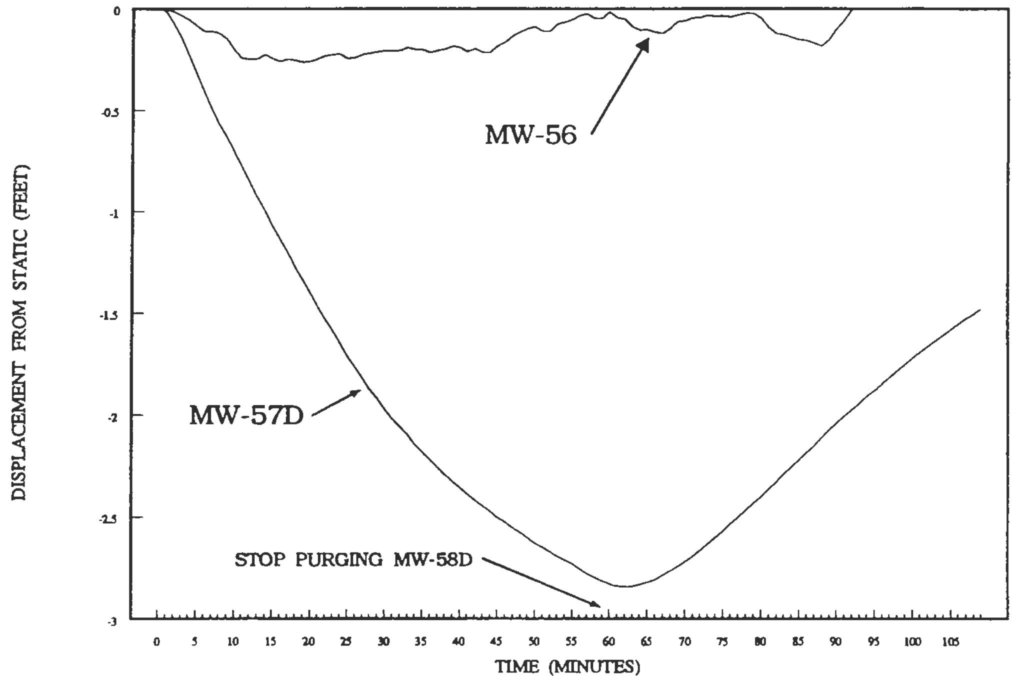


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FIGURE 3-24 CONTINUED

VERTICAL CONNECTION TESTS

SCALE

purged (Figure 3-24). The maximum displacement in PT-16 was 0.018 feet. Purging was performed for 60 minutes after which time MW-38D was allowed to recharge. At 30 minutes into the test, the maximum head differential (and maximum gradient) between the two wells of approximately 21 feet was achieved. Another vertical connection test was performed on paired wells MW-36 and MW-35D. Well MW-36 also exhibited a very small displacement, although it was several times the displacement measured in PT-16 (Figure 3-24). The maximum displacement in MW-36 was 0.088 feet. Purging was performed for 62 minutes after which time MW-35D was allowed to recharge. At 30 minutes into the test, the maximum head differential between the two wells of approximately 32 feet was achieved. The paired well vertical connection tests indicate that there is a very small although measurable drawdown in the shallow wells screened in the till/weathered shale when water is purged from their respective paired deep wells screened in competent shale.

3.7.6.3 Well Clusters

Two vertical connection tests were performed at well cluster MW-46, MW-49D and MW-50D. The first test was performed by purging MW-49D and measuring the displacement in MW-46. Well MW-46 exhibited a very small displacement (a maximum of 0.053 feet) during purging. Purging was performed for 40 minutes after which time MW-49D was allowed to recharge. Well MW-46 exhibited an immediate trend toward recovery at 40 minutes although the recovery was slow and gradual throughout the remainder of the test. At 15 minutes into the test the maximum head differential between the two wells of approximately 12 feet was achieved. The second test was performed by purging MW-50D and measuring the displacements in MW-46 and MW-49D. Well MW-46 exhibited a very small displacement (a maximum at 0.018 feet). MW-49D, though, exhibited a significantly larger displacement which began less than 5 minutes into the test and reached a maximum displacement of 0.626 feet. Small perturbations in the displacement curve may be due to different speeds of bailing during the purging process. Purging was performed for 60 minutes after which time MW-50D was allowed to recharge. At 60 minutes into the test, the maximum head differential between the MW-46 and MW-50D was achieved.

Two vertical connection tests were performed at well cluster MW-47, MW-51D and MW-52D. The first test was performed by purging MW-51D and measuring the displacement in MW-47. Well MW-47 exhibited a significantly greater displacement than any of the previous tests of this type; a maximum displacement of 0.332 feet was measured. Purging was performed for 49 minutes. At 45 minutes into the test, the maximum head differential (9 feet) between the two wells was achieved. The second test at this cluster was performed by purging MW-52D and measuring displacements in MW-47 and MW-51D. Well MW-47 exhibited a very small displacement (a maximum of 0.022 feet). Well MW-51D showed a slightly greater displacement with a maximum of 0.110 feet. Purging was performed for 60 minutes in MW-52D. At 30 minutes into the test, the maximum head differential (43 feet) between MW-47 and MW-52D was achieved.

Again, two vertical connection tests were performed at cluster MW-53, MW-54D and MW-55D. The first test was performed by purging MW-54D and measuring the displacement in MW-53. As witnessed in previous tests of this type, MW-53 showed a very small displacement; a maximum of 0.05 feet was measured (Figure 3-24). Purging was performed for 60 minutes. At 32 minutes, the maximum head differential of 22 feet was achieved between the two wells. In the second test, MW-55D was purged and produced a very small displacement in MW-53 (a maximum of 0.015 feet) and a comparatively large displacement in MW-54D (a maximum of 1.480 feet) (Figure 3-24). Purging was performed for 60 minutes. At 40 minutes into the test, the maximum head differential of 45 feet was achieved between wells MW-53 and MW-55D.

At the fourth cluster (MW-56, MW-57D, and MW-58D) the vertical connection test were also performed. For the first test, MW-57D was purged for 60 minutes and the resulting data was not well behaved producing a variable displacement in MW-56 that may be due to different bailing speeds. A more detailed explanation for the anomalous curve is not apparent. At 60 minutes into the test, the maximum head differential of 24 feet was achieved between the two wells. In the second test at this cluster, MW-50D was purged and produced a small but variable displacement in MW-56 similar to the one observed in the first test. Well MW-57D exhibited a maximum displacement of 2.843 feet, the largest observed in all of the vertical connection tests. Purging of MW-58D was performed for 60 minutes. At 60 minutes into the test, the maximum head differential of 36 feet was achieved between MW-56 and MW-58D. Note that MW-57D began to recover within minutes after purging was stopped.

To summarize, in all vertical connection tests at the well clusters, the degree of displacement in the till/weathered shale wells (up to 0.3 feet) was greater during purging of the shallow shale wells than the deep shale wells. These greater displacements can be attributed to the close proximity of the shallow shale wells to the till/weathered shale wells. The degree of vertical connection within the competent shale aquifer is comparatively greater than the connection observed between the till/weathered shale and competent shale aquifers. The results indicate that the till/weathered shale aquifer is connected although not significantly to the competent shale aquifer below it. This could be due to refilling of bedding plane fractures and joints (note earlier) by silt and clay in the upper portions of the shale aquifer. Flow into the competent shale is likely controlled by vertical gradients. Vertical connections for wells screened within the competent shale aquifer are significantly greater due to clean vertical sub-millimeter scale joints which exist in the shale aquifer. However, the vertical connection between competent shale wells MW-51D and MW-52D is comparatively poor.

3.7.7 Summary of Aquifer Characteristics and Behavior

3.7.7.1 Introduction

An analysis of the tests performed for this investigation and 3 years of historical data collected at the Ash Landfill site provide information on the overall behavior of the till/weathered shale and competent shale aquifers. The historical depth to ground water data was collected for the years 1990 through 1993 during quarterly sampling events at the Ash Landfill site. No significant historical data is available from the wells installed during Phases I and II of this investigation so the data represents wells installed prior to 1992.

3.7.7.2 Till/Weathered Shale Aquifer

For the relatively thin till/weathered shale aquifer, historical plots of water table elevations indicate that they fluctuate as much as 8.72 feet in well PT-26, which is located off-site near the SEDA airfield. The maximum fluctuation on the Ash Landfill site is seen in the hydrography for well PT-25 which fluctuates up to 8.21 feet (Appendix I). The maximum thickness of the till/weathered shale aquifer is 11.6 feet, again in PT-26. On-site, the maximum thickness occurs in PT-25 at 8.59 feet. It is noteworthy that at certain times of the year, the aquifer becomes quite thin, approximately 1 to 3 feet thick, and even drys up in some locations (PT-29 and PT-30).

Based on the historical data, the 21 wells on the Ash Landfill site exhibit rhythmic, seasonal water table and saturated thickness fluctuations (Figures 3-25 and 3-26 and Appendix I). The aquifer is at its thinnest (generally between 1 and 3 feet thick) in the month of September and its thickest (generally between 6 and 8.5 feet thick) between the months of December and March. It is likely that for the portions of the graphs where data is not available (September

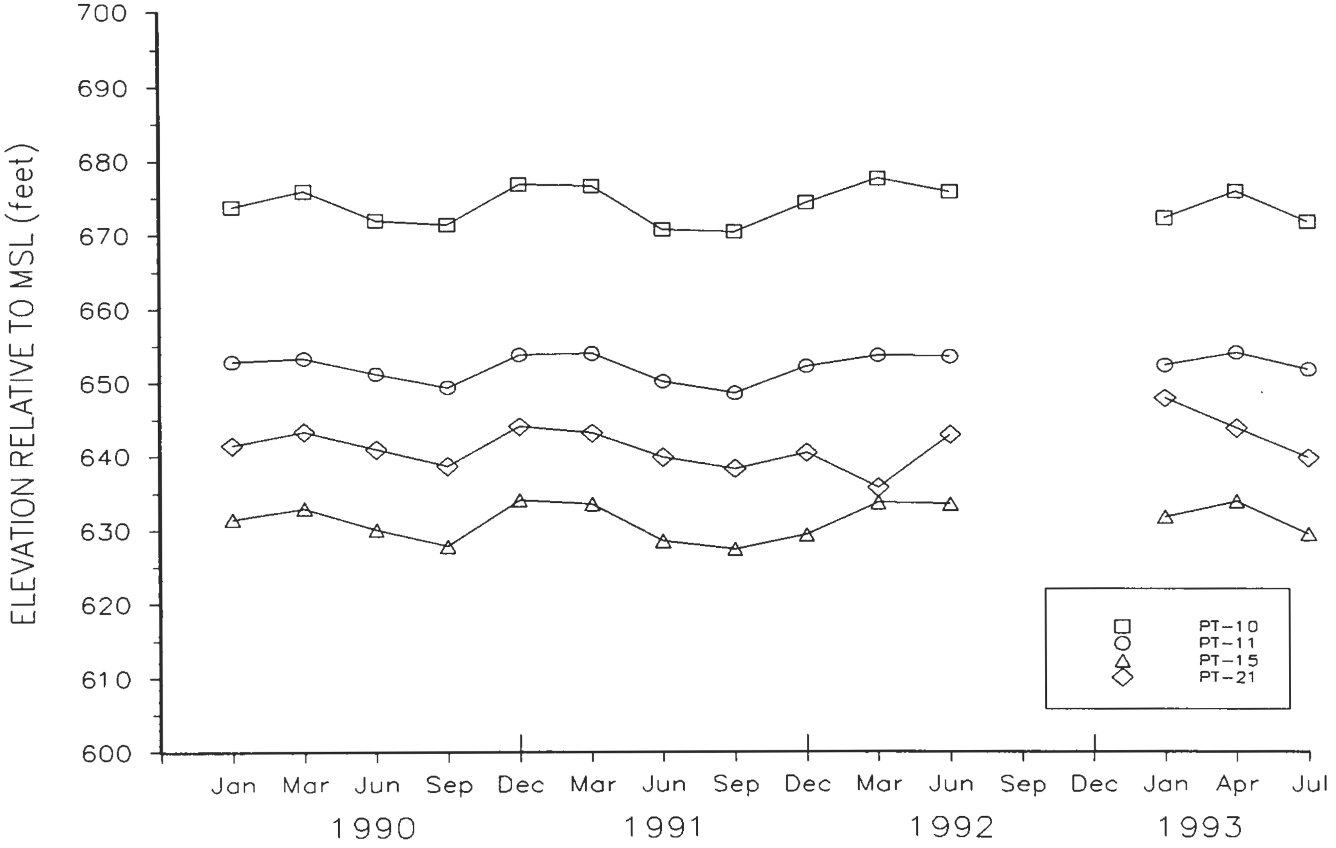

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FIGURE 3-25

HISTORICAL WATER TABLE ELEVATIONS

SCALE

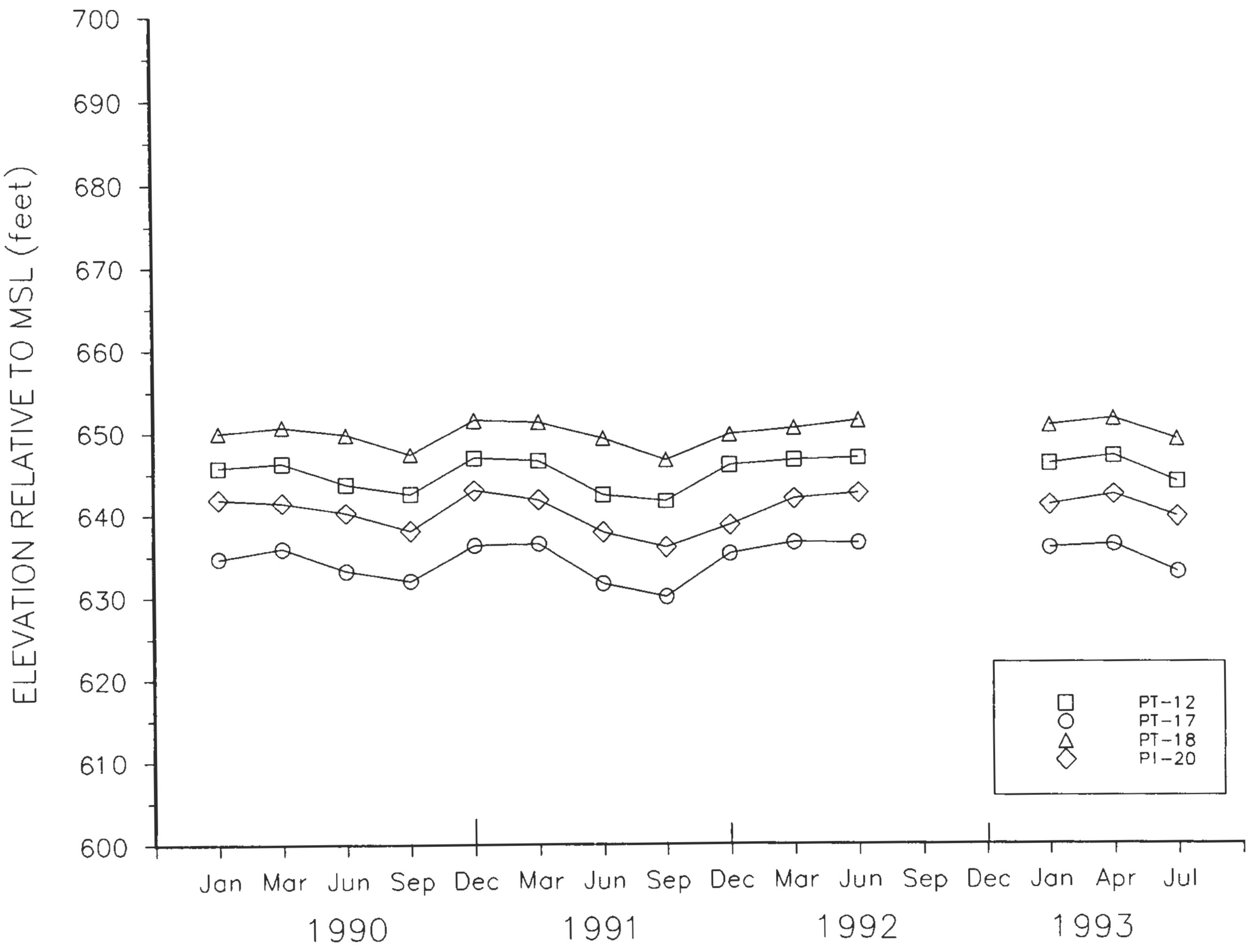

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FIGURE 3-25 CONTINUED
HISTORICAL WATER TABLE ELEVATIONS

SCALE

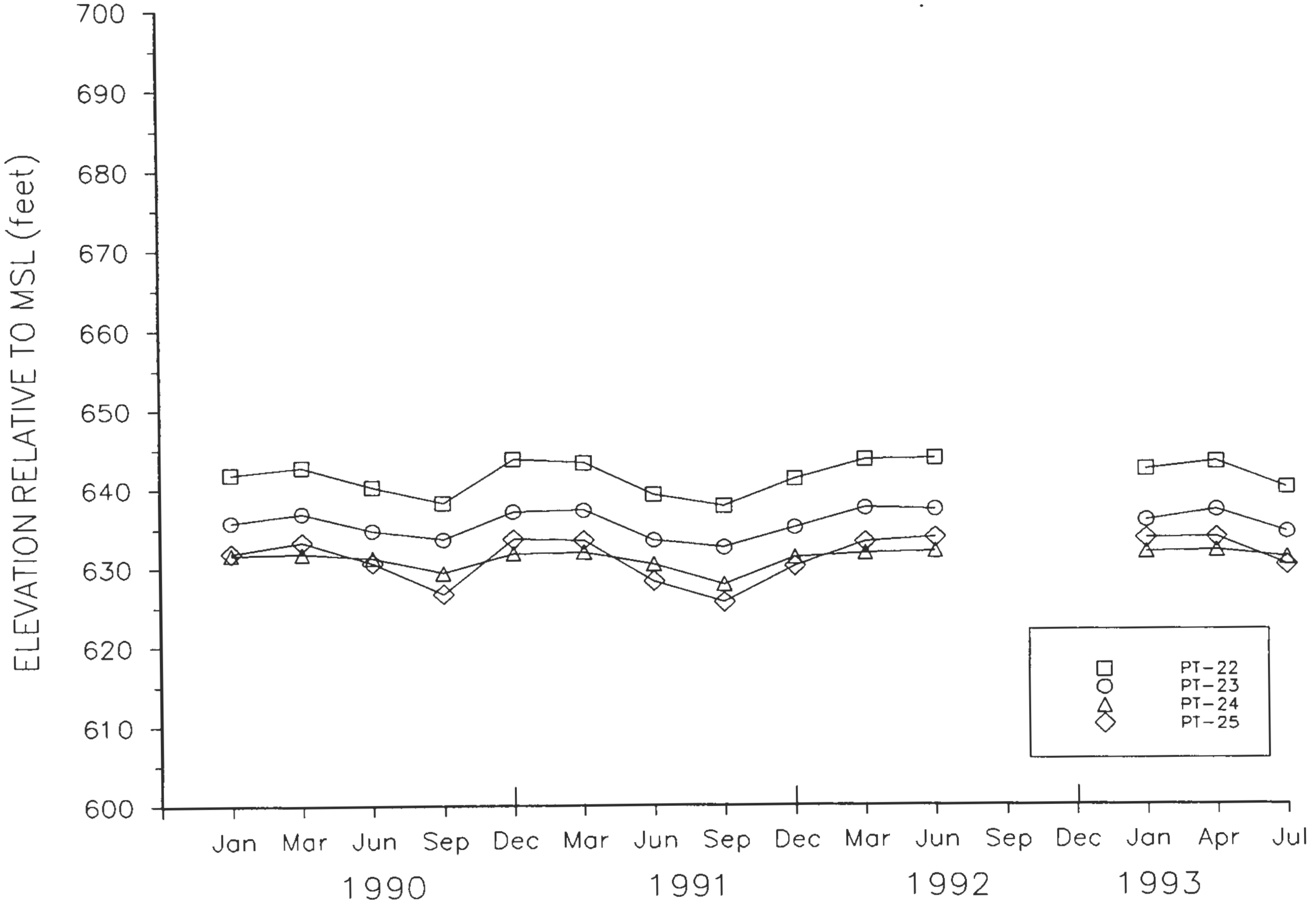

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FIGURE 3-25 CONTINUED
HISTORICAL WATER TABLE ELEVATIONS

SCALE

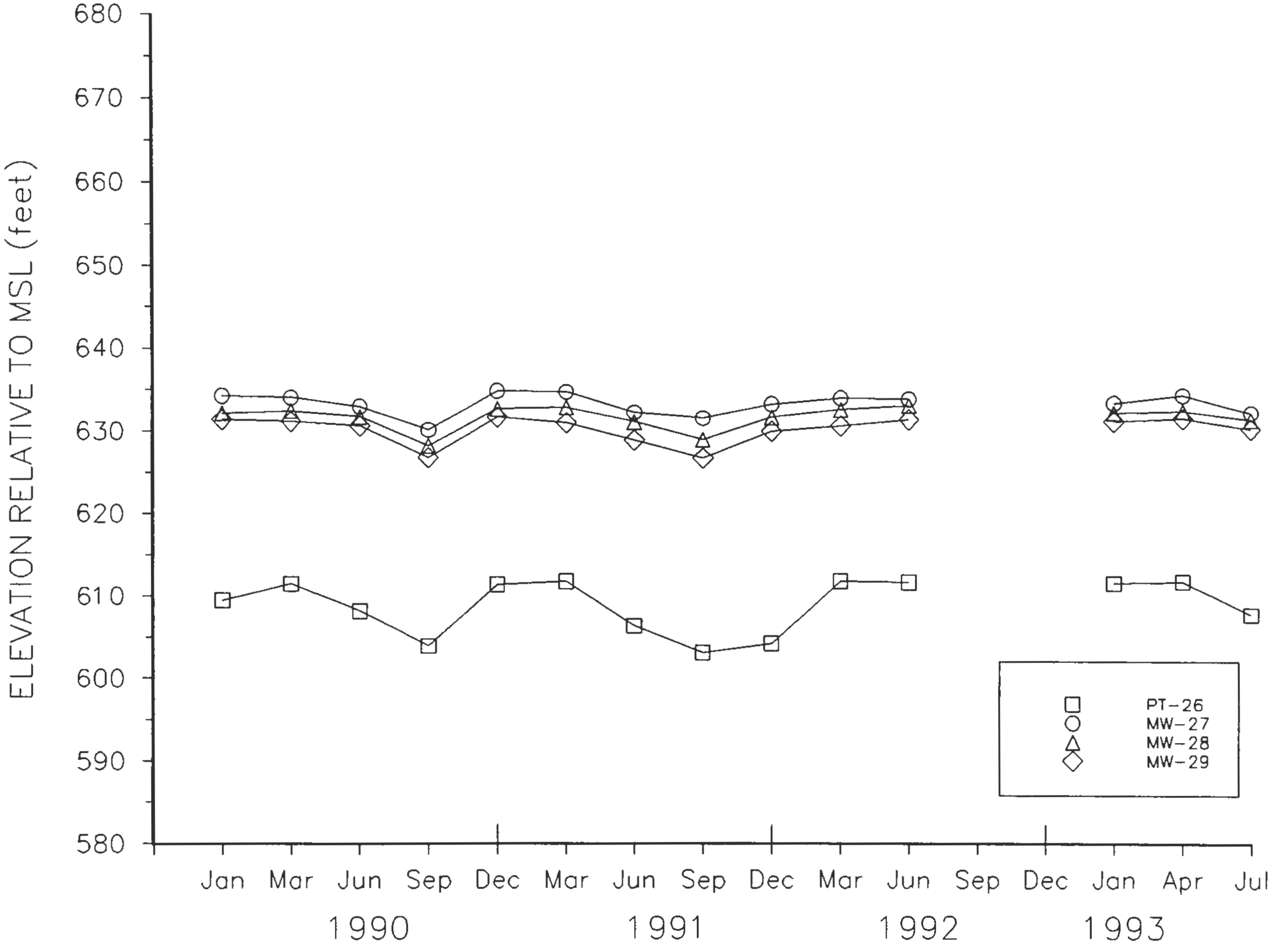

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FIGURE 3-25 CONTINUED
HISTORICAL WATER TABLE ELEVATIONS

SCALE

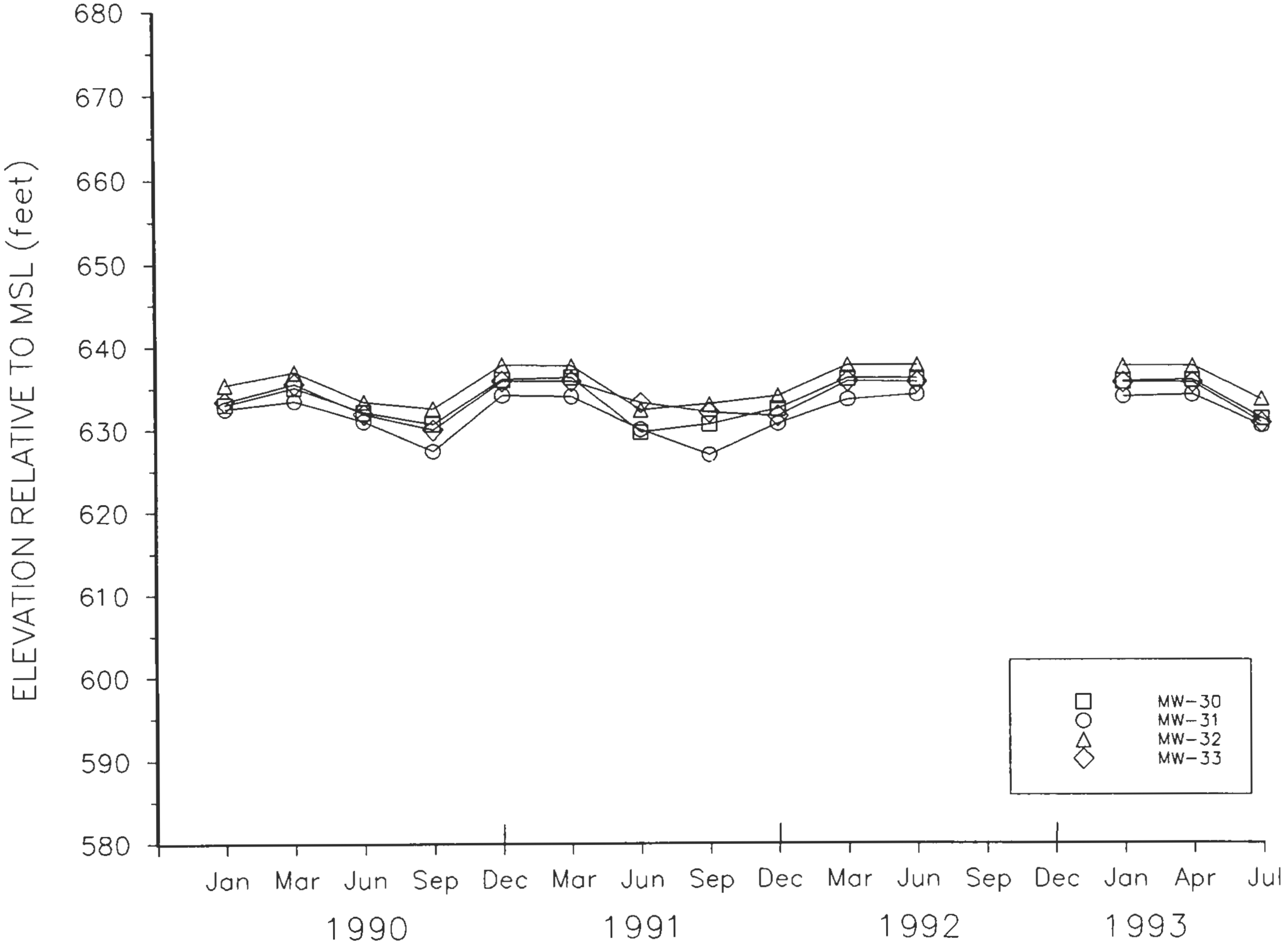

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FIGURE 3-25 CONTINUED
HISTORICAL WATER TABLE ELEVATIONS

SCALE

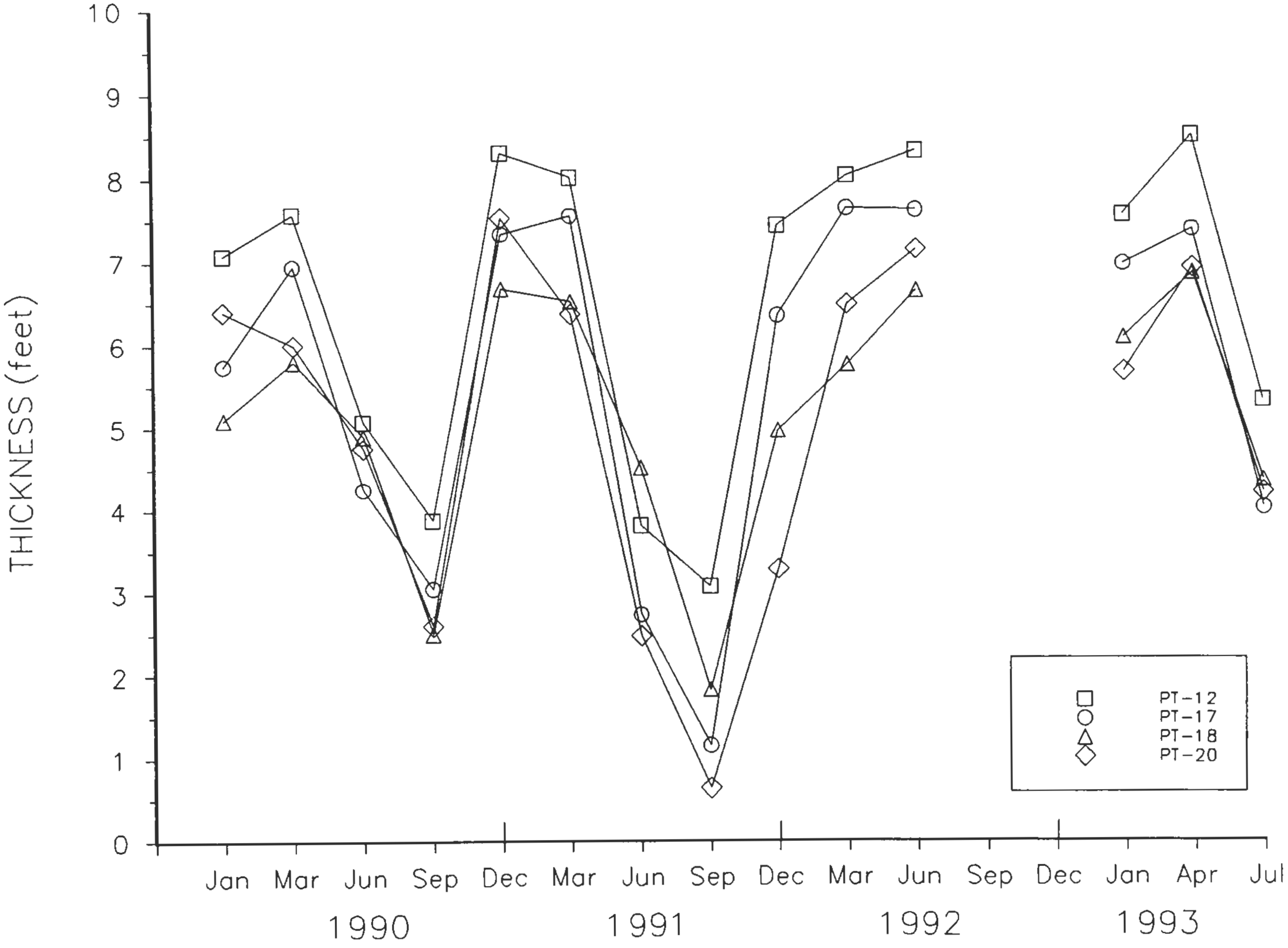

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FIGURE 3-26

HISTORICAL SATURATED THICKNESSES

SCALE

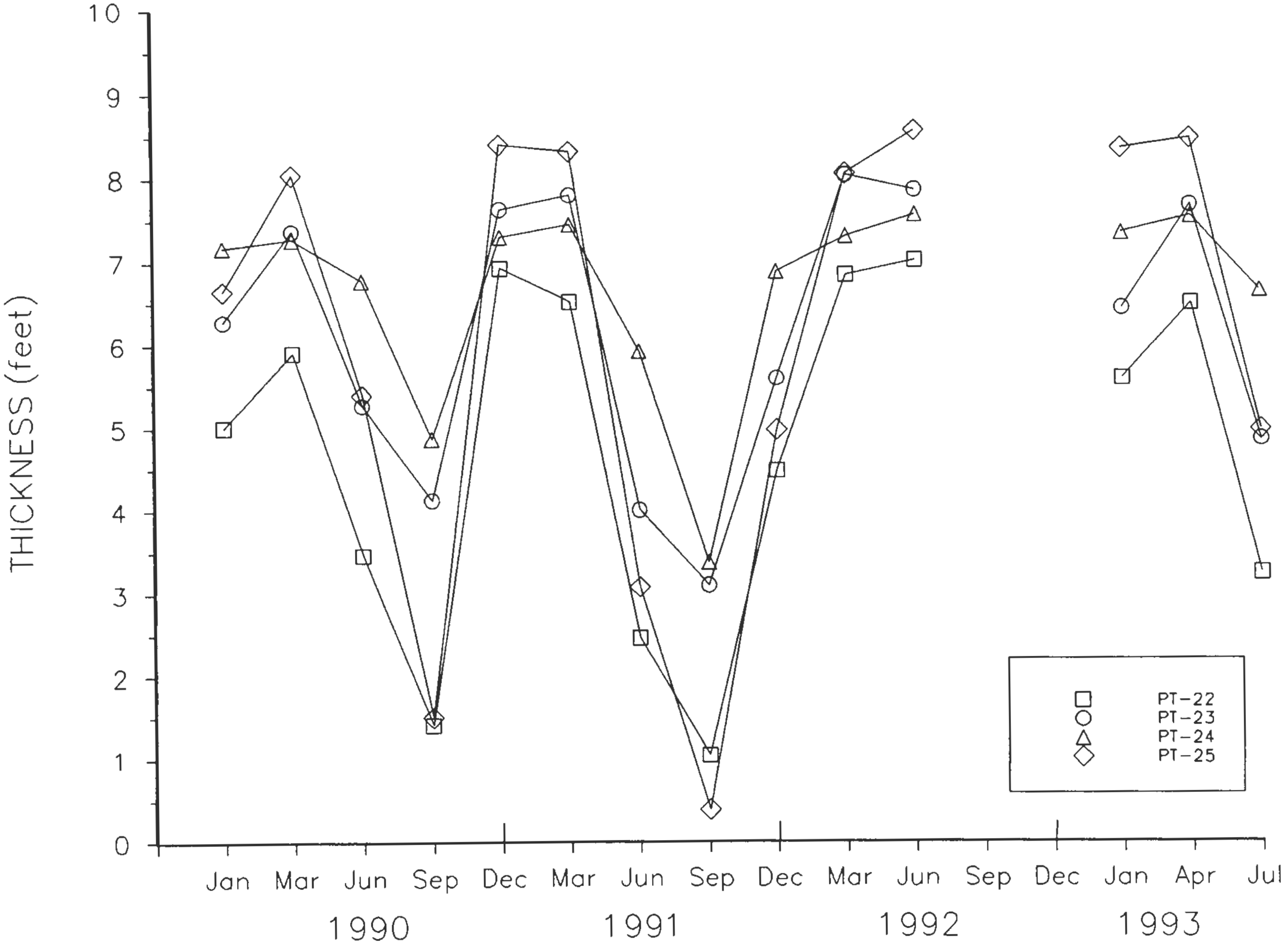

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FIGURE 3-26 CONTINUED
HISTORICAL SATURATED THICKNESSES

SCALE

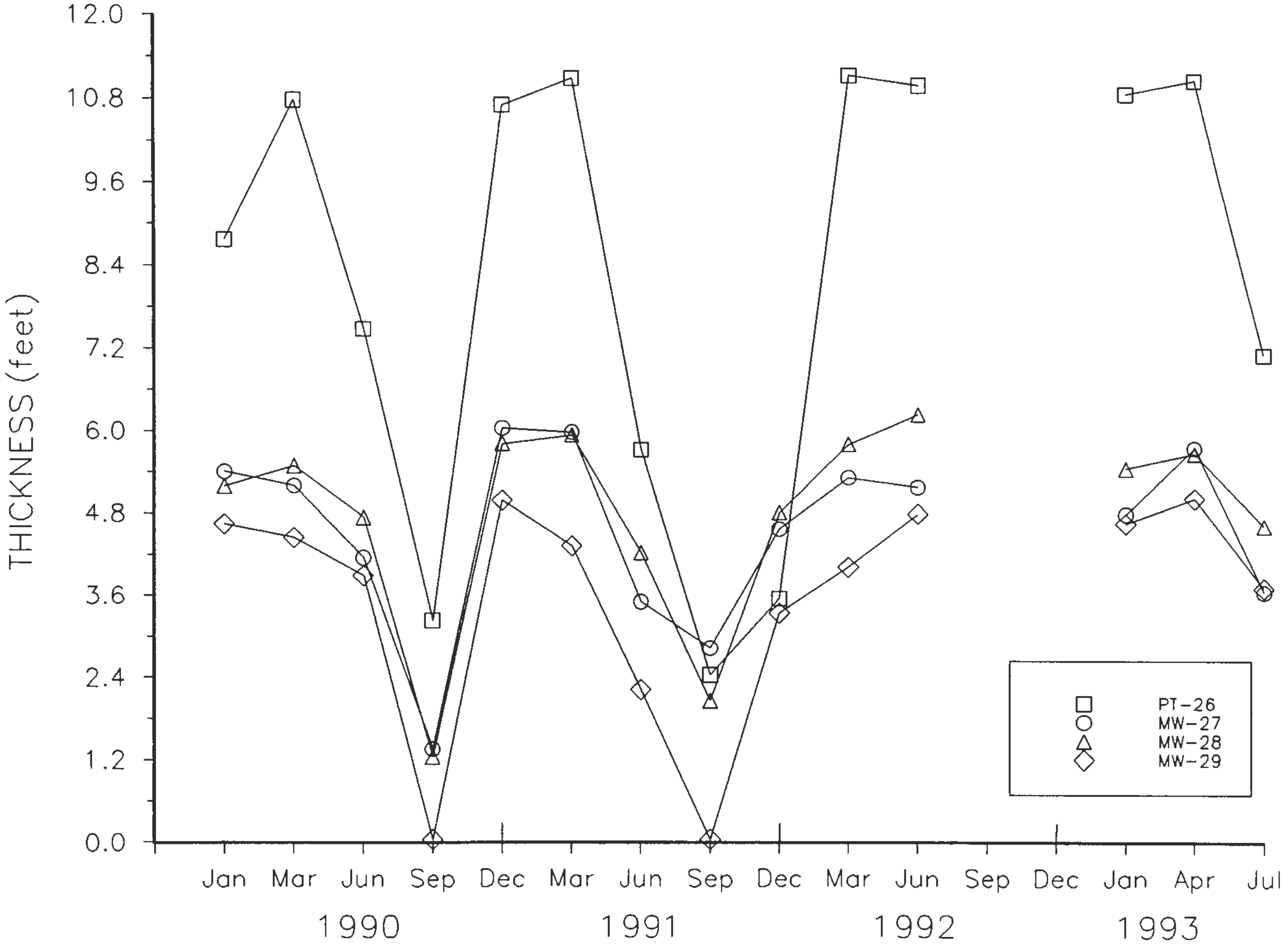

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FIGURE 3-26 CONTINUED
HISTORICAL SATURATED THICKNESSES

SCALE

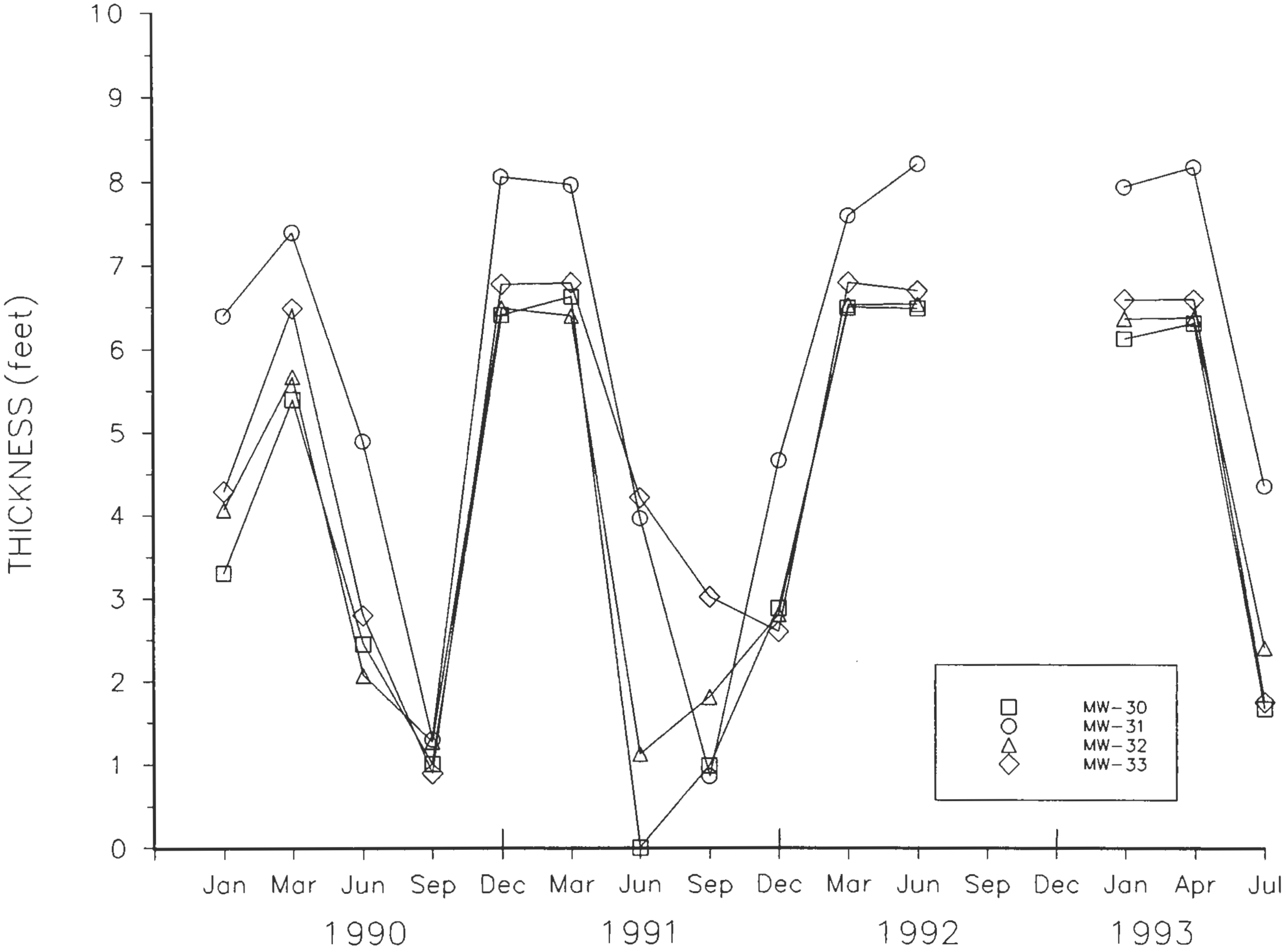

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FIGURE 3-26 CONTINUED
HISTORICAL SATURATED THICKNESSES

SCALE

and December 1992), the water table behaves in a similar way as in the past, exhibiting a seasonal low.

Mozola (1951) states that groundwater in Seneca County (including the Ash Landfill site) is derived almost totally from precipitation within the county. To investigate historical precipitation events and the likely relationship between fluctuations in the water table of the till/weathered shale aquifer and these precipitation events, monthly precipitation data for the years 1990 through most of 1993 were obtained from the Aurora Research Farm located 10 miles east of the site. The data for these four years is plotted in Figure 3-27. Although the no definitive trend is depicted by the data, they generally show higher amounts of precipitation in the Spring (March and April) and Fall (September) and relatively lower amounts in the Summer (with the exception of the month of July 1992) and Winter (January and February). These data alone do not explain the fluctuations observed on the water table elevation (Figure 3-25) and saturated thickness profiles (Figure 3-26).

The rhythmic behavior of the aquifer is not only controlled by precipitation events but is affected by a combination of precipitation amounts and evapotranspiration rates. The later phenomenon is affected by temperature, exposure to the intensity of the sun, velocity of the wind, and the amount of vegetation. Horizonal flow is not believed to play a major role in discharging water from the till/weathered shale unit which has a relatively low conductivity (an average of 4.5 X 10^{-4} cm/sec). While vertical connection tests indicate that low degrees of downward movement are possible from the till/weathered shale aquifer to the competent shale aquifer, no strong downward vertical gradients are believed to occur on-site and, therefore, downward flow is also believed to be minimal compared to evaporative losses. Based on the hydrographs for the wells, a conceptual scenario is that high water tables in the winter months are sustained by generally high precipitation amounts that last into the Spring (March and April) and low evapotranspiration rates. Decreasing precipitation amounts accompanied by an increase in evapotranspiration (due to an increase in temperature and more vegetation) in the Summer results in little recharge to the aquifer and thus a fall in the water table. In the summer, when there is generally less rainfall and increased temperatures, evapotranspiration at the surface causes water to move upwards from the water table to the surface by capillary action, a phenomenon noted by deMarsily (1986). In the Fall (September and October) there is generally an increase in precipitation and a decrease in evapotranspiration accounting for the increasing water table elevations observed into the winter months.

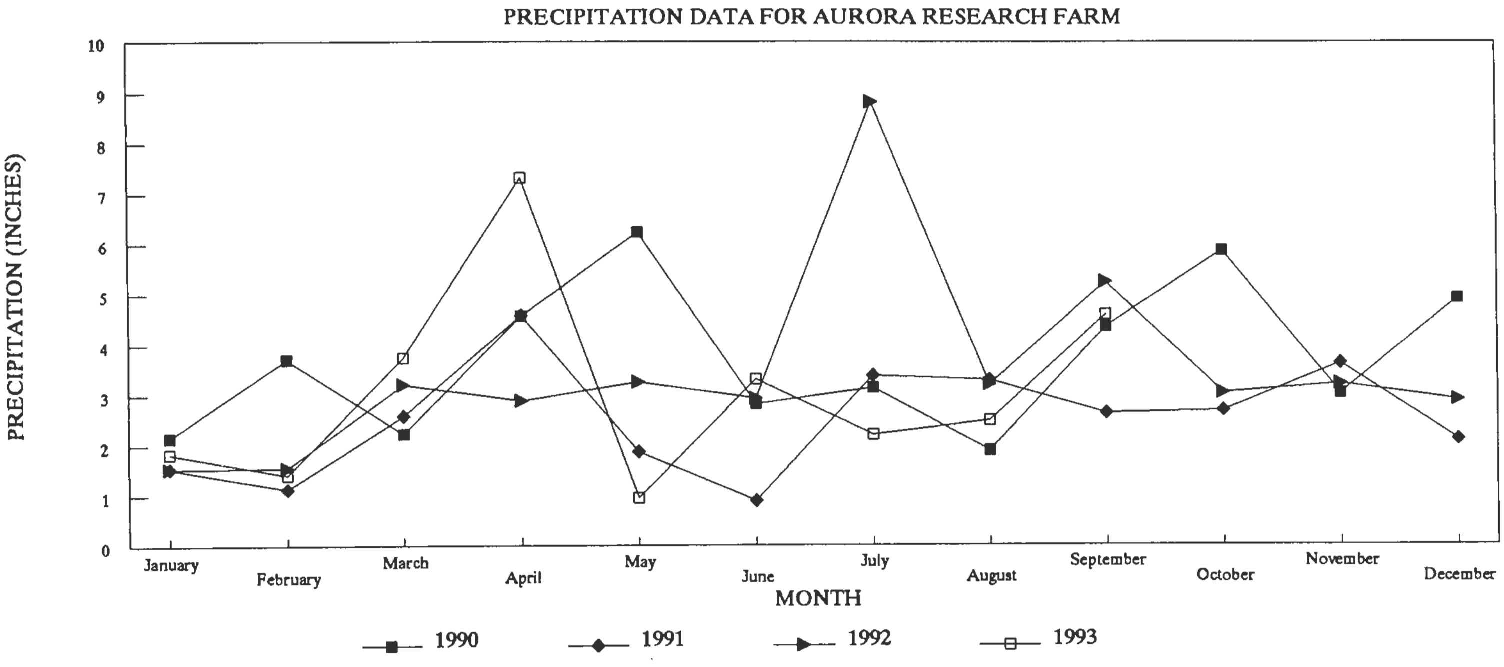

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FIGURE 3-27 PRECIPITATION DATA FOR AURORA RESEARCH FARM	
SCALE	

Support for the concept describing the behavior of the till/weathered shale aquifer can be found in the literature. Jones et al. (1992) discusses a shallow ground water flow system in a Wisconsin-age weathered till in Iowa and cites vertical upward movement and evapotranspiration as a primary source of discharge from the till. Cravens and Ruedisili (1987) and Hendry (1988) performed earlier studies at the Iowa site that showed that the recharge from surface percolation was predominantly discharged through capillary rise and evapotranspiration, and that lateral flow within the weathered till and vertical downward flow were minor. Cravens and Ruedisili (1987) also documented that the water table depth ranged from an average minimum of 2.4 feet in the Summer to an average maximum of 8.5 feet in the Fall; a similar seasonal trend is evident on the Ash Landfill site. Specifically, they attributed the rise and fall of the water table to "seasonal changes in precipitation, plant water use, and evaporation through micropores and fractures." According to Fetter (1980) water can rise by capillary action about 4.9 feet in silts and 9.8 feet in some clays and allows for large losses of water from the weathered till zone without the required movement of water downward through the unweathered till (Cravens and Ruedisili, 1987). Davis and Dewiest (1966) assert that use of water by plants is generally much more important as a means of ground water discharge than is direct soil evaporation. However, evaporation, aided by soil cracks and capillary transfer, is effective in the upper 3 feet of sandy soil and the upper 10 feet of clayey soil.

In another instance, hydrographs for peizometers screened in the upper portions of a Saskatchewan till showed seasonal fluctuations of up to 8 feet over an approximately 4 month period (Keller, at al., 1988). However, at this particular site, the seasonal ground water high occurs in September-October and the low in May-June. Based on hydrographs from nested peizometers the loss of groundwater at this site was shown not to be from downward flow, but was attributed to a combination of lateral flow and upward losses due to evapotranspiration, freezing in the unsaturated zone, and/or other causes.

DeMarsily (1986) describes the higher moisture content of the soil and generally a higher water table in the Winter compared to the Summer. A comparison of general moisture profiles in soil for these seasons indicates that precipitation events in the winter months are more likely to have a direct impact on the water table. This is due to the higher moisture content of the soil in the Winter which allows for greater infiltration (recharge) of water during and after precipitation events. The moisture profiles indicate that in the Summer, when evaporation is high, the atmosphere generally takes back all the moisture received during a storm, resulting in little recharge to the aquifer.

The various losses and gains in the till/weathered shale aquifer at the Ash Landfill site, as depicted on the water table elevation and saturated thickness plots and in the conceptual water balance described above, are supported by a monthly water balance model that was run for the same four years of historical data. The monthly water balance is presented in Table 3-10. This water balance was developed using the rational method described in "Use of the Water Balance Method for Predicting Leachate Generation From Solid Waste Disposal Sites" (EPA, 1975). The model takes into account evapotranspiration, precipitation, precipitation runoff, and infiltration. A more complete discussion of the water balance model can be found in Section 5.1.1. As shown in Table 3-10, much of the runoff and almost all of the percolation (groundwater recharge) occur during March, April, and May, during the snow melt period. There is a continued runoff throughout the time period when the temperature stays above freezing. This is consisted with observations made at the site regarding runoff and groundwater. There is always runoff at the site during a major rainfall since the clay soils on-site prevent rapid infiltration. Groundwater levels measured in the spring have been highest with levels dropping over the summer. Water levels in the Winter have been lower than those in Spring, indicating little or no recharge in Summer and Fall.

The large fluctuations in the saturated thickness of the till/weathered shale aquifer would likely have direct impact on the ground water flow regime and thus the transport of volatile organics or other constituents. This would be especially true when the aquifer is at its thinnest (1 to 3 feet) in the Summer and early Fall, becoming dry at some locations.

3.7.7.3 Competent Shale Aquifer

The historical data base for the competent shale aquifer is very limited. Historical water table elevations are available for only one well (PT-10) which is believed to be screened in the competent shale. Unfortunately, the screened interval for this well is not known. Seasonally this well shows the same magnitude of fluctuations in water table elevation as the till/weathered shale wells.

3.8 LAND USE

3.8.1 Current Land Use

The SEDA is situated between Seneca Lake and Cayuga Lake and encompasses portions of Romulus and Varick Townships. Land use in this region of New York is largely agricultural, with some forestry and public land (school, recreational and state parks). Figure 3-28

TABLE 3 – 10

MONTHLY WATER BALANCE
1992

SENECA ARMY DEPOT
ASH LANDFILL

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Temp. (°F)	22.5	23.4	32.0	44.8	54.5	64.6	69.1	66.9	60.6	50.4	39.4	27.9	46.3
Heat Index	0	0	0	1.7	4.0	7.0	8.5	7.8	5.8	2.9	0.7	0.0	38.4
Unadj. PET (in)	0.000	0.000	0.000	0.039	0.079	0.118	0.134	0.126	0.102	0.063	0.024	0.000	
Corr. Factor	24.6	24.6	30.9	33.6	37.8	38.1	38.4	35.7	31.2	28.5	24.6	23.7	
Adj. PET (in)	0.0	0.0	0.0	1.3	3.0	4.5	5.1	4.5	3.2	1.8	0.6	0.0	24.0
P (in)	1.54	1.56	3.22	2.90	3.27	2.93	8.81	3.20	5.25	3.04	3.22	2.90	41.8
Corr. P (in)	0	0	5.4	3.8	3.3	2.9	8.8	3.2	5.3	3.0	3.2	2.9	41.8
C R/O	0.22	0.22	0.22	0.22	0.20	0.18	0.18	0.18	0.18	0.18	0.20	0.22	
R/O (in)	0.0	0.0	1.2	0.8	0.7	0.5	1.6	0.6	0.9	0.5	0.6	0.6	8.1
I (in)	0.0	0.0	4.2	3.0	2.6	2.4	7.2	2.6	4.3	2.5	2.6	2.3	33.7
I−PET(in)	0.0	0.0	4.2	1.7	−0.4	−2.1	2.1	−1.9	1.1	0.7	2.0	2.3	9.7
neg (I−PET)					−0.4	−2.5		−1.9					
ST (in)	3.9	3.9	3.9	3.9	3.5	2.0	3.9	2.4	3.5	3.9	3.9	3.9	
delta ST (in)	0.0	0.0	0.0	0.0	−0.4	−1.5	1.9	−1.5	1.1	0.4	0.0	0.0	
AET (in)	0.0	0.0	0.0	1.3	3.1	3.9	5.1	4.1	3.2	1.8	0.6	0.0	23.1
PERC (in)	0.0	0.0	4.2	1.7	0.0	0.0	0.2	0.0	0.0	0.3	2.0	2.3	10.6
delta W.T. (feet)	0.0	0.0	1.2	0.1	−1.0	−1.5	−0.8	−1.6	−0.6	−0.3	0.4	0.6	

summarizes the regional and local land use. The most recent land use report is that issued by Cornell University. This report classifies in further detail land uses and environments of this region (Cornell 1967). Agricultural land use is categorized as inactive and active use. Inactive agricultural land consists of land committed to eventual forest regeneration, land waiting to be developed, or land presently under construction. Active agricultural land surrounding SEDA consists largely of cropland and cropland pasture. The U.S. Geologic Survey (USGS) quadrangle maps for the Towns of Ovid and Dresden, New York (1970), New York State Department of Transportation (DOT) quadrangles for Romulus, New York (1978) and Geneva South, New York (1978) do not indicate land designated for dairy production in the vicinity of SEDA.

SEDA is a government-owned installation under the jurisdiction of the U.S. Army Material Command (AMC). SEDA lies immediately west of the village of Romulus, NY, 12 miles south of the villages of Waterloo and Seneca Falls, and 2.5 miles north of the village of Ovid, NY (Figure 1-1). The nearest major cities are Rochester, NY and Syracuse, NY located 60 miles northwest and northeast, respectively. The total area of SEDA is 10,587 acres, of which 8,382 are designated storage areas for ammunition, storage and warehouse, and open storage and warehouse. On-post family housing is in two parcels, a 54-acre development adjacent to Route 96 and another 69 acres situated along Seneca Lake. Additionally, troop housing is available for 270 enlisted men (Buildings 703, 704, and 708). Bachelor officer quarters are located in Building 702, which is designated for 18 men. Other land uses include Administration, Community Services and an airfield. SEDA has a swimming pool at the north end of the facility, along with tennis courts, a gymnasium, and a sports field complex. Picnic and playground areas are found on the installation at Hancock Park, the Lake Area and the Family Housing Area. There is also a skeet and trap range at the field. There are no recreational facilities located within 1,000 feet of the Ash Landfill.

Forest land adjacent to SEDA is primarily under regeneration with sporadic occurrence of mature forestry. Public and semi-public land use surrounding and within the vicinity of SEDA is Sampson State Park, Willard Psychiatric Center, and Central School (at the Town of Romulus). Sampson State Park entails approximately 1,853 acres of land and includes a boat ramp on Seneca Lake. Historically, Varick and Romulus Townships within Seneca County developed as an agricultural center supporting a rural population. However, increased population occurred in 1941 due to the opening of SEDA. Population has progressed since then largely due to the increased emphasis on promoting tourism and recreation in this area.

The Ash Landfill is situated in the southwestern corner of SEDA. Land use adjacent to and off-site of the southwestern corner of SEDA is sparse residential areas with some farmland (Figure 3-28).

3.8.2 Potential Future Land Uses

EPA guidance for determining future land uses recommends that, if available, master plans, which include future land uses, Bureau of Censur projections and established land use trends in the general area should be utilized to establish future land use trends. Since SEDA is located in Romulus, the Romulus Town Clerk was contacted to determine if any master plans exist for this area or if any land use restrictions could apply to the future use of the Ash Landfill. No zoning maps or master plans were found to exist for the site or surrounding areas in the town of Romulus. Consequently, the use of this area for light industrial or residential uses is not restricted by local zoning laws and either use could be permitted. The existing land use surrounding SEDA is generally agricultural with sparse housing. Large tracts of undeveloped land are widely available for future development. The area is not experiencing a high degree of growth nor is it expected to. There is no pressure to develop land in this area, nor will there likely to be the need to develop the Ash Landfill for residential purposes. Section 6.2.2 of RAGS discusses future land uses and states: "If the site is industrial and is located in a very rural area with a low population density and projected low growth, future residential use would probably be unlikely. In this case, a more likely alternate future land use may be recreational. At some sites, it may be most reasonable to assume that the land use will not change in the future."

The army has no plans to change the use of this facility or to transfer the ownership. If the property is to change ownership, CERCLA, Section 120(h)(1),(2) and (3), requires that the prospective owner must be notified that hazardous substances were stored on the parcel. This will include the quantity and type of the substances that were stored. The content of the deed must also include a covenant warranting that all remedial actions necessary to protect human health and the environment with respect to any such hazardous substances remaining of the property have been taken before the date of the transfer. If a property transfer is contemplated by the Army, this information, under penalty of the law, must be supplied to prospective owner. Should the actual future use of the parcel be residential, then the Army will perform any additional remedial activities to ensure that human health and the environment, under residential scenario, are protected.

3.9 ECOLOGY

This section presents the results of the aquatic and terrestrial assessment programs. The aquatic assessment program discusses the benthic invertebrate and fish communities. The terrestrial assessment program discusses significant resources and resources used by humans, vegetative resources, wildlife resources, stressed or altered terrestrial biota, and potential terrestrial receptors.

3.9.1 Aquatic Assessment Program

3.9.1.1 Benthic Invertebrate Community

Based on the results of the macroinvertebrate Surber sampling program at three stations (SW-800, SW-801, and SW-802), the benthic community of Kendaia Creek was found to be dominated by insects. Insects comprised approximately 72 percent of the 356 organisms collected. The remaining 28 percent was a combination of worms (Turbellaria and Oligochaeta), leeches (Hirudinea), snails (Gastropoda), clams (Bivalvia), seed shrimp (Ostracoda), aquatic sow bugs (Isopoda) and scuds (Amphipoda) (Table 3-11). Insects collected included stoneflies (Plecoptera), caddisflies (Trichoptera), hellgramites (Megaloptera), beetles (Coleoptera), and true flies (Diptera). The fauna collected are characteristic of stony habitat with equal amounts of pools and riffles, such as Kendaia Creek (Hynes 1979).

The combined relative abundance of all organisms collected indicates that the beetles dominated the collection (35.1 percent), closely followed by true flies (28.9 percent). Subdominate groups, in order of abundance include snails (12.6 percent), aquatic earthworms (7.3 percent), scuds (6.5 percent) and caddisflies (4.9 percent). The remaining six groups collected (flatworms, clams, seed shrimp, aquatic sow bugs, stoneflies, and hellgramites) comprised a total of 4.8 percent of the overall collection. Thus, as frequently occurs in streams of this nature, the benthic macroinvertebrate taxa in Kendaia Creek are unevenly distributed.

The relative abundance of taxa identified at the station most likely to receive surface water run-off from the areas influenced by the Ash Landfill site (SW-800), and the downstream station (SW-802), were similar to the reference station (SW-801), in that insects comprised the majority of the collection: 58.0 percent at SW-800, 79.8 percent at SW-802 and 75.0 percent

TABLE 3-11

TOTAL NUMBER AND RELATIVE ABUNDANCE OF MACROINVERTEBRATES IN KENDAIA CREEK

SENECA ARMY DEPOT
ASH LANDFILL

CLASS Order Family Genus species	STATION SW-800					STATION SW-801					STATION SW-802					GRAND ORDINAL TOTAL	COMBINED RELATIVE ABUNDANCE
	REPLICATES			Ordinal Total	Relative Abundance	REPLICATES			Ordinal Total	Relative Abundance	REPLICATES			Ordinal Total	Relative Abundance		
	A	B	C			A	B	C			A	B	C				
	(#/ft^2)					(#/ft^2)					(#/ft^2)						
TURBELLARIA (flatworms)																	
Tricladida				1	0.76				0	0.00				1	0.47	2	0.56
Planaridae			1										1				
ANNELIDA																	
Oligochaeta (aquatic earthworms)				20	15.27				0	0.00				6	2.82	26	7.30
Lumberculidae		8	12									5	1				
MOLLUSCA																	
Gastropoda (snails)				9	6.87				2	16.67				34	15.96	45	12.64
Lymnaeidae A	1		1														
Planorbidae A			2										3				
Physidae	1		4					2			11	4	16				
Bivalvia (clams)				2	1.53				0	0.00				0	0.00	2	0.56
Sphaeridae			2														
CRUSTACEA																	
Ostracoda (seed shrimps)				0	0.00			1	1	8.33				0	0.00	1	0.28
Isopoda (aquatic sow bugs)				1	0.76				0	0.00				1	0.47	2	0.56
Asellidae			1										1				
Amphipoda (scuds, sideswimmers)				22	16.79				0	0.00				1	0.47	23	6.46
Gammaridae																	
Gammarus sp.	7	9	6									1					
INSECTA																	
Plecoptera (stoneflies)				4	3.05				0	0.00				4	1.88	8	2.25
UNID[1] Plecoptera												4					
Nemouridae	3																
Chloroperlidae			1														

TABLE 3–11

TOTAL NUMBER AND RELATIVE ABUNDANCE OF MACROINVERTEBRATES IN KENDAIA CREEK

SENECA ARMY DEPOT
ASH LANDFILL

CLASS Order Family Genus species	STATION SW–800					STATION SW–801					STATION SW–802					GRAND ORDINAL TOTAL	COMBINED RELATIVE ABUNDANCE
	REPLICATES			Ordinal Total	Relative Abundance	REPLICATES			Ordinal Total	Relative Abundance	REPLICATES			Ordinal Total	Relative Abundance		
	A	B	C			A	B	C			A	B	C				
	(#/ft²)					(#/ft²)					(#/ft²)						
INSECTA (CONTINUED)																	
Trichoptera (caddisflies)				1	0.76				2	16.67				14	6.57	17	4.78
Hydropsychidae A							2				9	2					
Limnephleidae			1									3					
Megaloptera (hellgramites)				1	0.76				1	8.33				0	0.00	2	0.56
Sialidae																	
Sialis sp.			1				1										
Coleoptera (beetles)				55	41.98				2	16.67				68	31.92	125	35.11
UNID Coleoptera (larvae)			3			1											
Elmidae A (adult)		1															
Elmidae A (larvae)			2														
Elmidae B (adult)	9		7				1				10	9	42				
Elmidae B (larvae)	4		25														
Elmidae C (larvae)			1														
Psephenidae																	
Psephenus herricki (larvae)			1								3	3	1				
Ectopria nervosa (larvae)			2														
Diptera (true flies)				15	11.45				4	33.33				84	39.44	103	28.93
Chironomidae (midge larvae)	3	4	2								17	50	16				
Tabanidae (horsefly larvae)			3					2									
Culicidae (mosquito larvae)			2														
Tipulidae A (cranefly larvae)							1				1						
Empididae A (dancefly larvae)		1						1									
Total Specimens	28	23	80	131	100.00	1	5	6	12	100.00	51	81	81	213	100.00	356	100.00
Total Taxa	7	5	21	24		1	4	4	9		6	9	8	13		27	

Note:
1) UNID = Unidentified

at SW-801. However, the distribution of dominant insect taxa at the three stations differed slightly. At stations SW-801 and SW-802 true flies were highest in relative abundance (33.3 percent and 39.4 percent, respectively) followed by beetles (16.7 percent and 31.9 percent, respectively). This relationship is reversed at station SW-800 (beetles are 42 percent and true flies are 11.5 percent). Similarly, at stations SW-801 and SW-802, caddisflies followed beetles as the third most common insect collected (16.7 percent at station SW-801 and 6.6 percent at station SW-802). Stoneflies replaced caddisflies as the third most common insect group at station SW-800 (3.1 percent). For the remaining major taxonomic groups collected, snails accounted for approximately 16 percent of all organisms collected at both stations SW-801 and SW-802. At station SW-800, snails represented only 6.9 percent of the collection and approximately 16 percent of the collection. No other trends or obvious differences were noted among the three stations.

Species richness between the three stations sampled in Kendaia Creek was variable. Overall 27 different taxa were identified at these stations. The highest number of taxa were identified at station SW-800 (24) followed by station SW-802 (13) and lastly station SW-801 (9). The variability of species identified at these three stations may be attributed to several factors. Among them are natural variability, decreased habitat diversity, and differences in water quality. Any one or a combination of these factors may contribute to the depressed number of species collected at station SW-801. If adverse effects to the macroinvertebrate community were resulting from contaminants in Kendaia Creek emanating from the ash landfill site, a lowered species richness would be expected at station SW-800 rather than SW-801. To the contrary, the highest number of organisms were reported at station SW-800. Sampling and chemical analysis were performed at station SW-800 and the reference station, SW-801. The results of the chemical analyses indicate that the reference station has been impacted by several semi-volatile organic compounds. The presence of semi-volatile organic compounds at station SW-801 may be responsible for the low species richness found at this station when compared to the higher species richness at the downstream station SW-800, which does not contain semi-volatiles.

The apparent chemical and species richness data suggests that the reference station has been impacted by a nearby source other than the Ash Landfill, and that surface water drainage from the Ash Landfill has not impacted Kendaia Creek, which is located approximately 4,500 feet to the north.

The distribution of taxa in Kendaia Creek was also variable. Some of the differences among the three stations are the apparent lack of worms (flatworms and earthworms), scuds and stoneflies at reference station SW-801, whereas these groups were present at the other two stations. In addition, there was a depressed number of both beetles and true flies at station SW-801 (2 and 4, respectively) when compared to both stations SW-800 (55 and 15, respectively) and SW-802 (68 and 84, respectively).

The number of individuals collected at three stations in Kendaia Creek was also highly variable. Combining three replicates per each station, resulted in a range of individuals collected from a low value of 12 at reference station SW-801, to a midrange value of 131 at station SW-800 and a high of 213 at station SW-802. Overall 356 organisms were collected.

Although organisms were not identified to the species level, it is possible to discuss guild structure in Kendaia Creek in a generalized manner. Trophic relationships of all insect families identified are presented in Table 3-12. The functional feeding groups of insect families in Kendaia Creek appear varied and incorporate virtually all types of feeding mechanisms. This overall hierarchy (including scrapers, herbivores, detritivores, predators and piercers) suggest that no apparent vacancies in trophic relationships exist in Kendaia Creek.

The macroinvertebrate community in Kendaia Creek is composed of first and second order consumers. These species form the basis for the aquatic food chain. The primary value of the macrobenthic community in Kendaia Creek is as prey items to aquatic species, especially fish. Larval aquatic forms and emergent adult forms of macrobenthos are also primary prey items to certain birds and some small mammals (e.g., water shrew and bats).

The macroinvertebrate community in Kendaia Creek within proximity of the Ash Landfill site offers little direct value to humans since they are not consumed by man. Many of the taxa collected in Kendaia Creek are consumed by fish but, the fish species that occur in the studied stream reach are generally not sought by anglers. The restricted access to SEDA further reduces the value of the fisheries to the general public. However, the benthic community of Kendaia Creek would seem to offer sufficient dietary abundance and diversity to support those fish found in the stream.

TABLE 3-12

TROPHIC RELATIONSHIPS OF SELECTED MACROINVERTEBRATES COLLECTED IN KENDAIA CREEK BASED ON PUBLISHED LITERATURE

CLASS ORDER FAMILY	TROPHIC RELATIONSHIP
Insecta	
Plecoptera	
Nemouridae	Generally shredders; detritivores
Chloroperlidae	Generally engulfers (predators) scrapers collectors - gatherers
Trichoptera	
Hydropsychidae	Generally collectors; filterers some engulfers (predators)
Limnephliedae	Generally shredders; detritivores (chewers) collectors; gatherers and scrapers
Megaloptera	
Sialidae	Engulfers (predators-one species reported to be collector-gatherer).
Coleoptera	
Psephenidae (larvae)	Scrapers
Elmidae	Generally collectors scrapers and gatherers
Diptera	
Chironomidae	Generally of two types: 1. Collectors-gatherers and filterers 2. Engulfers (predators) and piercers-predators
Culicidae	Generally collectors-filterers (gatherers)
Tabanidae	Generally piercers-predators
Tipulidae	Generally shredders-detritivores, collectors gatherers

After Merritt and Cummins 1978.

The presence or absence of "indicator species" is commonly used to assess adverse effects to ecological communities. Pollution tolerance values for each of the aquatic arthropods identified in Kendaia Creek (Crustacea and Insecta combined) is given in Table 3-13. The pollution tolerance of the arthropods identified in Kendaia Creek is wide and ranges from pollution tolerant organisms such as the Asellidae, with a tolerance value of 8, to pollution intolerant organisms such as Chloroperlidae and Nemouridae, with a tolerance values of 1 and 2 respectively. However, most of the individuals identified are within the facultative classification (4-6). These are organisms that have a wide range of tolerance and are often associated with moderate levels of organic contamination (USEPA 1990). The presence of intolerant groups, specifically Chloroperlidae and Nemouridae, at station SW-800, provides evidence of favorable water quality at this location. The absence of this taxa at stations SW-801 and SW-802 does not necessarily imply degraded water quality at these locations. If the water quality at specific location were consistently degraded, tolerant taxa such as Asellidae would be expected to be especially common. Such was not the case at any Kendaia Creek Station. Most healthy benthic communities have a mixture of tolerant, facultative and intolerant organisms.

An additional measure of pollution sensitivity is the presence and/or absence of mayflies, (Ephemeroptera), stoneflies, (Plecoptera), and caddisflies (Tricoptera) (EPT), because these organisms are generally sensitive or facultative and are often first to suffer in a polluted environment (USEPA 1990, USEPA 1989). The presence of two of these groups (Plecoptera and Tricoptera) in Kendaia Creek is suggestive of good water quality. The total number of taxa within these groups generally increases with improving water quality (USEPA 1990). Only two EPTs were collected at the reference station, SW-801. The relative abundance of EPTs compared to the generally tolerant Chironomidae is also used as a measure of biotic conditions. Chironomids tend to increase in relative abundance along a gradient of increasing enrichment or heavy metals concentration (USEPA 1990). There is no clearly defined trend of EPTs compared to chironomids at the three Kendaia Creek stations based on the limited data collected in 1991.

3.9.1.2 Fish Community

Based on the results of the aquatic sampling program, the fish community of Kendaia Creek is dominated by minnows (Table 3-14). Three of the four species collected were minnows. A single banded killifish was the only non-minnow collected. As is frequently the case in small streams, most of the fish were relatively small. The majority of fish collected were from 30 to 102 mm (1-4 inches) in length, the largest fish being a 139 mm (5 inch) creek chub.

TABLE 3-13
POLLUTION TOLERANCE VALUES FOR SELECTED MACROBENTHIC ARTHROPODS

ORDER FAMILY	TOLERANCE VALUE
Isopoda	
Asellidae	8*
Amphipoda	
Gammaridae	4*
Plecoptera	
Nemouridae	2
Chloroperlidae	1
Trichoptera	
Hydropsycidae	4
Limnephleidae	4
Megaloptera	
Salidae	4
Coleoptera	
Elmidae	4
Psephenidae	4
Ephemeroptera	
Baetidae	4
Heptageniidae	4
Diptera	
Chironomidae	6
Empididae	6
Tabanidae	6
Tipulidae	3

*ranking from 0-10 with 0 being least tolerant

Source: USEPA 1990

TABLE 3-14

COMMON AND SCIENTIFIC NAMES OF FISH COLLECTED FROM KENDAIA CREEK

Common Name	Scientific Name	Length Range (MM)
Central Stoneroller	Campostoma anomalum	42-78
Creek Chub	Semotilus atromaculatus	32-139
Blacknose Dace	Rhinichthys atratulus	30-76
Banded Killifish	Fundulus diaphanus	49

Overall, central stonerollers were the dominant species in Kendaia Creek, comprising 40.5 percent of the total catch (Table 3-15). Creek chubs and blacknose dace comprised 29.7 and 27.0 percent of the total catch, respectively, and were the only species present in every collection. The most fish (23 in number) were collected at the reference station (SW-801). This was also the only station where all four species of fish were captured. This station has a fairly deep (3-4 feet) plunge pool below a large culvert that passes under a road, affording cover to resident fish. This culvert forms a barrier to the movement of fish upstream of this location. Such obstructions often cause fish to concentrate below them, which may be the case at this station. The least number of species (2) and individuals (3 per collection) was collected at station SW-800. It should be noted that because the total catch of fish was relatively low (37), caution should be used in drawing conclusions regarding abundance and species richness at specific stations.

Based on published dietary information, the four fish species collected in Kendaia Creek typically are found at lower trophic levels; they are usually secondary consumers. Creek chubs and banded killifish are considered to be omnivorous, with the size of prey limited by the relatively small size of the predator. Creek chubs, the only species in Kendaia Creek that can be considered to be piscivorous (fish eating), also consumes insects, cladocerans, and crayfish (Smith 1955, Lee et al. 1989). At times, creek chubs consume algae and other plant tissue (Smith 1985). Blacknose dace also consume aquatic insects, especially midge larvae, as well as diatoms and desmoids during the fall (Smith 1985). Central stonerollers, are specialized feeders, scraping algae and small invertebrates from the surface of rocks (Smith 1985). Most likely, predation on the population of these four species is minimal. Small fish may occasionally be consumed by large creek chubs and all four species would probably eat fish eggs if they were encountered. Habitat availability, rather than predation, is likely to limit the size of fish populations in Kendaia Creek.

Any abnormalities in the fish collected were documented. There was a degree of subjectivity in these observations, since the time spent examining each fish was, by necessity, brief in an effort to quickly return collected fish to the stream. The blacknose dace was the only species showing an abnormality - tumors that are associated with endoparasitic cysts. Tumors were observed on one of three blacknose dace collected at station SW-802 and two of four blacknose dace collected at reference station SW-801. This distribution pattern makes it extremely unlikely that there is a correlation between these tumors and any contaminants originating from the Ash Landfill site. Many fish at all stations also had varying degrees of

TABLE 3-15

TOTAL CATCH AND RELATIVE ABUNDANCE OF FISH COLLECTED BY ELECTROSHOCKER IN KENDAIA CREEK

SPECIES	SW-802[1]	SW-800[1]			SW-801[1]	TOTAL
		A[2]	B[2]	A&B		
Central Stoneroller	2 (25.0)[3]				13(56.5)	15(40.5)
Creek Chub	3(37.5)	2(66.7)	1(33.3)	3(50.0)	5(21.7)	11(29.7)
Blacknose Dace	3(37.5)	1(33.3)	2(66.7)	3(50.0)	4(17.4)	10(27.0)
Banded Killifish					1(4.3)	1(2.7)
TOTAL	8(100.0)	3(100.0)	3(100.0)	6(100.0)	23(99.9)	37(99.9)
Salamander					1	1
Temperature (°C)	7.7	8.7			8.3	
Dissolved Oxygen (mg/l)	11.0	10.2			13.4	
Conductivity (micromhos) (not corrected to 25°C)	570	575			550	
pH	8.2	7.8			7.9	

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[1] Stations arranged sequentially with downstream - most station to the left. Station SW801 is upstream of site influence.

[2] Collection A taken along a 150 ft. stream reach immediately downstream of railroad bridge. Collection B was taken along a 75 ft. stream reach downstream of collection A.

[3] Relative abundance values are presented in parenthesis after the total catch values.

infestations of "black spot," thought to be the "black grub" phase of parasitic trematodes. This is a fairly common phenomena in many aquatic ecosystems (Hynes 1979).

The results of this assessment indicate that the fish species in Kendaia Creek are predominantly minnows. No species collected would be considered to be sport fish. Most, if not all, have fairly localized home ranges. Localized movements of all species collected are expected in response to environmental factors such as low flow conditions or mid-summer heat (movement to pools and/or areas of groundwater discharge).

The significance of the fisheries resources of Kendaia Creek should be considered in terms of its value to associated fauna and its value to humans. It is clear from the species of fish collected that the community in the evaluated stream segment is essentially non-piscivorous, relying mostly on other food sources. Although small fish may occasionally migrate to downstream stream reaches where more carnivorous fish may be present, it is unlikely that they contribute substantially to the diet of such fish. The primary value of the fish community in Kendaia Creek near the Ash Landfill site is to fish-eating wildlife. Examples of wildlife that could consume the fish in Kendaia Creek, as well as other aquatic organisms, include the northern water snake, various turtles, wading birds, such as herons and egrets, and occasional ducks that may use pools on this portion of the creek.

No sport fish were collected during the survey. The lower reaches of Kendaia Creek may support a limited fishery (SEDA 1992), although no data are available to support this. Dip netting for smelt near the Route 125 bridge (adjacent to Seneca Lake) is reported by local residents to occur during the spring spawning run.

3.9.2 Terrestrial Assessment Program

3.9.2.1 Significant Resources and Resources Used by Humans

Significant Resources

Based on the New York state regulated wetland maps (Geneva South, Romulus, Ovid, and Dresden quads), there are six regulated wetlands within the 2-mile study area, but none are in close proximity to the site perimeter (Figure 3-29). The closest wetland is OV-9 which is approximately 2,000 feet (0.4 mile) northeast of the site perimeter. The other five regulated wetlands are over one mile from the site perimeter. GS-3 and GS-4 are to the north, RO-19

TABLE 3-16

PLANT SPECIES RECORDED IN THE VEGETATIVE COVER TYPES IN THE 0.5-MILE STUDY AREA

PLANT SPECIES	VEGETATIVE COVER TYPE			
	Old Field	Shrubland	Deciduous Wood/ Tree Rows	Freshwater Wetland/ Creek Edge
TREES				
Eastern Red Cedar Juniperus virginiana		X	X	
Big-toothed Aspen Populus grandidenta			X	
Quaking Aspen Populus tremuloides	X	X	X	X
Black Willow Salix niger				X
Staghorn Sumac Rhus typhina	X	X	X	
Smooth Sumac Rhus glabra	X	X	X	
American Elm Ulmus americana				X
Slippery Elm Ulmus rubra	X	X	X	
Sugar Maple Acer saccharum	X		X	
Red Maple Acer rubrum			X	X
Boxelder Acer Acer negundo		X	X	
Common Buckthorn Rhamnus cathartica		X		

TABLE 3-16
(Con't)

PLANT SPECIES	VEGETATIVE COVER TYPE			
	Old Field	Shrubland	Deciduous Wood/ Tree Rows	Freshwater Wetland/ Creek Edge
Shagbark Hickory Carya ovata			X	
Bitternut Hickory Carya cordipormis			X	
Choke Cherry Prunus virginiana		X		
Domestic Apple Pyrus malus		X	X	
Crabapple Pyrus coronaria		X		
Common Pear Pyrus communis		X		
Black Locust Robinia pseudo-acacia		X	X	
Honey Locust Gleditsia triacanthos	X			
Gray Dogwood Cornus racemosa	X	X		
Blue Beech Carpinus carolinana			X	
Yellow Birch Betula lutea	X	X	X	
Northern Red Oak Quercus rubra			X	
Black Oak Quercus velutina			X	

TABLE 3-16
(Con't)

PLANT SPECIES	VEGETATIVE COVER TYPE Old Field	Shrubland	Deciduous Wood/ Tree Rows	Freshwater Wetland/ Creek Edge
White Oak Quercus alba			X	
Chestnut Oak Quercus prinus			X	
White Ash Fraxinus americana	X	X	X	
Hawthorn Crataegus sp.	X	X	X	
SHRUBS AND VINES				
Willow Salix sp.	X	X		X
Poison-ivy Rhus radicans			X	
Wild Grape Vitis sp.		X	X	
Red Raspberry Rubus idaeus	X	X	X	
Blackberry Rubus sp.	X	X	X	
Multiflora Rose Rosa multiflora	X	X	X	
Wild Rose Rosa sp.	X	X		
Red-osier Dogwood Cornus stolonifera				X

TABLE 3-16
(Con't)

PLANT SPECIES	VEGETATIVE COVER TYPE			
	Old Field	Shrubland	Deciduous Wood/ Tree Rows	Freshwater Wetland/ Creek Edge
Arrow-wood Viburnum recognition	X	X	X	
Bush Honeysuckle Lonicera sp.	X	X	X	
HERBACEOUS				
Sphagnum Moss Sphagnum sp.				X
Sensitive Fern Onodea sensibilis				X
Marsh Fern Dryopteris Thelypteris				X
Woodfern Dryopteris sp.			X	
Horsetail Equisetum pratense			X	
Narrow-leaved Cattail Typha angustifolia				X
Broad-leaved Cattail Typha latifolia			X	
Panic Grass Panicum sp.	X	X		X
Common Reed Phragmites australis				X

TABLE 3-16
(Con't)

PLANT SPECIES	VEGETATIVE COVER TYPE			
	Old Field	Shrubland	Deciduous Wood/ Tree Rows	Freshwater Wetland/ Creek Edge
Spike-rush Eleocharis sp.				X
Long Sedge Carex lonchocarpa				X
Sedge Carex sp.			X	X
Rush Juncus sp.				X
Wild Garlic Allium sp.	X		X	
Curled Dock Rumex Crispus	X			
Sicklepod Arabis canadensis	X		X	
Treade Mustard Erysimum cheiranthoides	X			
Indian Strawberry Duchesnea indica	X		X	
Red Clover Trifolium pratense	X			
Purple Loosestrife Lythrum salicaria				X
Common Evening-primrose Oenothera biennis	X			
Queen Anne's-lace Daucus carota	X			

TABLE 3-16
(Con't)

PLANT SPECIES	VEGETATIVE COVER TYPE			
	Old Field	Shrubland	Deciduous Wood/ Tree Rows	Freshwater Wetland/ Creek Edge
Spreading Dogbane Apocynum androsaemifolium	X			
Blue Vervain Verbena hastala	X			
Common Mullein Verbascum thapsus	X			
Teasel Dipsacus sylvestris	X			
King Devel Hieracium pratense	X			
Canada Goldenrod Solidago canadensis	X			
Goldenrod Solidago sp.	X	X	X	
New England aster Aster noval-angliae	X			
Heath Aster Aster ericoides	X			
Beggerticks Bidens frontosa	X		X	
Yarrow Achillea millefolium	X			
Field Thistle Cirsium discolor	X	X		
Spotted Knapweed Centaurea maculosa	X			

Anne's-lace, panic grass, teasel, goldenrods, asters and field thistle are the most abundant species in these fields. Shrublands are comprised primarily of shrubs and small trees with some herbaceous species (Table 3-16). Gray-stemmed dogwood, raspberry and blackberry, multiflora rose, buckhorn, black locust, sumacs and wild grape are the most common shrubs and vines in this cover type. Prior to becoming part of the SEDA in 1941, most of the old fields and shrublands were active farmland. When they became part of the Depot and left fallow, these croplands succeeded to old field vegetation and shrubland and were maintained in these cover types by periodic strip mowing and brush cutting for wildlife habitat improvement. The ammunition storage area to the east of the Ash Landfill area, as well as the roadsides, are mowed to maintain the low cover for security purposes (SEDA 1992).

Agricultural fields are the next most prevalent cover type in the study area. However, all occur on the privately owned farms west of the site. Crops typically grown in these cropfields surrounding the depot include corn, wheat, soybeans, and various hay mixtures.

Deciduous forests comprise a relatively minor cover type in the study area and occur as woodlots and tree rows which line the fields and roads. Various oaks, sugar maple, hickory, black locust, black cherry, and aspens are the major overstory trees in these woodlots and tree rows (Table 3-16).

Wetland Cover Types

Several small freshwater emergent wetlands are located on the Ash Landfill area (W-A, W-B, W-C, W-D, W-E, W-F, Figure 3-31). Some of these emergent wetlands may have been created by landfill excavation operations. Several drainage ditches were also constructed to catch surface water run-off from the Ash Landfill area and roads. These ditches are also vegetated with emergent wetland plants. Common reed (Phragmites australis) is the most abundant and widely distributed emergent plant species, comprising 40-95 percent cover. Purple loosestrife (Lythrum salicara), rush (Juncus sp.), broad-leaved cattail (Typha latifolia), sedge (Carex sp.) and spike-rush (Eleocharis sp.) also have wide distribution, but are not as abundant (10-50 percent cover). No standing water was observed in these wetlands when they were surveyed. (Refer to Appendix L for wetland data sheets).

There are several other small wetlands in the study area, including a common reed stand, which was the reference wetland (Figure 3-31). None of the other wetlands were large enough to be mapped.

TABLE 3-18

BIRD SPECIES POSSIBLY OCCURRING IN THE 0.5-MILE STUDY AREA

COMMON NAME	SCIENTIFIC NAME
American Bittern*	Botaurus lentiginosus
Least Bittern*	Ixobrychus exilis
Great Blue Heron*	Ardea herodias
Great Egret	Casmerodius albus
Snowy Egret	Egretta thula
Little Blue Heron	Florida caeruea
Green-backed Heron	Butorides striatus
Black-crowned Night Heron	Nyciticorax nyciticorax
Canada Goose*	Branta canadensis
Wood Duck*	Aix sponsa
Green-winged Teal	Anas crecca
American Black Duck	Anas rubripes
Mallard*	Anas platyrhynchos
Northern Pintail	Anas acuta
Blue-winged Teal*	Anas discors
Northern Shoveler	Anas clypeata
Gadwall	Anas strepera
American Widgeon	Anas wigeon
Turkey Vulture*	Cathartes aura
Northern Harrier*	Circus cyaneus
Sharp-shinned Hawk	Accipiter striatus
Cooper's Hawk	Accipiter cooperii
Northern Goshawk*	Accipiter gentilis
Red-shouldered Hawk*	Buteo lineatus
Broad-winged Hawk	Buteo platypterus
Red-tailed Hawk*	Buteo jamaicensis
Rough-legged Hawk	Buteo lagopus
American Kestrel*	Falco sparverius
Ring-necked Pheasant*	Phasianus colchicus
Ruffed Grouse	Bonasa umbellus
Wild Turkey*	Melegris gallopavo
Virginia Rail	Rallus limicola
Sora	Porzana carolina
Killdeer*	Charadrius vociferus

TABLE 3-18
(Con't)

BIRD SPECIES POSSIBLY OCCURRING IN THE 0.5-MILE STUDY AREA

COMMON NAME	SCIENTIFIC NAME
Spotted Sandpiper*	Actitis macularia
Upland Sandpiper*	Bartramia longicauda
Common Snipe*	Capella gallinago
American Woodcock*	Philohela minor
Ring-billed Gull	Larus delawarensis
Herring Gull	Larus argentatus
Greator Black-backed Gull	Larus marinus
Rock Dove*	Columba livia
Mourning Dove*	Zenaida macroura
Black-billed Cuckoo*	Coccyzus erythropthalmus
Yellow-billed Cuckoo	Coccyzus americanus
Common Barn Owl*	Tyto alba
Eastern Screech Owl*	Otus asio
Great Horned Owl*	Bubo virginianus
Snowy Owl	Nytca scandiaca
Barrred Owl	Strix varia
Short-eared Owl	Asio flammeus
Long-eared Owl	Asio otus
Common Nighthawk*	Chordeiles minor
Whip-poor-will	Caprimulgus vociferus
Chimney Swift*	Chaetura pelagica
Ruby-throated Hummingbird*	Archilochus colubris
Belted Kingfisher*	Megaceryle alcyon
Red-headed Woodpecker*	Melanerpes erythrocephalus
Red-bellied Woodpecker*	Melanerpes carolinus
Yellow-bellied Sapsucker	Sphyrapicus varius
Downy Woodpecker*	Picoides pubescens
Hairy Woodpecker*	Picoides villosus
Common Flicker*	Colaptes auratus
Pileated Woodpecker*	Dryocopus pileatus
Eastern Wood Pewee*	Contopus virens
Acadian Flycatcher	Empidonax virescens
Alder Flycatcher	Empidonax alnorum
Willow Flycatcher*	Empidonax traillis
Least Flycatcher*	Empidonax minimus
Eastern Phoebe*	Sayornis phoebe
Great Crested Flycatcher*	Myiarchus crinitus
Eastern Kingbird*	Tyrannus tyrannus
Horned Lark*	Eremophila alpestris
Purple Martin*	Progne subis

TABLE 3-18
(Con't)

BIRD SPECIES POSSIBLY OCCURRING IN THE 0.5-MILE STUDY AREA

COMMON NAME	SCIENTIFIC NAME
Tree Swallow*	
Northern Rough-winged Swallow*	Stelgidopteryx ruficollis
Bank Swallow	Riparia riperia
Cliff Swallow	Petrochelidon pyrrhonota
Barn Swallow*	Hirundo rustica
Blue Jay*	Cyanocitta cristata
American Crow*	Corvus brachyrhynchos
Black-capped Chickadee*	Parus atricapillus
Tufted Titmouse*	Parus bicolor
Red-breasted Nuthatch	Sitta canadensis
White-breasted Nuthatch*	Sitta carolinensis
Brown Creeper*	Certhia familiaris
Carolina Wren*	Thryothorus ludovicianus
House Wren*	Troglodytes aedon
Winter Wren	Troglodytes troglodytes
Marsh Wren*	Cistothorus palustris
Golden-crowned Kinglet	Regulus satrapa
Ruby-crowned Kinglet	Regulus calendula
Blue-gray Gnatchatcher*	Polioptila caerulea
Eastern Bluebird*	Sialia sialis
Veery*	Catharus minimus
Gray-cheeked Thrush	Catharus fuscescens
Swainson's Thrush	Catharus ustulatus
Hermit Thrush	Cathdrus guttatus
Wood Thrush*	Hylocichla mustelina
American Robin*	Turdis migratorius
Gray Catbird*	Dumetella carolenensis
Northern Mockingbird	Mimus polyglotto
Brown Thrasher*	Toxostoma rufum
Water Pipit	Anthus spinoletta
Cedar Waxwing*	Bombycilla cedrorum
European Starling*	Sturnus vulgaris
Solitary Vireo	Vireo solitarius
Yellow-throated Vireo	Vireo flavifrons
Warbling Vireo*	Vireo gilvus
Red-eyed Vireo*	Vireo olivaceus
Blue-winged Warbler*	Vermivora pinus
Golden-winged Warbler	Vermivora chrysoptera
Tennessee Warbler	Vermivora peregrina
Orange-crowned Warbler	Vermivora celata

TABLE 3-18
(Con't)

BIRD SPECIES POSSIBLY OCCURRING IN THE 0.5-MILE STUDY AREA

COMMON NAME	SCIENTIFIC NAME
Nashville Warbler	Vermivora ruficapilla
Northern Parula	Parula americana
Yellow Warbler*	Dendroica petechia
Chestnut-sided Warbler*	Dendroica pensylvanica
Magnolia Warbler	Dendroica magnolia
Black-throated Blue Warbler	Dendroica caerulescens
Black-throated Green Warbler	Dendroica virens
Blackburnian Warbler	Dendroica fusca
Pine Warbler	Dendroica pinus
Cerulean Warbler	Dendroica caerulea
Black-and-white Warbler*	Mniotilta varia
American Redstart*	Setophaga ruticilla
Ovenbird*	Seiurus aurocapillus
Northern Waterthrush*	Seiurus noveboracensis
Mourning Warbler*	Oporornis philadeplua
Common Yellowthroat*	Geothlypis trichas
Canada Warbler	Wilsonia canadensis
Yellow-breasted Chat*	Icteria virens
Scarlet Tanager*	Piranga olivacea
House Sparrow*	Passer domesticus
Northern Cardinal*	Cardinalis cardinalis
Rose-breasted Grosbeak*	Pheucticus ludovicianus
Indigo Bunting*	Passerina cyomea
Rufus-sided Towhee*	Pipilo erythrophtalmus
American Tree Sparrow*	Spizella arborea
Chipping Sparrow*	Spizella passerina
Field Sparrow*	Spizella pusilla
Vesper Sparrow*	Pooecetes gramineus
Savannah Sparrow*	Passerculus sandwichensis
Grasshopper Sparrow*	Ammodramus savannarum
Song Sparrow*	Melospiza melodia
Swamp Sparrow*	Melospiza georgiana
Sparrow	Zonotrichia albicollis
Henslow's Sparrow*	Ammodramus henslowii
Northern Junco	Junco hyemalis
Bobolink*	Dolichonyx oryzivorus
Red-winged Blackbird*	Agelaius phoeniceus
Eastern Meadowlark*	Sturnella magna
Common Grackle*	Quiscalus quiscula
Brown-headed Cowbird*	Molothrus ater

TABLE 3-18
(Con't)

BIRD SPECIES POSSIBLY OCCURRING IN THE 0.5-MILE STUDY AREA

COMMON NAME	SCIENTIFIC NAME
Northern Oriole*	Icterus galbula
Purple Finch	Carpodacus purpureus
House Finch	Carpodacus mexicanus
Common Redpoll	Carduelis flammea
Pine Siskin	Carduelis pinus
American Goldfinch*	Carduelis tristis
Evening Grosbeak	Hesperiphona vespertina
Fox Sparrow	Passerella iliaca

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* Observed on Seneca Army Depot (SEAD 1992, U.S. AEHA 1980); other species listings based on U.S. Fish and Wildlife Service and N.Y. State Department of Environmental Conservation (1991) and Peterson (1980).

TABLE 3-19

MAMMAL SPECIES POSSIBLY OCCURRING IN THE 0.5 - MILE STUDY AREA

COMMON NAME	SCIENTIFIC NAME
Opossum*	Didelphis marsupialis
Masked Shrew**	Sorex cinereus
Longtail Shrew*	Sorex dispar
Pygmy Shrew*	Microsorex hovi
Least Shrew*	Cryptotis parva
Short-tailed Shrew**	Blarina brevicauda
Starnose Mole*	Condylura cristata
Hairytail Mole*	Parascalops breweri
Little Brown Myotis*	Myotis lucifugus
Keen Myotis*	Myotis Keeni
Small-footed Myotis	Myotis subulatus
Silver-haired Bat*	Lasionycteris noctivagans
Eastern Pipestrel*	Pipistrellus subflavlus
Big Brown Bat*	Eptesicus fuscus
Red Bat*	Lasiurus borealis
Hoary Bat*	Lasiurus cinerius
Raccoon*	Procyon lotor
Short-tailed Weasel*	Mustela erminea
Long-tailed Weasel*	Mustela frenata
Mink*	Mustela vison
Striped Skunk*	Mephitis mephitis
Coyote*	Canis latrans
Red Fox*	Vulpes fulva
Gray Fox	Urocyon cinereoargenteus
Bobcat	Lynx rufus
Woodchuck*	Marmota monax
Eastern Chipmunk*	Tamias striatus
Eastern Gray Squirrel*	Sciurus carolinensis
Red Squirrel*	Tamiasciurus hudsonicus
Northern Flying squirrel*	Glaucomys sabrinus
White-footed Mouse*	Peromyscus leucopus
Deer Mouse*	Peromyscus maniculatus
Southern Bog Lemming*	Synaptomys cooperi

TABLE 3-19
(Con't)

COMMON NAME	SCIENTIFIC NAME
Boreal Redback Vole*	Clethrionomys gapperi
Meadow Vole**	Microtus pennsylvanicus
Pine Vole*	Pityms pinetorium
Norway Rat	Rattus norvegicus
House Mouse*	Mus musculus
Meadow Jumping Mouse**	Zapus hudsonius
Woodland Jumping Mouse*	Napaeozapus insignis
Porcupine*	Erethizon dorsatum
Snowshoe Hare	Lepus americanus
Eastern Cottontail*	Sylvilagus floridanus
White-tailed Deer*	Odocoileus virginianus

* Species known to occur in Upstate New York (SEAD 1992).

** Trapped at Wetland Wastewater Treatment area (U.S. AEHA 1980).

TABLE 3-20

MAMMAL SPECIES OBSERVED AND/OR EVIDENCE OF THEIR EXISTENCE IN THE 0.5-MILE STUDY AREA

Species	HABITAT				
	Old Field	Shrubland	Deciduous Woods/Tree Row	Wetland	Argicultural Fields
Woodchuck	x (burrows)	x (burrows)	x (burrows)		
Mouse/Vole (Cricetidae)	x	x		x (scat)	
White-tailed Deer	x	x	x	x	x

nearby reference area off the depot. The trapping success at the two areas was similar (0.07 catch per trap night for the Ash Landfill area and 0.11 catch per trap night at the reference area) (Table 3-21). Only 16 bird species were noted (Table 3-22). Many small bird nests were found in the shrublands south of the Ash Landfill area.

3.9.2.4 Stressed or Altered Terrestrial Biota

No signs of stressed or altered terrestrial biota (vegetation and wildlife species) were observed during the surveys in the 0.5-mile study area. Due to late fall period of the surveys, many of the plant species had naturally lost their leaves or had been killed by frost and cold. However, there was no indications of unnatural die-off or stunted vegetation.

3.9.2.5 Potential Terrestrial Receptors

The results of the Phase I terrestrial assessment indicate that five vegetative communities (old fields, shrubland, deciduous woods, agricultural fields, wetlands) are on or nearby the study area. The old fields, shrubland and small wetlands, as well as some drainage ditches, presently occupy the Ash Landfill area and would have the highest potential for being impacted by the site. The other vegetative communities, including deciduous woodlots and tree rows, and agricultural fields (off the depot), as well as other old fields, shrublands, and small wetlands, would be less likely to be receptors due to their distance from the site.

State regulated wetlands are the only significant vegetative resource off-site in the vicinity of the Ash Landfill area. It is unlikely that these wetlands would be impacted by the site due to the distance away (0.4 miles or greater). This is also likely to be the case for the agricultural crops, one of the two vegetative resources used by man. The other, deciduous woods in the study area, are under SEDA and private forest management, but also appear to be in a healthy, normal condition. If any of the on-site wetlands are determined to be federally regulated, they are protected under Section 404 of the Clean Water Act and would represent significant ecological resources at SEDA.

TABLE 3-21

SMALL MAMMALS LIVE-TRAPPED IN THE 0.5-MILE STUDY AREA FOR THE ASH LANDFILL AREA REMEDIAL STUDY DURING THE FALL 1991 SURVEYS

MAMMAL SPECIES	ASH LANDFILL AREA		REFERENCE AREA	
	Old Field/ Shrubland	Common Reed Wetland	Old Field/ Shrubland	Common Reed Wetland
White-footed Mouse	1	1		
Deer Mouse			1	2
Meadow Vole	1	1		
House Mouse			3	
Total Catch	2	2	4	2
Trap Nights	37	21	32	21
Catch per Trap Night	0.05	0.10	0.13	0.10
Catch per Trap Night for Area	0.07		0.11	

TABLE 3-22

BIRDS OBSERVED IN THE 0.5-MILE STUDY AREA

Bird Species	Number Observed by Habitat			
	Old Field	Deciduous Wood/Tree Row	Shrubland	Other*
Northern Harrier	1			
Red-tailed Hawk	2*			
Rock Dove	5			3
Common Flicker		1		
Downy Woodpecker	1**			
Hairy Woodpecker		1		
Blue Jay		4	2	
Common Crow		1		1
Black-capped Chicadee			4	
European Starling	30		2	
Northern Mockingbird	2	3	1	
American Robin			1	
Northern Junco			1	
House Finch			20	
American Goldfinch		10		
Field Sparrow			2	

* Flying over area.
** In tree within old field.

The vegetative and wildlife species inhabiting the old fields, shrublands, wetlands and ditches on the Ash Landfill area would have the highest potential for being impacted by the site. Those having the lowest potential would be the plants and wildlife species inhabiting the deciduous forest and tree rows, and agricultural fields, shrublands, as well as other old fields and small wetlands, beyond the Ash Landfill area. The white-tailed deer is the only big game species hunted in the study area, as well as being the only significant wildlife resource in its white-pelaged form. Deer utilize all habitat types in the study area, including those on the Ash Landfill area. Waterfowl and other small game species are hunted on the depot, although waterfowl are not hunted in or near the Ash Landfill area. In addition, waterfowl usage of the Ash Landfill area and vicinity would be limited due to the lack of waterfowl habitat (large wetlands and streams). The eastern cottontail, red fox, and raccoon are the small game and furbearing species with the most potential as receptors since they would inhabit the Ash Landfill area. Other game and furbearing species with less potential for being impacted include the ruffed grouse, wild turkey, ring-necked pheasant, gray squirrel, muskrat and beaver since these wildlife species would occur in habitats outside the Ash Landfill area. Many non-game wildlife species are potential receptors, in particular those which are permanent residents and have localized (small) home ranges such as amphibians, reptiles, small mammals (e.g., mice), and some small non-migratory birds.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 INTRODUCTION

This section presents the results of analyses of all media sampled for Phase I and Phase II of this investigation. The discussion focuses primarily on the three features at the site that were targeted during the course of the Phase I and II investigations because of their likelihood of having been impacted. The features are 1) the Ash Landfill, 2) the Non-Combustible Fill Landfill , and 3) three debris piles and a grease disposal pit located north and east of the Ash Landfill. Historically, the Ash Landfill area had been used for refuse burning pits (from 1941 until the 1960s) and for disposal of ash from the incinerator (which operated from 1974 to 1979).

The investigation activities included both field screening (such as soil gas and headspace surveys) and Level IV sampling and analysis. The primary purpose of the soil gas and headspace screening was to provide information to be used in locating the soil borings and monitoring wells near the source of the volatile organics plume in ground water. Level IV analyses were used to define the extent of the constituents and to positively identify their presence. The analytical results are discussed first by media and then by constituent group. The media sampled at the site include surface water, sediment, soil gas and soil headspace, soil, ground water, and incinerator dust. With the exception of the discussion of the soil gas and headspace results, the constituents for each media include volatile organic compounds, semi-volatile organic compounds, pesticides and PCBs, metals and cyanide, and herbicides. The results are summarized on data tables and, where appropriate, maps are used to show the geographic distribution of constituents of concern. A full description of the investigation activities at the site can be found in Section 2.0. Complete analytical data tables for the Phase I and II investigations are in Appendix J.

4.2 SOIL GAS AND SOIL HEADSPACE

4.2.1 Introduction

Three separate soil gas investigations were performed at the Ash Landfill. The first was conducted by Target Environmental, Inc. (Target) under the supervision of ICF (USATHAMA, 1989). In their investigation, Target assembled a grid over the entire Ash Landfill site to identify potential hot spots. The highest concentration determined was from an area near PT-18 southeast of the bend in the road which contained a concentration of 11,000 ug/L of total volatiles. The second highest soil gas value was 655 ug/L which was located at the bend in the road. The soil gas program indicated that generally soil gas concentrations decreased westward toward West Patrol Road with some isolated areas of higher concentrations around 0.01 ug/L.

The next soil gas investigation was conducted in 1991 by ES. The concentration units for this investigation were parts per million by volume (ppmv) expressed in TCE equivalents. The intent of this investigation was to build upon the results of the Target investigation by further investigating the areas where elevated concentrations of volatile organic compounds were found and to identify the presence of volatiles at geophysical anomalies previously identified. The results of ES's investigation correlated reasonably well with the two elevated soil gas results of the Target investigation, however, ES's investigation suggested that both the extent and magnitude of the concentrations at the bend-in-the-road area were greater than previously determined by Target. This soil gas survey clearly identified a source area for volatile organic compounds in soil. No elevated soil gas concentrations were determined at any geophysical anomalies.

The third soil gas investigation was carried out by ES in 1993. The purpose of this investigation was to fully delineate the two hot spots identified near the bend in the road for the purpose of determining the extent of the source area and for locating soil borings. The original plan was to conduct the investigation using the same methodology as that of the Phase I investigation. However, due to heavy precipitation and a seasonally high water table, the surface soils at the site were saturated. This eliminated the possibility of performing soil gas since no soil gas was present, necessitating a change in the methodology. For this phase of the investigation two 2-foot long 2-inch-diameter split spoons were driven to a total depth of 4 feet. The first spoon was discarded. An approximately 30 gram soil sample from the 2- to 4- foot depth was collected and placed in a 40-ml VOA vial with a Teflon septum. Headspace samples were collected from the vial and analyzed in a manner similar to the analysis of the soil gas using a Photovac Model 10S-50 portable GC.

4.2.2 Soil Gas and Headspace Summary

The most notable result of the soil gas and headspace program was the detection of an area near the bend in the unpaved road, north of the old incinerator building. This area has been identified as a likely source of solvent impacted soil. In addition, low levels of solvents were detected at the Non-Combustible Fill Landfill located east-southeast of the old incinerator building. The concentrations of solvents detected in the soil gas extracted from the Non-Combustible Fill Landfill were substantially less than the levels detected at the bend in the road.

Results of the soil gas and headspace investigation are tabulated in Tables 4-1 and 4-2. For the soil gas data, detector responses were used in conjunction with calibration curve data to calculate corresponding concentrations of 1,2-DCE and TCE. Total volatile concentrations, determined as the sum of all detectable peaks, expressed as TCE, and OVM readings are also provided on the table. Additionally, syringe and probe blanks are included on the table. The spatial distribution of the soil gas data sample locations is shown on Figure 4-1. These samples are mostly at locations where geophysical anomalies were identified. Additional locations were investigated and included areas where volatile organic compounds were detected during field screening of initial split spoon soil samples. Figure 4-1 does not provide results of the two areas that have relatively higher concentrations and a higher density of soil gas sampling locations. The results for these two areas are provided on enlarged plans of these areas of concern. The two areas where total volatile organic compounds exceed 1 ppmv are: 1) at the bend in the unpaved road north of the incinerator building and 2) in the central portion of the Non-Combustible Fill Landfill. Discussions of these areas are provided below.

4.2.3 Bend in the Road

Near the bend in the road total volatile organics in soil gas were as high as 86.6 ppmv at SG-70. A 1 ppmv total volatile organics isocontour encompasses an area approximately 250 feet by 175 feet (Figure 4-2). Based on the concentration detected at SG-14 and the recreated data from the Target investigation this area extends to the south toward the Ash Landfill and incinerator building. TCE concentrations in soil gas are provided on Figure 4-3. The soil gas survey clearly identifies a source area for volatile organic compounds in soil (i.e., area encompassed by 1 ppmv isocontour).

Areas identified in the Target (1989) soil gas survey with soil gas concentrations of over 100 ug/L (17 ppmv as TCE) are identified on Figures 4-2 and 4-3. In the southeasternmost location, a total volatile organics concentration of approximately 11,000 ug/L (approximately 1800 ppmv as TCE) was detected. This was the highest concentration detected in the Target (1989) survey. As a basis for comparison, this location was sampled during ES's soil gas survey (SG-14) and a concentration of approximately 50 ppmv was determined. Differences in concentration are not unexpected using different soil gas techniques, and at this location this difference is not unreasonable. However, soil gas concentrations determined by ES are higher near the bend in the unpaved road (up to 86.6 ppmv) than was previously identified by Target. Locationally, ES's soil gas results correlate well with the northernmost "hot spot"

TABLE 4 – 1

SOIL GAS RESULTS USING GAS CHROMATOGRAPHY[1]

SENECA ARMY DEPOT
ASH LANDFILL

SOIL GAS ID	SOIL GAS LOCATION	DCE Area Vs	DCE Conc. PPMV	TCE Area Vs	TCE Conc. PPMV	TOTAL Area Vs	TOTAL Conc.[2] PPMV	OVM Reading[3] PPMV
	Nov. 15, 1991							
SG–01	Line 16, 1482 Ft.	< 0.10	< 0.02	< 0.10	< 0.01	2.80	0.45	<1
SG–02	Dup. of SG–01	< 0.10	< 0.02	< 0.10	< 0.01	4.46	0.71	<1
SG–03	Line 16, 1446 Ft.	< 0.10	< 0.02	< 0.10	< 0.01	0.56	0.09	<1
	Syringe Blank	< 0.10	< 0.02	< 0.10	< 0.01	0.24	0.04	–
SG–04	Line 16, 1432 Ft.	< 0.10	< 0.02	< 0.10	< 0.01	5.50	0.88	<1
SG–05	Dup. of SG–04	< 0.10	< 0.02	< 0.10	< 0.01	5.45	0.87	<1
SG–06	Line 16, 1252 Ft.	< 0.10	< 0.02	< 0.10	< 0.01	4.50	0.72	<1
	Nov. 18, 1991							
SG–07	Line 16, 765 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.21	0.03	<1
SG–08	Line 16, 665 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	1.78	0.22	<1
SG–09	Line 16, 630 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	1.10	0.14	<1
SG–10	Line 16, 610 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	1.36	0.17	<1
SG–11	Line 16, 585 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.97	0.12	<1
SG–12	Line 16, 480 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.65	0.08	<1
SG–12A	Dup. of SG–12	< 0.10	< 0.03	< 0.10	< 0.01	< 0.10	< 0.01	<1
SG–13	Near B2–91	< 0.10	< 0.03	< 0.10	< 0.01	1.25	0.16	<1
SG–14	Near Old Hot Spot.	16.90	4.76	36.80	4.60	400.00	49.99	12
SG–14A	Dup. of SG–14	26.00	7.33	36.20	4.52	377.00	47.11	12
	Syringe #4 Blank	< 0.10	< 0.03	< 0.10	< 0.01	1.40	0.17	–
	Nov. 19, 1991							
SG–15	Near B2–91	< 0.10	< 0.03	< 0.10	< 0.01	2.94	0.39	2
SG–16	Line 16,374 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	2.00	0.27	<1
SG–17	Line 17, 340 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	2.00	0.27	<1
	Syringe #3 Blank	< 0.10	< 0.03	< 0.10	< 0.01	1.20	0.16	–
SG–18	Line 17, 510 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	3.12	0.42	4
SG–19	Line 17, 610 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	1.85	0.25	<1
SG–20	Line 17, 700 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.39	0.05	<1
SG–21	Line 17, 750 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.32	0.04	<1
	Syringe #4 Blank	< 0.10	< 0.03	< 0.10	< 0.01	0.24	0.03	–
SG–22	Line 17, 1188 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.78	0.10	<1
SG–23	Line 17, 1285 Ft.	< 0.10	< 0.03	0.31	0.04	41.06	5.46	<1
SG–23A	Dup. of SG–23	< 0.10	< 0.03	0.25	0.03	43.25	5.75	<1
SG–24	Line 17, 1490 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.52	0.07	<1
SG–25	Line 18, 1490 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.86	0.11	<1
SG–26	Line 18, 1365 Ft.	< 0.10	< 0.03	5.10	0.68	6.30	0.84	2
	Syringe #3 Blank	< 0.10	< 0.03	< 0.10	< 0.01	0.28	0.04	–
SG–27	Line 17, 1320 Ft.	< 0.10	< 0.03	1.40	0.19	4.37	0.58	1
SG–28	Line 17, 25' N of SG–23	< 0.10	< 0.03	< 0.10	< 0.01	55.00	7.32	2
SG–29	Dup. of SG–28	< 0.10	< 0.03	< 0.10	< 0.01	61.85	8.23	2
SG–30	Line 17, 25' S of SG–23	1.15	0.32	0.80	0.11	63.00	8.38	<1
	Syringe #3 Blank	< 0.10	< 0.03	< 0.10	< 0.01	0.38	0.05	–
	Nov. 20, 1991							
	Syringe #4 Blank	< 0.10	< 0.03	< 0.10	< 0.01	1.70	0.24	–
SG–31	Probe Blank	< 0.10	< 0.03	< 0.10	< 0.01	2.12	0.30	<1
SG–32	Line 17, 20' S of SG–27	0.19	0.06	2.30	0.33	3.17	0.45	2
SG–33	Line 16, 1285 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.65	0.09	<1
SG–34	Line 17, 67' S of SG–23	< 0.10	< 0.03	0.08	0.01	23.83	3.37	<1
	Syringe #4 Blank	< 0.10	< 0.03	< 0.10	< 0.01	0.12	0.02	–
SG–35	Line 19, 1340 Ft.	< 0.10	< 0.03	0.05	0.01	0.37	0.05	<1
SG–36	Line 19, 1245 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	1.50	0.21	<1
	Syringe #5 Blank	< 0.10	< 0.03	< 0.10	< 0.01	0.94	0.13	–
	Syringe #3 Blank	< 0.10	< 0.03	< 0.10	< 0.01	0.77	0.11	–
SG–37	Line 18, 445 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.42	0.06	<1
SG–38	Line 19, 770 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.73	0.10	<1
SG–39	Line 3, 150 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.47	0.07	<1
SG–40	Line 3, 225 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	1.25	0.18	<1
SG–41	Line 4, 200 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	1.51	0.21	<1
SG–42	Line 5, 225 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.78	0.11	<1
SG–43	Line 5, 175 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.55	0.08	<1
	Syringe #3 Blank	< 0.10	< 0.03	< 0.10	< 0.01	0.24	0.03	–
SG–44	Line 10, 770 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.67	0.09	<1
SG–45	Line 10, 850 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	2.63	0.37	<1
SG–46	Line 10, 990 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.74	0.10	<1
SG–47	Line 12, 930 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.46	0.07	<1
SG–48	Line 12, 990 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	2.65	0.38	<1

TABLE 4 – 1

SOIL GAS RESULTS USING GAS CHROMATOGRAPHY[1]

SENECA ARMY DEPOT
ASH LANDFILL

SOIL GAS ID	SOIL GAS LOCATION	DCE Area Vs	DCE Conc. PPMV	TCE Area Vs	TCE Conc. PPMV	TOTAL Area Vs	TOTAL Conc.[2] PPMV	OVM Reading[3] PPMV
	Nov. 21, 1991							
SG–49	Probe Blank	< 0.10	< 0.03	< 0.10	< 0.01	1.33	0.19	–
SG–50	Line 14, 1370 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.46	0.07	<1
SG–51	Line 13, 1010 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.41	0.06	<1
SG–52	Line 13, 960 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.20	0.03	<1
SG–53	Line 13, 915 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.47	0.07	<1
SG–54	Line 13, 850 Ft.	< 0.10	< 0.03	< 0.10	< 0.01	0.54	0.08	<1
SG–55	Near Boring B3–91	< 0.10	< 0.03	0.39	0.06	0.75	0.11	<1
SG–56	South of Boring B3–91	< 0.10	< 0.03	< 0.10	< 0.01	1.37	0.19	<1
	Syringe #5 Blank	< 0.10	< 0.03	< 0.10	< 0.01	0.33	0.05	<1
SG–57	South of Boring B4–91	< 0.10	< 0.03	< 0.10	< 0.01	0.63	0.09	<1
SG–58	Near Boring B4–91	< 0.10	< 0.03	1.35	0.19	1.77	0.25	<1
SG–59	North of Boring B4–91	< 0.10	< 0.03	< 0.10	< 0.01	0.83	0.12	<1
SG–60	Near Bend in Road	429.00	127.04	83.00	11.75	530.00	75.02	32
SG–61	Dup. of SG–60	99.60	29.49	372.00	52.66	514.00	72.76	32
	Syringe #5 Blank	< 0.10	< 0.03	< 0.10	< 0.01	1.74	0.25	–
SG–62	Near Bend in Road	24.80	7.34	5.50	0.78	33.30	4.71	11
	Syringe #4 Blank	< 0.10	< 0.03	< 0.10	< 0.01	1.50	0.21	–
SG–63	Near B15–91	4.30	1.27	12.40	1.76	18.79	2.66	4
	Syringe #3 Blank	< 0.10	< 0.03	0.31	0.04	2.11	0.30	–
SG–64	Near Bend in Road	< 0.10	< 0.03	0.50	0.07	5.70	0.81	5
SG–65	Near Bend in Road	< 0.10	< 0.03	0.10	0.01	54.00	7.64	<1
SG–66	Near Bend in Road	< 0.10	< 0.03	< 0.10	0.01	0.61	0.09	2
SG–67	Near Bend in Road	0.28	0.08	1.90	0.27	2.83	0.40	<1
	Nov. 22, 1991							
	Syringe #5 Blank	< 0.10	< 0.03	< 0.10	< 0.01	1.10	0.16	–
SG–68	Near Bend in Road	140.20	41.52	< 0.10	< 0.01	546.20	77.31	129
SG–69	Near B28–91	6.20	1.84	2.20	0.31	14.60	2.07	75
SG–70	Near B30–91	312.00	92.39	28.40	4.02	612.00	86.63	132
SG–71	Near Bend in Road	4.60	1.36	2.10	0.30	7.56	1.07	8
SG–72	Probe Blank	< 0.10	< 0.03	< 0.10	< 0.01	0.58	0.08	–
SG–73	Near Bend in Road	20.80	6.16	24.10	3.41	48.20	6.82	10
SG–74	Near B27–91	14.80	4.38	16.45	2.33	32.10	4.54	25
SG–75	Near Bend in Road	1.05	0.31	2.90	0.41	7.10	1.01	6
SG–76	Near Bend in Road	< 0.10	< 0.03	< 0.10	< 0.01	1.38	0.20	2

Notes:

1) PPMV – Parts Per Million Volume

2) [1] – Soil Gas analyses were performed with a Photovac 10S50 Gas Chromatograph; Peak identification was based upon retention time matching of a soil gas sample with a known compound fron a certified, calibrated gas standard.

3) [2] – Total Volatile Organic Compounds (VOC) was determined as the sum of all detectable peaks, expressed as Trichloroethene (TCE).

4) [3] – This value represents the highest Total Organic Vapor Meter (OVM) Reading observed during the purging of the soil gas probe. Sample collection corresponded to this observed value as much as possible. The OVM was calibrated daily against a 60 PPMV isobutylene standard.

TABLE 4 – 2

SOIL HEADSPACE RESULTS USING GAS CHROMATOGRAPHY

SENECA ARMY DEPOT
ASH LANDFILL

HEADSPACE POINT	INJECTION VOLUME (mL)	TCE (Vs)	DCE (Vs)	TCE ADJUSTED (Vs)	DCE ADJUSTED (Vs)	TOTAL TCE+DCE (Vs)
SG–0	0.2	17.9	91.4	89.5	457	546.5
SG–0	0.1	3.3	84.6	33	846	879
AE–1	0.1	727	293	7270	2930	10200
AE–1	0.1	327	244	3270	2440	5710
AE–2	0.05	1500	199	30000	3980	33980
AE–3	0.05	5.5	50	110	1000	1110
AE–3	0.025	2	17.4	80	696	776
AE–4	0.05	1200	228	24000	4560	28560
AE–5	0.05	1.6	–	32	0	32
AE–6	0.5	–	–	0	0	0
AE–7	0.5	3.6	0.2	7.2	0.4	7.6
AW–1	0.5	344	269	688	538	1226
AW–2	0.5	35.2	88.9	70.4	177.8	248.2
AW–3	1	70.3	88.8	70.3	88.8	159.1
AW–4	1	12	5.2	12	5.2	17.2
AW–5	1	26.3	12.9	26.3	12.9	39.2
AW–6	1	13.1	2.2	13.1	2.2	15.3
AW–7	1	1.8	–	1.8	0	1.8
BS–1	0.25	3.4	54.5	13.6	218	231.6
BS–2	0.25	5	100	20	400	420
BS–2	0.1	2.5	51.4	25	514	539
BS–3	0.25	12.5	13.7	50	54.8	104.8
BS–3	0.1	5.5	8.5	55	85	140
BS–4	0.25	5.5	10.8	22	43.2	65.2
BS–5	0.5	6.8	1.8	13.6	3.6	17.2
BS–5	0.25	3.7	1.1	14.8	4.4	19.2
BS–6	1	0.7	31.6	0.7	31.6	32.3
BS–7	0.5	12.9	285	25.8	570	595.8
BS–5E–1	0.25	–	–	0	0	0
BS–5E–2	0.5	1.4	–	2.8	0	2.8
BS–5W–1	0.25	2	1.6	8	6.4	14.4
BS–5W–2	0.5	11.9	1.8	23.8	3.6	27.4
BS–5W–3	0.5	17.5	10.5	35	21	56
BN–1	0.25	0.6	0.3	2.4	1.2	3.6
BN–2	1	1.7	81.5	1.7	81.5	83.2
BN–3	0.5	22	14.2	44	28.4	72.4
BN–4	0.5	–	–	0	0	0
BN–5	0.5	–	–	0	0	0
BN–6	not run	not run	not run	not run	not run	not run
BN–7	1	–	–	0	0	0
CSE–1	0.1	0.4	356	4	3560	3564
CSE–2	0.05	79.6	58	1592	1160	2752
CSE–3	0.25	–	0.9	–	3.6	3.6
CSE–4	0.5	0.9	1	1.8	2	3.8
CSE–5	0.5	0.5	–	1	0	1
CSE–6	0.5	8.8	1	17.6	2	19.6
CSE–7	0.5	4	–	8	0	8
CSE–8	0.5	–	–	0	0	0
CNW–1	0.5	1	7.9	2	15.8	17.8
CNW–1	0.25	0.3	4.2	1.2	16.8	18
CNW–2	0.5	45.3	118	90.6	236	326.6
CNW–3	0.5	1	12.7	2	25.4	27.4
CNW–4	0.5	5.4	0.4	10.8	0.8	11.6
CNW–5	1	–	–	0	0	0
CNW–6	not run	not run	not run	not run	not run	not run
CNW–7	0.5	–	–	0	0	0
SG–00	0.1	26	24.1	260	241	501

TABLE 4 – 2

SOIL HEADSPACE RESULTS USING GAS CHROMATOGRAPHY

SENECA ARMY DEPOT
ASH LANDFILL

HEADSPACE POINT	INJECTION VOLUME (mL)	TCE (Vs)	DCE (Vs)	TCE ADJUSTED (Vs)	DCE ADJUSTED (Vs)	TOTAL TCE+DCE (Vs)
DE–1	0.5	2	2.4	4	4.8	8.8
DE–2	1	16.6	43.6	16.6	43.6	60.2
DW–1	0.5	722	233	1444	466	1910
DW–1	0.5	703	139	1406	278	1684
DW–2	0.05	–	–	0	0	0
DW–2	0.5	–	–	0	0	0
DW–3	0.5	28.6	293	57.2	586	643.2
DW–4	0.25	2.9	111	11.6	444	455.6
DW–5	0.25	38.5	24.7	154	98.8	252.8
DW–6	0.5	4.5	4.8	9	9.6	18.6
EN–1	0.1	4.1	52.7	41	527	568
EN–2	0.1	17.9	12.9	179	129	308
ES–1	0.5	0.8	–	1.6	0	1.6
ES–2	1	–	–	0	0	0
FN–1	0.25	1.7	3.9	6.8	15.6	22.4
FN–2	0.25	18.1	5.6	72.4	22.4	94.8
FS–1	0.25	–	0.5	0	2	2
FS–2	1	3.4	0.5	3.4	0.5	3.9
GNE–1	0.05	–	1.6	0	32	32
GNE–2	0.25	–	193	0	772	772
GNE–3	0.25	–	0.2	0	0.8	0.8
GNE–4	0.5	2.2	14.8	4.4	29.6	34
GNE–5	0.5	–	–	0	0	0
GNE–6	not run	not run	not run	not run	not run	not run
GNE–7	0.5	–	–	0	0	0
GSW–1	0.1	1.7	98.7	17	987	1004
GSW–2	0.25	2.4	162	9.6	648	657.6
GSW–3	0.5	5.7	149	11.4	298	309.4
GSW–4	0.5	–	0.7	0	1.4	1.4
GSW–4	1	–	1.6	0	1.6	1.6
GSW–5	0.5	15.8	118	31.6	236	267.6
GSW–6	0.5	18	94.8	36	189.6	225.6
GSW–7	1	25	187	25	187	212
GSW–8	0.5	5.6	13.7	11.2	27.4	38.6
18E	0.5	0.1	–	0.2	0	0.2
18W	0.25	0.1	–	0.4	0	0.4
DW–1–S1	0.25	–	–	0	0	0
DW–1–S1	1	–	–	0	0	0
DW–2–S1	0.5	–	–	0	0	0
DW–7	1	–	–	0	0	0
DW–3–SW1	0.25	38.4	77.8	153.6	311.2	464.8
DW–3–SW2	0.5	–	19.2	0	38.4	38.4
DW–3–SW3	0.5	–	–	0	0	0
DW–3–NW1	0.25	15.2	124	60.8	496	556.8
DW–3–NW2	0.25	3.3	7.1	13.2	28.4	41.6
DW–3–NW3	0.5	22.6	6.4	45.2	12.8	58
EN–3	0.5	–	–	0	0	0
EN–3–E1	0.5	–	–	0	0	0
GSW–4–SE1	0.5	–	18.5	0	37	37
GSW–4–NW1	0.5	1.3	28	2.6	56	58.6
GSW–6–NW1	0.5	7.6	8.5	15.2	17	32.2
GSW–6–NW2	0.5	3.8	0.76	7.6	1.52	9.12
GSW–9	0.5	13.7	72.9	27.4	145.8	173.2

Notes:

1) Vs = volt seconds as measured on the gas chromatograph.

ES
ENGINEERING-SCIENCE, INC.

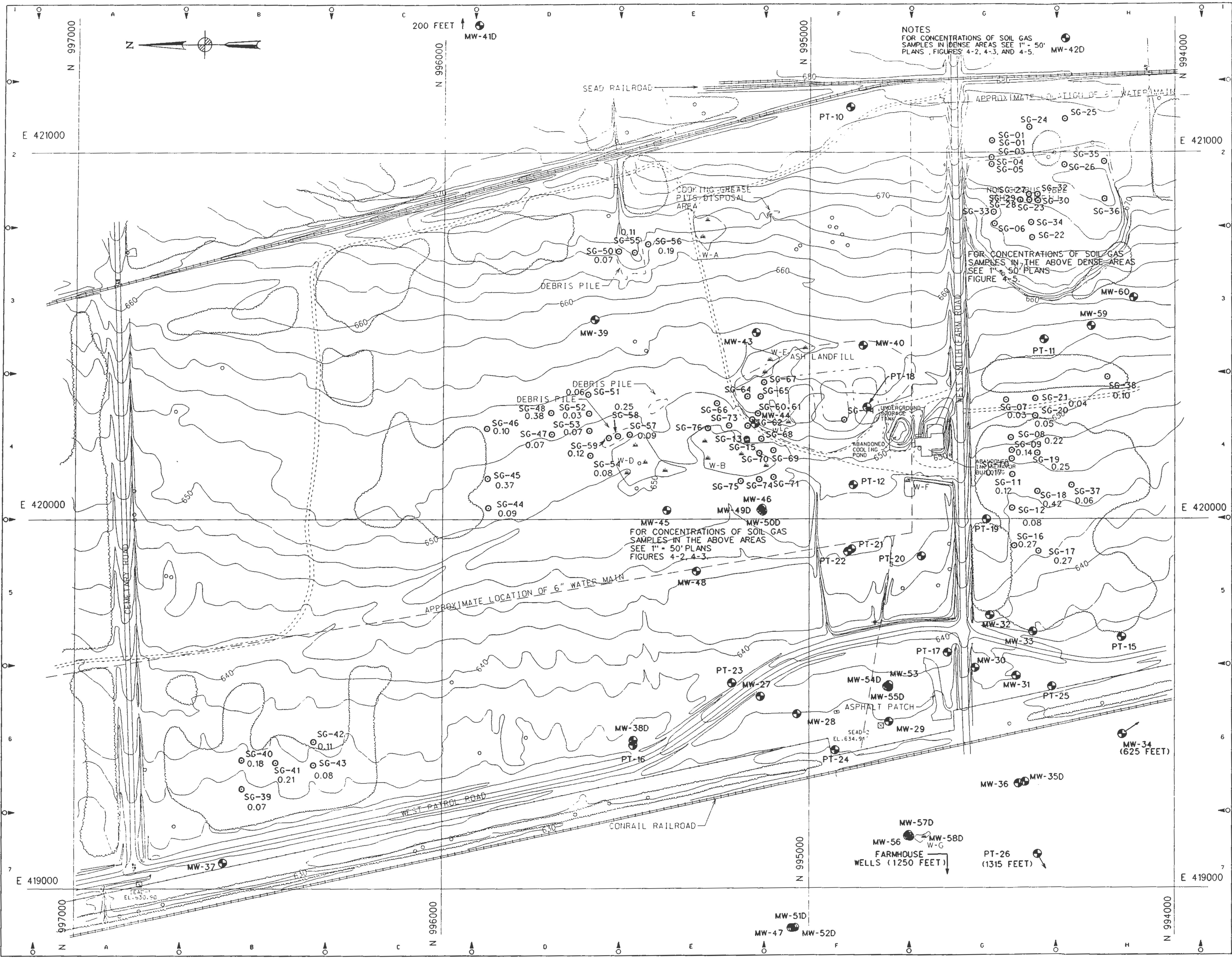
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

ENVIRONMENTAL ENGINEERING | NO 720447-03000

FIGURE 3-30

NATURAL RESOURCES WITHIN 0.5 MILE OF THE ASH LANDFILL SITE

1" = 500'



REV	DATE	DESCRIPTION
C	6/3/94	DRAFT-FINAL RI REPORT
B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN · CHECKED · DES.SUPV. · RESP.ENGR. · CH.DISC.ENG. · PROJ. MGR. · MF

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IN CHARGE W.D.PATTERSON	

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ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY
ASH LANDFILL

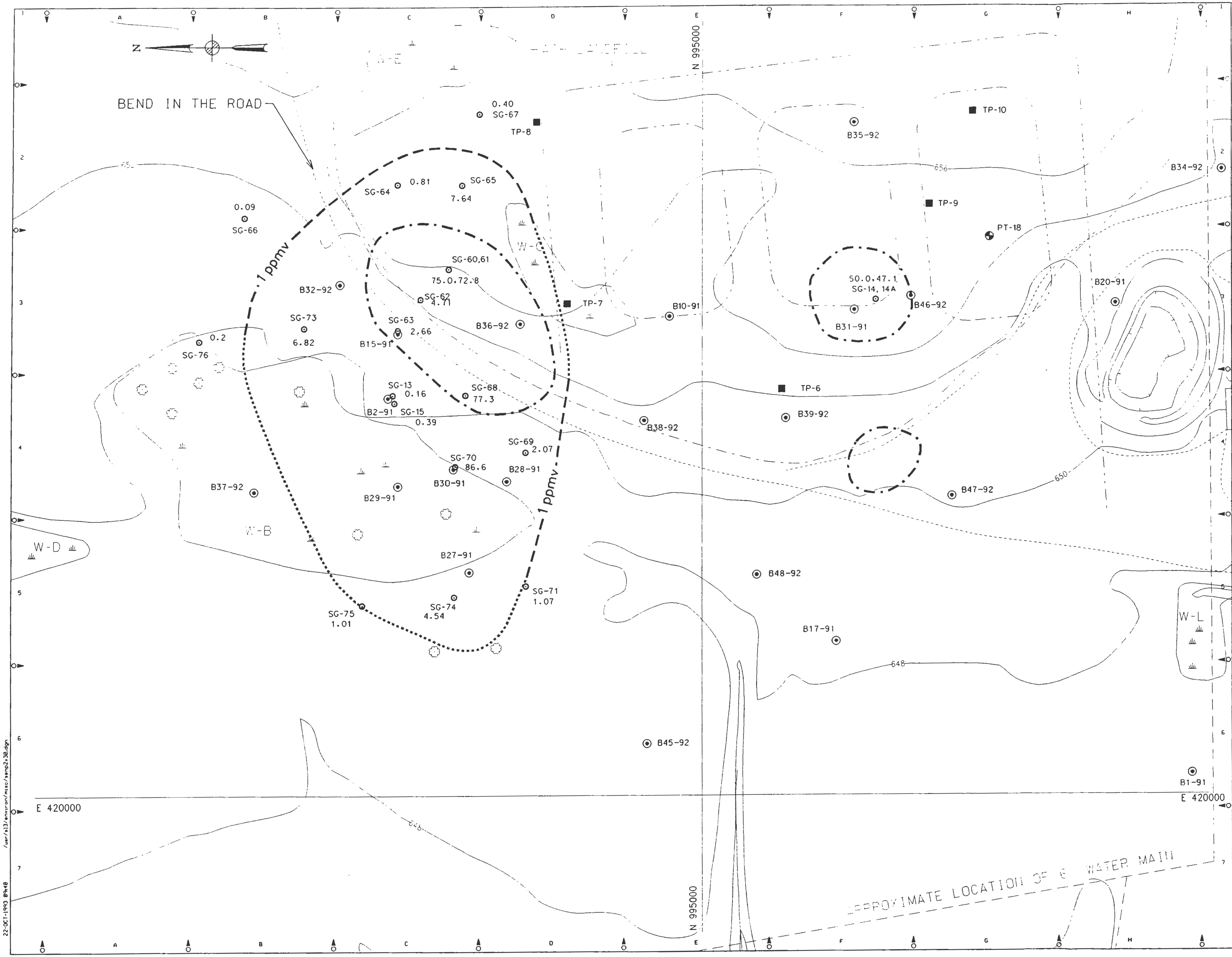
DEPT. ENVIRONMENTAL ENGINEERING
NO.

FIGURE 4-1
TOTAL VOLATILE ORGANIC CONCENTRATIONS OF PHASE I SOIL GAS SAMPLES

SCALE 1" = 250'

ES'S DWG. NO. 720447-03000-1-1
REV C

/usr/413/environ/misc/senp2-29.dgn
02-JUN-1994 13:39



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A	10/93	PREDRAFT PHASE II RI/FS

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DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 4-2
TOTAL VOC SOIL GAS
ISOCONTOURS (ppmv)
FROM PHASE I

SCALE 1" = 50'

ES'S DWG. NO. 720447-03000-2-6
REV A

22-OCT-1993 09:40
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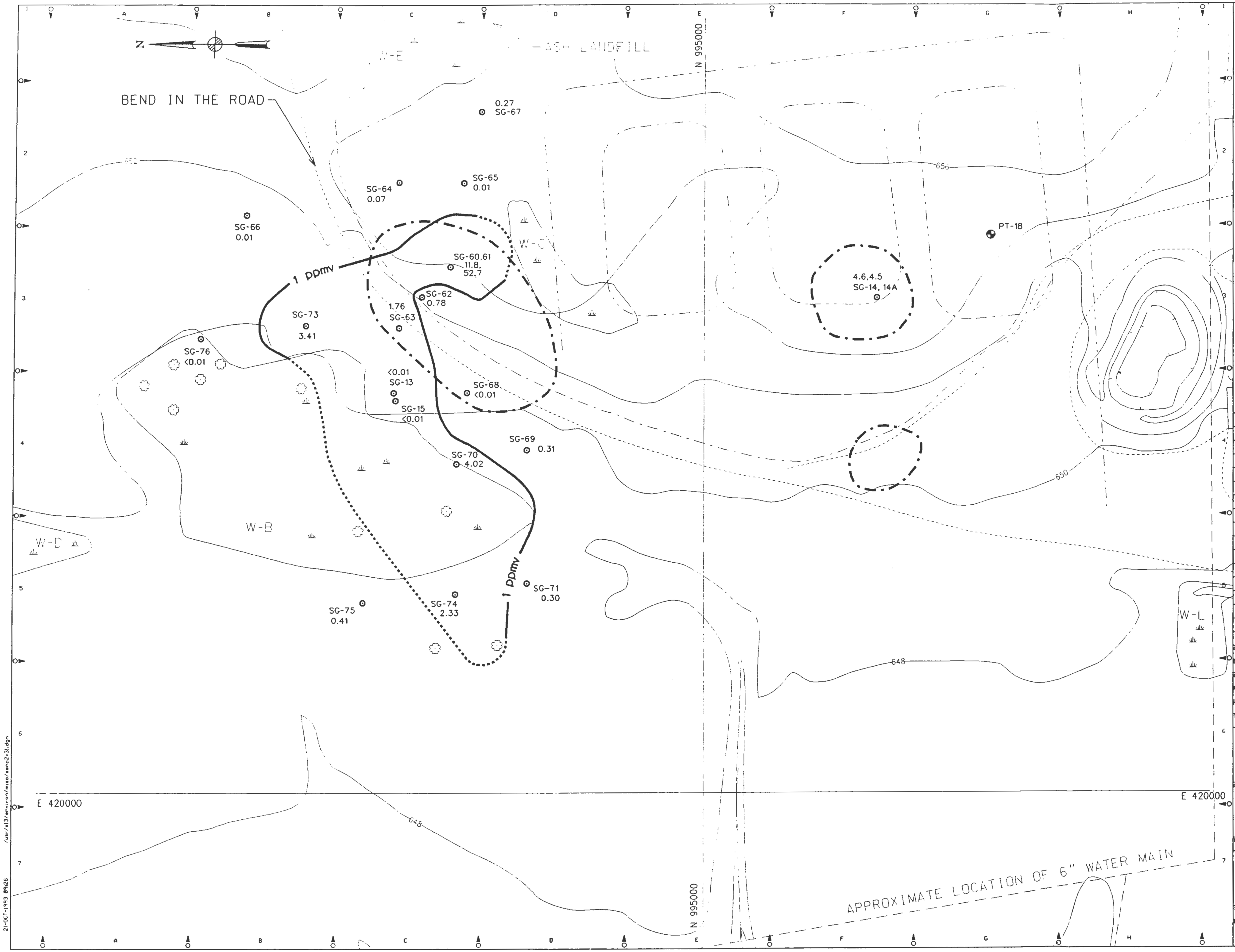

LEGEND:

	PAVED ROAD
	DIRT ROAD
650	GROUND CONTOUR AND ELEVATION
○	TREE
W-B	WETLAND & DESIGNATION
	APPROXIMATE EXTENT OF FILL
	OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
PT-12	MONITORING WELL AND DESIGNATION
B17-91	SOIL BORING & DESIGNATION
■ TP-9	TEST PIT & DESIGNATION
SG-66 0.09	SOIL GAS SAMPLE, DESIGNATION, & CONCENTRATION IN ppmv
1 ppmv	SOIL GAS ISOCONTOUR (ppmv) FROM PHASE 1 REMEDIAL INVESTIGATION. (DOTTED WHERE INFERRED)
	ICF (1989) SOIL GAS SURVEY >100ug/L TOTAL VOLATILES

REV	DATE	DESCRIPTION
A	10/93	PREDRAFT PHASE II RI/FS

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REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 4-3
TRICHLOROETHENE
SOIL GAS ISOCONTOURS (ppmv)
FROM PHASE I

SCALE 1" = 50'

ES'S DWG. NO. 720447-03000-2-6
REV A

(i.e., concentrations 100 ug/L) defined by Target (Figures 4-2 and 4-3), although ES's soil gas results suggests that the source area for volatile organic compounds extends farther north than was previously defined by Target's (1989) soil gas survey.

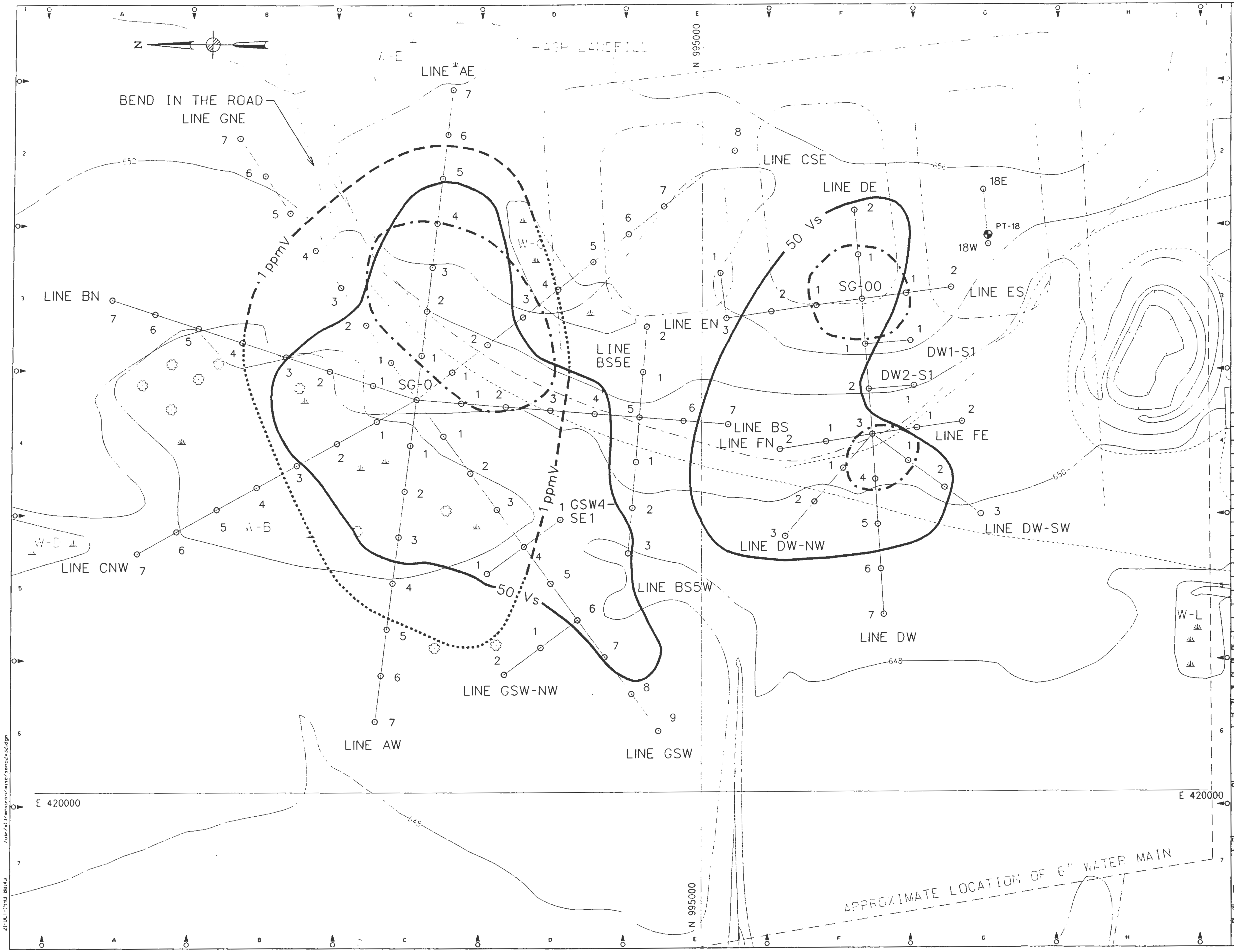
The results of the Phase II soil headspace investigation are summarized in Table 4-2 and Figure 4-4. The purpose of the soil headspace survey was to screen the soil for volatile organics and not to quantify the concentration of the volatiles, although relative degrees of impacts were noted during this investigation. The results were tabulated in units of Volt-seconds (Vs), the unit reported by the GC, since it was impossible to quantify the concentration of the organics in the soil. The data were normalized (adjusted) to reflect a 1 mL injection volume. These units provided a good means for comparing the data and determining which soils were significantly impacted by volatile organics. The 50 Vs contour lines shown on Figure 4-4 were chosen to best represent the distribution of volatile organics of interest in this area of the site. Two distinct source areas for volatile organics are defined by these contours. The larger of the two areas is at the bend in the road and the other smaller areas is located immediately north of PT-18.

4.2.4 Non-Combustible Fill Landfill

A small area of total volatile organics in soil gas is defined by a 1 ppmv isocontour on Figure 4-5. Here concentrations of total VOCs range as high as 8.38 ppmv. Concentrations of TCE in soil gas, which are significantly less than 1 ppmv, are also shown on Figure 4-5. Comparatively, the Non-Combustible Fill Landfill contains lower concentrations of total volatile organics and TCE in soil gas when compared to those near the Ash Landfill. Furthermore, the major constituent of the soil gas is vinyl chloride rather than 1,2-DCE or TCE, indicating an older source that has undergone more degradation.

4.3 SOIL

A total of 41 soil borings were advanced to refusal during this investigation. Soil samples were collected at depth intervals of 0 to 2 feet, 2 to 4 feet and 4 to 6 feet and where possible 6 to 8 feet. Infrequently there was enough soil at the 8 to 10 foot interval to collect a sample. Borings were done in three areas of investigation the Ash Landfill, Non-Combustible Fill Landfill, and the Debris Piles.



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A	10/93	PREDRAFT PHASE II RI/FS

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IN CHARGE W.D.PATTERSON

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ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

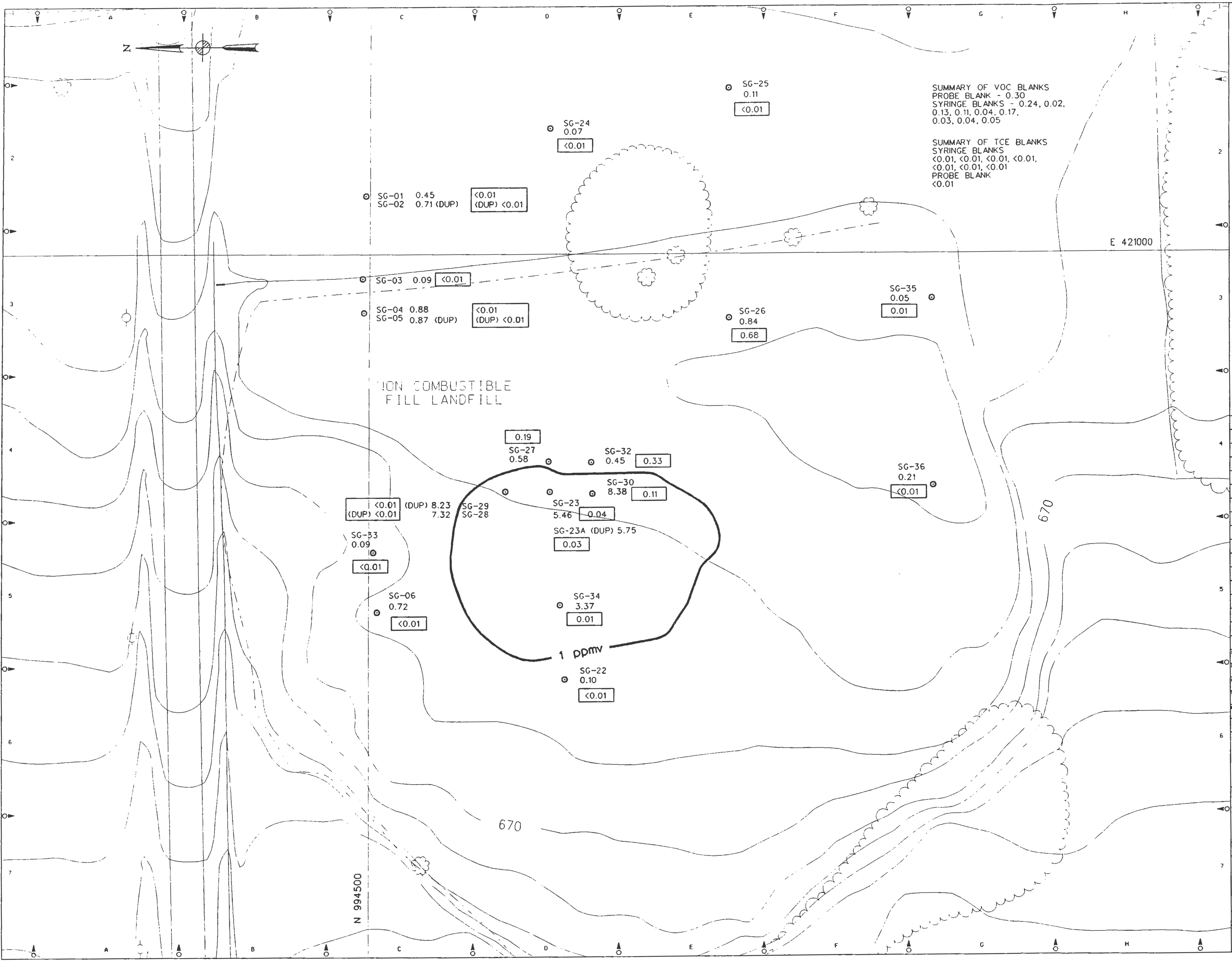
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 4-4
SOIL GAS AND SOIL HEADSPACE RESULTS FROM PHASES I AND II

SCALE 1" = 50'

ES'S DWG. NO. 720447-03000-2-6
REV A



SUMMARY OF VOC BLANKS
PROBE BLANK - 0.30
SYRINGE BLANKS - 0.24, 0.02, 0.13, 0.11, 0.04, 0.17, 0.03, 0.04, 0.05

SUMMARY OF TCE BLANKS
SYRINGE BLANKS
<0.01, <0.01, <0.01, <0.01, <0.01, <0.01, <0.01
PROBE BLANK
<0.01

LEGEND:

	PAVED ROAD
	DIRT ROAD
650	GROUND CONTOUR AND ELEVATION
○	TREE
W-B	WETLAND & DESIGNATION
	APPROXIMATE EXTENT OF FILL
	OUTLINE OF FORMER REFUSE PITS (IDENTIFIED FROM AERIAL PHOTO)
	UTILITY POLE
	APPROXIMATE EXTENT OF DEBRIS PILE
	BRUSH
	CHAIN LINK FENCE
◦	UTILITY POLE
✦	APPROXIMATE LOCATION OF FIRE HYDRANT
⊂	FUEL OR UNDERGROUND STORAGE TANK
☒ SEAD-1 EL.630.90'	SURVEY MONUMENT
⊙ SG-25	SOIL GAS SAMPLE. DESIGNATION.
0.11	VOC CONCENTRATION IN PPMV
<0.01	TCE CONCENTRATION IN PPMV
1 ppmv	VOC SOIL GAS ISOCONTOUR IN (ppmv) FROM PHASE 1 REMEDIAL INVESTIGATION

REV	DATE	DESCRIPTION
A	10/93	PREDRAFT PHASE II RI/FS

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DESIGN SUPV. G.A.KAEUN	RESP. ENGR. M.N.DUCHESNEAU
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DRAWN CHECKED DES.SUPV. RESP.ENGR. CH.DISC.ENG. PROJ.MGR. MF

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING NO. 720447-03000

FIGURE 4-5
SOIL GAS AND SOIL HEADSPACE RESULTS FROM PHASES I AND II

SCALE 1" = 50'

ES'S DWG. NO. 720489-01000-2-17 REV A

Soil samples collected were analyzed for volatile organics, semivolatile organics, pesticides/PCBs, herbicides and metals. The sample from boring B-26 was analyzed for TPH only, using a modified EPA method 418.1. The following discussion is further subdivided into the following groups of analytes:

- chlorinated volatile organics
- BTEX (benzene, toluene, ethylbenzene & xylenes)
- phthalates
- PAHs (polynuclear aromatic hydrocarbons)
- pesticides and PCBs
- herbicides
- Tentatively Identified Compounds (TICs)
- metals and cyanide

The results of the soil analytical data are presented in Table 4-3 and discussed in the following subsections. The discussion is organized first by analyte group (e.g., BTEX) and second by area of investigation (e.g., Debris Piles). Within each area of investigation maximum constituent concentrations, concentrations with respect to NYSDEC Technical and Administrative Guidance Memorandum (TAGM) clean-up limits (NYSDEC TAGM HWR-92-4046, November 16, 1992), and vertical/horizontal distributions of chemical constituents are discussed.

4.3.1 Total Chlorinated Volatile Organic Compounds

4.3.1.1 Ash Landfill

The primary chlorinated volatile organic compounds at the Ash Landfill are 1,2-dichloroethene (1,2-DCE: both cis and trans isomers), trichloroethene (TCE) and vinyl chloride. It is these compounds that most often exceed the NYSDEC TAGM clean-up guidelines. As indicated on Table 4-3, approximately 95 percent of the chlorinated volatiles TAGM excursions observed in this investigation were observed in the Ash Landfill (26 of 27 1,2-DCE excursions, 15 of 16 TCE excursions and 5 of 5 vinyl chloride excursions). These excursions involved borings B2, B10, B15, B28, B29, B30, B31 and B39. It is expected that these three compounds are related in location and concentration ranges because they are related in biodegradation processes. Vinyl chloride is a breakdown product of 1,2-DCE and 1,2-DCE is a breakdown product of TCE.

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-1 0-2 10/30/91 S1030-1	B-1 2-4 10/30/91 S1030-2	B-1 4-6 10/30/91 S1030-3	B-2 0-2 10/31/91 S1031-4	B-2 2-4 10/31/91 S1031-5	B-2 6-8 10/31/91 S1031-6	B-2 8-10 10/31/91 S1031-7	B-3 0-2 10/31/91 S1031-8	B-3 2-4 10/31/91 S1031-9	B-3 4-6 10/31/91 S1031-10
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	–	200	5	12 U	12 U	N	1500 U J	1500 U	920 J	2800 U	13 U J	12 U	11 U
Chloroethane	0.5%	3	–	1900	0	12 U	12 U	N	1500 U J	1500 U	1600 U	2800 U	13 U J	12 U	11 U
Acetone	8.0%	680	–	200	1	12 U	12 U	N	1500 U J	1500 U	1600 U	2800 U	13 U J	12 U	11 U
Carbon Disulfide	1.1%	120	–	2700	0	6 U	6 U	N	740 U J	730 U	780 U	1400 U	6 U J	6 U	6 U
1,1-Dichloroethene	5.9%	140	–	400	0	6 U	6 U	N	740 U J	730 U	780 U	1400 U	6 U J	6 U	6 U
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	6 U	6 U	N	12000 J	1900	21000	1400 U	6 U J	6 U	6 U
Chloroform	7.0%	32	–	300	0	6 U	6 U	N	740 U J	730 U	780 U	1400 U	6 U J	6 U	6 U
1,2-Dichloroethane	1.1%	210	–	100	2	6 U	6 U	N	740 U J	730 U	780 U	1400 U	6 U J	6 U	6 U
2-Butanone	6.4%	22	–	300	0	12 U	12 U	N	1500 U J	1500 U	1600 U	2800 U	13 U J	12 U	11 U
1,1,1-Trichloroethane	0.5%	3	–	800	0	6 U	6 U	N	740 U J	730 U	780 U	1400 U	6 U J	6 U	6 U
Trichloroethene	54.0%	540000	–	700	16	6 U	6 U	N	28000	4400	120000	69000	23 J	6 U	6 U
Benzene	2.1%	6	–	60	0	6 U	6 U	N	740 U J	730 U	780 U	1400 U	6 U J	6 U	6 U
Tetrachloroethene	2.1%	7	–	1400	0	6 U	6 U	N	740 U J	730 U	780 U	1400 U	6 U J	6 U	6 U
Toluene	25.1%	5700	–	1500	2	6 U	6 U	N	560 J	220 J	280 J	1400 U	4 J	2 J	1 J
Chlorobenzene	1.1%	620	–	1700	0	6 U	6 U	N	740 U J	730 U	780 U	1400 U	6 U J	6 U	6 U
Ethylbenzene	7.0%	2000	–	5500	0	6 U	6 U	N	580 J	250 J	780 U	1400 U	6 U J	6 U	6 U
Xylene (total)	12.3%	17000	–	1200	5	6 U	6 U	N	2900 J	1200	400 J	1400 U	6 U J	6 U	6 U
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	–	30	2	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
2-Nitrophenol	0.5%	1300	–	330	1	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Benzoic acid	4.0%	1500	–	2700	0	3500 U	3500 U	3300 U	3400 U	3600 U	3500 U	N	4300 U	N	3500 U
Naphthalene	19.7%	2500	–	13000	0	720 U	730 U	690 U	270 J	210 J	360 J	N	890 U	N	730 U
2-Methylnaphthalene	18.7%	3600	–	36400	0	720 U	730 U	690 U	280 J	730 U	240 J	N	890 U	N	730 U
Acenaphthylene	8.3%	510	–	41000	0	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Acenaphthene	16.1%	14000	–	50000*	0	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
4-Nitrophenol	1.0%	1600	–	100	1	3500 U	3500 U	3300 U	3400 U	3600 U	3500 U	N	4300 U	N	3500 U
Dibenzofuran	11.9%	7000	–	6200	1	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Fluorene	17.6%	12000	–	50000*	0	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Phenanthrene	42.0%	43000	–	50000*	0	720 U	730 U	690 U	170 J	82 J	720 U	N	420 J	N	730 U
Anthracene	23.8%	15000	–	50000*	0	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Di-n-butylphthalate	27.5%	25000	–	8100	1	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Fluoranthene	44.0%	29000	–	50000*	0	720 U	730 U	690 U	710 U	730 U	720 U	N	750 J	N	730 U
Pyrene	46.1%	24000	–	50000*	0	720 U	730 U	690 U	130 J	730 U	720 U	N	550 J	N	730 U
Butylbenzylphthalate	3.1%	300	–	50000*	0	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Benzo(a)anthracene	36.3%	9600	–	220	32	720 U	730 U	690 U	710 U	730 U	720 U	N	290 J	N	730 U
Chrysene	38.3%	9900	–	400	26	720 U	730 U	690 U	710 U	730 U	720 U	N	350 J	N	730 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	720 U	730 U	530 J	710 U	730 U	720 U	N	890 U	N	730 U
Di-n-octylphthalate	3.6%	430	–	50000*	0	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	720 U	730 U	690 U	710 U	730 U	720 U	N	220 J	N	730 U
benzo(k)fluoranthene	34.2%	6700	–	1100	9	720 U	730 U	690 U	710 U	730 U	720 U	N	180 J	N	730 U
Benzo(a)pyrene	33.2%	9000	–	61	52	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	720 U	730 U	690 U	710 U	730 U	720 U	N	890 U	N	730 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-1 0-2 10/30/91 S1030-1	B-1 2-4 10/30/91 S1030-2	B-1 4-6 10/30/91 S1030-3	B-2 0-2 10/31/91 S1031-4	B-2 2-4 10/31/91 S1031-5	B-2 6-8 10/31/91 S1031-6	B-2 8-10 10/31/91 S1031-7	B-3 0-2 10/31/91 S1031-8	B-3 2-4 10/31/91 S1031-9	B-3 4-6 10/31/91 S1031-10
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	–	100	0	17 U	18 U	17 U	17 U	18 U	17 U	N	22 U	N	18 U
Dieldrin	0.6%	46	–	44	1	35 U	35 U	33 U	34 U	36 U	35 U	N	43 U	N	35 U
4,4'-DDE	28.9%	290	–	2100	0	35 U	35 U	33 U	34 U	36 U	35 U	N	43 U	N	35 U
4,4'-DDD	16.7%	350	–	2900	0	35 U	35 U	33 U	34 U	36 U	35 U	N	43 U	N	35 U
4,4'-DDT	19.4%	260	–	2100	0	35 U	35 U	33 U	34 U	36 U	35 U	N	43 U	N	35 U
Aroclor-1242	3.5%	260	–	1000[2]	0	170 U	180 U	170 U	170 U	180 U	170 U	N	220 U	N	180 U
Aroclor-1260	11.7%	770	–	1000[2]	0	350 U	350 U	330 U	340	190 J	390	N	430 U	N	350 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	–	–	NA	54 U J	350 J	53 U J	250 J	56 U J	55 U J	N	68 U J	N	100 J
2,4,5-TP (Silvex)	0.6%	10	–	700	0	5.4 U J	5.5 U J	5.3 U J	5.4 U J	5.6 U J	5.5 U J	N	6.8 U J	N	5.6 U J
MCPP	3.0%	24000	–	–	NA	5400 U J	5500 U J	5300 U J	5400 U J	5600 U J	5500 U J	N	7500 J	N	5600 U J
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	17600	17600	13200	15800	17400	18100	N	11700	N	15100
Antimony	8.6%	78.3	5.16	5.2	13	10 U J	9.5 U J	8 U J	11.1 U J	7.9 U J	8.1 U J	N	78.3 J	N	6.5 U J
Arsenic	99.4%	66.3	5.93	7.5	17	6	4.4	3.7	4.9	4.1	4	N	66.3	N	3.8
Barium	100.0%	1010	101.81	300	4	102	64.8	42.2	58	72.3	58.7	N	1010	N	56.9
Beryllium	96.5%	1.4	0.99	1	34	1	0.93	0.67 J	0.84 J	0.79	0.83	N	0.78 U	N	0.69
Cadmium	69.9%	43.1	1.76	1.8	92	2	2.8	1.9	2.3	2.3	2.9	N	43.1	N	2.2
Calcium	100.0%	172000	46825	46825	42	22900	55200	71000	31500	32500	22300	N	15800	N	65800
Chromium	100.0%	62	26.57	26.6	81	28	27.5	22	26.1	27.8	28.4	N	57.9	N	22.5
Cobalt	100.0%	25.1	15.27	30	0	13	11.7	11.9	12.1	11.3	14.6	N	13.6	N	11
Copper	100.0%	836	24.07	25	92	36 J	21.9 J	13.9 J	33.1 J	24.7 J	18.9 J	N	836	N	14.8 J
Iron	100.0%	642000	32698	32698	77	37500	34400	27800	35000	32900	36500	N	55600	N	30000
Lead	100.0%	2890	14.02	30	50	27	7.5	6.9	52.4	23	11.9 J	N	1630	N	8.4
Magnesium	100.0%	24900	9071	9071.1	30	6870	7690	6900	7510	8440	8130	N	3930	N	8120
Manganese	100.0%	2740	1065.8	1065.8	17	746	943	802	403	673	505	N	615	N	547
Mercury	61.7%	1.2	0.07	0.1	31	0 U	0.04 U	0.04 U	0.04 J	0.06 J	0.04 U	N	0.86	N	0.04 U
Nickel	100.0%	2520	41.31	41.3	62	45	42.4	33.3	43.1	40.3	46.9	N	65.4	N	34.5
Potassium	100.0%	19000	1530	4000	1	2420	1810	1410	1950	2280	2150	N	1380	N	1490
Selenium	30.1%	2.1	0.35	2	1	1 U	0.59 U	0.9 U	0.21 U	0.17 U	0.18 U	N	1.1 U	N	0.17 U
Silver	14.7%	10.5	0.59	200	0	2 U	1.4 U	1.2 U	1.7 U	1.2 U	1.2 U	N	1.8 U	N	0.98 U
Sodium	65.1%	1010	76.4	3000	0	424 U J	72.6 U J	151 J	84.9 U J	60.4 U J	62.2 U J	N	143 J	N	79.1 J
Vanadium	100.0%	36.8	25.49	150	0	24	22.8	15.8	17.8	22.1	20.3	N	18.1	N	17.6
Zinc	99.4%	55700	89.14	89.1	108	104	77.6	60.2	58.6	85.5	88.1	N	55700	N	213
Cyanide	3.7%	2.2	0.35	NA	0	1 U	0.6 U	0.59 U	0.62 U	0.67 U	0.66 U	N	1.6	N	0.66 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-3 6-8 10/31/91 S1031-11	B-3 6-8 10/31/91 S1031-11RE(4)	B-4 0-2 11/01/91 S1101-12	B-4 2-4 11/01/91 S1101-13	B-4 4-6 11/01/91 S1101-14	B-5 0-2 11/01/91 S1101-15	B-5 0-2 11/01/91 S1101-15RE(4)	B-5 2-4 11/01/91 S1101-16	B-5 4-6 11/01/91 S1101-17	B-5 8-10 11/01/91 S1101-18
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	–	200	5	10 U J	10 U	13 U	11 U	11 U	15 U J	14 U J	11 U	11 U	10 U J
Chloroethane	0.5%	3	–	1900	0	10 U J	10 U	13 U	11 U	11 U	15 U J	14 U J	11 U	11 U	10 U J
Acetone	8.0%	680	–	200	1	10 U J	12 U	13 U	11 U	11 U	15 U J	18 U J	11 U	11 U	24 U J
Carbon Disulfide	1.1%	120	–	2700	0	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	3 U J
1,1-Dichloroethene	5.9%	140	–	400	0	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	5 U J
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	5 U J
Chloroform	7.0%	32	–	300	0	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	5 U J
1,2-Dichloroethane	1.1%	210	–	100	2	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	5 U J
2-Butanone	6.4%	22	–	300	0	10 U J	10 U	13 U	11 U	11 U	15 U J	14 U J	11 U	11 U	10 U J
1,1,1-Trichloroethane	0.5%	3	–	800	0	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	5 U J
Trichloroethene	54.0%	540000	–	700	16	5 J	4 J	130	6 U	2 J	7 U J	7 U J	5 U	6 U	5 U J
Benzene	2.1%	6	–	60	0	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	5 U J
Tetrachloroethene	2.1%	7	–	1400	0	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	5 U J
Toluene	25.1%	5700	–	1500	2	4 J	3 J	6 U	2 J	2 J	3 J	9 J	1 J	2 J	6 J
Chlorobenzene	1.1%	620	–	1700	0	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	5 U J
Ethylbenzene	7.0%	2000	–	5500	0	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	5 U J
Xylene (total)	12.3%	17000	–	1200	5	5 U J	5 U	6 U	6 U	5 U	7 U J	7 U J	5 U	6 U	5 U J
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	–	30	2	N	N	1300 U	720 U	710 U	840 U	N	730 U	760 U	N
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	N	N	1300 U	720 U	710 U	840 U	N	730 U	760 U	N
2-Nitrophenol	0.5%	1300	–	330	1	N	N	1300 U	720 U	710 U	840 U	N	730 U	760 U	N
Benzoic acid	4.0%	1500	–	2700	0	N	N	6300 U	3500 U	3400 U	4100 U	N	3500 U	3700 U	N
Naphthalene	19.7%	2500	–	13000	0	N	N	2400	720 U	710 U	210 J	N	730 U	760 U	N
2-Methylnaphthalene	18.7%	3600	–	36400	0	N	N	610 J	720 U	710 U	120 J	N	730 U	760 U	N
Acenaphthylene	8.3%	510	–	41000	0	N	N	1300 U	720 U	710 U	310 J	N	730 U	760 U	N
Acenaphthene	16.1%	14000	–	50000*	0	N	N	2200	720 U	710 U	190 J	N	730 U	760 U	N
4-Nitrophenol	1.0%	1600	–	100	1	N	N	6300 U	3500 U	3400 U	4100 U	N	3500 U	3700 U	N
Dibenzofuran	11.9%	7000	–	6200	1	N	N	1400	720 U	710 U	160 J	N	730 U	760 U	N
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	N	N	2000	720 U	710 U	320 J	N	730 U	760 U	N
Fluorene	17.6%	12000	–	50000*	0	N	N	2000	720 U	710 U	310 J	N	730 U	760 U	N
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	N	N	450 J	720 U	710 U	840 U	N	730 U	760 U	N
Phenanthrene	42.0%	43000	–	50000*	0	N	N	13000	130 J	120 J	3900	N	730 U	760 U	N
Anthracene	23.8%	15000	–	50000*	0	N	N	4200	720 U	710 U	790 J	N	730 U	760 U	N
Di-n-butylphthalate	27.5%	25000	–	8100	1	N	N	1300 U	720 U	710 U	840 U	N	730 U	760 U	N
Fluoranthene	44.0%	29000	–	50000*	0	N	N	14000	160 J	150 J	6200	N	73 J	89 J	N
Pyrene	46.1%	24000	–	50000*	0	N	N	12000	140 J	120 J	5100	N	69 J	73 J	N
Butylbenzylphthalate	3.1%	300	–	50000*	0	N	N	1300 U	720 U	710 U	840 U	N	730 U	760 U	N
Benzo(a)anthracene	36.3%	9600	–	220	32	N	N	8800	110 J	86 J	3000	N	730 U	75 J	N
Chrysene	38.3%	9900	–	400	26	N	N	8000	110 J	90 J	3100	N	730 U	76 J	N
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	N	N	160 J	720 U	710 U	840 U	N	3600	760 U	N
Di-n-octylphthalate	3.6%	430	–	50000*	0	N	N	1300 U	720 U	710 U	840 U	N	730 U	760 U	N
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	N	N	8800	91 J	710 U	2600	N	730 U	74 J	N
benzo(k)fluoranthene	34.2%	6700	–	1100	9	N	N	6700	85 J	710 U	2300	N	730 U	70 J	N
Benzo(a)pyrene	33.2%	9000	–	61	52	N	N	9000	110 J	78 J	2100	N	730 U	81 J	N
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	N	N	4800	720 U	710 U	1300	N	730 U	760 U	N
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	N	N	2000	720 U	710 U	640 J	N	730 U	760 U	N
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	N	N	5000	720 U	710 U	1400	N	730 U	760 U	N

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B-3 6-8 10/31/91 S1031-11	B-3 6-8 10/31/91 S1031-11RE(4)	B-4 0-2 11/01/91 S1101-12	B-4 2-4 11/01/91 S1101-13	B-4 4-6 11/01/91 S1101-14	B-5 0-2 11/01/91 S1101-15	B-5 0-2 11/01/91 S1101-15RE(4)	B-5 2-4 11/01/91 S1101-16	B-5 4-6 11/01/91 S1101-17	B-5 8-10 11/01/91 S1101-18
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	-	100	0	N	N	19 U	17 U	17 U	20 U	N	18 U	18 U	N
Dieldrin	0.6%	46	-	44	1	N	N	38 U	35 U	34 U	41 U	N	35 U	37 U	N
4,4'-DDE	28.9%	290	-	2100	0	N	N	38 U	35 U	34 U	41 U	N	35 U	37 U	N
4,4'-DDD	16.7%	350	-	2900	0	N	N	38 U	35 U	34 U	41 U	N	35 U	37 U	N
4,4'-DDT	19.4%	260	-	2100	0	N	N	38 U	35 U	34 U	41 U	N	35 U	37 U	N
Aroclor-1242	3.5%	260	-	1000[3]	0	N	N	190 U	170 U	170 U	200 U	N	180 U	180 U	N
Aroclor-1260	11.7%	770	-	1000[3]	0	N	N	380 U	350 U	340 U	410 U	N	350 U	370 U	N
Herbicides (µg/kg)															
2,4-DB	4.3%	410	-	-	NA	N	N	59 U J	140 J	230 J	64 U J	N	55 U J	180 J	N
2,4,5-TP (Silvex)	0.6%	10	-	700	0	N	N	5.9 U J	5.5 U J	5.4 U J	6.4 U J	N	5.5 U J	5.8 U J	N
MCPP	3.0%	24000	-	-	NA	N	N	5900 U J	5500 U J	5400 U J	6400 U J	N	5500 U J	5800 U J	N
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	N	N	16400	11500	16100	8610	N	14000	14900	N
Antimony	8.6%	78.3	5.16	5.2	13	N	N	18.3 J	8.3 J	10.4 U J	12 U J	N	8.5 U J	8.7 U J	N
Arsenic	99.4%	66.3	5.93	7.5	17	N	N	11.4	5.6	6.5	17.3	N	5.1	5.3	N
Barium	100.0%	1010	101.81	300	4	N	N	455	62.9	58.5	399	N	61.3	78.7	N
Beryllium	96.5%	1.4	0.99	1	34	N	N	0.75 U	0.59 J	0.87 J	0.79 U	N	0.7 J	0.82	N
Cadmium	69.9%	43.1	1.76	1.8	92	N	N	7.9	1.7	2.4	10.4	N	2	2.4	N
Calcium	100.0%	172000	46825	46825	42	N	N	27500	1E+05	42200	1E+05	N	89100	29700	N
Chromium	100.0%	62	26.57	26.6	81	N	N	62	16.8	24.2	57	N	20.2	21.6	N
Cobalt	100.0%	25.1	15.27	30	0	N	N	15.7	8.2	14.5	10.9 J	N	12.5	17.3	N
Copper	100.0%	836	24.07	25	92	N	N	311	19.6 J	21.5 J	498	N	26.5 J	27.7 J	N
Iron	100.0%	642000	32698	32698	77	N	N	83800	23200	37200	81400	N	30900	6E+05	N
Lead	100.0%	2890	14.02	30	50	N	N	2890	10.1	10.5	1750	N	248	16.2 J	N
Magnesium	100.0%	24900	9071	9071.1	30	N	N	6990	13100	9050	4090	N	8450	5460	N
Manganese	100.0%	2740	1065.8	1065.8	17	N	N	806	485	549	964	N	796	1000	N
Mercury	61.7%	1.2	0.07	0.1	31	N	N	1.1	0.04 U	0.04 J	1	N	0.07 J	0.08 J	N
Nickel	100.0%	2520	41.31	41.3	62	N	N	67.2	26.1	39	74.8	N	32	39.8	N
Potassium	100.0%	19000	1530	4000	1	N	N	2350	1720	1740	1380	N	1750	1780	N
Selenium	30.1%	2.1	0.35	2	1	N	N	0.19 U	0.7 U	0.2 U	0.25 U	N	0.17 U	0.91 U	N
Silver	14.7%	10.5	0.59	200	0	N	N	2.8	1.1 U	1.6 U	1.8 U	N	1.3 U	1.3 U	N
Sodium	65.1%	1010	76.4	3000	0	N	N	285 J	83 J	79.6 U J	198 J	N	65.4 U J	66.2 U J	N
Vanadium	100.0%	36.8	25.49	150	0	N	N	24.9	15.3	18.1	14.5	N	20.2	20.1	N
Zinc	99.4%	55700	89.14	89.1	108	N	N	3050	74.4	92.7	27600	N	513	841	N
Cyanide	3.7%	2.2	0.35	NA	0	N	N	0.69 U	0.63 U	0.6 U	0.61 U	N	0.64 U	0.68 U	N

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-5 8-10 11/01/91 S1101-18RE(4)	B-6 0-2 11/04/91 S1104-19	B-6 2-4 11/04/91 S1104-20	B-7 0-2 11/04/91 S1104-21	B-7 2-4 11/04/91 S1104-22	B-7 10-12 11/04/91 S1104-23	B-8 0-2 11/05/91 S1105-24	B-8 2-4 11/05/91 S1105-25	B-8 2-4 11/05/91 S1105-26(1)	B-8 6-8 11/05/91 S1105-27
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	–	200	5	10 U J	12 U	11 U	11 U	11 U	13 U	12 U	11 U	11 U	11 U
Chloroethane	0.5%	3	–	1900	0	10 U J	12 U	11 U	11 U	11 U	13 U	12 U	11 U	11 U	11 U
Acetone	8.0%	680	–	200	1	29 U J	12 U	11 U	13 U	11 U	29 U	13 U	11 U	11 U	11 U
Carbon Disulfide	1.1%	120	–	2700	0	3 J	6 U	6 U	6 U	5 U	7 U	6 U	5 U	6 U	5 U
1,1-Dichloroethene	5.9%	140	–	400	0	5 U J	6 U	6 U	6 U	5 U	7 U	6 U	5 U	6 U	5 U
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	5 U J	6 U	6 U	6 U	12	8	6 U	5 U	6 U	5 U
Chloroform	7.0%	32	–	300	0	5 U J	6 U	6 U	6 U	5 U	7 U	2 J	5 U	4 J	5 U
1,2-Dichloroethane	1.1%	210	–	100	2	5 U J	6 U	6 U	6 U	5 U	7 U	6 U	5 U	6 U	5 U
2-Butanone	6.4%	22	–	300	0	10 U J	12 U	11 U	11 U	11 U	13 U	12 U	11 U	11 U	11 U
1,1,1-Trichloroethane	0.5%	3	–	800	0	5 U J	6 U	6 U	6 U	5 U	7 U	6 U	5 U	6 U	5 U
Trichloroethene	54.0%	540000	–	700	16	5 U J	6 U	6 U	6 U	5 J	4 J	6 U	5 U	6 U	5 U
Benzene	2.1%	6	–	60	0	5 U J	6 U	6 U	6 U	5 U	7 U	6 U	5 U	6 U	5 U
Tetrachloroethene	2.1%	7	–	1400	0	5 U J	6 U	6 U	6 U	5 U	7 U	6 U	5 U	6 U	5 U
Toluene	25.1%	5700	–	1500	2	6 J	6 U	6 U	6 U	5 J	7 U	2 J	5 U	6 U	5 U
Chlorobenzene	1.1%	620	–	1700	0	5 U J	6 U	6 U	6 U	5 U	7 U	6 U	5 U	6 U	5 U
Ethylbenzene	7.0%	2000	–	5500	0	5 U J	6 U	6 U	6 U	2 J	7 U	6 U	5 U	6 U	5 U
Xylene (total)	12.3%	17000	–	1200	5	5 U J	6 U	6 U	6 U	8	7 U	6 U	5 U	6 U	5 U
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	–	30	2	N	780 U	740 U	1900 U	720 U	870 U	760 U	750 U	720 U	700 U
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	N	780 U	740 U	1900 U	720 U	870 U	760 U	750 U	720 U	700 U
2-Nitrophenol	0.5%	1300	–	330	1	N	780 U	740 U	1900 U	720 U	870 U	760 U	750 U	720 U	700 U
Benzoic acid	4.0%	1500	–	2700	0	N	3800 U	3600 U	9000 U	500 J	4200 U	3700 U	3600 U	3500 U	3400 U
Naphthalene	19.7%	2500	–	13000	0	N	780 U	740 U	830 J	440 J	870 U	760 U	750 U	720 U	700 U
2-Methylnaphthalene	18.7%	3600	–	36400	0	N	780 U	740 U	430 J	360 J	870 U	760 U	750 U	720 U	700 U
Acenaphthylene	8.3%	510	–	41000	0	N	780 U	740 U	1900 U	720 U	870 U	760 U	750 U	720 U	700 U
Acenaphthene	16.1%	14000	–	50000*	0	N	780 U	740 U	2200	1000	870 U	760 U	750 U	720 U	700 U
4-Nitrophenol	1.0%	1600	–	100	1	N	3800 U	3600 U	9000 U	3500 U	4200 U	3700 U	3600 U	3500 U	3400 U
Dibenzofuran	11.9%	7000	–	6200	1	N	780 U	740 U	960 J	400 J	870 U	760 U	750 U	720 U	700 U
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	N	780 U	740 U	1900 U	720 U	870 U	760 U	750 U	720 U	700 U
Fluorene	17.6%	12000	–	50000*	0	N	780 U	740 U	2000	880	870 U	760 U	750 U	720 U	700 U
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	N	780 U	740 U	1900 U	720 U	870 U	760 U	750 U	720 U	700 U
Phenanthrene	42.0%	43000	–	50000*	0	N	780 U	740 U	15000	5200	870 U	760 U	750 U	720 U	700 U
Anthracene	23.8%	15000	–	50000*	0	N	780 U	740 U	3500	1300	870 U	760 U	750 U	720 U	700 U
Di-n-butylphthalate	27.5%	25000	–	8100	1	N	780 U	740 U	1900 U	630 J	870 U	760 U	750 U	720 U	700 U
Fluoranthene	44.0%	29000	–	50000*	0	N	780 U	740 U	22000	6700	870 U	760 U	750 U	720 U	700 U
Pyrene	46.1%	24000	–	50000*	0	N	780 U	740 U	16000	4800	870 U	760 U	750 U	720 U	700 U
Butylbenzylphthalate	3.1%	300	–	50000*	0	N	780 U	740 U	1900 U	720 U	870 U	760 U	750 U	720 U	700 U
Benzo(a)anthracene	36.3%	9600	–	220	32	N	780 U	740 U	9600	3000	870 U	760 U	750 U	720 U	700 U
Chrysene	38.3%	9900	–	400	26	N	780 U	740 U	9900	3200	870 U	760 U	750 U	720 U	700 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	N	780 U	740 U	1900 U	720 U	870 U	760 U	750 U	720 U	700 U
Di-n-octylphthalate	3.6%	430	–	50000*	0	N	780 U	740 U	1900 U	720 U	870 U	760 U	750 U	720 U	700 U
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	N	780 U	740 U	9500	2900	870 U	760 U	750 U	720 U	700 U
benzo(k)fluoranthene	34.2%	6700	–	1100	9	N	780 U	740 U	6100	1700	870 U	760 U	750 U	720 U	700 U
Benzo(a)pyrene	33.2%	9000	–	61	52	N	780 U	740 U	8400	2500	870 U	760 U	750 U	720 U	700 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	N	780 U	740 U	4600	1200	870 U	760 U	750 U	720 U	700 U
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	N	780 U	740 U	1800 J	620 J	870 U	760 U	750 U	720 U	700 U
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	N	780 U	740 U	4000	1200	870 U	760 U	750 U	720 U	700 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B-5 8-10 11/01/91 S1101-18RE(4)	B-6 0-2 11/04/91 S1104-19	B-6 2-4 11/04/91 S1104-20	B-7 0-2 11/04/91 S1104-21	B-7 2-4 11/04/91 S1104-22	B-7 10-12 11/04/91 S1104-23	B-8 0-2 11/05/91 S1105-24	B-8 2-4 11/05/91 S1105-25	B-8 2-4 11/05/91 S1105-26(1)	B-8 6-8 11/05/91 S1105-27
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	-	100	0	N	19 U	18 U	18 U	17 U	21 U	18 U	18 U	18 U	17 U
Dieldrin	0.6%	46	-	44	1	N	38 U	36 U	36 U	35 U	42 U	37 U	36 U	35 U	34 U
4,4'-DDE	28.9%	290	-	2100	0	N	38 U	36 U	27 J	18 J	42 U	37 U	36 U	35 U	34 U
4,4'-DDD	16.7%	350	-	2900	0	N	38 U	36 U	27 J	29 J	42 U	37 U	36 U	35 U	34 U
4,4'-DDT	19.4%	260	-	2100	0	N	38 U	36 U	36	19 J	42 U	37 U	36 U	35 U	34 U
Aroclor-1242	3.5%	260	-	1000[2]	0	N	190 U	180 U	180 U	170 U	210 U	180 U	180 U	180 U	170 U
Aroclor-1260	11.7%	770	-	1000[2]	0	N	380 U	360 U	360 U	350 U	420 U	370 U	360 U	350 U	340 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	-	-	NA	N	91 U	56 U J	56 U J	54 U J	66 U J	58 U J	56 U J	56 U J	53 U J
2,4,5-TP (Silvex)	0.6%	10	-	700	0	N	5.9 U J	5.6 U J	6 U J	5 U J	7 U J	6 U J	6 U J	6 U J	5 U J
MCPP	3.0%	24000	-	-	NA	N	5900 U J	5600 U J	5600 U J	5400 U J	6600 U J	5800 U J	5600 U J	5600 U J	5300 U J
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	N	20800	22500	15200	N	21600	19200	20500	17700	12700
Antimony	8.6%	78.3	5.16	5.2	13	N	7.7 U J	11.2 J	11.8 U J	N	10.8 U J	10.3 U J	8.8 U J	8.2 U J	8.4 U J
Arsenic	99.4%	66.3	5.93	7.5	17	N	6.7	8.1	7.1 J	N	6.1 J	5.1 J	6.1 J	6 J	4.2 J
Barium	100.0%	1010	101.81	300	4	N	123	108	181 J	N	119 J	136 J	98.9 J	86.7 J	56.2 J
Beryllium	96.5%	1.4	0.99	1	34	N	1.2	1.4	1.2	N	1.4	1.4	1.2	1	0.78 J
Cadmium	69.9%	43.1	1.76	1.8	92	N	2.5	2.7	3.2	N	3.1	2.6	2.9	2.4	1.9
Calcium	100.0%	172000	46825	46825	42	N	2710	9730	47000	N	4760	5390	4870	3560	85900
Chromium	100.0%	62	26.57	26.6	81	N	27.9	31.5	33.7 J	N	29.3 J	27.4 J	30.1 J	26.9 J	19.8 J
Cobalt	100.0%	25.1	15.27	30	0	N	14.5	18.7	12.9	N	17.3	13.8	18.4	14	14.2
Copper	100.0%	836	24.07	25	92	N	33.7 J	33.5 J	46.4	N	23.9	22.3	27.6	26	16.2
Iron	100.0%	642000	32698	32698	77	N	31000	37900	34100	N	38500	37200	36100	32500	27400
Lead	100.0%	2890	14.02	30	50	N	12	10.8	85.9	N	14.3	14.5	11.4	13.6	10.1
Magnesium	100.0%	24900	9071	9071.1	30	N	5380	8910	9900	N	5620	5850	7300	6490	6720
Manganese	100.0%	2740	1065.8	1065.8	17	N	917	739	688	N	1240	1130	956	832	926
Mercury	61.7%	1.2	0.07	0.1	31	N	0.05 J	0.06 J	0.29	N	0.09 J	0.09	0.06 J	0.06 J	0.05 J
Nickel	100.0%	2520	41.31	41.3	62	N	37.4	50.4	43	N	33.9	42.3	48.7	44.4	30.4
Potassium	100.0%	19000	1530	4000	1	N	2080	3030	2300	N	2270	1910	2110	1760	1430
Selenium	30.1%	2.1	0.35	2	1	N	0.18 J	0.13 U	0.18 U J	N	0.22 U J	0.17 U J	0.21 U J	0.2 U J	0.61 U J
Silver	14.7%	10.5	0.59	200	0	N	1.2 U	1.7 U	2.2	N	2.2	1.6 U	1.3 U	1.2 U	1.3 U
Sodium	65.1%	1010	76.4	3000	0	N	58.9 U J	85.5 U J	127 J	N	83.6 J	79.2 U	67.5 U	62.6 U	75.3 J
Vanadium	100.0%	36.8	25.49	150	0	N	32.7	31.3	36.8	N	29.2	32.2	25.4	26.4	15.7
Zinc	99.4%	55700	89.14	89.1	108	N	89.6	108	252 J	N	94.9 J	85.1 J	94.2 J	85 J	75 J
Cyanide	3.7%	2.2	0.35	NA	0	N	0.68 U	0.68 U	0.67 U	N	0.77 U	0.6 U	0.63 U	0.67 U	0.58 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-9 0-2 11/05/91 S1105-28	B-9 2-4 11/05/91 S1105-29	B-9 6-8 11/05/91 S1105-30	B-10 0-2 11/06/91 S1106-31	B-10 2-4 11/06/91 S1106-32	B-10 2-4 11/06/91 S1106-33 (1)	B-10 6-8 11/06/91 S1106-34	B-11 0-2 11/06/91 S1106-36	B-11 2-4 11/06/91 S1106-37	B-11 6-8 11/06/91 S1106-38
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	-	200	5	11 U	11 U	11 U	N	12 U	11 U	92	11 U	10 U	11 U
Chloroethane	0.5%	3	-	1900	0	11 U	11 U	11 U	N	12 U	11 U	3 J	11 U	10 U	11 U
Acetone	8.0%	680	-	200	1	11 U	11 U	11 U	N	43	11 U	11 U	11 U	10 U	36 U
Carbon Disulfide	1.1%	120	-	2700	0	6 U	6 U	5 U	N	6 U	6 U	6 U	6 U	5 U	6 U
1,1-Dichloroethene	5.9%	140	-	400	0	6 U	6 U	5 U	N	6 U	6 U	1 J	6 U	5 U	6 U
1,2-Dichloroethene (total)	38.5%	79000	-	300	27	6 U	6 U	5 U	N	6 U	6 U	1300	6 U	5 U	6 U
Chloroform	7.0%	32	-	300	0	6 U	4 J	1 J	N	6 U	6 U	6 U	6 U	5 U	6 U
1,2-Dichloroethane	1.1%	210	-	100	2	6 U	6 U	5 U	N	6 U	6 U	6 U	6 U	5 U	6 U
2-Butanone	6.4%	22	-	300	0	11 U	11 U	11 U	N	12 U	11 U	11 U	11 U	10 U	6 J
1,1,1-Trichloroethane	0.5%	3	-	800	0	6 U	6 U	5 U	N	6 U	6 U	6 U	6 U	5 U	6 U
Trichloroethene	54.0%	540000	-	700	16	6 U	6 U	5 U	N	4 J	6 U	220	6 U	5 U	6 U
Benzene	2.1%	6	-	60	0	6 U	6 U	5 U	N	6 U	6 U	6 U	6 U	5 U	6 U
Tetrachloroethene	2.1%	7	-	1400	0	6 U	6 U	5 U	N	6 U	6 U	6 U	6 U	5 U	6 U
Toluene	25.1%	5700	-	1500	2	6 U	6 U	5 U	N	2 J	2 J	6 U	6 U	5 U	6 U
Chlorobenzene	1.1%	620	-	1700	0	6 U	6 U	5 U	N	6 U	6 U	6 U	6 U	5 U	6 U
Ethylbenzene	7.0%	2000	-	5500	0	6 U	6 U	5 U	N	6 U	3 J	6 U	6 U	5 U	6 U
Xylene (total)	12.3%	17000	-	1200	5	6 U	6 U	5 U	N	5 J	20 J	6 U	6 U	5 U	6 U
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	-	30	2	780 U	730 U J	710 U	740 U	730 U	760 U	750 U	780 U	710 U	720 U
bis(2-Chloroethyl) ether	0.5%	9	-	-	NA	780 U	730 U J	710 U	740 U	730 U	760 U	750 U	780 U	710 U	720 U
2-Nitrophenol	0.5%	1300	-	330	1	780 U	730 U J	710 U	740 U	730 U	760 U	750 U	780 U	710 U	720 U
Benzoic acid	4.0%	1500	-	2700	0	3800 U	3500 U J	3400 U	3600 U	3600 U	3700 U	3600 U	3800 U	3400 U	3500 U
Naphthalene	19.7%	2500	-	13000	0	780 U	730 U J	710 U	310 J	730 U	760 U	750 U	780 U	710 U	720 U
2-Methylnaphthalene	18.7%	3600	-	36400	0	780 U	730 U J	710 U	140 J	730 U	760 U	750 U	780 U	710 U	720 U
Acenaphthylene	8.3%	510	-	41000	0	780 U	730 U J	710 U	740 U	730 U	760 U	750 U	780 U	710 U	720 U
Acenaphthene	16.1%	14000	-	50000*	0	780 U	730 U J	710 U	640 J	730 U	760 U	750 U	780 U	710 U	720 U
4-Nitrophenol	1.0%	1600	-	100	1	3800 U	3500 U J	3400 U	3600 U	3600 U	3700 U	3600 U	3800 U	3400 U	3500 U
Dibenzofuran	11.9%	7000	-	6200	1	780 U	730 U J	710 U	310 J	730 U	760 U	750 U	780 U	710 U	720 U
2,4-Dinitrotoluene	1.0%	2000	-	50000*	0	780 U	730 U J	710 U	640 U	730 U	760 U	750 U	780 U	710 U	720 U
Fluorene	17.6%	12000	-	50000*	0	780 U	730 U J	710 U	570 J	730 U	760 U	750 U	780 U	710 U	720 U
N-Nitrosodiphenylamine	0.5%	450	-	50000*	0	780 U	730 U J	710 U	740 U	730 U	760 U	750 U	780 U	710 U	720 U
Phenanthrene	42.0%	43000	-	50000*	0	780 U	730 U J	710 U	4400	160 J	180 J	750 U	67 J	710 U	720 U
Anthracene	23.8%	15000	-	50000*	0	780 U	730 U J	710 U	1200	730 U	760 U	750 U	780 U	710 U	720 U
Di-n-butylphthalate	27.5%	25000	-	8100	1	780 U	730 U J	710 U	740 U	77 J	760 U	750 U	780 U	710 U	720 U
Fluoranthene	44.0%	29000	-	50000*	0	780 U	730 U J	710 U	5400	280 J	300 J	750 U	110 J	710 U	720 U
Pyrene	46.1%	24000	-	50000*	0	780 U	730 U J	710 U	5000	250 J	240 J	750 U	91 J	710 U	720 U
Butylbenzylphthalate	3.1%	300	-	50000*	0	780 U	730 U J	710 U	740 U	730 U	760 U	750 U	780 U	710 U	720 U
Benzo(a)anthracene	36.3%	9600	-	220	32	780 U	730 U J	710 U	2700	160 J	150 J	750 U	76 J	710 U	720 U
Chrysene	38.3%	9900	-	400	26	780 U	730 U J	710 U	2200	160 J	160 J	750 U	79 J	710 U	720 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	-	50000*	1	780 U	730 U J	710 U	600 J	100 J	360 J	100 J	780 U	710 U	720 U
Di-n-octylphthalate	3.6%	430	-	50000*	0	780 U	730 U J	710 U	740 U	730 U	760 U	750 U	780 U	710 U	720 U
Benzo(b)fluoranthene	34.2%	9500	-	1100	11	780 U	730 U J	710 U	2500	160 J	140 J	750 U	780 U	710 U	720 U
benzo(k)fluoranthene	34.2%	6700	-	1100	9	780 U	730 U J	710 U	1400	110 J	140 J	750 U	780 U	710 U	720 U
Benzo(a)pyrene	33.2%	9000	-	61	52	780 U	730 U J	710 U	2200	170 J	150 J	750 U	780 U	710 U	720 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	-	3200	2	780 U	730 U J	710 U	1200	110 J	96 J	750 U	780 U	710 U	720 U
Dibenz(a,h)anthracene	13.5%	2100	-	14	26	780 U	730 U J	710 U	630 J	730 U	760 U	750 U	780 U	710 U	720 U
Benzo(g,h,i)perylene	24.9%	5000	-	50000*	0	780 U	730 U J	710 U	1200	120 J	99 J	750 U	780 U	710 U	720 U

TABLE 4 – 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B–9 0–2 11/05/91 S1105–28	B–9 2–4 11/05/91 S1105–29	B–9 6–8 11/05/91 S1105–30	B–10 0–2 11/06/91 S1106–31	B–10 2–4 11/06/91 S1106–32	B–10 2–4 11/06/91 S1106–33 (1)	B–10 6–8 11/06/91 S1106–34	B–11 0–2 11/06/91 S1106–36	B–11 2–4 11/06/91 S1106–37	B–11 6–8 11/06/91 S1106–38
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	–	100	0	19 U	17 U J	17 U J	18 U	18 U	18 U	18 U	19 U	17 U	18 U
Dieldrin	0.6%	46	–	44	1	38 U	35 U J	34 U J	36 U	36 U	37 U	36 U	38 U	34 U	35 U
4,4'–DDE	28.9%	290	–	2100	0	38 U	35 U J	34 U J	30 J	28 J	30 J	36 U	38 U	34 U	35 U
4,4'–DDD	16.7%	350	–	2900	0	38 U	35 U J	34 U J	23 J	36	34 J	36 U	38 U	34 U	35 U
4,4'–DDT	19.4%	260	–	2100	0	38 U	35 U J	34 U J	36 U	36 U	37 U	36 U	38 U	34 U	35 U
Aroclor–1242	3.5%	260	–	1000^{P}	0	190 U	170 U J	170 U J	180 U	180 U	180 U	180 U	190 U	170 U	180 U
Aroclor–1260	11.7%	770	–	1000^{P}	0	380 U	350 U J	340 U J	360 U	360 U	370 U	360 U	380 U	340 U	350 U
Herbicides (µg/kg)															
2,4–DB	4.3%	410	–	–	NA	60 U J	56 U J	54 U J	57 U J	56 U J	57 U J	57 U J	60 U J	54 U J	55 U J
2,4,5–TP (Silvex)	0.6%	10	–	700	0	6 U J	6 U J	5 U J	10 J	6 U J	6 U J	6 U J	6 U J	5 U J	5 U J
MCPP	3.0%	24000	–	–	NA	6000 U J	5600 U J	5400 U J	13000 J	5600 U J	5700 U J	5700 U J	24000 J	5400 U J	5500 U J
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	14800	8880	7160	16600	17300	15100	18800	19000	15800	19600
Antimony	8.6%	78.3	5.16	5.2	13	9.9 U J	9.9 U J	7 U J	8 U J	8.4 U J	10.3 U J	10.2 U J	12.3 U J	10.9 U J	8 U J
Arsenic	99.4%	66.3	5.93	7.5	17	4.3 J	3.8 J	4.4 J	9.8 J	9.7 J	6.1 J	4.9 J	11.4 J	6 J	5 J
Barium	100.0%	1010	101.81	300	4	101 J	110 J	39.9 J	170 J	145 J	83 J	56.9 J	190 J	82.8 J	73.6 J
Beryllium	96.5%	1.4	0.99	1	34	1.1	0.76	0.52 J	0.67 J	0.94	0.85 J	1	1.1 J	1.1	0.93
Cadmium	69.9%	43.1	1.76	1.8	92	2.3	1.7	1.5	5.6	3.1	2.8	2.9	4.2	2.8	2.5
Calcium	100.0%	172000	46825	46825	42	45600	1E+05	1E+05	48500	53600	43900	31000	6440	25400	28800
Chromium	100.0%	62	26.57	26.6	81	22.5 J	13.8 J	11.2 J	38.5 J	30.4 J	26.5 J	28.3 J	39.3 J	21.8 J	29.9 J
Cobalt	100.0%	25.1	15.27	30	0	13.7	10.7	8.1	14.7	13.8	10.7	15.8	13.4	12.4	13
Copper	100.0%	836	24.07	25	92	22.6	21.6	19.3	105	56.9	41.2	25.6	109	29.2	34.4
Iron	100.0%	642000	32698	32698	77	31000	19600	17300	71100	32200	34900	35400	1E+05	33000	31500
Lead	100.0%	2890	14.02	30	50	10.8	10.1	7.8	191	83.1	54.8	14.1	244	13.3	41.3
Magnesium	100.0%	24900	9071	9071.1	30	8860	17000	12600	13300	16900	12000	8150	5390	5170	7460
Manganese	100.0%	2740	1065.8	1065.8	17	903	532	514	670	732	632	953	975	1050	602
Mercury	61.7%	1.2	0.07	0.1	31	0.08 J	0.04 J	0.05 J	0.24	0.33	0.47	0.05 J	0.48	0.11	0.09
Nickel	100.0%	2520	41.31	41.3	62	38.4	23.8	19	43.3	42.2	40.6	44.5	40.6	30.4	41.2
Potassium	100.0%	19000	1530	4000	1	1320	1080	1050	1730	2380	2150	2180	2930	19000	2270
Selenium	30.1%	2.1	0.35	2	1	0.21 U J	0.65 U J	0.21 U J	0.17 U J	0.13 U J	0.16 U J	0.16 U J	0.18 U J	0.18 U J	0.18 U J
Silver	14.7%	10.5	0.59	200	0	1.5 U	1.5 U	1.1 U	1.8	5.6	4.3	1.5 U	1.8 U	1.6 U	1.2 U
Sodium	65.1%	1010	76.4	3000	0	84.2 J	112 J	116 J					94 U	83.1 U	
Vanadium	100.0%	36.8	25.49	150	0	19.7	19.5	12.9	22.1	28.6	21.6	26	29.6	20	21.7
Zinc	99.4%	55700	89.14	89.1	108	126 J	84.3 J	74.8 J	1940 U	554	537	114 J	1080 J	121 J	240 J
Cyanide	3.7%	2.2	0.35	NA	0	0.7 U	0.63 U	0.62 U	0.66	0.64 U	0.68 U	0.65 U	0.71 U	0.64 U	0.62 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-12 0-2 11/07/91 S1107-39	B-12 2-4 11/07/91 S1107-40	B-12 6-8 11/07/91 S1107-41	B-13 0-2 11/07/91 S1107-42	B-13 2-4 11/07/91 S1107-43	B-13 6-8 11/07/91 S1107-44	B-14 0-2 11/08/91 S1108-45	B-14 2-4 11/08/91 S1108-46	B-14 2-4 11/08/91 S1108-47(1)	B-14 4-6 11/08/91 S1108-48
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	–	200	5	12 U	11 U	11 U	12 U	11 U	11 U	12 U	11 U	11 U	10 U J
Chloroethane	0.5%	3	–	1900	0	12 U	11 U	11 U	12 U	11 U	11 U	12 U	11 U	11 U	10 U J
Acetone	8.0%	680	–	200	1	12 U	11 U	11 U	12 U	11 U	11 U	12 U	11 U	11 U	12 U J
Carbon Disulfide	1.1%	120	–	2700	0	6 U	5 U	5 U	6 U	5 U	5 U	6 U	5 U	5 U	5 U J
1,1-Dichloroethene	5.9%	140	–	400	0	6 U	5 U	5 U	6 U	5 U	5 U	6 U	5 U	5 U	5 U J
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	6 U	2 J	5 U	6 U	5 U	5 U	4 J	3 J	16 J	6 J
Chloroform	7.0%	32	–	300	0	6 U	5 U	5 U	6 U	5 U	5 J	6 U	5 U	5 U	5 U J
1,2-Dichloroethane	1.1%	210	–	100	2	6 U	5 U	5 U	6 U	5 U	5 U	6 U	5 U	5 U	5 U J
2-Butanone	6.4%	22	–	300	0	12 U	11 U	11 U	12 U	11 U	11 U	12 U	11 U	11 U	10 U J
1,1,1-Trichloroethane	0.5%	3	–	800	0	6 U	5 U	5 U	6 U	5 U	5 U	6 U	5 U	5 U	5 U J
Trichloroethene	54.0%	540000	–	700	16	6 U	2 J	2 J	6 U	5 U	5 U	7	3 J	8 J	8 J
Benzene	2.1%	6	–	60	0	6 U	5 U	5 U	6 U	5 U	5 U	6 U	5 U	5 U	5 U J
Tetrachloroethene	2.1%	7	–	1400	0	6 U	5 U	5 J	6 U	5 U	5 U	6 U	5 U	5 U	5 U J
Toluene	25.1%	5700	–	1500	2	6 U	5 U	5 U	6 U	5 U	1 J	2 J	5 U	5 U	3 U J
Chlorobenzene	1.1%	620	–	1700	0	6 U	5 U	5 U	6 U	5 U	5 U	6 U	5 U	5 U	5 U J
Ethylbenzene	7.0%	2000	–	5500	0	6 U	5 U	5 U	6 U	5 U	5 U	6 U	5 U	5 U	5 U J
Xylene (total)	12.3%	17000	–	1200	5	6 U	5 U	5 U	6 U	5 U	5 U	6 U	5 U	5 U	5 U J
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	–	30	2	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
2-Nitrophenol	0.5%	1300	–	330	1	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
Benzoic acid	4.0%	1500	–	2700	0	3700 U	3400 U	N	4000 U	3400 U	3200 U	3700 U	3400 U	3500 U	3300 U
Naphthalene	19.7%	2500	–	13000	0	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
2-Methylnaphthalene	18.7%	3600	–	36400	0	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
Acenaphthylene	8.3%	510	–	41000	0	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
Acenaphthene	16.1%	14000	–	50000*	0	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
4-Nitrophenol	1.0%	1600	–	100	1	3700 U	3400 U	N	4000 U	3400 U	3200 U	3700 U	3400 U	3500 U	3300 U
Dibenzofuran	11.9%	7000	–	6200	1	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
Fluorene	17.6%	12000	–	50000*	0	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
Phenanthrene	42.0%	43000	–	50000*	0	760 U	700 U	N	250 J	710 U	670 U	310 J	700 U	720 U	690 U
Anthracene	23.8%	15000	–	50000*	0	760 U	700 U	N	810 U	710 U	670 U	71 J	700 U	720 U	690 U
Di-n-butylphthalate	27.5%	25000	–	8100	1	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
Fluoranthene	44.0%	29000	–	50000*	0	760 U	700 U	N	240 J	710 U	670 U	290 J	700 U	720 U	690 U
Pyrene	46.1%	24000	–	50000*	0	760 U	700 U	N	260 J	710 U	670 U	240 J	700 U	720 U	690 U
Butylbenzylphthalate	3.1%	300	–	50000*	0	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
Benzo(a)anthracene	36.3%	9600	–	220	32	760 U	700 U	N	130 J	710 U	670 U	160 J	700 U	720 U	690 U
Chrysene	38.3%	9900	–	400	26	760 U	700 U	N	130 J	710 U	670 U	150 J	700 U	720 U	690 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	760 U	700 U	N	810 U	710 U	670 U	1300	290 J	2000 J	690 U
Di-n-octylphthalate	3.6%	430	–	50000*	0	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	760 U	700 U	N	140 J	710 U	670 U	110 J	700 U	720 U	690 U
benzo(k)fluoranthene	34.2%	6700	–	1100	9	760 U	700 U	N	96 J	710 U	670 U	140 J	700 U	720 U	690 U
Benzo(a)pyrene	33.2%	9000	–	61	52	760 U	700 U	N	130 J	710 U	670 U	140 J	700 U	720 U	690 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	760 U	700 U	N	810 U	710 U	670 U	760 U	700 U	720 U	690 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-12 0-2 11/07/91 S1107-39	B-12 2-4 11/07/91 S1107-40	B-12 6-8 11/07/91 S1107-41	B-13 0-2 11/07/91 S1107-42	B-13 2-4 11/07/91 S1107-43	B-13 6-8 11/07/91 S1107-44	B-14 0-2 11/08/91 S1108-45	B-14 2-4 11/08/91 S1108-46	B-14 2-4 11/08/91 S1108-47(1)	B-14 4-6 11/08/91 S1108-48
<u>Pesticides / PCBs (μg/kg)</u>															
Heptachlor	0.6%	14	–	100	0	14 J	17 U	N	20 U	17 U	16 U	18 U	17 U	17 U	17 U
Dieldrin	0.6%	46	–	44	1	46	34 U	N	40 U	34 U	32 U	37 U	34 U	35 U	33 U
4,4'-DDE	28.9%	290	–	2100	0	37 U	34 U	N	40 U	34 U	32 U	37 U	34 U	35 U	33 U
4,4'-DDD	16.7%	350	–	2900	0	37 U	34 U	N	40 U	34 U	32 U	37 U	34 U	35 U	33 U
4,4'-DDT	19.4%	260	–	2100	0	37 U	34 U	N	40 U	34 U	32 U	37 U	34 U	35 U	33 U
Aroclor-1242	3.5%	260	–	1000^{P}	0	190 U	170 U	N	200 U	170 U	160 U	180 U	170 U	170 U	170 U
Aroclor-1260	11.7%	770	–	1000^{P}	0	370 U	340 U	N	400 U	340 U	320 U	370 U	340 U	350 U	330 U
<u>Herbicides (μg/kg)</u>															
2,4-DB	4.3%	410	–	–	NA	59 U J	54 U J	N	61 U J	555 U J	52 U J	57 U J	54 U J	55 U J	53 U J
2,4,5-TP (Silvex)	0.6%	10	–	700	0	6 U J	5 U J	N	6 U J	5 U J	5 U J	6 U J	5 U J	5 U J	5 U J
MCPP	3.0%	24000	–	–	NA	18000 J	5400 U J	N	6100 U J	5500 U J	5200 U J	8800 J	5400 U J	5500 U J	5300 U J
<u>Metals (mg/kg)</u>															
Aluminum	100.0%	25500	17503	17503	51	17500	14200	N	19900	14400	18200	12600	12400	12600	18100
Antimony	8.6%	78.3	5.16	5.2	13	10.2 U J	10 U	N	12.5 U J	10.8 U J	8.4 U J	10.6 U J	10.6 U J	9.3 U J	10.5 U J
Arsenic	99.4%	66.3	5.93	7.5	17	4.8 J	4.2	N	5.4	4.7	5.6	5	4	4.6	2.7
Barium	100.0%	1010	101.81	300	4	91.4 J	54.5	N	380	78.3	101	86.1	56.7	64	55.8
Beryllium	96.5%	1.4	0.99	1	34	0.99	0.73 J	N	1.2	0.77 J	0.88	0.69 U	0.71 J	0.69 J	0.87 J
Cadmium	69.9%	43.1	1.76	1.8	92	1.9	3.2 J	N	4.7 J	3.2 J	4.2 J	3.4 J	2.9 J	2.7	3.7 J
Calcium	100.0%	172000	46825	46825	42	9480	53100	N	11400	61400	26700	49200	87500	93800	29700
Chromium	100.0%	62	26.57	26.6	81	24.2 J	21	N	30.9	22.7	27.7	22.1	19	18.9	28.2
Cobalt	100.0%	25.1	15.27	30	0	11.1	12.2	N	16.8	10.8	16.3	6.2 J	10.3	8.4 J	14.1
Copper	100.0%	836	24.07	25	92	26.9	23	N	55	25.9	23.4	43	22.3	21.1	15.6
Iron	100.0%	642000	32698	32698	77	32300	30900	N	37000	29500	36000	27000	24900	24600	37800
Lead	100.0%	2890	14.02	30	50	40.2	6.4 J	N	65.6	15.8	11.6 J	141	11.9 J	9.3	5.4 J
Magnesium	100.0%	24900	9071	9071.1	30	5570	8410	N	5740	9940	7670	10300	8500	8280	7770
Manganese	100.0%	2740	1065.8	1065.8	17	1090	586	N	2740	572	470	330	520	557	483
Mercury	61.7%	1.2	0.07	0.1	31	0.06 J	0.04 J	N	0.09 J	0.04 U	0.04 J	0.07 J	0.04 U	0.04 U	0.04 U
Nickel	100.0%	2520	41.31	41.3	62	35.5	34	N	37.2	36.4	44	20.9	29.3	29	41
Potassium	100.0%	19000	1530	4000	1	2150	1330	N	2420	2030	1790	1730	1480	1640	1770
Selenium	30.1%	2.1	0.35	2	1	0.16 U J	1 U J	N	0.4 U J	1.5 U J	0.31 U J	0.33 U J	1.4 U J	1.5 U J	1.6 U J
Silver	14.7%	10.5	0.59	200	0	1.6 J	5.4 J	N	1.9 U J	1.6 U J	1.3 U J	1.6 U J	1.6 U J	1.4 U J	1.6 U J
Sodium	65.1%	1010	76.4	3000	0	77.9 U		N							
Vanadium	100.0%	36.8	25.49	150	0	26.4	19	N	31.8	21.6	21.6	22.7	18.1	18.1	21.8
Zinc	99.4%	55700	89.14	89.1	108	110 J	95.3	N	461	164	118	357	85.7	87.1	99
Cyanide	3.7%	2.2	0.35	NA	0	0.71 U	0.64 U	N	0.68 U	0.61 U	0.61 U	0.67 U	0.63 U	0.58 U	0.6 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-14 4-6 11/08/91 S1108-48RE(4)	B-15 0-2 11/08/91 S1108-49	B-15 2-4 11/08/91 S1108-50	B-15 2-4 11/08/91 S1108-50RE(4)	B-15 2-4 11/08/91 S1108-51 (1)	B-15 2-4 11/08/91 S1108-51DL(5)	B-15 6-8 11/08/91 S1108-52	B-16 0-2 11/12/91 S1112-53	B-16 2-4 11/12/91 S1112-54	B-16 6-8 11/12/91 S1112-55
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	–	200	5	10 U J	38 U	2200 U J	N	29000 U J	N	1400 U J	12 U	11 U	10 U
Chloroethane	0.5%	3	–	1900	0	10 U J	38 U	2200 U J	N	29000 U J	N	1400 U J	12 U	11 U	10 U
Acetone	8.0%	680	–	200	1	10 U J	38 U	2200 U J	N	8400 U J	N	1400 U J	12 U	15 U	27 U
Carbon Disulfide	1.1%	120	–	2700	0	5 U J	19 U	1100 U J	N	14000 U J	N	680 U J	6 U	6 U	5 U
1,1-Dichloroethene	5.9%	140	–	400	0	5 U J	19 U	1100 U J	N	14000 U J	N	680 U J	6 U	6 U	5 U
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	3 J	29000	40000 J	N	79000 J	N	11000 J	6 U	6 U	5 U
Chloroform	7.0%	32	–	300	0	5 U J	18 J	1100 U J	N	14000 U J	N	680 U J	6 U	2 J	5 U
1,2-Dichloroethane	1.1%	210	–	100	2	5 U J	19 U	1100 U J	N	14000 U J	N	680 U J	6 U	6 U	5 U
2-Butanone	6.4%	22	–	300	0	10 U J	38 U	2200 U J	N	29000 U J	N	1400 U J	12 U	11 U	10 U
1,1,1-Trichloroethane	0.5%	3	–	800	0	5 U J	19 U	1100 U J	N	14000 U J	N	680 U J	6 U	6 U	5 U
Trichloroethene	54.0%	540000	–	700	16	5 J	110000	470000 J	N		5E+05 J	38000 J	6 U	6 U	7
Benzene	2.1%	6	–	60	0	5 U J	19 U	1100 U J	N	14000 U J	N	680 U J	6 U	6 U	5 U
Tetrachloroethene	2.1%	7	–	1400	0	5 U J	7 J	1100 U J	N	14000 U J	N	680 U J	6 U	6 U	5 U
Toluene	25.1%	5700	–	1500	2	2 J	4 J	3700 J	N	5700 J	N	850 J	6 U	6 U	6
Chlorobenzene	1.1%	620	–	1700	0	5 U J	19 U	1100 U J	N	14000 U J	N	680 U J	6 U	6 U	5 U
Ethylbenzene	7.0%	2000	–	5500	0	5 U J	19 U	2000 J	N	2800 U J	N	800 J	6 U	6 U	5 U
Xylene (total)	12.3%	17000	–	1200	5	5 U J	19 U	14000 J	N	17000 J	N	4900 J	6 U	6 U	28
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	–	30	2	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
2-Nitrophenol	0.5%	1300	–	330	1	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
Benzoic acid	4.0%	1500	–	2700	0	N	3400 U	7700 U J	7700 U J	9500 U J	9500 U J	4600 U J	3900 U	3600 U	3400 U
Naphthalene	19.7%	2500	–	13000	0	N	700 U	1900 J	2000 J	2500 J	2400 J	1200 J	800 U	730 U	710 U
2-Methylnaphthalene	18.7%	3600	–	36400	0	N	700 U	2000 J	2000 J	2700 J	2600 J	950 U J	800 U	730 U	710 U
Acenaphthylene	8.3%	510	–	41000	0	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	510 J	730 U	710 U
Acenaphthene	16.1%	14000	–	50000*	0	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
4-Nitrophenol	1.0%	1600	–	100	1	N	3400 U	7700 U J	7700 U J	9500 U J	9500 U J	4600 U J	3900 U	3600 U	3400 U
Dibenzofuran	11.9%	7000	–	6200	1	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
Fluorene	17.6%	12000	–	50000*	0	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
Phenanthrene	42.0%	43000	–	50000*	0	N	700 U	300 J	290 J	420 J	400 J	170 J	170 J	730 U	710 U
Anthracene	23.8%	15000	–	50000*	0	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
Di-n-butylphthalate	27.5%	25000	–	8100	1	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
Fluoranthene	44.0%	29000	–	50000*	0	N	96 J	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800	730 U	710 U
Pyrene	46.1%	24000	–	50000*	0	N	100 J	180 J	160 J	230 J	2000 U J	150 J	1800	730 U	710 U
Butylbenzylphthalate	3.1%	300	–	50000*	0	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
Benzo(a)anthracene	36.3%	9600	–	220	32	N	97 J	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	1300	730 U	710 U
Chrysene	38.3%	9900	–	400	26	N	120 J	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	1800	730 U	710 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	N	460 J	450 J	360 J	940 J	790 J	110 J	800 U	730 U	700 J
Di-n-octylphthalate	3.6%	430	–	50000*	0	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	800 U	730 U	710 U
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	N	140 J	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	740 J	730 U	710 U
benzo(k)fluoranthene	34.2%	6700	–	1100	9	N	140 J	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	870	730 U	710 U
Benzo(a)pyrene	33.2%	9000	–	61	52	N	150 J	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	1500	730 U	710 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	N	180 J	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	660 J	730 U	710 U
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	N	700 U	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	330 J	730 U	710 U
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	N	190 J	1600 U J	1600 U J	2000 U J	2000 U J	950 U J	880	730 U	710 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B-14 4-6 11/08/91 S1108-48RE(4)	B-15 0-2 11/08/91 S1108-49	B-15 2-4 11/08/91 S1108-50	B-15 2-4 11/08/91 S1108-50RE(4)	B-15 2-4 11/08/91 S1108-51 (1)	B-15 2-4 11/08/91 S1108-51DL(5)	B-15 6-8 11/08/91 S1108-52	B-16 0-2 11/12/91 S1112-53	B-16 2-4 11/12/91 S1112-54	B-16 6-8 11/12/91 S1112-55
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	-	100	0	N	17 U	19 U	N	19 U	N	17 U J	19 U	18 U	17 U
Dieldrin	0.6%	46	-	44	1	N	34 U	39 U	N	38 U	N	35 U J	39 U	36 U	34 U
4,4'-DDE	28.9%	290	-	2100	0	N	250	39 U	N	38 U	N	69 J	21 J	36 U	34 U
4,4'-DDD	16.7%	350	-	2900	0	N	34 U	39 U	N	38 U	N	35 U J	39 U	36 U	34 U
4,4'-DDT	19.4%	260	-	2100	0	N	34 U	39 U	N	38 U	N	35 U J	39 U	36 U	34 U
Aroclor-1242	3.5%	260	-	1000[F]	0	N	170 U	190 U	N	190 U	N	170 U J	190 U	180 U	170 U
Aroclor-1260	11.7%	770	-	1000[F]	0	N	330 J	370 J	N	430	N	230 J	390 U	360 U	340 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	-	-	NA	N	53 U J	60 U J	N	59 U J	N	54 U J	59 U J	55 U J	54 U J
2,4,5-TP (Silvex)	0.6%	10	-	700	0	N	5 U J	6 U J	N	6 U J	N	5 U J	6 U J	6 U J	5 U J
MCPP	3.0%	24000	-	-	NA	N	5300 U J	6000 U J	N	5900 U J	N	5400 U J	5900 U J	5500 U J	5400 U J
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	N	16100	13900	N	18100	N	16600	12700	19800	19300
Antimony	8.6%	78.3	5.16	5.2	13	N	11 U J	10.6 J	N	12.1 U J	N	9.3 U J	8.5 U J	10.9 U J	8.4 U J
Arsenic	99.4%	66.3	5.93	7.5	17	N	4.1	5.5 U	N	5	N	3.4	5.1	4.4	3.8
Barium	100.0%	1010	101.81	300	4	N	121	75.7	N	109	N	49.9	91.1	101	64.8
Beryllium	96.5%	1.4	0.99	1	34	N	0.89 J	0.78 J	N	1 J	N	0.81 J	0.78 J	1	0.96
Cadmium	69.9%	43.1	1.76	1.8	92	N	3.4 J	3.2 J	N	3.4 J	N	3.7 J	1.8	3.2 J	2.9 J
Calcium	100.0%	172000	46825	46825	42	N	30900	50000 J	N	10500 J	N	12400	26100	27800	43000
Chromium	100.0%	62	26.57	26.6	81	N	30.5	22	N	26.5	N	26.7	15.9	26.6	27.4
Cobalt	100.0%	25.1	15.27	30	0	N	14	10.1	N	13.7	N	12.6	5.8 J	12.8	13.3
Copper	100.0%	836	24.07	25	92	N	38.6	25.4	N	28.9	N	16.9	23.4	23.9	19.1
Iron	100.0%	642000	32698	32698	77	N	35300	27700	N	32800	N	31000	16500	32000	31800
Lead	100.0%	2890	14.02	30	50	N	40.7	27	N	33.1	N	9.8 J	39.8	9.5 J	5.3 J
Magnesium	100.0%	24900	9071	9071.1	30	N	8190	6190	N	5840	N	8290	10200	8730	11000
Manganese	100.0%	2740	1065.8	1065.8	17	N	476	653	N	600	N	467	582	634	574
Mercury	61.7%	1.2	0.07	0.1	31	N	0.06 J	0.05 J	N	0.06 J	N	0.04 U	0.07 J	0.05 J	0.04 U
Nickel	100.0%	2520	41.31	41.3	62	N	53	37	N	35.6	N	41.8	17.5	35.3	38.6
Potassium	100.0%	19000	1530	4000	1	N	1910	1280	N	2200	N	1310	1960	2970	2540
Selenium	30.1%	2.1	0.35	2	1	N	0.31 U J	1.4 U J	N	1.5 U J	N	1.6 U J	0.39 U J	0.24 U J	0.35 U J
Silver	14.7%	10.5	0.59	200	0	N	1.7 U J	1.6 U J	N	1.8 U J	N	1.4 U J	1.3 U J	1.6 U J	1.3 U J
Sodium	65.1%	1010	76.4	3000	0	N		81.1 U	N	92.4 U	N	71.4 U	64.9 U	83.6 U	139 J
Vanadium	100.0%	36.8	25.49	150	0	N	23.3	21	N	28.6	N	21	23.8	31	26.4
Zinc	99.4%	55700	89.14	89.1	108	N	117	123	N	106	N	94.4	58.1	83.3	94.6
Cyanide	3.7%	2.2	0.35	NA	0	N	0.47 U	0.59 U	N	0.68 U	N	0.59 U	0.65 U	0.6 U	0.66 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B-17 0-2 11/13/91 S1113-56	B-17 0-2 11/13/91 S1113-56RE(4)	B-17 2-4 11/13/91 S1113-57	B-17 4-6 11/13/91 S1113-58	B-17 6-8 11/13/91 S1113-59 (2)	B-18 0-2 11/13/91 S1113-60	B-18 2-4 11/13/91 S1113-61	B-18 4-6 11/13/91 S1113-62	B-19 0-2 11/13/91 S1113-63	B-19 2-4 11/13/91 S1113-64
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	–	200	5	11 U J	11 U J	12 U J	12 U	33 U	12 U	11 U	11 U	12 U	12 U
Chloroethane	0.5%	3	–	1900	0	11 U J	11 U J	12 U J	12 U	33 U	12 U	11 U	11 U	12 U	12 U
Acetone	8.0%	680	–	200	1	11 U J	16 U J	12 U J	15 U	16 U	12 U	11 U	11 U	12 U	12 U
Carbon Disulfide	1.1%	120	–	2700	0	5 U J	5 U J	6 U J	6 U	17 U	6 U	5 U	5 U	6 U	6 U
1,1-Dichloroethene	5.9%	140	–	400	0	5 U J	5 U J	6 U J	6 U	17 U	6 U	5 U	5 U	6 U	6 U
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	5 U J	5 U J	14 J	4 J	190	6 U	4 J	5 U	6 U	6 U
Chloroform	7.0%	32	–	300	0	5 U J	5 U J	6 U J	6 U	17 U	6 U	4 J	6	6 U	1 J
1,2-Dichloroethane	1.1%	210	–	100	2	5 U J	5 U J	6 U J	6 U	21	6 U	5 U	5 U	6 U	6 U
2-Butanone	6.4%	22	–	300	0	11 U J	11 U J	12 U J	12 U	33 U	12 U	11 U	11 U	12 U	10 J
1,1,1-Trichloroethane	0.5%	3	–	800	0	5 U J	5 U J	6 U J	6 U	17 U	6 U	3 J	5 U	6 U	6 U
Trichloroethene	54.0%	540000	–	700	16	9 J	9 J	210 J	47	540 J	6 U	5 U	5 U	6 U	1 J
Benzene	2.1%	6	–	60	0	5 U J	5 U J	6 U J	6 U	17 U	6 U	5 U	5 U	6 U	2 J
Tetrachloroethene	2.1%	7	–	1400	0	5 U J	5 U J	6 U J	6 U	17 U	6 U	6	5 U	6 U	6 U
Toluene	25.1%	5700	–	1500	2	5 U J	1 J	5 J	6 U	17 U	6 U	5 U	5 U	6 U	15
Chlorobenzene	1.1%	620	–	1700	0	5 U J	5 U J	6 U J	6 U	17 U	6 U	5 U	5 U	6 U	6 U
Ethylbenzene	7.0%	2000	–	5500	0	5 U J	5 U J	6 U J	6 U	17 U	6 U	5 U	5 U	6 U	4 J
Xylene (total)	12.3%	17000	–	1200	5	5 U J	5 U J	6 U J	6 U	17 U	6 U	5 U	5 U	6 U	18
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	–	30	2	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	9 J
2-Nitrophenol	0.5%	1300	–	330	1	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Benzoic acid	4.0%	1500	–	2700	0	3600 U	N	3900 U	3700 U	3300 U	3600 U	3600 U	3400 U	3800 U	3500 U
Naphthalene	19.7%	2500	–	13000	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
2-Methylnaphthalene	18.7%	3600	–	36400	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	88 J
Acenaphthylene	8.3%	510	–	41000	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Acenaphthene	16.1%	14000	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	6 J
4-Nitrophenol	1.0%	1600	–	100	1	3600 U	N	3900 U	3700 U	3300 U	3600 U	3600 U	3400 U	3800 U	3500 U
Dibenzofuran	11.9%	7000	–	6200	1	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Fluorene	17.6%	12000	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Phenanthrene	42.0%	43000	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Anthracene	23.8%	15000	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Di-n-butylphthalate	27.5%	25000	–	8100	1	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Fluoranthene	44.0%	29000	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Pyrene	46.1%	24000	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Butylbenzylphthalate	3.1%	300	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Benzo(a)anthracene	36.3%	9600	–	220	32	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Chrysene	38.3%	9900	–	400	26	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	740 U	N	790 U	770 U	680 U	740 U	400 J	110 J	780 U	730 U
Di-n-octylphthalate	3.6%	430	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
benzo(k)fluoranthene	34.2%	6700	–	1100	9	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Benzo(a)pyrene	33.2%	9000	–	61	52	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	740 U	N	790 U	770 U	680 U	740 U	740 U	700 U	780 U	730 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-17 0-2 11/13/91 S1113-56	B-17 0-2 11/13/91 S1113-56RE(4)	B-17 2-4 11/13/91 S1113-57	B-17 4-6 11/13/91 S1113-58	B-17 6-8 11/13/91 S1113-59 (2)	B-18 0-2 11/13/91 S1113-60	B-18 2-4 11/13/91 S1113-61	B-18 4-6 11/13/91 S1113-62	B-19 0-2 11/13/91 S1113-63	B-19 2-4 11/13/91 S1113-64
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	-	100	0	18 U	N	19 U	19 U	17 U	18 U	18 U	17 U	19 U	18 U
Dieldrin	0.6%	46	-	44	1	36 U	N	39 U	37 U	33 U	36 U	36 U	34 U	38 U	35 U
4,4'-DDE	28.9%	290	-	2100	0	39	N	39 U	37 U	33 U	36 U	36 U	34 U	38 U	35 U
4,4'-DDD	16.7%	350	-	2900	0	36 U	N	39 U	37 U	33 U	36 U	36 U	34 U	38 U	35 U
4,4'-DDT	19.4%	260	-	2100	0	36 U	N	39 U	37 U	33 U	36 U	36 U	34 U	38 U	35 U
Aroclor-1242	3.5%	260	-	1000[P]	0	180 U	N	190 U	190 U	170 U	180 U	180 U	170 U	190 U	180 U
Aroclor-1260	11.7%	770	-	1000[P]	0	360 U	N	390 U	370 U	330 U	360 U	360 U	340 U	380 U	350 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	-	-	NA	56 U J	N	60 U J	60 U J	53 U J	56 U J	57 U J	53 U J	60 U J	56 U J
2,4,5-TP (Silvex)	0.6%	10	-	700	0	6 U J	N	6 U J	6 U J	5 U J	6 U J	6 U J	5 U J	6 U J	6 U J
MCPP	3.0%	24000	-	-	NA	5600 U J	N	6000 U J	6000 U J	5300 U J	5600 U J	5700 U J	5300 U J	6000 U J	5600 U J
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	10900	N	18700	16800	15100	22600	21100	22300	16600	21600
Antimony	8.6%	78.3	5.16	5.2	13	12.3 J	N	10.3 U J	6.6 U J	10.6 U J	8 U J	8.6 U J	8.7 J	10.6 U J	11 U J
Arsenic	99.4%	66.3	5.93	7.5	17	7	N	5.5	4.6	4.6	5.1	5.6	6.5	5.9	4.8
Barium	100.0%	1010	101.81	300	4	82.5	N	157	73.5	40.1	85.8	59.9	59.7	89.9	81.7
Beryllium	96.5%	1.4	0.99	1	34	0.74 U	N	1.1	0.88	0.81 J	1.1	0.95	1	1	1.1
Cadmium	69.9%	43.1	1.76	1.8	92	8.2 J	N	3.7 J	2.9 J	3	4	4.1	4.2	3.7	4
Calcium	100.0%	172000	46825	46825	42	74700	N	20500	13200	58100	6180	3100	30000	3440	9750
Chromium	100.0%	62	26.57	26.6	81	28.1	N	31.6	26.5	22.4	30.4	30.5	31.9	26	34.8
Cobalt	100.0%	25.1	15.27	30	0	11.2	N	13.1	10.6	11.3	16	15.7	16.3	11	16.9
Copper	100.0%	836	24.07	25	92	52.1	N	48.7	20.2	12.9	24.6 J	15.8 J	18.4 J	22.5 J	18.3 J
Iron	100.0%	642000	32698	32698	77	86400	N	34600	30200	26700	34500	36700	37800	33300	40300
Lead	100.0%	2890	14.02	30	50	40.1	N	106	12.8	5.2 J	8.9 J	4.6 J	4.9 J	13.7 J	7.4 J
Magnesium	100.0%	24900	9071	9071.1	30	24900	N	9340	8270	6750	6440	7790	8260	5460	8050
Manganese	100.0%	2740	1065.8	1065.8	17	602	N	1090	400	677	666	522	615	517	918
Mercury	61.7%	1.2	0.07	0.1	31	0.06 J	N	0.11	0.05 U	0.04 U	0.06 J	0.04 U	0.04 U	0.05 J	0.04 U
Nickel	100.0%	2520	41.31	41.3	62	39.7	N	37.2	39.2	33.7	41.8	46.5	46.5	37.3	53.2
Potassium	100.0%	19000	1530	4000	1	1610	N	2750	1610	1630	2870	1850	2450	1240	2110
Selenium	30.1%	2.1	0.35	2	1	0.32 U J	N	0.34 U J	0.26 U J	0.31 U J	0.29 U J	0.32 U J	0.27 U J	0.29 U J	0.36 U J
Silver	14.7%	10.5	0.59	200	0	1.7 U J	N	1.5 U J	0.99 U J	1.6 U	1.2 U	1.3 U	1.2 U	1.6 U	1.6 U
Sodium	65.1%	1010	76.4	3000	0	99.3 J	N	78.9 U	50.7 U	242 J	105 J	99.9 J	176 J	85.7 J	122 J
Vanadium	100.0%	36.8	25.49	150	0	23.5	N	30.8	24.3	19.8	29	24.5	27	25	27.2
Zinc	99.4%	55700	89.14	89.1	108	244	N	1710	253	67.2	113	98.6	102	90.7	86.1
Cyanide	3.7%	2.2	0.35	NA	0	0.65 U	N	0.64 U	0.59 U	0.52 U	0.66 U	0.65 U	0.64 U	0.66 U	0.64 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-19 4-6 11/13/91 S1113-65	B-20 0-2 11/14/91 S1114-66	B-20 2-4 11/14/91 S1114-67	B-20 4-6 11/14/91 S1114-68	B-21 0-2 11/14/91 S1114-69	B-21 2-4 11/14/91 S1114-70	B-21 2-4 11/14/91 S1114-71(1)	B-21 4-6 11/14/91 S1114-72	B-22 0-2 12/02/91 S1202-73 (3)	B-22 2-4 12/02/91 S1202-74 (4)
<u>VOCs (µg/kg)</u>															
Vinyl Chloride	6.4%	1000	-	200	5	11 U	12 U	11 U	11 U	12 U	12 U	11 U	11 U	12 U	10 U
Chloroethane	0.5%	3	-	1900	0	11 U	12 U	11 U	11 U	12 U	12 U	11 U	11 U	12 U	10 U
Acetone	8.0%	680	-	200	1	11 U	12 U	11 U	11 U	31 U	12 U	11 U	11 U	12 U	11 U
Carbon Disulfide	1.1%	120	-	2700	0	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
1,1-Dichloroethene	5.9%	140	-	400	0	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
1,2-Dichloroethene (total)	38.5%	79000	-	300	27	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
Chloroform	7.0%	32	-	300	0	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
1,2-Dichloroethane	1.1%	210	-	100	2	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
2-Butanone	6.4%	22	-	300	0	11 U	12 U	11 U	11 U	12 U	12 U	11 U	11 U	12 U	10 U
1,1,1-Trichloroethane	0.5%	3	-	800	0	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
Trichloroethene	54.0%	540000	-	700	16	5 U	6 U	2 J	5 U	6 U	6 U	6 U	5 U	6 U	5 U
Benzene	2.1%	6	-	60	0	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
Tetrachloroethene	2.1%	7	-	1400	0	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
Toluene	25.1%	5700	-	1500	2	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
Chlorobenzene	1.1%	620	-	1700	0	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
Ethylbenzene	7.0%	2000	-	5500	0	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
Xylene (total)	12.3%	17000	-	1200	5	5 U	6 U	6 U	5 U	6 U	6 U	6 U	5 U	6 U	5 U
<u>Semivolatiles (µg/kg)</u>															
Phenol	1.0%	14000	-	30	2	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
bis(2-Chloroethyl) ether	0.5%	9	-	-	NA	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
2-Nitrophenol	0.5%	1300	-	330	1	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
Benzoic acid	4.0%	1500	-	2700	0	3700 U	3800 U	3600 U	3600 U	3800 U	3700 U	3600 U	N	3900 U	3500 U
Naphthalene	19.7%	2500	-	13000	0	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
2-Methylnaphthalene	18.7%	3600	-	36400	0	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
Acenaphthylene	8.3%	510	-	41000	0	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
Acenaphthene	16.1%	14000	-	50000*	0	760 U	780 U	750 U	740 U	220 J	770 U	740 U	N	800 U	710 U
4-Nitrophenol	1.0%	1600	-	100	1	3700 U	3800 U	3600 U	3600 U	3800 U	3700 U	3600 U	N	3900 U	3500 U
Dibenzofuran	11.9%	7000	-	6200	1	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
2,4-Dinitrotoluene	1.0%	2000	-	50000*	0	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
Fluorene	17.6%	12000	-	50000*	0	760 U	780 U	750 U	740 U	160 J	770 U	740 U	N	800 U	710 U
N-Nitrosodiphenylamine	0.5%	450	-	50000*	0	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
Phenanthrene	42.0%	43000	-	50000*	0	760 U	290 J	750 U	740 U	1700	770 U	740 U	N	800 U	710 U
Anthracene	23.8%	15000	-	50000*	0	760 U	84 J	750 U	740 U	460 J	770 U	740 U	N	800 U	710 U
Di-n-butylphthalate	27.5%	25000	-	8100	1	760 U	88 J	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
Fluoranthene	44.0%	29000	-	50000*	0	760 U	270 J	750 U	740 U	2000	770 U	740 U	N	800 U	710 U
Pyrene	46.1%	24000	-	50000*	0	760 U	300 J	750 U	740 U	2100	770 U	740 U	N	800 U	710 U
Butylbenzylphthalate	3.1%	300	-	50000*	0	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
Benzo(a)anthracene	36.3%	9600	-	220	32	760 U	150 J	750 U	740 U	830	770 U	740 U	N	800 U	710 U
Chrysene	38.3%	9900	-	400	26	760 U	160 J	750 U	740 U	880	770 U	740 U	N	800 U	710 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	-	50000*	1	88 J	780 U	750 U	740 U	630 J	770 U	740 U	N	800 U	710 U
Di-n-octylphthalate	3.6%	430	-	50000*	0	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
Benzo(b)fluoranthene	34.2%	9500	-	1100	11	760 U	93 J	750 U	740 U	670 J	770 U	740 U	N	800 U	710 U
benzo(k)fluoranthene	34.2%	6700	-	1100	9	760 U	160 J	750 U	740 U	700 J	770 U	740 U	N	800 U	710 U
Benzo(a)pyrene	33.2%	9000	-	61	52	760 U	120 J	750 U	740 U	760 J	770 U	740 U	N	800 U	710 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	-	3200	2	760 U	780 U	750 U	740 U	350 J	770 U	740 U	N	800 U	710 U
Dibenz(a,h)anthracene	13.5%	2100	-	14	26	760 U	780 U	750 U	740 U	780 U	770 U	740 U	N	800 U	710 U
Benzo(g,h,i)perylene	24.9%	5000	-	50000*	0	760 U	780 U	750 U	740 U	370 J	770 U	740 U	N	800 U	710 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-19 4-6 11/13/91 S1113-65	B-20 0-2 11/14/91 S1114-66	B-20 2-4 11/14/91 S1114-67	B-20 4-6 11/14/91 S1114-68	B-21 0-2 11/14/91 S1114-69	B-21 2-4 11/14/91 S1114-70	B-21 2-4 11/14/91 S1114-71(1)	B-21 4-6 11/14/91 S1114-72	B-22 0-2 12/02/91 S1202-73 (3)	B-22 2-4 12/02/91 S1202-74 (4)
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	–	100	0	18 U	19 U	18 U	18 U	19 U	19 U	18 U	N	19 U	17 U
Dieldrin	0.6%	46	–	44	1	37 U	38 U	36 U	36 U	38 U	37 U	36 U	N	38 U	35 U
4,4'-DDE	28.9%	290	–	2100	0	37 U	26 J	140 J	18 J	38 U	37 U	36 U	140 J	38 U	35 U
4,4'-DDD	16.7%	350	–	2900	0	37 U	38 U	36 U	36 U	38 U	37 U	36 U	N	38 U	35 U
4,4'-DDT	19.4%	260	–	2100	0	37 U	38 U	29 J	36 U	38 U	37 U	36 U	N	38 U	35 U
Aroclor-1242	3.5%	260	–	1000[2]	0	180 U	190 U	180 U	180 U	190 U	190 U	180 U	N	190 U	170 U
Aroclor-1260	11.7%	770	–	1000[2]	0	370 U	380 U	360 U	360 U	380 U	370 U	360 U	N	380 U	350 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	–	–	NA	59 U J	60 U J	57 U J	56 U J	58 U J	57 U J	57 U J	N	60 U J	54 U J
2,4,5-TP (Silvex)	0.6%	10	–	700	0	6 U J	6 U J	6 U J	6 U J	6 U J	6 U J	6 U J	N	6 U J	5 U J
MCPP	3.0%	24000	–	–	NA	5900 U J	6000 U J	5700 U J	5600 U J	5800 U J	5700 U J	5700 U J	N	6000 U J	5400 U J
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	19500	13200	20300	19900	19400	21300	21400	N	18400	16500
Antimony	8.6%	78.3	5.16	5.2	13	10.3 U J	10.6 U J	10.6 U J	7.5 U J	9.8 U J	7.6 U J	9 U J	N	9.2 U J	10.5 U J
Arsenic	99.4%	66.3	5.93	7.5	17	5.2	4.9	4.5	4	4.8	4.8	4.9	N	7.6 J	4.6 J
Barium	100.0%	1010	101.81	300	4	90.7	74.5	90.7	62.8	110	75.9	74.7	N	107	70
Beryllium	96.5%	1.4	0.99	1	34	1	0.8 J	1.1	1	0.99	1.1	1.1	N	1.1	0.9 J
Cadmium	69.9%	43.1	1.76	1.8	92	3.8	2.6	4	4	3.3	4.8	4.2	N	1.8	2.5
Calcium	100.0%	172000	46825	46825	42	18000	1E+05	32500	35500	38300	7850	9720	N	3270	10800
Chromium	100.0%	62	26.57	26.6	81	29.8	17.5	29.8	29.8	28	33.4	33.9	N	27.4	29.4
Cobalt	100.0%	25.1	15.27	30	0	16.5	6.9 J	15.5	14.3	13.9	17.8	19	N	11.5	16.2
Copper	100.0%	836	24.07	25	92	22.8 J	26.5 J	26.1 J	19.8 J	26 J	21.8 J	20.3 J	N	21.4	22.8
Iron	100.0%	642000	32698	32698	77	38300	19900	36800	35500	31600	41500	38900	N	32000	37300
Lead	100.0%	2890	14.02	30	50	8.6 J	18.4	26.3	6.2 J	15.7	8.2 J	7.6 J	N		
Magnesium	100.0%	24900	9071	9071.1	30	6890	24100	8010	7890	9500	7720	7540	N	5470	7570
Manganese	100.0%	2740	1065.8	1065.8	17	947	681	1080	920	1460	924	834	N	578	848
Mercury	61.7%	1.2	0.07	0.1	31	0.07 J	0.05 J	0.04 U	0.05 U	0.31	0.04 U	0.03 U	N	0.04 U	0.07 J
Nickel	100.0%	2520	41.31	41.3	62	45.7	20.1	43.6	43.5	41.1	52.2	51.3	N	34.5	46.8
Potassium	100.0%	19000	1530	4000	1	1860	2050	2310	2070	2300	1630	1940	N	1970	1470
Selenium	30.1%	2.1	0.35	2	1	0.29 U J	0.37 U J	0.23 U J	0.28 U J	0.32 U J	0.34 U J	0.32 U J	N	0.21 U J	0.19 U J
Silver	14.7%	10.5	0.59	200	0	1.5 U	1.6 U	1.6 U	1.1 U	1.5 U	1.1 U	1.3 U	N	1.5 J	1.7 U
Sodium	65.1%	1010	76.4	3000	0	126 J	150 J	115 J	162 J	133 J	101 J	111 J	N	53 U	63.2 J
Vanadium	100.0%	36.8	25.49	150	0	26.3	22.2	29.3	24.8	27.9	26.4	28.3	N	28.2	21
Zinc	99.4%	55700	89.14	89.1	108	88.9	130	273	104	335	92.2	84	N	76.4	74.5
Cyanide	3.7%	2.2	0.35	NA	0	0.68 U	0.67 U	0.63	0.63 U	0.58 U	0.67 U	0.68 U	N	0.72 U	0.65 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-22 4-6 12/02/91 S1202-75(3)	B-23 0-2 12/02/91 S1202-76	B-23 2-4 12/02/91 S1202-77	B-23 4-6 12/02/91 S1202-78	B-24 0-2 12/03/91 S1203-79(3)	B-24 2-4 12/03/91 S1203-80 (3)	B-24 4-6 12/03/91 S1203-81 (3)	B-25 0-2 12/03/91 S1203-82	B-25 2-4 12/03/91 S1203-83	B-25 4-6 12/03/91 S1203-84
<u>VOCs (µg/kg)</u>															
Vinyl Chloride	6.4%	1000	–	200	5	11 U	12 U	11 U	11 U	13 U	11 U	11 U	13 U	12 U	11 U
Chloroethane	0.5%	3	–	1900	0	11 U	12 U	11 U	11 U	13 U	11 U	11 U	13 U	12 U	11 U
Acetone	8.0%	680	–	200	1	11 U	12 U	13 U	12 U	13 U	11 U	11 U	13 U	12 U	11 U
Carbon Disulfide	1.1%	120	–	2700	0	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
1,1-Dichloroethene	5.9%	140	–	400	0	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
Chloroform	7.0%	32	–	300	0	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
1,2-Dichloroethane	1.1%	210	–	100	2	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
2-Butanone	6.4%	22	–	300	0	11 U	12 U	11 U	11 U	13 U	11 U	11 U	13 U	12 U	11 U
1,1,1-Trichloroethane	0.5%	3	–	800	0	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
Trichloroethene	54.0%	540000	–	700	16	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
Benzene	2.1%	6	–	60	0	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
Tetrachloroethene	2.1%	7	–	1400	0	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
Toluene	25.1%	5700	–	1500	2	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	1 J
Chlorobenzene	1.1%	620	–	1700	0	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
Ethylbenzene	7.0%	2000	–	5500	0	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
Xylene (total)	12.3%	17000	–	1200	5	5 U	6 U	5 U	6 U	6 U	5 U	5 U	6 U	6 U	5 U
<u>Semivolatiles (µg/kg)</u>															
Phenol	1.0%	14000	–	30	2	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
2-Nitrophenol	0.5%	1300	–	330	1	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Benzoic acid	4.0%	1500	–	2700	0	N	3800 U	3600 U	3600 U	4400 U	3500 U	3400 U	4300 U	3600 U	3400 U
Naphthalene	19.7%	2500	–	13000	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
2-Methylnaphthalene	18.7%	3600	–	36400	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Acenaphthylene	8.3%	510	–	41000	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Acenaphthene	16.1%	14000	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
4-Nitrophenol	1.0%	1600	–	100	1	N	3800 U	3600 U	3600 U	4400 U	3500 U	3400 U	4300 U	3600 U	3400 U
Dibenzofuran	11.9%	7000	–	6200	1	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Fluorene	17.6%	12000	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Phenanthrene	42.0%	43000	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Anthracene	23.8%	15000	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Di-n-butylphthalate	27.5%	25000	–	8100	1	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Fluoranthene	44.0%	29000	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Pyrene	46.1%	24000	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Butylbenzylphthalate	3.1%	300	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Benzo(a)anthracene	36.3%	9600	–	220	32	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Chrysene	38.3%	9900	–	400	26	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	510 J
Di-n-octylphthalate	3.6%	430	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
benzo(k)fluoranthene	34.2%	6700	–	1100	9	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Benzo(a)pyrene	33.2%	9000	–	61	52	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	N	790 U	740 U	730 U	900 U	720 U	700 U	880 U	730 U	710 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B-22 4-6 12/02/91 S1202-75(3)	B-23 0-2 12/02/91 S1202-76	B-23 2-4 12/02/91 S1202-77	B-23 4-6 12/02/91 S1202-78	B-24 0-2 12/03/91 S1203-79(3)	B-24 2-4 12/03/91 S1203-80 (3)	B-24 4-6 12/03/91 S1203-81 (3)	B-25 0-2 12/03/91 S1203-82	B-25 2-4 12/03/91 S1203-83	B-25 4-6 12/03/91 S1203-84
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	-	100	0	N	19 U	18 U	18 U	22 U	17 U	17 U	21 U	18 U	17 U
Dieldrin	0.6%	46	-	44	1	N	38 U	36 U	36 U	44 U	34 U	34 U	43 U	36 U	34 U
4,4'-DDE	28.9%	290	-	2100	0	N	38 U	36 U	36 U	44 U	34 U	34 U	43 U	36 U	34 U
4,4'-DDD	16.7%	350	-	2900	0	N	38 U	36 U	36 U	44 U	34 U	34 U	43 U	36 U	34 U
4,4'-DDT	19.4%	260	-	2100	0	N	38 U	36 U	36 U	44 U	34 U	34 U	43 U	36 U	34 U
Aroclor-1242	3.5%	260	-	1000[2]	0	N	190 U	180 U	180 U	220 U	170 U	170 U	210 U	180 U	170 U
Aroclor-1260	11.7%	770	-	1000[2]	0	N	380 U	360 U	360 U	440 U	340 U	340 U	430 U	360 U	340 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	-	-	NA	N	60 U J	56 U J	56 U J	68 U J	55 U J	53 U J	66 U J	55 U J	53 U J
2,4,5-TP (Silvex)	0.6%	10	-	700	0	N	6 U J	6 U J	6 U J	7 U J	5 U J	5 U J	7 U J	6 U J	5 U J
MCPP	3.0%	24000	-	-	NA	N	6000 U J	5600 U J	5600 U J	6800 U J	5500 U J	5300 U J	6600 U J	5500 U J	5300 U J
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	N	15700	18700	18100	21700	14200	17200	16300	16200	19800
Antimony	8.6%	78.3	5.16	5.2	13	N	10.2 U J	9.8 U J	10.5 U J	12.3 U J	9.2 U J	9.8 U J	12.4 U J	7.5 U J	11.7 U J
Arsenic	99.4%	66.3	5.93	7.5	17	N	3.6 J	5.5 J	5.2 J	6.1 J	5.2	3.1 J	5 J	6.2 J	3.5 J
Barium	100.0%	1010	101.81	300	4	N	96.2	69	67	166	59.8	67.6	104	68.6	54.9
Beryllium	96.5%	1.4	0.99	1	34	N	0.98	1.1	0.98	1.3	0.82 J	1	0.99 J	0.88	1.2
Cadmium	69.9%	43.1	1.76	1.8	92	N	2.1	2.4	2.6	2.7	2.1	2.2	2.3	2.3	2.7
Calcium	100.0%	172000	46825	46825	42	N	1980	6970	11400	5440	92200	33900	3970	16900	33200
Chromium	100.0%	62	26.57	26.6	81	N	22.6	31.1	31.7	29.6	24.2	29.3	25.6	28.5	34.5
Cobalt	100.0%	25.1	15.27	30	0	N	11.5	16.1	16.2	13.9	12	15.4	12.9	16	19.7
Copper	100.0%	836	24.07	25	92	N	18.4	22.7	21.3	32	19.5	22.5	25.8	26.3	17.5
Iron	100.0%	642000	32698	32698	77	N	27800	36000	39400	33500	30800	36100	31200	35600	41100
Lead	100.0%	2890	14.02	30	50	N									
Magnesium	100.0%	24900	9071	9071.1	30	N	4150	7830	8620	5710	8340	8170	5190	6950	9190
Manganese	100.0%	2740	1065.8	1065.8	17	N	632	577	733	1420	622	920	653	700	1030
Mercury	61.7%	1.2	0.07	0.1	31	N	0.04 U	0.07 J	0.07 J	0.1 J	0.04 U	0.04 J	0.08 J	0.04 U	0.04 U
Nickel	100.0%	2520	41.31	41.3	62	N	20.9	43.8	48.1	38.5	38.1	43.8	31.4	45.6	54.6
Potassium	100.0%	19000	1530	4000	1	N	1530	1920	1580	2790	1580	2190	2130	1550	1860
Selenium	30.1%	2.1	0.35	2	1	N	0.19 U J	0.15 U J	0.16 U J	0.27 U J	0.21 U J	0.18 U J	0.18 U J	0.15 U J	0.18 U J
Silver	14.7%	10.5	0.59	200	0	N	1.7 U	1.6 U	1.7 U	2 U	1.5 U	1.6 U	2 U	1.2 U	1.9 U
Sodium	65.1%	1010	76.4	3000	0	N	59.3 U	56.9 U	60.7 U	71.1 U	104 J	106 J	72 U	55.4 J	106 J
Vanadium	100.0%	36.8	25.49	150	0	N	27.4	25.4	27.2	33.8	22	24.5	28.8	23.3	26.5
Zinc	99.4%	55700	89.14	89.1	108	N	56	79.6	102	107	69.8	88.6	93.2	99	66.9
Cyanide	3.7%	2.2	0.35	NA	0	N	0.7 U	0.67 U	0.65 U	0.79 U	0.63 U	0.59 U	0.78 U	0.6 U	0.62 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-27 0-2 12/04/91 S1204-86(2,3)	B-27 2-4 12/04/91 S1204-87 (3)	B-28 0-2 12/04/91 S1204-88 (3)	B-28 2-4 12/04/91 S1204-89	B-28 2-4 12/04/91 S1204-89A(1)	B-28 2-4 12/04/91 S1204-89DL(5)	B-28 4-6 12/04/91 S1204-90(3)	B-28 4-6 12/04/91 S1204-90RE(4)	B-29 0-2 12/04/91 S1204-91	B-29 0-2 12/04/91 S1204-91A(1)
<u>VOCs (µg/kg)</u>															
Vinyl Chloride	6.4%	1000	–	200	5	12 U	12 U	12 U	39 U	56 U	59 U	1400 U	N	12 U	12 U
Chloroethane	0.5%	3	–	1900	0	12 U	12 U	12 U	39 U	56 U	59 U	1400 U	N	12 U	12 U
Acetone	8.0%	680	–	200	1	12 U	12 U	12 U	39 U	56 J	59 U	1400 U	N	12 U	12 U
Carbon Disulfide	1.1%	120	–	2700	0	6 U	6 U	6 U	20 U	28 U	29 U	690 U	N	6 U	6 U
1,1-Dichloroethene	5.9%	140	–	400	0	6 U	6 U	6 U	20 U	28 U	29 U	690 U	N	6 U	6 U
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	100	250	160	2500 J	1600	440	20000	N	76	66
Chloroform	7.0%	32	–	300	0	6 U	6 U	6 U	20 U	28 U	32	690 U	N	6 U	6 U
1,2-Dichloroethane	1.1%	210	–	100	2	6 U	6 U	6 U	20 U	28 U	29 U	690 U	N	6 U	6 U
2-Butanone	6.4%	22	–	300	0	12 U	12 U	12 U	39 U	56 U	59 U	1400 U	N	12 U	12 U
1,1,1-Trichloroethane	0.5%	3	–	800	0	6 U	6 U	6 U	20 U	28 U	29 U	690 U	N	6 U	6 U
Trichloroethene	54.0%	540000	–	700	16	10	13	18	83	74	31	2600	N	49	58
Benzene	2.1%	6	–	60	0	6 U	6 U	6 U	20 U	28 U	29 U	690 U	N	6 U	6 U
Tetrachloroethene	2.1%	7	–	1400	0	4 J	6 U	6 U	20 U	28 U	29 U	690 U	N	6 U	6 U
Toluene	25.1%	5700	–	1500	2	6 U	6 U	6 U	20 U	28 U	29 U	690 U	N	6 U	6 U
Chlorobenzene	1.1%	620	–	1700	0	6 U	6 U	6 U	20 U	28 U	29 U	690 U	N	6 U	6 U
Ethylbenzene	7.0%	2000	–	5500	0	6 U	6 U	6 U	20 U	28 U	29 U	690 U	N	6 U	6 U
Xylene (total)	12.3%	17000	–	1200	5	6 U	6 U	6 U	20 U	28 U	29 U	690 U	N	6 U	6 U
<u>Semivolatiles (µg/kg)</u>															
Phenol	1.0%	14000	–	30	2	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
2-Nitrophenol	0.5%	1300	–	330	1	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Benzoic acid	4.0%	1500	–	2700	0	4100 U	3800 U	3500 U	3700 U	3700 U	N	3500 U	N	3800 U	3800 U
Naphthalene	19.7%	2500	–	13000	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
2-Methylnaphthalene	18.7%	3600	–	36400	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Acenaphthylene	8.3%	510	–	41000	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Acenaphthene	16.1%	14000	–	50000*	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
4-Nitrophenol	1.0%	1600	–	100	1	4100 U	3800 U	3500 U	3700 U	3700 U	N	3500 U	N	3800 U	3800 U
Dibenzofuran	11.9%	7000	–	6200	1	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Fluorene	17.6%	12000	–	50000*	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Phenanthrene	42.0%	43000	–	50000*	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Anthracene	23.8%	15000	–	50000*	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Di-n-butylphthalate	27.5%	25000	–	8100	1	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Fluoranthene	44.0%	29000	–	50000*	0	110 J	780 U	710 U	760 U	760 U	N	730 U	N	72 J	100 J
Pyrene	46.1%	24000	–	50000*	0	90 J	780 U	710 U	760 U	760 U	N	730 U	N	790 U	120 J
Butylbenzylphthalate	3.1%	300	–	50000*	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Benzo(a)anthracene	36.3%	9600	–	220	32	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	160 J
Chrysene	38.3%	9900	–	400	26	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	160 J
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Di-n-octylphthalate	3.6%	430	–	50000*	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	140 J
benzo(k)fluoranthene	34.2%	6700	–	1100	9	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	210 J
Benzo(a)pyrene	33.2%	9000	–	61	52	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	190 J
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	840 U	780 U	710 U	760 U	760 U	N	730 U	N	790 U	780 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-27 0-2 12/04/91 S1204-86(2,3)	B-27 2-4 12/04/91 S1204-87 (3)	B-28 0-2 12/04/91 S1204-88 (3)	B-28 2-4 12/04/91 S1204-89	B-28 2-4 12/04/91 S1204-89A(1)	B-28 2-4 12/04/91 S1204-89DL(5)	B-28 4-6 12/04/91 S1204-90(3)	B-28 4-6 12/04/91 S1204-90RE(4)	B-29 0-2 12/04/91 S1204-91	B-29 0-2 12/04/91 S1204-91A(1)
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	–	100	0	20 U	19 U	17 U	18 U	19 U	N	18 U	18 U J	19 U	19 U
Dieldrin	0.6%	46	–	44	1	41 U	38 U	35 U	37 U	37 U	N	35 U	35 U J	38 U	38 U
4,4'-DDE	28.9%	290	–	2100	0	41 U	38 U	35 U	37 U	37 U	N	35 U	35 U J	38 U	38 U
4,4'-DDD	16.7%	350	–	2900	0	41 U	38 U	35 U	37 U	37 U	N	35 U	35 U J	38 U	38 U
4,4'-DDT	19.4%	260	–	2100	0	41 U	38 U	35 U	37 U	37 U	N	35 U	35 U J	38 U	38 U
Aroclor-1242	3.5%	260	–	1000[P]	0	200 U	190 U	170 U	180 U	190 U	N	180 U	180 U J	190 U	190 U
Aroclor-1260	11.7%	770	–	1000[P]	0	410 U	380 U	350 U	370 U	370 U	N	390	230 J	380 U	380 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	–	–	NA	63 U J	59 U J	54 U J	58 U J	59 U	N	55 U	N	61 U	60 U
2,4,5-TP (Silvex)	0.6%	10	–	700	0	6 U J	6 U J	5 U J	6 U J	5.9 U	N	5.5 U	N	6.1 U	6 U
MCPP	3.0%	24000	–	–	NA	6300 U J	5900 U J	5400 U J	5800 U J	5900 U	N	5500 U	N	6100 U	6000 U
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	14600	17800	14500	15600	20100	N	19200	N	19100	16300
Antimony	8.6%	78.3	5.16	5.2	13	12.4 U J	8.4 U J	12.1 U J	7.6 U J	6.8 U J	N	8.9 U J	N	11.2 U J	10.4 U J
Arsenic	99.4%	66.3	5.93	7.5	17	5.5 J	4.6 J	3.9 J	6.3 J	6.1	N	4.5	N	5.1	4.7
Barium	100.0%	1010	101.81	300	4	114	96.7	94.7	69.5	71.5	N	50.4	N	144	84.1
Beryllium	96.5%	1.4	0.99	1	34						N		N		
Cadmium	69.9%	43.1	1.76	1.8	92	1.8	2.4	2.6	2.4	4.1	N	3.9	N	3.8	3.4
Calcium	100.0%	172000	46825	46825	42	4570	4930	3540	2870	3010 J	N	10900 J	N	5110 J	5040 J
Chromium	100.0%	62	26.57	26.6	81	22.4	28	21.5	26.3	30.5	N	29	N	26.6	23.2
Cobalt	100.0%	25.1	15.27	30	0	8.1 J	18	14.3	16.7	17.7	N	14.4	N	13.9	10.8
Copper	100.0%	836	24.07	25	92	29.9	19.7	23.2	24.6	25.6	N	13.6	N	28.9	24.5
Iron	100.0%	642000	32698	32698	77	23200	36100	26200	35800	44000	N	40900	N	32000	26100
Lead	100.0%	2890	14.02	30	50	33.2		16		12.4 J	N	5.5 J	N	12.8 J	9.4 J
Magnesium	100.0%	24900	9071	9071.1	30	4000	6170	4240	6370	7500	N	7720	N	5300	5230
Manganese	100.0%	2740	1065.8	1065.8	17	526	1120	1290	1070	938	N	646	N	1700	551
Mercury	61.7%	1.2	0.07	0.1	31	0.09 J	0.04 J	0.05 J	0.04 U	0.04 U	N	0.03 U	N	0.07 J	0.05 J
Nickel	100.0%	2520	41.31	41.3	62	25.3	39.5	28.3	43.1	48.2	N	46.9	N	35.3	31.1
Potassium	100.0%	19000	1530	4000	1	1850	1920	1590	1550	1980	N	1700	N	2480	2230
Selenium	30.1%	2.1	0.35	2	1	0.22 U J	0.14 U J	0.14 U J	0.22 U J	0.19 U J	N	0.14 U J	N	0.13 U J	0.13 U J
Silver	14.7%	10.5	0.59	200	0	2 U	1.4 U	2 U	1.2 U	0.43 U	N	0.56 U	N	1.1 J	0.66 U
Sodium	65.1%	1010	76.4	3000	0	71.7 U	48.5 U	69.9 U	44.2 U	63.1 J	N	84.3 J	N	66 J	64.9 J
Vanadium	100.0%	36.8	25.49	150	0	25.6	28	19.1	22.4	26	N	23.7	N	32.6	27.8
Zinc	99.4%	55700	89.14	89.1	108	284	84.4	131	136	168	N	112	N	101	77.2
Cyanide	3.7%	2.2	0.35	NA	0	0.6 U	0.61 U	0.65 U	0.65 U	0.62 U	N	0.62 U	N	0.71 U	0.71 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-29 0-2 12/04/91 S1204-92	B-29 4-6 12/04/91 S1204-93	B-29 4-6 12/04/91 S1204-93A(1)	B-30 0-2 12/04/91 S1204-94	B-30 0-2 12/04/91 S1204-94A(1)	B-30 2-4 12/04/91 S1204-95RE(4)	B-30 2-4 12/04/91 S1204-95	B-30 2-4 12/04/91 S1204-95RE(4)	B-30 4-6 12/04/91 S1204-96	B-30 4-6 12/04/91 S1204-96A(1)	B-30 4-6 12/04/91 S1204-96RE(4)
VOCs (µg/kg)																
Vinyl Chloride	6.4%	1000	-	200	5	41 U	1400 U	1400 U	12 U	12 U	57 U J	57 U J	N	1400 U	1400 U	N
Chloroethane	0.5%	3	-	1900	0	41 U	1400 U	1400 U	12 U	12 U	57 U J	57 U J	N	1400 U	1400 U	N
Acetone	8.0%	680	-	200	1	42	1400 U	1400 U	12 U	12 U	57 U J	57 U J	N	1400 U	680 J	N
Carbon Disulfide	1.1%	120	-	2700	0	21 U	680 U	700 U	6 U	6 U	29 U J	29 U J	N	720 U	710 U	N
1,1-Dichloroethene	5.9%	140	-	400	0	21 U	680 U	700 U	6 U	6 U	29 U J	29 U J	N	720 U	710 U	N
1,2-Dichloroethene (total)	38.5%	79000	-	300	27	610	14000	11000	45	31	1400 J	1700 J	N	18000	16000	N
Chloroform	7.0%	32	-	300	0	21 U	680 U	700 U	6 U	4 J	29 U J	29 U J	N	720 U	710 U	N
1,2-Dichloroethane	1.1%	210	-	100	2	21 U	680 U	700 U	6 U	6 U	29 U J	29 U J	N	720 U	710 U	N
2-Butanone	6.4%	22	-	300	0	41 U	1400 U	1400 U	12 U	12 U	57 U J	57 U J	N	1400 U	1400 U	N
1,1,1-Trichloroethane	0.5%	3	-	800	0	21 U	680 U	700 U	6 U	6 U	29 U J	29 U J	N	720 U	710 U	N
Trichloroethene	54.0%	540000	-	700	16	250	21000	17000	5 J	5 J	110 J	91 J	N	450 J	390 J	N
Benzene	2.1%	6	-	60	0	21 U	680 U	700 U	6 U	6 U	29 U J	29 U J	N	720 U	710 U	N
Tetrachloroethene	2.1%	7	-	1400	0	21 U	680 U	700 U	6 U	6 U	29 U J	29 U J	N	720 U	710 U	N
Toluene	25.1%	5700	-	1500	2	21 U	680 U	700 U	6 U	6 U	29 U J	29 U J	N	410 J	640 J	N
Chlorobenzene	1.1%	620	-	1700	0	21 U	620 J	360 J	6 U	6 U	29 U J	29 U J	N	720 U	710 U	N
Ethylbenzene	7.0%	2000	-	5500	0	21 U	680 U	700 U	6 U	6 U	29 U J	29 U J	N	720 U	660 J	N
Xylene (total)	12.3%	17000	-	1200	5	21 U	680 U	700 U	6 U	6 U	41 J	28 J	N	970	2100	N
Semivolatiles (µg/kg)																
Phenol	1.0%	14000	-	30	2	720 U	730 U	750 U	800 U J	760 U	N	720 U	720 U	1500 U J	1400 U J	N
bis(2-Chloroethyl) ether	0.5%	9	-	-	NA	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
2-Nitrophenol	0.5%	1300	-	330	1	720 U	730 U	750 U	800 U J	760 U	N	720 U	720 U	1500 U J	1400 U J	N
Benzoic acid	4.0%	1500	-	2700	0	3500 U	3500 U	3600 U	3900 U J	120 J	N	3500 U J	720 U J	7100 U J	7000 U J	N
Naphthalene	19.7%	2500	-	13000	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	240 J	240 J	N
2-Methylnaphthalene	18.7%	3600	-	36400	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	250 J	220 J	N
Acenaphthylene	8.3%	510	-	41000	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Acenaphthene	16.1%	14000	-	50000*	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
4-Nitrophenol	1.0%	1600	-	100	1	3500 U	3500 U	3600 U	3900 U J	81 J	N	3500 U	3500 U	7100 U J	7000 U J	N
Dibenzofuran	11.9%	7000	-	6200	1	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
2,4-Dinitrotoluene	1.0%	2000	-	50000*	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Fluorene	17.6%	12000	-	50000*	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
N-Nitrosodiphenylamine	0.5%	450	-	50000*	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Phenanthrene	42.0%	43000	-	50000*	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Anthracene	23.8%	15000	-	50000*	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Di-n-butylphthalate	27.5%	25000	-	8100	1	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Fluoranthene	44.0%	29000	-	50000*	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Pyrene	46.1%	24000	-	50000*	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Butylbenzylphthalate	3.1%	300	-	50000*	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Benzo(a)anthracene	36.3%	9600	-	220	32	720 U	730 U	750 U	800 U J	85 J	N	720 U J	720 U J	1500 U J	1400 U J	N
Chrysene	38.3%	9900	-	400	26	720 U	730 U	750 U	800 U J	79 J	N	720 U J	720 U J	1500 U J	1400 U J	N
bis(2-Ethylhexyl)phthalate	50.8%	230000	-	50000*	1	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Di-n-octylphthalate	3.6%	430	-	50000*	0	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Benzo(b)fluoranthene	34.2%	9500	-	1100	11	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
benzo(k)fluoranthene	34.2%	6700	-	1100	9	720 U	730 U	750 U	800 U J	760 U	N	720 U J	720 U J	1500 U J	1400 U J	N
Benzo(a)pyrene	33.2%	9000	-	61	52	720 U	730 U	750 U	800 U J	70 J	N	720 U J	720 U J	1500 U J	1400 U J	N
Indeno(1,2,3-cd)pyrene	28.0%	48000	-	3200	2	720 U	730 U	750 U	800 U J	81 J	N	720 U J	720 U J	1500 U J	1400 U J	N
Dibenz(a,h)anthracene	13.5%	2100	-	14	26	720 U	730 U	750 U	800 U J	81 J	N	720 U J	720 U J	1500 U J	1400 U J	N
Benzo(g,h,i)perylene	24.9%	5000	-	50000*	0	720 U	730 U	750 U	800 U J	84 J	N	720 U J	720 U J	1500 U J	1400 U J	N

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ^{1}	NUMBER OF SAMPLES ABOVE TAGM	B-29 0-2 12/04/91 S1204-92	B-29 4-6 12/04/91 S1204-93	B-29 4-6 12/04/91 S1204-93A(1)	B-30 0-2 12/04/91 S1204-94	B-30 0-2 12/04/91 S1204-94A(1)	B-30 2-4 12/04/91 S1204-95RE(4)	B-30 2-4 12/04/91 S1204-95	B-30 2-4 12/04/91 S1204-95RE(4)	B-30 4-6 12/04/91 S1204-96	B-30 4-6 12/04/91 S1204-96A(1)	B-30 4-6 12/04/91 S1204-96RE(4)
Pesticides / PCBs (µg/kg)																
Heptachlor	0.6%	14	-	100	0	18 U	18 U	18 U	N	18 U	19 U	17 U	18 U J	18 U	17 U	17 U J
Dieldrin	0.6%	46	-	44	1	35 U	35 U	36 U	N	37 U	38 U	35 U	35 U J	36 U	35 U	35 U J
4,4'-DDE	28.9%	290	-	2100	0	35 U	35 U	36 U	N	37 U	38 U	35 U	35 U J	36 U	35 U	35 U J
4,4'-DDD	16.7%	350	-	2900	0	35 U	35 U	36 U	N	37 U	38 U	35 U	35 U J	36 U	35 U	36 J
4,4'-DDT	19.4%	260	-	2100	0	35 U	35 U	36 U	N	37 U	38 U	35 U	35 U J	36 U	35 U	35 U J
Aroclor-1242	3.5%	260	-	1000^{2}	0	180 U	180 U	180 U	N	180 U	190 U		180 U J		160 J	170 U J
Aroclor-1260	11.7%	770	-	1000^{2}	0	350 U	350 U	360 U	N	370 U	380 U	580	770 J	370	270 J	490 J
Herbicides (µg/kg)																
2,4-DB	4.3%	410	-	-	NA	57 U	410 J	56 U J	61 U	60 U	N	56 U	N	56 U	55 U	N
2,4,5-TP (Silvex)	0.6%	10	-	700	0	5.7 U	5.7 U	5.6 U	6.1 U	6 U	N	5.6 U	N	5.6 U	5.5 U	N
MCPP	3.0%	24000	-	-	NA	5700 U	5700 U	5600 U	6100 U	6000 U	N	5600 U	N	5600 U	5500 U	N
Metals (mg/kg)																
Aluminum	100.0%	25500	17503	17503	51	18100	18500	14700	16200	14400	N	15700	N	13000	19600	N
Antimony	8.6%	78.3	5.16	5.2	13	6.6 U J	10.4 U J	10.3 U J	7.3 U J	9.5 U J	N	7.6 U J	N	6.3 U J	11.1 U J	N
Arsenic	99.4%	66.3	5.93	7.5	17	4.2	4.4	4.2	5.1	4.8	N	5.5	N	3	4.3	N
Barium	100.0%	1010	101.81	300	4	71.8	49.9	34.8 J	86.4	74.6	N	64.9	N	38.5	63.9	N
Beryllium	96.5%	1.4	0.99	1	34						N		N			N
Cadmium	69.9%	43.1	1.76	1.8	92	3.7	4	3	2.9	2.2	N	3	N	2.9	3.7	N
Calcium	100.0%	172000	46825	46825	42	60500 J	12100 J	15900 J	16900 J	20200	N	44800 J	N	2460 J	4110 J	N
Chromium	100.0%	62	26.57	26.6	81	25.7	27.5	22	20	18.5	N	22.5	N	20.7	29.7	N
Cobalt	100.0%	25.1	15.27	30	0	15.2	15.2	10.1	8.9	7.8 J	N	12.5	N	10.4	13.7	N
Copper	100.0%	836	24.07	25	92	27.3	21.5	16	18.9	18.1	N	22.9	N	12	15.6	N
Iron	100.0%	642000	32698	32698	77	35300	36800	27500	24000	19700	N	27700	N	29800	35500	N
Lead	100.0%	2890	14.02	30	50	6.8 J	4.1 J	4.3 J	11.5 J	8.8 J	N	7 J	N	7.3 J	8.2 J	N
Magnesium	100.0%	24900	9071	9071.1	30	9690	7460	6030	5190	10700	N	7660	N	5160	7230	N
Manganese	100.0%	2740	1065.8	1065.8	17	667	492 J	364 J	735	597	N	627	N	347	449	N
Mercury	61.7%	1.2	0.07	0.1	31	0.03 U	0.05 J	0.05 U	0.04 U	0.05 J	N	0.04 J	N	0.04 U	0.04 U	N
Nickel	100.0%	2520	41.31	41.3	62	41.8	41.2	32.4	23.7	19.8	N	36.7	N	31	42.4	N
Potassium	100.0%	19000	1530	4000	1	2180	1690	1350	2040	2120	N	1910	N	938	2060	N
Selenium	30.1%	2.1	0.35	2	1	0.75 U J	0.15 U J	0.22 U J	0.17 U J	1.1 U J	N	0.98 U J	N	0.61 U J	0.19 U J	N
Silver	14.7%	10.5	0.59	200	0	0.42 U	0.89 J	0.66 U	0.47 U	0.61 U	N	0.48 U	N	0.45 J	0.76 J	N
Sodium	65.1%	1010	76.4	3000	0	131 J	80.8 J	78.6 J	83.3 J	74.8 J	N	101 J	N	40 J	62.9 J	N
Vanadium	100.0%	36.8	25.49	150	0	25.3	23.5		25.2	24	N		N		24.8	N
Zinc	99.4%	55700	89.14	89.1	108	101	100	68.5	68.5	69.5	N	98.5	N	74.4	111	N
Cyanide	3.7%	2.2	0.35	NA	0	0.65 U	0.59 U	0.6 U	0.69 U	0.68 U	N	0.61 U	N	0.65 U	0.65 U	N

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-30 4-6 12/04/91 S1204-96ARE(1,4)	B-31 0-2 12/05/91 S1205-97	B-31 0-2 12/05/91 S1205-97A(1)	B-31 0-2 12/05/91 S1205-97RE(4)	B-31 0-2 12/05/91 S1205-97ARE(1,4)	B-31 2-4 12/05/91 S1205-98(3)	B-31 2-4 12/05/91 S1205-98RE(3,4)	B-31 4-6 12/05/91 S1205-99	B-31 4-6 12/05/91 S1205-99RE(4)	B-31 6-8 12/05/91 S1205-100(2)	B-31 6-8 12/05/91 S1205-100RE(4)
VOCs (µg/kg)																
Vinyl Chloride	6.4%	1000	-	200	5	N	12 U	12 U	N	N	12 U	N	66	N	370	320
Chloroethane	0.5%	3	-	1900	0	N	12 U	12 U	N	N	12 U	N	56 U	N	63 U	63 U
Acetone	8.0%	680	-	200	1	N	12 U	12 U	N	N	12 U	N	56 U	N	63 U	63 U
Carbon Disulfide	1.1%	120	-	2700	0	N	6 U	6 U	N	N	6 U	N	120	N	32 U	32 U
1,1-Dichloroethene	5.9%	140	-	400	0	N	6 U	6 U	N	N	6 U	N	28 U	N	32 U	32 U
1,2-Dichloroethene (total)	38.5%	79000	-	300	27	N	6 U	6 U	N	N	6 U	N	660	N	630	600
Chloroform	7.0%	32	-	300	0	N	6 U	6 U	N	N	5 J	N	28 U	N	32 U	32 U
1,2-Dichloroethane	1.1%	210	-	100	2	N	6 U	6 U	N	N	6 U	N	28 U	N	32 U	32 U
2-Butanone	6.4%	22	-	300	0	N	12 U	12 U	N	N	12 U	N	56 U	N	63 U	63 U
1,1,1-Trichloroethane	0.5%	3	-	800	0	N	6 U	6 U	N	N	6 U	N	28 U	N	32 U	32 U
Trichloroethene	54.0%	540000	-	700	16	N	23 J	110 J	N	N	5 J	N	2400 E	N	640	610
Benzene	2.1%	6	-	60	0	N	6 U	6 U	N	N	6 U	N	6 J	N	32 U	32 U
Tetrachloroethene	2.1%	7	-	1400	0	N	6 U	6 U	N	N	6 U	N	28 U	N	32 U	32 U
Toluene	25.1%	5700	-	1500	2	N	6 U	6 U	N	N	6 U	N	85	N	32 U	32 U
Chlorobenzene	1.1%	620	-	1700	0	N	6 U	6 U	N	N	6 U	N	28 U	N	32 U	32 U
Ethylbenzene	7.0%	2000	-	5500	0	N	6 U	6 U	N	N	6 U	N	23 J	N	32 U	32 U
Xylene (total)	12.3%	17000	-	1200	5	N	6 U	6 U	N	N	6 U	N	69	N	32 U	32 U
Semivolatiles (µg/kg)																
Phenol	1.0%	14000	-	30	2	N	800 U	780 U	N	N	780 U	N	720 U	720 U	14000 J	N
bis(2-Chloroethyl) ether	0.5%	9	-	-	NA	N	800 U	780 U	N	N	780 U	N	720 U J	720 U J	4100 U J	N
2-Nitrophenol	0.5%	1300	-	330	1	N	800 U	780 U	N	N	780 U	N	720 U	720 U	1300 J	N
Benzoic acid	4.0%	1500	-	2700	0	N	3900 U	94 J	N	N	3800 U	N	3500 U J	3500 U J	1500 J	N
Naphthalene	19.7%	2500	-	13000	0	N	800 U	780 U	N	N	780 U	N	180 J	200 J	4100 U J	N
2-Methylnaphthalene	18.7%	3600	-	36400	0	N	78 J	780 U	N	N	780 U	N	720 U J	720 U J	4100 U J	N
Acenaphthylene	8.3%	510	-	41000	0	N	800 U	780 U	N	N	780 U	N	720 U J	720 U J	4100 U J	N
Acenaphthene	16.1%	14000	-	50000*	0	N	800 U	780 U	N	N	780 U	N	720 U J	720 U J	4100 U J	N
4-Nitrophenol	1.0%	1600	-	100	1	N	3900 U	3800 U	N	N	3800 U	N	3500 U	3500 U	1600 J	N
Dibenzofuran	11.9%	7000	-	6200	1	N	800 U	780 U	N	N	780 U	N	110 U J	720 U J	4100 U J	N
2,4-Dinitrotoluene	1.0%	2000	-	50000*	0	N	800 U	780 U	N	N	780 U	N	720 U J	720 U J	4100 U J	N
Fluorene	17.6%	12000	-	50000*	0	N	800 U	780 U	N	N	780 U	N	720 U J	720 U J	4100 U J	N
N-Nitrosodiphenylamine	0.5%	450	-	50000*	0	N	800 U	780 U	N	N	780 U	N	720 U J	720 U J	4100 U J	N
Phenanthrene	42.0%	43000	-	50000*	0	N	180 J	120 J	N	N	780 U	N	110 U J	110 U J	4100 U J	N
Anthracene	23.8%	15000	-	50000*	0	N	800 U	780 U	N	N	780 U	N	720 U J	720 U J	4100 U J	N
Di-n-butylphthalate	27.5%	25000	-	8100	1	N	800 U	150 J	N	N	780 U	N	720 U J	720 U J	4100 U J	N
Fluoranthene	44.0%	29000	-	50000*	0	N	250 J	250 J	N	N	150 J	N	120 U J	110 U J	4100 U J	N
Pyrene	46.1%	24000	-	50000*	0	N	190 J	250 J	N	N	110 J	N	140 U J	130 U J	4100 U J	N
Butylbenzylphthalate	3.1%	300	-	50000*	0	N	800 U	140 J	N	N	780 U	N	390 U J	720 U J	4100 U J	N
Benzo(a)anthracene	36.3%	9600	-	220	32	N	140 J	260 J	N	N	100 J	N	720 U J	720 U J	4100 U J	N
Chrysene	38.3%	9900	-	400	26	N	150 J	210 J	N	N	100 J	N	83 U J	110 U J	4100 U J	N
bis(2-Ethylhexyl)phthalate	50.8%	230000	-	50000*	1	N	83 J	230 J	N	N	170 J	N	220 U J	210 U J	4100 U J	N
Di-n-octylphthalate	3.6%	430	-	50000*	0	N	800 U	150 J	N	N	780 U	N	250 U J	720 U J	4100 U J	N
Benzo(b)fluoranthene	34.2%	9500	-	1100	11	N	130 J	240 J	N	N	100 J	N	720 U J	720 U J	4100 U J	N
benzo(k)fluoranthene	34.2%	6700	-	1100	9	N	99 J	160 J	N	N	82 J	N	720 U J	720 U J	4100 U J	N
Benzo(a)pyrene	33.2%	9000	-	61	52	N	110 J	200 J	N	N	86 J	N	720 U J	720 U J	4100 U J	N
Indeno(1,2,3-cd)pyrene	28.0%	48000	-	3200	2	N	82 J	200 J	N	N	780 U	N	720 U J	720 U J	4100 U J	N
Dibenz(a,h)anthracene	13.5%	2100	-	14	26	N	800 U	170 J	N	N	780 U	N	720 U J	720 U J	4100 U J	N
Benzo(g,h,i)perylene	24.9%	5000	-	50000*	0	N	83 J	220 J	N	N	72 J	N	720 U J	720 U J	4100 U J	N

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ^{1}	NUMBER OF SAMPLES ABOVE TAGM	B-30 4-6 12/04/91 S1204-96ARE(1,4)	B-31 0-2 12/05/91 S1205-97	B-31 0-2 12/05/91 S1205-97A(1)	B-31 0-2 12/05/91 S1205-97RE(4)	B-31 0-2 12/05/91 S1205-97ARE(1,4)	B-31 2-4 12/05/91 S1205-98(3)	B-31 2-4 12/05/91 S1205-98RE(3,4)	B-31 4-6 12/05/91 S1205-99	B-31 4-6 12/05/91 S1205-99RE(4)	B-31 6-8 12/05/91 S1205-100(2)	B-31 6-8 12/05/91 S1205-100RE(4)
Pesticides / PCBs (µg/kg)																
Heptachlor	0.6%	14	–	100	0	17 U J	20 U	19 U	19 U J	19 U J	19 U	19 U J	17 U	17 U J	20 U	20 U J
Dieldrin	0.6%	46	–	44	1	34 U J	39 U	38 U	39 U J	38 U J	38 U	38 U J	35 U	35 U J	40 U	40 U J
4,4'-DDE	28.9%	290	–	2100	0	34 U J	39 U	41	43 J	43 J	57	71 J	35 U	35 U J	40 U	40 U J
4,4'-DDD	16.7%	350	–	2900	0	34 U J	39 U	38 U	39 U J	38 U J	38 U	38 U J	35 U	35 U J	40 U	40 U J
4,4'-DDT	19.4%	260	–	2100	0	34 U J	36 J	43	100 J	72 J	38 U	38 U J	35 U	35 U J	40 U	40 U J
Aroclor-1242	3.5%	260	–	1000^{P}	0	170 U J			190 U J	190 U J		190 U J		170 U J		200 U J
Aroclor-1260	11.7%	770	–	1000^{P}	0	280 J	390 U	380 U	390 U J	380 U J	380 U	380 U J	350 U	350 U J	400 U	400 U J
Herbicides (µg/kg)																
2,4-DB	4.3%	410	–	–	NA	N	60 U	59 U	N	N	60 U	N	54 U	N	61 U	N
2,4,5-TP (Silvex)	0.6%	10	–	700	0	N	6 U	5.9 U	N	N	6 U	N	5.4 U	N	6.1 U	N
MCPP	3.0%	24000	–	–	NA	N	6000 U	5900 U	N	N	6000 U	N	6200 U	N	6100 U	N
Metals (mg/kg)																
Aluminum	100.0%	25500	17503	17503	51	N	18400	14100	N	N	25500	N	15000	N	21200	N
Antimony	8.6%	78.3	5.16	5.2	13	N	9.9 U J	7.4 J	N	N	8.7 U J	N	11.4 U J	N	13.1 U J	N
Arsenic	99.4%	66.3	5.93	7.5	17	N	10.8	8.6	N	N	45.8	N	3.9	N	2.6	N
Barium	100.0%	1010	101.81	300	4	N	136	111	N	N	121	N	52.2	N	61.1	N
Beryllium	96.5%	1.4	0.99	1	34	N			N	N		N		N		N
Cadmium	69.9%	43.1	1.76	1.8	92	N	3.8	3.7	N	N	4.3	N	3.5	N	4.4	N
Calcium	100.0%	172000	46825	46825	42	N	24700 J	79200 J	N	N	17800 J	N	25500 J	N	3460	N
Chromium	100.0%	62	26.57	26.6	81	N	28.3 J	22.4 J	N	N	34.8	N	28.8	N	30.4	N
Cobalt	100.0%	25.1	15.27	30	0	N	11.8	10.8	N	N	15.4	N	14.4	N	18.1	N
Copper	100.0%	836	24.07	25	92	N	64.8	146	N	N	76.1	N	31.6	N	26.4	N
Iron	100.0%	642000	32698	32698	77	N	34400	30700	N	N	41800	N	29000	N	44100	N
Lead	100.0%	2890	14.02	30	50	N	160	202	N	N	696	N	68.5	N	15.3 J	N
Magnesium	100.0%	24900	9071	9071.1	30	N	7810	8510	N	N	9290	N	7020	N	7010	N
Manganese	100.0%	2740	1065.8	1065.8	17	N	670	495	N	N	724	N	337	N	541	N
Mercury	61.7%	1.2	0.07	0.1	31	N	0.76	0.17	N	N	0.17	N	0.05 J	N	0.05 U	N
Nickel	100.0%	2520	41.31	41.3	62	N	35.5 J	39.9 J	N	N	40.9	N	51.1	N	47	N
Potassium	100.0%	19000	1530	4000	1	N	2610	2110	N	N	2330	N	2170	N	1280	N
Selenium	30.1%	2.1	0.35	2	1	N	0.23 U J	0.22 U J	N	N	0.23 U J	N	0.24 J	N	0.23 U J	N
Silver	14.7%	10.5	0.59	200	0	N	0.63 U	0.56 J	N	N	0.55 U	N	0.9 J	N	0.84 U	N
Sodium	65.1%	1010	76.4	3000	0	N	113 J	141 J	N	N	201 J	N	141 J	N	326 J	N
Vanadium	100.0%	36.8	25.49	150	0	N	29.7	24.1	N	N	28.3	N		N	25.3	N
Zinc	99.4%	55700	89.14	89.1	108	N	797	1210	N	N	472	N	393	N	93.5	N
Cyanide	3.7%	2.2	0.35	NA	0	N	0.72 U	0.63 U	N	N	0.63 U	N	0.64 U	N	0.73 U	N

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B-32 0-2 04/27/93 B32-1	B-32 2-4 04/27/93 B32-2	B-32 4-6 04/27/93 B32-3	B-32 6-7.8 04/27/93 B32-4	B-33 0-2 12/14/92 B33-1	B-33 2-3.5 12/14/92 B33-2	B-34 0-2 12/14/92 B34-1	B-34 2-2.75 12/14/92 B34-2	B-35 0-2 12/15/92 B35-1	B-35 0-2 12/15/92 B35-1RE
<u>VOCs (µg/kg)</u>															
Vinyl Chloride	6.4%	1000	–	200	5	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
Chloroethane	0.5%	3	–	1900	0	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
Acetone	8.0%	680	–	200	1	17 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
Carbon Disulfide	1.1%	120	–	2700	0	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
1,1-Dichloroethene	5.9%	140	–	400	0	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	110	12 U	1300 U	240 J	12 U	12 U	12 U	12 U	13 U J	13 U J
Chloroform	7.0%	32	–	300	0	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
1,2-Dichloroethane	1.1%	210	–	100	2	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
2-Butanone	6.4%	22	–	300	0	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
1,1,1-Trichloroethane	0.5%	3	–	800	0	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
Trichloroethene	54.0%	540000	–	700	16	140	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	44 J	45 J
Benzene	2.1%	6	–	60	0	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
Tetrachloroethene	2.1%	7	–	1400	0	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
Toluene	25.1%	5700	–	1500	2	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
Chlorobenzene	1.1%	620	–	1700	0	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
Ethylbenzene	7.0%	2000	–	5500	0	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
Xylene (total)	12.3%	17000	–	1200	5	11 U	12 U	1300 U	1300 U	12 U	12 U	12 U	12 U	13 U J	13 U J
<u>Semivolatiles (µg/kg)</u>															
Phenol	1.0%	14000	–	30	2	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	400 UJ	400 UJ
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	400 UJ	400 UJ
2-Nitrophenol	0.5%	1300	–	330	1	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	400 UJ	400 UJ
Benzoic acid	4.0%	1500	–	2700	0										
Naphthalene	19.7%	2500	–	13000	0	360 U	400 U	440 U	290 J	420 U	380 U	400 U	360 U	52 J	23 J
2-Methylnaphthalene	18.7%	3600	–	36400	0	360 U	400 U	440 U	320 J	420 U	380 U	400 U	360 U	20 J	19 J
Acenaphthylene	8.3%	510	–	41000	0	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	14 J	400 UJ
Acenaphthene	16.1%	14000	–	50000*	0	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	40 J	36 J
4-Nitrophenol	1.0%	1600	–	100	1	870 U	970 U	1100 U	860 U	1000 U	910 U	970 U	880 U	960 UJ	960 UJ
Dibenzofuran	11.9%	7000	–	6200	1	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	24 J	24 J
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	400 UJ	400 UJ
Fluorene	17.6%	12000	–	50000*	0	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	36 J	35 J
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	400 UJ	400 UJ
Phenanthrene	42.0%	43000	–	50000*	0	360 U	400 U	440 U	140 J	20 J	380 U	51 J	360 U	460 J	430 J
Anthracene	23.8%	15000	–	50000*	0	360 U	400 U	440 U	350 U	420 U	380 U	19 J	360 U	75 J	69 J
Di-n-butylphthalate	27.5%	25000	–	8100	1	360 U	400 U	440 U	180 J	420 U	380 U	400 U	360 U	400 UJ	400 UJ
Fluoranthene	44.0%	29000	–	50000*	0	80 J	400 U	440 U	350 U	28 J	380 U	62 J	360 U	530 J	560 J
Pyrene	46.1%	24000	–	50000*	0	74 J	400 U	440 U	130 J	30 J	380 U	64 J	16 J	630 J	500 J
Butylbenzylphthalate	3.1%	300	–	50000*	0	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	400 UJ	400 UJ
Benzo(a)anthracene	36.3%	9600	–	220	32	58 J	400 U	440 U	350 U	18 J	380 U	42 J	360 U	220 J	220 J
Chrysene	38.3%	9900	–	400	26	66 J	400 U	440 U	350 U	25 J	380 U	51 J	13 J	290 J	290 J
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	53 J	110 J	200 J	440	400 J	380 U	650	780	400 UJ	400 UJ
Di-n-octylphthalate	3.6%	430	–	50000*	0	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	400 UJ	400 UJ
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	67 J	400 U	440 U	350 U	420 U	380 U	39 J	360 U	180 J	220 J
benzo(k)fluoranthene	34.2%	6700	–	1100	9	49 J	400 U	440 U	350 U	420 U	380 U	39 J	360 U	210 J	210 J
Benzo(a)pyrene	33.2%	9000	–	61	52	56 J	400 U	440 U	350 U	420 U	380 U	38 J	360 U	100 J	120 J
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	360 U	400 U	440 U	350 U	420 U	380 U	34 J	360 U	89 J	110 J
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	360 U	400 U	440 U	350 U	420 U	380 U	400 U	360 U	46 J	29 J
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	360 U	400 U	440 U	350 U	420 U	380 U	37 J	360 U	31 J	42 J

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B-32 0-2 04/27/93 B32-1	B-32 2-4 04/27/93 B32-2	B-32 4-6 04/27/93 B32-3	B-32 6-7.8 04/27/93 B32-4	B-33 0-2 12/14/92 B33-1	B-33 2-3.5 12/14/92 B33-2	B-34 0-2 12/14/92 B34-1	B-34 2-2.75 12/14/92 B34-2	B-35 0-2 12/15/92 B35-1	B-35 0-2 12/15/92 B35-1RE
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	-	100	0	1.9 U	2.1 U	2.3 U	1.9 U	2.2 U	1.9 U	2.1 U	1.9 U	2 U	N
Dieldrin	0.6%	46	-	44	1	3.6 U	4 U	4.4 U	3.6 U	4.2 U	3.8 U	4 U	3.7 U	4 U	N
4,4'-DDE	28.9%	290	-	2100	0	6.6	4 U	4.4 U	3.6 U	2.5 J	3.8 U	4.7 J	3.7 U	3.9 J	N
4,4'-DDD	16.7%	350	-	2900	0	3.6 U	4 U	4.4 U	3.6 U	4.2 U	3.8 U	4 U	3.7 U	4 U	N
4,4'-DDT	19.4%	260	-	2100	0	1.8 J	4 U	4.4 U	3.6 U	3.6 J	3.8 U	9	2.5 J	3.9 J	N
Aroclor-1242	3.5%	260	-	1000[2]	0	36 U	40 U	44 U	36 U	42 U	38 U	40 U	37 U	40 U	N
Aroclor-1260	11.7%	770	-	1000[2]	0	36 U	40 U	170	320 J	42 U	38 U	40 U	37 U	40 U	N
Herbicides (µg/kg)															
2,4-DB	4.3%	410	-	-	NA	56 U	61 U	68 U	55 U	64 U	57 U	61 U	55 U	60 U	N
2,4,5-TP (Silvex)	0.6%	10	-	700	0	5.6 U	6.1 U	6.8 U	5.5 U	6.4 U	5.7 U	6.1 U	5.5 U	6 U	N
MCPP	3.0%	24000	-	-	NA	5600 U	6100 U	6800 U	5500 U	6400 U	5700 U	6100 U	5500 U	6000 U	N
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	13900	14400	16800	13900	19700	16000	21400	17200	14300	N
Antimony	8.6%	78.3	5.16	5.2	13	5.7 UJ	5.7 UJ	4.9 UJ	3.7 UJ	6.9 UJ	7.7 UJ	7.5 UJ	7.7 UJ	8 J	N
Arsenic	99.4%	66.3	5.93	7.5	17	4.5	4.5	5	2.7	2	1.6	3.6	1.9	1.7	N
Barium	100.0%	1010	101.81	300	4	85.1	105	81.8	46.6	108 J	58.9 J	99.1 J	65.9 J	163 J	N
Beryllium	96.5%	1.4	0.99	1	34	0.69 J	0.81 J	0.8 J	0.62 J	1	0.74	1.1	0.76	0.59 J	N
Cadmium	69.9%	43.1	1.76	1.8	92	0.41 U	0.42 U	0.36 U	0.27 U	0.4 U	0.44 U	0.43 U	0.44 U	0.71	N
Calcium	100.0%	172000	46825	46825	42	27900	8740	4310	3910	4620	46100	4340	41300	25200	N
Chromium	100.0%	62	26.57	26.6	81	25.5	22.9	27.4	22.7	32 J	26.6 J	35 J	28.5 J	28.9 J	N
Cobalt	100.0%	25.1	15.27	30	0	15.8	11.2	16.5	12	17.1	17.3	16.5	15.5	10.6	N
Copper	100.0%	836	24.07	25	92	36.8	32.8	29.8	17.3	24.4	18.7	26	18.4	75.5	N
Iron	100.0%	642000	32698	32698	77	29800	26500	34900	28300	36800	35300	40200	33400	28600	N
Lead	100.0%	2890	14.02	30	50	44.8	36.1	15.5	5.6	19.2				126	N
Magnesium	100.0%	24900	9071	9071.1	30	7520	6030	6200	5710	6550	7260	7020	7200	7360	N
Manganese	100.0%	2740	1065.8	1065.8	17	499	799	430	513	1070	780	857	852	476	N
Mercury	61.7%	1.2	0.07	0.1	31	0.21	0.04 U	0.05 U	0.03 U					0.39	N
Nickel	100.0%	2520	41.31	41.3	62	49.7	29.1	46.2	36	45.6	43.7	49.5	42.6	35.4	N
Potassium	100.0%	19000	1530	4000	1	1450	1550	1320	904	1580	1370	1520	1410	1130	N
Selenium	30.1%	2.1	0.35	2	1	0.24 J	0.19 U	0.23 U	0.17 U	0.15 U	0.48 J	0.58 J	0.69	1	N
Silver	14.7%	10.5	0.59	200	0	0.89 U	0.9 U	0.76 U	0.58 U	0.41 U	0.45 U	0.44 U	0.46 U	0.4 U	N
Sodium	65.1%	1010	76.4	3000	0	118 J	107 U	91 U	68.7 U	52 J	162 J	55 J	155 J	203 J	N
Vanadium	100.0%	36.8	25.49	150	0	19.3	23.7	24.7	17	26.9	20.9	29	22.4	21.3	N
Zinc	99.4%	55700	89.14	89.1	108	194	129	132	79.1	114 J	87.8 J	200 J	84.2 J	6290	N
Cyanide	3.7%	2.2	0.35	NA	0	0.66 U	0.71 U	0.81 U	0.66 U	0.76 U	0.65 U	0.7 U	0.63 U	0.49 U	N

TABLE 4-3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-35 2-4 12/15/92 B35-2	B-35 2-4 12/15/92 B35-2RE	B-35 4-5.1 12/15/92 B35-3	B-36 0-2 04/27/93 B36-1	B-36 2-4 04/27/93 B36-2	B-36 4-6 04/27/93 B36-3	B-36 6-7.9 04/27/93 B36-4	B-36 4-6 04/27/93 B36-6	B-37 0-2 04/28/93 B37-1	B-37 2-4 04/28/93 B37-2
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	-	200	5	13 U	N	8 J	12 U	12 U	53 U	1300 U	58 U	13 U	11 U
Chloroethane	0.5%	3	-	1900	0	13 U	N	12 U	12 U	12 U	53 U	1300 U	58 U	13 U	11 U
Acetone	8.0%	680	-	200	1	23 U	N	20 U	12 U	130	87	1300 U	100	13 U	11 U
Carbon Disulfide	1.1%	120	-	2700	0	13 U	N	12 U	12 U	12 U	53 U	1300 U	58 U	13 U	11 U
1,1-Dichloroethene	5.9%	140	-	400	0	3 J	N	140	12 U	12 U	53 U	1300 U	58 U	13 U	11 U
1,2-Dichloroethene (total)	38.5%	79000	-	300	27	13 J	N	200	12 U	12 U	53 U	1300 U	58 U	3 J	2 J
Chloroform	7.0%	32	-	300	0	13 U	N	12 U	12 U	12 U	53 U	1300 U	58 U	13 U	11 U
1,2-Dichloroethane	1.1%	210	-	100	2	13 U	N	12 U	12 U	12 U	53 U	1300 U	58 U	13 U	11 U
2-Butanone	6.4%	22	-	300	0	13 U	N	12 U	12 U	17	53 U	1300 U	58 U	13 U	11 U
1,1,1-Trichloroethane	0.5%	3	-	800	0	13 U	N	12 U	12 U	12 U	53 U	1300 U	58 U	13 U	11 U
Trichloroethene	54.0%	540000	-	700	16	5 J	N	110	12 U	12 U	53 U	1300 U	58 U	8 J	10 J
Benzene	2.1%	6	-	60	0	13 U	N	12 U	12 U	12 U	53 U	1300 U	58 U	13 U	11 U
Tetrachloroethene	2.1%	7	-	1400	0	13 U	N	12 U	12 U	12 U	53 U	1300 U	58 U	13 U	11 U
Toluene	25.1%	5700	-	1500	2	13 U	N	12 U	12 U	3 J	11 J	1300 U	8 J	13 U	11 U
Chlorobenzene	1.1%	620	-	1700	0	13 U	N	12 U	12 U	12 U	53 U	1300 U	58 U	13 U	11 U
Ethylbenzene	7.0%	2000	-	5500	0	13 U	N	12 U	12 U	12 U	8 J	1300 U	58 U	13 U	11 U
Xylene (total)	12.3%	17000	-	1200	5	13 U	N	12 U	12 U	12 U	91	500 J	76	13 U	11 U
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	-	30	2	8100 UJ	400 UJ	410 U	370 U	410 U	770 U	610 U	390 U	460 U	390 U
bis(2-Chloroethyl) ether	0.5%	9	-	-	NA	8100 UJ	400 UJ	410 U	370 U	410 U	770 U	610 U	390 U	460 U	390 U
2-Nitrophenol	0.5%	1300	-	330	1	8100 UJ	400 UJ	410 U	370 U	410 U	770 U	610 U	390 U	460 U	390 U
Benzoic acid	4.0%	1500	-	2700	0										
Naphthalene	19.7%	2500	-	13000	0	8100 UJ	25 J	410 U	370 U	410 U	410 J	480 J	370 J	460 U	390 U
2-Methylnaphthalene	18.7%	3600	-	36400	0	8100 UJ	20 J	410 U	370 U	410 U	3600	1900	3200	460 U	390 U
Acenaphthylene	8.3%	510	-	41000	0	8100 UJ	400 UJ	410 U	54 J	39 J	770 U	610 U	390 U	460 U	390 U
Acenaphthene	16.1%	14000	-	50000*	0	8100 UJ	13 J	410 U	37 J	410 U	770 U	610 U	390 U	460 U	390 U
4-Nitrophenol	1.0%	1600	-	100	1	20000 UJ	980 UJ	990 U	910 U	980 U	1900 U	1500 U	940 U	1100 U	940 U
Dibenzofuran	11.9%	7000	-	6200	1	8100 UJ	400 UJ	410 U	370 U	410 U	770 U	610 U	390 U	460 U	390 U
2,4-Dinitrotoluene	1.0%	2000	-	50000*	0	8100 UJ	400 UJ	410 U	370 U	410 U	770 U	610 U	390 U	460 U	390 U
Fluorene	17.6%	12000	-	50000*	0	8100 UJ	16 J	410 U	43 J	410 U	470 J	480 J	660	460 U	390 U
N-Nitrosodiphenylamine	0.5%	450	-	50000*	0	8100 UJ	400 UJ	410 U	370 U	410 U	770 U	610 U	390 U	460 U	390 U
Phenanthrene	42.0%	43000	-	50000*	0	330 J	260 J	410 U	300 J	230 J	1200	1200	1400	460 U	390 U
Anthracene	23.8%	15000	-	50000*	0	8100 UJ	67 J	410 U	61 J	410 U	770 U	610 U	390 U	460 U	390 U
Di-n-butylphthalate	27.5%	25000	-	8100	1	8100 UJ	23 J	260 J	370 U	220 J	330 J	420 J	290 J	460 U	390 U
Fluoranthene	44.0%	29000	-	50000*	0	550 J	480 J	410 U	630	210 J	160 J	610 U	94 J	460 U	390 U
Pyrene	46.1%	24000	-	50000*	0	800 J	710 J	410 U	510	190 J	230 J	290 J	98 J	460 U	390 U
Butylbenzylphthalate	3.1%	300	-	50000*	0	8100 UJ	130 J	410 U	370 U	410 U	770 U	610 U	390 U	460 U	390 U
Benzo(a)anthracene	36.3%	9600	-	220	32	8100 UJ	430 J	410 U	460	150 J	770 U	610 U	390 U	460 U	390 U
Chrysene	38.3%	9900	-	400	26	420 J	450 J	410 U	430	100 J	770 U	610 U	390 U	460 U	390 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	-	50000*	1	1400 J	340 J	1700	190 J	370 J	700 J	790	300 J	83 J	99 J
Di-n-octylphthalate	3.6%	430	-	50000*	0	8100 UJ	400 UJ	410 U	370 U	410 U	770 U	610 U	390 U	460 U	390 U
Benzo(b)fluoranthene	34.2%	9500	-	1100	11	420 J	380 J	410 U	640	130 J	770 U	610 U	390 U	460 U	390 U
benzo(k)fluoranthene	34.2%	6700	-	1100	9	8100 UJ	360 J	410 U	400	130 J	770 U	610 U	390 U	460 U	390 U
Benzo(a)pyrene	33.2%	9000	-	61	52	8100 UJ	300 J	410 U	470	120 J	770 U	610 U	390 U	460 U	390 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	-	3200	2	8100 UJ	200 J	410 U	280 J	110 J	770 U	610 U	390 U	460 U	390 U
Dibenz(a,h)anthracene	13.5%	2100	-	14	26	8100 UJ	86 J	410 U	140 J	410 U	770 U	610 U	390 U	460 U	390 U
Benzo(g,h,i)perylene	24.9%	5000	-	50000*	0	8100 UJ	56 J	410 U	150 J	410 U	770 U	610 U	390 U	460 U	390 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ^{1}	NUMBER OF SAMPLES ABOVE TAGM	B-35 2-4 12/15/92 B35-2	B-35 2-4 12/15/92 B35-2RE	B-35 4-5.1 12/15/92 B35-3	B-36 0-2 04/27/93 B36-1	B-36 2-4 04/27/93 B36-2	B-36 4-6 04/27/93 B36-3	B-36 6-7.9 04/27/93 B36-4	B-36 4-6 04/27/93 B36-6	B-37 0-2 04/28/93 B37-1	B-37 2-4 04/28/93 B37-2
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	–	100	0	2.1 U	N	2.1 U	1.9 U	4.2 U	2 U	1.9 U	2 U	2.4 U	2 U
Dieldrin	0.6%	46	–	44	1	4 U	N	4 U	3.7 U	8.1 U	3.8 U	3.6 U	3.9 U	4.6 U	3.9 U
4,4'-DDE	28.9%	290	–	2100	0	5.6 J	N	4 U	22	27	2.3 J	3.6 U	2.2 J	4.6 U	3.9 U
4,4'-DDD	16.7%	350	–	2900	0	7.6	N	4 U	18	74	36	15	35	4.6 U	3.9 U
4,4'-DDT	19.4%	260	–	2100	0	4 U	N	4 U	7.1 J	13 J	3.8 U	3.6 U	3.9 U	4.6 U	3.9 U
Aroclor-1242	3.5%	260	–	1000^2	0	40 U	N	40 U	37 U	81 U	38 U	36 U	39 U	46 U	39 U
Aroclor-1260	11.7%	770	–	1000^2	0	40 U	N	40 U	37 U	350 J	180 J	390 J	170 J	46 U	39 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	–	–	NA	61 U	N	61 U	57 U	62 U	58 U	56 U	59 U	71 U	59 U
2,4,5-TP (Silvex)	0.6%	10	–	700	0	6.1 U	N	6.1 U	5.7 U	6.2 U	5.8 U	5.6 U	5.9 U	7.1 U	5.9 U
MCPP	3.0%	24000	–	–	NA	6100 U	N	6100 U	5700 U	6200 U	5800 U	5600 U	5900 U	7100 U	5900 U
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	15000	N	22000	11700	16200	15300	11500	15700	15400	15400
Antimony	8.6%	78.3	5.16	5.2	13	9.1 UJ	N	7.2 UJ	3.8 UJ	4.7 UJ	5.8 UJ	3.1 UJ	4.1 UJ	7.3 UJ	5.4 UJ
Arsenic	99.4%	66.3	5.93	7.5	17	3.8	N	2.1	9.8	8.1	4.6	4.1	5.3	2.5	4.4
Barium	100.0%	1010	101.81	300	4	182 J	N	98.1 J	73.7	133	82.5	50.6	75.2	114	75.2
Beryllium	96.5%	1.4	0.99	1	34	0.7 J	N	1.1	0.57 J	0.85 J	0.71 J	0.52 J	0.77	0.92 J	0.74 J
Cadmium	69.9%	43.1	1.76	1.8	92	0.8 J	N	0.42 U	0.39 J	0.35 U	0.43 U	0.22 U	0.3 U	0.74 J	0.4 U
Calcium	100.0%	172000	46825	46825	42	30400	N	5010	40400	7650	14200	61500	7700	6020	26900
Chromium	100.0%	62	26.57	26.6	81	34.2 J	N	36.9 J	26.5	24.8	24.4	18.1	25.5	22.7	24.7
Cobalt	100.0%	25.1	15.27	30	0	11	N	17.7	11.5	12	12.6	10.6	15.2	9.6 J	14.5
Copper	100.0%	836	24.07	25	92	73.2	N	23.3	51.8	27.1	28.4	19.4	31.4	34.7	26.4
Iron	100.0%	642000	32698	32698	77	30200	N	42900	36900	28100	30200	23400	34600	25200	30000
Lead	100.0%	2890	14.02	30	50	203	N	25.4	110	57.9	14.9	9.5	12.4	16.3	8.2
Magnesium	100.0%	24900	9071	9071.1	30	7410	N	7690	7020	5320	6000	7780	6090	4210	6080
Manganese	100.0%	2740	1065.8	1065.8	17	443	N	1250	472	669	886	495	618	337	757
Mercury	61.7%	1.2	0.07	0.1	31	0.76	N		0.33	0.14	0.05 U	0.05 U	0.05 U	0.05 U	0.04 U
Nickel	100.0%	2520	41.31	41.3	62	36.1	N	54.4	42.9	32.8	40.1	31	44.1	26	41.3
Potassium	100.0%	19000	1530	4000	1	1600	N	1680	1210	1420	1420	985	1300	1540	1680
Selenium	30.1%	2.1	0.35	2	1	1.1	N	0.67 J	0.23 U	0.59 J	0.22 J	0.53 J	0.19 J	0.41 J	0.21 U
Silver	14.7%	10.5	0.59	200	0	0.82 J	N	0.43 U	0.82 J	0.75 U	0.92 U	0.48 U	0.65 U	1.1 U	0.86 U
Sodium	65.1%	1010	76.4	3000	0	268 J	N	248 J	120 J	88.9 U	109 U	184 J	77.3 U	137 U	102 U
Vanadium	100.0%	36.8	25.49	150	0	22.8	N	28.9	23.9	25.5	23.6	15.3	23.8	24.1	22.7
Zinc	99.4%	55700	89.14	89.1	108	4210	N	116 J	252	108	99.6	75.7	111	96.7	90
Cyanide	3.7%	2.2	0.35	NA	0	2.2	N	0.67 U	0.68 U	0.74 U	0.59 U	0.56 U	0.59 U	0.85 U	0.7 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-37 4-5.5 04/28/93 B37-3	B-37 4-5.5 04/28/93 B37-6	B-38 0-2 04/28/93 B38-1	B-38 0-2 04/28/93 B38-1RE	B-38 2-4 04/28/93 B38-2	B-38 4-6 04/28/93 B38-3	B-38 6-8 04/28/93 B38-4	B-38 4-6 04/28/93 B38-6	B-39 0-2 12/15/92 B39-1	B-39 0-2 12/15/92 B39-1RE
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	–	200	5	11 U	11 U	11 U	N	2 J	11 U	9 J	9 J	1300 U	N
Chloroethane	0.5%	3	–	1900	0	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
Acetone	8.0%	680	–	200	1	11 U	13 U	11 U	N	140	11 U	12 U	12 U	1300 U	N
Carbon Disulfide	1.1%	120	–	2700	0	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
1,1-Dichloroethene	5.9%	140	–	400	0	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	16	12	7 J	N	7 J	46	190	95	38000	N
Chloroform	7.0%	32	–	300	0	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
1,2-Dichloroethane	1.1%	210	–	100	2	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	210 J	N
2-Butanone	6.4%	22	–	300	0	11 U	11 U	11 U	N	22	11 U	12 U	12 U	1300 U	N
1,1,1-Trichloroethane	0.5%	3	–	800	0	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
Trichloroethene	54.0%	540000	–	700	16	37	38	73	N	28	47	150	64	2E+05 J	N
Benzene	2.1%	6	–	60	0	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
Tetrachloroethene	2.1%	7	–	1400	0	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
Toluene	25.1%	5700	–	1500	2	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
Chlorobenzene	1.1%	620	–	1700	0	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
Ethylbenzene	7.0%	2000	–	5500	0	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
Xylene (total)	12.3%	17000	–	1200	5	11 U	11 U	11 U	N	12 U	11 U	12 U	12 U	1300 U	N
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	–	30	2	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
2-Nitrophenol	0.5%	1300	–	330	1	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
Benzoic acid	4.0%	1500	–	2700	0										
Naphthalene	19.7%	2500	–	13000	0	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
2-Methylnaphthalene	18.7%	3600	–	36400	0	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
Acenaphthylene	8.3%	510	–	41000	0	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
Acenaphthene	16.1%	14000	–	50000*	0	360 U	370 U	64 J	67 J	400 U	370 U	380 U	360 U	360 UJ	360 UJ
4-Nitrophenol	1.0%	1600	–	100	1	870 U	890 U	880 U	880 U	960 U	910 U	920 U	880 U	870 UJ	870 UJ
Dibenzofuran	11.9%	7000	–	6200	1	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
Fluorene	17.6%	12000	–	50000*	0	360 U	370 U	65 J	72 J	400 U	370 U	380 U	360 U	360 UJ	360 UJ
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
Phenanthrene	42.0%	43000	–	50000*	0	360 U	370 U	870	830	200 J	370 U	380 U	360 U	96 J	91 J
Anthracene	23.8%	15000	–	50000*	0	360 U	370 U	210 J	250 J	58 J	370 U	380 U	360 U	360 UJ	13 J
Di-n-butylphthalate	27.5%	25000	–	8100	1	110 J	160 J	130 J	120 J	190 J	180 J	110 J	280 J	360 UJ	60 J
Fluoranthene	44.0%	29000	–	50000*	0	360 U	370 U	1500	1300	530	370 U	380 U	33 J	110 J	110 J
Pyrene	46.1%	24000	–	50000*	0	360 U	370 U	1400	1300	460	370 U	380 U	24 J	140 J	130 J
Butylbenzylphthalate	3.1%	300	–	50000*	0	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
Benzo(a)anthracene	36.3%	9600	–	220	32	360 U	370 U	730 J	740 J	260 J	370 U	380 U	360 U	38 J	51 J
Chrysene	38.3%	9900	–	400	26	360 U	370 U	490	500	220 J	370 U	380 U	360 U	63 J	66 J
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	170 J	290 J	260 J	250 J	360 J	520	240 J	550	410 UJ	340 J
Di-n-octylphthalate	3.6%	430	–	50000*	0	360 U	51 J	360 U	360 U	400 U	370 U	380 U	23 J	360 UJ	360 UJ
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	360 U	370 U	660	740 J	260 J	370 U	380 U	360 U	41 J	50 J
benzo(k)fluoranthene	34.2%	6700	–	1100	9	360 U	370 U	360 J	310 J	200 J	370 U	380 U	360 U	40 J	47 J
Benzo(a)pyrene	33.2%	9000	–	61	52	360 U	370 U	370	380	220 J	370 U	380 U	360 U	360 UJ	24 J
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	360 U	370 U	160 J	150 J	400 U	370 U	380 U	360 U	360 UJ	360 UJ
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	360 U	370 U	360 UJ	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	360 U	370 U	360 U	360 U	400 U	370 U	380 U	360 U	360 UJ	360 UJ

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B-37 4-5.5 04/28/93 B37-3	B-37 4-5.5 04/28/93 B37-6	B-38 0-2 04/28/93 B38-1	B-38 0-2 04/28/93 B38-1RE	B-38 2-4 04/28/93 B38-2	B-38 4-6 04/28/93 B38-3	B-38 6-8 04/28/93 B38-4	B-38 4-6 04/28/93 B38-6	B-39 0-2 12/15/92 B39-1	B-39 0-2 12/15/92 B39-1RE
Pesticides / PCBs (μg/kg)															
Heptachlor	0.6%	14	–	100	0	1.8 U	1.9 U	1.9 U	N	2 U	1.9 U	2 U	1.9 U	1.8 U	N
Dieldrin	0.6%	46	–	44	1	3.6 U	3.7 U	3.6 U	N	4 U	3.7 U	3.8 U	3.6 U	3.6 U	N
4,4'-DDE	28.9%	290	–	2100	0	3.6 U	3.7 U	3.4 J	N	3.2 J	3.7 U	3.8 U	3.6 U	6.9 J	N
4,4'-DDD	16.7%	350	–	2900	0	3.6 U	3.7 U	3.6 U	N	4 U	3.7 U	3.8 U	3.6 U	3.6 U	N
4,4'-DDT	19.4%	260	–	2100	0	3.6 U	3.7 U	3.6 U	N	4 U	3.7 U	3.8 U	3.6 U	4.1 J	N
Aroclor-1242	3.5%	260	–	1000[2]	0	36 U	37 U	36 U	N	40 U	37 U	38 U	36 U	36 U	N
Aroclor-1260	11.7%	770	–	1000[2]	0	36 U	37 U	36 U	N	40 U	37 U	38 U	36 U	36 U	N
Herbicides (μg/kg)															
2,4-DB	4.3%	410	–	–	NA	54 U	56 U	55 U	N	61 U	57 U	58 U	57 U	54 U	N
2,4,5-TP (Silvex)	0.6%	10	–	700	0	5.4 U	5.6 U	5.5 U	N	6.1 U	5.7 U	5.8 U	5.7 U	5.4 U	N
MCPP	3.0%	24000	–	–	NA	5400 U	5600 U	5500 U	N	6100 U	5700 U	5800 U	5700 U	5400 U	N
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	16000	12800	9120	N	13500	10600	14800	10500	7410	N
Antimony	8.6%	78.3	5.16	5.2	13	3.5 UJ	4.8 UJ	4.2 J	N	5.3 UJ	5.5 UJ	6.3 UJ	4.4 UJ	6.4 UJ	N
Arsenic	99.4%	66.3	5.93	7.5	17	5.9	2.1 J	2.8	N	4.6	2.9	3.5	4.5	2.3	N
Barium	100.0%	1010	101.81	300	4	68.7	36.4	211	N	105	47.5	51.7	48.4	88.8 J	N
Beryllium	96.5%	1.4	0.99	1	34	0.74	0.55 J	0.46 J	N	0.69 J	0.51 J	0.72 J	0.53 J	0.38 J	N
Cadmium	69.9%	43.1	1.76	1.8	92	0.26 U	0.35 U	0.36 J	N	0.39 U	4.4	0.47 U	0.32 U	0.63	N
Calcium	100.0%	172000	46825	46825	42	7240	21700	16000	N	53900	64500	11500	61900	1E+05	N
Chromium	100.0%	62	26.57	26.6	81	25.6	20.1	18.4	N	25	17.8	24.6	17.3	17.4 J	N
Cobalt	100.0%	25.1	15.27	30	0	14.3	10.8	11.5	N	12.1	10.4	14.8	10.2	7	N
Copper	100.0%	836	24.07	25	92	22.8	10.3	38.4	N	31	24.5	15.6	27.5	38.4	N
Iron	100.0%	642000	32698	32698	77	31000	25800	19000	N	27600	22900	30000	21800	16900	N
Lead	100.0%	2890	14.02	30	50	8.7	2.9	59	N	55.9	59.1 J	6.2	8.2 J	165	N
Magnesium	100.0%	24900	9071	9071.1	30	6200	5520	4270	N	7270	8610	6290	9160	23400	N
Manganese	100.0%	2740	1065.8	1065.8	17	676	476	400	N	1040	488	855	454	436	N
Mercury	61.7%	1.2	0.07	0.1	31	0.04 U	0.05 U	0.04 J	N	0.04 U	0.02 U	0.04 U	0.03 U		N
Nickel	100.0%	2520	41.31	41.3	62	39.9	31.1	34.3	N	36.9	30	39.8	30.4	24.8	N
Potassium	100.0%	19000	1530	4000	1	1320	1000	1250	N	1340	867 J	1130 J	1020	1400	N
Selenium	30.1%	2.1	0.35	2	1	0.16 U	0.22 U	0.19 J	N	0.54 J	0.11 U	0.14 U	0.19 U	1.8	N
Silver	14.7%	10.5	0.59	200	0	0.55 U	0.75 U	0.61 U	N	0.83 U	0.86 U	1 U	0.7 U	0.38 U	N
Sodium	65.1%	1010	76.4	3000	0	65.9 U	89.2 J	102 J	N	257 J	226 J	119 U	245 J	225 J	N
Vanadium	100.0%	36.8	25.49	150	0	21.4	14.9	15.3	N	23.7	15.1	18.6	16.1	12.9	N
Zinc	99.4%	55700	89.14	89.1	108	84.5	68.4	4070	N	1110	88.5	64	104	3540	N
Cyanide	3.7%	2.2	0.35	NA	0	0.65 U	0.66 U	0.66 U	N	0.72 U	0.66 U	0.69 U	0.55 U	1.4	N

TABLE 4-3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-39 3-4 12/15/92 B39-2	B-39 3-4 12/15/92 B39-2RE	B-39 4-6 12/15/92 B39-3	B-39 4-6 12/15/92 B39-3RE	B-39 6-6.5 12/15/92 B39-4	BK-1 0-2 12/16/92 BK-1	BK-2 0-2 12/16/92 BK-2	BK-2RE 0-2 12/16/92 BK-2RE	B-40 0-2 12/08/92 B40-1	B-40 2-3.4 12/08/92 B40-2
VOCs (μg/kg)															
Vinyl Chloride	6.4%	1000	-	200	5	1000	N	160	N	240 J	14 U	13 U	N	13 U	12 U
Chloroethane	0.5%	3	-	1900	0	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
Acetone	8.0%	680	-	200	1	60 J	N	57 U	N	21 U	14 U	13 U	N	13 U	12 U
Carbon Disulfide	1.1%	120	-	2700	0	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
1,1-Dichloroethene	5.9%	140	-	400	0	30 J	N	130	N	140	14 U	13 U	N	13 U	12 U
1,2-Dichloroethene (total)	38.5%	79000	-	300	27	7300 J	N	1600	N	1700	13 U	13 U	N	13 U	12 U
Chloroform	7.0%	32	-	300	0	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
1,2-Dichloroethane	1.1%	210	-	100	2	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
2-Butanone	6.4%	22	-	300	0	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
1,1,1-Trichloroethane	0.5%	3	-	800	0	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
Trichloroethene	54.0%	540000	-	700	16	700	N	1000	N	2200 J	14 U	13 U	N	13 U	12 U
Benzene	2.1%	6	-	60	0	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
Tetrachloroethene	2.1%	7	-	1400	0	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
Toluene	25.1%	5700	-	1500	2	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
Chlorobenzene	1.1%	620	-	1700	0	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
Ethylbenzene	7.0%	2000	-	5500	0	60 U	N	57 U	N	12 U	14 U	13 U	N	13 U	12 U
Xylene (total)	12.3%	17000	-	1200	5	30 J	N	57 U	N	5 J	14 U	13 U	N	13 U	12 U
Semivolatiles (μg/kg)															
Phenol	1.0%	14000	-	30	2	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
bis(2-Chloroethyl) ether	0.5%	9	-	-	NA	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
2-Nitrophenol	0.5%	1300	-	330	1	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
Benzoic acid	4.0%	1500	-	2700	0										
Naphthalene	19.7%	2500	-	13000	0	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
2-Methylnaphthalene	18.7%	3600	-	36400	0	400 UJ	15 J	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
Acenaphthylene	8.3%	510	-	41000	0	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	13 J	400 U
Acenaphthene	16.1%	14000	-	50000*	0	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
4-Nitrophenol	1.0%	1600	-	100	1	980 UJ	980 UJ	940 U	940 U	900 U	1000 U	1000 UJ	1000 UJ	950 U	960 U
Dibenzofuran	11.9%	7000	-	6200	1	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
2,4-Dinitrotoluene	1.0%	2000	-	50000*	0	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
Fluorene	17.6%	12000	-	50000*	0	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
N-Nitrosodiphenylamine	0.5%	450	-	50000*	0	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
Phenanthrene	42.0%	43000	-	50000*	0	31 J	28 J	390 U	390 U	370 U	420 U	29 J	130 J	53 J	16 J
Anthracene	23.8%	15000	-	50000*	0	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	31 J	15 J	400 U
Di-n-butylphthalate	27.5%	25000	-	8100	1	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	160 J	240 J
Fluoranthene	44.0%	29000	-	50000*	0	17 J	400 UJ	390 U	390 U	370 U	23 J	47 J	190 J	92 J	26 J
Pyrene	46.1%	24000	-	50000*	0	28 J	400 UJ	390 U	390 U	370 U	21 J	41 J	140 J	110 J	24 J
Butylbenzylphthalate	3.1%	300	-	50000*	0	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
Benzo(a)anthracene	36.3%	9600	-	220	32	400 UJ	400 UJ	390 U	390 U	370 U	420 U	21 J	77 J	46 J	400 U
Chrysene	38.3%	9900	-	400	26	400 UJ	400 UJ	390 U	390 U	370 U	420 U	28 J	80 J	74 J	400 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	-	50000*	1	800 UJ	590 UJ	1500	1300	540 U	670 U	430 UJ	280 J	600	320 J
Di-n-octylphthalate	3.6%	430	-	50000*	0	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 J	390 U	400 U
Benzo(b)fluoranthene	34.2%	9500	-	1100	11	400 UJ	400 UJ	390 U	390 U	370 U	420 U	20 J	66 J	62 J	400 U
benzo(k)fluoranthene	34.2%	6700	-	1100	9	400 UJ	400 UJ	390 U	390 U	370 U	420 U	20 J	70 J	65 J	400 U
Benzo(a)pyrene	33.2%	9000	-	61	52	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	48 J	48 J	400 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	-	3200	2	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	34 J	36 J	400 U
Dibenz(a,h)anthracene	13.5%	2100	-	14	26	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	390 U	400 U
Benzo(g,h,i)perylene	24.9%	5000	-	50000*	0	400 UJ	400 UJ	390 U	390 U	370 U	420 U	430 UJ	430 UJ	37 J	400 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-39 3-4 12/15/92 B39-2	B-39 3-4 12/15/92 B39-2RE	B-39 4-6 12/15/92 B39-3	B-39 4-6 12/15/92 B39-3RE	B-39 6-6.5 12/15/92 B39-4	BK-1 0-2 12/16/92 BK-1	BK-2 0-2 12/16/92 BK-2	BK-2RE 0-2 12/16/92 BK-2RE	B-40 0-2 12/08/92 B40-1	B-40 2-3.4 12/08/92 B40-2
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	-	100	0	2.1 U	N	2 U	N	1.9 U	2.2 U	2.2 U	N	2 U	2 U
Dieldrin	0.6%	46	-	44	1	4.1 U	N	3.9 U	N	3.7 U	4.3 U	4.3 U	N	3.9 U	3.9 U
4,4'-DDE	28.9%	290	-	2100	0	4.1 U	N	3.9 U	N	3.7 U	4.3 U	2.2 J	N	3.9 U	3.9 U
4,4'-DDD	16.7%	350	-	2900	0	4.1 U	N	3.9 U	N	3.7 U	4.3 U	4.3 U	N	3.9 U	3.9 U
4,4'-DDT	19.4%	260	-	2100	0	4.1 U	N	3.9 U	N	3.7 U	4.3 U	4.3 U	N	3.9 U	3.9 U
Aroclor-1242	3.5%	260	-	1000[2]	0	41 U	N	39 U	N	37 U	43 U	43 U	N	39 U	39 U
Aroclor-1260	11.7%	770	-	1000[2]	0	41 U	N	39 U	N	37 U	43 U	43 U	N	39 U	39 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	-	-	NA	61 U	N	58 U	N	57 U	64 U	65 U	N	59 U	60 U
2,4,5-TP (Silvex)	0.6%	10	-	700	0	6.1 U	N	5.8 U	N	5.7 U	6.4 U	6.5 U	N	5.9 U	6 U
MCPP	3.0%	24000	-	-	NA	6100 U	N	5800 U	N	5700 U	6400 U	6500 U	N	5900 U	6000 U
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	11100	N	11000	N	10800	19400	14400	N	16900	14900
Antimony	8.6%	78.3	5.16	5.2	13	6.9 UJ	N	6.5 UJ	N	7.8 UJ	7.9 U	7.2 U	N	9.9 UJ	10.5 UJ
Arsenic	99.4%	66.3	5.93	7.5	17	4.4	N	2.2	N	3.4	3	2.7	N	4.6	5
Barium	100.0%	1010	101.81	300	4	78.8 J	N	54.1 J	N	59 J	159	106	N	73.1	70.3
Beryllium	96.5%	1.4	0.99	1	34	0.57 J	N	0.47 J	N	0.45 J	1.1	0.81	N	0.7 J	0.69 J
Cadmium	69.9%	43.1	1.76	1.8	92	0.4 U	N	0.37 U	N	0.45 U	0.45 U	0.41 U	N	0.57 U	0.6 U
Calcium	100.0%	172000	46825	46825	42	1E+05	N	1E+05	N	54700	4590	22500	N	3500	56900
Chromium	100.0%	62	26.57	26.6	81	15.9 J	N	16.6 J	N	17.9 J	30	22.3	N	27	24.2
Cobalt	100.0%	25.1	15.27	30	0	6.9	N	9.2	N	10.2	14.4	12.3	N	11.6	12.8
Copper	100.0%	836	24.07	25	92	22.5	N	20.9	N	23.2	26.9	18.8	N	16.9	25.4
Iron	100.0%	642000	32698	32698	77	17700	N	20800	N	21100	38600	26600	N	32700	29200
Lead	100.0%	2890	14.02	30	50	11	N	19	N	17	15.8	18.9	N	17.3	12.1
Magnesium	100.0%	24900	9071	9071.1	30	10300	N	8430	N	17500	5980	7910	N	5570	8890
Manganese	100.0%	2740	1065.8	1065.8	17	573	N	488	N	758	2380	800	N	723	623
Mercury	61.7%	1.2	0.07	0.1	31		N		N		0.13 J	0.11	N	0.09 J	0.03 J
Nickel	100.0%	2520	41.31	41.3	62	18.4	N	27.4	N	27.2	47.7	31	N	32.9	38.8
Potassium	100.0%	19000	1530	4000	1	1320	N	1140	N	1200	1720	1210	N	1060	1420
Selenium	30.1%	2.1	0.35	2	1	1.6	N	0.26 J	N	0.5 J	0.73 J	0.94	N	0.45 J	0.56 J
Silver	14.7%	10.5	0.59	200	0	0.41 U	N	0.38 U	N	0.46 U	0.47 U	0.43 U	N	0.59 U	0.62 U
Sodium	65.1%	1010	76.4	3000	0	442 J	N	407 J	N	342 J	49.1 J	61.1 J	N	54.8 U	110 J
Vanadium	100.0%	36.8	25.49	150	0	18.4	N	15.9	N	17.2	28	22.4	N	24.3	21.4
Zinc	99.4%	55700	89.14	89.1	108	88.2 J	N	108 J	N	434	98.6	63.7	N	83.1	99.8
Cyanide	3.7%	2.2	0.35	NA	0	0.73 U	N	0.68 U	N	0.65 U	0.57 U	0.61 U	N	0.57 U	0.58 U

TABLE 4 – 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM 1	NUMBER OF SAMPLES ABOVE TAGM	B–40 6–8 12/08/92 B40–4	B–40 8–10 12/08/92 B40–5	B–41 0–2 12/08/92 B41–1	B–41 0–2 12/08/92 B41–1RE	B–41 2–4 12/08/92 B41–2	B–41 2–4 12/08/92 B41–2RE	B–41 5.5–6.5 12/08/92 B41–3	B–41 5.5–6.5 12/08/92 B41–3RE	B–41 6.5–8 12/09/92 B41–4	B–41 6.5–8 12/08/92 B41–4RE
VOCs (μg/kg)															
Vinyl Chloride	6.4%	1000	–	200	5	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Chloroethane	0.5%	3	–	1900	0	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Acetone	8.0%	680	–	200	1	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Carbon Disulfide	1.1%	120	–	2700	0	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
1,1–Dichloroethene	5.9%	140	–	400	0	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
1,2–Dichloroethene (total)	38.5%	79000	–	300	27	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Chloroform	7.0%	32	–	300	0	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
1,2–Dichloroethane	1.1%	210	–	100	2	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
2–Butanone	6.4%	22	–	300	0	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
1,1,1–Trichloroethane	0.5%	3	–	800	0	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Trichloroethene	54.0%	540000	–	700	16	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Benzene	2.1%	6	–	60	0	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Tetrachloroethene	2.1%	7	–	1400	0	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Toluene	25.1%	5700	–	1500	2	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Chlorobenzene	1.1%	620	–	1700	0	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Ethylbenzene	7.0%	2000	–	5500	0	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Xylene (total)	12.3%	17000	–	1200	5	11 U	12 U	11 U	N	12 U	N	11 U	N	11 U	N
Semivolatiles (μg/kg)															
Phenol	1.0%	14000	–	30	2	360 U	380 U	380 UJ	380 UJ	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
bis(2–Chloroethyl) ether	0.5%	9	–	–	NA	360 U	380 U	380 UJ	380 UJ	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
2–Nitrophenol	0.5%	1300	–	330	1	360 U	380 U	380 UJ	380 UJ	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
Benzoic acid	4.0%	1500	–	2700	0										
Naphthalene	19.7%	2500	–	13000	0	360 U	380 U	380 UJ	39 J	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
2–Methylnaphthalene	18.7%	3600	–	36400	0	360 U	380 U	380 UJ	21 J	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
Acenaphthylene	8.3%	510	–	41000	0	360 U	380 U	380 UJ	61 J	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
Acenaphthene	16.1%	14000	–	50000*	0	360 U	380 U	380 UJ	72 J	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
4–Nitrophenol	1.0%	1600	–	100	1	930 U	910 U	920 UJ	960 UJ	960 UJ	950 UJ	960 UJ	860 UJ	860 UJ	870 UJ
Dibenzofuran	11.9%	7000	–	6200	1	360 U	380 U	380 UJ	26 J	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
2,4–Dinitrotoluene	1.0%	2000	–	50000*	0	360 U	380 U	380 UJ	380 UJ	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
Fluorene	17.6%	12000	–	50000*	0	360 U	380 U	380 UJ	54 J	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
N–Nitrosodiphenylamine	0.5%	450	–	50000*	0	360 U	380 U	380 UJ	380 UJ	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
Phenanthrene	42.0%	43000	–	50000*	0	360 U	380 U	130 J	760 J	40 J	60 J	390 UJ	16 J	360 UJ	360 UJ
Anthracene	23.8%	15000	–	50000*	0	360 U	380 U	17 J	150 J	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
Di–n–butylphthalate	27.5%	25000	–	8100	1	360 J	380 U	380 UJ	380 UJ	400 UJ	400 UJ	390 UJ	400 UJ	110 J	430 J
Fluoranthene	44.0%	29000	–	50000*	0	360 U	380 U	280 J	1300 J	76 J	120 J	390 UJ	30 J	360 UJ	360 UJ
Pyrene	46.1%	24000	–	50000*	0	360 U	380 U	220 J	1300 J	63 J	94 J	390 UJ	400 UJ	360 UJ	360 UJ
Butylbenzylphthalate	3.1%	300	–	50000*	0	360 U	380 U	380 UJ	380 UJ	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
Benzo(a)anthracene	36.3%	9600	–	220	32	360 U	380 U	93 J	590 J	27 J	45 J	390 UJ	400 UJ	360 UJ	360 UJ
Chrysene	38.3%	9900	–	400	26	360 U	380 U	150 J	850 J	45 J	65 J	390 UJ	18 J	360 UJ	360 UJ
bis(2–Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	280 J	380 U	380 UJ	380 UJ	400 UJ	400 UJ	690 J	1100 J	380 J	1100 J
Di–n–octylphthalate	3.6%	430	–	50000*	0	360 U	380 U	380 UJ	380 UJ	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	360 U	380 U	160 J	1100 J	43 J	63 J	390 UJ	400 UJ	360 UJ	360 UJ
benzo(k)fluoranthene	34.2%	6700	–	1100	9	360 U	380 U	150 J	670 J	45 J	65 J	390 UJ	400 UJ	360 UJ	360 UJ
Benzo(a)pyrene	33.2%	9000	–	61	52	360 U	380 U	48 J	650 J	15 J	46 J	390 UJ	400 UJ	360 UJ	360 UJ
Indeno(1,2,3–cd)pyrene	28.0%	48000	–	3200	2	360 U	380 U	93 J	290 J	30 J	45 J	390 UJ	400 UJ	360 UJ	360 UJ
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	360 U	380 U	380 UJ	120 J	400 UJ	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	360 U	380 U	74 J	280 J	26 J	400 UJ	390 UJ	400 UJ	360 UJ	360 UJ

TABLE 4 – 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B–40 6–8 12/08/92 B40–4	B–40 8–10 12/08/92 B40–5	B–41 0–2 12/08/92 B41–1	B–41 0–2 12/08/92 B41–1RE	B–41 2–4 12/08/92 B41–2	B–41 2–4 12/08/92 B41–2RE	B–41 5.5–6.5 12/08/92 B41–3	B–41 5.5–6.5 12/08/92 B41–3RE	B–41 6.5–8 12/09/92 B41–4	B–41 6.5–8 12/08/92 B41–4RE
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	–	100	0	1.9 U	2 U	19 U	N	20 U	N	10 U	N	1.8 U	N
Dieldrin	0.6%	46	–	44	1	3.7 U	3.8 U	37 U	N	39 U	N	20 U	N	3.6 U	N
4,4'–DDE	28.9%	290	–	2100	0	3.7 U	3.8 U	91 J	N	66	N	74	N	3.6 U	N
4,4'–DDD	16.7%	350	–	2900	0	3.7 U	3.8 U	260 J	N	350	N	170	N	3.6 U	N
4,4'–DDT	19.4%	260	–	2100	0	3.7 U	3.8 U	39 J	N	27 J	N	29	N	3.6 U	N
Aroclor–1242	3.5%	260	–	1000[2]	0	37 U	38 U	370 U	N	390 U	N	200 U	N	36 U	N
Aroclor–1260	11.7%	770	–	1000[2]	0	37 U	38 U	370 U	N	390 U	N	200 U	N	36 U	N
Herbicides (µg/kg)															
2,4–DB	4.3%	410	–	–	NA	56 U	59 U	56 U	N	60 U	N	60 U	N	54 U	53 U
2,4,5–TP (Silvex)	0.6%	10	–	700	0	5.6 U	5.9 U	5.6 U	N	6 U	N	6 U	N	5.4 U	5.3 U
MCPP	3.0%	24000	–	–	NA	5600 U	5900 U	5600 U	N	6000 U	N	6000 U	N	5400 U	5300 U
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	11600	9270	10100	N	12000	N	18700	N	7460	N
Antimony	8.6%	78.3	5.16	5.2	13	11.6 UJ	12.2 UJ	9.9 UJ	N	8.8 UJ	N	6.7 UJ	N	9.8 UJ	N
Arsenic	99.4%	66.3	5.93	7.5	17	4.1	4.5	4.9	N	3.2	N	4.4	N	2.4	N
Barium	100.0%	1010	101.81	300	4	62.7	43.3 J	68.9	N	87.8	N	105	N	20.4 J	N
Beryllium	96.5%	1.4	0.99	1	34	0.51 J	0.49 J	0.57 J	N	0.55 J	N	0.84	N	0.29 J	N
Cadmium	69.9%	43.1	1.76	1.8	92	0.67 U	0.7 U	0.7 J	N	0.5 U	N	0.38 U	N	0.56 U	N
Calcium	100.0%	172000	46825	46825	42	50500	57300	89100	N	42500	N	7920	N	12100	N
Chromium	100.0%	62	26.57	26.6	81	19.9	16.3	19	N	19.4	N	30.3	N	12.2	N
Cobalt	100.0%	25.1	15.27	30	0	10.4 J	8.5 J	9.7	N	8.2	N	17	N	6 J	N
Copper	100.0%	836	24.07	25	92	25.4	25.1	29.2	N	32.2	N	25.1	N		N
Iron	100.0%	642000	32698	32698	77	25200	22300	20000	N	20000	N	40900	N	15300	N
Lead	100.0%	2890	14.02	30	50	14.2	8.9	81.4	N	52.5	N	26.9	N	4.2	N
Magnesium	100.0%	24900	9071	9071.1	30	9810	6790	16200	N	8600	N	7250	N	3300	N
Manganese	100.0%	2740	1065.8	1065.8	17	523	590	462	N	299	N	528	N		N
Mercury	61.7%	1.2	0.07	0.1	31	0.03 U	0.03 J	0.04 J	N	0.06 J	N	0.06 J	N	0.06	N
Nickel	100.0%	2520	41.31	41.3	62	34.5	26.2	29	N	28.5	N	45.9	N	18	N
Potassium	100.0%	19000	1530	4000	1	1290	941 J	1200	N	1320	N	1140	N	405 J	N
Selenium	30.1%	2.1	0.35	2	1	0.67 J	0.45 J	0.58 J	N	0.82	N	0.54 J	N	0.38 J	N
Silver	14.7%	10.5	0.59	200	0	0.69 U	0.72 U	0.59 U	N	0.52 U	N	0.4 U	N	0.58 U	N
Sodium	65.1%	1010	76.4	3000	0	78.5 J	67.2 U	108 J	N	91.3 J	N	40.3 J	N	54.1 U	N
Vanadium	100.0%	36.8	25.49	150	0	17.3	13.8	27	N	23.6	N	26.4	N	8.3 J	N
Zinc	99.4%	55700	89.14	89.1	108	76.9	96.3	139	N	223	N	123	N	40.5	N
Cyanide	3.7%	2.2	0.35	NA	0	0.53 U	0.47 U	0.69 U	N	0.7 U	N	0.66 U	N	0.62 U	N

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-42 0-2 12/09/92 B42-1	B-42 0-2 12/09/92 B42-1RE	B-42 2-4 12/09/92 B42-2	B-42 2-4 12/09/92 B42-2RE	B-42 4-6 12/09/92 B42-3	B-42 4-6 12/09/92 B42-3RE	B-42 6-7.2 12/09/92 B42-4	B-42 6-7.2 12/09/92 B42-4RE	B-43 0-2 12/09/92 B43-1	B-43 0-2 12/09/92 B43-1RE
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	-	200	5	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
Chloroethane	0.5%	3	-	1900	0	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
Acetone	8.0%	680	-	200	1	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
Carbon Disulfide	1.1%	120	-	2700	0	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
1,1-Dichloroethene	5.9%	140	-	400	0	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
1,2-Dichloroethene (total)	38.5%	79000	-	300	27	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
Chloroform	7.0%	32	-	300	0	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
1,2-Dichloroethane	1.1%	210	-	100	2	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
2-Butanone	6.4%	22	-	300	0	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
1,1,1-Trichloroethane	0.5%	3	-	800	0	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
Trichloroethene	54.0%	540000	-	700	16	90 J	98 J	170 J	230 J	38	N	2 J	N	8 J	N
Benzene	2.1%	6	-	60	0	11 UJ	11 UJ	2 J	3 J	15 U	N	11 U	N	11 U	N
Tetrachloroethene	2.1%	7	-	1400	0	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
Toluene	25.1%	5700	-	1500	2	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
Chlorobenzene	1.1%	620	-	1700	0	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
Ethylbenzene	7.0%	2000	-	5500	0	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	3 J	N
Xylene (total)	12.3%	17000	-	1200	5	11 UJ	11 UJ	12 UJ	12 UJ	15 U	N	11 U	N	11 U	N
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	-	30	2	380 UJ	380 UJ	390 UJ	390 UJ	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
bis(2-Chloroethyl) ether	0.5%	9	-	-	NA	380 UJ	380 UJ	390 UJ	390 UJ	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
2-Nitrophenol	0.5%	1300	-	330	1	380 UJ	380 UJ	390 UJ	390 UJ	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
Benzoic acid	4.0%	1500	-	2700	0										
Naphthalene	19.7%	2500	-	13000	0	380 UJ	44 J	120 J	150 J	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
2-Methylnaphthalene	18.7%	3600	-	36400	0	14 J	15 J	40 J	71 J	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
Acenaphthylene	8.3%	510	-	41000	0	41 J	44 J	390 UJ	23 J	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
Acenaphthene	16.1%	14000	-	50000*	0	54 J	48 J	240 J	390 J	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
4-Nitrophenol	1.0%	1600	-	100	1	920 UJ	920 UJ	950 UJ	950 UJ	990 UJ	990 UJ	870 UJ	880 UJ	6200 UJ	62000 UJ
Dibenzofuran	11.9%	7000	-	6200	1	32 J	25 J	110 J	180 J	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
2,4-Dinitrotoluene	1.0%	2000	-	50000*	0	380 UJ	380 UJ	390 UJ	390 UJ	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
Fluorene	17.6%	12000	-	50000*	0	49 J	39 J	200 J	320 J	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
N-Nitrosodiphenylamine	0.5%	450	-	50000*	0	380 UJ	380 UJ	390 UJ	390 UJ	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
Phenanthrene	42.0%	43000	-	50000*	0	570 J	530 J	1900 J	2200 J	22 J	76 J	360 UJ	360 UJ	160 J	820 J
Anthracene	23.8%	15000	-	50000*	0	120 J	130 J	310 J	560 J	410 UJ	19 J	360 UJ	360 UJ	2500 UJ	25000 UJ
Di-n-butylphthalate	27.5%	25000	-	8100	1	1100 J	820 J	390 UJ	390 UJ	410 UJ	410 UJ	390 J	90 J	82 J	25000 UJ
Fluoranthene	44.0%	29000	-	50000*	0	1100 J	920 J	2700 J	2800 J	32 J	100 J	360 UJ	18 J	240 J	1300 J
Pyrene	46.1%	24000	-	50000*	0	810 J	890 J	2100 J	2400 J	35 J	77 J	360 UJ	13 J	270 J	1100 J
Butylbenzylphthalate	3.1%	300	-	50000*	0	380 UJ	380 UJ	390 UJ	390 UJ	410 UJ	410 UJ	14 J	14 J	2500 UJ	25000 UJ
Benzo(a)anthracene	36.3%	9600	-	220	32	490 J	560 J	1100 J	1500 J	14 J	39 J	360 UJ	360 UJ	140 J	25000 UJ
Chrysene	38.3%	9900	-	400	26	600 J	710 J	1300 J	1600 J	22 J	49 J	360 UJ	360 UJ	170 J	25000 UJ
bis(2-Ethylhexyl)phthalate	50.8%	230000	-	50000*	1	2200 J	1100 J	600 J	550 J	260 UJ	370 J	1500	1200 J	33000 J	2E+05 J
Di-n-octylphthalate	3.6%	430	-	50000*	0	380 UJ	380 UJ	390 UJ	390 UJ	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
Benzo(b)fluoranthene	34.2%	9500	-	1100	11	770 J	800 J	1400 J	1700 J	27 J	59 J	360 UJ	360 UJ	170 J	25000 UJ
benzo(k)fluoranthene	34.2%	6700	-	1100	9	670 J	730 J	1000 J	1200 J	27 J	50 J	360 UJ	360 UJ	180 J	25000 UJ
Benzo(a)pyrene	33.2%	9000	-	61	52	580 J	660 J	780 J	1300 J	410 UJ	38 J	360 UJ	360 UJ	94 J	25000 UJ
Indeno(1,2,3-cd)pyrene	28.0%	48000	-	3200	2	370 J	460 J	510 J	810 J	21 J	39 J	360 UJ	360 UJ	120 J	25000 UJ
Dibenz(a,h)anthracene	13.5%	2100	-	14	26	130 J	170 J	200 J	360 J	410 UJ	410 UJ	360 UJ	360 UJ	2500 UJ	25000 UJ
Benzo(g,h,i)perylene	24.9%	5000	-	50000*	0	290 J	300 J	320 J	620 J	60 J	46 J	360 UJ	360 UJ	2500 UJ	25000 UJ

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-42 0-2 12/09/92 B42-1	B-42 0-2 12/09/92 B42-1RE	B-42 2-4 12/09/92 B42-2	B-42 2-4 12/09/92 B42-2RE	B-42 4-6 12/09/92 B42-3	B-42 4-6 12/09/92 B42-3RE	B-42 6-7.2 12/09/92 B42-4	B-42 6-7.2 12/09/92 B42-4RE	B-43 0-2 12/09/92 B43-1	B-43 0-2 12/09/92 B43-1RE
Pesticides / PCBs (μg/kg)															
Heptachlor	0.6%	14	-	100	0	9.8 U	N	10 U	N	2.1 U	N	1.9 UJ	N	2 UJ	N
Dieldrin	0.6%	46	-	44	1	19 U	N	20 U	N	4.1 U	N	3.6 UJ	N	3.9 UJ	N
4,4'-DDE	28.9%	290	-	2100	0	90 J	N	290	N	14	N	3.6 UJ	N	17 J	N
4,4'-DDD	16.7%	350	-	2900	0	8.4 J	N	15 J	N	1.3 J	N	3.6 UJ	N	18 J	N
4,4'-DDT	19.4%	260	-	2100	0	260 J	N	240	N	30	N	3.6 UJ	N	5.5 J	N
Aroclor-1242	3.5%	260	-	1000[2]	0	190 U	N	200 U	N	41 U	N	36 UJ	N	45 J	N
Aroclor-1260	11.7%	770	-	1000[2]	0	190 U	N	200 U	N	41 U	N	36 UJ	N	39 UJ	N
Herbicides (μg/kg)															
2,4-DB	4.3%	410	-	-	NA	58 U	N	60 U	N	62 U	N	55 U	N	58 U	N
2,4,5-TP (Silvex)	0.6%	10	-	700	0	5.8 U	N	6 U	N	6.2 U	N	5.5 U	N	5.8 U	N
MCPP	3.0%	24000	-	-	NA	5800 U	N	6000 U	N	6200 U	N	5500 U	N	5800 U	N
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	12500	N	12500	N	20600	N	12900	N	13600	N
Antimony	8.6%	78.3	5.16	5.2	13	15.2 J	N	8.6 UJ	N	8.9 UJ	N	7.7 UJ	N	8.5 UJ	N
Arsenic	99.4%	66.3	5.93	7.5	17	8.7	N	10.5	N	7.1	N	3.9	N	7.4	N
Barium	100.0%	1010	101.81	300	4	168	N	218	N	104	N	61	N	116	N
Beryllium	96.5%	1.4	0.99	1	34	0.45 J	N	0.45 J	N	1.1	N	0.57 J	N	0.57 J	N
Cadmium	69.9%	43.1	1.76	1.8	92	2.8	N	3.7	N	0.51 U	N	0.44 U	N	1.8	N
Calcium	100.0%	172000	46825	46825	42	31200	N	32300	N	6320	N	65200	N	37700	N
Chromium	100.0%	62	26.57	26.6	81	48.6	N	52.4	N	41.5	N	21.9	N	33.8	N
Cobalt	100.0%	25.1	15.27	30	0	12.8	N	25.1	N	15.2	N	11.9	N	10.6	N
Copper	100.0%	836	24.07	25	92	177	N	311	N	51.6	N	24.4	N	79.4	N
Iron	100.0%	642000	32698	32698	77	43800	N	49300	N	40900	N	25100	N	35000	N
Lead	100.0%	2890	14.02	30	50	1170	N	672	N	158	N	17.3	N	151	N
Magnesium	100.0%	24900	9071	9071.1	30	8470	N	6760	N	6500	N	9910	N	8830	N
Manganese	100.0%	2740	1065.8	1065.8	17	630	N	589	N	641	N	435	N	476	N
Mercury	61.7%	1.2	0.07	0.1	31	1.2	N	0.89	N	0.38	N	0.04 J	N	0.42	N
Nickel	100.0%	2520	41.31	41.3	62	66	N	2520	N	76.8	N	36.5	N	38.5	N
Potassium	100.0%	19000	1530	4000	1	1420	N	1730	N	1950	N	1460	N	1250	N
Selenium	30.1%	2.1	0.35	2	1	1 J	N	2.1	N	0.88	N	0.67 J	N	1 J	N
Silver	14.7%	10.5	0.59	200	0	10.5	N	2	N	0.53 U	N	0.45 U	N	0.83 J	N
Sodium	65.1%	1010	76.4	3000	0	309 J	N	375 J	N	87.6 J	N	119 J	N	98.5 J	N
Vanadium	100.0%	36.8	25.49	150	0	27.1	N	27.7	N	30.3	N	19.4	N	26.1	N
Zinc	99.4%	55700	89.14	89.1	108	649	N	907	N	171	N	61.5	N	745	N
Cyanide	3.7%	2.2	0.35	NA	0	0.52 U	N	0.51 U	N	0.58 U	N	0.55 U	N	0.59 U	N

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-43 2-4 12/09/92 B43-2	B-43 2-4 12/09/92 B43-2RE	B-43 4-6 12/09/92 B43-3	B-43 4-6 12/09/92 B43-3RE	B-43 8-10 12/09/92 B43-4	B-43 8-10 12/09/92 B43-4RE	B-44 8-8.2 12/10/92 B44A-3	B-44 8-8.2 12/10/92 B44A-3RE	B-44 0-2 12/10/92 B44B-1	B-44 0-2 12/10/92 B44B-1RE
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	-	200	5	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	12 UJ	12 U	12 U	N
Chloroethane	0.5%	3	-	1900	0	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	12 UJ	12 U	12 U	N
Acetone	8.0%	680	-	200	1	13 U	N	36 UJ	48 UJ	24 UJ	14 UJ	93 J	19 J	12 U	N
Carbon Disulfide	1.1%	120	-	2700	0	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	12 UJ	12 U	12 U	N
1,1-Dichloroethene	5.9%	140	-	400	0	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	12 UJ	12 U	12 U	N
1,2-Dichloroethene (total)	38.5%	79000	-	300	27	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	5 J	12 U	12 U	N
Chloroform	7.0%	32	-	300	0	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	12 UJ	12 U	12 U	N
1,2-Dichloroethane	1.1%	210	-	100	2	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	12 UJ	12 U	12 U	N
2-Butanone	6.4%	22	-	300	0	13 U	N	7 J	7 J	13 UJ	13 UJ	16 J	6 J	12 U	N
1,1,1-Trichloroethane	0.5%	3	-	800	0	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	12 UJ	12 U	12 U	N
Trichloroethene	54.0%	540000	-	700	16	8 J	N	11 J	9 J	15 J	15 J	5 J	5 J	12 U	N
Benzene	2.1%	6	-	60	0	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	12 UJ	12 U	12 U	N
Tetrachloroethene	2.1%	7	-	1400	0	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	12 UJ	12 U	12 U	N
Toluene	25.1%	5700	-	1500	2	13 U	N	12 UJ	12 UJ	2 J	2 J	10 J	10 J	12 U	N
Chlorobenzene	1.1%	620	-	1700	0	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	12 UJ	12 U	12 U	N
Ethylbenzene	7.0%	2000	-	5500	0	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	48 J	44 J	12 U	N
Xylene (total)	12.3%	17000	-	1200	5	13 U	N	12 UJ	12 UJ	13 UJ	13 UJ	250 J	240 J	12 U	N
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	-	30	2	2100 J	2800 UJ	1000 UJ	1000 UJ	5800 UJ	7000 UJ	1000 UJ	5100 UJ	410 UJ	420 UJ
bis(2-Chloroethyl) ether	0.5%	9	-	-	NA	2100 UJ	2800 UJ	1000 UJ	1000 UJ	5800 UJ	7000 UJ	1000 UJ	5100 UJ	410 UJ	420 UJ
2-Nitrophenol	0.5%	1300	-	330	1	2100 UJ	2800 UJ	1000 UJ	1000 UJ	5800 UJ	7000 UJ	1000 UJ	5100 UJ	410 UJ	420 UJ
Benzoic acid	4.0%	1500	-	2700	0										
Naphthalene	19.7%	2500	-	13000	0	500 J	2800 UJ	1000 UJ	1000 UJ	1300 J	770 J	150 J	5100 UJ	410 UJ	420 UJ
2-Methylnaphthalene	18.7%	3600	-	36400	0	350 J	2800 UJ	1000 UJ	1000 UJ	1600 J	1300 J	66 J	5100 UJ	410 UJ	420 UJ
Acenaphthylene	8.3%	510	-	41000	0	2100 UJ	2800 UJ	1000 UJ	1000 UJ	5800 UJ	7000 UJ	1000 UJ	5100 UJ	410 UJ	13 J
Acenaphthene	16.1%	14000	-	50000*	0	2100 J	250 J	66 J	1000 UJ	9500 J	14000 J	120 J	5100 UJ	18 J	420 UJ
4-Nitrophenol	1.0%	1600	-	100	1	5200 UJ	6700 UJ	2500 UJ	2500 UJ	14000 UJ	17000 UJ	2500 UJ	12000 UJ	1000 UJ	1000 UJ
Dibenzofuran	11.9%	7000	-	6200	1	990 J	120 J	1000 UJ	1000 UJ	5600 J	7000 J	71 J	5100 UJ	410 UJ	420 UJ
2,4-Dinitrotoluene	1.0%	2000	-	50000*	0	2100 UJ	2800 UJ	1000 UJ	1000 UJ	5800 UJ	7000 UJ	1000 UJ	5100 UJ	410 UJ	420 UJ
Fluorene	17.6%	12000	-	50000*	0	1900 J	230 J	53 J	1000 UJ	12000 J	11000 J	130 J	5100 UJ	17 J	420 UJ
N-Nitrosodiphenylamine	0.5%	450	-	50000*	0	2100 UJ	2800 UJ	1000 UJ	1000 UJ	5800 UJ	7000 UJ	1000 UJ	5100 UJ	410 UJ	420 UJ
Phenanthrene	42.0%	43000	-	50000*	0	15000 J	2600 J	320 J	240 J	43000 J	35000 J	610 J	850 J	140 J	93 J
Anthracene	23.8%	15000	-	50000*	0	2900 J	680 J	95 J	79 J	13000 J	15000 J	140 J	260 J	32 J	22 J
Di-n-butylphthalate	27.5%	25000	-	8100	1	200 J	320 J	1000 UJ	1000 UJ	5800 UJ	7000 UJ	120 J	25000 J	40 J	420 UJ
Fluoranthene	44.0%	29000	-	50000*	0	15000 J	4300 J	410 J	460 J	25000 J	29000 J	440 J	1000 J	200 J	220 J
Pyrene	46.1%	24000	-	50000*	0	14000 J	3600 J	500 J	340 J	24000 J	16000 J	510 J	820 J	180 J	160 J
Butylbenzylphthalate	3.1%	300	-	50000*	0	300 J	300 J	1000 UJ	1000 UJ	5800 UJ	7000 UJ	1000 UJ	5100 UJ	410 UJ	420 UJ
Benzo(a)anthracene	36.3%	9600	-	220	32	8000 J	2200 J	250 J	200 J	5600 J	4300 J	250 J	470 J	97 J	88 J
Chrysene	38.3%	9900	-	400	26	8600 J	2400 J	300 J	230 J	5700 J	4100 J	250 J	520 J	110 J	130 J
bis(2-Ethylhexyl)phthalate	50.8%	230000	-	50000*	1	13000 J	21000 J	3000 J	5800 J	5800 J	3500 J	610 J	25000 J	410 UJ	420 UJ
Di-n-octylphthalate	3.6%	430	-	50000*	0	2100 UJ	2800 UJ	1000 UJ	1000 UJ	5800 UJ	7000 UJ	1000 UJ	5100 UJ	410 UJ	420 UJ
Benzo(b)fluoranthene	34.2%	9500	-	1100	11	7200 J	1900 J	260 J	250 J	2700 J	1400 J	210 J	5100 UJ	110 J	120 J
benzo(k)fluoranthene	34.2%	6700	-	1100	9	5900 J	1600 J	290 J	200 J	2600 J	1400 J	230 J	5100 UJ	99 J	100 J
Benzo(a)pyrene	33.2%	9000	-	61	52	6400 J	1800 J	210 J	210 J	2100 J	1200 J	170 J	350 J	97 J	82 J
Indeno(1,2,3-cd)pyrene	28.0%	48000	-	3200	2	4700 J	1400 J	200 J	150 J	1000 J	450 J	150 J	250 J	79 J	70 J
Dibenz(a,h)anthracene	13.5%	2100	-	14	26	2100 J	480 J	1000 UJ	1000 UJ	5800 UJ	7000 UJ	1000 UJ	5100 UJ	23 J	420 UJ
Benzo(g,h,i)perylene	24.9%	5000	-	50000*	0	2300 J	950 J	260 J	140 J	590 J	7000 UJ	130 J	280 J	57 J	60 J

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ^{1}	NUMBER OF SAMPLES ABOVE TAGM	B-43 2-4 12/09/92 B43-2	B-43 2-4 12/09/92 B43-2RE	B-43 4-6 12/09/92 B43-3	B-43 4-6 12/09/92 B43-3RE	B-43 8-10 12/09/92 B43-4	B-43 8-10 12/09/92 B43-4RE	B-44 8-8.2 12/10/92 B44A-3	B-44 8-8.2 12/10/92 B44A-3RE	B-44 0-2 12/10/92 B44B-1	B-44 0-2 12/10/92 B44B-1RE
Pesticides/ PCBs (µg/kg)															
Heptachlor	0.6%	14	-	100	0	11 U	N	2.1 U	N	2.1 U	N	4.2 U	N	2.1 U	N
Dieldrin	0.6%	46	-	44	1	21 U	N	4.2 U	N	4.1 U	N	8.1 U	N	4.1 U	N
4,4'-DDE	28.9%	290	-	2100	0	64	N	22	N	7.8 J	N	37	N	2.9 J	N
4,4'-DDD	16.7%	350	-	2900	0	88	N	24	N	11 J	N	34	N	4.1 U	N
4,4'-DDT	19.4%	260	-	2100	0	22 J	N	6.7 J	N	4.1 J	N	7.6 J	N	4.1 U	N
Aroclor-1242	3.5%	260	-	1000^2	0	260	N	96	N	68 J	N	50 J	N	41 U	N
Aroclor-1260	11.7%	770	-	1000^2	0	210 U	N	42 U	N	41 U	N	81 U	N	41 U	N
Herbicides (µg/kg)															
2,4-DB	4.3%	410	-	-	NA	64 U	N	63 U	N	62 U	N	N	N	62 U	N
2,4,5-TP (Silvex)	0.6%	10	-	700	0	6.4 U	N	6.3 U	N	6.2 U	N	N	N	6.2 U	N
MCPP	3.0%	24000	-	-	NA	6400 U	N	6300 U	N	6200 U	N	N	N	6200 U	N
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	11100	N	16300	N	13500	N	11600	N	15000	N
Antimony	8.6%	78.3	5.16	5.2	13	10.2 UJ	N	7.8 UJ	N	13.5 UJ	N	8.5 UJ	N	10.7 UJ	N
Arsenic	99.4%	66.3	5.93	7.5	17	8.4	N	7.5	N	6.5	N	6.1	N	5.3	N
Barium	100.0%	1010	101.81	300	4	114	N	166	N	108	N	113	N	73.3	N
Beryllium	96.5%	1.4	0.99	1	34	0.44 J	N	0.55 J	N	0.58 J	N	0.44 J	N	0.63 J	N
Cadmium	69.9%	43.1	1.76	1.8	92	11.4	N	3.9	N	7.8	N	1.5	N	0.61 U	N
Calcium	100.0%	172000	46825	46825	42	21100	N	54400	N	38500	N	37500	N	9720	N
Chromium	100.0%	62	26.57	26.6	81	35.6	N	36.8	N	35.1	N	32	N	35.8	N
Cobalt	100.0%	25.1	15.27	30	0	21.6	N	12.2	N	10.9 J	N	9	N	12.3	N
Copper	100.0%	836	24.07	25	92	91.8	N	89.3	N	68.1	N	224	N	24.2	N
Iron	100.0%	642000	32698	32698	77	65100	N	67500	N	60800	N	46700	N	28700	N
Lead	100.0%	2890	14.02	30	50	2610	N	233	N	150	N	250	N	21.1	N
Magnesium	100.0%	24900	9071	9071.1	30	4900	N	9960	N	7940	N	9020	N	6190	N
Manganese	100.0%	2740	1065.8	1065.8	17	405	N	860	N	792	N	585	N	634	N
Mercury	61.7%	1.2	0.07	0.1	31	0.38	N	0.38	N	0.26	N	0.65	N	0.04 J	N
Nickel	100.0%	2520	41.31	41.3	62	43.3	N	51	N	42.8	N	35.3	N	46.6	N
Potassium	100.0%	19000	1530	4000	1	1140	N	1420	N	1440	N	1340	N	1220	N
Selenium	30.1%	2.1	0.35	2	1	1.2	N	0.82 J	N	0.77 J	N	1.1 J	N	0.7 J	N
Silver	14.7%	10.5	0.59	200	0	1.3 J	N	0.9 J	N	1.8 J	N	2.4	N	0.63 U	N
Sodium	65.1%	1010	76.4	3000	0	118 J	N	216 J	N	127 J	N	1010	N	58.9 U	N
Vanadium	100.0%	36.8	25.49	150	0	20.5	N	29.3	N	26.1	N	18.2	N	22.9	N
Zinc	99.4%	55700	89.14	89.1	108	1410	N	3100	N	1710	N	525	N	75.7	N
Cyanide	3.7%	2.2	0.35	NA	0	0.62 U	N	0.95	N	0.77 U	N	0.74 U	N	0.75 U	N

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-44 2-4 12/10/92 B44B-2	B-44 2-4 12/10/92 B44B-2RE	B-44 8-10 12/10/92 B44B-3	B-44 8-10 12/10/92 B44B-3RE	B-44 12-13.5 12/10/92 B44B-4	B-44 12-13.5 12/10/92 B44B-4RE	B-45 0-2 04/28/93 B45-1	B-45 2-4 04/28/93 B45-2	B-45 4-6 04/28/93 B45-3	B-45 4-6 04/28/93 B45-6
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	–	200	5	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
Chloroethane	0.5%	3	–	1900	0	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
Acetone	8.0%	680	–	200	1	12 U	12 U	45	N	11 U	N	12 U	12 U	12 U	12 U
Carbon Disulfide	1.1%	120	–	2700	0	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
1,1-Dichloroethene	5.9%	140	–	400	0	12 U	12 U	12 U	N	14	N	12 U	12 U	12 U	12 U
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	12 U	12 U	2 J	N	36	N	3 J	3 J	210 J	4 J
Chloroform	7.0%	32	–	300	0	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
1,2-Dichloroethane	1.1%	210	–	100	2	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
2-Butanone	6.4%	22	–	300	0	12 U	12 U	6 J	N	11 U	N	12 U	12 U	12 U	12 U
1,1,1-Trichloroethane	0.5%	3	–	800	0	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
Trichloroethene	54.0%	540000	–	700	16	12 U	2 J	12 U	N	11 U	N	12 U	12 U	71 J	12 U
Benzene	2.1%	6	–	60	0	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
Tetrachloroethene	2.1%	7	–	1400	0	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
Toluene	25.1%	5700	–	1500	2	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
Chlorobenzene	1.1%	620	–	1700	0	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
Ethylbenzene	7.0%	2000	–	5500	0	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
Xylene (total)	12.3%	17000	–	1200	5	12 U	12 U	12 U	N	11 U	N	12 U	12 U	12 U	12 U
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	–	30	2	400 UJ	400 UJ	380 UJ	390 UJ	360 UJ	360 UJ	430 U	410 U	380 U	400 U
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	400 UJ	400 UJ	380 UJ	390 UJ	360 UJ	360 UJ	430 U	410 U	380 U	400 U
2-Nitrophenol	0.5%	1300	–	330	1	400 UJ	400 UJ	380 UJ	390 UJ	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Benzoic acid	4.0%	1500	–	2700	0										
Naphthalene	19.7%	2500	–	13000	0	400 UJ	100 J	87 J	86 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
2-Methylnaphthalene	18.7%	3600	–	36400	0	400 UJ	100 J	33 J	48 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Acenaphthylene	8.3%	510	–	41000	0	400 UJ	76 J	380 UJ	44 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Acenaphthene	16.1%	14000	–	50000*	0	400 UJ	280 J	120 J	140 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
4-Nitrophenol	1.0%	1600	–	100	1	970 UJ	980 UJ	930 UJ	950 UJ	860 UJ	870 UJ	1000 U	1000 U	930 U	970 U
Dibenzofuran	11.9%	7000	–	6200	1	400 UJ	120 J	47 J	69 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	400 UJ	400 UJ	380 UJ	390 UJ	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Fluorene	17.6%	12000	–	50000*	0	400 UJ	250 J	89 J	130 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	400 UJ	400 UJ	380 UJ	390 UJ	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Phenanthrene	42.0%	43000	–	50000*	0	87 J	2000 J	640 J	1000 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Anthracene	23.8%	15000	–	50000*	0	14 J	550 J	140 J	260 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Di-n-butylphthalate	27.5%	25000	–	8100	1	18 J	400 UJ	72 J	390 UJ	73 J	360 UJ	430 U	25 J	140 J	42 J
Fluoranthene	44.0%	29000	–	50000*	0	120 J	2600 J	700 J	1200 J	360 UJ	13 J	430 U	410 U	380 U	400 U
Pyrene	46.1%	24000	–	50000*	0	140 J	2200 J	560 J	1200 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Butylbenzylphthalate	3.1%	300	–	50000*	0	400 UJ	400 UJ	380 UJ	390 UJ	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Benzo(a)anthracene	36.3%	9600	–	220	32	62 J	1400 J	340 J	550 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Chrysene	38.3%	9900	–	400	26	81 J	1500 J	370 J	660 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	400 UJ	400 UJ	400 J	740 J	470 J	860 J	260 J	320 J	450	530
Di-n-octylphthalate	3.6%	430	–	50000*	0	400 UJ	400 UJ	380 UJ	390 UJ	360 UJ	360 UJ	430 U	410 U	47 J	400 U
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	88 J	1500 J	360 J	610 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
benzo(k)fluoranthene	34.2%	6700	–	1100	9	81 J	1200 J	300 J	490 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Benzo(a)pyrene	33.2%	9000	–	61	52	51 J	1200 J	270 J	460 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	62 J	610 J	170 J	150 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	400 UJ	270 J	63 J	22 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	44 J	430 J	90 J	120 J	360 UJ	360 UJ	430 U	410 U	380 U	400 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM [1]	NUMBER OF SAMPLES ABOVE TAGM	B-44 2-4 12/10/92 B44B-2	B-44 2-4 12/10/92 B44B-2RE	B-44 8-10 12/10/92 B44B-3	B-44 8-10 12/10/92 B44B-3RE	B-44 12-13.5 12/10/92 B44B-4	B-44 12-13.5 12/10/92 B44B-4RE	B-45 0-2 04/28/93 B45-1	B-45 2-4 04/28/93 B45-2	B-45 4-6 04/28/93 B45-3	B-45 4-6 04/28/93 B45-6
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	-	100	0	2.1 U	N	2 U	N	1.9 U	N	2.2 U	2.2 U	2 U	2.1 U
Dieldrin	0.6%	46	-	44	1	4 U	N	3.9 U	N	3.6 U	N	4.3 U	4.2 U	3.8 U	4 U
4,4'-DDE	28.9%	290	-	2100	0	14	N	7.3 J	N	3.6 U	N	4.3 U	4.2 U	3.8 U	4 U
4,4'-DDD	16.7%	350	-	2900	0	17	N	3.8 J	N	3.6 U	N	4.3 U	4.2 U	3.8 U	4 U
4,4'-DDT	19.4%	260	-	2100	0	14	N	5.8	N	3.6 U	N	4.3 U	4.2 U	3.8 U	4 U
Aroclor-1242	3.5%	260	-	1000[2]	0	40 U	N	39 U	N	36 U	N	43 U	42 U	38 U	40 U
Aroclor-1260	11.7%	770	-	1000[2]	0	40 U	N	39 U	N	36 U	N	43 U	42 U	38 U	40 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	-	-	NA	61 U	N	59 U	N	55 U	N	68 U	64 U	59 U	62 U
2,4,5-TP (Silvex)	0.6%	10	-	700	0	6.1 U	N	5.9 U	N	5.5 U	N	6.8 U	6.4 U	5.9 U	6.2 U
MCPP	3.0%	24000	-	-	NA	6100 U	N	5900 U	N	5500 U	N	6800 U	6400 U	5900 U	6200 U
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	13400	N	9850	N	15400	N	19700	14800	15200	16900
Antimony	8.6%	78.3	5.16	5.2	13	10.2 UJ	N	12.1 UJ	N	11.9 UJ	N	5.3 UJ	5.4 UJ	10.1 J	5.7 UJ
Arsenic	99.4%	66.3	5.93	7.5	17	5.4	N	5.1	N	4.7	N	4.6	5.2	2.7	5.8
Barium	100.0%	1010	101.81	300	4	91	N	58.5	N	59.3	N	114	71.4	64.8	87.1
Beryllium	96.5%	1.4	0.99	1	34	0.68 J	N	0.53 J	N	0.72 J	N	0.96 J	0.73 J	0.7 J	0.84 J
Cadmium	69.9%	43.1	1.76	1.8	92	0.58 U	N	0.69 U	N	0.68 U	N	0.39 U	0.39 U	0.37 U	0.41 U
Calcium	100.0%	172000	46825	46825	42	36300	N	44500	N	7260	N	4870	16300	2690	6710
Chromium	100.0%	62	26.57	26.6	81	25.1	N	17.6	N	26.9	N	31.2	23.3	25.5	27
Cobalt	100.0%	25.1	15.27	30	0	11.8	N	9.1 J	N	13.7	N	16.8	12.7	13.7	15.8
Copper	100.0%	836	24.07	25	92	27.9	N	29.6	N	16.2	N	31.6	27.7	19.5	29.4
Iron	100.0%	642000	32698	32698	77	26100	N	20600	N	32100	N	38300	30200	31700	34400
Lead	100.0%	2890	14.02	30	50	31.8	N	192	N	8.6	N	11.1	10.5	5.9	8.4
Magnesium	100.0%	24900	9071	9071.1	30	9120	N	8820	N	6280	N	7320	6770	5960	6530
Manganese	100.0%	2740	1065.8	1065.8	17	583	N	415	N	511	N	1020	621	601	736
Mercury	61.7%	1.2	0.07	0.1	31	0.07	N	0.07 J	N	0.03 J	N	0.05 U	0.04 U	0.05 U	0.03 U
Nickel	100.0%	2520	41.31	41.3	62	37.7	N	30.8	N	39.5	N	50	37.9	39.5	44.9
Potassium	100.0%	19000	1530	4000	1	982	N	1060 J	N	1110	N	1320	1130	925 J	1110
Selenium	30.1%	2.1	0.35	2	1	0.58 J	N	0.54 J	N	0.59 J	N	0.18 U	0.2 U	0.16 U	0.17 U
Silver	14.7%	10.5	0.59	200	0	0.6 U	N	0.71 U	N	0.71 U	N	0.83 U	0.84 U	0.8 U	0.89 U
Sodium	65.1%	1010	76.4	3000	0	136 J	N	160 J	N	65.9 U	N	98.8 U	100 U	95.1 U	106 U
Vanadium	100.0%	36.8	25.49	150	0	25.1	N	17.4	N	19.7	N	29.8	21.3	19.7	24.6
Zinc	99.4%	55700	89.14	89.1	108	102	N	83.9	N	107	N	86.6	94.1	98.8	108
Cyanide	3.7%	2.2	0.35	NA	0	0.74 U	N	0.67 U	N	0.68 U	N	0.81 U	0.77 U	0.69 U	0.74 U

TABLE 4-3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-46 0-2 04/29/93 B46-1	B-46 0-2 04/29/93 B46-1RE	B-46 2-4 04/29/93 B46-2	B-46 4-6 04/29/93 B46-3	B-46 6-7.1 04/29/93 B46-4	B-47 0-2 04/29/93 B47-1	B-47 0-2 04/29/93 B47-1RE	B-47 2-4 04/29/93 B47-2	B-47 4-5.3 04/29/93 B47-3	B-48 0-2 04/29/93 B48-1
VOCs (µg/kg)															
Vinyl Chloride	6.4%	1000	-	200	5	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
Chloroethane	0.5%	3	-	1900	0	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
Acetone	8.0%	680	-	200	1	12 U	N	100	75	12 U	10 UJ	10 UJ	42	53 U	12 U
Carbon Disulfide	1.1%	120	-	2700	0	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
1,1-Dichloroethene	5.9%	140	-	400	0	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	13	28 J	12 U
1,2-Dichloroethene (total)	38.5%	79000	-	300	27	12 U	N	2 J	12 U	12 U	2 J	1 J	170	650	12 U
Chloroform	7.0%	32	-	300	0	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
1,2-Dichloroethane	1.1%	210	-	100	2	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
2-Butanone	6.4%	22	-	300	0	12 U	N	22	17	12 U	10 UJ	10 UJ	7 J	53 U	12 U
1,1,1-Trichloroethane	0.5%	3	-	800	0	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
Trichloroethene	54.0%	540000	-	700	16	12 U	N	3 J	1 J	12 U	110 J	39 J	2 J	98	75
Benzene	2.1%	6	-	60	0	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
Tetrachloroethene	2.1%	7	-	1400	0	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
Toluene	25.1%	5700	-	1500	2	12 U	N	12 U	12 U	12 U	4 J	2 J	12 U	53 U	2 J
Chlorobenzene	1.1%	620	-	1700	0	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
Ethylbenzene	7.0%	2000	-	5500	0	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
Xylene (total)	12.3%	17000	-	1200	5	12 U	N	12 U	12 U	12 U	10 UJ	10 UJ	12 U	53 U	12 U
Semivolatiles (µg/kg)															
Phenol	1.0%	14000	-	30	2	360 UJ	360 UJ	380 U	370 U	380 U	350 U	N	380 U	360 U	410 U
bis(2-Chloroethyl) ether	0.5%	9	-	-	NA	360 UJ	360 UJ	380 U	370 U	380 U	350 U	N	380 U	360 U	410 U
2-Nitrophenol	0.5%	1300	-	330	1	360 UJ	360 UJ	380 U	370 U	380 U	350 U	N	380 U	360 U	410 U
Benzoic acid	4.0%	1500	-	2700	0							N			
Naphthalene	19.7%	2500	-	13000	0	21 J	20 J	39 J	370 U	380 U	350 U	N	380 U	360 U	410 U
2-Methylnaphthalene	18.7%	3600	-	36400	0	360 UJ	360 UJ	70 J	370 U	380 U	350 U	N	380 U	360 U	410 U
Acenaphthylene	8.3%	510	-	41000	0	42 J	32 J	27 J	370 U	380 U	350 U	N	380 U	360 U	410 U
Acenaphthene	16.1%	14000	-	50000*	0	38 J	36 J	160 J	370 U	380 U	350 U	N	380 U	360 U	410 U
4-Nitrophenol	1.0%	1600	-	100	1	880 UJ	880 UJ	920 U	900 U	920 U	840 U	N	930 U	880 U	1000 U
Dibenzofuran	11.9%	7000	-	6200	1	18 J	18 J	130 J	370 U	380 U	350 U	N	380 U	360 U	410 U
2,4-Dinitrotoluene	1.0%	2000	-	50000*	0	360 UJ	360 UJ	380 U	370 U	380 U	350 U	N	380 U	360 U	410 U
Fluorene	17.6%	12000	-	50000*	0	39 J	41 J	280 J	22 J	380 U	350 U	N	380 U	360 U	410 U
N-Nitrosodiphenylamine	0.5%	450	-	50000*	0	360 UJ	360 UJ	380 U	370 U	380 U	350 U	N	380 U	360 U	410 U
Phenanthrene	42.0%	43000	-	50000*	0	530 J	520 J	1100	91 J	380 U	90 J	N	380 U	360 U	110 J
Anthracene	23.8%	15000	-	50000*	0	140 J	130 J	340 J	32 J	380 U	18 J	N	380 U	360 U	21 J
Di-n-butylphthalate	27.5%	25000	-	8100	1	68 J	62 J	87 J	66 J	170 J	180 J	N	260 J	160 J	100 J
Fluoranthene	44.0%	29000	-	50000*	0	1100 J	900 J	900	160 J	18 J	170 J	N	28 J	360 U	180 J
Pyrene	46.1%	24000	-	50000*	0	1200 J	1300 J	630	130 J	380 U	140 J	N	23 J	360 U	130 J
Butylbenzylphthalate	3.1%	300	-	50000*	0	360 UJ	360 UJ	380 U	370 U	380 U	350 U	N	380 U	360 U	410 U
Benzo(a)anthracene	36.3%	9600	-	220	32	640 J	640 J	330 J	68 J	380 U	70 J	N	380 U	360 U	76 J
Chrysene	38.3%	9900	-	400	26	670 J	660 J	300 J	64 J	380 U	91 J	N	22 J	360 U	96 J
bis(2-Ethylhexyl)phthalate	50.8%	230000	-	50000*	1	190 J	190 J	220 J	200 J	340 J	340 J	N	580	250 J	320 J
Di-n-octylphthalate	3.6%	430	-	50000*	0	360 UJ	360 UJ	380 U	370 U	29 J	350 U	N	27 J	360 U	410 U
Benzo(b)fluoranthene	34.2%	9500	-	1100	11	560 J	560 J	210 J	55 J	380 U	67 J	N	380 U	360 U	93 J
benzo(k)fluoranthene	34.2%	6700	-	1100	9	540 J	600 J	240 J	53 J	380 U	52 J	N	18 J	360 U	85 J
Benzo(a)pyrene	33.2%	9000	-	61	52	660 J	670 J	270 J	68 J	380 U	52 J	N	380 U	360 U	75 J
Indeno(1,2,3-cd)pyrene	28.0%	48000	-	3200	2	410 J	400 J	140 J	40 J	380 U	31 J	N	380 U	360 U	59 J
Dibenz(a,h)anthracene	13.5%	2100	-	14	26	120 J	75 J	30 J	370 U	380 U	350 U	N	380 U	360 U	410 U
Benzo(g,h,i)perylene	24.9%	5000	-	50000*	0	200 J	200 J	71 J	23 J	380 U	21 J	N	380 U	360 U	35 J

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B-46 0-2 04/29/93 B46-1	B-46 0-2 04/29/93 B46-1RE	B-46 2-4 04/29/93 B46-2	B-46 4-6 04/29/93 B46-3	B-46 6-7.1 04/29/93 B46-4	B-47 0-2 04/29/93 B47-1	B-47 0-2 04/29/93 B47-1RE	B-47 2-4 04/29/93 B47-2	B-47 4-5.3 04/29/93 B47-3	B-48 0-2 04/29/93 B48-1
Pesticides / PCBs (µg/kg)															
Heptachlor	0.6%	14	-	100	0	9.3 U	N	1.9 U	1.9 U	1.9 U	1.8 U	N	2 U	1.9 U	4.2 U
Dieldrin	0.6%	46	-	44	1	18 U	N	3.8 U	3.6 U	3.8 U	3.4 U	N	3.9 U	3.6 U	8.2 U
4,4'-DDE	28.9%	290	-	2100	0	45	N	3.7 J	6.6	3.8 U	240 J	N	4.4	3.6 U	70
4,4'-DDD	16.7%	350	-	2900	0	42 J	N	3.8 U	1.8 J	3.8 U	3.4 U	N	3.9 U	3.6 U	15 J
4,4'-DDT	19.4%	260	-	2100	0	160	N	2.2 J	3 J	3.8 U	23	N	3.9 U	3.6 U	26
Aroclor-1242	3.5%	260	-	1000^2	0	180 U	N	38 U	36 U	38 U	34 U	N	39 U	36 U	82 U
Aroclor-1260	11.7%	770	-	1000^2	0	180 U	N	38 U	36 U	38 U	34 U	N	39 U	36 U	82 U
Herbicides (µg/kg)															
2,4-DB	4.3%	410	-	-	NA	55 U	N	58 U	56 U	58 U	53 U	N	59 U	56 U	63 U
2,4,5-TP (Silvex)	0.6%	10	-	700	0	5.5 U	N	5.8 U	5.6 U	5.8 U	5.3 U	N	5.9 U	5.6 U	6.3 U
MCPP	3.0%	24000	-	-	NA	5500 U	N	5800 U	5600 U	5800 U	5300 U	N	5900 U	5600 U	6300 U
Metals (mg/kg)															
Aluminum	100.0%	25500	17503	17503	51	12100	N	15300	9600	14400	10100	N	17500	17300	10800
Antimony	8.6%	78.3	5.16	5.2	13	4.5 UJ	N	4.1 UJ	5.9 UJ	5.1 UJ	4 UJ	N	3.5 UJ	6.1 UJ	5.6 J
Arsenic	99.4%	66.3	5.93	7.5	17	4.8	N	7.3	4.7	3.9	3.1	N	4.8	3.2	4.9
Barium	100.0%	1010	101.81	300	4	109	N	96.4	69.9	66.4	55.8	N	79.3	68.8	82.2
Beryllium	96.5%	1.4	0.99	1	34	0.64 J	N	0.78	0.52 J	0.76 J	0.5 J	N	0.85	0.81 J	0.61 J
Cadmium	69.9%	43.1	1.76	1.8	92	0.33 U	N	0.3 U	0.54 J	0.37 U	0.29 U	N	0.26 U	0.44 U	0.34 J
Calcium	100.0%	172000	46825	46825	42	39300	N	20200	2E+05	90500	69400	N	8640	37100	18200
Chromium	100.0%	62	26.57	26.6	81	18.7	N	28	15.3	24.1	19.9	N	26.3	31	21.8
Cobalt	100.0%	25.1	15.27	30	0	13.3	N	12	7.3 J	11.7	9.9	N	16.4	12.6	9
Copper	100.0%	836	24.07	25	92	19.8	N	34	19.2	18.7	30.3	N	21.6	23.3	48
Iron	100.0%	642000	32698	32698	77	24600	N	27200	16200	27700	22800	N	32700	33400	22700
Lead	100.0%	2890	14.02	30	50	45.4	N	64	19.1	8.7	40.9	N	12	6	82.5
Magnesium	100.0%	24900	9071	9071.1	30	6520	N	6760	9270	10900	8850	N	5460	7330	4410
Manganese	100.0%	2740	1065.8	1065.8	17	1570	N	526	445	898	370	N	942	643	520
Mercury	61.7%	1.2	0.07	0.1	31	0.05 J	N	0.07 J	0.05 J	0.04 U	0.06 J	N	0.05 U	0.05 U	0.1
Nickel	100.0%	2520	41.31	41.3	62	29.9	N	35.9	22.9	37	35.3	N	36.2	43.6	31.4
Potassium	100.0%	19000	1530	4000	1	1330	N	1570	1440	1470	1170	N	973	1420	1090
Selenium	30.1%	2.1	0.35	2	1	0.14 U	N	0.2 U	0.54 J	0.2 U	0.15 U	N	0.2 U	0.82 J	0.71 J
Silver	14.7%	10.5	0.59	200	0	0.71 U	N	0.65 U	0.92 U	0.8 U	0.63 U	N	0.56 U	0.95 U	0.61 U
Sodium	65.1%	1010	76.4	3000	0	230 J	N	249 J	232 J	141 J	137 J	N	68 J	187 J	75 J
Vanadium	100.0%	36.8	25.49	150	0	18.9	N	23.1	17.3	19.1	15.4	N	22.3	22.4	18.1
Zinc	99.4%	55700	89.14	89.1	108	136	N	235	86.7	65.6	472	N	84.3	74.9	308
Cyanide	3.7%	2.2	0.35	NA	0	0.56 U	N	0.56 U	0.55 U	0.57 U	0.53 U	N	0.71 U	0.67 U	0.75 U

Notes:

1) [1] New York State Guidelines

No TAGM was available for 1,2 DCE total, therefore the value for trans 1,2 DCE was used.

* = As per proposed TAGM, total VOCs <10,000ppb, total Semi-VOCs<500,000 ppb, Individual Semi-VOCs<50,000 ppb.

Values for Arocolor-1242 and Arodor-1260 are for total PCBs.

2) NA = Not Applicable

3) N = Compound not analyzed

4) U = Compound not detected at tabulated detection limit.

5) J = The reported value should be considered an estimate.

6) R = This datum was rejected during the data validation process.

7) UJ = The analyte was not detected; however, the associated reporting limit is approximate.

TABLE 4-3

SUMMARY OF COMPOUNDS DETI
SOIL

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM ¹	NUMBER OF SAMPLES ABOVE TAGM	B-48 2-4 04/29/93 B48-2	B-48 4-6 04/29/93 B48-3	B-48 4-6 04/29/93 B48-6
VOCs (µg/kg)								
Vinyl Chloride	6.4%	1000	–	200	5	12 U	19 U	18 U
Chloroethane	0.5%	3	–	1900	0	12 U	19 U	18 U
Acetone	8.0%	680	–	200	1	12 U	19 U	18 U
Carbon Disulfide	1.1%	120	–	2700	0	12 U	19 U	18 U
1,1-Dichloroethene	5.9%	140	–	400	0	12 U	5 J	5 J
1,2-Dichloroethene (total)	38.5%	79000	–	300	27	12 U	110	130
Chloroform	7.0%	32	–	300	0	12 U	19 U	18 U
1,2-Dichloroethane	1.1%	210	–	100	2	12 U	19 U	18 U
2-Butanone	6.4%	22	–	300	0	12 U	19 U	18 U
1,1,1-Trichloroethane	0.5%	3	–	800	0	12 U	19 U	18 U
Trichloroethene	54.0%	540000	–	700	16	10 J	200	200
Benzene	2.1%	6	–	60	0	12 U	19 U	18 U
Tetrachloroethene	2.1%	7	–	1400	0	12 U	19 U	18 U
Toluene	25.1%	5700	–	1500	2	12 U	19 U	18 U
Chlorobenzene	1.1%	620	–	1700	0	12 U	19 U	18 U
Ethylbenzene	7.0%	2000	–	5500	0	12 U	19 U	18 U
Xylene (total)	12.3%	17000	–	1200	5	12 U	19 U	18 U
Semivolatiles (µg/kg)								
Phenol	1.0%	14000	–	30	2	390 U	380 U	400 U
bis(2-Chloroethyl) ether	0.5%	9	–	–	NA	390 U	380 U	400 U
2-Nitrophenol	0.5%	1300	–	330	1	390 U	380 U	400 U
Benzoic acid	4.0%	1500	–	2700	0			
Naphthalene	19.7%	2500	–	13000	0	390 U	380 U	400 U
2-Methylnaphthalene	18.7%	3600	–	36400	0	390 U	380 U	400 U
Acenaphthylene	8.3%	510	–	41000	0	390 U	380 U	400 U
Acenaphthene	16.1%	14000	–	50000*	0	390 U	380 U	400 U
4-Nitrophenol	1.0%	1600	–	100	1	950 U	930 U	960 U
Dibenzofuran	11.9%	7000	–	6200	1	390 U	380 U	400 U
2,4-Dinitrotoluene	1.0%	2000	–	50000*	0	390 U	380 U	400 U
Fluorene	17.6%	12000	–	50000*	0	390 U	380 U	400 U
N-Nitrosodiphenylamine	0.5%	450	–	50000*	0	390 U	380 U	400 U
Phenanthrene	42.0%	43000	–	50000*	0	390 U	380 U	400 U
Anthracene	23.8%	15000	–	50000*	0	390 U	380 U	400 U
Di-n-butylphthalate	27.5%	25000	–	8100	1	130 J	110 J	72 J
Fluoranthene	44.0%	29000	–	50000*	0	390 U	380 U	400 U
Pyrene	46.1%	24000	–	50000*	0	390 U	380 U	400 U
Butylbenzylphthalate	3.1%	300	–	50000*	0	390 U	380 U	400 U
Benzo(a)anthracene	36.3%	9600	–	220	32	390 U	380 U	400 U
Chrysene	38.3%	9900	–	400	26	390 U	380 U	400 U
bis(2-Ethylhexyl)phthalate	50.8%	230000	–	50000*	1	520	240 J	170 J
Di-n-octylphthalate	3.6%	430	–	50000*	0	390 U	380 U	400 U
Benzo(b)fluoranthene	34.2%	9500	–	1100	11	390 U	380 U	400 U
benzo(k)fluoranthene	34.2%	6700	–	1100	9	390 U	380 U	400 U
Benzo(a)pyrene	33.2%	9000	–	61	52	390 U	380 U	400 U
Indeno(1,2,3-cd)pyrene	28.0%	48000	–	3200	2	390 U	380 U	400 U
Dibenz(a,h)anthracene	13.5%	2100	–	14	26	390 U	380 U	400 U
Benzo(g,h,i)perylene	24.9%	5000	–	50000*	0	390 U	380 U	400 U

TABLE 4 - 3

SUMMARY OF COMPOUNDS DETECTED SOIL

SENECA ARMY DEPOT ASH LANDFILL

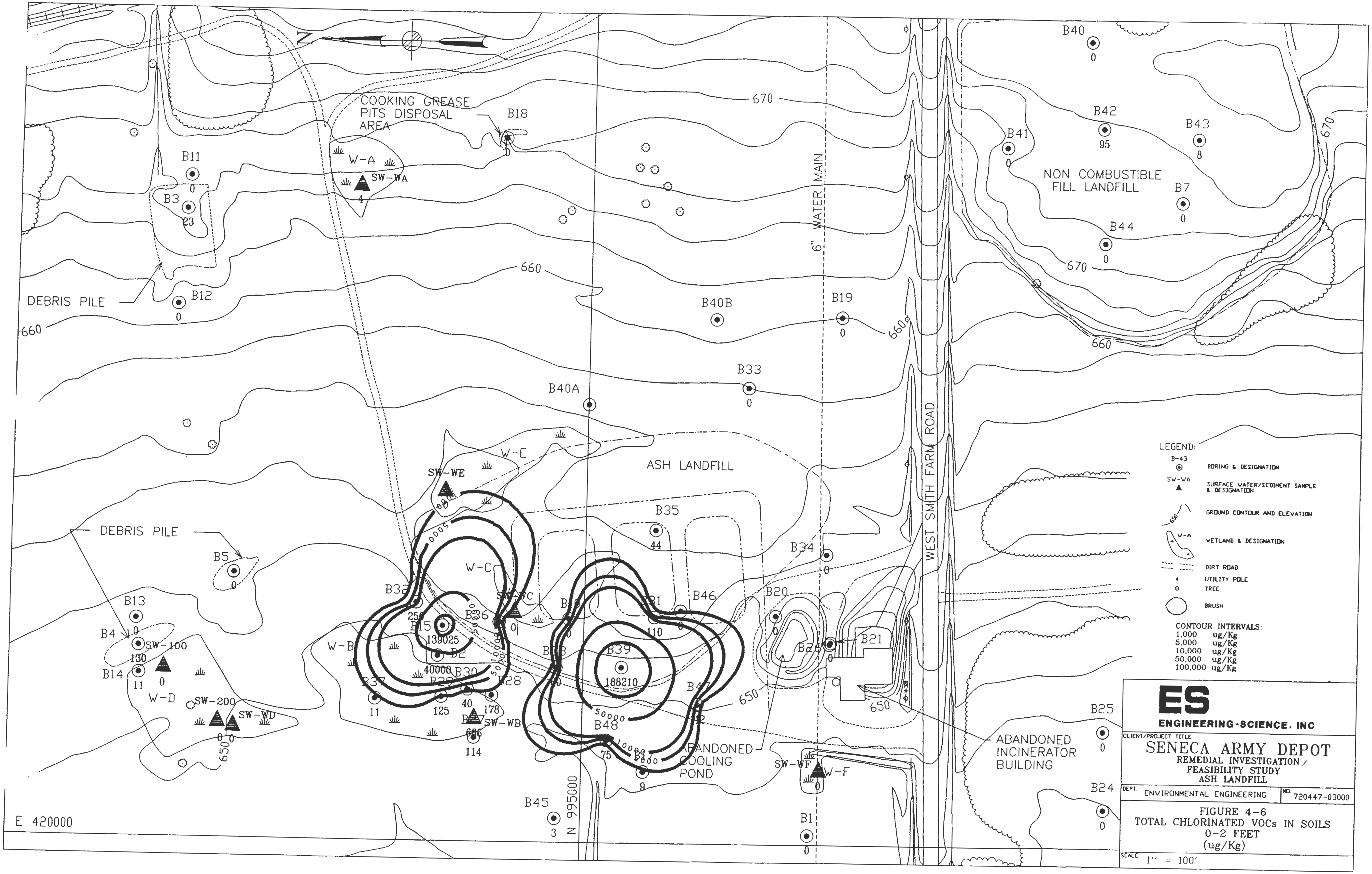
	FREQUENCY OF DETECTION	MAXIMUM VALUE	SITE BACKGROUND	TAGM[1]	NUMBER OF SAMPLES ABOVE TAGM	B-48 2-4 04/29/93 B48-2	B-48 4-6 04/29/93 B48-3	B-48 4-6 04/29/93 B48-6
Pesticides / PCBs (µg/kg)								
Heptachlor	0.6%	14	-	100	0	2 U	2 U	2 U
Dieldrin	0.6%	46	-	44	1	3.9 U	3.9 U	4 U
4,4'-DDE	28.9%	290	-	2100	0	5.4	5.8	4 U
4,4'-DDD	16.7%	350	-	2900	0	2.7 J	2.5 J	4 U
4,4'-DDT	19.4%	260	-	2100	0	2 J	4.9	4 U
Arodor-1242	3.5%	260	-	1000[2]	0	39 U	39 U	40 U
Arodor-1260	11.7%	770	-	1000[2]	0	39 U	39 U	40 U
Herbicides (µg/kg)								
2,4-DB	4.3%	410	-	-	NA	60 U	59 U	61 U
2,4,5-TP (Silvex)	0.6%	10	-	700	0	6 U	5.9 U	6.1 U
MCPP	3.0%	24000	-	-	NA	6000 U	5900 U	6100 U
Metals (mg/kg)								
Aluminum	100.0%	25500	17503	17503	51	14000	12100	11100
Antimony	8.6%	78.3	5.16	5.2	13	4.8 UJ	4.4 J	4 UJ
Arsenic	99.4%	66.3	5.93	7.5	17	4.9	4.9	5.1
Barium	100.0%	1010	101.81	300	4	115	50.6	41.1
Beryllium	96.5%	1.4	0.99	1	34	0.76 J	0.55 J	0.53 J
Cadmium	69.9%	43.1	1.76	1.8	92	0.35 U	1.3	0.29 U
Calcium	100.0%	172000	46825	46825	42	3780	60100 J	16000 J
Chromium	100.0%	62	26.57	26.6	81	21.2	19.9	18.6
Cobalt	100.0%	25.1	15.27	30	0	13.3	11.4	11
Copper	100.0%	836	24.07	25	92	28.1	24.1	19.9
Iron	100.0%	642000	32698	32698	77	26900	24800	23100
Lead	100.0%	2890	14.02	30	50	15.5	8.4	9.2
Magnesium	100.0%	24900	9071	9071.1	30	4310	8210	7090
Manganese	100.0%	2740	1065.8	1065.8	17	1290	571	501
Mercury	61.7%	1.2	0.07	0.1	31	0.04 U	0.04 U	0.03 U
Nickel	100.0%	2520	41.31	41.3	62	29.8	34.1	31.3
Potassium	100.0%	19000	1530	4000	1	1540	1110	894
Selenium	30.1%	2.1	0.35	2	1	0.37 J	0.87 J	0.25 J
Silver	14.7%	10.5	0.59	200	0	0.75 U	0.53 U	0.62 U
Sodium	65.1%	1010	76.4	3000	0	89.8 U	176 J	121 J
Vanadium	100.0%	36.8	25.49	150	0	26.4	16.7	15.2
Zinc	99.4%	55700	89.14	89.1	108	115	103	83.5
Cyanide	3.7%	2.2	0.35	NA	0	0.71 U	0.68 U	0.69 U

Notes:

1) [1] New York State Guidelines
No TAGM was available for 1,2 DCE total, therefore the value for trans 1,2 DCE was used.
* = As per proposed TAGM, total VOCs <10,000ppb, total Semi-VOCs<500,000 ppb, Individual Semi-VOCs<50,000 ppb.
Values for Arocolor-1242 and Aroclor-1260 are for total PCBs.
2) NA = Not Applicable
3) N = Compound not analyzed
4) U = Compound not detected at tabulated detection limit.
5) J = The reported value should be considered an estimate.
6) R = This datum was rejected during the data validation process.
7) UJ = The analyte was not detected; however, the associated reporting limit is approximate.

The highest chlorinated volatile organic concentration in soil for this investigation was observed north and adjacent to the Ash Landfill at the bend in the road. As shown on Table 4-3 the maximum soil constituent concentration in this area is 540,000 ug/kg TCE in the 2 to 4-foot depth interval in boring B15. As shown on Figures 4-6 and 4-7, this boring is the horizontal and vertical center of the maximum total chlorinated volatile organic concentration observed in soil in this investigation (north TCE hot spot). Figures 4-6 and 4-7 indicate a second TCE hotspot west and adjacent to the Ash Landfill (west TCE hotspot). This TCE hotspot is centered horizontally on B39 where the maximum total chlorinated volatiles concentration is estimated to be 188,000 ug/kg at the 0 to 2-foot depth interval (refer to Table 4-3). This concentration is 150,000 ug/kg TCE and 38,000 ug/kg 1,2-DCE. At the next depth interval down (2 to 4 feet) the total chlorinated volatiles concentration drops to 9,000 ug/kg and, consists of 7,300 ug/kg 1,2-DCE, only 700 ug/kg TCE and 1,000 ug/kg vinyl chloride.

The horizontal extent of the two TCE hotspots are defined by the 1,000 ug/kg contours on Figures 4-6 and 4-7. The 1,000 ug/kg concentration is an approximate sum of the NYSDEC soil clean-up limits (TAGM limits TCE = 700 ug/kg, 1,2 DCE = 300 ug/kg, and vinylchloride = 200 ug/kg), for chlorinated volatiles present in this area. Within the 0 to 4 foot depth range, the north TCE hotspot encompasses a one-half acre area and the west TCE hotspot encompasses a one acre area. Within the depth range of 4 to 8 feet the two TCE hotspots merge together and the center shifts westward slightly; the maximum total chlorinated volatiles is estimated to be 35,000 ug/kg at the 4 to 6 foot depth interval of B29 (21,000 ug/kg TCE and 14,000 ug/kg 1,2-DCE). Within the depth range of 6 to 8 feet the maximum concentration is estimated to be 142,000 ug/kg at B2 (120,000 ug/kg TCE, 21,000 ug/kg 1,2-DCE and 1,000 ug/kg vinyl chloride). The contours for depths greater than 4 feet are on Figures 4-8 through 4-10. The vertical extent of total chlorinated volatiles in the soil is defined by the deepest soil sample collected before competent shale was encountered. This was collected at a depth of nine feet from B2 where a concentration of 69,000 ug/kg of TCE was estimated. All other borings in the area of the Ash Landfill encountered refusal at depths shallower than eight feet and therefore no deeper soil samples could be collected. The horizontal extent of the merged hotspot, as defined by concentrations exceeding the TAGM, is approximately one and one-half acres within the depth interval of 4 to 8 feet.



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ENGINEERING-SCIENCE, INC

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING

NO. 720447-03000

FIGURE 4-6
TOTAL CHLORINATED VOCs IN SOILS
0-2 FEET
(ug/Kg)

SCALE 1" = 100'

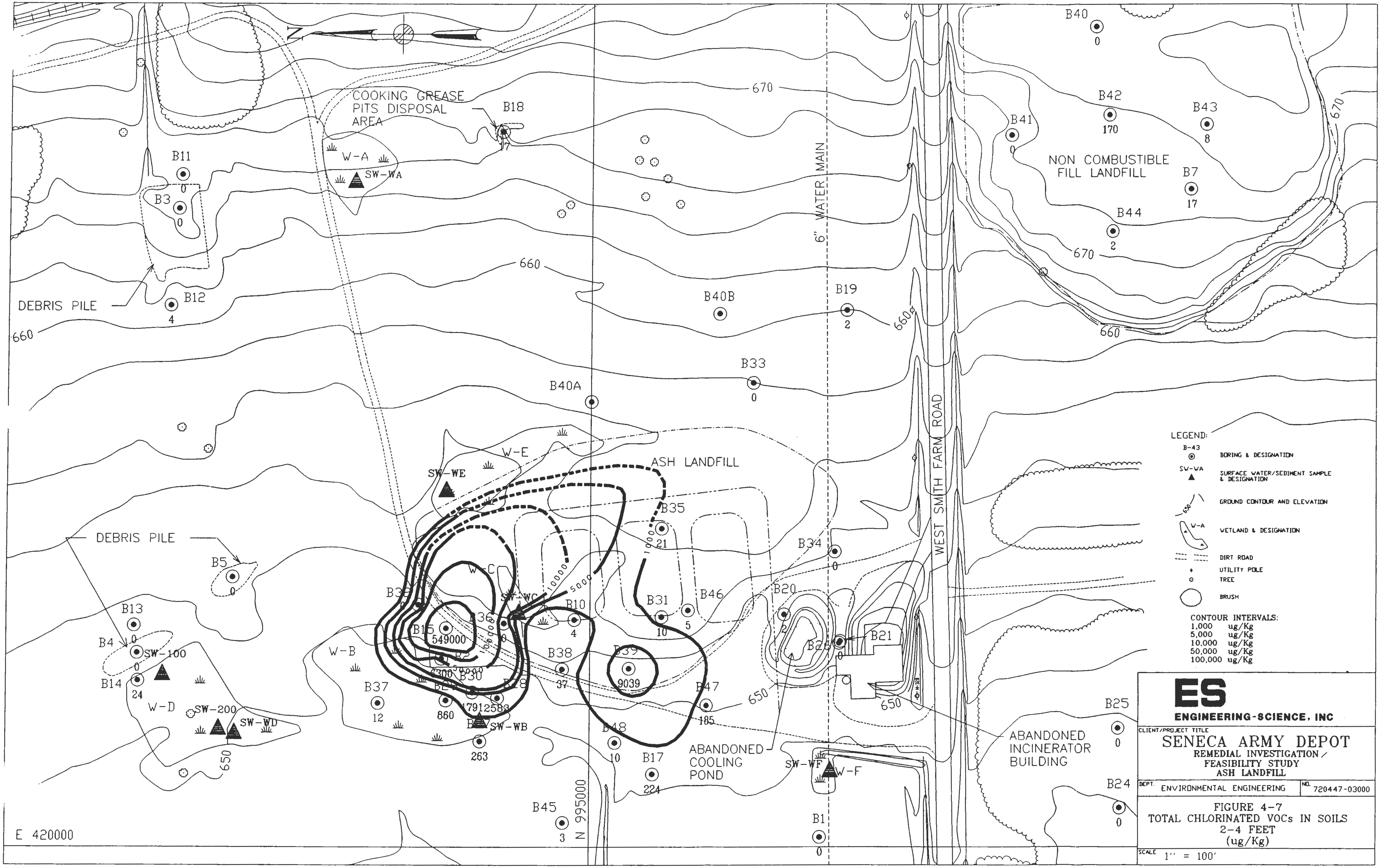

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FIGURE 4-7
TOTAL CHLORINATED VOCs IN SOILS
2-4 FEET
(ug/Kg)

SCALE 1" = 100'

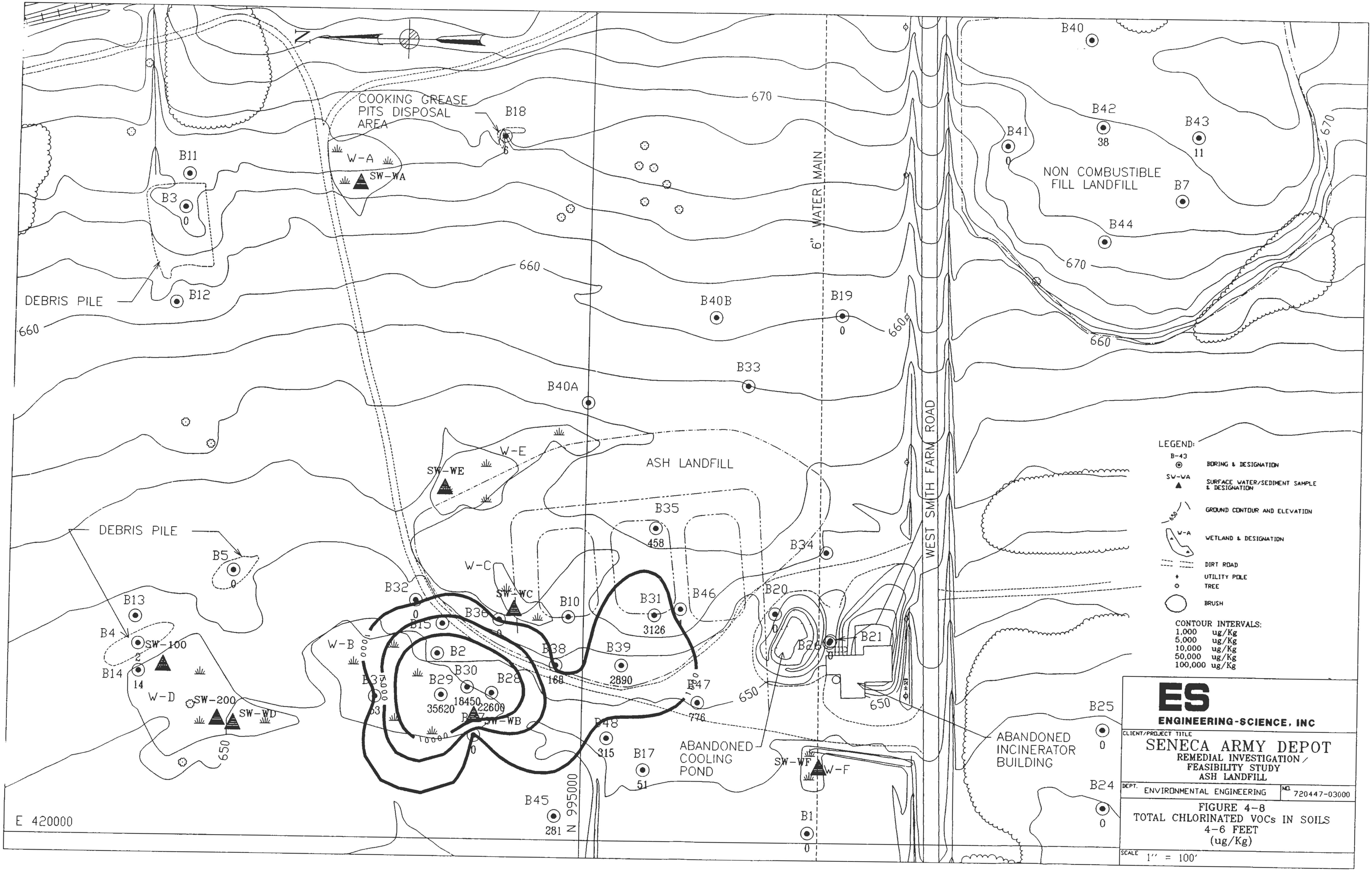

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FIGURE 4-8
TOTAL CHLORINATED VOCs IN SOILS
4-6 FEET
(ug/Kg)

SCALE 1'' = 100'

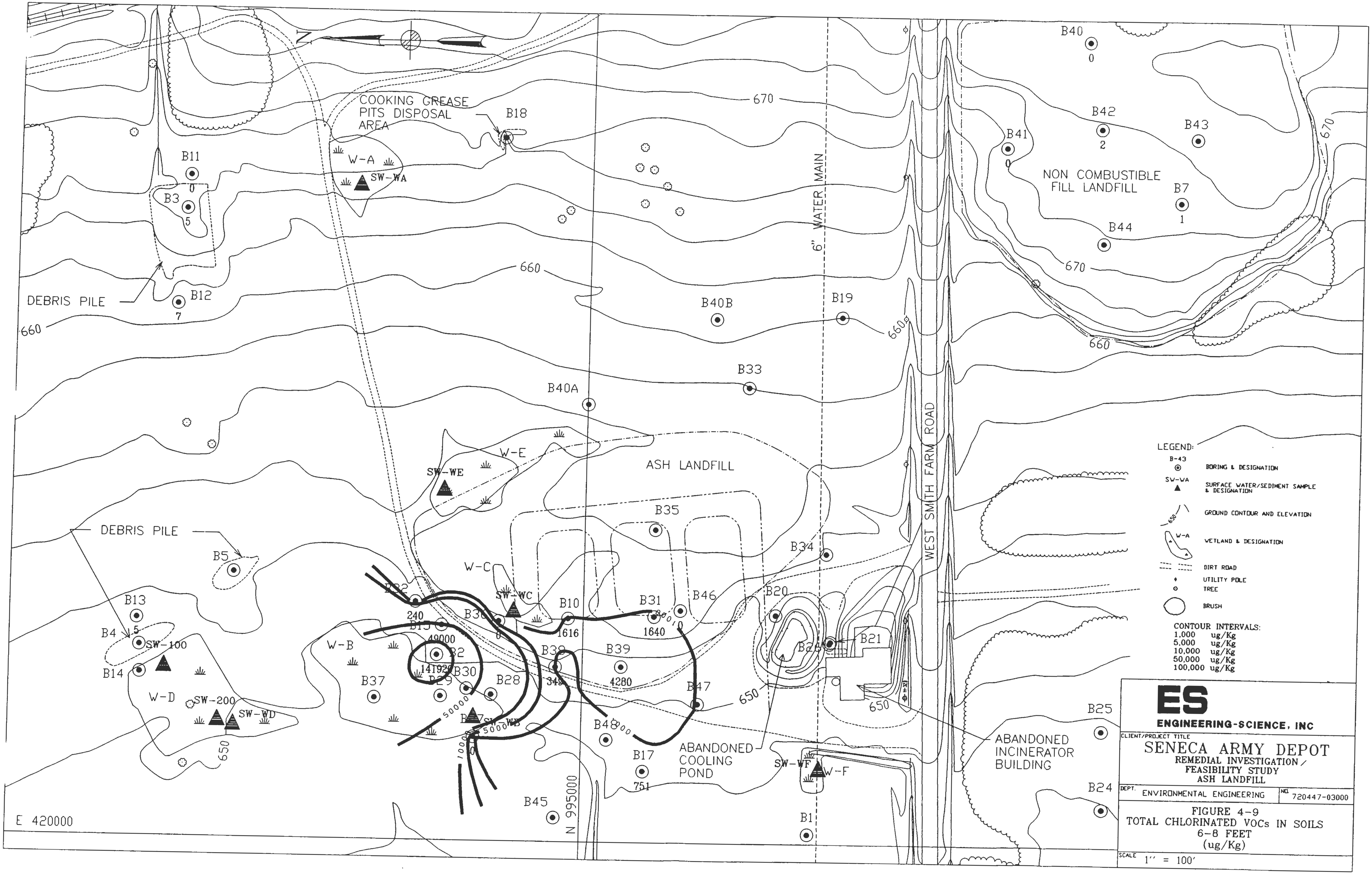

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FIGURE 4-9
TOTAL CHLORINATED VOCs IN SOILS
6-8 FEET
(ug/Kg)

SCALE 1" = 100'

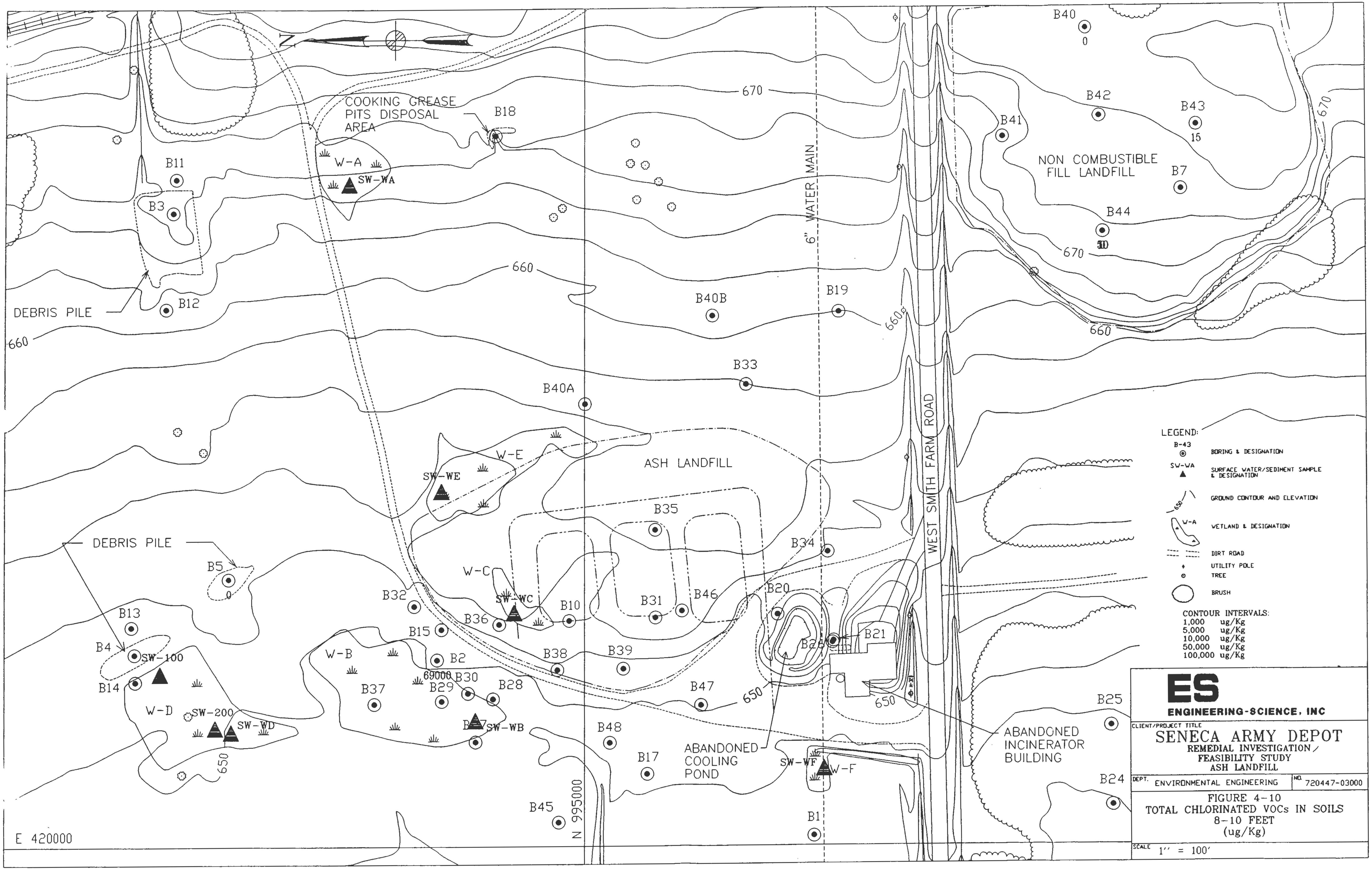

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FIGURE 4-10
TOTAL CHLORINATED VOCs IN SOILS
8-10 FEET
(ug/Kg)

SCALE 1'' = 100'

4.3.1.2 Non-Combustible Fill Landfill

The soil samples collected from the Non-Combustible Fill Landfill (borings B7, B40 through B44) were typically below detection limits (BDL) for chlorinated volatiles. Only one TAGM excursion was observed for chlorinated volatiles in the Ash Landfill. That occurred at B47 in the 4 to 5.3 foot depth interval: 650 ug/kg 1,2-DCE. Low concentrations of 1,2-DCE and TCE were detected (max. 230 ug/kg TCE) in B42, B43, B47 and B48: all below the TAGM. All other concentrations were BDL or near the detection limit (trace) and well below the TAGM.

4.3.1.3 Debris Piles

The debris piles consist of three areas; the cooking grease disposal area (B18) the east pile (B3, B11 and B12) and the west pile (B4, B5, B13 and B-14). The soil samples collected from the debris piles were typically BDL for chlorinated volatiles. The maximum of 130 ug/kg total chlorinated volatiles (all TCE) was detected in B4 at a depth of 0 to 2 feet, well below the TAGM. All other concentrations were BDL or near the detection limit (trace) and well below the TAGM.

4.3.2 BTEX

4.3.2.1 Ash Landfill

As with total chlorinated volatiles, the highest concentration of the BTEX group of volatile organics was observed at B15 north and adjacent to the Ash Landfill. As shown on Table 4-3 the maximum BTEX concentration was 23,000 ug/kg (17,000 ug/kg xylenes and 6,000 ug/kg toluene) at the depth interval 2 to 4 feet. This is the horizontal and vertical center of the maximum BTEX concentration observed in soil in this investigation. The primary constituents in the BTEX group are toluene and xylene. Benzene is near zero in this group, observed at trace amounts in 2 percent of all soil sample and BDL in the remaining samples. Therefore a BTEX TAGM of 2,000 ug/kg (conservative, based on toluene of 1,500 ug/kg and xylenes of 1200 ug/kg), is used to define the extent of the BTEX hotspot. As shown on the Figures 4-11 through 4-13, this hotspot coincides with the north TCE hotspot (discussed previously in Section 4.3.1.1). The horizontal extent is approximately one quarter acre centered on B15 and the vertical extent is 0 to 4 feet (above the water table).

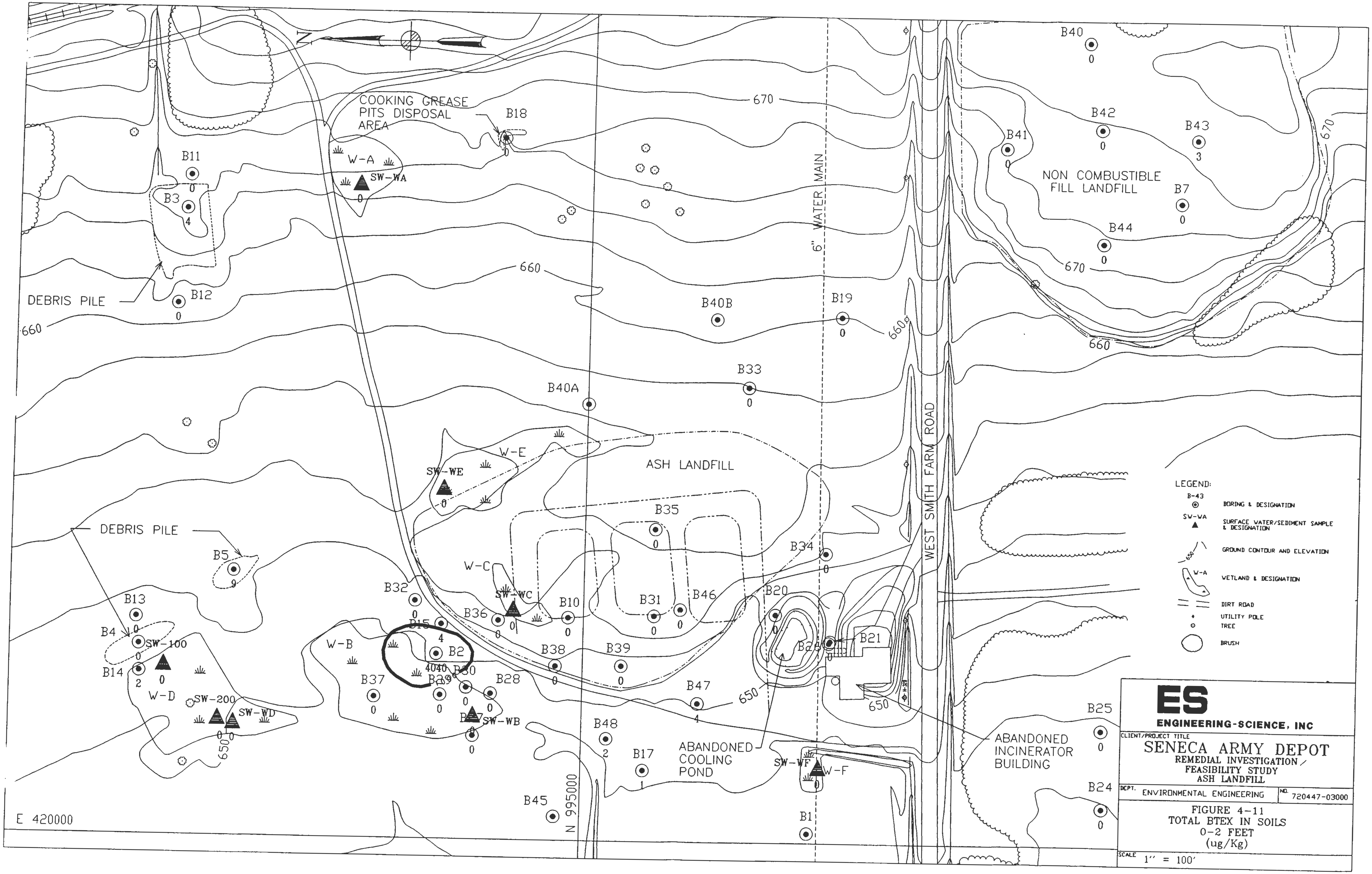

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FIGURE 4-11
TOTAL BTEX IN SOILS
0-2 FEET
(ug/Kg)

SCALE 1'' = 100'

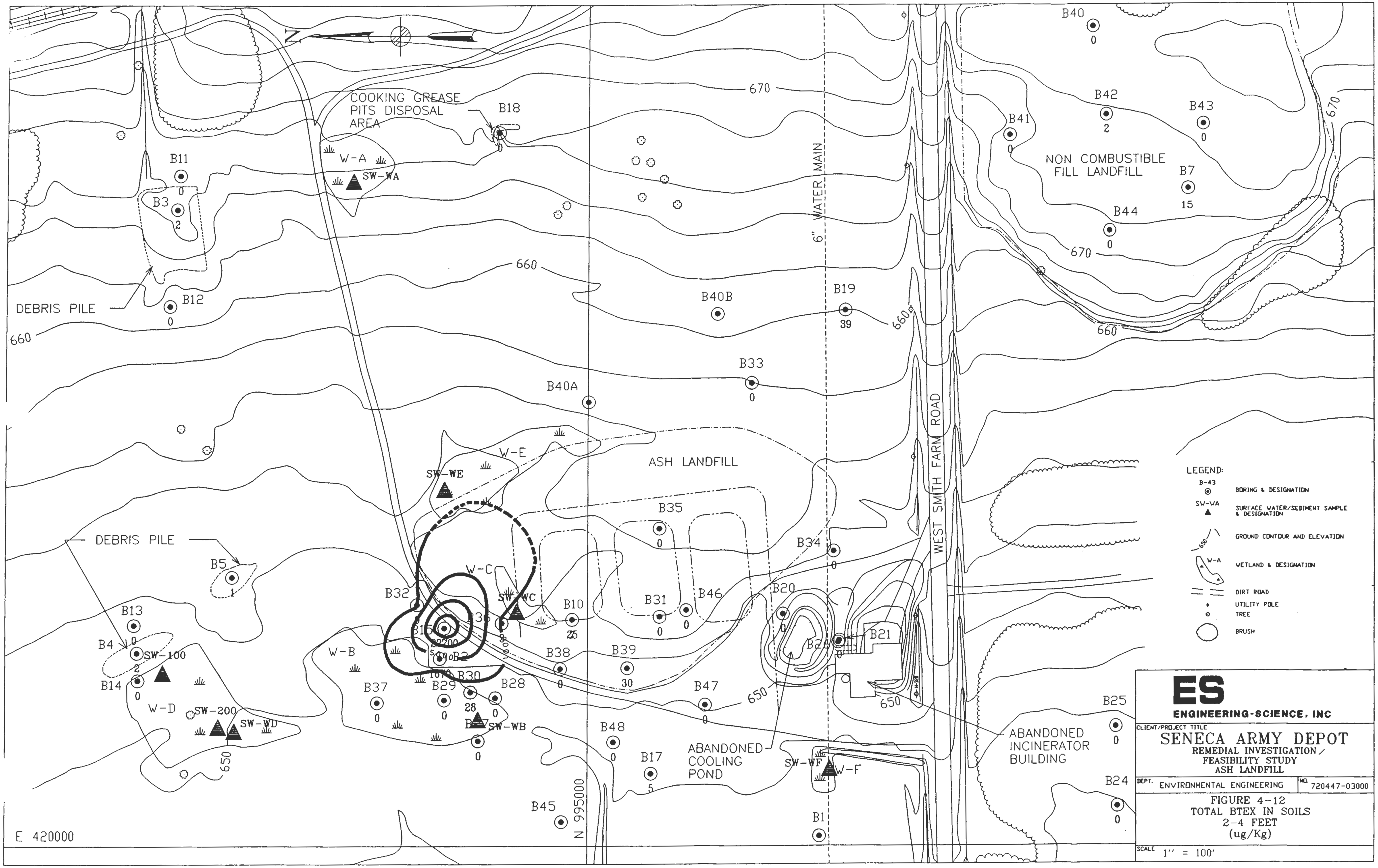

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FIGURE 4-12
TOTAL BTEX IN SOILS
2-4 FEET
(ug/Kg)

SCALE 1" = 100'

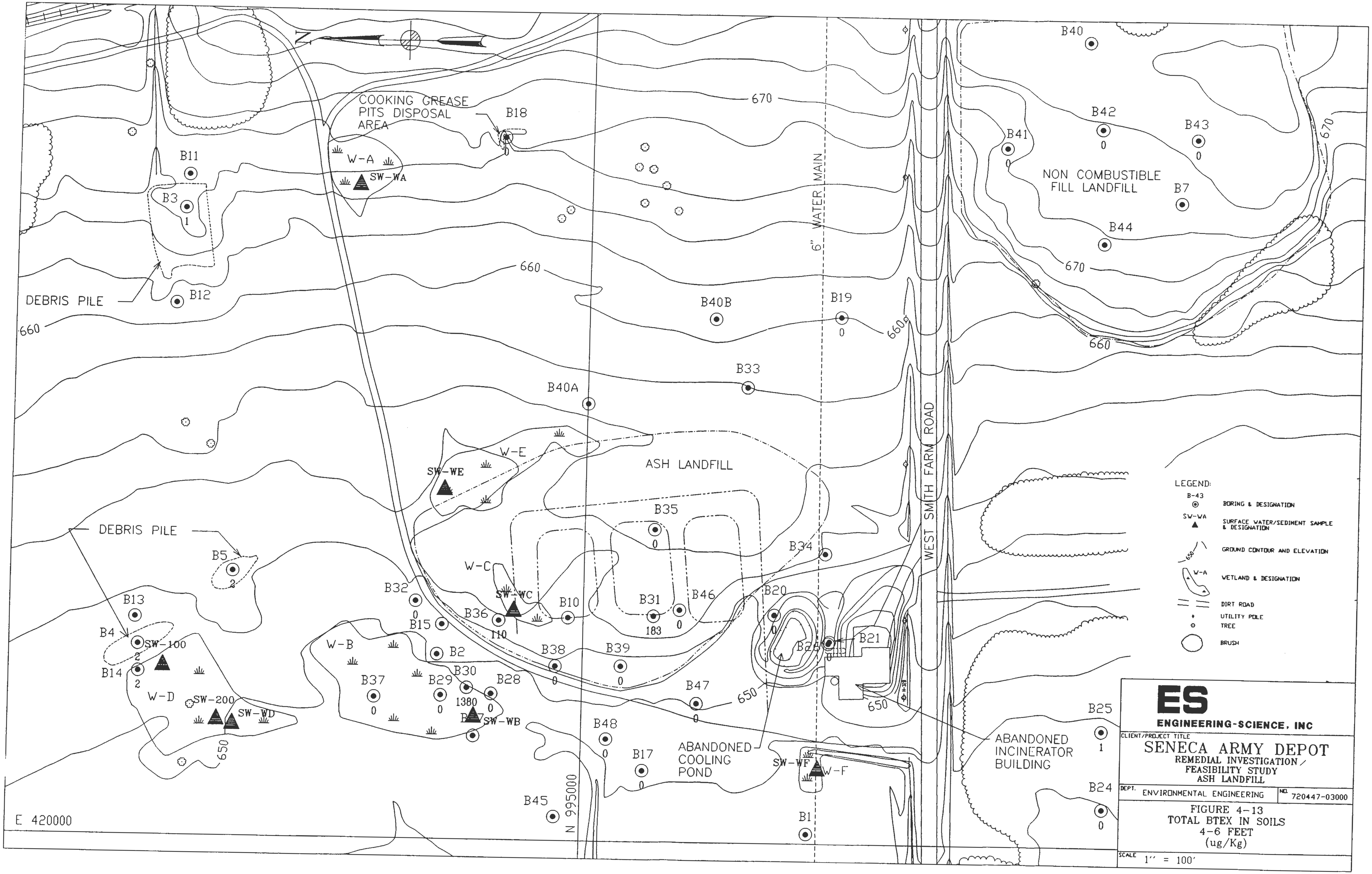

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FIGURE 4-13
TOTAL BTEX IN SOILS
4-6 FEET
(ug/Kg)

SCALE 1" = 100'

4.3.2.2 Non-Combustible Fill Landfill

Soil BTEX concentrations are typically BDL in this area, with a maximum value of 3 ug/kg at B43 in the 0 to 2 foot depth interval.

4.3.2.3 Debris Piles

Soil BTEX concentrations are typically BDL in this area, with a maximum value of 9 ug/kg at B5, in the 0 to 2 foot depth interval.

4.3.3 Total Phthalates

There are a total of four phthalates in this subset group which is within the larger semi-volatile organic compounds group listed in Table 4-3. These four phthalates are di-n-butylphthate, butylbenzylphthate, bis (2-ethylhexyl)phthalate, and di-n-octylphthalate. These compounds have been grouped separately from other semi-volatiles because they are relatively prevalent in these soil samples (bis(2-ethylhexyl)phthalate was detected in 50 percent of the soil samples; the highest frequency of detection) and low in toxicity (TAGM range of 8,100 to 50,000 ug/kg). The source of these phthalates is not known. However, most of the phthalates were found in the landfill areas, particularly the Non-Combustible Fill Landfill, where test pits uncovered scrap plastic pieces. Since phthalates are used as plasticizers in many plastics, it is very possible that this is the source.

4.3.3.1 Ash Landfill

There are no phthalates above the TAGM in this area of investigation. The maximum concentration observed was 1,700 ug/kg (bis(2-ethylhexyl)phthalate (TAGM of 50,000 ug/kg in the 4 to 5 foot interval of B35). The vast majority of samples are BDL or at low concentrations for phthalates.

4.3.3.2 Non-Combustible Fill Landfill

The one sample above the TAGM for phthalates is in the Non-Combustible Fill Landfill (B43 at 0 to 2 feet) where the concentration of bis(2-ethylhexyl) phthalate was measured at 230,000 ug/kg (TAGM of 50,000 ug/kg). Figures 4-14 through 4-17 show the concentration contours

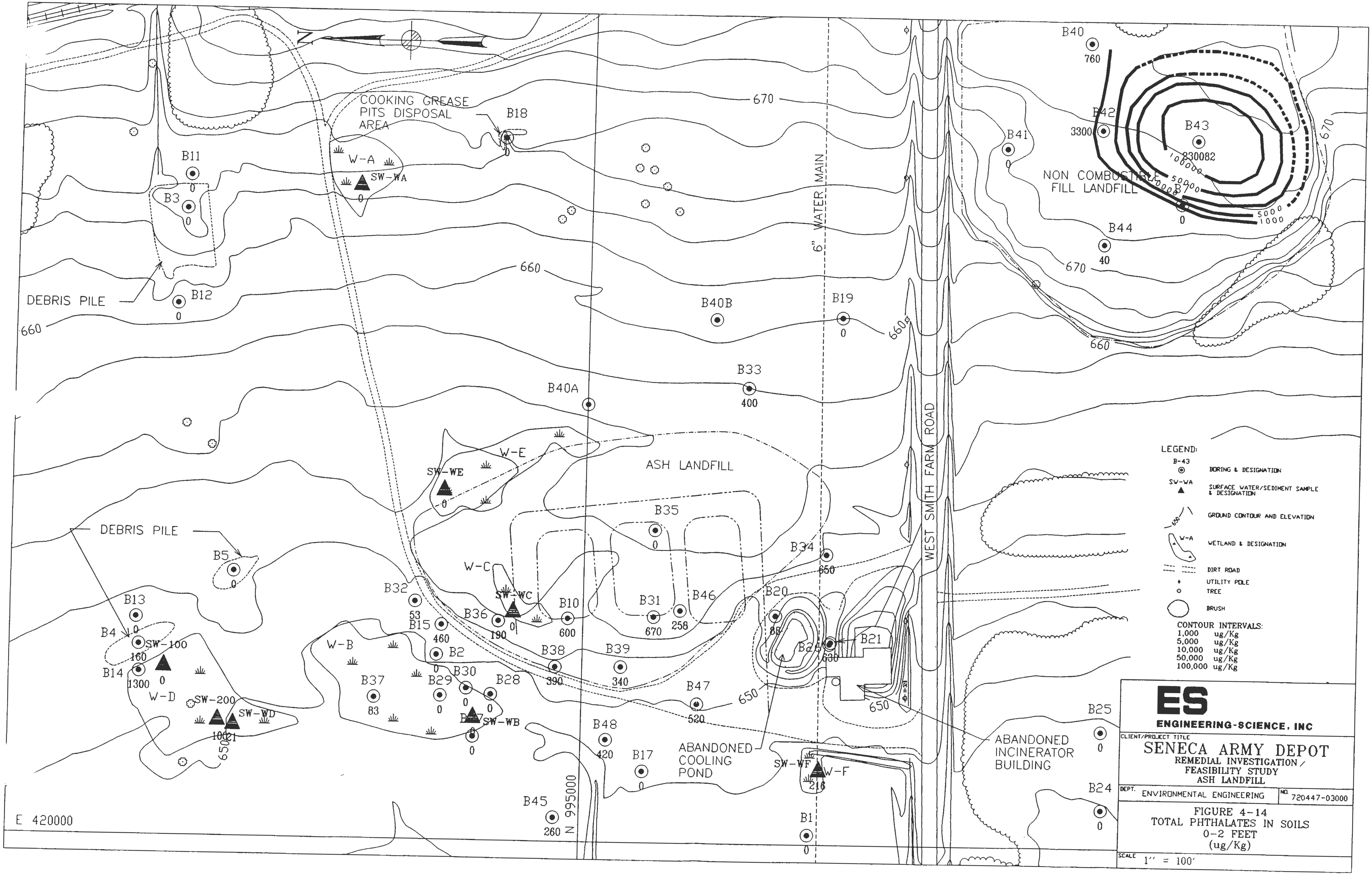

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FIGURE 4-14
TOTAL PHTHALATES IN SOILS
0-2 FEET
(ug/Kg)

SCALE 1'' = 100'

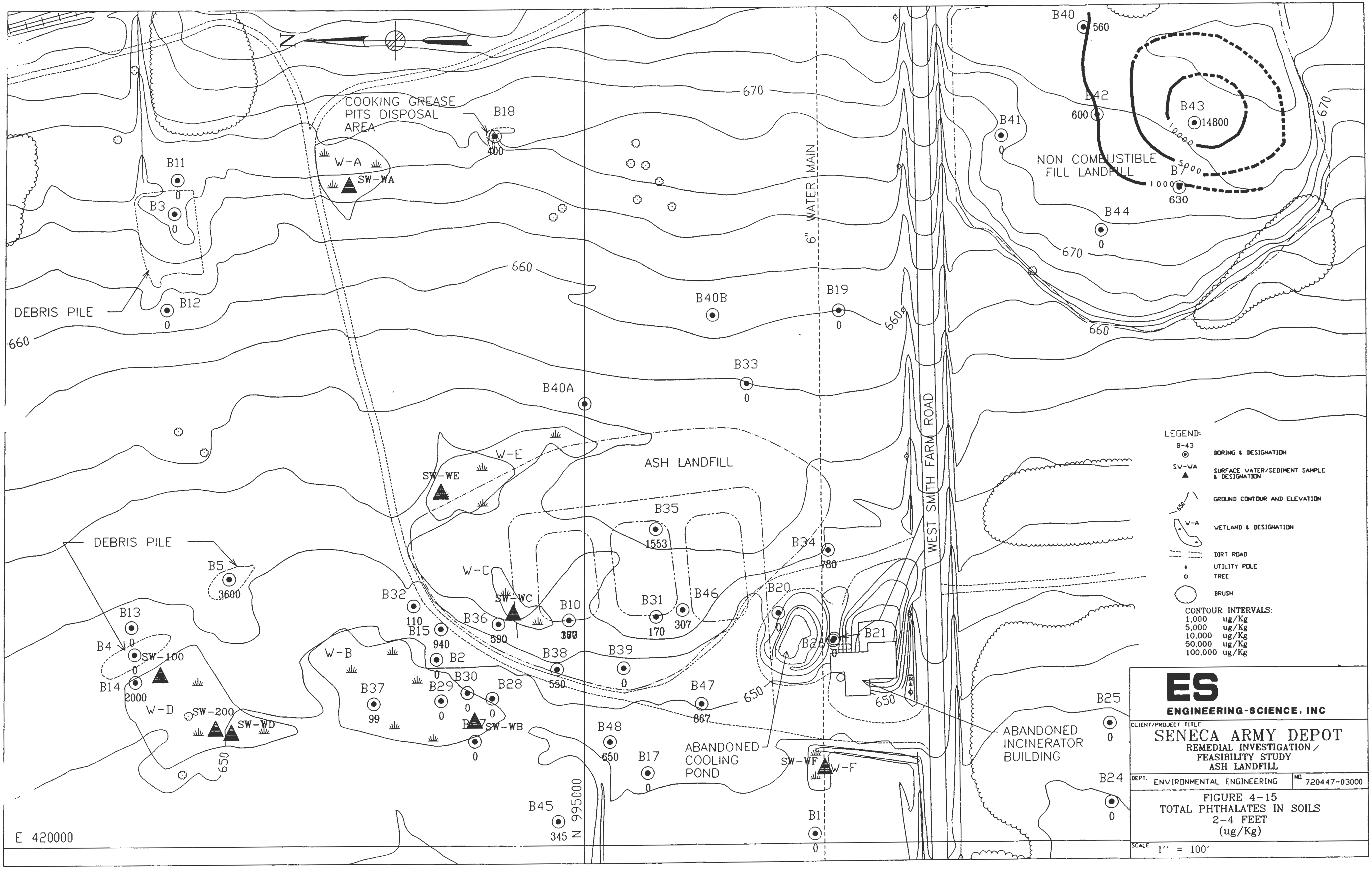

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FIGURE 4-15
TOTAL PHTHALATES IN SOILS
2-4 FEET
(ug/Kg)

SCALE 1'' = 100'

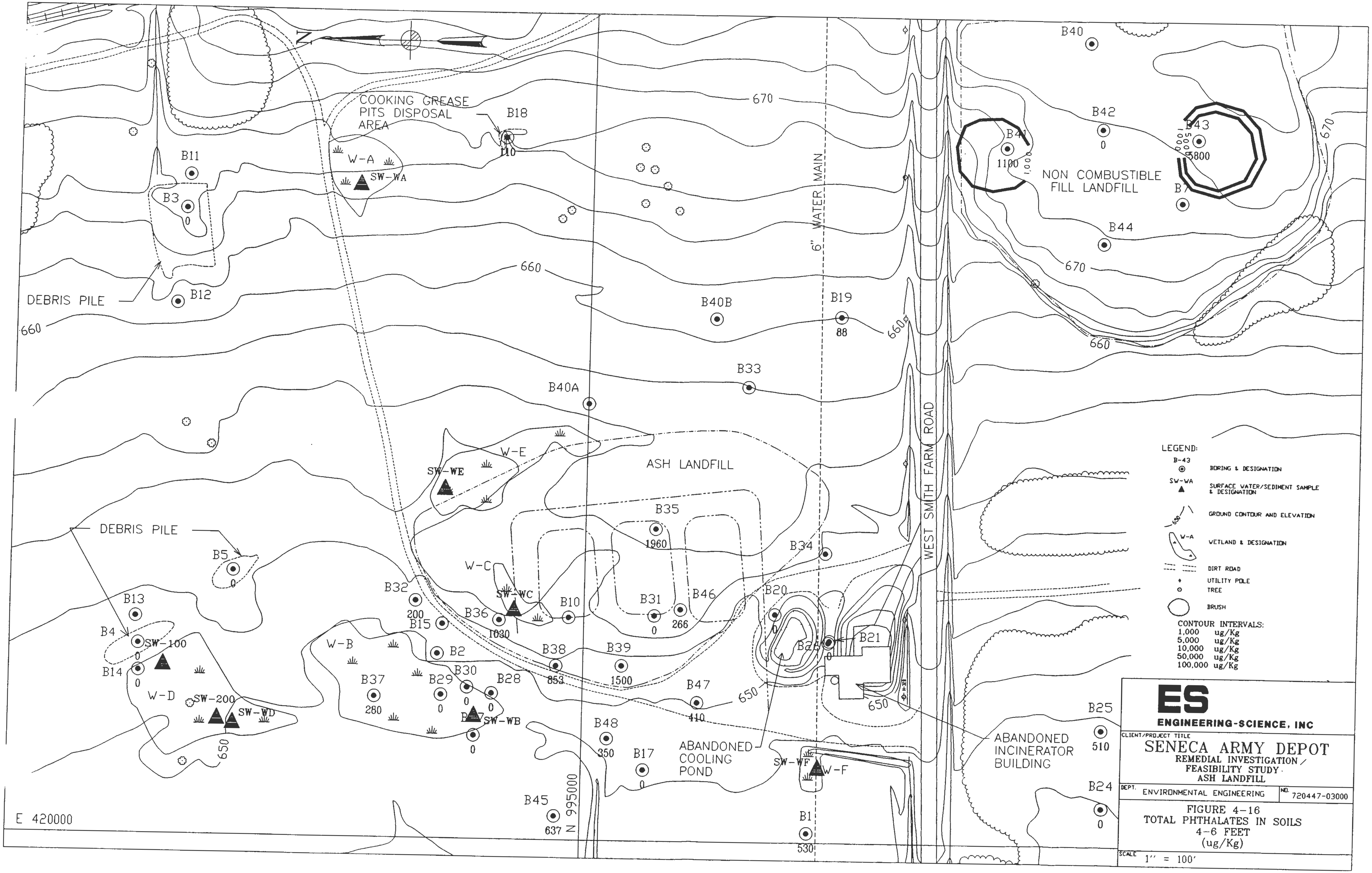

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FIGURE 4-16
TOTAL PHTHALATES IN SOILS
4-6 FEET
(ug/Kg)

SCALE 1" = 100'

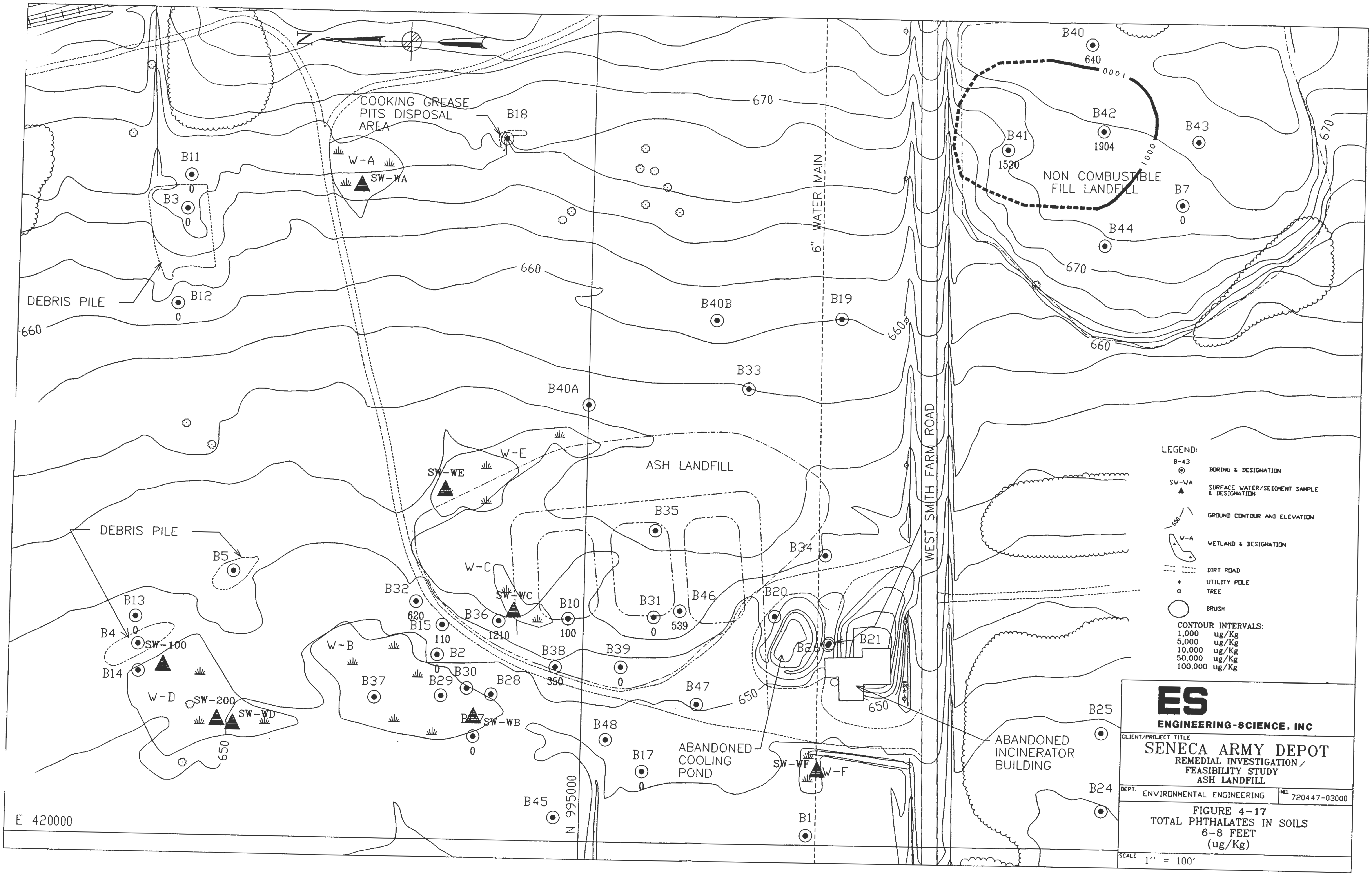

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FIGURE 4-17
TOTAL PHTHALATES IN SOILS
6-8 FEET
(ug/Kg)

SCALE 1'' = 100'

for total phthalates. Note that, except for the one sample previously stated, the contours are below the TAGM. The average total phthalate concentration is typically on the order of 1,000 ug/kg, well below the 8,100 to 50,000 ug/kg TAGM range.

4.3.3.3 Debris Piles

No phthalates were detected above the TAGM in this area of investigation. The maximum observed concentration was of bis(2-ethylhexyl)phthalate estimated at 2,000 ug/kg in the 2 to 4 foot depth interval of B14 (west debris pile). The remainder of the samples from this area were low concentration or BDL.

4.3.4 Total Polynuclear Aromatic Hydrocarbons

There are 18 polynuclear aromatic hydrocarbons (PAHs) in this subset group of semi-volatile organic compounds listed on Table 4-3. These PAHs are as follows:

- naphthalene
- 2-methylnaphthalene
- acenaphthylene
- accenaphthene
- dibenzofuran
- phenathrene
- anthracene
- fluoranthene
- pyrene
- benzo(a)anthracene
- chrysene
- benzo(b)fluoranthene
- benzo(k)fluoranthene
- benzo(a)pyrene
- indeno(1,2,3-cd)pyrene
- dibenzo(a,h)anthracene
- benzo(g,h,i)perylene

Polyaromatic hydrocarbons are moderately prevalent in the three areas of investigation, detected in an average of 25 percent of all soil samples. While most PAHs have relatively high TAGMs (1,000 to 50,000 ug/kg), there are four PAHs with low TAGMs as follows:

• benzo(a)anthracene	220 ug/kg
• chrysene	400 ug/kg
• benzo(a)pyrene	61 ug/kg
• dibenz(a,h)anthracene	14 ug/kg

These four PAHs were the cause of 90 percent of the PAH TAGM excursions observed in the investigation. It is important to note that the total PAH data presented on Figures 4-18 through 4-21 combines PAHs with high TAGM's with the four PAHs with low TAGM's. Thus contouring total PAHs may exaggerate areas that are actually well below the TAGM.

4.3.4.1 Ash Landfill

The Ash Landfill soil samples had 30 percent of the PAH TAGM excursions in this investigation. TAGM excursions were observed in borings B10, B15, B16, B29, B30, B31, B35, B36, B38, B46 and B48. The majority of PAH TAGM excursions and detectable concentrations were observed in the 0 to 2-foot intervals of these borings suggesting a near-surface source. In addition a TAGM exceedance was measured in B21 (0 to 2-feet) near the northeast corner of the abandoned incinerator building.

4.3.4.2 Non-Combustible Fill Landfill

This area soil samples had 60 percent of the PAH TAGM excursions, with all borings except B40 having at least one TAGM excursion. Relatively high PAH concentrations (one order of magnitude or more above TAGM) were observed in most borings in this area (B7, B41, B42, B43 and B44) at depth intervals as deep as 10 feet.

4.3.4.3 Debris Pile

All PAH concentrations detected in these areas were in the 0 to 2 foot depth interval. Approximately 10 percent of all PAH excursions were observed in these areas, with high concentrations (one order of magnitude or more above TAGM) in borings B4 and B5: the western-most debris pile.

4.3.5 Pesticides and PCBs

As shown on Table 4-3 the maximum concentrations of pesticides and PCBs are generally low (one order of magnitude or more below the TAGM) except for one sample which was slightly above the TAGM for Dieldrin (46 ug/kg Dieldrin at the 0 to 2 foot depth interval of B12, the eastern-most debris pile TAGM of 44 ug/kg). Most of the samples are BDL or near the detection limit. Pesticide contours are shown in Figures 4-22 through 4-24. PCB contours are shown on Figures 4-25 through 4-28.

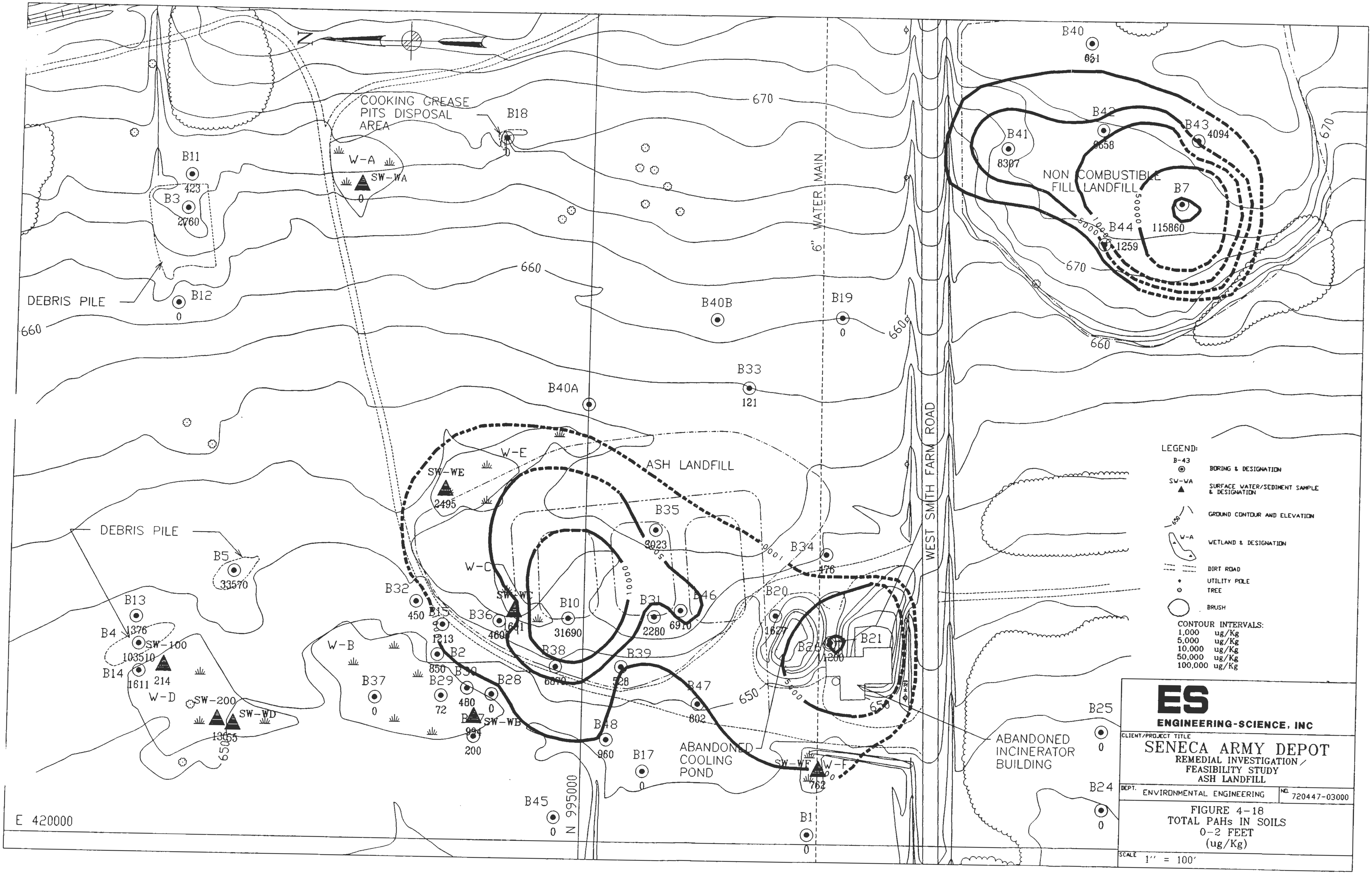

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FIGURE 4-18
TOTAL PAHs IN SOILS
0-2 FEET
(ug/Kg)

SCALE 1" = 100'

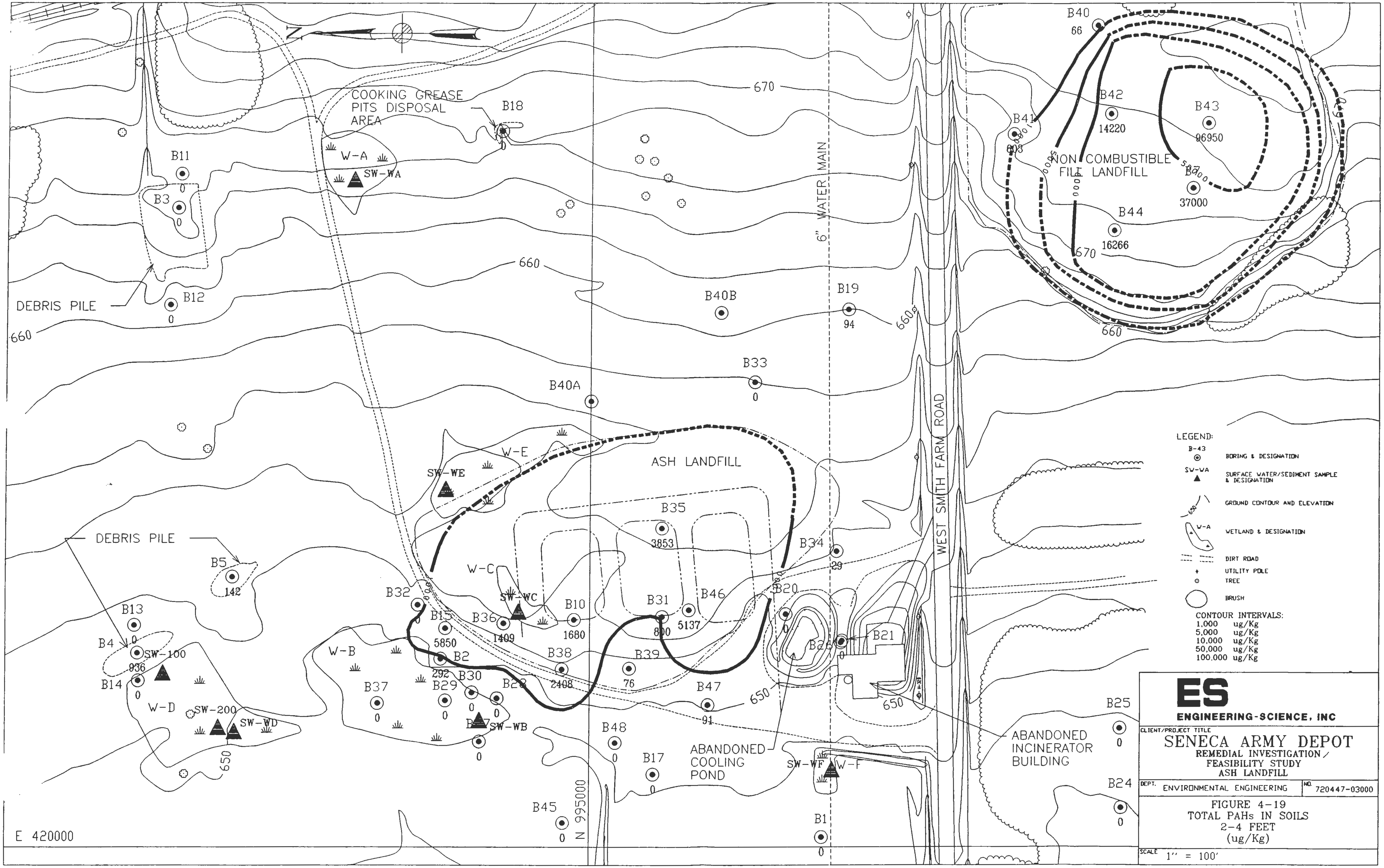

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FIGURE 4-19
TOTAL PAHs IN SOILS
2-4 FEET
(ug/Kg)

SCALE 1" = 100'

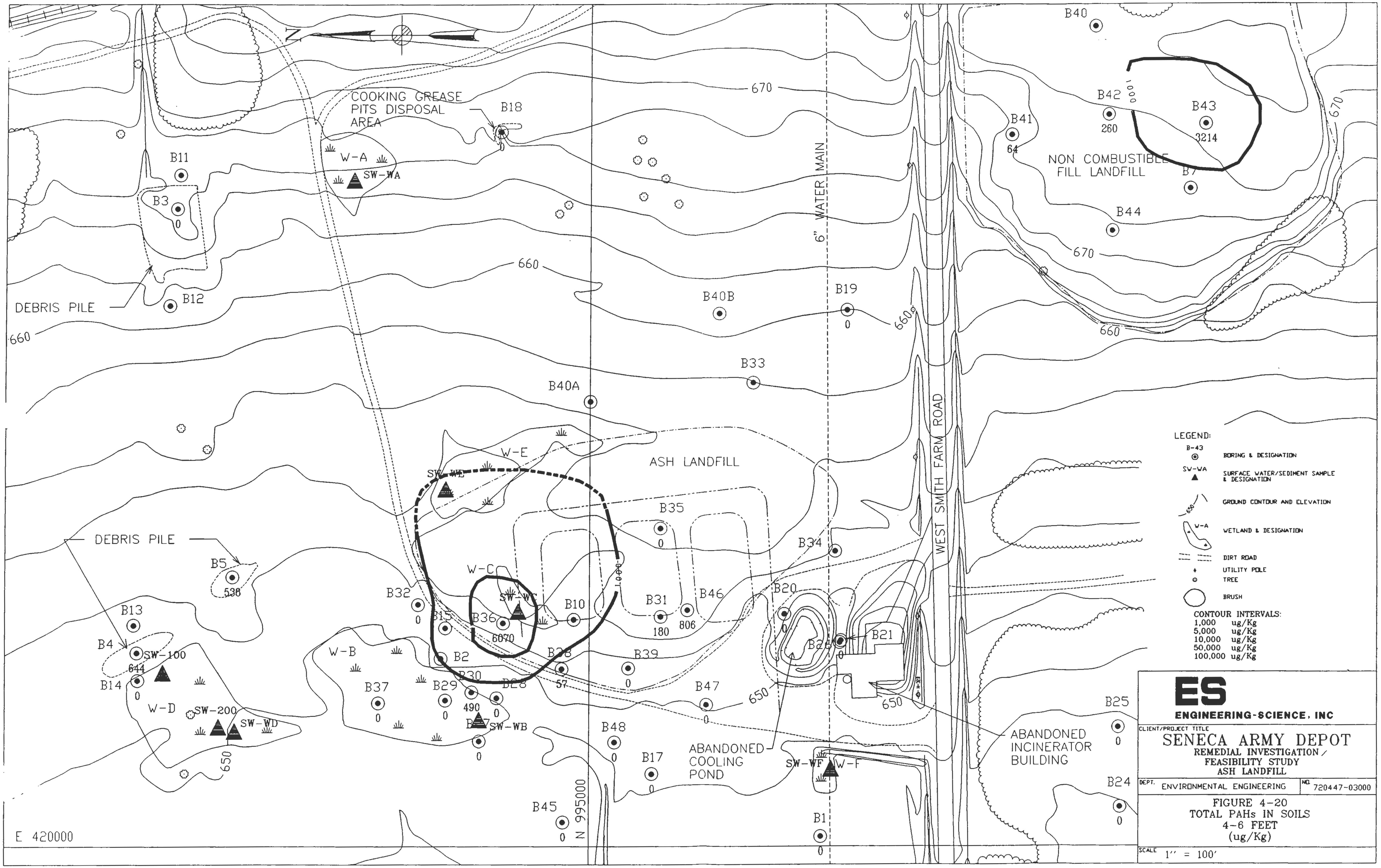

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FIGURE 4-20
TOTAL PAHs IN SOILS
4-6 FEET
(ug/Kg)

SCALE 1'' = 100'

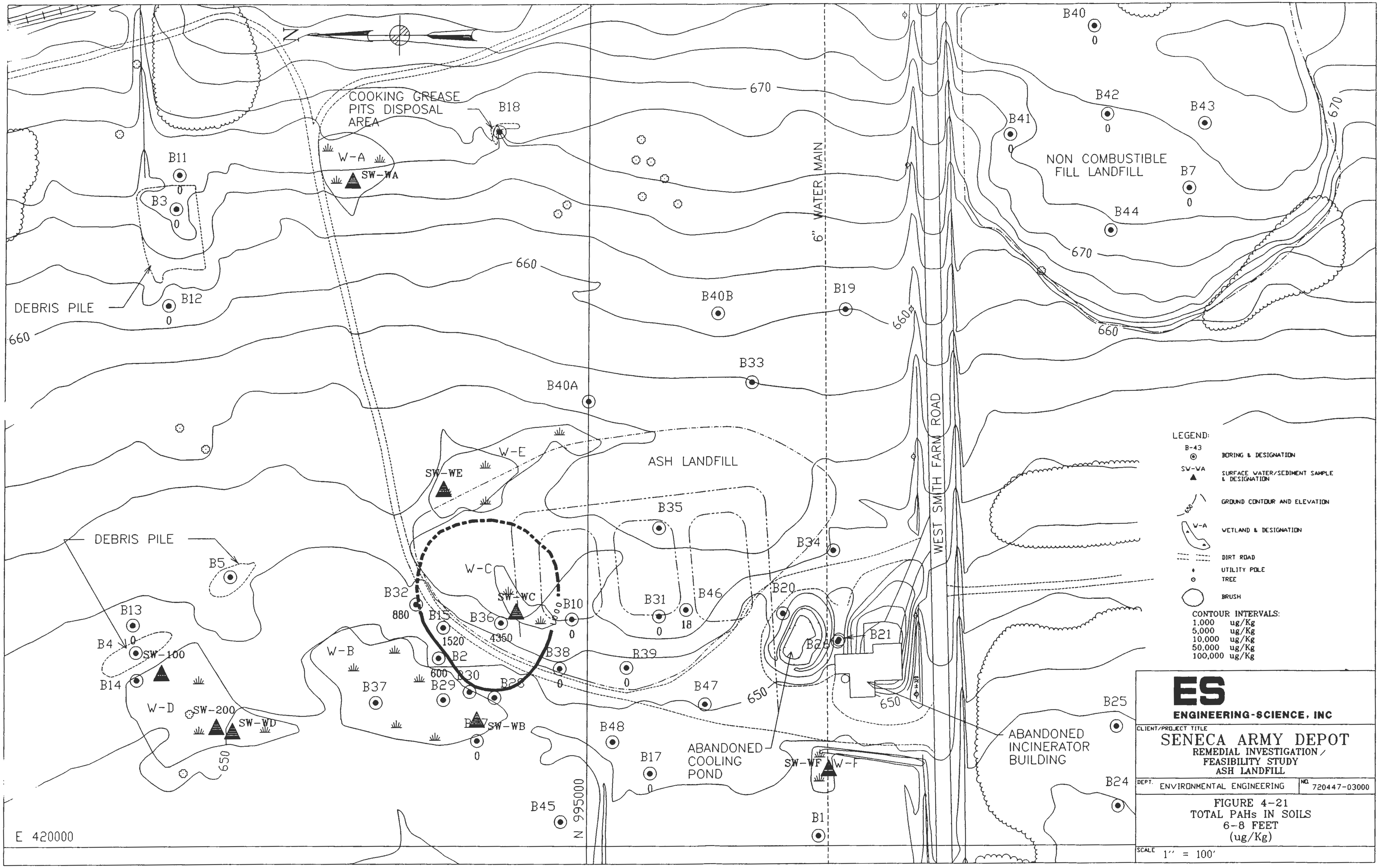

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FIGURE 4-21
TOTAL PAHs IN SOILS
6-8 FEET
(ug/Kg)

SCALE 1" = 100'

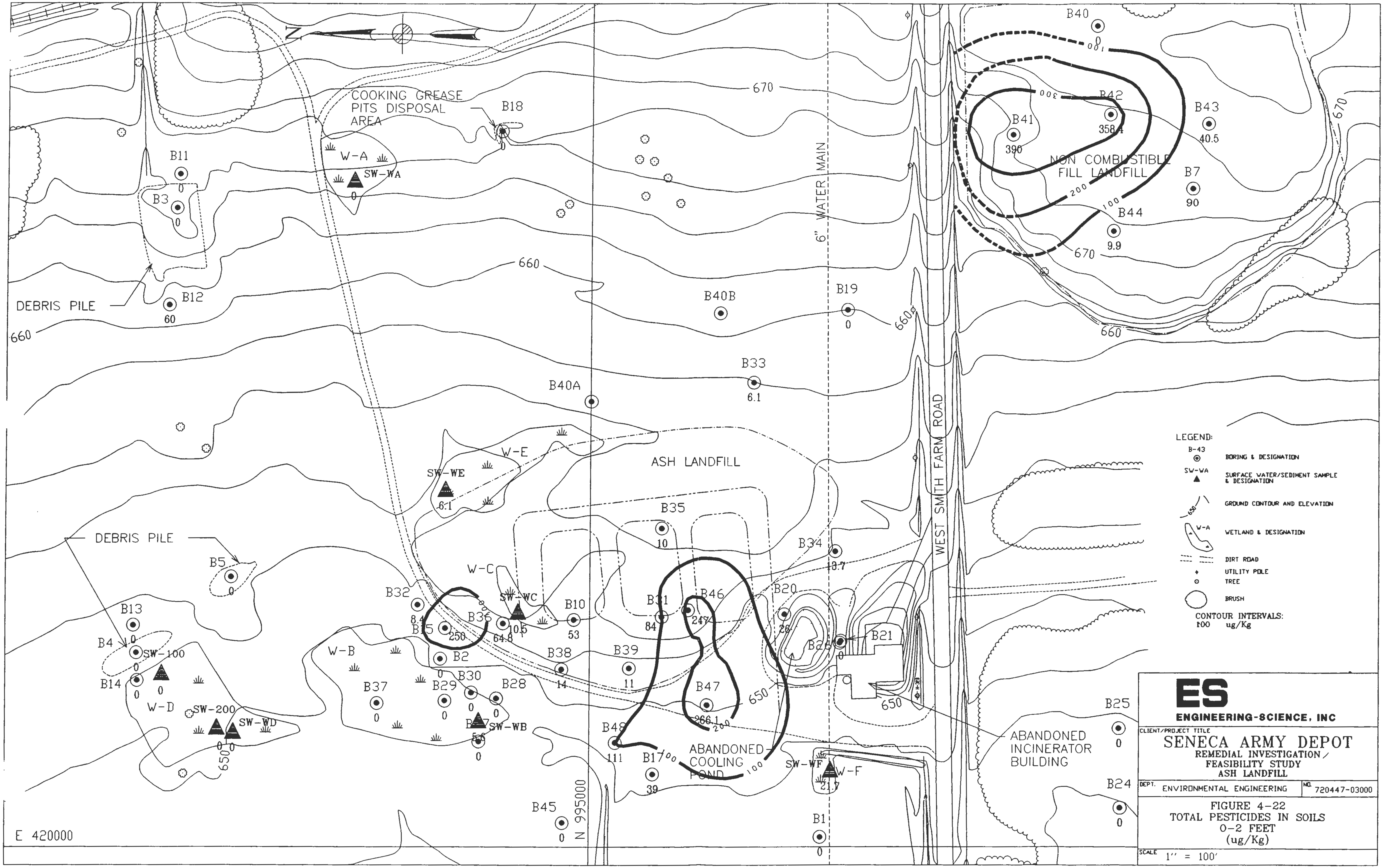

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FIGURE 4-22
TOTAL PESTICIDES IN SOILS
0-2 FEET
(ug/Kg)

SCALE 1" = 100'

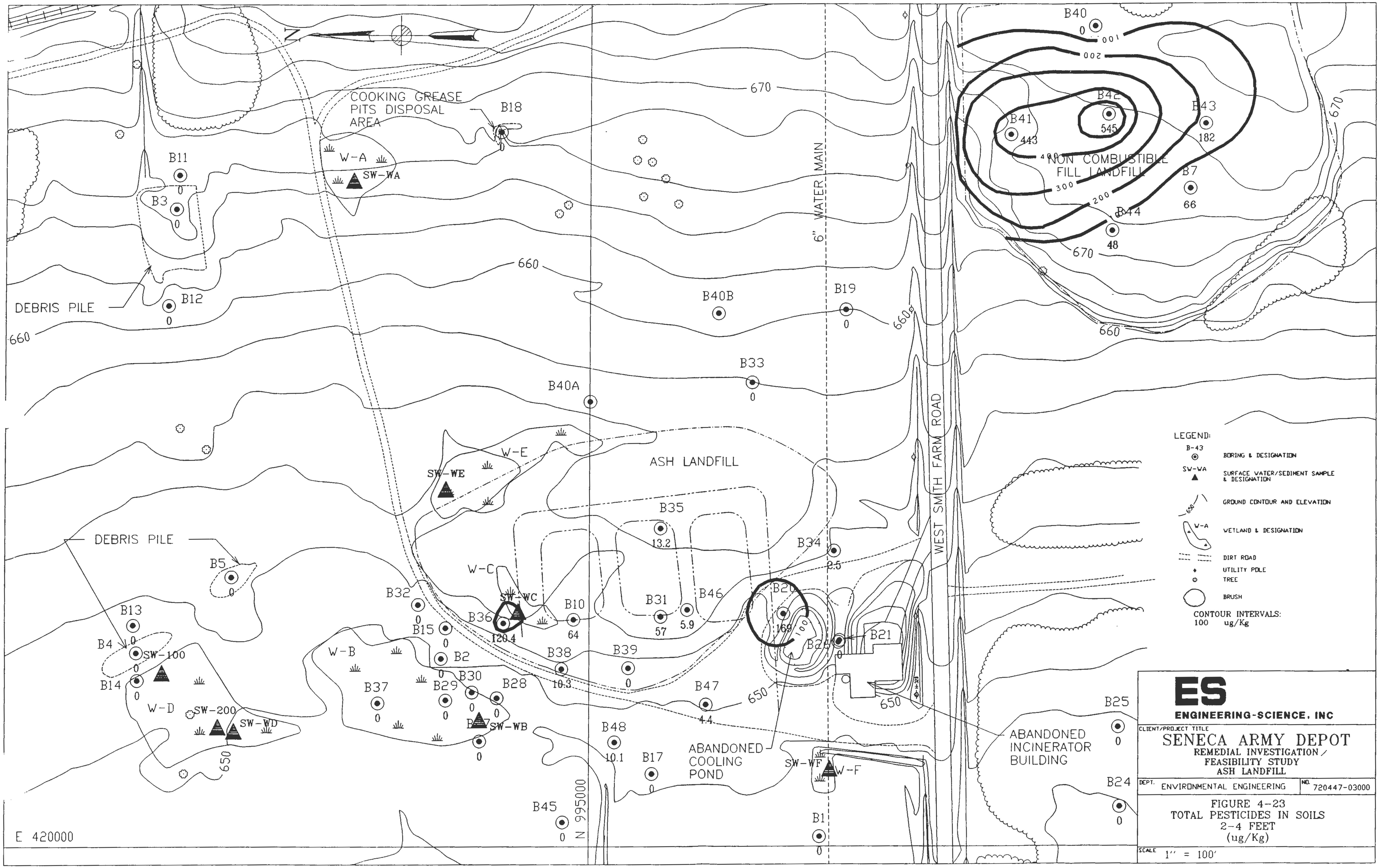

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FIGURE 4-23
TOTAL PESTICIDES IN SOILS
2-4 FEET
(ug/Kg)

SCALE 1" = 100'

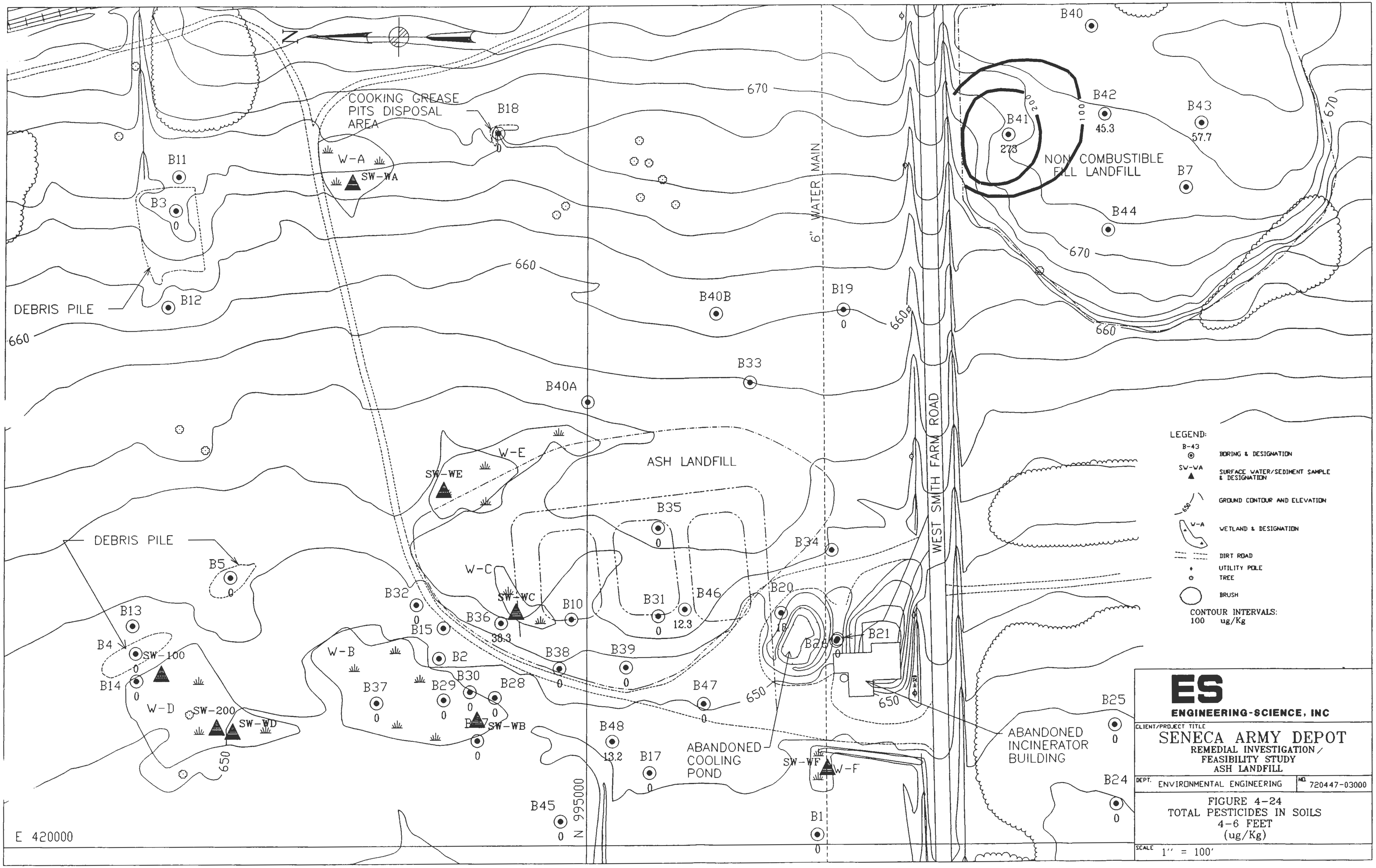

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FIGURE 4-24
TOTAL PESTICIDES IN SOILS
4-6 FEET
(ug/Kg)

SCALE 1" = 100'

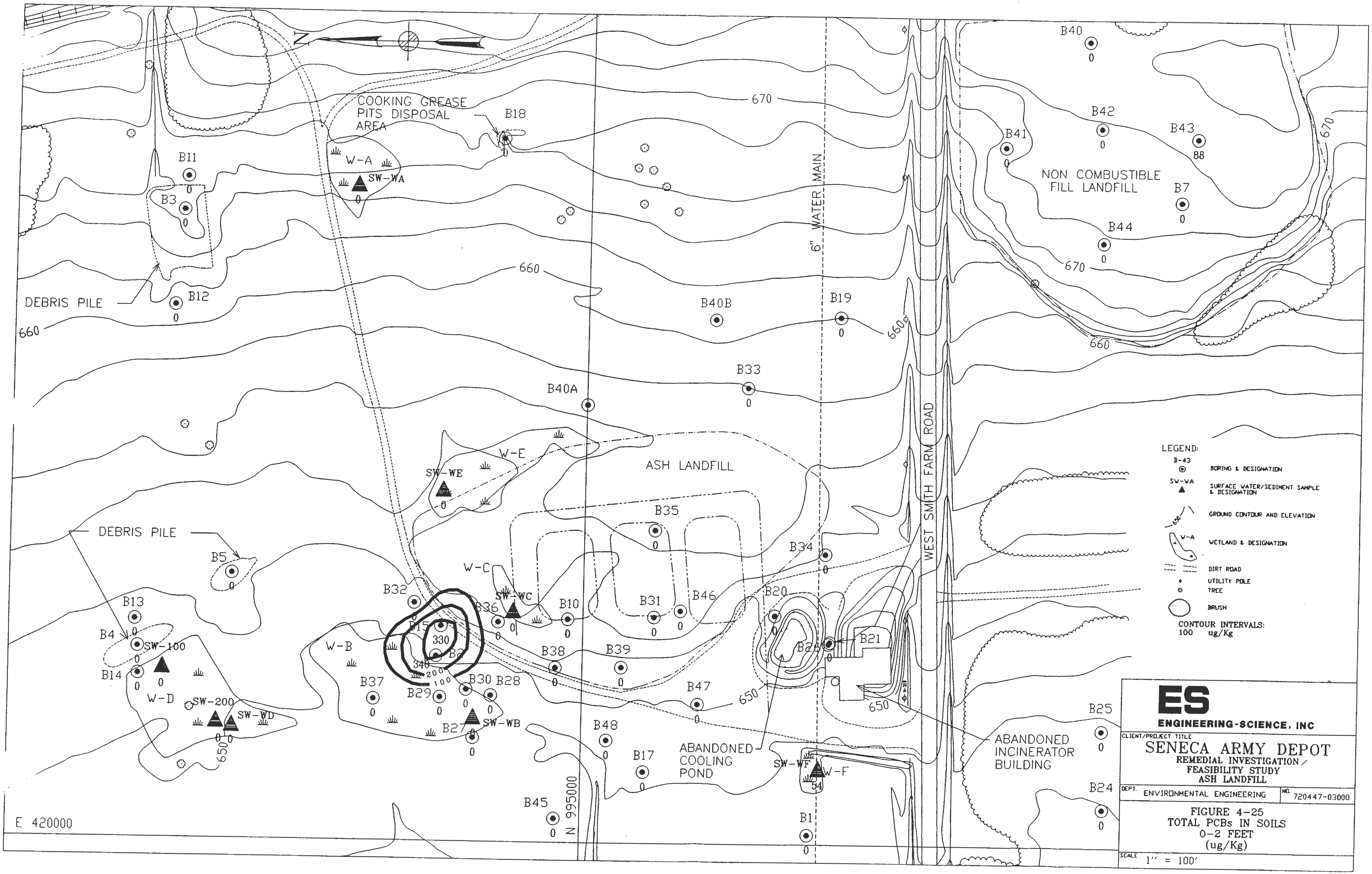

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FIGURE 4-25
TOTAL PCBs IN SOILS
0-2 FEET
(ug/Kg)

SCALE 1" = 100'

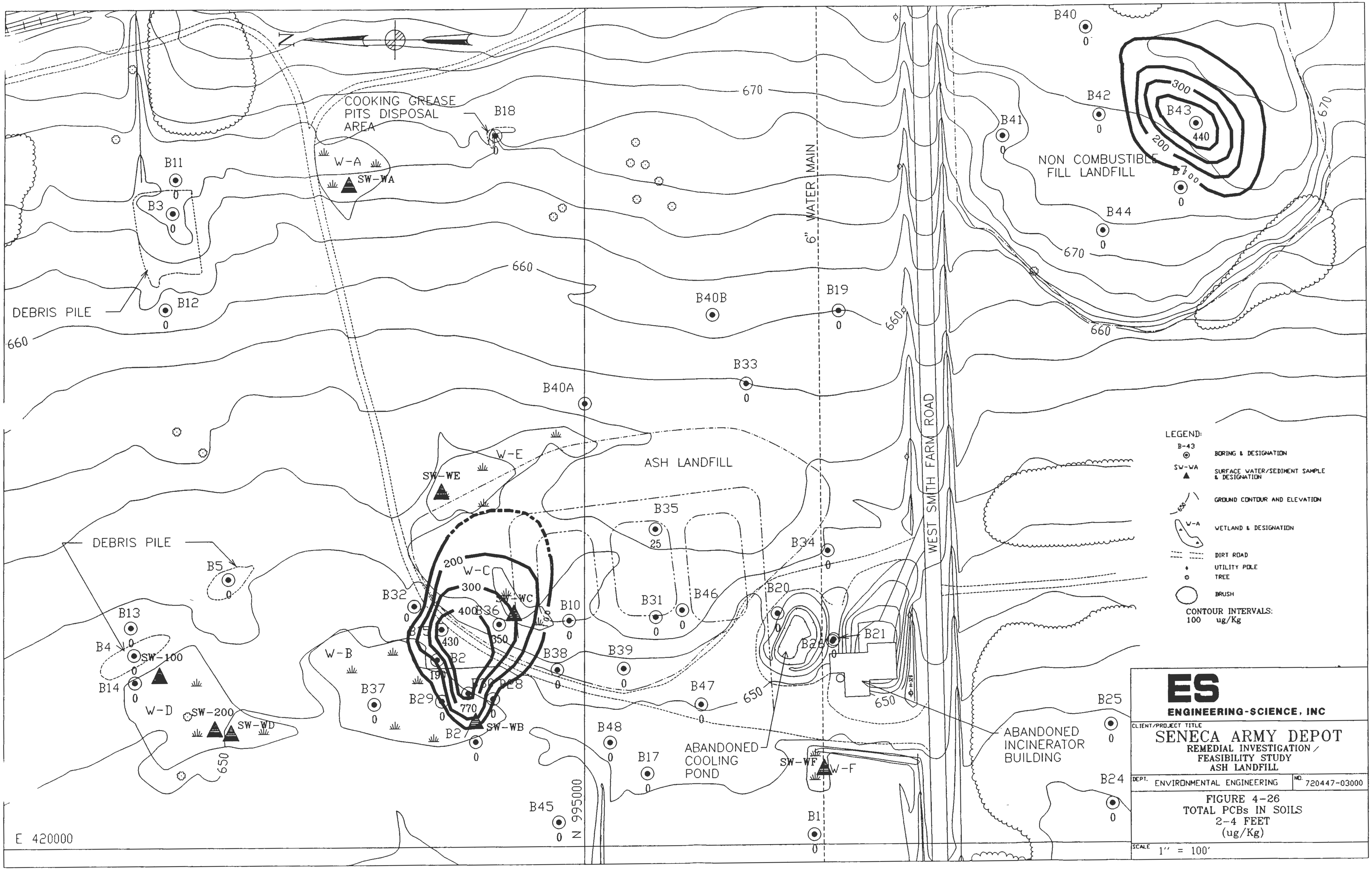

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FIGURE 4-26
TOTAL PCBs IN SOILS
2-4 FEET
(ug/Kg)

SCALE 1" = 100'

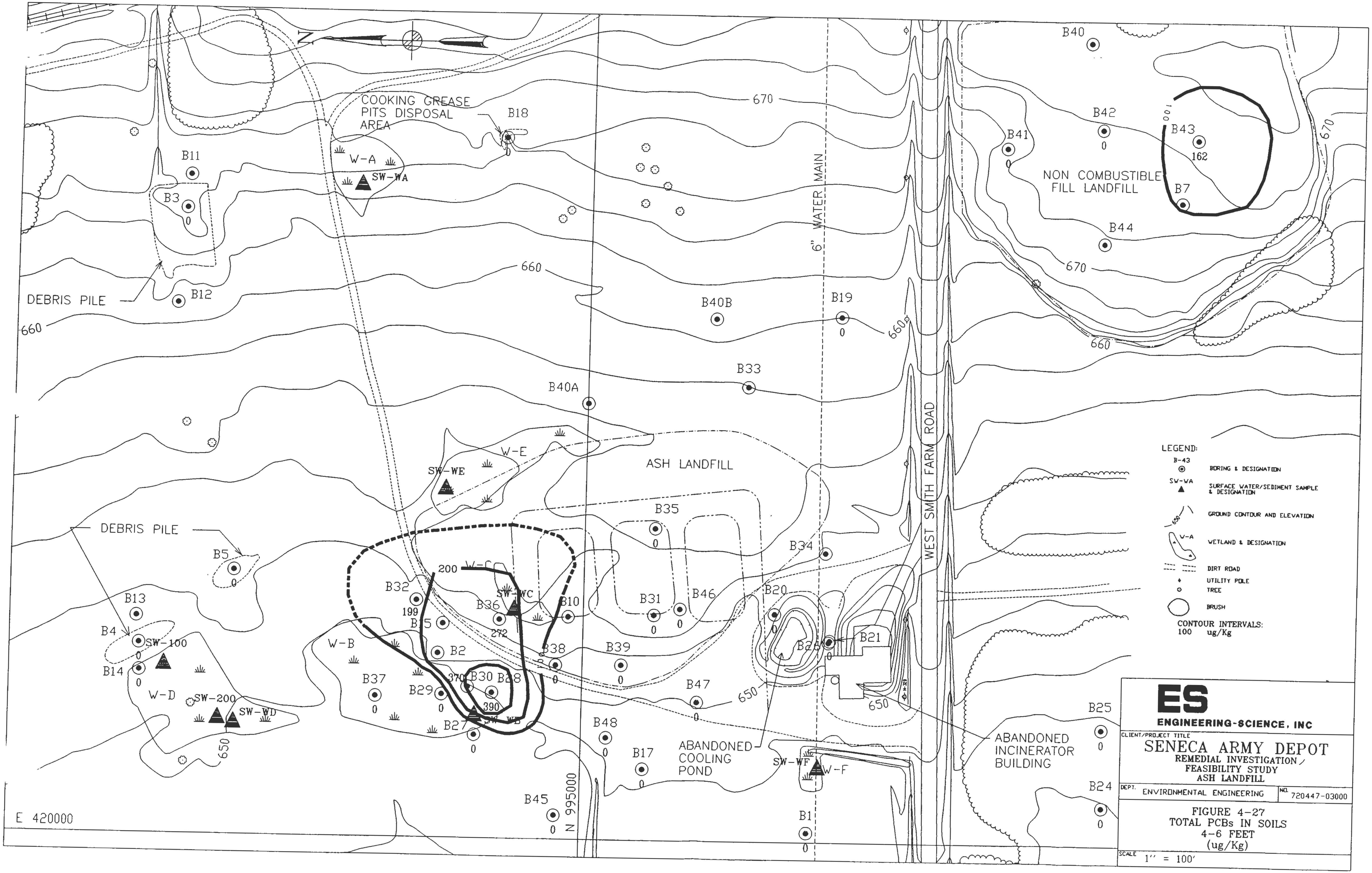

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FIGURE 4-27
TOTAL PCBs IN SOILS
4-6 FEET
(ug/Kg)

SCALE 1" = 100'

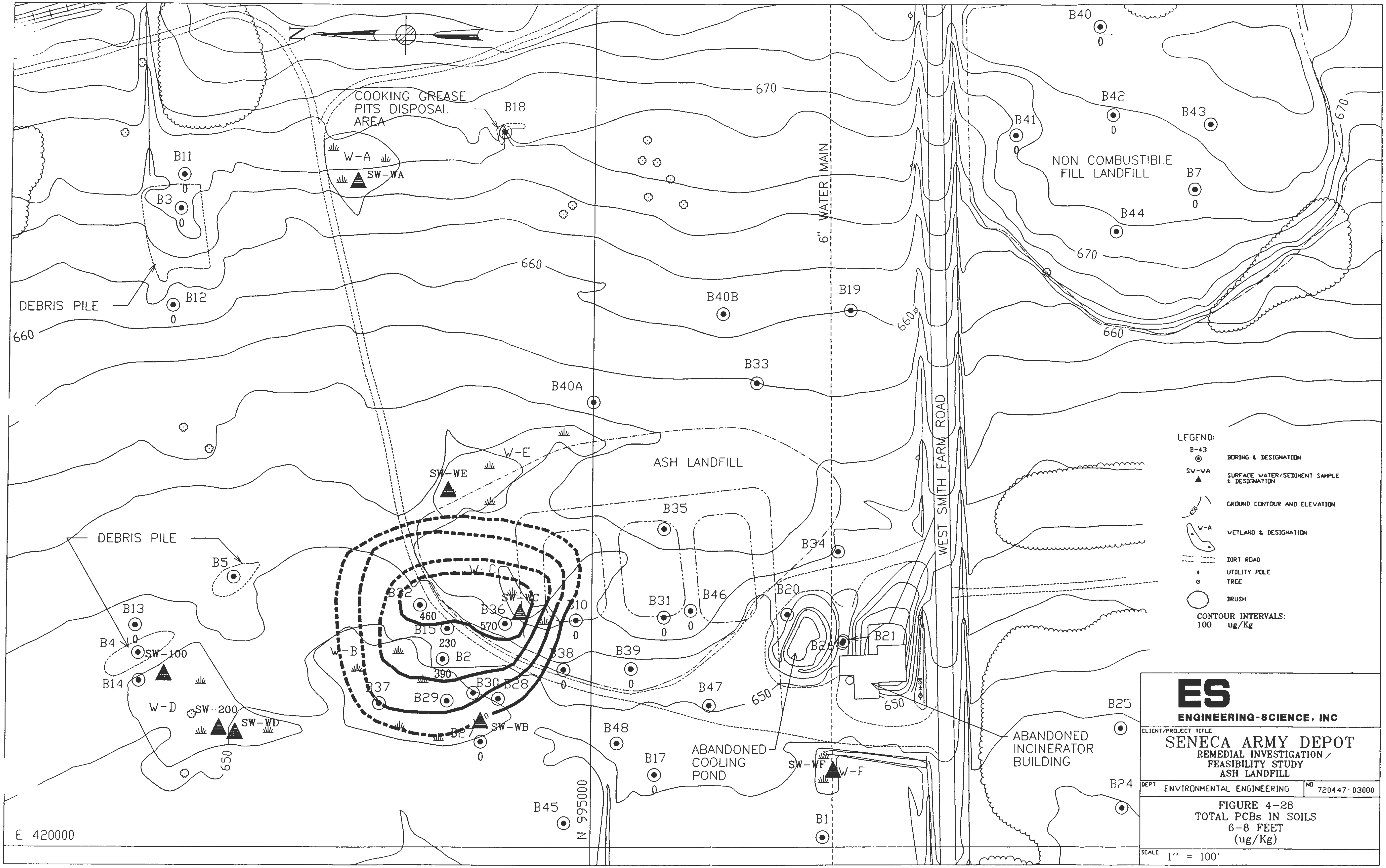

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FIGURE 4-28
TOTAL PCBs IN SOILS
6-8 FEET
(ug/Kg)

SCALE 1" = 100'

4.3.6 Herbicides

There were no samples above the TAGM for 2,4,5-TP (Silvex) and the two other herbicides detected have no TAGM assigned. The concentrations of all herbicides were BDL except for five borings at the 0 to 2 foot depth interval that showed concentrations of the herbicide 4-Chloro-2-methylphenoxy-α-propionic acid (MCPP) at estimated concentrations of 13,000 ug/kg, 7,500 ug/kg, 24,000 ug/kg, 18,000 ug/kg, and 8,800 ug/kg (borings B10 in the Ash Landfill and B3, B11, B12 and B14 in the debris piles), and several borings that showed low levels of herbicides at the 4 to 6 foot interval. Herbicide contours are shown in Figures 4-29 through 4-31.

4.3.7 Tentatively Identified Compounds (TICs)

The majority of the TIC's quantified in the soil borings were petroleum hydrocarbons. Although no individual TAGM's exist for these compounds, a NYSDEC total petroleum hydrocarbon standard of 10 mg/kg in soils is a relevant standard for comparison. Concentrations of total semi-volatile TIC's in soil are summarized in Table 4-4. The horizontal and vertical extents of TICs in the three regions listed below are defined on Figures 4-32 through 4-35.

4.3.7.1 Ash Landfill

At most locations in the Ash Landfill concentrations ranged between 1,000 to 30 ug/kg (Table 4-4). Samples from borings near the bend in the road (B2, B32, B15, and B36) had concentrations ranging from 2,055 to 327,600 ug/kg. Elevated TIC concentrations were detected both at the surface and at depth in these locations.

4.3.7.2 Non-Combustible Landfill

Concentrations ranging from ND to 264,700 ug/kg were found at the Non-Combustible Landfill. The maximum concentration was observed at B44 at the sample interval 8 to 10 feet.

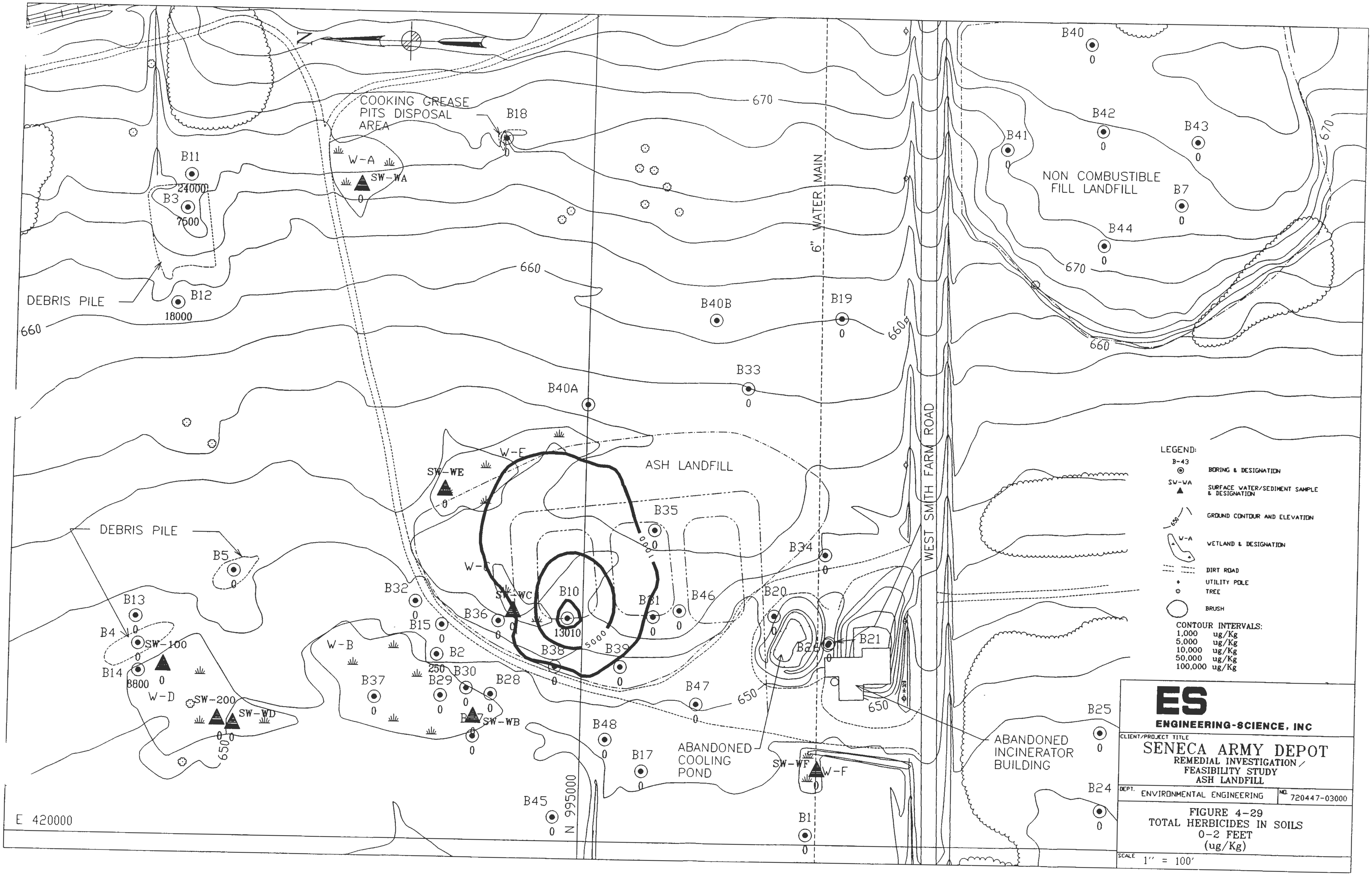

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FIGURE 4-29
TOTAL HERBICIDES IN SOILS
0-2 FEET
(ug/Kg)

SCALE 1" = 100'

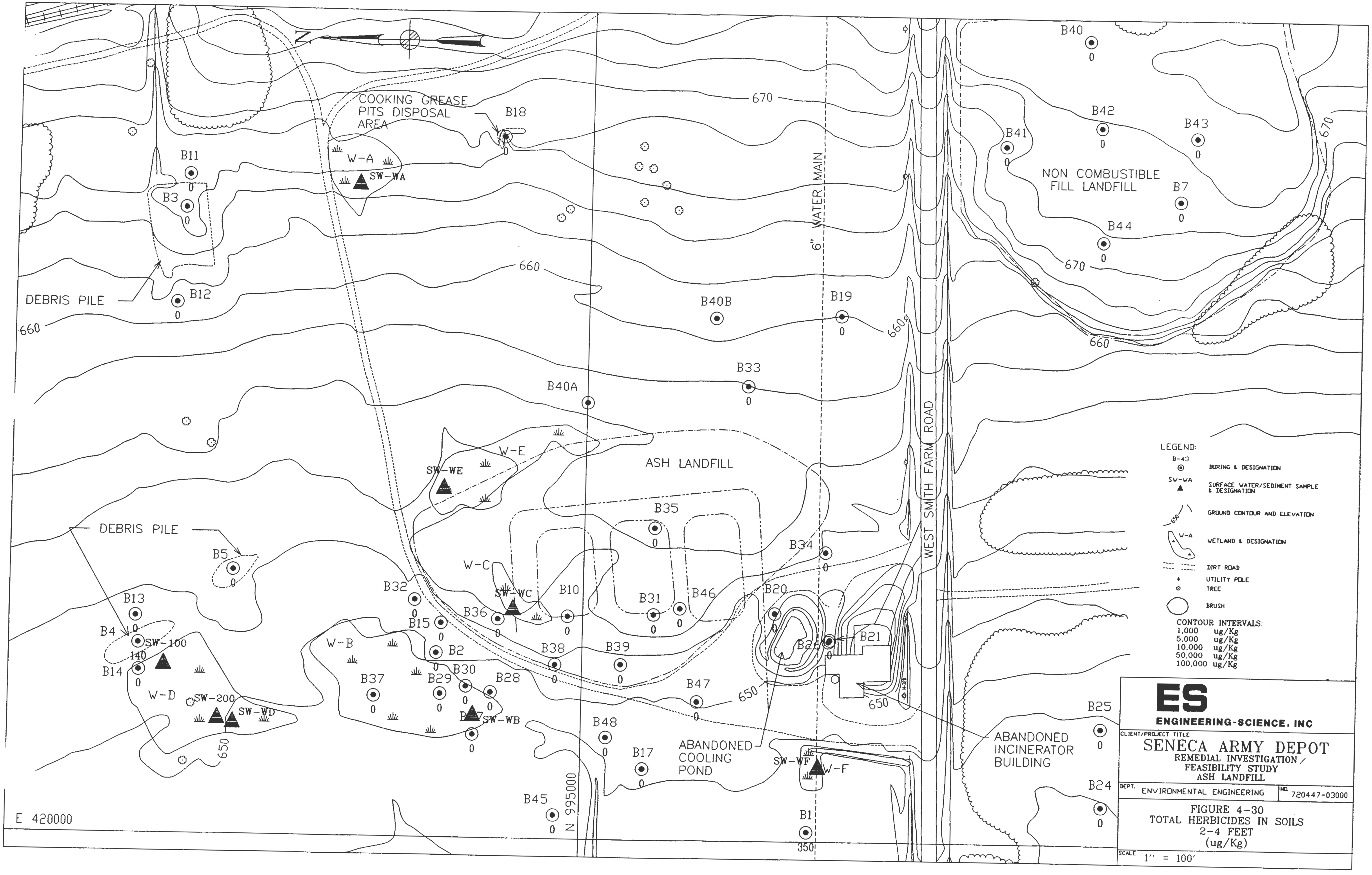

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FIGURE 4-30
TOTAL HERBICIDES IN SOILS
2-4 FEET
(ug/Kg)

SCALE 1'' = 100'

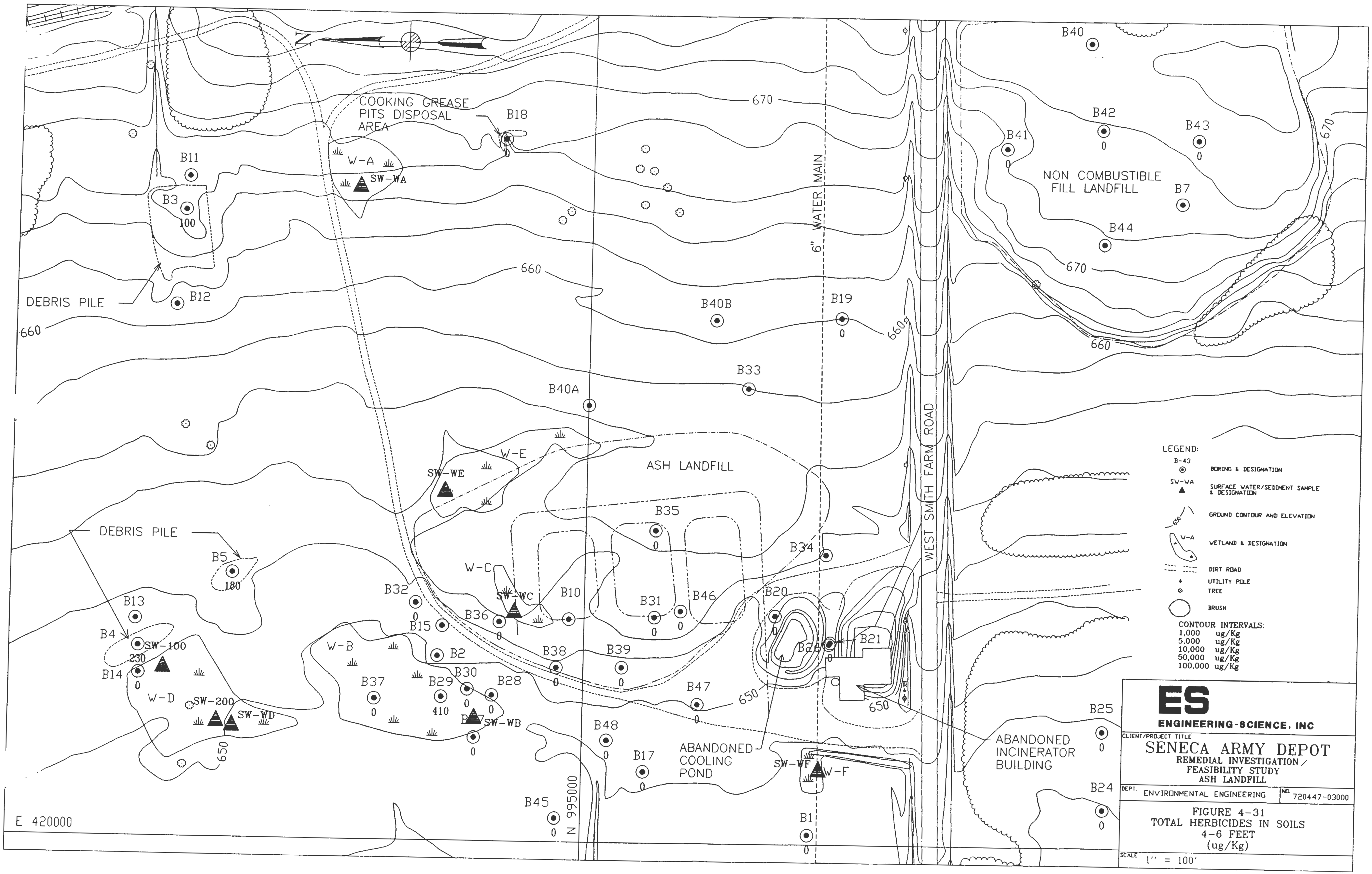

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FIGURE 4-31
TOTAL HERBICIDES IN SOILS
4-6 FEET
(ug/Kg)

SCALE 1'' = 100'

TABLE 4 – 4

TENTATIVELY IDENTIFIED SEMIVOLATILE ORGANIC COMPOUNDS FOR SOIL BORINGS SAMPLES PHASES I & II

SENECA ARMY DEPOT
ASH LANDFILL

BORING	PHASE	SAMPLE INTERVAL	TICs (ug/kg or ppb)
B1–91	I	0–2'	0
	I	2–4'	0
	I	4–6'	0
B2–91	I	0–2'	219900
	I	2–4'	294500
	I	6–8'	71700
B3–91	I	2–4'	8010
	I	4–6'	0
	I	6–8'	(no sample for SVOCs)
B4–91	I	0–2'	47100
	I	2–4'	0
	I	4–6'	1500
B5–91	I	0–2'	37960
	I	2–4'	1110
	I	4–6'	0
	I	8–10'	(no sample for SVOCs)
B6–91	I	0–2'	0
	I	2–4'	0
B7–91	I	0–2'	38670
	I	2–4'	34050
	I	10–12'	470
B8–91	I	0–2'	320
	I	2–4'	0
	I	2–4'	0
	I	6–8'	0
B9–91	I	0–2'	0
	I	2–4'	400
	I	6–8'	0
B10–91	I	0–2'	23350
	I	2–4'	3180
	I	2–4'	3950
	I	6–8'	0
B11–91	I	0–2'	4610
	I	2–4'	520
	I	6–8'	1230
B12–91	I	0–2'	990
	I	2–4'	1040
	I	6–8'	(no sample for SVOCs)
B13–91	I	0–2'	1250
	I	2–4'	2900
	I	6–8'	2670
B14–91	I	0–2'	3230
	I	2–4'	790
	I	2–4'	870
	I	4–6'	1330
B15–91	I	0–2'	4280
	I	2–4'	272500
	I	2–4'	327600
	I	6–8'	128700
B16–91	I	0–2'	17490
	I	2–4'	1440
	I	6–8'	1280
B17–91	I	0–2'	1140
	I	2–4'	690
	I	4–6'	1180
B18–91	I	0–2'	4120
	I	2–4'	0
	I	4–6'	0

TABLE 4 – 4

TENTATIVELY IDENTIFIED SEMIVOLATILE ORGANIC COMPOUNDS FOR SOIL BORINGS SAMPLES PHASES I & II

SENECA ARMY DEPOT
ASH LANDFILL

BORING	PHASE	SAMPLE INTERVAL	TICs (ug/kg or ppb)
B19–91	I	0–2'	0
	I	2–4'	0
	I	4–6'	0
B20–91	I	0–2'	1360
	I	2–4'	0
	I	4–6'	0
B21–91	I	0–2'	2440
	I	2–4'	0
	I	2–4'	0
B22–91	I	0–2'	1050
	I	2–4'	0
B23–91	I	0–2'	400
	I	2–4'	620
	I	4–6'	330
B24–91	I	0–2'	1890
	I	2–4'	0
	I	4–6'	310
B25–91	I	0–2'	2700
	I	2–4'	0
	I	4–6'	680
B27–91	I	0–2'	350
	I	2–4'	0
B28–91	I	0–2'	0
	I	2–4'	0
	I	2–4'	0
	I	4–6'	9800
B29–91	I	0–2'	320
	I	0–2'	320
	I	2–4'	1770
	I	4–6'	8400
	I	4–6'	330
B30–91	I	0–2'	400
	I	0–2'	850
	I	2–4'	22830
	I	4–6'	132100
	I	4–6'	107400
B31–91	I	0–2'	6230
	I	0–2'	7890
	I	2–4'	1010
	I	4–6'	86200
	I	6–8'	58900
B32	II	0–2'	2055
	II	2–4'	4042
	II	4–6'	25740
	II	6–7.9'	112300
B33	II	0–2'	4014
	II	2–3.5'	862
B34	II	0–2'	2044
	II	2–2.75'	1317
B35	II	0–2'	4328
	II	2–4'	90464
	II	4–6'	12720
B36	II	0–2'	28300
	II	2–4'	109020
	II	4–6'	156200
	II	6–7.9'	200300
	II	4–6'	101600
B37	II	0–2'	500
	II	2–4'	460
	II	4–5.5'	1050
	II	4–5.5'	1101

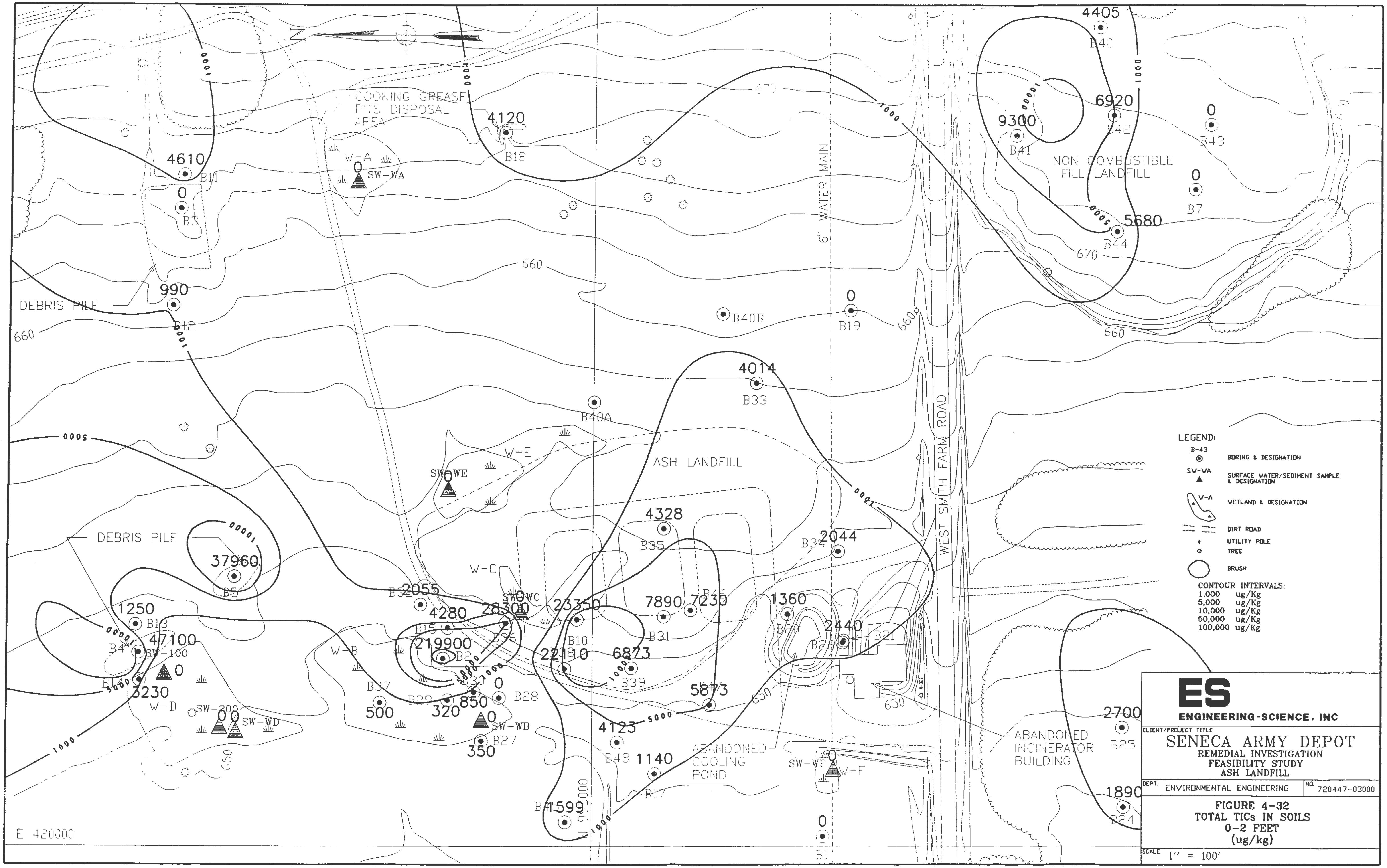
TABLE 4 – 4

TENTATIVELY IDENTIFIED SEMIVOLATILE ORGANIC COMPOUNDS FOR SOIL BORINGS SAMPLES PHASES I & II

SENECA ARMY DEPOT
ASH LANDFILL

BORING	PHASE	SAMPLE INTERVAL	TICs (ug/kg or ppb)
B38	II	0–2'	22110
	II	2–4'	3662
	II	4–6'	1631
	II	6–8'	1010
	II	4–6'	1420
B39	II	0–2'	6873
	II	2–4'	16960
	II	4–6'	4899
	II	6–6.5'	5100
B40	II	0–2'	4405
	II	2–4'	3720
	II	6–8'	1479
	II	9.5–10.5'	1325
B41	II	0–2'	9300
	II	2–4'	3820
	II	5.5–6.5'	2163
	II	6.5–8.0'	2533
B42	II	0–2'	6920
	II	2–4'	9106
	II	4–6'	1528
	II	6–7.2'	1665
B43	II	0–2'	0
	II	2–4'	23820
	II	4–6'	12490
	II	8–10'	90600
B44A	II	8–10'	264700
B44B	II	0–2'	5680
	II	2–4'	7527
	II	8–10'	7980
	II	12–13.5'	1693
B45	II	0–2'	1599
	II	2–4'	1738
	II	4–6'	1521
	II	4–6'	1170
B46	II	0–2'	7230
	II	2–4'	2987
	II	4–6'	2300
	II	6–7.1'	3177
B47	II	0–2'	5873
	II	2–4'	4865
	II	4–5.3'	5059
B48	II	0–2'	4123
	II	0–4'	2286
	II	4–6'	3180
	II	4–6'	1210
BK1	II	0–2'	3888
BK2	II	0–2'	4868

Notes:
The TIC totals do not include the compounds 4–hydroxy,4–methyl,2–pentanone and 4–methyl,–3–penten–2–one.
These compounds are laboratory contaminants, and are not representative of the samples.



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REMEDIAL INVESTIGATION
FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 4-32
TOTAL TICs IN SOILS
0-2 FEET
(ug/kg)

SCALE 1" = 100'

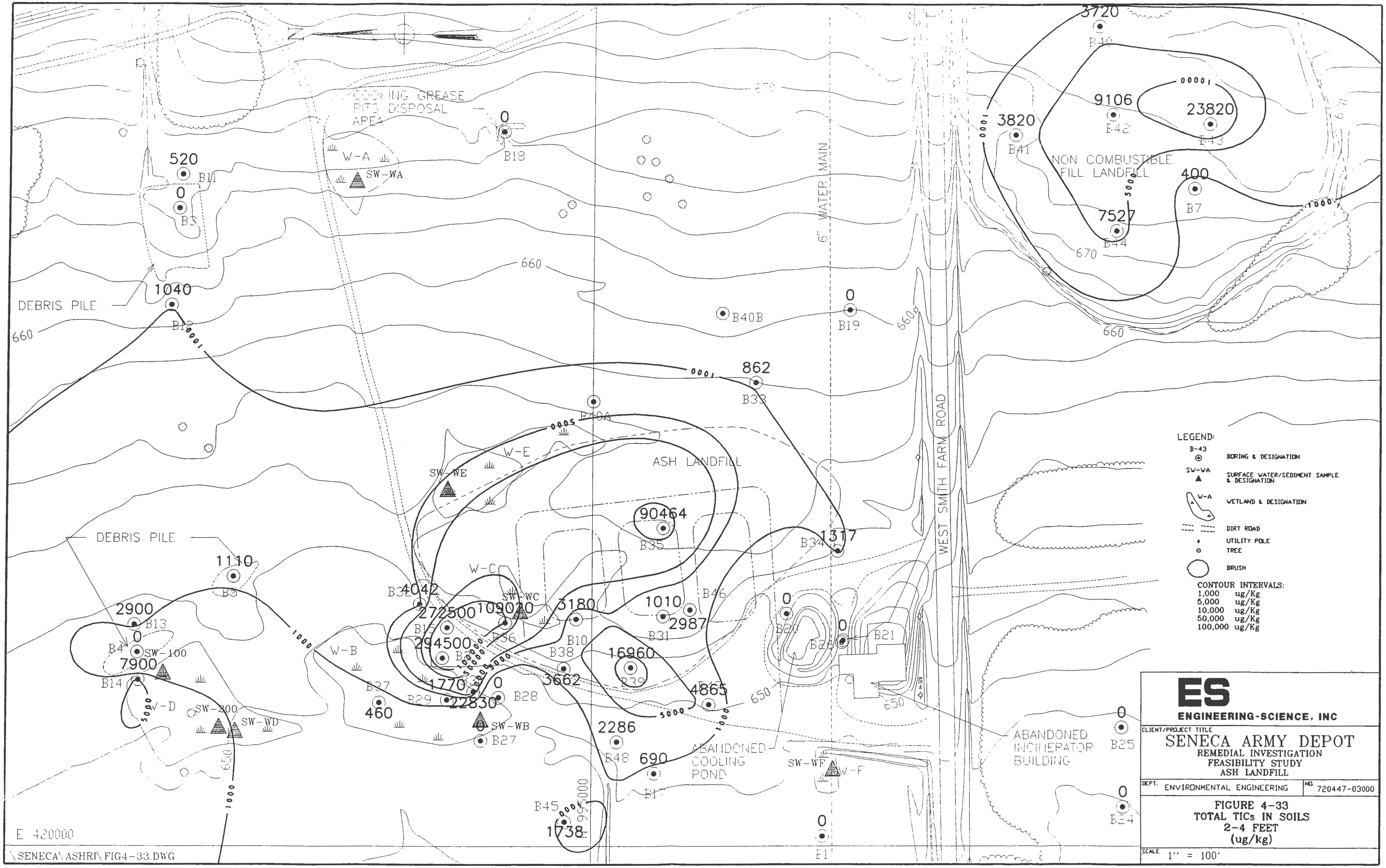

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FIGURE 4-33
TOTAL TICs IN SOILS
2-4 FEET
(ug/kg)

SCALE 1" = 100'

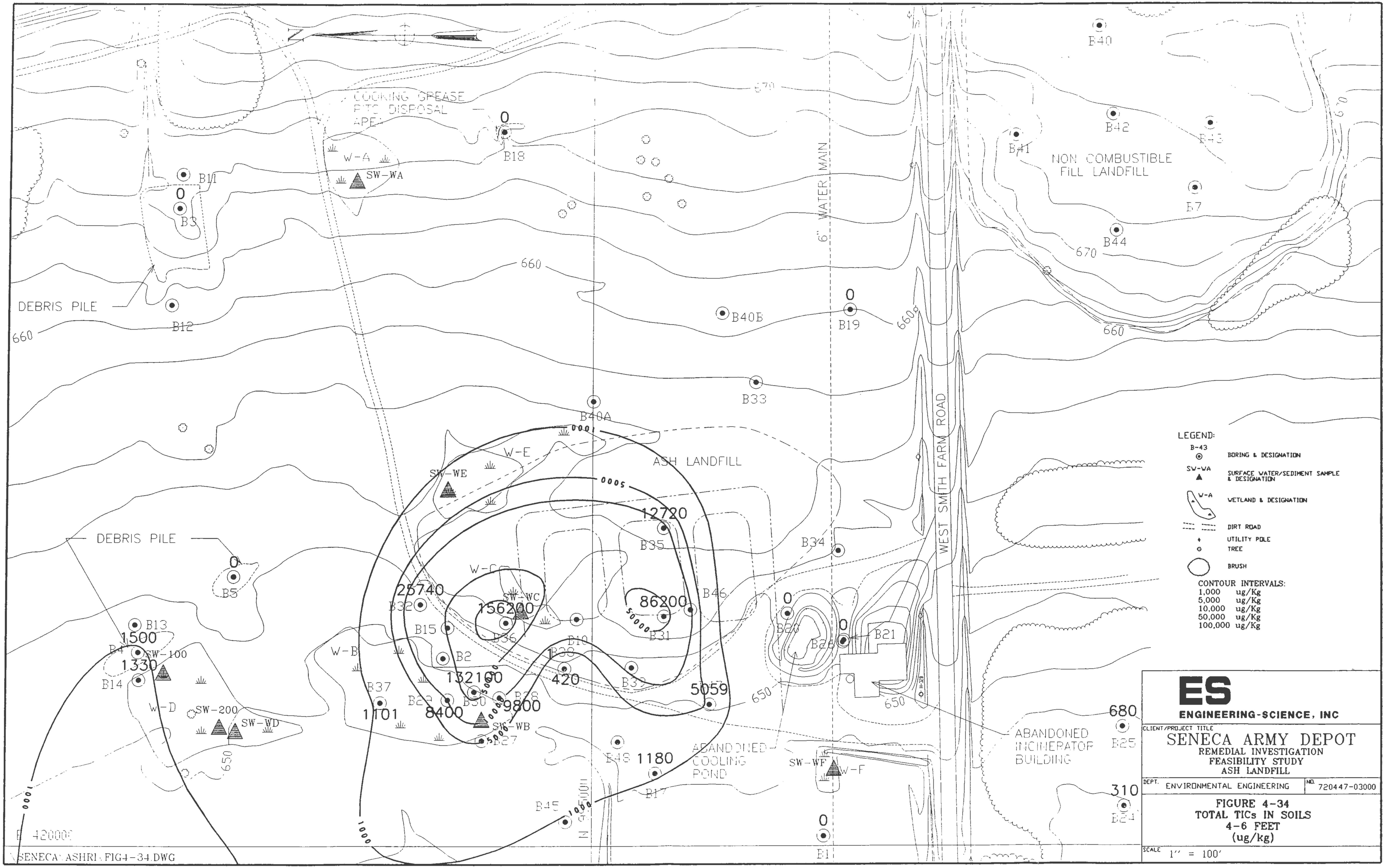

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FIGURE 4-34
TOTAL TICs IN SOILS
4-6 FEET
(ug/kg)

SCALE 1" = 100'

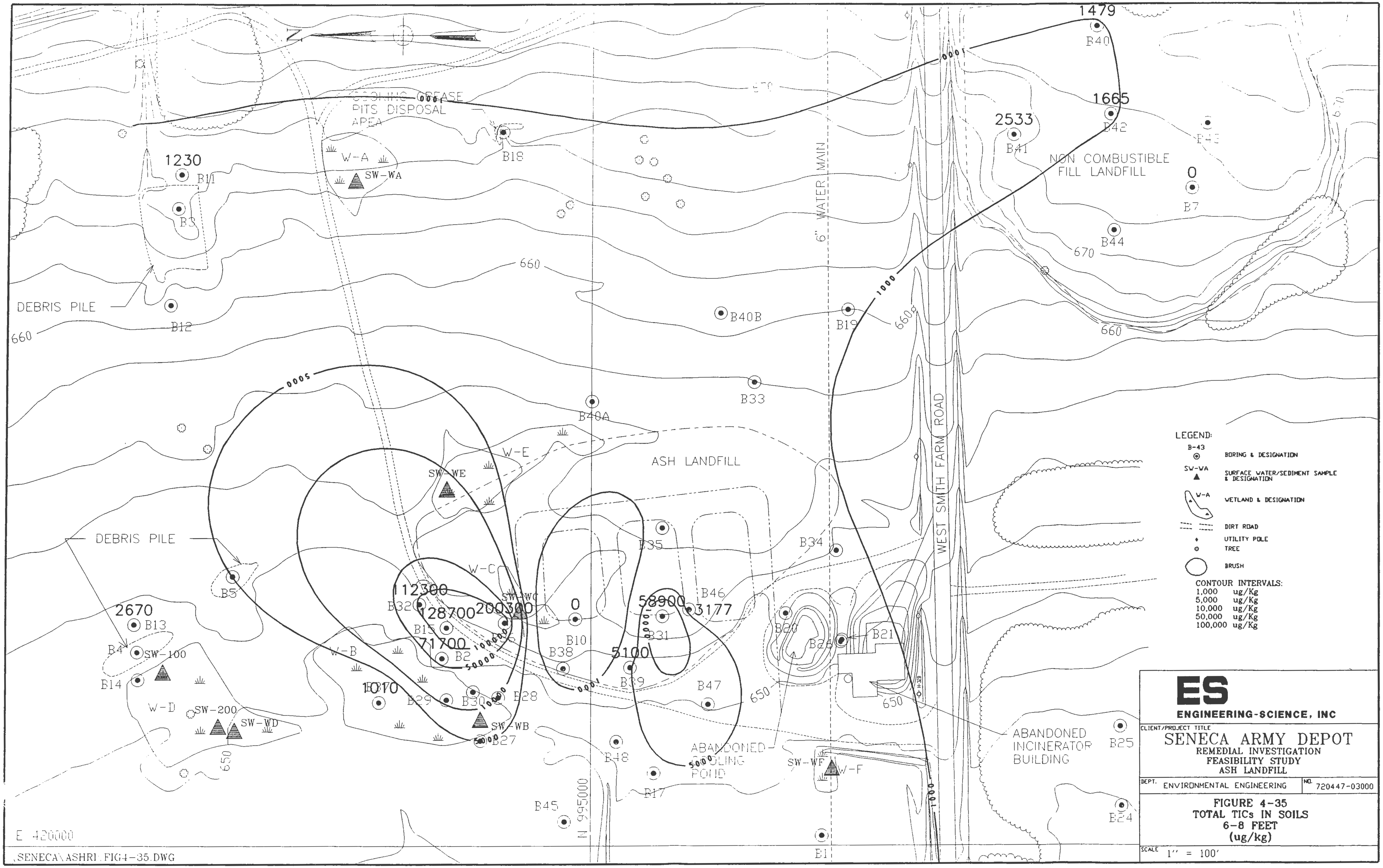

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FIGURE 4-35
TOTAL TICs IN SOILS
6-8 FEET
(ug/kg)

SCALE 1'' = 100'

4.3.7.3 Debris Piles

The debris piles had concentrations ranging from ND to 47,100 ug/kg. The two most significant concentrations were collected from samples at location B4 and B5 in the west debris pile. These values were collected at sample intervals of 0 to 2 feet and were 47,100 and 37,960 ug/kg, respectively.

4.3.8 Copper

4.3.8.1 Ash Landfill

Moderate concentrations of copper were detected in the central portion of the Ash Landfill, primarily at the 0 to 2 foot depth interval of B10 and B31. The maximum copper concentration observed here was 146 mg/kg in B31 (TAGM of 25 mg/kg). The horizontal and vertical extent is defined on Figures 4-36 through 4-38. The vertical extent is 0 to 4 feet with some concentrations slightly elevated above the TAGM below a depth of four feet.

4.3.8.2 Non-Combustible Fill Landfill

An area of moderate to high copper concentrations is observed within the Non-Combustible Fill Landfill, centered on B42. The maximum copper concentration observed here was 311 mg/kg in the 2 to 4 foot sample. The horizontal extent includes the center of this landfill, extending vertically down to a depth of four feet (Figures 4-36 through 4-38). Moderate copper concentrations are observed in B42 and B43 within the 4 to 6 foot depth interval.

4.3.8.3 Debris Piles

Moderate to high copper concentrations were observed in the 0 to 2 foot depth interval only of B3, B11 (east pile) and B4 and B5 (west pile). The maximum copper concentration for this investigation occurred in the 0 to 2 foot depth interval of B3: 836 mg/kg. Maximum concentrations for the five other heavy metals antimony, arsenic, barium, cadmium and zinc also were observed at B3, 0 to 2 feet. The horizontal extent is likely to be the pile boundaries since the areas outside these pile are not disturbed. The vertical extent is two feet deep.

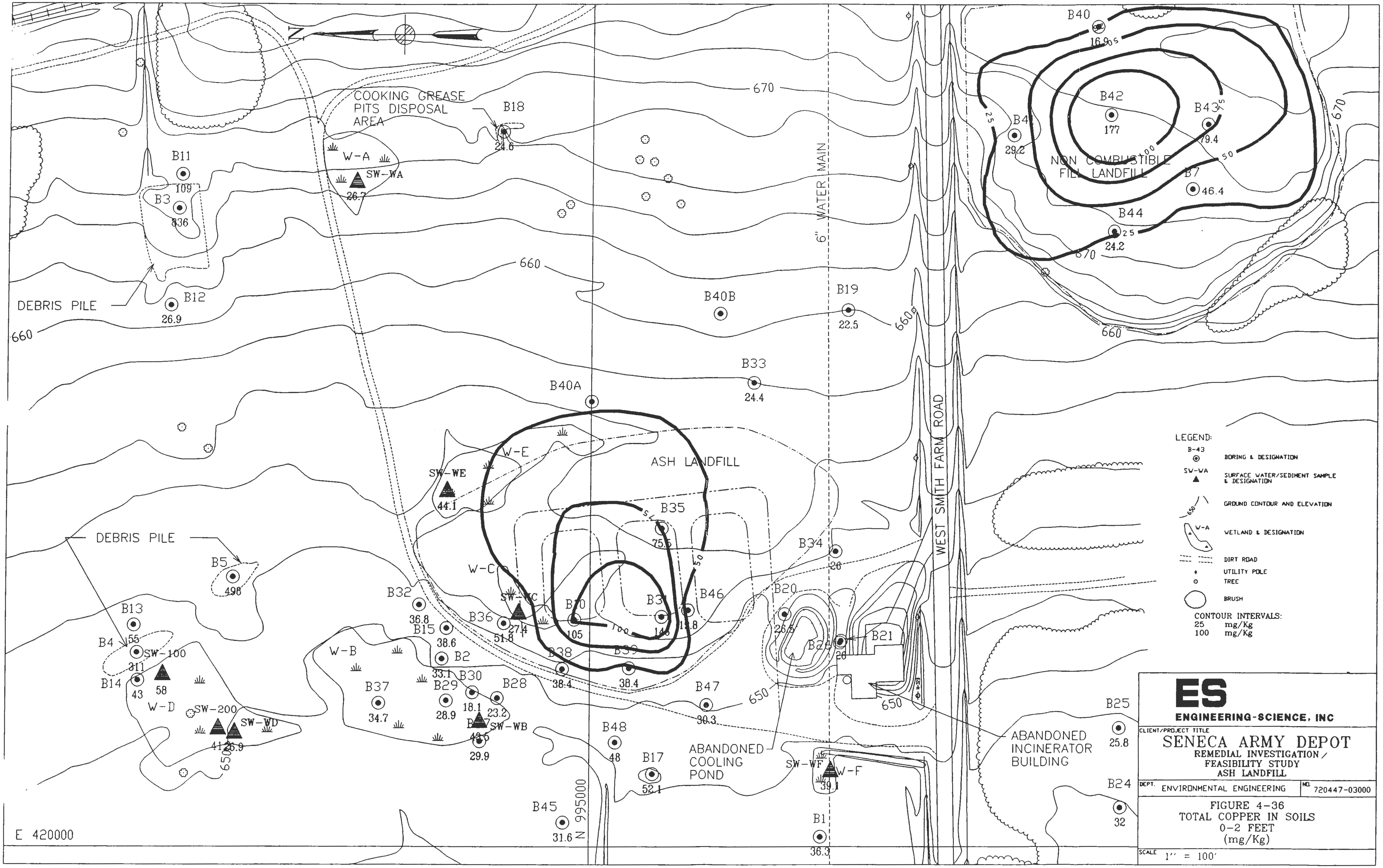

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FIGURE 4-36
TOTAL COPPER IN SOILS
0-2 FEET
(mg/Kg)

SCALE 1'' = 100'

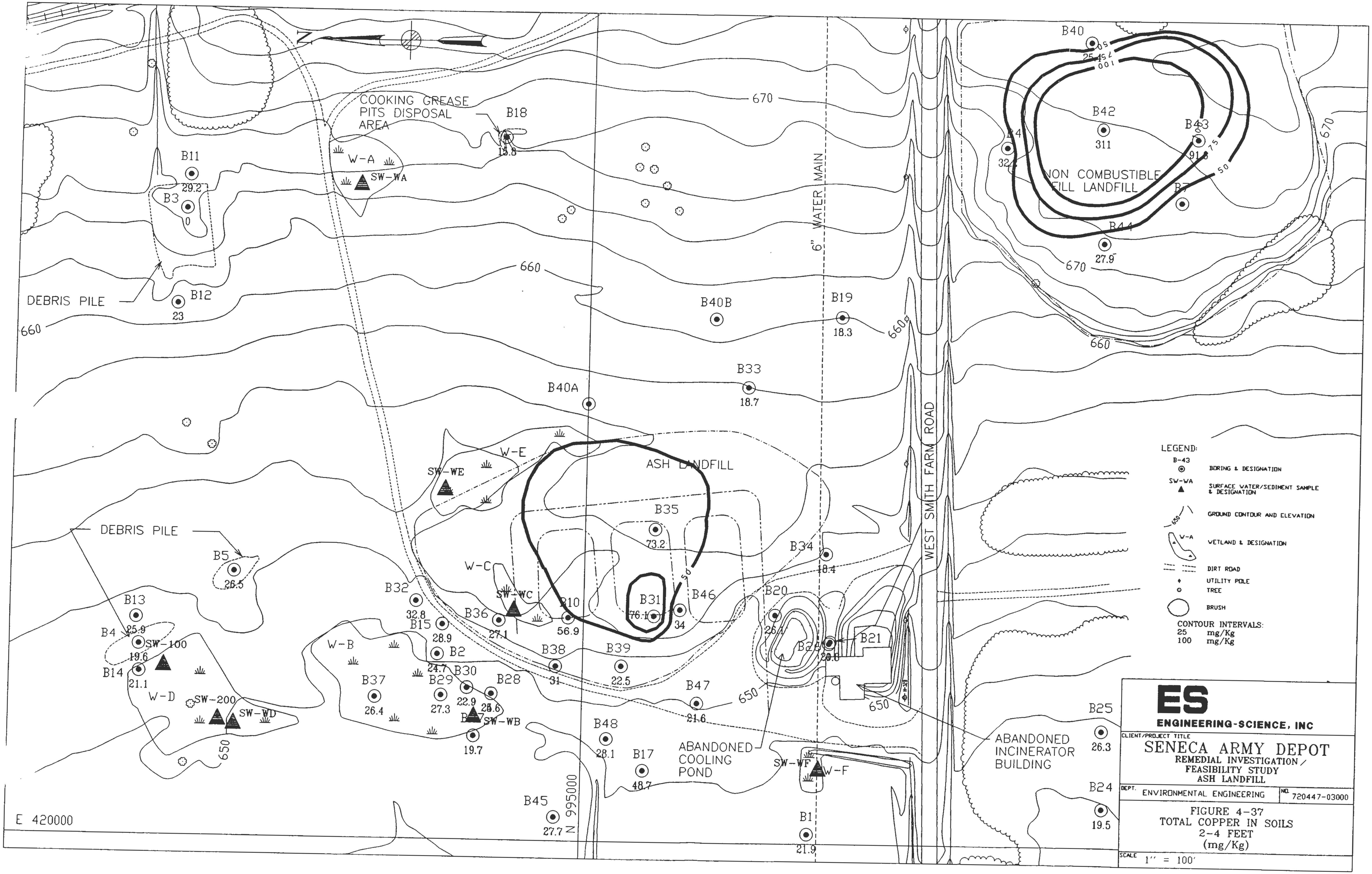

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FIGURE 4-37
TOTAL COPPER IN SOILS
2-4 FEET
(mg/Kg)

SCALE 1'' = 100'

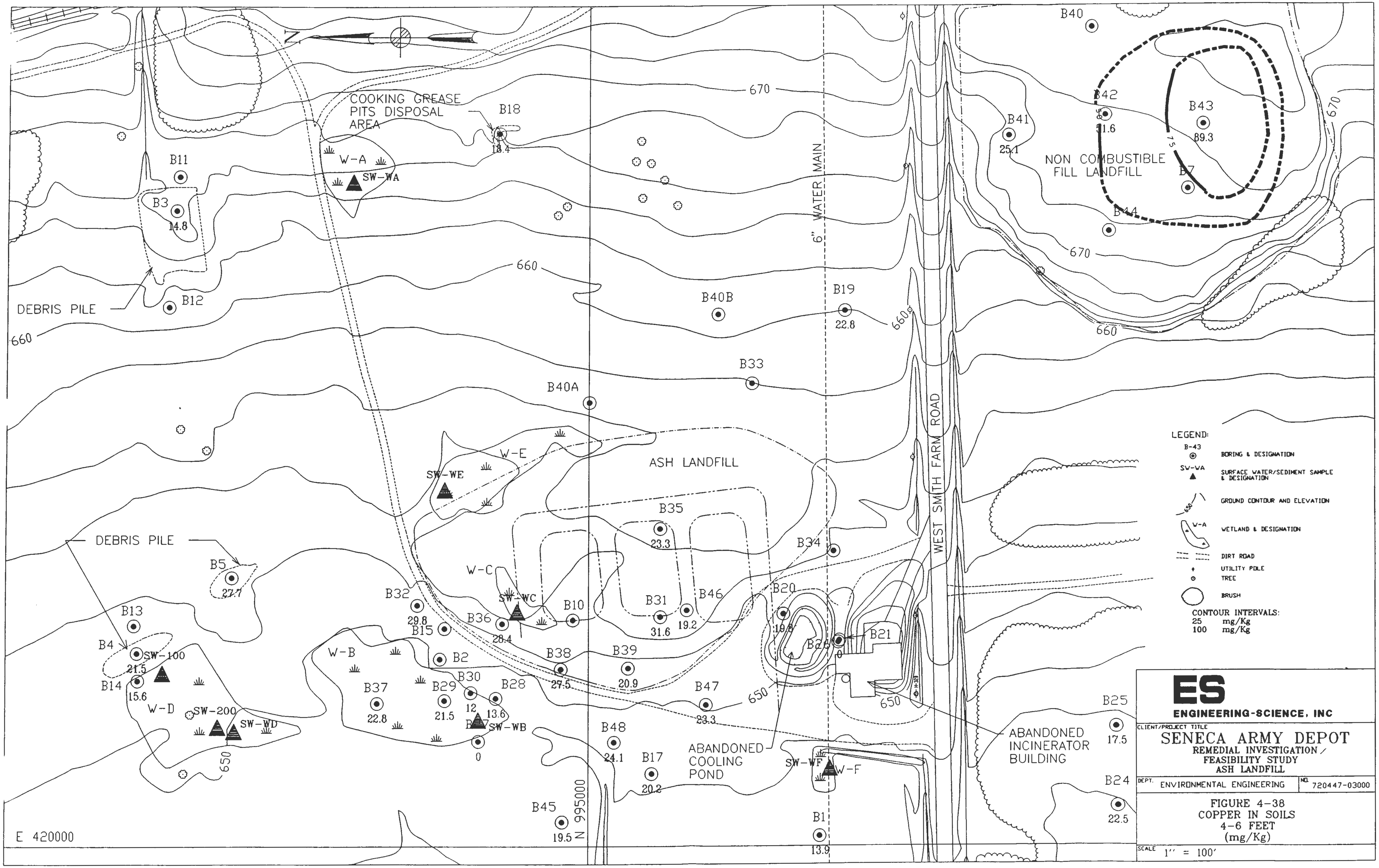

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FIGURE 4-38
COPPER IN SOILS
4-6 FEET
(mg/Kg)

SCALE 1" = 100'

4.3.9 Lead

4.3.9.1 Ash Landfill

Moderate to high lead concentrations were detected in B31, B35 and B46 at the center of the Ash Landfill (Figures 4-39 through 4-41), in the depth interval 2 to 4 feet. The maximum concentration detected was 696 mg/kg. Concentration are low in next depth interval down.

4.3.9.2 Non-Combustible Fill Landfill

High lead concentrations were detected in the 2 to 4 foot depth interval in the center of this landfill (borings B7, B42 and B43). The highest concentration observed was 2,610 mg/kg at B43 (TAGM of 30 mg/kg). The horizontal extent is likely to be the center portion of the landfill as indicated on Figures 4-39 through 4-41 and is not likely to extend beyond the landfill fill area. The vertical extent is the 2 to 4 foot depth interval, with some moderate lead concentrations in B42 and B43 above and below this interval.

4.3.9.3 Debris Piles

The investigation maximum lead concentration of 2,890 mg/kg was observed in the 0 to 2 foot depth interval of boring B4 in the west debris pile (together with moderate to high concentrations of cadmium, chromium, copper, nickel and zinc in the same sample). A moderate lead concentration of 248 mg/kg was observed the next interval down (2 to 4 feet). Elevated lead concentrations also measured in the east debris pile in boring B-3 in the 0-2 foot interval (1,630 mg/kg). Low lead levels were measured below this depth.

4.3.10 Mercury

4.3.10.1 Ash Landfill

Moderate concentrations of mercury were detected in the Ash Landfill from B35, B10, B21 north to wetland WE (sediment sample) at the depth interval 0 to 2 feet. The maximum mercury concentration detected was 0.81 mg/kg in the sediment sample SD-WE (TAGM of 0.1 mg/kg). The horizontal extent of these moderate concentrations appears to be coincident with the Ash Landfill (Figures 4-42 through 4-44). The next interval down, 2 to 4 feet also shows moderate concentrations in B10, B17 and B35. Levels are low below this depth so that the vertical extent is likely to be 0 to 4 feet.

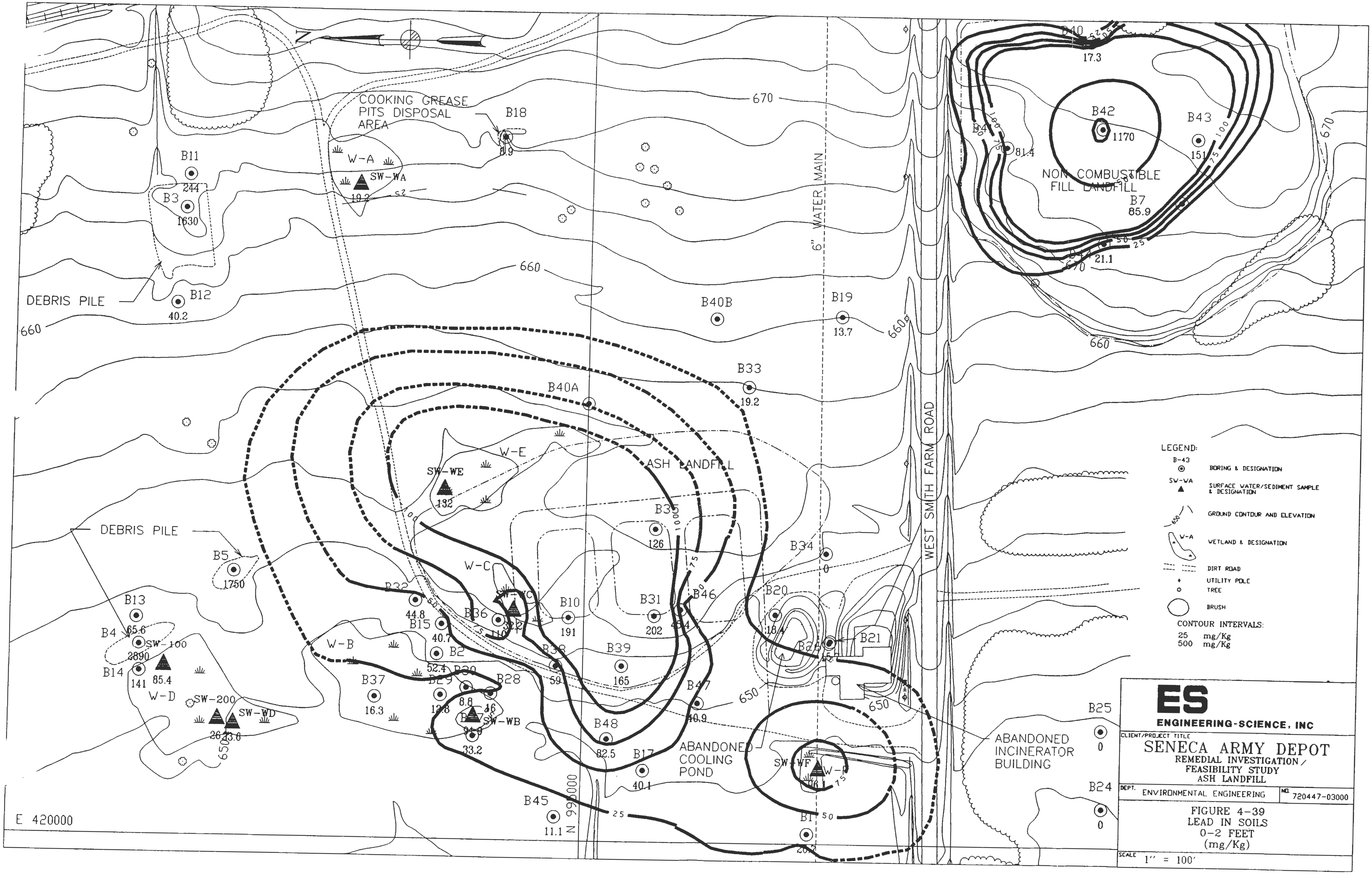

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FIGURE 4-39
LEAD IN SOILS
0-2 FEET
(mg/Kg)

SCALE 1" = 100'

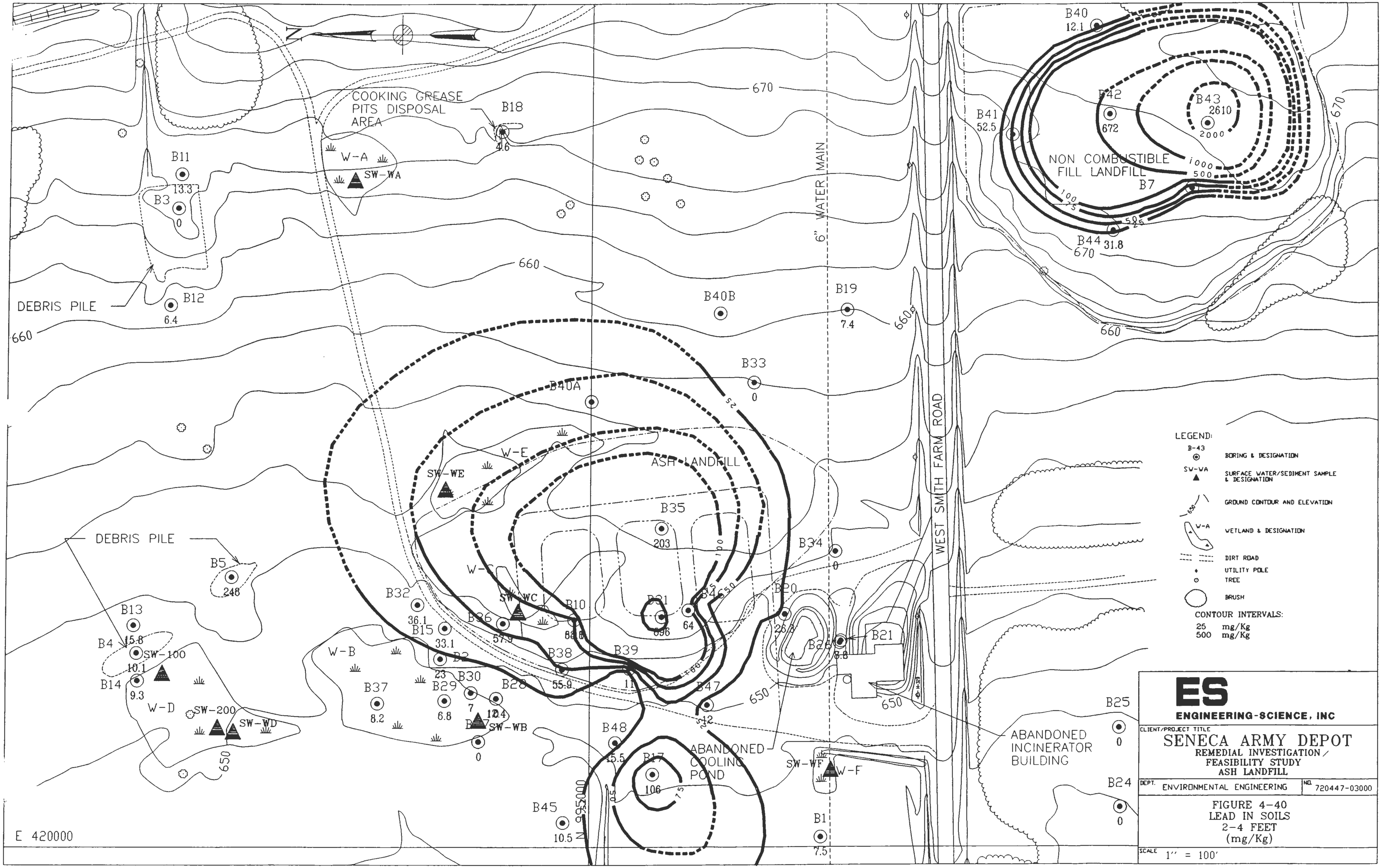

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FIGURE 4-40
LEAD IN SOILS
2-4 FEET
(mg/Kg)

SCALE 1" = 100'

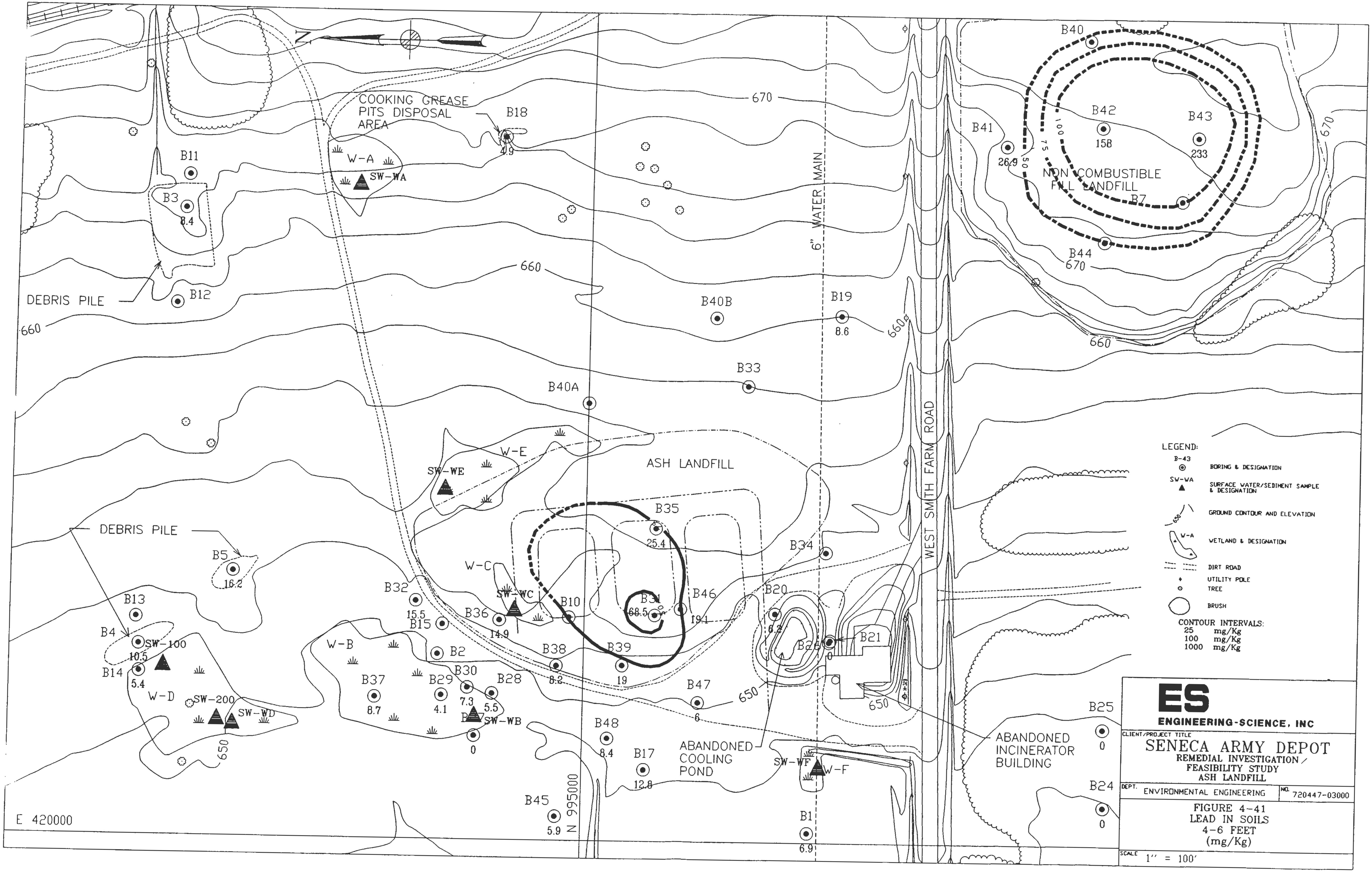

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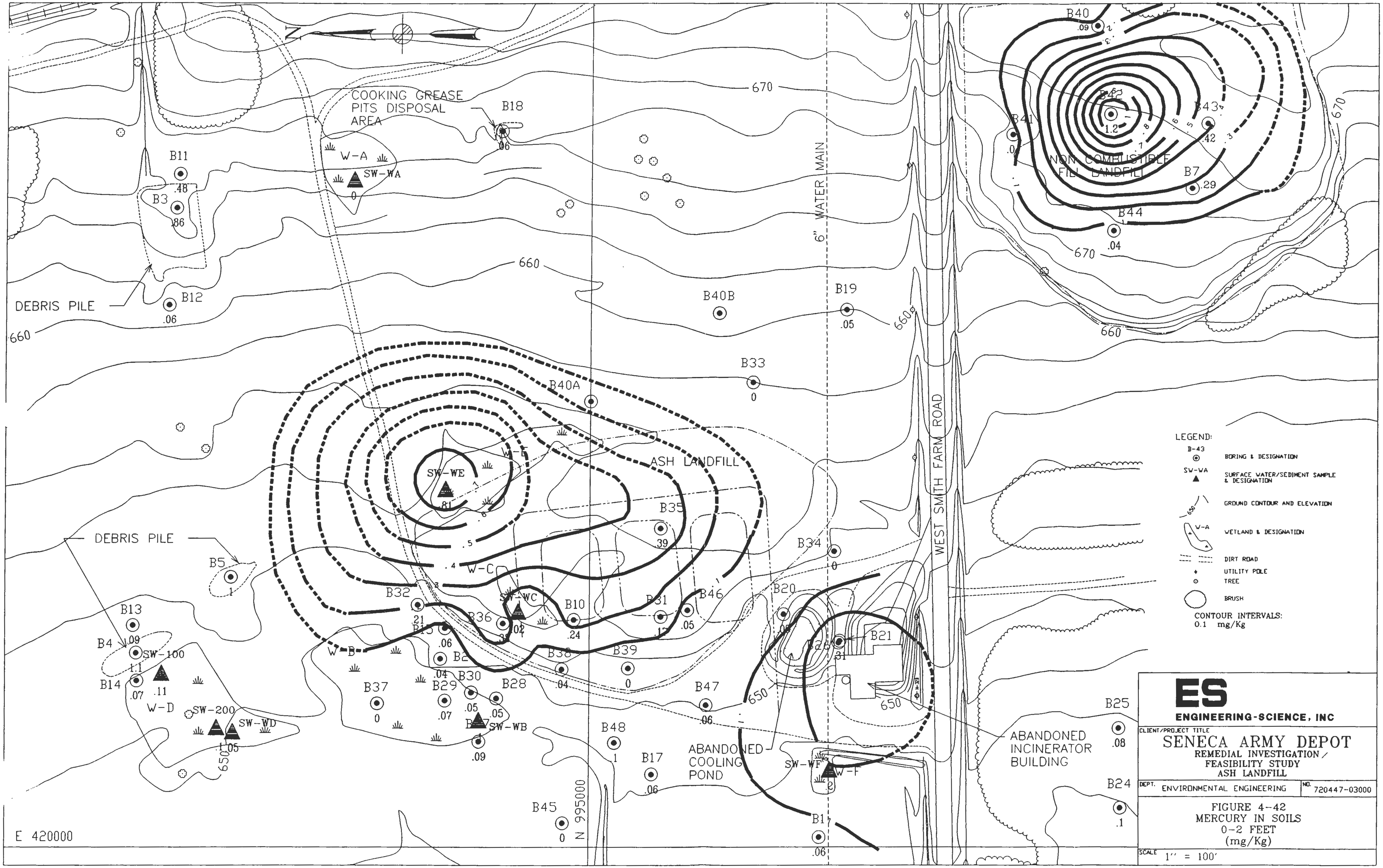
FIGURE 4-41
LEAD IN SOILS
4-6 FEET
(mg/Kg)

SCALE 1" = 100'



LEGEND:

B-43 ⊙ BORING & DESIGNATION

SW-WA ▲ SURFACE WATER/SEDIMENT SAMPLE & DESIGNATION

650 GROUND CONTOUR AND ELEVATION

W-A WETLAND & DESIGNATION

DIRT ROAD

♦ UTILITY POLE

⊙ TREE

○ BRUSH

CONTOUR INTERVALS:
0.1 mg/Kg

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FIGURE 4-42
MERCURY IN SOILS
0-2 FEET
(mg/Kg)

SCALE 1'' = 100'

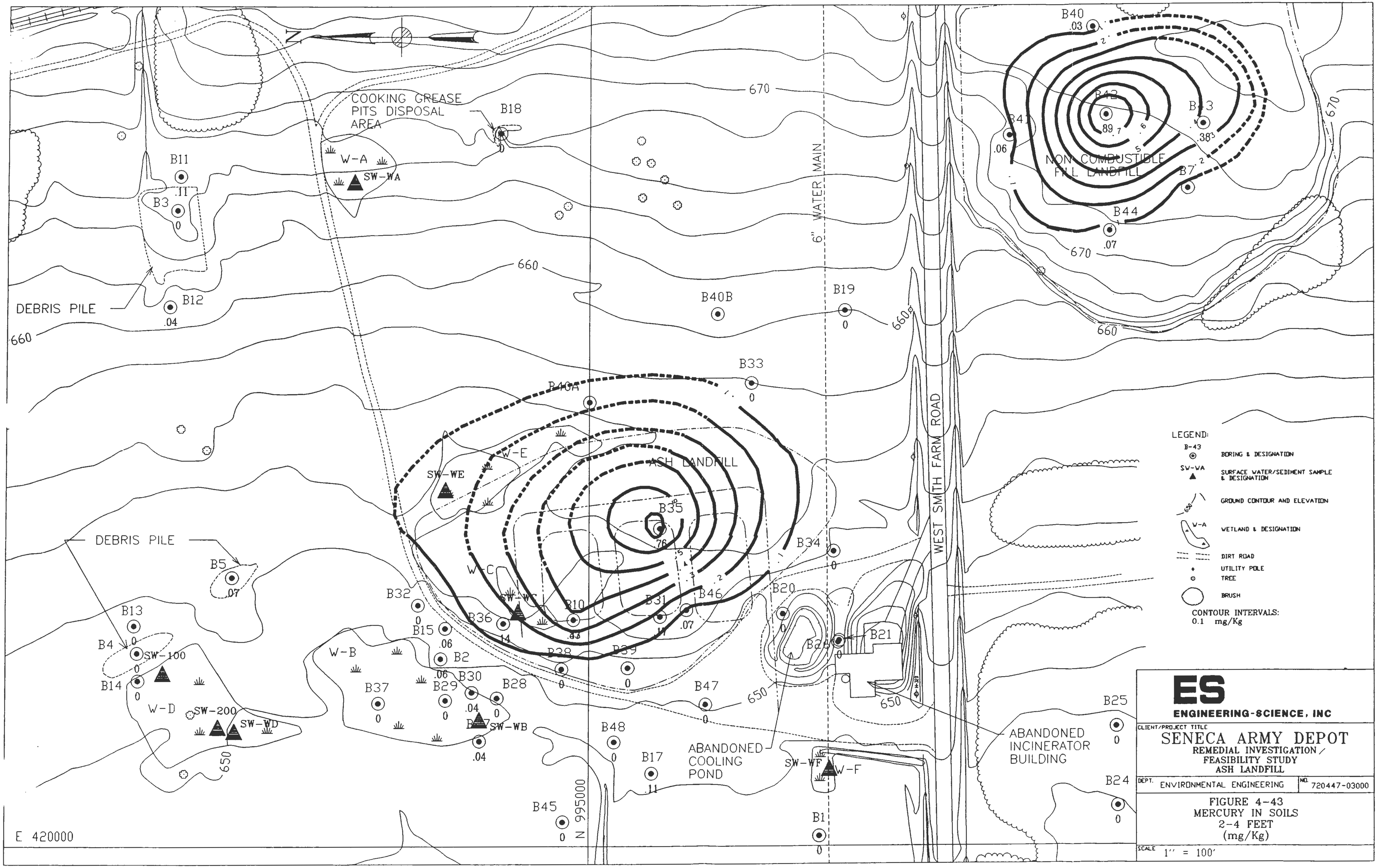

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FIGURE 4-43
MERCURY IN SOILS
2-4 FEET
(mg/Kg)

SCALE 1" = 100'

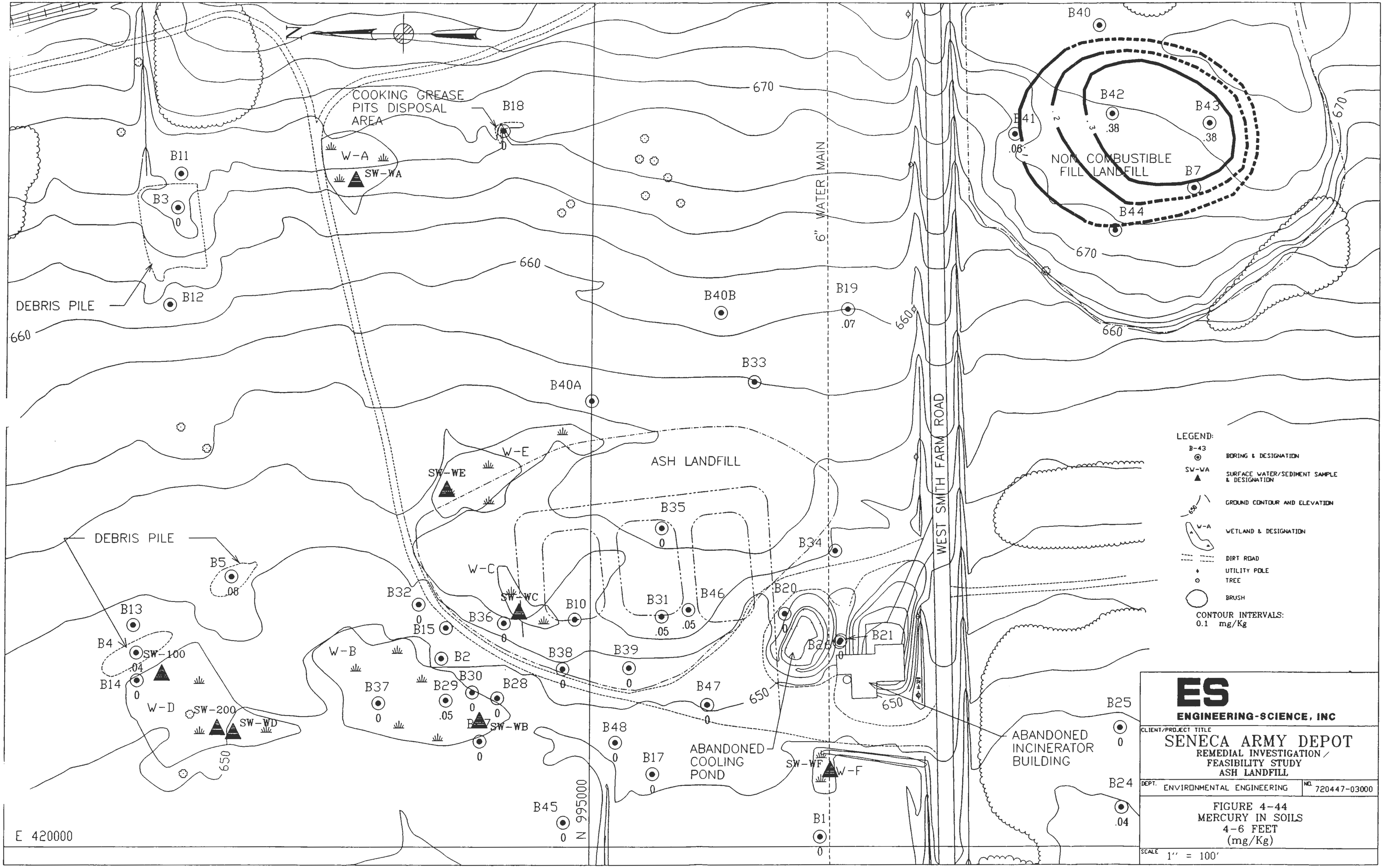

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FIGURE 4-44
MERCURY IN SOILS
4-6 FEET
(mg/Kg)

SCALE 1" = 100'

4.3.10.2 Non-Combustible Fill Landfill

Relatively high concentrations of mercury were detected in the central portion of this landfill within the 0 to 2 foot depth interval as indicated on Figure 4-42. The maximum concentration detected here was 1.2 mg/kg mercury in B42. This is the maximum mercury concentration detected in this investigation. The concentrations are moderate in the next two depth intervals below (2 to 4 feet and 4 to 6 feet) with maximums of 0.89 mg/kg and 0.38 mg/kg respectively in the 2 to 4 foot and 4 to 6 foot intervals of B42. The vertical extent appears to be a depth of six feet.

4.3.10.3 Debris Piles

Within the 0 to 2-foot depth interval only, high mercury concentrations (maximum 1.1 mg/kg) were detected at B4 and B5 of the west pile and moderate concentrations were detected at B3 and B11 of the east pile (maximum 0.86 mg/kg). The horizontal extent is likely to be the pile boundaries since areas outside the boundaries are undisturbed. Elevated mercury was not measured below this depth so the vertical extent is likely limited to 0 to 2 feet.

4.3.11 Zinc

4.3.11.1 Ash Landfill

Relatively high zinc concentrations were detected in the Ash Landfill, as shown on Figure 4-45 through 4-47, for the depth intervals 0 to 2 feet, and 2 to 4 feet. The maximum concentration was detected at B35 for both depth intervals: 6,290 mg/kg and 4,210 mg/kg respectively. The TAGM for zinc is 89 mg/kg. The Ash Landfill area appears to be affected by high concentrations of zinc down to a depth of four feet. Below four feet only B31 appears affected by zinc where the concentration is moderate (less than 400 mg/kg).

4.3.11.2 Non-Combustible Fill Landfill

Moderate to high concentrations of zinc were detected in this landfill, with concentrations increasing with depth. The maximum zinc concentrations of 745 mg/kg, 1,410 mg/kg and 3,100 mg/kg, were all detected in B43 at depth intervals 0 to 2 feet, 2 to 4 feet, and 4 to 6 feet respectively. The horizontal and vertical extent of zinc affected soil is likely to be limited to the central portion of the landfill.

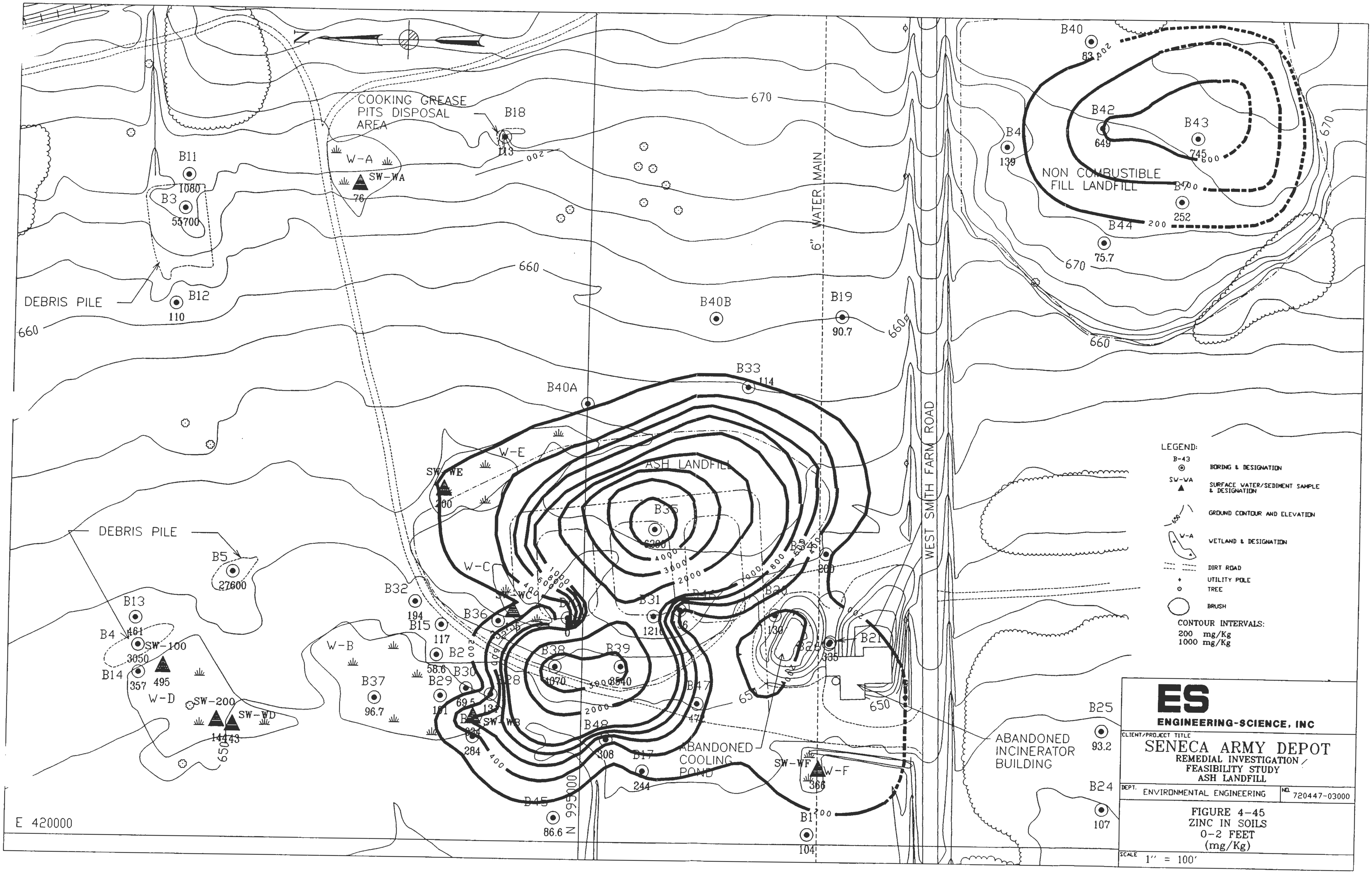

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FIGURE 4-45
ZINC IN SOILS
0-2 FEET
(mg/Kg)

SCALE 1" = 100'

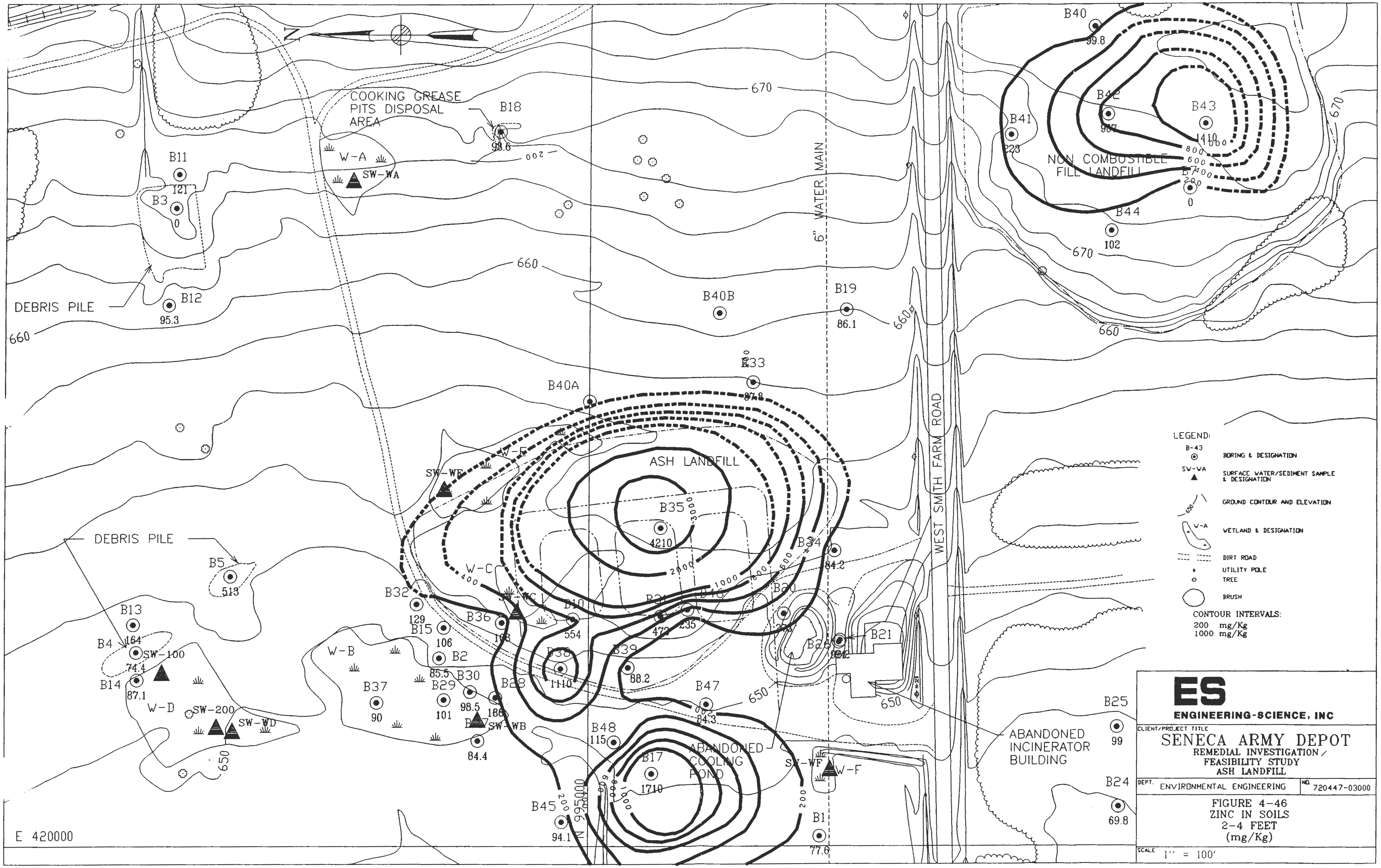

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FIGURE 4-46
ZINC IN SOILS
2-4 FEET
(mg/Kg)

SCALE 1'' = 100'

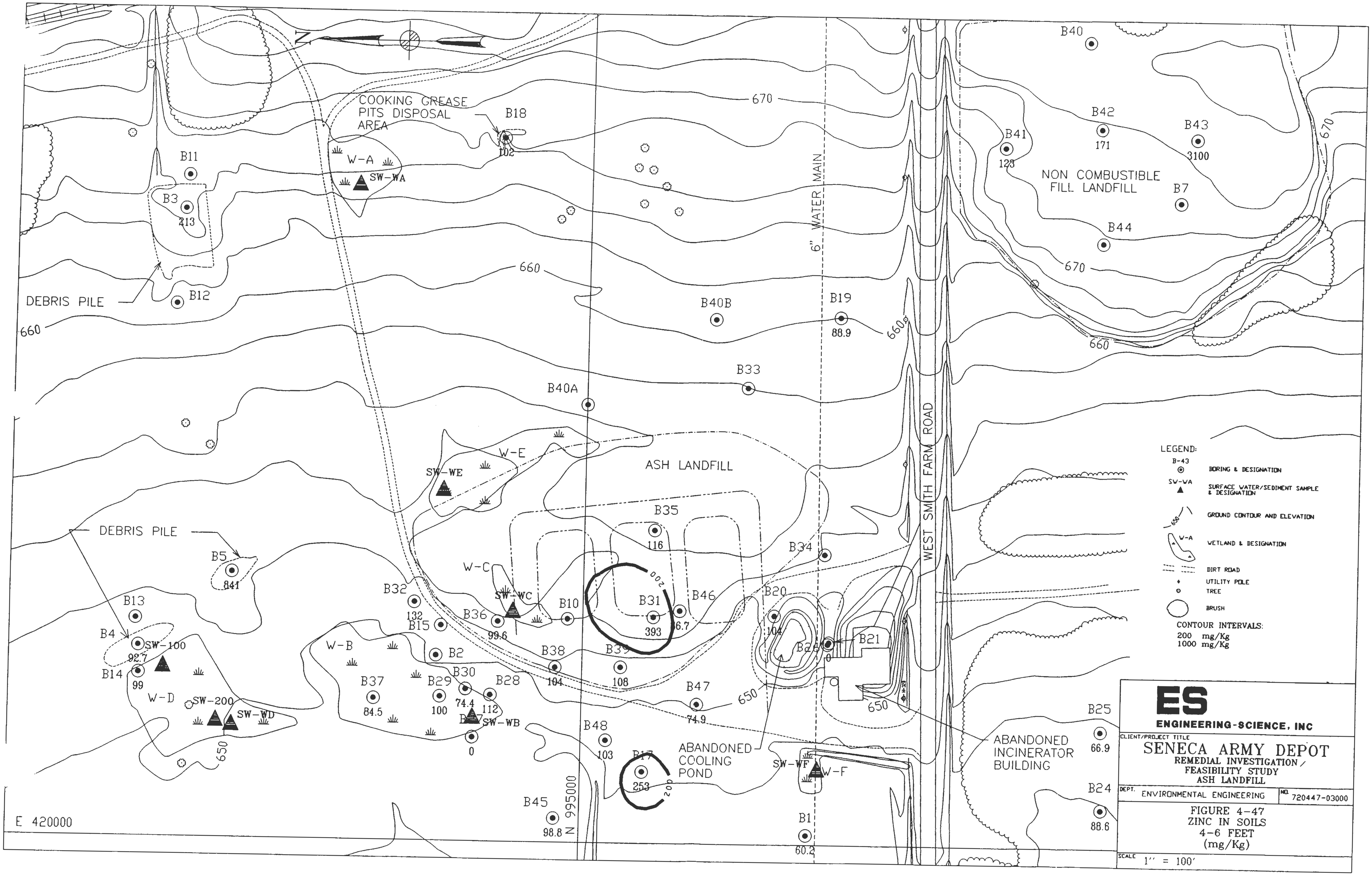

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FIGURE 4-47
ZINC IN SOILS
4-6 FEET
(mg/Kg)

SCALE 1'' = 100'

4.3.11.3 Debris Piles

The highest concentration of zinc observed in this investigation was detected at the 0 to 2-foot depth interval of B3 (55,700 mg/kg) in the east debris pile where maximum concentrations for five other metals were detected. Moderate to low zinc concentrations were detected in the adjacent borings (B11 and B12), likely confirming the east pile horizontal extent of zinc-affected soil to be approximately the pile boundary. The vertical extent is likely to be 0 to 2 feet for this east pile. Similarly high concentrations of zinc were detected in the 0 to 2 foot depth interval of B5 (max. 27,600 mg/kg) which is the west pile. Again, high concentrations of five other heavy metals were observed in the same samples. The horizontal extent is likely to be the west pile boundaries. The vertical extent is likely to be 0 to 2 feet.

4.3.12 Other Metals and Cyanide

A statistical comparison made of on-site soil concentrations to background using the Students T-test. The results of this comparison are presented in Table 6-2. Of the 22 metals and cyanide listed in Table 4-3, only 8 were measured on-site at concentrations statistically significantly higher than background. These are cadmium, chromium, copper, lead, potassium, silver, sodium and zinc. Three of these, copper, lead and zinc, were discussed previously. Of the remaining five, silver and sodium concentrations were all below the TAGM, and potassium and only one sample in exceedance of the TAGM. The remaining two metals, cadmium and chromium, had 92 and 91 TAGM exceedances, respectively. For both of these metals, the TAGM value is the calculated site specific background concentration. The majority of the highest concentrations of these two metals were measured in borings B3, B4, and B5 in the debris piles in the 0 to 2 foot depth interval.

4.3.13 Total Recoverable Petroleum Hydrocarbons

The 2 to 4 foot sample from boring B26-91 near the underground fuel oil tank was analyzed for total recoverable petroleum hydrocarbons using a modified EPA method 418.1. The sample contained 13.6 mg/kg of total recoverable petroleum hydrocarbons. However, during drilling no VOCs or visual or olfactory evidence of petroleum hydrocarbons were detected in the soil from this boring.

4.4 GROUNDWATER

Groundwater samples were collected from a total of 47 monitoring wells at the Ash Landfill site. Because the investigation was performed in two phases (Phases I and II), two complete rounds of data are available for 31 wells (PT-10 through MW-42D) and one complete round of data for 16 wells (MW-43 through MW-58D). Two rounds of VOA data are available for wells MW-43, MW-45, and MW-47 through MW-58D. Wells PT-13 and PT-14 were destroyed prior to this investigation and thus were not sampled. It is noteworthy that the purging procedure was modified in Phase II to include low flow withdrawal from the wells producing lower turbidities for the samples when compared to those obtained in Phase I. The Phase II groundwater results are, therefore, believed to be more representative of the water quality present at the Ash Landfill, particularly for the metals. A complete description of the sampling procedure is described in Section 2.0 A summary of the results of the groundwater analyses conducted for this investigation is presented in Table 4-5. Comprehensive analytical data tables are included in Appendix J.

4.4.1 Chlorinated Volatile Organic Compounds

Chlorinated volatile organic compounds were detected in 18 of the 47 monitoring wells sampled on the Ash Landfill site. The primary VOCs detected were TCE, 1,2-DCE (total), 1,1-DCE and vinyl chloride with frequencies of detection of 38.3 percent, 31.9 percent, 6.4 percent and 6.4 percent, respectively (Table 4-5). TCE, where detected, ranges in concentration from 0.4 ug/L in wells MW-49D and MW-51D to 37,000 ug/L in well MW-44. The New York Drinking Water Quality Standard (DWQS) for this compound is 5 ug/L. 1,2-DCE, where detected, ranges in concentration from 0.2 ug/L in well MW-56 to 74,000 ug/L in well MW-44 with many of these concentrations being over the 5 ug/L DWQS for this compound. Vinyl chloride was detected in only three wells and ranges in concentration from 4 ug/L in well PT-12 to 23,000 ug/L in MW-44. The DWQS for vinyl chloride is 2 ug/L (Table 4-5).

Less common chlorinated volatiles, all with low frequencies of detection, include chloroform (4.3 percent), 1,1-dichloroethane (2.1 percent), 1,2-dichloroethane (2.1 percent), 1,1,1-trichloroethane (4.3 percent), and tetrachloroethene (2.1 percent). These compounds were detected in only 1 or 2 wells. Concentrations of these compounds were generally low. Chloroform ranged from 3 ug/L in well PT-17 to 210 ug/L in well PT-18, the latter of which is above the 100 ug/L TAGM for this compound. 1,1-dichloroethene ranged in concentration

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I PT-10 01/08/92 PT-10(2) BACKGROUND	PHASE I PT-10 01/08/92 PT-10(2) (Filtered) BACKGROUND	PHASE II PT-10 06/23/93 PT-10 BACKGROUND	PHASE I MW-34 01/10/92 MW-34 BACKGROUND	PHASE I MW-34 01/10/92 MW-34 (Filtered) BACKGROUND	PHASE I MW-34 01/10/92 PT-1(1) BACKGROUND
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	N	0.5 U	10 U	N	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	5 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	5 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	5 U	N	0.5 U	5 U	N	5 U
Chloroform	4.3%	210	100	100	2	7	2	ND	5 U	N	0.5 U	5 U	N	5 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	5 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	5 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	5 U	N	0.5 U	5 U	N	5 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	5 U	N	0.5 U	5 U	N	5 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	N	5 U	10 U	N	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	5 U	N	0.5 U	5 U	N	5 U
Toluene	4.3%	900	1000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	5 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	5 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	5 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	10 U	N	10 U	11 U	N	11 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	10 U	N	10 U	11 U	N	11 U
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	10 U	N	10 U	11 U	N	11 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	10 U	N	10 U	11 U	N	11 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	10 U	N	10 U	11 U	N	11 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	10 U	N	10 U	11 U	N	11 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	52 U	N	25 U	54 U	N	54 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	10 U	N	18	11 U	N	11 U
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.3 U	N	2.4 U	2.4 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	N	0.11 U	0.1 U	N	0.1 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	98.1 U	24.4 U	72 U	8250 J	24.4 U	7310 J
Antimony	6.4%	191	6	-	NA	3	4	ND	55.9 U	53 U	49.5 UJ	55.9 U J	53 U	55.9 U J
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5 U J	3.5 U	1.4 UJ	3.5 U	3.5 U	3.5 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	196 J	203	193 J	225		191 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND			0.89 U			
Cadmium	29.8%	64.6	5	5	8	10	3	ND	2.9 U	3 U	2.8 U	2.9 U	3 U	2.9 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	86500 J	86900	79100	352000 J	108000	268000 J
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	6.2 U	6.2 U	2.7 UJ	10.3	6.2 U	12
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	20 U	20.3 U	5.4 U	20 U	20.3 U	20 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	14.5 U	10.1 U	4.7 U	14.5 U	10.1 U	14.9 J
Iron	100.0%	610000	-	300	63	300	63	ND-27800	109	6.9 U	85.6 J	10600 J	6.9 U	11300 J
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	1.2 U	1.4 J	0.79 U	8.2	1.2 U	7.4
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	32700 J	39600	34200	32100	20200	26300 J
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	99.6	43.8	124	2200	132	1680 J
Mercury	19.1%	2.3	2	2	1	2	1	ND			0.09 UJ			
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	16 U	14.7 U	7.4 UJ	17.6 J	14.7 U	18 J
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	1300 J	1830 J	2870 J	8910	7980	9760
Selenium	19.1%	2.9	50	10	0	10	0	ND	1 U	1 U	0.99 UJ	1 U	1 U	1 U
Silver	6.4%	7.2	-	50	0	50	0	ND	9.1 U	3.4 U	5.4 U	9.1 U		9.1 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	37700 J	35900	41100	24900 J	31200	36500 J
Vanadium	63.8%	358	-	-	NA	-	NA	ND	30.5 U	9.4 U	6.7 UJ	30.5 U	9.4 U	30.5 U
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	19.2 J	8.4 U	8.8 J	51.9	8.4 U	
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	11.2 J		10 UJ	10 U J		10 U J

TABLE 4 - 5

SUMMARY OF COMPOUNDS
DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I MW-34 01/10/92 PT-1(1) (Filtered) BACKGROUND	PHASE II MW-34 06/24/93 MW-34 BACKGROUND	PHASE I MW-37 01/10/92 MW-37 BACKGROUND	PHASE I MW-37 01/10/92 MW-37 (Filtered) BACKGROUND	PHASE II MW-37 06/24/93 MW-37 BACKGROUND	PHASE I MW-41D 01/13/92 MW-41D BACKGROUND
VOCs (ug/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	N	0.5 U	10 U	N	0.5 U	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	N	0.5 U	5 U	N	0.5 U	5 U
Chloroform	4.3%	210	100	100	2	7	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	N	0.5 U	5 U	N	0.5 U	5 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	N	0.5 U	5 U	N	0.5 U	5 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	N	0.5 U	5 U	N	0.5 U	5 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	N	0.5 U	5 U	N	0.5 U	5 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	N	5 U	10 U	N	5 U	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	N	0.5 U	5 U	N	0.5 U	5 U
Toluene	4.3%	900	1000	5	2	5	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
Semivolatiles (ug/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	N	10 U	11 U	N	10 U	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	N	10 U	11 U	N	10 U	10 U
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	N	10 U	11 U	N	10 U	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	N	10 U	11 U	N	10 U	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	N	10 U	11 U	N	10 U	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	N	10 U	11 U	N	10 U	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	N	25 U	55 U	N	25 U	52 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	N	10 U	11 U	N	10 U	10 U
Herbicides (ug/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	2.3 U	2.4 U	N	2.3 U	2.4 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N	0.1 U	0.1 U	N	0.1 U	0.1 U
Metals (ug/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	24.5 U	253	19100	24.5 U	637	146 J
Antimony	6.4%	191	6	-	NA	3	4	ND	53.2 U	49.8 UJ	55.9 U J	53.2 U	49.7 UJ	
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5 U	1.4 UJ	3.5 U	3.5 U	1.4 UJ	3.5 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329		82.5 J	329		79.6 J	97 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND		0.9 U			0.89 U	
Cadmium	29.8%	64.6	5	5	8	10	3	ND	3 U	2.8 U	2.9 U	3 U	2.8 U	2.9 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	114000	122000	279000 J	109000	115000	45800 J
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	6.2 U	2.7 UJ	29.8	6.2 U	2.7 UJ	6.2 U
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	20.4 U	5.5 U	28 J	20.4 U	5.5 U	19.9 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	10.2 U	4.7 U	25.3	10.2 U	5.4 J	14.4 U
Iron	100.0%	610000	-	300	63	300	63	ND-27800	7 U	395	27800	7 U	1080	
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	1.2 U	0.79 U	8	1.2 U	0.8 U	1.2 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	20500	17400	28600	17900	16100	
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	127	135	2190	84.9	129	113
Mercury	19.1%	2.3	2	2	1	2	1	ND		0.09 UJ			0.09 UJ	
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	14.7 U	7.5 UJ	36.9 J	14.8 U	7.4 UJ	15.9 U
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	7210	1270 J	4470 J	1330 J	1160 J	2530 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1 U	0.99 UJ	1 U	1 U	1 UJ	1 U
Silver	6.4%	7.2	-	50	0	50	0	ND	3.4 U	5.5 U	9.1 U	3.4 U	5.5 U	9.1 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	25100	18200	11900 J	11200	15000	77600 J
Vanadium	63.8%	358	-	-	NA	-	NA	ND	9.5 U	6.8 UJ	30.6 U	9.5 U	6.8 UJ	30.5 U
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	8.5 U		58.8	8.5 U		13.4 U
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2		10 UJ	10 U J		10 UJ	10 U J

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE II MW-41D 06/22/93 MW-41D BACKGROUND	PHASE I MW-42D 01/13/92 MW-42D BACKGROUND	PHASE I MW-42D 01/13/92 MW-42D (Filtered) BACKGROUND	PHASE II MW-42D 06/23/93 MW-42D BACKGROUND	PHASE I PT-11 01/15/92 PT-11	PHASE I PT-11 01/15/92 PT-11 (Filtered)
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	0.5 U	10 U	N	0.5 U	10 U	N
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	0.5 U	5 U	N	0.5 U	5 U	N
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	0.5 U	5 U	N	0.5 U	5 U	N
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	0.5 U	5 U	N	0.5 U	5 U	N
Chloroform	4.3%	210	100	100	2	7	2	ND	0.5 U	5 U	N	0.5 U	5 U	N
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	0.5 U	5 U	N	0.5 U	5 U	N
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	0.5 U	5 U	N	0.5 U	5 U	N
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	0.5 U	5 U	N	0.5 U	5 U	N
Benzene	8.5%	170	5	5	4	0.7	5	ND	0.5 U	5 U	N	0.5 U	5 U	N
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	5 U	10 U	N	5 U	10 U	N
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	0.5 U	5 U	N	0.5 U	5 U	N
Toluene	4.3%	900	1000	5	2	5	2	ND	0.5 U	5 U	N	0.5 U	5 U	N
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	0.5 U	5 U	N	0.5 U	5 U	N
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	0.5 U	5 U	N	0.5 U	4 J	N
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	10 U	10 U	N	10 U	11 U	N
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	10 U	10 U	N	10 U	11 U	N
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	10 U	10 U	N	10 U	11 U	N
Naphthalene	2.1%	66	-	50	2	10	2	ND	10 U	10 U	N	10 U	11 U	N
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	10 U	10 U	N	10 U	11 U	N
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	10 U	10 U	N	10 U	11 U	N
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	25 U	52 U	N	25 U	55 U	N
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	4 J	10 U	N	10	11 U	N
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.3 U	2.7 U	N	2.3 U	2.7 U	N
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	0.1 U	N	0.1 U	0.1 U	N
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	72 U	209	24.5 U	72.5 U	2960	24.4 U
Antimony	6.4%	191	6	-	NA	3	4	ND	49.5 UJ	55.5 U J	53.2 U	49.9 UJ	53.3 U	52.9 U
Arsenic	31.9%	8.6	50	50	0	50	0	ND	1.4 UJ	3.5 U	3.5 U	1.4 UJ	3.5 U	3.5 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	67.9 J	112 J	96.3 J	98 J	121 J	77 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	0.89 U			0.9 U		
Cadmium	29.8%	64.6	5	5	8	10	3	ND	2.8 U	2.9 U	3 U	2.8 U	3 U	3 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	39200	67300 J	58000	59200	124000	114000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	2.7 UJ	8.7 J	6.2 U	2.7 UJ	6.6 J	6.1 U
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	5.4 U	19.8 U	20.4 U	5.5 U	20.5 U	20.3 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	4.7 U	14.4 U	10.2 U	4.7 U	10.2 U	10.1 U
Iron	100.0%	610000	-	300	63	300	63	ND-27800	128		7 U	106	3270	6.9 U
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	0.8 U	1.2 U	1.2 U	0.79 U	1.2 U	1.2 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	14700	28200 J	32600	30100	37300	33600
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	43.7	169	112	56	59.1	4.8 U
Mercury	19.1%	2.3	2	2	1	2	1	ND	0.09 UJ			0.09 UJ		
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	7.4 UJ	15.8 U	14.8 U	7.5 UJ	14.8 U	14.7 U
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	2210 J	9470	11200	2950 J	3480 J	1880 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1 UJ	1 U	1 U	0.99 UJ	1.3 U	1 U
Silver	6.4%	7.2	-	50	0	50	0	ND	5.4 U	9 U		5.5 U	3.4 U	3.4 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	91000	18700 J	19700	17200	40300	37600
Vanadium	63.8%	358	-	-	NA	-	NA	ND	6.7 UJ	30.3 U	9.5 U	6.8 UJ	9.5 U	9.4 U
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	13.9 J	13.4 U	8.5 U	4.9 J		8.4 U
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	10 UJ	10 U J		10 UJ	10 U	

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE II PT-11 07/10/93 PT-11	PHASE I PT-12 01/17/92 PT-12	PHASE I PT-12 01/17/92 PT-12 (Filtered)	PHASE I PT-12 01/17/92 PT-3(1)	PHASE I PT-12 01/17/92 PT-3(1) (Filtered)	PHASE II PT-12 07/15/93 PT-12
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	4 J	N	4 J	N	88
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	10 U	5 U	N	5 U	N	3 J
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	10 U	5 U	N	5 U	N	10 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	10 U	190	N	200	N	1400
Chloroform	4.3%	210	100	100	2	7	2	ND	10 U	5 U	N	5 U	N	10 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	10 U	5 U	N	5 U	N	10 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	10 U	5 U	N	5 U	N	10 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	10 U	180	N	180	N	970
Benzene	8.5%	170	5	5	4	0.7	5	ND	10 U	5 U	N	5 U	N	10 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	10 U	N	10 U	N	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	10 U	5 U	N	5 U	N	10 U
Toluene	4.3%	900	1000	5	2	5	2	ND	10 U	5 U	N	5 U	N	2 J
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	10 U	5 U	N	5 U	N	10 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	10 U	5 U	N	5 U	N	10 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	10 U	11 U	N	11 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	10 U	11 U	N	11 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	10 U	11 U	N	11 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	10 U	11 U	N	11 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	10 U	11 U	N	11 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	10 U	11 U	N	11 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	25 U	55 U	N	55 U	N	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	10 U	11 U	N	11 U	N	3 J
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	3.2 U	N	2.3 U	N	3.9
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N	0.1 U	N	0.1 U	N	0.11 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	3530	27300 J	24.5 U	18400 J	24.4 U	10100 J
Antimony	6.4%	191	6	-	NA	3	4	ND	49.7 U	53.2 U	53.2 U	53.1 U	53 U	49.9 U
Arsenic	31.9%	8.6	50	50	0	50	0	ND	1.4 U	4.5 J	3.5 U	7.5 J	3.5 U	2.4 J
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	143 J	258		255		115 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	0.89 U		1.1 U		1.1 U	0.9 U
Cadmium	29.8%	64.6	5	5	8	10	3	ND	2.8 U	4.5 J	3 U	3.8 J	3 U	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	128000	274000 J	180000	246000 J	175000	285000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	6.1 J	36.8	6.2 U	28.3	6.1 U	13.6 J
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	5.5 U	20.4 U	20.4 U	20.4 U	20.3 U	6.7 J
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	6.2 J	32.6	10.2 U	24.7 J	10.1 U	4.7 UJ
Iron	100.0%	610000	-	300	63	300	63	ND-27800	4370 J	36400 J	7 U	28900 J	6.9 U	14200 J
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	2.3 J		1.2 U		1.2 U	2.9 J
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	36200	41800 J	20800	37000 J	20000	38800
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	191	1270 J	4.8 U	970 J	4.8 U	608
Mercury	19.1%	2.3	2	2	1	2	1	ND	0.09 UJ	0.03 U	0.03 U	0.03 U	0.03 U	0.09 U
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	7.4 U	46.3	14.7 U	30 J	14.7 U	18 J
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	3910 J	8120	1800 J	5690	1430 J	4900 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1.5 U	1 U J	1.7 J	1.3 J	1 U	0.99 UJ
Silver	6.4%	7.2	-	50	0	50	0	ND	5.5 U	3.4 U	3.4 U	3.4 U	3.4 U	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	33300	33900	34900	33800	27200	133000
Vanadium	63.8%	358	-	-	NA	-	NA	ND	8.3 J	35.6 J	9.5 U	25.3 J	9.4 U	14.8 J
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	31.4	201 J		159 J		
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	4.3 J	10 U J		10 U J		4.1 J

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I PT-15 01/10-13/92 PT-15	PHASE I PT-15 01/10-13/92 PT-15 (Filtered)	PHASE II PT-15 06/24-30/93 PT-15	PHASE I PT-16 01/08/92 PT-16	PHASE I PT-16 01/08/92 PT-16 (Filtered)	PHASE II PT-16 07/03/93 PT-16
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	N	0.5 U	10 U	N	0.5 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	5 U	N	0.5 U	5 U	N	0.5 U
Chloroform	4.3%	210	100	100	2	7	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	0.5 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	5 U	N	0.5 U	5 U	N	0.5 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	5 U	N	0.5 U	5 U	N	0.5 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	N	5 U	10 U	N	5 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	5 U	N	0.5 U	5 U	N	0.5 U
Toluene	4.3%	900	1000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	12 U	N	10 U	11 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	12 U	N	10 U	11 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	12 U	N	10 U	11 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	12 U	N	10 U	11 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	12 U	N	10 U	11 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	12 U	N	10 U	11 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	60 U	N	26 U	56 U	N	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	12 U	N	10 U	11 U	N	10 U
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.3 U	N	2.3 U	2.7 U	N	2.4 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	N	0.1 U	0.1 U	N	0.11 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	389	24.6 U	693	1520	24.4 U	179 J
Antimony	6.4%	191	6	-	NA	3	4	ND	55.8 U J	53.4 U	49.9 UJ	53.4 U	53 U	49.6 UJ
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5 U	3.5 U	1.4 UJ	3.5 U J	3.5 U	1.4 UJ
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	93.5 J	79.7 J	100 J	75 J		48.5 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND			0.9 U			0.89 U
Cadmium	29.8%	64.6	5	5	8	10	3	ND	2.9 U	3 U	2.8 U	2.9 U	3 U	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	58500 J	59700	68400	129000 J	100000	162000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	6.2 U	6.2 U	2.7 UJ	7.2 J	6.2 U	2.7 UJ
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	19.9 U	20.5 U	5.5 U	19.9 U	20.4 U	5.5 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	14.5 U	10.2 U	4.7 U	14.5 U	10.1 U	4.7 U
Iron	100.0%	610000	-	300	63	300	63	ND-27800	673	7 U	1400	2780	6.9 U	119
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	1.2 U	1.2 U	1.7 J	4.2	1.2 U	0.79 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	16000 J	17600	17800	14300 J	14300	14900
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	60.8	6 J	158	483	4.8 U	24.6
Mercury	19.1%	2.3	2	2	1	2	1	ND			0.09 UJ			0.09 UJ
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	15.9 U	14.8 U	7.5 UJ	16 U	14.7 U	7.4 UJ
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	1620 J	2030 J	2430 J	633 U	287 U	1080 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1 U	1 U	0.99 UJ	1 U	1 U	1.5 UJ
Silver	6.4%	7.2	-	50	0	50	0	ND	9.1 U	3.4 U	5.5 U	9.1 U	3.4 U	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	29900	29800	27600	5930 J	5890	6340
Vanadium	63.8%	358	-	-	NA	-	NA	ND	30.5 U	9.5 U	6.8 UJ	30.5 U	9.4 U	6.7 UJ
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	17.4 J	8.5 U		24.1	8.4 U	9.2 J
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	10 U J		10 UJ	10 U J		10 UJ

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TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I PT-17 01/16/92 PT-17	PHASE I PT-17 01/16/92 PT-17 (Filtered)	PHASE II PT-17 07/13/93 PT-17	PHASE I PT-18 01/09/92 PT-18	PHASE I PT-18 01/09/92 PT-18 (Filtered)	PHASE II PT-18 07/15/93 PT-18
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	14 U	N	10 U	670 U	N	10
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	7 U	N	10 U	330 U	N	3 J
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	7 U	N	10 U	330 U	N	10 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	53	N	43	400	N	730 J
Chloroform	4.3%	210	100	100	2	7	2	ND	3 J	N	10 U	180 J	N	210 J
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	7 U	N	10 U	330 U	N	10 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	7 U	N	10 U	330 U	N	10 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	260	N	190	11000	N	13000
Benzene	8.5%	170	5	5	4	0.7	5	ND	7 U	N	10 U	330 U	N	1 J
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	14 U	N	10 U	670 U	N	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	7 U	N	10 U	330 U	N	10 U
Toluene	4.3%	900	1000	5	2	5	2	ND	7 U	N	10 U	330 U	N	10 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	7 U	N	10 U	330 U	N	10 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	7 U	N	10 U	330 U	N	10 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	11 U	N	10 U	11 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	11 U	N	10 U	11 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	11 U	N	10 U	11 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	11 U	N	10 U	11 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	11 U	N	10 U	11 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	11 U	N	10 U	11 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	54 U	N	25 U	57 U	N	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	11 U	N	3 J	11 U	N	10 U
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.3 U	N	2.3 U	2.4 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	N	0.1 U	0.1 U	N	0.1 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	14200	24.6 U	72.6 U	1510	24.4 U	318 J
Antimony	6.4%	191	6	-	NA	3	4	ND		53.4 U		55.5 U J	52.9 U	49.7 U
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5 J	3.5 U	1.4 U	3.5 U	3.5 U	1.9 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	131 J		54.6 J	53.9 J		40 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND		1.1 U	0.9 U			0.9 U
Cadmium	29.8%	64.6	5	5	8	10	3	ND	3 U	3 U	2.8 U	2.9 U	3 U	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	115000	106000	114000	329000 J	271000	203000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	20	6.2 U	2.7 U	6.1 U	6.1 U	2.8 J
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	20.3 U	20.5 U	5.5 U	19.8 U	20.3 U	5.9 J
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	11.9 J	10.2 U	4.7 U	14.4 U	10.1 U	4.7 UJ
Iron	100.0%	610000	-	300	63	300	63	ND-27800	21500	7 U	105 J	2270	6.9 U	496 J
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	6.3	1.2 U	0.6 U	17.8	1.2 U	0.8 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	15700	10700	11100	37000 J	39400	24900
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	520	4.8 U	5.1 J	1530	964	752
Mercury	19.1%	2.3	2	2	1	2	1	ND		0.03 U	0.09 UJ			0.09 U
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	21.3 J	14.8 U	7.5 U	15.9 U	14.7 U	7.5 UJ
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	3200 J	289 U	1080 J	2280 J	2010 J	1360 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1.3 U	1 U	1.5 U	1 U	1 U	0.99 UJ
Silver	6.4%	7.2	-	50	0	50	0	ND	3.4 U	3.4 U	5.5 U	9 U		5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	29400	27800	28300	114000 J	109000	93900
Vanadium	63.8%	358	-	-	NA	-	NA	ND	21.6 J	9.5 U	6.8 U	30.3 U	9.4 U	6.8 UJ
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8			2.8 U	496	120	
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	10 U		3 J	10 U J		1.4 J

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I PT-19 01/17/92 PT-19	PHASE I PT-19 01/17/92 PT-19 (Filtered)	PHASE II PT-19 06/30/93 PT-19	PHASE I PT-20 01/17/92 PT-20(2,3)	PHASE I PT-20 01/17/92 PT-20(2,3) (Filtered)	PHASE II PT-20 07/12/93 PT-20
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	N	0.5 U	10 U	N	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	10 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	10 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	5 U	N	0.5 U	24	N	53
Chloroform	4.3%	210	100	100	2	7	2	ND	5 U	N	0.5 U	5 U	N	10 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	10 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	10 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	5 U	N	0.5 U	25	N	37
Benzene	8.5%	170	5	5	4	0.7	5	ND	5 U	N	0.5 U	5 U	N	10 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	N	5 U	10 U	N	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	5 U	N	0.5 U	5 U	N	10 U
Toluene	4.3%	900	1000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	10 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	10 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	10 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	11 U	N	10 U	10 U J	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	11 U	N	10 U	10 U J	N	10 U
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	11 U	N	2 J	10 U J	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	11 U	N	10 U	10 U J	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	11 U	N	10 U	10 U J	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	11 U	N	10 U	10 U J	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	55 U	N	25 U	50 U J	N	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	11 U	N	10 U	10 U J	N	2 J
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.4 U	N	2.3 U	2.3 U	N	N
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	N	0.1 U	0.1 U	N	N
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	36100	24.5 U	207	10800	24.4 U	124 J
Antimony	6.4%	191	6	-	NA	3	4	ND	53.3 U	53.1 U	49.8 UJ	53.1 U	52.9 U	
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5 U	3.5 U	1.4 UJ	3.5 U	3.5 U	1.4 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	217		58 J	124 J		73.9 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND		1.1 U	0.9 U		1.1 U	0.9 U
Cadmium	29.8%	64.6	5	5	8	10	3	ND	6.1 J	3 U	2.8 U	3 U	3 U	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	110000	95300	114000	145000	125000	143000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	47.2	6.2 U	2.7 UJ	16.5	6.1 U	2.7 U
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	20.5 U	20.4 U	5.5 U	20.4 U	20.3 U	5.5 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	41.3	10.1 U	6.6 J	11.8 J	10.1 U	4.7 U
Iron	100.0%	610000	-	300	63	300	63	ND-27800	48300	7 U	409	16000		197 J
Lead	80.9%	147	15*	15	15	250	0	ND-8.2		1.2 U	0.8 U		1.2 U	0.6 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	24700 J	12900	14400	17400 J	13600	14700
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	543 J	8.8 J	361	378 J	4.8 U	35.1
Mercury	19.1%	2.3	2	2	1	2	1	ND		0.03 U	0.22 J	0.03 U	0.03 U	0.09 UJ
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	60.7	14.7 U	7.5 UJ	17.1 J	14.7 U	7.5 U
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	7550	288 U	1900 J	3440 J	655 J	1800 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1 U	1 U	1 UJ	1 U J	1 U	1.5 U
Silver	6.4%	7.2	-	50	0	50	0	ND	3.4 U	3.4 U	5.5 U	3.4 U	3.4 U	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	19700	18300	22100	35100	33900	29700
Vanadium	63.8%	358	-	-	NA	-	NA	ND	45.4 J	9.5 U	6.8 UJ	18.3 J	9.4 U	6.8 U
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	154 J		14.1 J			5.1 J
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	10 U J		10 UJ	10 U		1.2 U

TABLE 4 - 5

SUMMARY OF COMPOUNDS
DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I PT-21 01/17/92 PT-21	PHASE I PT-21 01/25/92CK PT-21	PHASE I PT-21 01/23/92 PT-21 (Filtered)	PHASE II PT-21 07/12/93 PT-21	PHASE I PT-22 01/09/92 PT-22	PHASE I PT-22 01/09/92 PT-22 (Filtered)
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	N	N	10 U	10 U	N
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	5 U	N	N	10 U	5 U	N
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	5 U	N	N	10 U	5 U	N
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	16	N	N	14	100	N
Chloroform	4.3%	210	100	100	2	7	2	ND	5 U	N	N	10 U	5 U	N
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	5 U	N	N	10 U	4 J	N
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	5 U	N	N	10 U	5 U	N
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	2 J	N	N	3 J	80	N
Benzene	8.5%	170	5	5	4	0.7	5	ND	5 U	N	N	6 J	5 U	N
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	N	N	10 U	10 U	N
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	5 U	N	N	10 U	5 U	N
Toluene	4.3%	900	1000	5	2	5	2	ND	5 U	N	N	10 U	5 U	N
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	5 U	N	N	10 U	5 U	N
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	5 U	N	N	10 U	5 U	N
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	N	10 U	N	N	11 U	N
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	N	10 U	N	N	11 U	N
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	N	10 U	N	N	11 U	N
Naphthalene	2.1%	66	-	50	2	10	2	ND	N	10 U	N	N	11 U	N
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	N	10 U	N	N	11 U	N
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	N	10 U	N	N	11 U	N
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	N	50 U	N	N	54 U	N
Di-n-butylphthalate	42.6%	18	:	50	0	50	0	ND - 18	N	10 U	N	N	11 U	N
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	N	N	N	2.4 U	N
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N	N	N	N	0.1 U	N
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	N	14200	24.4 U	N	4090	24.4 U
Antimony	6.4%	191	6	-	NA	3	4	ND	N	52.9 U	52.9 U	N	55.8 U J	53 U
Arsenic	31.9%	8.6	50	50	0	50	0	ND	N	3.5 U	3.5 U	N	3.5 U	3.5 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	N	230		N	148 J	
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	N		1.1 U	N		
Cadmium	29.8%	64.6	5	5	8	10	3	ND	N	4 J	3 U	N	2.9 U	3 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	N	185000	130000	N	197000 J	128000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	N	18.6	6.1 U	N	8.5 J	6.2 U
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	N	20.3 U	20.3 U	N	19.9 U	20.4 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	N	17.9 J	10.1 U	N	14.4 U	10.1 U
Iron	100.0%	610000	-	300	63	300	63	ND-27800	N	20100		N	6010	6.9 U
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	N		1.2 U	N	10.5	1.2 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	N	34300 J	25800	N	18200 J	16600
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	N	666 J	68.8	N	1140	4.8 U
Mercury	19.1%	2.3	2	2	1	2	1	ND	N	0.03 U	0.03 U	N		
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	N	19.6 J	14.7 U	N	15.9 U	14.7 U
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	N	8300	4780 J	N	632 U	380 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	N	1 U J	1 U	N	1 U	1 U
Silver	6.4%	7.2	-	50	0	50	0	ND	N	3.4 U	3.4 U	N	9.1 U	3.4 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	N	47800	44400	N	52800 J	54100
Vanadium	63.8%	358	-	-	NA	-	NA	ND	N	21.1 J	9.4 U	N	30.5 U	9.4 U
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	N	773 J		N		8.4 U
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	N	10 U		N	10 U	

TABLE 4 - 5

SUMMARY OF COMPOUNDS
DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE II PT-22 07/10-12/93 PT-22	PHASE I PT-23 01/14/92 PT-23	PHASE I PT-23 01/14/92 PT-23 (Filtered)	PHASE II PT-23 06/24/93 PT-23	PHASE I PT-24 01/14/92 PT-24	PHASE I PT-24 01/14/92 PT-24 (Filtered)
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	10 U	N	0.5 U	10 U	N
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	10 U	5 U	N	0.5 U	5 U	N
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	10 U	5 U	N	0.5 U	5 U	N
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	150	5 U	N	0.5 U	100	N
Chloroform	4.3%	210	100	100	2	7	2	ND	10 U	5 U	N	0.5 U	5 U	N
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	6 J	5 U	N	0.5 U	5 U	N
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	10 U	5 U	N	0.5 U	5 U	N
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	98	5 U	N	0.5 U	4 J	N
Benzene	8.5%	170	5	5	4	0.7	5	ND	10 U	5 U	N	0.5 U	5 U	N
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	10 U	N	5 U	10 U	N
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	10 U	5 U	N	0.5 U	5 U	N
Toluene	4.3%	900	1000	5	2	5	2	ND	10 U	5 U	N	0.5 U	5 U	N
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	10 U	5 U	N	0.5 U	5 U	N
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	10 U	5 U	N	0.5 U	5 U	N
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	10 U	12 U	N	10 U	11 U	N
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	0.6 J	12 U	N	10 U	11 U	N
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	10 U	12 U	N	10 U	11 U	N
Naphthalene	2.1%	66	-	50	2	10	2	ND	10 U	12 U	N	10 U	11 U	N
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	10 U	12 U	N	10 U	11 U	N
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	10 U	12 U	N	10 U	11 U	N
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	25 U	61 U	N	25 U	55 U	N
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	3 J	12 U	N	10 U	11 U	N
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	6.4 J	2.4 U	N	2.3 U	2.4 U	N
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND		0.1 U	N	0.1 U	0.1 U	N
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	178 J	2000	24.4 U	209	18600	24.4 U
Antimony	6.4%	191	6	-	NA	3	4	ND	50 U	53 U	53 U	49.8 UJ	53.1 U	53 U
Arsenic	31.9%	8.6	50	50	0	50	0	ND	1.4 U	3.5 U	3.5 U	1.4 UJ	3.5 U	3.5 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	69.8 J			46.9 J	132 J	
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	0.9 U			0.9 U		
Cadmium	29.8%	64.6	5	5	8	10	3	ND	2.8 U	3 U	3 U	2.8 U	3 U	3 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	147000	98200	85200	118000	135000	106000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	2.7 U	6.6 J	6.2 U	2.7 UJ	27.1	6.2 U
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	5.5 U	20.4 U	20.4 U	5.5 U	20.4 U	20.4 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	4.7 U	10.1 U	10.1 U	4.7 U	11.1 J	10.1 U
Iron	100.0%	610000	-	300	63	300	63	ND-27800	214 J	2510	7 U	283	26000	7 U
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	0.78 J	1.2 U	1.2 U	0.79 U	9	1.2 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	17400	11200	9510	13000	19100	12200
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	57.9	80.4	4.8 U	39.2	423	4.8 U
Mercury	19.1%	2.3	2	2	1	2	1	ND	0.09 UJ			0.09 UJ		
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	7.5 U	14.7 U	14.7 U	7.5 UJ	28.1 J	14.7 U
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	1840 J	1080 J	904 B	1440 J	4530 J	500 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1.5 U	1.3 U	1 U	0.99 UJ	1.3 U	1.7 J
Silver	6.4%	7.2	-	50	0	50	0	ND	5.5 U	3.4 U	3.4 U	5.5 U	3.4 U	
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	64900	4780 J	4940 J	4820 J	14900	13600
Vanadium	63.8%	358	-	-	NA	-	NA	ND	6.8 U	9.4 U	9.4 U	6.8 UJ	25.5 J	9.4 U
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	9.6 J		14.7 J			8.4 U
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	1.2 U	10 U		10 UJ	10 U	

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (μg/l)	DWQS (μg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (μg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE II PT-24 07/10/93 PT-24	PHASE II PT-24RE 07/10/93 PT-24RE	PHASE I PT-25 01/15/92 PT-25	PHASE I PT-25 01/15/92 PT-25 (Filtered)	PHASE II PT-25 06/30/93 PT-25	PHASE I PT-26 01/17/92 PT-26
VOCs (μg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	N	10 U	N	0.5 U	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	10 U	N	5 U	N	0.5 U	5 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	10 U	N	5 U	N	0.5 U	5 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	62	N	5 U	N	0.5 U	5 U
Chloroform	4.3%	210	100	100	2	7	2	ND	10 U	N	5 U	N	0.5 U	5 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	10 U	N	5 U	N	0.5 U	5 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	10 U	N	5 U	N	0.5 U	5 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	4 J	N	5 U	N	0.5 U	5 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	10 U	N	5 U	N	0.5 U	5 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	N	10 U	N	5 U	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	10 U	N	5 U	N	0.5 U	5 U
Toluene	4.3%	900	1000	5	2	5	2	ND	10 U	N	5 U	N	0.5 U	5 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	10 U	N	5 U	N	0.5 U	5 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	10 U	N	5 U	N	0.5 U	5 U
Semivolatiles (μg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	10 U	10 U	11 U	N	10 U	11 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	10 U	10 U	11 U	N	10 U	11 U
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	10 U	10 U	11 U	N	10 U	11 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	10 U	10 U	11 U	N	10 U	11 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	10 U	10 U	11 U	N	10 U	11 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	10 U	10 U	11 U	N	10 U	11 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	25 U	25 U	55 U	N	25 U	55 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	10 U	10 U	11 U	N	10 U	11 U
Herbicides (μg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.3 U	N	2.4 U	N	2.3 U	2.4 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	N	0.1 U	N	0.1 U	0.1 U
Metals (μg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	150 J	N	24000	24.5 U	318	306000
Antimony	6.4%	191	6	-	NA	3	4	ND	49.7 UJ	N	52.9 U	53.3 U	49.7 UJ	
Arsenic	31.9%	8.6	50	50	0	50	0	ND	1.4 UJ	N	3.5 U	3.5 U	1.4 UJ	3.5 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	48.4 J	N	135 J		40.9 J	1600
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	0.89 U	N		1.1 U	0.89 U	
Cadmium	29.8%	64.6	5	5	8	10	3	ND	2.8 U	N	3.2 J	3 U	2.8 U	64.6 J
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	117000	N	75300	72100	101000	1790000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	2.7 UJ	N	32.2	6.2 U	2.7 UJ	418
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	5.5 U	N	20.3 U	20.4 U	5.5 U	196
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	4.7 U	N	22.5 J	10.2 U	4.7 U	412
Iron	100.0%	610000	-	300	63	300	63	ND-27800	181	N	39000	7 U	360	610000
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	0.59 U	N	5.6	1.2 U	0.8 U	103
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	13200	N	16800	8220	10700	267000 J
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	36.4	N	595	4.8 U	25	11400
Mercury	19.1%	2.3	2	2	1	2	1	ND	0.09 UJ	N		0.03 U	0.09 UJ	
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	7.5 UJ	N	40.6	14.8 U	7.5 UJ	622
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	817 J	N	4620 J	289 U	1210 J	23200
Selenium	19.1%	2.9	50	10	0	10	0	ND	1.5 UJ	N	1.3 U	1 U	1 UJ	5 U J
Silver	6.4%	7.2	-	50	0	50	0	ND	5.5 U	N	3.4 U	3.4 U	5.5 U	
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	15400	N	15900	15000	21600	40600
Vanadium	63.8%	358	-	-	NA	-	NA	ND	6.8 UJ	N	31.4 J	9.5 U	6.8 UJ	358
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8		N	119		8 J	1750 J
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	3 UJ	N	10 U		10 UJ	10 U J

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I PT-26 01/17/92 PT-26 (Filtered)	PHASE II PT-26 07/03/93 PT-26	PHASE I MW-27 01/15/92 MW-27	PHASE I MW-27 01/15/92 MW-27 (Filtered)	PHASE II MW-27 07/01-03/93 MW-27	PHASE I MW-28 01/15/92 MW-28
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	N	0.5 U	10 U	N	0.5 U	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	N	0.5 U	5 U	N	0.5 U	60
Chloroform	4.3%	210	100	100	2	7	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	N	0.5 U	5 U	N	0.5 U	5 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	N	0.5 U	5 U	N	0.5 U	5 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	N	0.5 U	5 U	N	0.5 U	32
Benzene	8.5%	170	5	5	4	0.7	5	ND	N	0.5 U	5 U	N	0.5 U	5 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	N	5 U	10 U	N	5 U	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	N	0.5 U	5 U	N	0.5 U	5 U
Toluene	4.3%	900	1000	5	2	5	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	N	0.5 U	5 U	N	0.5 U	5 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	N	10 U	12 U	N	11 U	11 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	N	10 U	12 U	N	11 U	11 U
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	N	10 U	12 U	N	11 U	11 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	N	10 U	12 U	N	11 U	11 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	N	10 U	12 U	N	11 U	11 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	N	10 U	12 U	N	11 U	11 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	N	25 U	61 U	N	27 U	54 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	N	10 U	12 U	N	11 U	11 U
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	2.3 U	2.4 U	N	2.3 U	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N	0.1 U	0.1 U	N	0.1 U	0.1 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	24.5	43800	8590	24.4 U	3870	41100 J
Antimony	6.4%	191	6	-	NA	3	4	ND	53.1	56.9 J	53.4 U	52.9 U	49.6 UJ	
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5	2.4 J	3.5 U	3.5 U	1.4 UJ	4.4 J
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329		376	90.8 J		105 J	200
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	1.1	2.5 J		1.1 U	0.89 U	
Cadmium	29.8%	64.6	5	5	8	10	3	ND	3	2.8 U	3 U	3 U	2.8 U	6.1
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	93700	395000	102000	85300	137000	170000 J
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	6.2	69.7 J	10.4	6.1 U	6.9 J	53.1 J
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	20.4	33.4 J	20.5 U	20.3 U	5.5 U	20.5 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	10.1	62.2	10.2 U	10.1 U	4.7 U	33.9
Iron	100.0%	610000	-	300	63	300	63	ND-27800	7	78400	10500	6.9 U	6530	60300 J
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	1.2	17.3	3.2	1.2 U	0.85 J	10.7
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	37600	74900	13800	10800	19000	26600
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	4.8	1760	355	88	567	1510 J
Mercury	19.1%	2.3	2	2	1	2	1	ND	0.03	0.09 UJ		0.03 U	0.09 UJ	
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	14.7	106 J	14.8 U	14.7 U	7.4 UJ	72.5
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	1080	8540	4160 J	2400 J	5160	6910 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1.4	1.5 UJ	1.3 U	1 U	1.5 UJ	1.3 U
Silver	6.4%	7.2	-	50	0	50	0	ND	3.4	5.5 U	3.4 U	3.4 U	5.5 U	3.4 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	36800	31600	28300	27200	17600	9460
Vanadium	63.8%	358	-	-	NA	-	NA	ND	9.4	64.7 J	10 J	9.4 U	8 J	46.7 J
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8		277			37.7	165 J
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2		10 UJ	10 U			10 U

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I MW-28 01/15/92 MW-28 (Filtered)	PHASE I MW-28 01/15/92 PT-2(1)	PHASE I MW-28 01/15/92 PT-2(1)	PHASE II MW-28 07/10/93 MW-28 (Filtered)	PHASE I MW-29 01/15/92 MW-29	PHASE I MW-29 01/15/92 MW-29 (Filtered)
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	N	10 U	N	10 U	10 U	N
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	N	5 U	N	10 U	5 U	N
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	N	5 U	N	10 U	5 U	N
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	N	62	N	53	71	N
Chloroform	4.3%	210	100	100	2	7	2	ND	N	5 U	N	10 U	5 U	N
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	N	5 U	N	10 U	5 U	N
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	N	5 U	N	10 U	5 U	N
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	N	33	N	35	1 J	N
Benzene	8.5%	170	5	5	4	0.7	5	ND	N	5 U	N	10 U	5 U	N
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	N	10 U	N	10 U	10 U	N
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	N	5 U	N	10 U	5 U	N
Toluene	4.3%	900	1000	5	2	5	2	ND	N	5 U	N	10 U	5 U	N
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	N	5 U	N	10 U	5 U	N
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	N	5 U	N	10 U	5 U	N
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	N	11 U	N	10 U	11 U	N
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	N	11 U	N	10 U	11 U	N
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	N	11 U	N	10 U	11 U	N
Naphthalene	2.1%	66	-	50	2	10	2	ND	N	11 U	N	10 U	11 U	N
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	N	11 U	N	10 U	11 U	N
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	N	11 U	N	10 U	11 U	N
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	N	55 U	N	25 U	55 U	N
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	N	11 U	N	10 U	11 U	N
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	2.5 U	N	2.3 U	N	N
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N	0.1 U	N	0.1 U	N	N
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	24.5 U	27000 J	24.5 U	6980	85700	24.4 U
Antimony	6.4%	191	6	-	NA	3	4	ND	53.3 U	53 U	53.3 U	49.5 UJ	53.3 U	53 U
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5 U	3.5 U	3.5 U	1.4 UJ	3.5 U	3.5 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329		154 J		76.9 J	418	
Beryllium	25.5%	11.7	4	-	NA	3	3	ND				0.89 U		
Cadmium	29.8%	64.6	5	5	8	10	3	ND	3 U	5.2	3 U	2.8 U	17	3 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	111000	152000 J	111000	121000	248000	124000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	6.2 U	34.6 J	6.2 U	9.6 J	122	6.2 U
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	20.5 U	20.3 U	20.5 U	5.4 U	63.8	20.4 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	10.2 U	27.6	10.2 U	6.1 J	111	10.1 U
Iron	100.0%	610000	-	300	63	300	63	ND-27800	7 U	46500 J	7 U	8530	159000	7 U
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	1.2 U	8.9	1.2 U	2.2 J	39.4	1.2 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	123000	23400	11800	13900	59400	14700
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	4.8 U	1100 J	4.8 U	271	4110	4.8 U
Mercury	19.1%	2.3	2	2	1	2	1	ND				0.09 UJ		
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	14.8 U	62.9	14.8 U	8.2 J	182	14.7 U
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	347 J	4020 J	289 U	2570 J	10800	563 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1 U	1.3 U	1 U	1.5 UJ	13 U	1.4 J
Silver	6.4%	7.2	-	50	0	50	0	ND	3.4 U	3.4 U	3.4 U	5.4 U	3.4 U	
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	8580	9250	8570	10100	26200	25000
Vanadium	63.8%	358	-	-	NA	-	NA	ND	9.5 U	32.7 J	9.5 U	12.6 J	98.3	9.4 U
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	8.5 U	124 J	8.5 U		503	8.4 U
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2		10 U		1.7 UJ	10 U	

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE II MW-29 07/09/93 MW-29	PHASE I MW-30 01/16/92 MW-30	PHASE I MW-30 01/16/92 MW-30 (Filtered)	PHASE II MW-30 07/01/93 MW-30	PHASE I MW-31 01/16/92 MW-31	PHASE I MW-31 01/16/92 MW-31 (Filtered)	PHASE II MW-31 07/01/93 MW-31
VOCs (µg/l)															
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	10 U	N	0.5 U	10 U	N	0.5 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	10 U	5 U	N	0.5 U	5 U	N	0.5 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	10 U	5 U	N	0.5 U	5 U	N	0.5 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	97	5 U	N	0.5 U	5 U	N	0.5 U
Chloroform	4.3%	210	100	100	2	7	2	ND	10 U	5 U	N	0.5 U	5 U	N	0.5 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	10 U	5 U	N	0.5 U	5 U	N	0.5 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	2 J	5 U	N	0.5 U	5 U	N	0.5 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	2 J	5 U	N	1	5 U	N	0.5 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	10 U	5 U	N	0.5 U	5 U	N	0.5 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	10 U	N	5 U	10 U	N	5 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	10 U	5 U	N	0.5 U	5 U	N	0.5 U
Toluene	4.3%	900	1000	5	2	5	2	ND	10 U	5 U	N	0.5 U	5 U	N	0.5 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	10 U	5 U	N	0.5 U	5 U	N	0.5 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	10 U	5 U	N	0.5 U	5 U	N	0.5 U
Semivolatiles (µg/l)															
Phenol	2.1%	5	-	50	0	1	1	ND	10 U	11 U	N	10 U	10 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	10 U	11 U	N	10 U	10 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	10 U	11 U	N	10 U	10 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	10 U	11 U	N	10 U	10 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	10 U	11 U	N	10 U	10 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	10 U	11 U	N	10 U	10 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	25 U	56 U	N	25 U	52 U	N	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	10 U	11 U	N	12	10 U	N	10 U
Herbicides (µg/l)															
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.3 U	2.3 U	N	N	2.4 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	0.1 U	N	N	0.1 U	N	0.1 U
Metals (µg/l)															
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	55600	11200	24.5 U	188 J	83400	24.6 U	9690
Antimony	6.4%	191	6	-	NA	3	4	ND	86.2 J	53.3 U	53.2 U	49.6 UJ	53.3 U	53.3 U	50 UJ
Arsenic	31.9%	8.6	50	50	0	50	0	ND	2.4 J	3.5 U	3.5 U	1.4 UJ	3.5 U	3.5 U	1.4 UJ
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	382	93.3 J		56.5 J	397		95 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	3 J		1.1 U	0.89 U		1.1 U	0.9 U
Cadmium	29.8%	64.6	5	5	8	10	3	ND	2.8 U	30 U	3 U	2.8 U	13.9	3 U	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	234000	105000	102000	121000	171000	92300	122000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	83.8 J	13.2	6.2 U	2.9 J	109	6.2 U	14 J
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	57.5	20.5 U	20.4 U	5.5 U	46.2 J	20.5 U	6.5 J
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	84.5	10.5 J	10.2 U	4.7 U	88.1	10.2 U	10.7 J
Iron	100.0%	610000	-	300	63	300	63	ND-27800	92000	15600	7 U	281	147000	7 U	14700
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	28.8	3.5	1.2 U	0.59 U	20.9	1.2 U	2.3 J
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	48900	18900	147000	16300	48000	11900	17800
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	3270	250	4.8 U	11.8 J	2530	4.8 U	327
Mercury	19.1%	2.3	2	2	1	2	1	ND	0.09 UJ		0.03 U	0.09 UJ		0.03 U	0.09 UJ
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	122 J	16.8 J	14.7 U	7.4 UJ	157	14.8 U	15 J
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	9450	3450 J	1120 J	2910 J	11700	497 J	3820 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1.5 J	1.3 U	1 U	1.5 UJ	13 U	1 U	1.5 UJ
Silver	6.4%	7.2	-	50	0	50	0	ND	5.5 U	3.4 U	3.4 U	5.5 U	3.4 U	3.4 U	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	25600	18400	17800	26900	15600	14700	17100
Vanadium	63.8%	358	-	-	NA	-	NA	ND	78.2 J	18.5 J	9.5 U	6.7 UJ	97.3	9.5 U	15.2 J
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	300			10.2 J	412		51.5
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2		10 U			10 U		10 UJ

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I MW-32 01/16/92 MW-32	PHASE I MW-32 01/16/92 MW-32 (Filtered)	PHASE II MW-32 07/09/93 MW-32	PHASE I MW-33 01/16/92 MW-33	PHASE I MW-33 02/03/92 CK MW-33	PHASE I MW-33 01/16/92 MW-33 (Filtered)	PHASE II MW-33 07/10/93 MW-33
VOCs (µg/l)															
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	N	0.5 U	N	10 U	N	0.5 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
Chloroform	4.3%	210	100	100	2	7	2	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	N	5 U	N	10 U	N	5 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
Toluene	4.3%	900	1000	5	2	5	2	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	5 U	N	0.5 U	N	5 U	N	0.5 U
Semivolatiles (µg/l)															
Phenol	2.1%	5	-	50	0	1	1	ND	10 U	N	10 U	11 U	N	N	N
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	10 U	N	10 U	11 U	N	N	N
4-Methylphenol	4.3%	6	-	50	0	-	NA	ND	10 U	N	10 U	11 U	N	N	N
Naphthalene	2.1%	66	-	50	2	10	2	ND	10 U	N	10 U	11 U	N	N	N
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	10 U	N	10 U	11 U	N	N	N
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	10 U	N	10 U	11 U	N	N	N
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	50 U	N	25 U	55 U	N	N	N
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	10 U	N	10 U	11 U	N	N	N
Herbicides (µg/l)															
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.3 U	N	N	2.3 U	N	N	N
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	N	N	0.1 U	N	N	N
Metals (µg/l)															
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	35600	24.6 U	180 J	33700	N	24.5 U	N
Antimony	6.4%	191	6	-	NA	3	4	ND	53.2 U	53.3 U	49.5 UJ	53 U	N	53.1 U	N
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5 U	3.5 U	1.4 UJ	3.5 U	N	3.5 U	N
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	193 J		52.2 J	162 J	N		N
Beryllium	25.5%	11.7	4	-	NA	3	3	ND		1.1 U	0.89 U		N	1.1 U	N
Cadmium	29.8%	64.6	5	5	8	10	3	ND	5.4	3 U	2.8 U	3.8 J	N	3 U	N
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	156000	102000	131000	103000	N	95600	N
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	51.3	6.2 U	2.7 UJ	42	N	6.2 U	N
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	20.4 U	20.5 U	5.4 U	20.3 U	N	20.4 U	N
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	33.6	10.2 U	4.7 U	32.8	N	10.1 U	N
Iron	100.0%	610000	-	300	63	300	63	ND-27800	63800	7 U	240	56800	N	7 U	N
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	12.1	1.2 U	0.6 U	9.8	N	1.2 U	N
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	31000	13400	17300	22400	N	9960	N
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	1190	72.4	82.1	953	N	4.8 U	N
Mercury	19.1%	2.3	2	2	1	2	1	ND		0.03 U	0.09 UJ		N	0.03 U	N
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	67.3	14.8 U	7.4 UJ	69.2	N	14.7 U	N
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	6240	1250 J	1620 J	4500 J	N	288 U	N
Selenium	19.1%	2.9	50	10	0	10	0	ND	1.3 U	1.1 J	1.5 UJ	1.3 U	N	1 U	N
Silver	6.4%	7.2	-	50	0	50	0	ND	3.4 U	3.4 U	5.4 U	3.4 U	N	3.4 U	N
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	22200	21600	25500	15700	N	14700	N
Vanadium	63.8%	358	-	-	NA	-	NA	ND	46.8 J	9.5 U	6.7 UJ	41.8 J	N	9.4 U	N
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	174		5 J	162	N		N
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	10 U		3 J	10 U	N		N

TABLE 4-5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I MW-35D 01/14/92 MW-35D	PHASE I MW-35D 01/14/92 MW-35D (Filtered)	PHASE II MW-35D 07/03/93 MW-35D	PHASE I MW-36 01/14/92 MW-36	PHASE I MW-36 01/14/92 MW-36 (Filtered)	PHASE II MW-36 07/03/93 MW-36
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	N	0.5 U	10 U	N	0.5 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	5 U	N	0.5 U	5 U	N	0.5 U
Chloroform	4.3%	210	100	100	2	7	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	0.5 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	5 U	N	0.5 U	5 U	N	0.5 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	5 U	N	0.5 U	5 U	N	0.5 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	N	5 U	10 U	N	5 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	5 U	N	0.5 U	5 U	N	0.5 U
Toluene	4.3%	900	1000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	10 U	N	10 U	12 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	10 U	N	10 U	12 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	10 U	N	10 U	12 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	10 U	N	10 U	12 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	10 U	N	10 U	12 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	10 U	N	10 U	12 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	50 U	N	25 U	60 U	N	25 U
Di-n-butylphthalate	42.6%	18	:	50	0	50	0	ND - 18	10 U	N	10 U	12 U	N	10 U
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.9 U	N	2.3 U	2.4 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	N	0.1 U	0.1 U	N	0.1 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	23200	24.5 U	72.2 U	15900	24.4 U	1090
Antimony	6.4%	191	6	-	NA	3	4	ND	53.2 U	53.1 U	49.7 UJ	53.1 U	52.9 U	49.7 UJ
Arsenic	31.9%	8.6	50	50	0	50	0	ND	8.6 J	4.3 J	1.4 UJ	3.5 U	3.5 U	1.4 UJ
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	318	104 J	106 J	167 J		78.6 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND			0.89 U			0.9 U
Cadmium	29.8%	64.6	5	5	8	10	3	ND	5.4	3 U	2.8 U	3.6 J	3 U	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	41100	14600	28900	182000	117000	135000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	34.9	6.2 U	2.7 UJ	27.1	6.1 U	2.7 UJ
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	20.4 U	20.4 U	5.5 U	20.4 U	20.3 U	5.5 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	22.5 J	10.1 U	4.7 U	19.8 J	10.1 U	4.7 U
Iron	100.0%	610000	-	300	63	300	63	ND-27800	33800	7 U	40.9 J	29000	6.9 U	1260
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	5	1.2 U	0.8 U	5	1.2 U	0.8 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	13300	4590 J	9220	31000	17400	19300
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	662	110	61.8	658	44.9	139
Mercury	19.1%	2.3	2	2	1	2	1	ND			0.14 J			0.09 UJ
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	49.7	14.7 U	7.5 UJ	39.1 J	14.7 U	7.5 UJ
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	6230	2760 J	2590 J	3310 J	1620 J	2110 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1.3 U	1 U	1.5 UJ	1.3 U	1 U	1.8 J
Silver	6.4%	7.2	-	50	0	50	0	ND	3.4 U	3.4 U	5.5 U	3.4 U	3.4 U	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	130000	110000	81500	21300	19600	21300
Vanadium	63.8%	358	-	-	NA	-	NA	ND	32.7 J	9.4 U	6.8 UJ	23.2 J	9.4 U	6.8 UJ
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8		8.5 U	3.1 J	120	8.4 U	9.3 J
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	10 U		10 UJ	10 U		10 UJ

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I MW-37 01/10/92 MW-37	PHASE I MW-37 01/10/92 MW-37 (Filtered)	PHASE II MW-37 06/24/93 MW-37	PHASE I MW-38D 01/08/92 MW-38D	PHASE I MW-38D 01/08/92 MW-38D (Filtered)	PHASE II MW-38D 07/03/93 MW-38D
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	N	0.5 U	10 U	N	0.5 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	5 U	N	0.5 U	5 U	N	0.5 U
Chloroform	4.3%	210	100	100	2	7	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	0.5 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	5 U	N	0.5 U	5 U	N	0.5 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	5 U	N	0.5 U	5 U	N	0.5 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	N	5 U	10 U	N	5 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	5 U	N	0.5 U	5 U	N	0.5 U
Toluene	4.3%	900	1000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	11 U	N	10 U	12 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	11 U	N	10 U	12 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	11 U	N	10 U	12 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	11 U	N	10 U	12 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	11 U	N	10 U	12 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	11 U	N	10 U	12 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	55 U	N	25 U	60 U	N	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	11 U	N	10 U	12 U	N	10 U
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.4 U	N	2.3 U	2.5 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	N	0.1 U	0.1 U	N	0.1 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	19100	24.5 U	637	2110	24.4 U	72.5 U
Antimony	6.4%	191	6	-	NA	3	4	ND	55.9 U J	53.2 U	49.7 UJ	55.6 U J	52.9 U	49.9 UJ
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5 U	3.5 U	1.4 UJ	3.5 U	3.5 U	1.4 UJ
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	329		79.6 J	187 J	105 J	115 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND			0.89 U			0.9 U
Cadmium	29.8%	64.6	5	5	8	10	3	ND	2.9 U	3 U	2.8 U	2.9 U	3 U	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	279000 J	109000	115000	123000 J	93500	93500
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	29.8	6.2 U	2.7 UJ	6.6 J	6.1 U	2.7 UJ
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	28 J	20.4 U	5.5 U	19.9 U	20.3 U	5.5 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	25.3	10.2 U	5.4 J	14.4 U	10.1 U	4.7 U
Iron	100.0%	610000	-	300	63	300	63	ND-27800	27800	7 U	1080	3630	6.9 U	214
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	8	1.2 U	0.8 U	4.1	1.2 U	0.79 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	28600	17900	16100	16700 J	18400	16800
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	2190	84.9	129	508	130	174
Mercury	19.1%	2.3	2	2	1	2	1	ND			0.09 UJ			0.09 UJ
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	36.9 J	14.8 U	7.4 UJ	15.9 U	14.7 U	7.5 UJ
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	4470 J	1330 J	1160 J	4960 J	4830 J	3220 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1 U	1 U	1 UJ	1 U	1 J	1.5 UJ
Silver	6.4%	7.2	-	50	0	50	0	ND	9.1 U	3.4 U	5.5 U	9 U	3.4 U	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	11900 J	11200	15000	5480 J	5540	3750 J
Vanadium	63.8%	358	-	-	NA	-	NA	ND	30.6 U	9.5 U	6.8 UJ	30.4 U	9.4 U	6.8 UJ
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	58.8	8.5 U			8.4 U	3.4 J
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	10 U J		10 UJ	10 U J		10 UJ

TABLE 4 - 5

SUMMARY OF COMPOUNDS
DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I MW-39 01/14/92 MW-39	PHASE I MW-39 01/14/92 MW-39 (Filtered)	PHASE II MW-39 06/23/93 MW-39	PHASE I MW-40 01/09/92 MW-40	PHASE I MW-40 01/09/92 MW-40 (Filtered)	PHASE II MW-40 07/01/93 MW-40
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	N	0.5 U	10 U	N	0.5 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	5 U	N	0.5 U	5 U	N	0.5 U
Chloroform	4.3%	210	100	100	2	7	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	0.5 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	5 U	N	0.5 U	5 U	N	0.5 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	5 U	N	0.5 U	5 U	N	0.5 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	5 U	N	0.5 U	5 U	N	0.5 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	N	5 U	10 U	N	5 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	5 U	N	0.5 U	5 U	N	0.5 U
Toluene	4.3%	900	1000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	5 U	N	0.5 U	5 U	N	0.5 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	11 U	N	10 U	11 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	11 U	N	10 U	11 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	11 U	N	10 U	11 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	11 U	N	10 U	11 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	11 U	N	10 U	11 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	11 U	N	10 U	11 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	56 U	N	25 U	56 U	N	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	11 U	N	6 J	11 U	N	10 U
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.4 U	N	2.3 U	2.3 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	N	0.1 U	0.1 U	N	0.1 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	7930	24.5 U	72.6 U	2730	24.6 U	972
Antimony	6.4%	191	6	-	NA	3	4	ND	53.3 U	53.1 U	49.9 UJ	56 U J	53.4 U	49.9 UJ
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5 U	3.5 U	1.4 UJ	3.5 U	3.5 U	1.4 UJ
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	80.9 J		40 J	77.8 J		68 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND			0.9 U			0.9 U
Cadmium	29.8%	64.6	5	5	8	10	3	ND	3.1 J	3 U	2.8 U	2.9 U	3 U	3.3 J
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	97900	83500	102000	154000 J	101000	115000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	12.5	6.2 U	2.7 UJ	19.7	6.2 U	4.2 J
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	20.4 U	20.4 U	5.5 U	20 U	20.5 U	5.5 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	33.3	10.2 U	4.7 U	14.5 U	10.2 U	4.7 U
Iron	100.0%	610000	-	300	63	300	63	ND-27800	11400	7 U	28.2 U	6040	7 U	1390
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	2.3 J	1.2 U	0.8 U	2.1 J	1.2 U	0.8 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	15800	12400	14100	14300	13800	13000
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	229	21	29.6	931	454	77.9
Mercury	19.1%	2.3	2	2	1	2	1	ND			0.09 UJ			0.09 UJ
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	21.1 J	14.7 U	7.5 UJ	16 U	14.8 U	7.5 UJ
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	3720 J	1770 J	2420 J	2810 J	2610 J	2250 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1.3 U	1 U	1 UJ	1 U	1 U	1.6 J
Silver	6.4%	7.2	-	50	0	50	0	ND	3.4 U		5.5 U	9.1 U	3.4 U	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	15100	14000	10600	7540 J	7270	16600
Vanadium	63.8%	358	-	-	NA	-	NA	ND	13.3 J	9.5 U	6.8 UJ	30.6 U	9.5 U	6.8 UJ
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8		8.5 U	7 J		8.5 U	15.7 J
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	10 U		10 UJ	10 U J		10 UJ

TABLE 4-5

SUMMARY OF COMPOUNDS
DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE I MW-41D 01/13/92 MW-41D	PHASE II MW-41D 06/22/93 MW-41D	PHASE I MW-42D 01/13/92 MW-42D	PHASE I MW-42D 01/13/92 MW-42D (Filtered)	PHASE II MW-42D 06/23/93 MW-42D	PHASE II MW-43 06/30/93 MW-43
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	0.5 U	10 U	N	0.5 U	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
Chloroform	4.3%	210	100	100	2	7	2	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	5 U	10 U	N	5 U	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
Toluene	4.3%	900	1000	5	2	5	2	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	5 U	0.5 U	5 U	N	0.5 U	10 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	10 U	10 U	10 U	N	10 U	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	10 U	10 U	10 U	N	10 U	10 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	10 U	10 U	10 U	N	10 U	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	10 U	10 U	10 U	N	10 U	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	10 U	10 U	10 U	N	10 U	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	10 U	10 U	10 U	N	10 U	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	52 U	25 U	52 U	N	25 U	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	10 U	4 J	10 U	N	10	10 U
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.4 U	2.3 U	2.7 U	N	2.3 U	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.1 U	0.1 U	0.1 U	N	0.1 U	0.1 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	146 J	72 U	209	24.5 U	72.5 U	52700
Antimony	6.4%	191	6	-	NA	3	4	ND		49.5 UJ	55.5 U J	53.2 U	49.9 UJ	49.8 UJ
Arsenic	31.9%	8.6	50	50	0	50	0	ND	3.5 U	1.4 UJ	3.5 U	3.5 U	1.4 UJ	1.4 UJ
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	97 J	67.9 J	112 J	96.3 J	98 J	358
Beryllium	25.5%	11.7	4	-	NA	3	3	ND		0.89 U			0.9 U	2.5 J
Cadmium	29.8%	64.6	5	5	8	10	3	ND	2.9 U	2.8 U	2.9 U	3 U	2.8 U	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	45800 J	39200	67300 J	58000	59200	403000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	6.2 U	2.7 UJ	8.7 J	6.2 U	2.7 UJ	86.2 J
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	19.9 U	5.4 U	19.8 U	20.4 U	5.5 U	36.1 J
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	14.4 U	4.7 U	14.4 U	10.2 U	4.7 U	61.4
Iron	100.0%	610000	-	300	63	300	63	ND-27800		128		7 U	106	86500
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	1.2 U	0.8 U	1.2 U	1.2 U	0.79 U	21.9
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600		14700	28200 J	32600	30100	36100
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	113	43.7	169	112	56	2260
Mercury	19.1%	2.3	2	2	1	2	1	ND		0.09 UJ			0.09 UJ	0.35 J
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	15.9 U	7.4 UJ	15.8 U	14.8 U	7.5 UJ	107 J
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	2530 J	2210 J	9470	11200	2950 J	10300
Selenium	19.1%	2.9	50	10	0	10	0	ND	1 U	1 UJ	1 U	1 U	0.99 UJ	5 UJ
Silver	6.4%	7.2	-	50	0	50	0	ND	9.1 U	5.4 U	9 U		5.5 U	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	77600 J	91000	18700 J	19700	17200	11900
Vanadium	63.8%	358	-	-	NA	-	NA	ND	30.5 U	6.7 UJ	30.3 U	9.5 U	6.8 UJ	73.4 J
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	13.4 U	13.9 J	13.4 U	8.5 U	4.9 J	223
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	10 U J	10 UJ	10 U J		10 UJ	10 UJ

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE IIA MW-43 11/06/93 MW-43	PHASE II MW-44 07/15/93 MW-44	PHASE IIA MW-44 11/06/93 MW-44	PHASE II MW-45 07/15/93 MW-45	PHASE IIA MW-45 11/06/93 MW-45	PHASE II MW-46 07/14/93 MW-46
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	0.5 U	22000	23000	10 U	0.5 U	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	0.5 U	200 J	4200 U	10 U	0.5 U	10 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	0.5 U	160 J	4200 U	10 U	0.5 U	10 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	1	73000	130000	10 U	0.5 U	120
Chloroform	4.3%	210	100	100	2	7	2	ND	0.5 U	710 U	4200 U	10 U	0.5 U	10 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	0.5 U	710 U	4200 U	10 U	0.5 U	10 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	0.5 U	710 U	4200 U	10 U	0.5 U	10 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	5	37000	51000	10 U	0.5 J	47
Benzene	8.5%	170	5	5	4	0.7	5	ND	0.5 U	170 J	4200 U	10 U	0.5 U	10 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	5.0 U	710 U	4200 U	10 U	5.0 U	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	0.5 U	710 U	4200 U	10 U	0.5 U	10 U
Toluene	4.3%	900	1000	5	2	5	2	ND	0.5 U	880	4200 U	10 U	0.5 U	10 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	0.5 U	130 J	4200 U	10 U	0.5 U	10 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	0.5 U	590 J	4200 U	10 U	0.5 U	10 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	N	5 J	N	10 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	N	10 U	N	10 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	N	4 J	N	10 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	N	66 J	N	10 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	N	12 J	N	10 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	N	1 J	N	10 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	N	54 J	N	25 U	N	25 U
Di-n-butylphthalate	42.6%	18	:	50	0	50	0	ND - 18	N	2 J	N	2 J	N	0.5 J
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	2.7 U	N	2.4 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N	0.12 U	N	0.11 U	N	0.1 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	N	12300 J	N	21300 J	N	55300
Antimony	6.4%	191	6	-	NA	3	4	ND	N	49.7 U	N	49.6 U	N	49.7 U
Arsenic	31.9%	8.6	50	50	0	50	0	ND	N	7.8 J	N	2.7 J	N	3.1 J
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	N	317	N	243	N	813
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	N	1.5 J	N	1.6 J	N	2.5 J
Cadmium	29.8%	64.6	5	5	8	10	3	ND	N	2.8 U	N	2.8 U	N	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	N	370000	N	181000	N	459000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	N	18.2 J	N	29.1 J	N	88.4
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	N	22.5 J	N	28.3 J	N	36.7 J
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	N	12.9 J	N	8.7 J	N	49.6
Iron	100.0%	610000	-	300	63	300	63	ND-27800	N	18500 J	N	30100 J	N	85600 J
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	N	147	N	5.8	N	23
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	N	41100	N	22100	N	43600
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	N	7120	N	1010	N	2770
Mercury	19.1%	2.3	2	2	1	2	1	ND	N	0.38	N	0.18 J	N	0.41 J
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	N	30.5 J	N	45.3 J	N	101
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	N	6680	N	6220	N	11600
Selenium	19.1%	2.9	50	10	0	10	0	ND	N	10 UJ	N	0.99 UJ	N	2.9 J
Silver	6.4%	7.2	-	50	0	50	0	ND	N	5.5 U	N	5.5 U	N	7.2 J
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	N	37600	N	8420	N	11700
Vanadium	63.8%	358	-	-	NA	-	NA	ND	N	13.3 J	N	26.2 J	N	81.9
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	N	117 J	N	116 J	N	240
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	N	4.3 J	N	1.3 J	N	1.2 U

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (μg/l)	DWQS (μg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (μg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE IIA MW-46 11/06/93 MW-46	PHASE II MW-47 07/10/93 MW-47	PHASE IIA MW-47 11/07/93 MW-47	PHASE II MW-48 07/15/93 MW-48	PHASE IIA MW-48 11/05/93 MW-48	PHASE II MW-49D 07/14/93 MW-49D
VOCs (μg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	10 U	10 U	0.5 U	10 U	0.5 U	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	10 U	10 U	0.5 U	10 U	0.5 U	10 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	10 U	10 U	0.5 U	10 U	0.5 U	10 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	82	10 U	0.5 U	10 U	0.5 U	10 U
Chloroform	4.3%	210	100	100	2	7	2	ND	10 U	10 U	0.5 U	10 U	0.5 U	10 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	10 U	10 U	0.5 U	10 U	0.5 U	10 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	10 U	10 U	0.5 U	10 U	0.5 U	10 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	120	10 U	0.5 U	10 U	0.5 U	10 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	10 U	10 U	0.5 U	10 U	0.5 U	10 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	10 U	10 U	5.0 U	10 U	5.0 U	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	1 J	10 U	0.5 U	10 U	0.5 U	10 U
Toluene	4.3%	900	1000	5	2	5	2	ND	10 U	10 U	0.5 U	10 U	0.5 U	10 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	10 U	10 U	0.5 U	10 U	0.5 U	10 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	10 U	10 U	0.5 U	10 U	0.5 U	10 U
Semivolatiles (μg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	N	10 U	N	10 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	N	10 U	N	10 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	N	10 U	N	10 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	N	10 U	N	10 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	N	10 U	N	10 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	N	10 U	N	10 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	N	25 U	N	25 U	N	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	N	10 U	N	2 J	N	1 J
Herbicides (μg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	2.3 U	N	2.3 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N	0.1 U	N	0.1 U	N	0.1 U
Metals (μg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	N	17900	N	22700 J	N	82.9 J
Antimony	6.4%	191	6	-	NA	3	4	ND	N	49.6 UJ	N	49.5 U	N	
Arsenic	31.9%	8.6	50	50	0	50	0	ND	N	1.7 J	N	3.9 J	N	1.4 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	N	214	N	259	N	95 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	N	0.89 U	N	1.8 J	N	0.9 U
Cadmium	29.8%	64.6	5	5	8	10	3	ND	N	2.8 U	N	2.8 U	N	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	N	153000	N	202000	N	86600
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	N	27.5 J	N	36.2 J	N	2.7 U
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	N	11.2 J	N	27.8 J	N	5.5 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	N	18 J	N	14.4 J	N	5 J
Iron	100.0%	610000	-	300	63	300	63	ND-27800	N	23400	N	34700 J	N	719 J
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	N	8.3	N	22	N	0.59 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	N	18700	N	25800	N	20500
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	N	614	N	1230	N	98.9
Mercury	19.1%	2.3	2	2	1	2	1	ND	N	0.09 UJ	N	2.3	N	0.09 UJ
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	N	30 J	N	50 J	N	7.5 U
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	N	4730 J	N	5520	N	2520 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	N	1.5 UJ	N	10 UJ	N	1.5 U
Silver	6.4%	7.2	-	50	0	50	0	ND	N	5.5 U	N	5.5 U	N	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	N	11000	N	10400	N	12200
Vanadium	63.8%	358	-	-	NA	-	NA	ND	N	27.3 J	N	29.4 J	N	6.8 U
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	N		N	149 J	N	22.3
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	N	4.4 UJ	N	1.2 U	N	1.7 J

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE IIA MW-49D 11/06/93 MW-49D	PHASE II MW-50D 07/14/93 MW-50D	PHASE IIA MW-50D 11/06/93 MW-50D	PHASE II MW-51D 07/10/93 MW-51D	PHASE IIA MW-51D 11/07/93 MW-51D	PHASE II MW-52D 07/02/93 MW-52D
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	2.0	10 U	0.3 J	10 U	0.5 U	10 U
Chloroform	4.3%	210	100	100	2	7	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	0.4 J	10 U	0.6	10 U	0.4 J	10 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	0.5 U	10 U	0.5 U	5 J	0.5 U	10 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	5.0 U	10 U	5.0 U	10 U	5.0 U	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
Toluene	4.3%	900	1000	5	2	5	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	N	10 U	N	10 U	N	11 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	N	10 U	N	10 U	N	11 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	N	10 U	N	10 U	N	11 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	N	10 U	N	10 U	N	11 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	N	10 U	N	10 U	N	11 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	N	10 U	N	10 U	N	11 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	N	25 U	N	25 U	N	27 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	N	10	N	10 U	N	9 J
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	2.3 U	N	2.3 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N	0.1 U	N	0.1 U	N	0.1 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	N	81.6 J	N	113 J	N	31200
Antimony	6.4%	191	6	-	NA	3	4	ND	N		N	49.8 UJ	N	49.7 UJ
Arsenic	31.9%	8.6	50	50	0	50	0	ND	N	1.4 U	N	1.4 UJ	N	2.8 J
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	N	65.9 J	N	81.2 J	N	271
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	N	0.89 U	N	0.9 U	N	2.2 J
Cadmium	29.8%	64.6	5	5	8	10	3	ND	N	2.8 U	N	2.8 U	N	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	N	45900	N	103000	N	
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	N	2.7 U	N	2.7 UJ	N	23.8 J
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	N	5.5 U	N	5.5 U	N	8.3 J
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	N	7 J	N	4.7 U	N	13.9 J
Iron	100.0%	610000	-	300	63	300	63	ND-27800	N	112 J	N	121	N	24800
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	N	0.6 U	N	0.59 U	N	14
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	N	20800	N	15400	N	11700
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	N	72.2	N	81.7	N	340
Mercury	19.1%	2.3	2	2	1	2	1	ND	N	0.09 UJ	N	0.09 UJ	N	0.09 UJ
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	N	7.4 U	N	7.5 UJ	N	33.4 J
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	N	2800 J	N	774 J	N	5020
Selenium	19.1%	2.9	50	10	0	10	0	ND	N	1.5 U	N	1.5 UJ	N	1.5 UJ
Silver	6.4%	7.2	-	50	0	50	0	ND	N	5.6 J	N	5.5 U	N	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	N	21100	N	12100	N	126000
Vanadium	63.8%	358	-	-	NA	-	NA	ND	N	6.7 U	N	6.8 UJ	N	28.1 J
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	N	23.4	N		N	111
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	N	1.4 J	N	5.3 UJ	N	10 UJ

TABLE 4 - 5

SUMMARY OF COMPOUNDS
DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE IIA MW-52D 11/07/93 MW-52D	PHASE II MW-53 07/13/93 MW-53	PHASE IIA MW-53 11/05/93 MW-53	PHASE II MW-54D 07/13/93 MW-54D	PHASE IIA MW-54D 11/05/93 MW-54D	PHASE II MW-55D 07/15/93 MW-55D
VOCs (µg/l)														
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	0.5 U	51	16.0	10 U	0.5 U	10 U
Chloroform	4.3%	210	100	100	2	7	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	0.5 U	10 U	0.3 J	10 U	0.5 U	10 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	0.5 U	4 J	1.0	10 U	0.5 U	10 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	5.0 U	10 U	5.0 U	10 U	5.0 U	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
Toluene	4.3%	900	1000	5	2	5	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	0.5 U	10 U	0.5 U	10 U	0.5 U	10 U
Semivolatiles (µg/l)														
Phenol	2.1%	5	-	50	0	1	1	ND	N	10 U	N	10 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	N	10 U	N	10 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	N	10 U	N	10 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	N	10 U	N	10 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	N	10 U	N	10 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	N	10 U	N	10 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	N	25 U	N	25 U	N	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	N	1 J	N	1 J	N	9 J
Herbicides (µg/l)														
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	2.7 J	N	2.3 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N		N	0.1 U	N	0.1 U
Metals (µg/l)														
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	N	47700	N	246	N	4140 J
Antimony	6.4%	191	6	-	NA	3	4	ND	N		N		N	49.5 U
Arsenic	31.9%	8.6	50	50	0	50	0	ND	N	5.3 J	N	1.4 U	N	1.9 U
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	N	325	N	151 J	N	117 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	N	2.5 J	N	0.9 U	N	0.89 U
Cadmium	29.8%	64.6	5	5	8	10	3	ND	N	2.8 U	N	2.8 U	N	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	N	166000	N	64600	N	8580
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	N	76.2	N	2.7 U	N	7.1 J
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	N	54.5	N	5.5 U	N	5.4 U
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	N	70.5	N	5.5 J	N	4.7 UJ
Iron	100.0%	610000	-	300	63	300	63	ND-27800	N	80900 J	N	507 J	N	5310 J
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	N	25.8	N	0.59 U	N	1.3 J
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	N	34400	N	20700	N	2950 J
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	N	2930	N	145	N	86.2
Mercury	19.1%	2.3	2	2	1	2	1	ND	N	0.09 UJ	N	0.09 UJ	N	0.09 U
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	N	107	N	7.5 U	N	7.4 UJ
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	N	9280	N	2910 J	N	2670 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	N	1.5 U	N	1.5 U	N	1 UJ
Silver	6.4%	7.2	-	50	0	50	0	ND	N	5.5 U	N	5.5 U	N	5.4 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	N	33000	N	29500	N	114000
Vanadium	63.8%	358	-	-	NA	-	NA	ND	N	71.2	N	6.8 U	N	6.7 UJ
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	N	284	N	8 J	N	
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	N	1.8 J	N	2.1 J	N	1.2 U

TABLE 4-5

SUMMARY OF COMPOUNDS
DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE IIA MW-55D 11/05/93 MW-55D	PHASE II MW-56 07/02/93 MW-56	PHASE IIA MW-56 11/07/93 MW-56	PHASE IIA MW-56RE 11/07/93 MW-56RE	PHASE II MW-57D 07/02/93 MW-57D	PHASE IIA MW-57D 11/07/93 MW-57D	PHASE II MW-58D 07/10/93 MW-58D
VOCs (µg/l)															
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	0.5 U	10 U	0.2 J	0.5 U	10 U	0.5 U	10 U
Chloroform	4.3%	210	100	100	2	7	2	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
Benzene	8.5%	170	5	5	4	0.7	5	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	5.0 U	10 U	5.0 U	5.0 U	10 U	5.0 U	10 U
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
Toluene	4.3%	900	1000	5	2	5	2	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	10 U
Semivolatiles (µg/l)															
Phenol	2.1%	5	-	50	0	1	1	ND	N	13 U	N	N	10 U	N	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	N	13 U	N	N	10 U	N	10 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	N	13 U	N	N	10 U	N	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	N	13 U	N	N	10 U	N	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	N	13 U	N	N	10 U	N	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	N	13 U	N	N	10 U	N	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	N	33 U	N	N	25 U	N	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	N	13 U	N	N	10 U	N	10 U
Herbicides (µg/l)															
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	2.3 U	N	N	2.3 U	N	2.3 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N	0.1 U	N	N	0.1 U	N	0.1 U
Metals (µg/l)															
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	N	228000	N	N	18500	N	40100
Antimony	6.4%	191	6	-	NA	3	4	ND	N	191 J	N	N	49.6 UJ	N	49.6 UJ
Arsenic	31.9%	8.6	50	50	0	50	0	ND	N	1.4 UJ	N	N	2.8 J	N	3.3 J
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	N	1460	N	N	617	N	705
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	N	11.7	N	N	1.2 J	N	3.5 J
Cadmium	29.8%	64.6	5	5	8	10	3	ND	N	2.8 U	N	N	2.8 U	N	2.8 U
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	N	287000	N	N	61800	N	71400
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	N	351 J	N	N	32.2 J	N	59.2 J
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	N	201	N	N	11.3 J	N	19.8 J
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	N	272	N	N	18.1 J	N	32.3
Iron	100.0%	610000	-	300	63	300	63	ND-27800	N	379000	N	N	31000	N	50200
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	N	44.3	N	N	6.7	N	13.5
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	N	100000	N	N	12300	N	19100
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	N	10600	N	N	791	N	1100
Mercury	19.1%	2.3	2	2	1	2	1	ND	N	0.13 J	N	N	0.09 UJ	N	0.09 UJ
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	N	533 J	N	N	37.3 J	N	65.8 J
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	N	24800	N	N	4830 J	N	11200
Selenium	19.1%	2.9	50	10	0	10	0	ND	N	1.5 UJ	N	N	1.5 UJ	N	1.5 UJ
Silver	6.4%	7.2	-	50	0	50	0	ND	N	5.4 U	N	N	5.5 U	N	5.5 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	N	19500	N	N	148000	N	147000
Vanadium	63.8%	358	-	-	NA	-	NA	ND	N	317 J	N	N	28.8 J	N	67.1 J
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	N	1100	N	N	67.2	N	122
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	N	10 UJ	N	N	10 UJ	N	3.8 UJ

TABLE 4 - 5

SUMMARY OF COMPOUNDS DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (µg/l)	DWQS (µg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (µg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE IIA MW-58D 11/07/93 MW-58D	PHASE II MW-80 07/13/93 Dup of PT-17	PHASE II MW-82 07/10/93 Dup of PT-24	PHASE II MW-84 07/15/93 Dup of MW-44	PHASE II MW-86 07/14/93 Dup of MW-46	PHASE II MW-88 07/10/93 Dup of MW-58D	PHASE II MW-88RE 07/10/93 Dup of MW-58D
VOCs (µg/l)															
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	0.5 UJ	10 U	10 U	23000	10 U	10 U	N
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	0.5 UJ	10 U	10 U	170	10 U	10 U	N
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	0.5 UJ	10 U	10 U	150	10 U	10 U	N
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	0.5 UJ	47	80	74000	120	10 U	N
Chloroform	4.3%	210	100	100	2	7	2	ND	0.5 UJ	10 U	10 U	5 J	10 U	10 U	N
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	0.5 UJ	10 U	10 U	10 U	10 U	10 U	N
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	0.5 UJ	10 U	10 U	72	10 U	10 U	N
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	0.5 UJ	200	5 J	37000	46	10 U	N
Benzene	8.5%	170	5	5	4	0.7	5	ND	0.5 UJ	10 U	10 U	150	10 U	10 U	N
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	5.0 UJ	10 U	10 U	77	10 U	10 U	N
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	0.5 UJ	10 U	10 U	2 J	10 U	10 U	N
Toluene	4.3%	900	1000	5	2	5	2	ND	0.5 UJ	10 U	10 U	900 J	10 U	10 U	N
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	0.5 UJ	10 U	10 U	100	10 U	10 U	N
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	0.5 UJ	10 U	10 U	540	10 U	10 U	N
Semivolatiles (µg/l)															
Phenol	2.1%	5	-	50	0	1	1	ND	N	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	N	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	N	10 U	10 U	6 J	10 U	10 U	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	N	10 U	10 U	65 J	10 U	10 U	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	N	10 U	10 U	13 J	10 U	10 U	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	N	10 U	10 U	2 J	10 U	10 U	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	N	25 U	25 U	74 J	25 U	25 U	25 U
Di-n-butylphthalate	42.6%	18	-	50	0	50	0	ND - 18	N	2 J	10 U	2 J	0.6 J	9 J	10 U
Herbicides (µg/l)															
Dalapon	6.4%	6.4	200	50	0	50	0	ND	N	2.3 U	2.3 U	2.7 U	2.3 U	2.3 U	N
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	N	0.1 U	0.1 U	0.18	0.1 U	0.1 U	N
Metals (µg/l)															
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	N	84.7 J	142 J	45600 J	91200	76500	N
Antimony	6.4%	191	6	-	NA	3	4	ND	N		50 UJ	77.7		50 UJ	N
Arsenic	31.9%	8.6	50	50	0	50	0	ND	N	1.4 U	1.4 UJ	6.3 J	2.3 J	4.3 J	N
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	N	54.2 J	46.8 J	408	1190	1060	N
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	N	0.89 U	0.9 U	2.4 J	4 J	5.4	N
Cadmium	29.8%	64.6	5	5	8	10	3	ND	N	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	N
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	N	116000	113000	385000	481000	75100	N
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	N	2.7 U	2.7 UJ	77.8 J	143	111 J	N
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	N	5.5 U	5.5 U	40.3 J	57.4	36.7 J	N
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	N	5.8 J	4.7 U	49.2 J	75.4	53.2	N
Iron	100.0%	610000	-	300	63	300	63	ND-27800	N	93.8 J	162	75700 J	141000 J	91100	N
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	N	0.6 U	0.6 U	132	20.1	16.3	N
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	N	11400	12700	54700	57800	31300	N
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	N	6.4 J	32.3	7560	3290	1410	N
Mercury	19.1%	2.3	2	2	1	2	1	ND	N	0.09 UJ	0.09 UJ	0.18 J	0.25 J	0.09 UJ	N
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	N	7.4 U	7.5 UJ	99 J	169	118 J	N
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	N	1560 J	1260 J	11600	16400	21700	N
Selenium	19.1%	2.9	50	10	0	10	0	ND	N	1.5 U	1.5 UJ	9.9 UJ	1.5 U	1.5 UJ	N
Silver	6.4%	7.2	-	50	0	50	0	ND	N	5.5 U	5.5 U	5.5 U	5.5 U	5.5 U	N
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	N	28600	14800	38400	11900	149000	N
Vanadium	63.8%	358	-	-	NA	-	NA	ND	N	6.8 U	6.8 UJ	64.6 J	128	123 J	N
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	N	3.1 J		257 J	383	186	N
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	N	4 J	1.2 UJ	3.4 J	1.2 U	3.5 UJ	N

TABLE 4 - 5

SUMMARY OF COMPOUNDS
DETECTED-GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

	PERCENTAGE OF WELLS DETECTED IN	MAXIMUM DETECTED	MCL (μg/l)	DWQS (μg/l)	NUMBER OF SAMPLES ABOVE DWQS	NYSDEC CLASS GA AWQS (μg/l)	NUMBER OF SAMPLES ABOVE AWQS	BACKGROUND RANGE	PHASE IIB MW-59 04/11/94 MW-59	PHASE IIB MW-60 04/11/94 MW-60	PHASE IIB PT-11 04/18/94 PT-11
VOCs (μg/l)											
Vinyl Chloride	6.4%	23000	2	2	6	2	6	ND	0.5 U	0.5 U	0.5 UJ
1,1-Dichloroethene	6.4%	200	7	5	2	5	2	ND	0.5 U	0.5 U	0.5 UJ
1,1-Dichloroethane	2.1%	160	-	5	2	5	2	ND	0.5 U	0.5 U	0.5 UJ
1,2-Dichloroethene (total)	31.9%	130000	-	5	27	5	27	ND	0.5 U	0.5 U	0.5 UJ
Chloroform	4.3%	210	100	100	2	7	2	ND	0.5 U	0.5 U	0.5 UJ
1,2-Dichloroethane	2.1%	6	5	5	1	5	1	ND	0.5 U	0.5 U	0.5 UJ
1,1,1-Trichloroethane	4.3%	72	200	5	1	5	1	ND	0.5 U	0.5 U	0.5 UJ
Trichloroethene	38.3%	51000	5	5	20	5	20	ND	0.5 U	0.5 U	0.5 UJ
Benzene	8.5%	170	5	5	4	0.7	5	ND	0.5 U	0.5 U	0.5 UJ
4-Methyl-2-Pentanone	2.1%	77	-	-	NA	-	NA	ND	5 U	5 U	5 UJ
Tetrachloroethene	2.1%	2	5	5	0	5	0	ND	0.5 U	0.5 U	0.5 UJ
Toluene	4.3%	900	1000	5	2	5	2	ND	0.5 U	0.5 U	0.5 UJ
Ethylbenzene	2.1%	130	700	5	2	5	2	ND	0.5 U	0.5 U	0.5 UJ
Xylene (total)	4.3%	590	10,000	5	2	5	2	ND	0.5 U	0.5 U	0.5 UJ
Semivolatiles (μg/l)											
Phenol	2.1%	5	-	50	0	1	1	ND	10 U	10 U	10 U
bis(2-Chloroethyl) ether	2.1%	0.6	-	50	0	1	0	ND	10 U	10 U	10 U
4-Methylphenol	4.3%	6	-	50	0		NA	ND	10 U	10 U	10 U
Naphthalene	2.1%	66	-	50	2	10	2	ND	10 U	10 U	10 U
2-Methylnaphthalene	2.1%	13	-	50	0	-	NA	ND	10 U	10 U	10 U
Diethylphthalate	2.1%	2	-	-	NA	50	0	ND	10 U	10 U	10 U
Pentachlorophenol	2.1%	74	1	50	2	1	2	ND	26 U	26 U	26 U
Di-n-butylphthalate	42.6%	18	=	50	0	50	0	ND - 18	10 U	10 U	10 U
Herbicides (μg/l)											
Dalapon	6.4%	6.4	200	50	0	50	0	ND	2.5 U	2.5 U	2.4 U
Dicamba	2.1%	0.18	-	0.44	0	0.44	0	ND	0.11 U	0.11 U	0.11 U
Metals (μg/l)											
Aluminum	100.0%	306000	-	-	NA	-	NA	ND -19100	247	75.4 J	1010
Antimony	6.4%	191	6	-	NA	3	4	ND	1 U	0.99 U	1 U
Arsenic	31.9%	8.6	50	50	0	50	0	ND	1.5 U	1.5 U	2 J
Barium	100.0%	1600	2000	2000	0	1000	4	ND-329	101 J	30.6 J	82 J
Beryllium	25.5%	11.7	4	-	NA	3	3	ND	0.06 U	0.06 U	0.11 J
Cadmium	29.8%	64.6	5	5	8	10	3	ND	0.1 U	0.12 J	0.26 J
Calcium	100.0%	1790000	-	-	NA	-	NA	39200-352000	208000	97400	143000
Chromium	91.5%	418	100	10	43	50	14	ND-29.8	0.5 J	0.4 U	2.5 J
Cobalt	38.3%	201	-	-	NA	5	27	ND-28	0.87 J	0.6 J	2 J
Copper	76.6%	412	1300*	1300	0	200	2	ND-25.3	1.5 J	1.2 J	4 J
Iron	100.0%	610000	-	300	63	300	63	ND-27800	505	120	2020
Lead	80.9%	147	15*	15	15	250	0	ND-8.2	0.8 U	0.8 U	0.8 U
Magnesium	100.0%	267000	-	-	NA	35000	20	14700-39600	43300	13400	31200
Manganese	100.0%	11400	-	300	49	300	49	43.7-2200	79.1	17.7	102
Mercury	19.1%	2.3	2	2	1	2	1	ND	0.03 U	0.03 U	0.03 U
Nickel	66.0%	622	100	-	NA	-	NA	ND-36.9	2.1 J	1.1 J	3.5 J
Potassium	100.0%	24800	-	-	NA	-	NA	1160-11200	1570 J	490 J	2050 J
Selenium	19.1%	2.9	50	10	0	10	0	ND	1.7 U	1.7 U	1.7 U
Silver	6.4%	7.2	-	50	0	50	0	ND	0.7 U	0.7 U	0.7 U
Sodium	100.0%	149000	-	-	NA	20000	66	11200-91000	38300	8180	38700
Vanadium	63.8%	358	-	-	NA	-	NA	ND	0.86 J	0.81 J	2 J
Zinc	93.6%	1750	-	5000	0	300	6	ND-58.8	2.8 J	1.8 J	16.3 J
Cyanide	29.8%	11.2	200	-	NA	100	0	ND-11.2	5 U	5 U	5 UJ

Notes:

1) New York State Drinking Water Regulations.
2) New York State Class GA Groundwater Regulations
3) N = Compound not analyzed.
4) U = Not detected at tabulated detection limit
5) J = The reported value should be considered an estimate
6) R = Datum was rejected during the data validation process
7) UJ = The analyte was not detected; however, the associated reporting limit is approximate.
8) NA = Not Applicable.
9) ND = Not Detected

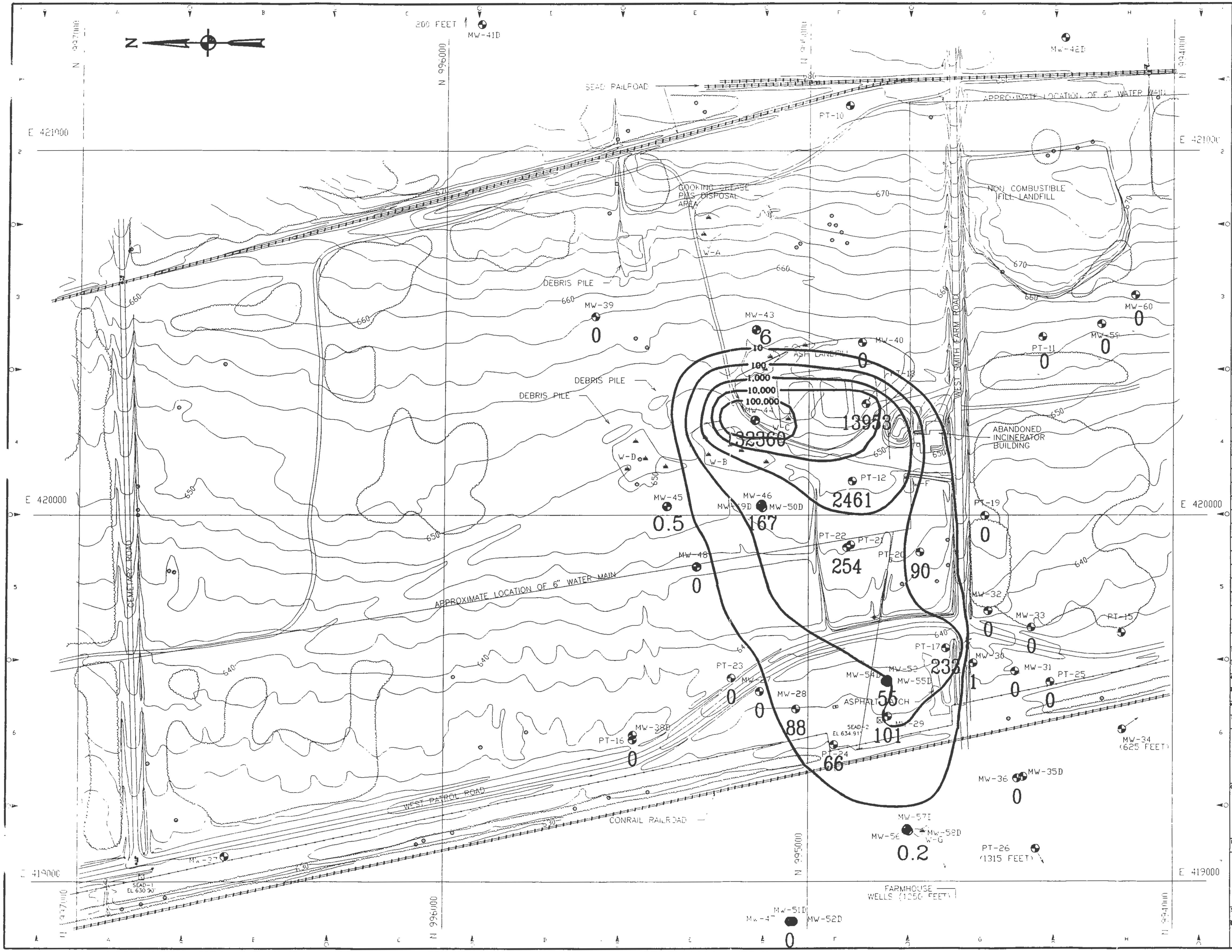
10. MCL - Maximum Contaminant Level; source: EPA Drinking Water Regulations and Health Advisories, EPA 822-R-94-001, May 1994.
11. No MCL is avialble for total 1,2-DCE; however, the MCL for cis 1,2-DCE is 70 ug/l and the MCL for trans 1,2-DCE is 100 ug/l.
12. * - No MCL is avialable; instead the actions level is given.

from 3 ug/L in wells PT-12 and PT-18 to 170 ug/L in MW-44. 1,1-dichloroethane was detected only in well MW-44, at a concentration of 160 ug/L. 1,2-dichloroethane was also detected in only one well, PT-22, at a concentration of 6 ug/L. 1,1,1-trichloroethane was detected in two wells, MW-29 and MW-44, at concentrations of 2 ug/L and 72 ug/L, respectively. Tetrachloroethene was detected in only well MW-44, at a concentration of 2 ug/L. New York Drinking Water Quality Standard (DWQS) for all of these compounds listed above are shown on Table 4-4.

To present these data in a more meaningful way, the geographic distribution of the chlorinated compounds is depicted on a total chlorinated volatile organic compound plume map (Figure 4-48). The plume is defined by isocontours of 0, 100, 10,000 and 100,000 ug/L. The data define the horizontal boundaries of the plume that originates in the western portion of the Ash Landfill and extends to the west in the direction of groundwater flow to approximately 100 feet beyond the SEDA depot fence. The data define two source areas for chlorinated volatile organics in the Ash Landfill. One in the vicinity of PT-18 (13,953 ug/L total chlorinated compounds) and a more concentrated area near the bend in the road at MW-44 (134,399 ug/L total chlorinated compounds). Dual source areas of differing magnitudes is also supported by the results of the soil gas and headspace surveys and soil borings described earlier. As depicted on the plume map, concentration gradients are steep near these source areas and flatten out to the west. Chemically, the plume is composed of mostly of TCE, 1,2-DCE and vinyl chloride (only at the source areas). In the source area of the plume the original parent compound, TCE, has chemically degraded to 1,2-DCE and vinyl chloride. Vinyl chloride is found only near the source area because of its tendency to volatilize and be released into the atmosphere soon after its formation. In farther downgradient portions of the plume the amount of TCE decreases relative to the amount of 1,2-dichloroethene, reflecting the continued degradation of TCE as the plume migrates.

The configuration of the plume suggests that it is generally controlled by regional directions of ground water flow at the Ash Landfill site, although local flow regimes have some influence. This is particularly evident near the intersection of West Patrol Road and West Smith Farm Road were a westward shift in the ground water flow direction may be responsible for a corresponding shift in the plume configuration (Figure 4-48). This may explain the sharp contrast between the total chlorinated concentrations at PT-17 (233 ug/L) and MW-30 (1 ug/L) which are separated by only 80 feet. The hydrogeologic data presented in Section 3 indicates that at times the saturated thickness of the shallow till/weathered shale aquifer becomes very small, generally from one to three feet and even becoming dry. Thus, at these times the flow of groundwater and the plume may be more influenced by local bedrock topography than by the regional directions of groundwater flow. Additionally, no chlorinated volatiles were detected in MW-48 (installed adjacent to the 6-inch water main north of the plume) indicating that no preferential migration of the plume is occurring along the trench excavated for the water main.

Vertically the plume of chlorinated compounds is defined by analytical data from two types of well arrays: 1) monitoring well pairs consisting of wells screened in the till/weathered shale and competent shale, and 2) well clusters installed in the till/weathered shale, shallow competent shale and deep competent shale. Profiles of the total chlorinated compound plumes are depicted in Figures 4-49 and 4-50. The plume profiles are constructed on portions of the geologic cross sections A-A' and B-B' previously shown in Section 3.5.5,which intersect the two source areas. The profiles indicate that the chlorinated plume is restricted to the till/weathered shale aquifer and is not present in the competent shale. Hydrogeologic data also support the presence of the plume only in the shallow till/weathered shale aquifer and not in the deep competent shale aquifer. Most importantly, hydraulic conductivity data indicate that the till/weathered shale is more permeable than the competent shale and, thus, is likely a preferred migration pathway for the shallow ground water as well as for the plume. Vertical connection testing indicates that there is a measurable, although very small, connection between the two aquifers only when a large artificial downward gradient is established. More significant vertical connections exist only within the competent shale, where unlike in the weathered shale and extreme upper portions of the competent shale, fractures are clean and not filled with silt and clay. For the most part the water level data indicate that there is a very small and generally consistent downward gradient on the site, however, it does not appear to influence the migration of ground water and chlorinated volatile organic compounds in the till/weathered shale aquifer. Exceptions to this occur at well pairs MW-36/MW-35D and MW-46/MW-49D where there is a very small upward gradient and at well cluster MW-47/MW-51/MW-52 where no gradient or vertical flow exists. Therefore, hydrologic conditions at these locations would tend not to promote the downward movement of chlorinated volatiles. While the contact between the till/weathered shale aquifer and the competent shale aquifer has been shown to not be an impermeable boundary, the geologic and hydrologic characteristics of the site (discussed above and in Section 3.0) suggest that the ground water and chlorinated volatile organics plume preferentially migrate in the shallow till/weathered shale aquifer.



LEGEND:

PAVED ROAD

DIRT ROAD

650 GROUND CONTOUR AND ELEVATION

TREE

W-B WETLAND & DESIGNATION

APPROXIMATE EXTENT OF FILL

OUTLINE OF FORMER TRASH PITS (IDENTIFIED FROM AERIAL PHOTO)

APPROXIMATE EXTENT OF DEBRIS PILE

BRUSH

CHAIN LINK FENCE

UTILITY POLE

APPROXIMATE LOCATION OF FIRE HYDRANT

FUEL OR UNDERGROUND STORAGE TANK

☒ SEAD-1 EL.630.90' SURVEY MONUMENT

PT-22 MW-37 MONITORING WELL AND DESIGNATION

—10,000— GROUNDWATER ISOCONTOUR (ug/L)

REV	DATE	DESCRIPTION
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B	10/93	PREDRAFT PHASE II RI/FS
A	7/2/93	ISSUED WITH PRELIMINARY SITE CHARACTERIZATION REPORT

DRAWN BY G.A. KAELIN
CHECKED BY M.E. BAKER
DESIGN SUPV. G.A. KAELIN
RESP. ENGR. M.N. DUCHESNEAU
CHIEF DISC. ENGR. M.E. BAKER
MGR. OF ENGR. J.P. CHAPLICK
PROJECT MANAGER M.N. DUCHESNEAU
MGR. OF PROJECTS J.P. CHAPLICK
IN CHARGE W.D. PATTERSON

DRAWN | CHECKED | DES.SUPV. | RESP.ENGR. | CH.DISC.ENG. | PROJ. MGR.

ES
ENGINEERING-SCIENCE, INC

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION FEASIBILITY STUDY ASH LANDFILL

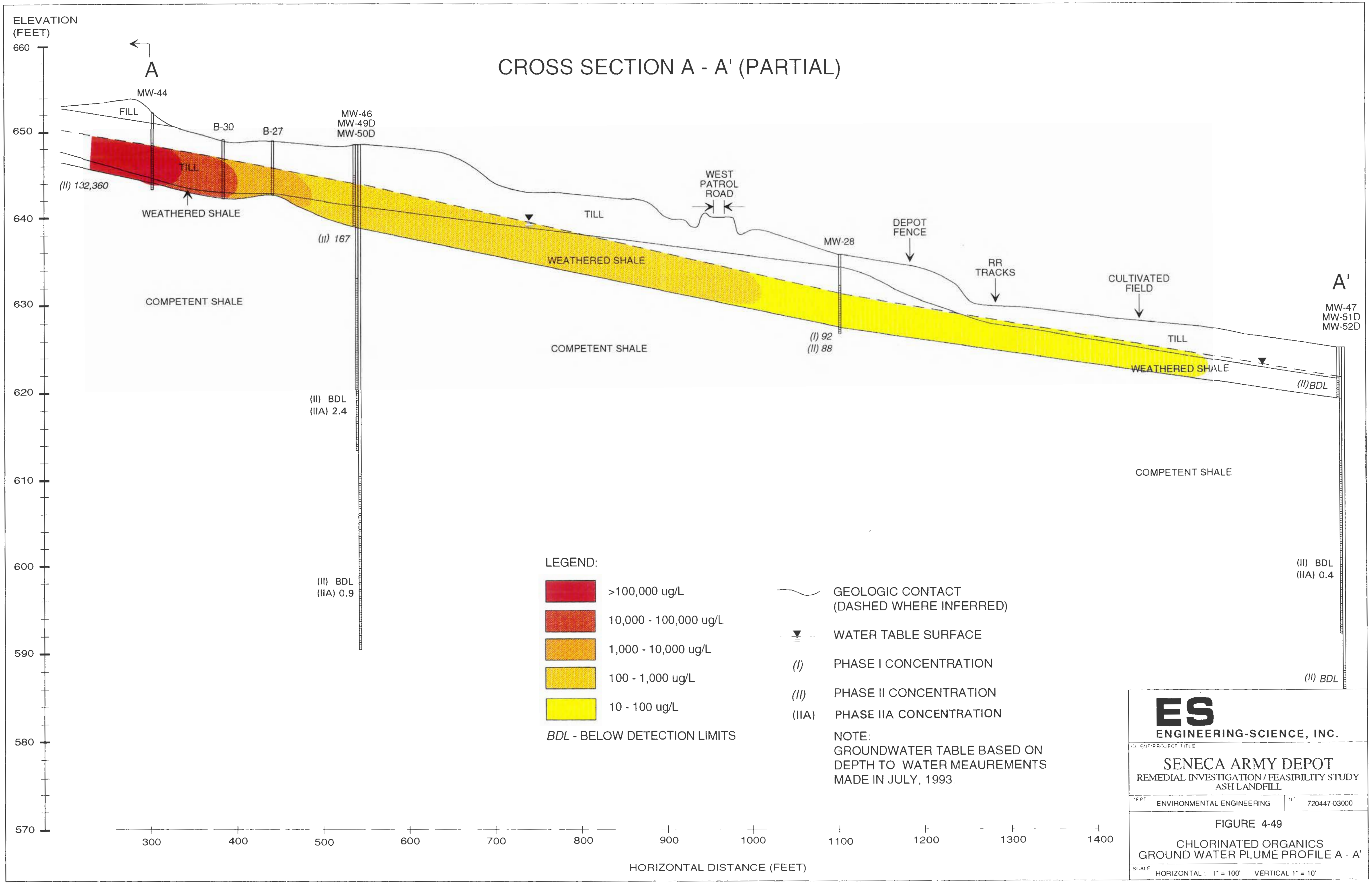
DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 4-48
TOTAL CHLORINATED VOLATILE ORGANIC PLUME (ug/L)

SCALE 1" = 250'

ES'S DWG NO. 720447-03000-1-1
REV B

/SENECA/ASH/4-48.DWG



NOTE:
GROUNDWATER TABLE BASED ON DEPTH TO WATER MEAUREMENTS MADE IN JULY, 1993.

ES
ENGINEERING-SCIENCE, INC.

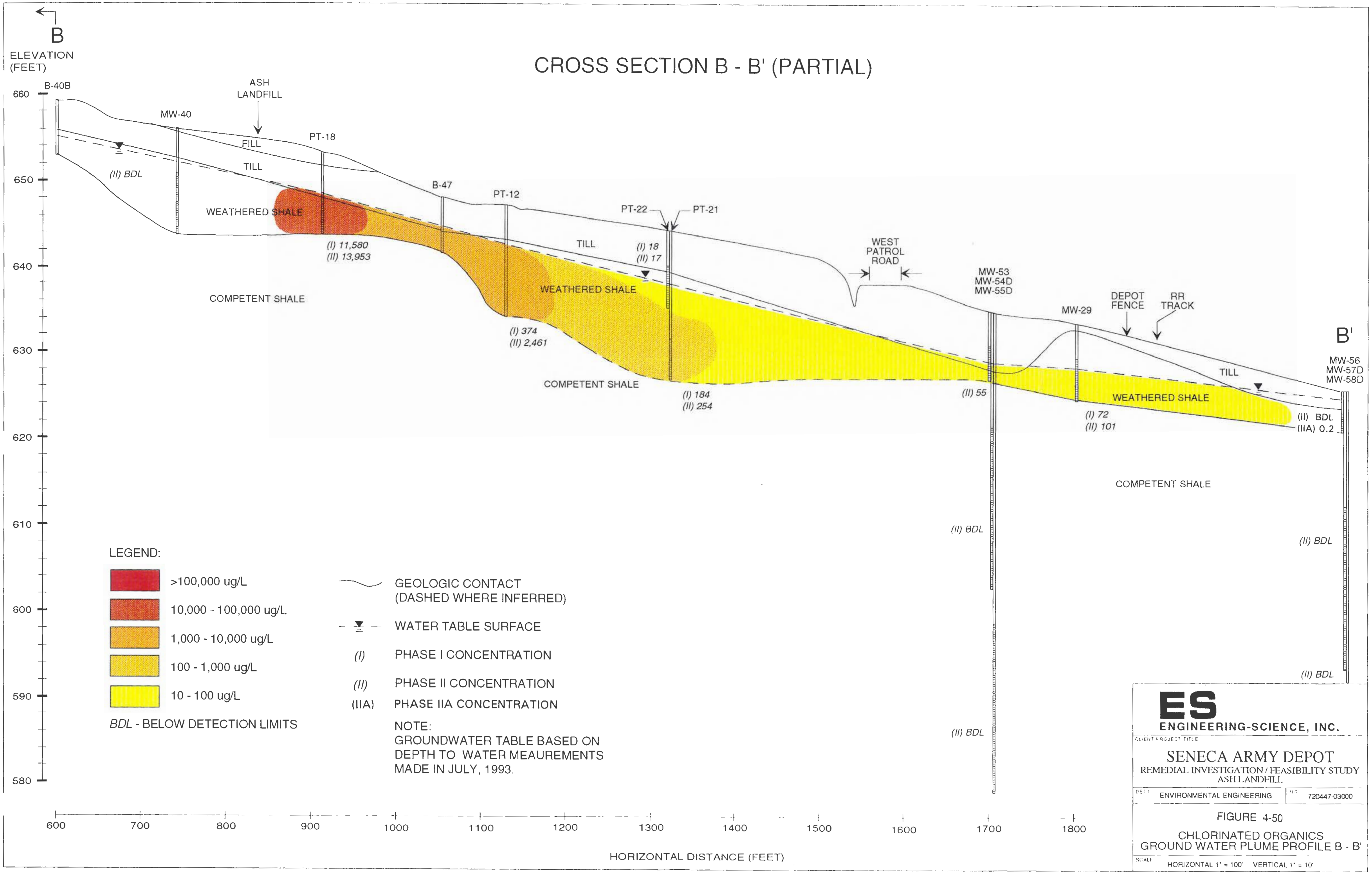
CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT ENVIRONMENTAL ENGINEERING | NO. 720447-03000

FIGURE 4-49

CHLORINATED ORGANICS
GROUND WATER PLUME PROFILE A - A'

SCALE HORIZONTAL : 1" = 100' VERTICAL 1" = 10'



LEGEND:

🟥 >100,000 ug/L

🟥 10,000 - 100,000 ug/L

🟧 1,000 - 10,000 ug/L

🟨 100 - 1,000 ug/L

🟨 10 - 100 ug/L

BDL - BELOW DETECTION LIMITS

GEOLOGIC CONTACT (DASHED WHERE INFERRED)

WATER TABLE SURFACE

(I) PHASE I CONCENTRATION

(II) PHASE II CONCENTRATION

(IIA) PHASE IIA CONCENTRATION

NOTE:
GROUNDWATER TABLE BASED ON DEPTH TO WATER MEAUREMENTS MADE IN JULY, 1993.

ES
ENGINEERING-SCIENCE, INC.

CLIENT PROJECT TITLE
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT ENVIRONMENTAL ENGINEERING
NO. 720447-03000

FIGURE 4-50

CHLORINATED ORGANICS
GROUND WATER PLUME PROFILE B - B'

SCALE HORIZONTAL 1" = 100' VERTICAL 1" = 10'

No volatile organic compounds were detected in the wells downgradient of the Non-Combustible Fill Landfill.

4.4.2 Aromatic Volatile Organic Compounds

Aromatic volatile organic compounds were detected in only 6 of the 47 monitoring wells sampled on the Ash Landfill site (Table 4-4). Five of the wells each contained only one of three aromatic compounds (benzene, toluene, and xylenes or BTEX) and their presence was not confirmed by both Phase I and II data. In addition, the aromatics in these five wells are generally widely distributed across the site and the individual compounds shown no consistent pattern of occurrence. The five wells (PT-11, PT-12, PT-18, PT-21 and MW-51D) each contained estimated concentration of less than 6 ug/L of only one aromatic compound. The DWQS for benzene was exceeded in well PT-21 within an estimated concentration of 6 ug/L. Well MW-44 contained significantly higher concentrations of the BTEX suite of aromatic compounds. The compounds detected in MW-44 are benzene (170 ug/L), ethylbenzene (180 ug/L), toluene (880 ug/L) and xylenes (540 ug/L) for a total BTEX of 1,720 ug/L. The BTEX suite of compounds, when present together, are generally indicative of a release of gasoline or fuel oil. The DWQSs for benzene, toluene, ethylbenzene, and xylenes were exceeded in well MW-44 (Table 4-5). In contrast to the chlorinated volatile organics, these data define only one source area for a release, namely the bend in the road (near MW-44). This area also overlaps with the previously defined release of chlorinated solvents as discussed in Section 4.4.1. Soil samples collected from borings performed near the bend in road also contain toluene, ethylbenzene, and xylenes providing additional support for the release. The BTEX groundwater contamination is very limited in extent. It is noteworthy that the BTEX contamination has not impacted the downgradient well MW-46, which has been impacted by chlorinated compounds.

4.4.3 Semi-Volatile Organic Compounds

Eight semi-volatile organic compounds were detected in groundwater at the Ash Landfill site. One semi-volatile organic compound, di-n-butylphthalate, was detected in 18 wells on-site. Seven (phenol, 4-methylphenol, naphthalene, 2-methylnaphthalene, diethylphthalate, pentachlorophenol and di-n-butylphthalate) were detected in well MW-44 (Table 4-5). Two compounds [4-methylphenol and bis (2-chloroethyl) ether] were detected in PT-19 and PT-22, respectively.

The detected concentrations of di-n-butylphthalate ranged from 0.5 ug/L to 18 ug/L with an average 5 ug/L. The DWQS for di-nibutylphthalate is 50 ug/L. The horizontal and vertical distribution of this compound appears to be random as it occurs in wells screened in both the till/weathered shale aquifer and in the competent shale. An example is at cluster MW-47/MW-51D/MW-52D were it was detected in only the deep shale well (MW-52D) and not in any of the shallower wells. It is also noteworthy that this compound was detected only in the Phase II sampling round and not in wells sampled for Phase I. Phthalates are common sampling and laboratory contaminants, and their presence may be due to this factor. Similarly,the compounds 4-methylphenol and bis (2-chloroethyl) ether were detected only in Phase II at low concentrations of 2 to 4 ug/L and 0.6 ug/L, respectively; the DWQS for both 4-methylphenol and bis (2-chloroethyl) ether is 50 ug/L.

Seven semi-volatiles were detected in monitoring well MW-44 at a total concentration of 144 ug/L. The highest concentrations were observed for naphthalene (66 ug/L) and pentachlorophenol (54 ug/L). These two concentrations are above the DWQS of 50 ug/L established for both of these compounds. The remaining compounds are phenol (5 ug/L), 4-methylphenol (4 ug/L), 2-methylnaphthalene (12 ug/L), diethylphthalate (1 ug/L) and di-n-butylphthalate (2 ug/L). The concentrations detected for these compounds are below their respective DWQSs.

4.4.4 Tentatively Identified Volatile Organic Compounds (TIC's)

Tentatively identified compounds (TICs) (primarily long chair alphatic hydrocarbons (C_{15} to C_{20}) were detected predominantly in the bedrock monitoring wells on the site. Although the TICs were found in bedrock wells throughout the site, the highest concentrations were found in two of three upgradient background bedrock wells, PT-10 and MW-42D. In these two wells the TIC concentrations totalled 1,073 ug/L and 750 ug/L, respectively. In the 10 bedrock wells downgradient of the Ash Landfill the TICs total less than 500 ug/L. In the three locations where shallow and deep bedrock well pairs exist, the deep well consistently shows higher TIC concentrations than the shallow well. Six overburden wells also contain relatively low-concentrations of these same compounds.

The specific source of the long chain aliphatic hydrocarbons is not known, however, the suspected source is naturally occurring aliphatic hydrocarbons indigenous to the black shale which comprises the bedrock below the site. Support for this is provided by the fact that the marcellus shale, the lower formation within the Hamilton Group of black shales, is a "black slate like bituminous shale" Mozola (1951). Additionally, numerous natural gas wells between Seneca and Cayuga Lakes are known to extract natural gas from the black shales.

4.4.5 Farmhouse Wells Quarterly Monitoring

There are three wells located at the farmhouse on Smith Farm Road, the nearest residence to the site. These wells are located downgradient of the Ash Landfill. These wells were not sampled as part of the RI, but have been sampled quarterly for several years as part of other site programs. Data from the three most recent rounds of quarterly monitoring are included here in order to help evaluate the potential affect of the Ash Landfill on these wells. The data is summarized in Table 4-6. More complete data are included in Appendix J. This data is all Level IV validated data. The three wells which were sampled are the shallow and deep farmhouse wells, FH-S and FH-D, respectively, and the shallow barn well BRN-S. For various reasons, it was not possible to sample each well during all sampling events. However, there is enough information to evaluate the impacts of the site on these wells.

The well samples were analyzed for volatile organics (by EPA method 524.1), metals, cyanide, and several water quality and indicator parameters, including chloride, sulfate, nitrogen, and TOC. As seen in Table 4-6, there were no volatile organics detected in any of the wells. This indicates that there has been no impact to these wells from the site, since volatile organics are the constituents of the site plume. Additionally, none of the indicator parameters have demonstrated unusually high values. The metals data from the well samples were compared with the New York State Drinking Water Quality Standards. These values were all below the standards, with one exception. The DWQS for iron of 300 ug/L, established primarily for aesthetic reasons, was exceeded in well FH-D in July, 1993 which had a measured concentration of 723 ug/L. This well is screened deep in the bedrock, of which iron is a major component, and this iron is most likely due to the bedrock chemistry.

4.4.6 Pesticides and PCBs

No pesticides or PCBs were detected in any of the groundwater samples collected from the wells at the Ash Landfill site.

22-Oct-93

TABLE 4 - 6
SUMMARY OF COMPOUNDS DETECTED

FARMHOUSE WELLS QUARTERLY MONITORING

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	NYS DWQS	NUMBER OF SAMPLES ABOVE NYS DWQS	FH-S 01/21/93	FH-S 04/16/93	FH-S 07/23/93	FH-D 04/16/93	FH-D 07/23/93	BRN-S 01/21/93	BRN-S 04/16/93	BRN-S 07/23/93
Metals (ug/L)												
Aluminum	60.0%	648	–	–	62.6 U	NS	14.6 U	NS	648	170 J	NS	28.1 J
Antimony	0.0%	–	–	0	54.1 U	NS	16.8 U	NS	16.8 U	53.6 U	NS	16.8 U
Arsenic	0.0%	–	50	0	1.2 U	NS	0.8 U	NS	0.8 U	1.2 U	NS	0.8 U
Barium	100.0%	558	2000	0	112 J	NS	98.4 J	NS	558	79.8 J	NS	81.2 J
Beryllium	40.0%	0.39	–	–	0.3 U	NS	0.3 J	NS	0.3 U	0.39 J	NS	0.3 U
Cadmium	0.0%	–	5	0	3.1 U	NS	2.4 U	NS	2.4 U	3.1 U	NS	2.4 U
Calcium	100.0%	131000	–	–	98900	NS	94000	NS	14200	131000	NS	131000
Chromium	0.0%	–	10	0	2 U	NS	3.3 U	NS	3.3 U	2 U	NS	3.3 U
Cobalt	20.0%	2.8	–	–	5 U	NS	2.8 J	NS	2.7 U	5 U	NS	2.7 U
Copper	0.0%	–	1300	0	1.9 U	NS	9 R	NS	3.1 R	1.9 U	NS	2.1 U
Iron	80.0%	723	300	1	36.5 J	NS	11.6 U	NS	723	250	NS	94.2 J
Lead	60.0%	4	15	0	0.89 U	NS	1.4 J	NS	1.4 J	0.89 U	NS	4 J
Magnesium	100.0%	24800	–	–	20500	NS	20600	NS	5910	24700	NS	24800
Manganese	100.0%	11.2	300	0	1.1 J	NS	11.2 J	NS	7.8 R	3.8 J	NS	3.4 R
Mercury	0.0%	–	2	0	0.06 U	NS	0.1 U	NS	0.1 U	0.06 U	NS	0.1 U
Nickel	0.0%	–	–	0	3.5 U	NS	8.3 U	NS	8.3 U	3.5 U	NS	8.3 U
Potassium	100.0%	12000	–	–	12000	NS	9240	NS	1800 J	5720	NS	6480
Selenium	20.0%	1.4	10	0	1.4 J	NS	1.1 U	NS	1.1 U	1.1 U	NS	1.1 U
Silver	0.0%	–	50	0	3.2 U	NS	2.6 U	NS	2.6 U	3.2 U	NS	2.6 U
Sodium	100.0%	162000	–	–	30600	NS	36000	NS	162000	3570 J	NS	3900 J
Thallium	0.0%	–		0	2.6 U	NS	1.2 U	NS	1.2 U	2.6 U	NS	1.2 U
Vanadium	40.0%	3.9	–	–	2.1 U	NS	3 U	NS	3.9 J	2.1 U	NS	3.3 J
Zinc	100.0%	501	5000	0	360	NS	501	NS	5 R	45.8	NS	34.8 R
Cyanide	20.0%	2.2	–	–	10 U	NS	1.8 U	NS	1.8 U	10 U	NS	2.2 J
Other Analyses												
Chloride (mg/L)	100.0%	16	250	0	5.2	8	8	18	13	16.5	3	15
Sulfate (mg/L)	100.0%	74	250	0	52	49	34	62	29	64	43	74
Nitrate/Nitrate Nitrogen (mg/L)	100.0%	8	10	0	3.3	NA	NA	NA	NA	8.0	NA	NA
Nitrite-Nitrogen (mg/L)	0.0%	–	1	0	<0.002	NA	NA	NA	NA	<0.002	NA	NA
Nitrate as N - Calculation (mg/L)	100.0%	8	10	0	3.3	2.5	1.3	0.05	0.05 U	8.0	4.1	8.3
Organic Halides, Total (mg/L)	50.0%	1.6	–	–	<0.02	0.02	0.02 U	0.02	0.02 U	<0.02	0.02	1.6
Conductivity (mS/cm)	–	830	–	–	746	770	760	820	800	817	650	830
pH (standard units)	–	–	–	–	7.30	7.16	7.21	8.16	8.67	7.38	7.18	7.25
Organic Carbon, Total (mg/L)	87.5%	11	–	–	2.9	2	3	2	2	NA	4	11

NOTES:
NYS DWQS = New York State Drinking Water Quality Standards
NS = Not sampled
NA = Not analyzed
U = Not detected at tabulated detection limit
J = This result should be considered an estimated value
R = This datum was rejected during the data validation process

4.4.7 Herbicides

Two herbicides, dalapon and dicamba, were detected in groundwater samples collected from three wells at the Ash Landfill site (Table 4-5). Specifically, dalapon was detected in wells PT-22 and MW-53 at concentrations of 6.4 ug/L and 2.7 ug/L, well below the DWQS of 50 ug/L. Dicamba was detected only in a duplicate sample for MW-44 (labeled MW-84) at a concentration of 0.18 ug/L, which is also below the DWQS of 0.44 ug/L.

4.4.8 Metals and Cyanide

The metals discussed in this section were statistically selected for inclusion in the human health risk assessment presented in Section 6 of this report. These metals were selected by statistically comparing their concentrations in groundwater from the background wells to their concentrations in groundwater from the other wells on-site. This comparison is presented in Table 6-2. The compounds antimony, barium, calcium, cobalt, magnesium, manganese, potassium, silver, sodium and cyanide were measured on-site at concentrations not determined to be statistically significantly above background. The wells that were used to calculate background concentrations are PT-10, MW-34, MW-37, MW-41D and MW-42D. These wells are all either hydraulically upgradient or sidegradient by 600 or more feet. Drinking water standards Class GA groundwater standards and concentrations in the background wells were used to evaluate the groundwater data presented in Table 4-5 for the remaining compounds. The standards are from the New York State Drinking Water Regulations (10 NYCRR Part 5). The average concentration and standard deviation was used to calculate the 95 percent upper confidence limit for the mean concentrations in the background wells. This limit was used when a drinking water standard was not available.

Aluminum

The 95 percent upper confidence limit (95th UCL) for the mean aluminum concentration in the background wells is 6,290 ug/L. There were 37 samples with aluminum above this limit. The aluminum detected in the Phase I and II groundwater samples is probably not representative of the concentrations in the groundwater. The aluminosilicate soil particles that caused the turbidity in these samples are the likely source. Modification of the purging and sampling procedures for the Phase II program reduced the turbidity and aluminum concentrations in the Phase II groundwater samples compared to the Phase I sample data.

Aluminum was detected in only one of the filtered samples obtained during the Phase I program.

Arsenic

Arsenic was not detected in any of the groundwater samples from Phases I and II at concentrations above the DWQS of 50 ug/L.

Beryllium

The 95th UCL for the mean beryllium concentration in the background wells is 0.45 ug/L. There were 13 samples with beryllium above this limit, all but one were Phase II samples. The samples with elevated beryllium are generally located west of the Ash Landfill on the north side of West Smith Farm Road. The highest concentration of 11.7 ug/L was at MW-56. This pattern of beryllium concentration is similar to chromium, nickel, and vanadium.

Cadmium

Cadmium was detected at concentrations greater than the DWQS of 5 ug/L in 8 Phase I samples from seven locations. When these seven locations were sampled during the Phase II program using a modified purging and sampling procedure, no cadmium was detected in any of the samples. Therefore, the Phase I results for cadmium are probably not representative of the groundwater quality.

Chromium

Chromium was detected at concentrations greater than the DWQS of 10 ug/L in 40 samples. Chromium concentrations from the Phase I samples are believed to not be representative of the groundwater quality. Modification of the purging and sampling procedures for the Phase II program reduced the turbidity of the Phase II samples. Groundwater samples were obtained during the Phase I and Phase II programs from 19 wells where the Phase I concentration was greater than 10 ug/L. In all but one data pair, the Phase II concentrations were less half the Phase I concentrations. In 12 data pairs, the Phase II concentrations were less than the detection limits. Chromium concentrations of the Phase II samples were variable over the site, though the chromium concentrations greater than 10 ug/L were generally located west of the Ash Landfill on the north side of West Smith Farm Road. The highest concentrations of 418 ug/L and 351 ug/L were at PT-26 and MW-56 respectively. Both of these wells are off depot, well west of the Ash Landfill area and are most likely not being affected by the Ash Landfill. This pattern of chromium concentration is very similar to that of beryllium, nickel, and vanadium.

Copper

Copper was not detected in any of the groundwater samples from Phases I and II at concentrations above the DWQS of 1,300 ug/L.

Iron

Iron was detected at concentrations above the DWQS of 300 ug/L in approximately half of the samples. The iron concentrations in the Phase II groundwater samples are generally an order of magnitude lower than in the Phase I samples from the same well. Use of the modified groundwater purging and sampling procedure during the Phase II sampling reduced the turbidity of the groundwater samples as shown in Table 2-7. Therefore, the Phase II iron data is believed to be more representative of the groundwater quality than the Phase I iron data.

Lead

Lead was detected at concentrations above the DWQS of 15 ug/L in 15 groundwater samples. Comparison of Phase I lead concentration and turbidity data to the Phase II data indicates that turbidity contributes to the lead concentrations detected in the groundwater. Data from PT-18, PT-26, MW-29, and MW-31 were used for this comparison. Eight Phase II groundwater samples contained lead above 15 ug/L. The highest concentration (147 ug/L) was from MW-44 which is located at the northwest edge of the Ash Landfill. Concentrations in the other seven samples ranged from 17.3 to 44.3 ug/L. Lead in the soil particles collected with these groundwater samples probably contributed to the lead concentrations in these seven samples. MW-43, located 100 to 150 feet upgradient of the Ash Landfill and PT-26, located approximately one half mile west of the Ash Landfill, had lead concentrations of 21.9 and 17.3 ug/L, respectively. The lead concentrations in these seven samples were relatively consistent.

Mercury

Mercury was detected at concentrations above the DWQS of 2.0 ug/L in only one sample. The Phase II groundwater sample from MW-28 had 2.3 ug/L mercury.

Nickel

The 95th UCL for the mean nickel concentration in groundwater from the background wells is 15.5 ug/L. There were 36 samples with nickel above this limit. Nickel concentrations from the Phase I samples are believed to not be representative of the groundwater quality. Groundwater samples were obtained during the Phase I and Phase II programs from 17 wells where the Phase I concentration was greater than 15.5 ug/L. In all but one data pair, the Phase II concentrations were less than half of the Phase I concentrations. In 12 sets of data, the Phase II concentrations were less than the detection limits. Nickel concentrations of the Phase II samples were variable over the site, though the nickel concentrations greater than 15.5 ug/L were generally located west of the Ash Landfill on the north side of West Smith Farm Road. The two highest concentration of 622 ug/L and 533 ug/L were at PT-26 and MW-56 respectively. This pattern of nickel concentrations is very similar to that of beryllium, chromium, and vanadium.

Selenium

Selenium was not detected in any of the groundwater samples from Phases I and II at concentrations above the DWQS of 10.0 ug/L.

Vanadium

The 95 percent upper confidence limit for the mean vanadium concentration in the background wells is 12.9 ug/L. There were 37 samples with vanadium above this limit. Vanadium concentrations from the samples obtained during Phase I are believed to not be representative of the groundwater quality. Groundwater samples were obtained during the Phase I and Phase II programs from 15 wells where the Phase I concentration was greater than 12.9 ug/L. In all but one data pair, the Phase II concentrations were less than half the Phase I concentrations. In 10 sets of data, the Phase II concentrations were less than the detection limits. Vanadium concentrations of the Phase II samples were variable over the site, though the vanadium concentrations greater than 12.9 ug/L were generally located west of the Ash Landfill on the north side of West Smith Farm Road. The two highest concentrations of 358 ug/L and 317 ug/L were at PT-26 and MW-56 respectively. This pattern of vanadium concentrations is very similar to that of beryllium, chromium and nickel.

Zinc

Zinc was not detected in any of the groundwater samples from Phases I and II at concentrations above the DWQS of 5,000 ug/L.

4.4.9 Indicator Parameters

The results for the nine additional parameters tested for in well PT-17, PT-23, and MW-42D are presented in Table 4-7. Generally, most of the concentrations vary only slightly from well to well.

4.5 SURFACE WATER

Of the proposed surface water sample locations, only seven had water present at the time of sampling, SW-100, SW-300, SW-400, SW-800, SW-801, SW-WD and SW-WE. Sample locations are shown on Figure 2-9. A summary of analytes detected in these samples is presented in Table 4-8.

4.5.1 Volatile Organic Compounds

Of the seven surface water locations sampled and analyzed, only in one sample location, SW-400, was a volatile organic compound observed. The compound observed was chloroform and its concentration was estimated to be 2 ug/L. Chloroform was not detected in sample SW-300 located upstream of SW-400 or in any surrounding monitoring wells No other volatile organic compounds were detected in these samples.

4.5.2 Semi-Volatile Organic Compounds

No semi-volatile organic compounds were detected in any of the surface water samples, with the exception being the reference station (SW-801) on Kendaia Creek which contained 1 ug/L of di-n-butylphthalate and 3 ug/L of bis(2-ethylhexyl)phthalate.

TABLE 4 – 7

INDICATOR PARAMETERS IN GROUNDWATER(mg/L)

SENECA ARMY DEPOT
ASH LANDFILL

PARAMETER	MONITORINGWELLS PT–17 (TILL/WEATHEREDSHALE)	 PT–23	 MW–42D (BEDROCK)
Biological Oxygen Demand	1.9	4.6	1.2
Alkalinity (as CaCO3)	234	220	280
Chloride	40	10.5	2.7
Sulfate	73	41	38
Total Hardness (as CaCO3)	322	346	308
Chemical Oxygen Demand	4.4	22	9.1
Total Dissolved Solids	405	282	600
Total Suspended Solids	180	2370	150
Total Organic Carbon	1.9	1.9	1.6

TABLE 4 – 8

SUMMARY OF COMPOUNDS DETECTED
SURFACE WATER

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	NYS CLASS C AWQS GUIDELINES (1)	NYS CLASS D AWQS GUIDELINES (1)	NUMBER ABOVE NYS CLASS C GUIDELINES	NUMBER ABOVE NYS CLASS D GUIDELINES	WATER SW–100 12/10/91 Wetland	WATER SW–300 11/15/91 Wetland	WATER SW–400 11/15/91 Wetland	WATER SW–800 11/16/91 Kendaia Crk	WATER SW–800 (Dup) 11/16/91 Kendaia Crk	(Upstream) WATER SW–801 4/17/94 Kendaia Crk	WATER SW–WD 12/09/92 Wetland	WATER SW–WE 12/09/92 Wetland
<u>VOCs (µg/L)</u>														
Chloroform	14.3%	2.00	NA	NA	NA	NA	5 U	5 U	2 J	5 U	5 U	10 U	10 U	10 U
<u>Metals (µg/L)</u>														
Aluminum	71.4%	2410.00	100	NA	4	NA	203 J	2410 J	97.8 U J	97.6 U J	97.4 U J	135 J	599	2370
Antimony	14.3%	141.00	NA	NA	NA	NA	53.2 U J	141 J	55.7 U J	55.6 U J	55.5 U J	1.0 U	54 U	53.9 U
Arsenic	28.6%	2.90	190	360	0	0	2.9 U J	3.7 U J	3.7 U J	3.7 U J	3.7 U J	1.5 U	2.9 J	1.3 J
Barium	100.0%	113.00	NA	NA	NA	NA	35.4 J	84.8 J	24.9 J	44.6 J	46.9 J	36.5 J	66.2 J	113 J
Beryllium	14.3%	1.20	1100	NA	NA	NA	1.2 J	1.2 U J	1.2 U J	1.2 U J	1.2 U J	0.06 U	0.3 U	0.3 U
Cadmium	0	NA	2.2	10.2	0	0	3 U J	2.9 U J	2.9 U J	2.9 U J	2.9 U J	0.10 U	3.1 U	3.1 U
Calcium	100.0%	165000.00	NA	NA	NA	NA	104000 J	125000 J	45800 J	71700 J	73400 J	74800 J	99300	165000
Chromium	42.9%	7.60	395	3466	0	0	6.2 U J	7.6 J	6.2 U J	6.2 J	6.1 U J	0.40 U	2 U	4.3 J
Cobalt	14.3%	6.90	5	NA	1	NA	20.4 U J	19.9 U J	19.9 U J	19.9 U J	19.8 U J	0.60 U	5 U	6.9 J
Copper	50.0%	21.70	24.3	39.2	0	0	15.7 J	14.5 U J	14.4 U J	14.4 U J	14.4 U J	1.3 J	R	21.7 J
Iron	71.4%	8750.00	300	300	3	3	218 J	2080 J	17 U J	17 U J	16.9 U J	196	8750	3080
Lead	33.3%	42.30	9.4	241	1	0	1.2 U J	R	0.7 U J	0.7 U J	0.7 U J	0.80 U	4.5	42.3
Magnesium	85.7%	16700.00	NA	NA	NA	NA	13200 J	11800 J	353 U J	9950 J	9960 J	11100	12800	16700
Manganese	71.4%	941.00	NA	NA	NA	NA	6.3 J	488 J	3.2 U J	3.2 U J	3.2 U J	52.8 J	941	860
Mercury	28.6%	0.15	0.2	0.2	0	0	0.08 U J	0.08 U J	0.08 U J	0.08 U J	0.08 U J	0.05 J	0.06 U	0.15 J
Nickel	14.3%	11.20	181	3502	0	0	14.7 U J	16 U J	15.9 U J	15.9 U J	15.9 U J	0.60 U	3.5 U	11.2 J
Potassium	100.0%	4690.00	NA	NA	NA	NA	828 J	3850 J	4690 J	1830 J	1650 J	1520 J	751 J	1740 J
Selenium	28.6%	3.40	1.0	NA	NA	NA	1 U J	1.7 U J	1.7 U J	1.7 U J	1.7 U J	1.7 U	1.1 J	3.4 J
Sodium	100.0%	2180000.00	NA	NA	NA	NA	9470 J	19400 J	2180000 J	83400 J	84200 J	13400	8200	13200
Vanadium	28.6%	16.30	14	190	1	0	16.3 J	30.5 U J	30.5 U J	30.4 U J	30.3 U J	0.70 U	2.1 U	5.2 J
Zinc	50.0%	187.00	30	647	2	0	28.6 U J	187 J	16.6 U J	13.4 U J	19.6 U J	2.2 J	R	133

<u>Notes:</u>
1) The New York State Ambient Water Quality Standards and Guidelines.
2) Hardness dependent values based on a calculated hardness of 232.5 mg/l at station SW–801.
3) N = Compound not analyzed for.
4) NA = Not Applicable.
5) R = Datum rejected during data validation process.

4.5.3 Pesticides and PCB's

No pesticides or PCBs were detected in any of the surface water samples.

4.5.4 Herbicides

No herbicides were detected in the surface water samples.

4.5.5 Metals and Cyanide

As shown in Table 4.8, a number of metals were detected in the surface water samples. Cyanide was not detected in any sample. The concentrations found in the surface water samples were compared to the Class "C" and Class "D" New York State Surface Water Quality Standards, since Kendaia Creek is a Class "D" surface water but may be reclassified to Class "C" in the near future. The on-site wetlands would likely be classified as Class "D". The standards for the hardness dependent values were calculated using a hardness of 232.5 mg/l. A value of 232.5 mg/l was derived from calcium and magnesium concentrations at the upstream surface water location in Kendaia Creek (SW-801) where:

$$\text{total hardness} = 2.5\,(Ca^{+2}) + 4.1\,(Mg^{+2})$$

and Ca^{+2} and Mg^{+2} concentrations are represented by 74.8 mg/l and 11.1 mg/l, respectively (Table 4-8).

Class "C" standards were available for a number of metals. Class "D" standards were available for arsenic, cadmium, chromium, copper, iron, lead, nickel, vanadium, and zinc. In total, there were 12 exceedances of the Class "C" standards and 3 of the Class "D" standards. All of the Class "C" exceedances were in the on-site wetlands or drainage ditches. There were no exceedences of the Class "C" standards in Kendaia Creek. The Class "D" exceedences were all for iron. The iron concentrations of 2,080 ug/L, 8,750 ug/L, and 3,080 ug/L in samples SW-300, SW-WD, and SW-WE respectively were above the 300 ug/L standard.

4.6 SEDIMENT

There are 16 sediment sample locations; SW-100, SW-200, SW-300, SW-400, SW-600, SW-700, SW-800, SW-801, SW-900, SW-901, SD-WA, SD-WB, SD-WC, SD-WD, SD-WE and

SD-WF. These locations are shown on Figure 2-9 (except SW-700, 800, 801 and 900). A summary of analytes detected in these samples is presented on Table 4-9.

4.6.1 Volatile Organic Compounds

Volatile organic compounds were detected in six of the sample locations. Compounds detected were acetone, 1,1-DCE, 1,2-DCE (total), chloroform and TCE. Five of the six sample locations contained only chloroform or acetone, which were likely introduced by the

TABLE 4 - 9

SUMMARY OF COMPOUNDS DETECTED - SEDIMENT

SENECA ARMY DEPOT ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	NYSDEC SEDIMENT CRITERIA FOR AQUATIC LIFE (1)	NUMBER OF SAMPLES ABOVE NYSDEC SEDIMENT CRITERIA	SW-100 11/15/91	SW-100 DUPLICATE 11/15/91	SW-100 12/10/91	SW-200 11/15/91	SW-300 11/15/91	SW-400 11/15/91	SW-600 11/16/91
<u>VOCs (µg/kg)</u>											
Acetone	25.0%	19	-	NA	15 U	13 U	21 U	16 U	18 U	22 U	14 U
1,1-Dichloroethene	6.3%	18	-	NA	8 U	6 U	10 U	8 U	9 U	11 U	7 U
1,2-Dichloroethene (total)	6.3%	640	-	NA	8 U	6 U	10 U	8 U	9 U	11 U	7 U
Chloroform	6.3%	6	-	NA	8 U	6 U	10 U	8 U	9 U	6 J	7 U
Trichloroethene	6.3%	11	-	NA	8 U	6 U	10 U	8 U	9 U	11 U	7 U
<u>Semivolatiles (µg/kg)</u>											
Phenol	6.3%	36	6 (2)	1	1000 U	1200 U	N	1100 U	1100 U	1200 U	880 U
4-Methylphenol	12.5%	120	6 (2)	1	1000 U	1200 U	N	1100 U	1100 U	1200 U	880 U
Naphthalene	6.3%	22	-	NA	1000 U	1200 U	N	1100 U	1100 U	1200 U	880 U
2-Methylnaphthalene	6.3%	30	-	NA	1000 U	1200 U	N	1100 U	1100 U	1200 U	880 U
Acenaphthylene	18.8%	170	-	NA	1000 U	1200 U	N	1100 U	1100 U	1200 U	120 J
2,4-Dinitrotoluene	6.3%	100	-	NA	1000 U	1200 U	N	1100 U	1100 U	1200 U	880 U
Fluorene	6.3%	20	-	NA	1000 U	1200 U	N	1100 U	1100 U	1200 U	880 U
N-Nitrosodiphenylamine	6.3%	55	-	NA	1000 U	1200 U	N	1100 U	1100 U	1200 U	880 U
Phenanthrene	50.0%	1200	1390	0	1000 U	1200 U	N	1100 U	1100 U	270 J	720 J
Anthracene	31.3%	270	-	NA	1000 U	1200 U	N	1100 U	1100 U	1200 U	180 J
Carbazole	18.8%	97	-	NA			N				
Di-n-butylphthalate	18.8%	21	1197 (3)	0	1000 U	1200 U	N	1100 U	1100 U	1200 U	880 U
Fluoranthene	81.3%	7400	-	NA	120 J	1200 U	N	1100 U	130 J	830 J	5500
Pyrene	81.3%	6700	-	NA	94 J	1200 U	N	130 J	180 J	740 J	4400
Benzo(a)anthracene	62.5%	4900	-	NA	1000 U	1200 U	N	1100 U	97 J	410 J	3300
Chrysene	62.5%	5300	-	NA	1000 U	1200 U	N	1100 U	130 J	520 J	3600
bis(2-Ethylhexyl)phthalate	18.8%	4300	1197 (3)	0	1000 U	1200 U	N	100 J	210 J	1200 U	880 U J
Benzo(b)fluoranthene	56.3%	4500	-	NA	1000 U	1200 U	N	1100 U	1100 U	450 J	3100
Benzo(k)fluoranthene	56.3%	3700	-	NA	1000 U	1200 U	N	1100 U	97 J	450 J	2400
Benzo(a)pyrene	62.5%	3900	-	NA	1000 U	1200 U	N	1100 U	110 J	460 J	2600
Indeno(1,2,3-cd)pyrene	43.8%	2400	-	NA	1000 U	1200 U	N	1100 U	1100 U	340 J	1700
Dibenz(a,h)anthracene	18.8%	1300	-	NA	1000 U	1200 U	N	1100 U	1100 U	160 J	690 J
Benzo(g,h,i)perylene	37.5%	2300	-	NA	1000 U	1200 U	N	1100 U	1100 U	340 J	1600

TABLE 4 – 9

SUMMARY OF COMPOUNDS DETECTED – SEDIMENT

SENECA ARMY DEPOT ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	NYSDEC SEDIMENT CRITERIA FOR AQUATIC LIFE (1)	NUMBER OF SAMPLES ABOVE NYSDEC SEDIMENT CRITERIA	SW–100 11/15/91	SW–100 DUPLICATE 11/15/91	SW–100 12/10/91	SW–200 11/15/91	SW–300 11/15/91	SW–400 11/15/91	SW–600 11/16/91
Pesticides / PCBs (µg/kg)											
4,4'–DDE	31.3%	63	500	0	50 U	60 U	N	51 U	51 U	63	43 U
Endrin	6.3%	2	10.4	0	50 U	60 U	N	51 U	51 U	57 U	43 U
4,4'–DDD	6.3%	2	500	0	50 U	60 U	N	51 U	51 U	57 U	43 U
Endosulfan sulfate	6.3%	3	–	NA	50 U	60 U	N	51 U	51 U	57 U	43 U
4,4'–DDT	6.3%	2	500	0	50 U	60 U	N	51 U	51 U	57 U	43 U
alpha–Chlordane	18.8%	4	0.06	3	250 U	300 U	N	260 U	250 U	290 U	210 U
Aroclor–1260	6.3%	54	–	NA	500 U	600 U	N	510 U	510 U	570 U	430 U
Metals (mg/kg)											
Aluminum	100.0%	20900	–	NA	17400	17400	N	14200	7340	12100	17400
Antimony	6.3%	11	–	NA	13.9 U	10.8 J	N	12.9 U	9.1 U	11.1 U	9.4 U
Arsenic	100.0%	12	5	11	3	3.5	N	7.9	3.4	8.7	8
Barium	100.0%	227	–	NA	129	126	N	110	52.7	79	157
Beryllium	100.0%	1	–	NA	1.1 J		N	0.9 J	0.45 J	0.75 J	1.1
Cadmium	68.8%	4	2.5	6	3.5	3.3	N	2.3	2	2.3	3
Calcium	100.0%	229000	–	NA	10600	13600	N	11400	229000	37300	9860
Chromium	100.0%	33	26	4	26	25.4	N	20.7	13.2	21.8	26.5
Cobalt	93.8%	17	–	NA	8.7 J	11.7	N	7.8 J	6.6 J	9.1 J	11.7
Copper	100.0%	59	19	16	58	58.6	N	41.2	14.9	31.2	39.2
Iron	100.0%	36800	24,000	10	26300	27900	N	23600	16200	22900	33100
Lead	100.0%	219	27	12	85.4	100	N	26.7	23.9	63.7	219
Magnesium	100.0%	14900	–	NA	5000	5250	N	4790	7240	11000	5460
Manganese	100.0%	1050	428	11	466	511 J	N	462	1040	383	837
Mercury	75.0%	1	0.11	4	0.11 J	0.08	N	0.1 J	0.06 J	0.12 J	0.12
Nickel	100.0%	46	22	16	28.1	28	N	24.8	22	32	29.6
Potassium	100.0%	2510	–	NA	2150	1670	N	2020	750 J	1740	1850
Selenium	43.8%	1	–	NA	0.66 J	0.52 J	N	2 U	0.48 U	0.39 U	0.38 U
Silver	18.8%	1	–	NA	2.1 U	0.69	N	2.1 U	1.5 U	1.8 U	1.5 U
Sodium	68.8%	195	–	NA	106 U	106	N	74.6 U	140 J	97.9 J	54.4 U
Thallium	6.3%	1	–	NA	0.71 U	0.52	N	0.65 U	0.78 U	0.65 U	0.62 U
Vanadium	100.0%	31	–	NA	26.1	23.6	N	23.1	10.7	21.8	29
Zinc	100.0%	834	85	17	495	523	N	144	276	661	448
Cyanide	18.8%	1	–	NA	0.86 U	0.89	N	0.92 U	0.85 U	1 U	0.7 U

TABLE 4 - 9

SUMMARY OF COMPOUNDS DETECTED - SEDIMENT

SENECA ARMY DEPOT ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	NYSDEC SEDIMENT CRITERIA FOR AQUATIC LIFE (1)	NUMBER OF SAMPLES ABOVE NYSDEC SEDIMENT CRITERIA	SW-600 DUPLICATE 11/16/91	SW-700 11/20/91	SW-700 11/20/91	SW-800 11/16/91	SW-801 4/17/94	SW-900 11/21/91	SW-900 11/20/91
VOCs (µg/kg)											
Acetone	25.0%	19	–	NA	13 U	14 U	N	N	34 J	N	54 U
1,1-Dichloroethene	6.3%	18	–	NA	7 U	7 U	N	N	20 U	N	16 U
1,2-Dichloroethene (total)	6.3%	640	–	NA	7 U	7 U	N	N	20 U	N	16 U
Chloroform	6.3%	6	–	NA	7 U	7 U	N	N	20 U	N	16 U
Trichloroethene	6.3%	11	–	NA	7 U	7 U	N	N	20 U	N	16 U
Semivolatiles (µg/kg)											
Phenol	6.3%	36	6 (2)	1	940 U	940 U	480 U	760 U	36 J	2100 U J	1100 U
4-Methylphenol	12.5%	120	6 (2)	1	940 U	940 U	480 U	760 U	120 J	2100 U J	100 J
Naphthalene	6.3%	22	–	NA	940 U	940 U	480 U	760 U	630 U	2100 U J	1100 U
2-Methylnaphthalene	6.3%	30	–	NA	940 U	940 U	480 U	760 U	630 U	2100 U J	1100 U
Acenaphthylene	18.8%	170	–	NA	170 J	940 U	480 U	760 U	630 U	2100 U J	1100 U
2,4-Dinitrotoluene	6.3%	100	–	NA	940 U	940 U	480 U	760 U	630 U	2100 U J	1100 U
Fluorene	6.3%	20	–	NA	940 U	940 U	480 U	760 U	630 U	2100 U J	1100 U
N-Nitrosodiphenylamine	6.3%	55	–	NA	940 U	940 U	480 U	760 U	630 U	2100 U J	1100 U
Phenanthrene	50.0%	1200	1390	0	1200	940 U	480 U	760 U	71 J	2100 U J	1100 U
Anthracene	31.3%	270	–	NA	270 J	940 U	480 U	760 U	630 U	2100 U J	1100 U
Carbazole	18.8%	97	–	NA							
Di-n-butylphthalate	18.8%	21	1197 (3)	0	940 U	940 U	480 U	760 U	80 J	2100 U J	1100 U
Fluoranthene	81.3%	7400	–	NA	7400	940 U	95 J	78 J	130 J	2100 U J	1100 U
Pyrene	81.3%	6700	–	NA	6700	940 U	110 J	760 U	160 J	2100 U J	1100 U
Benzo(a)anthracene	62.5%	4900	–	NA	4900	940 U	59 J	760 U	630 U	2100 U J	1100 U
Chrysene	62.5%	5300	–	NA	5300	940 U	84 J	760 U	96 J	2100 U J	1100 U
bis(2-Ethylhexyl)phthalate	18.8%	4300	1197 (3)	0	4300 J	940 U	480 U	760 U	38 J	2100 U J	1100 U
Benzo(b)fluoranthene	56.3%	4500	–	NA	4500	940 U	80 J	760 U	130 J	2100 U J	1100 U
Benzo(k)fluoranthene	56.3%	3700	–	NA	3700	940 U	66 J	760 U	70 J	2100 U J	1100 U
Benzo(a)pyrene	62.5%	3900	–	NA	3900	940 U	71 J	760 U	95 J	2100 U J	1100 U
Indeno(1,2,3-cd)pyrene	43.8%	2400	–	NA	2400	940 U	480 U	760 U	87 J	2100 U J	1100 U
Dibenz(a,h)anthracene	18.8%	1300	–	NA	1300	940 U	480 U	760 U	630 U	2100 U J	1100 U
Benzo(g,h,i)perylene	37.5%	2300	–	NA	2300	940 U	480 U	760 U	630 U	2100 U J	1100 U

TABLE 4 - 9

SUMMARY OF COMPOUNDS DETECTED - SEDIMENT

SENECA ARMY DEPOT ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	NYSDEC SEDIMENT CRITERIA FOR AQUATIC LIFE (1)	NUMBER OF SAMPLES ABOVE NYSDEC SEDIMENT CRITERIA	SW-600 DUPLICATE 11/16/91	SW-700 11/20/91	SW-700 11/20/91	SW-800 11/16/91	SW-801 4/17/94	SW-900 11/21/91	SW-900 11/20/91
Pesticides / PCBs (µg/kg)											
4,4'-DDE	31.3%	63	500	0	45 U	46 U	N	37 U	6.3 U	100 U	46 U
Endrin	6.3%	2	10.4	0	45 U	46 U	N	37 U	6.3 U	100 U	46 U
4,4'-DDD	6.3%	2	500	0	45 U	46 U	N	37 U	6.3 U	100 U	46 U
Endosulfan sulfate	6.3%	3	-	NA	45 U	46 U	N	37 U	6.3 U	100 U	46 U
4,4'-DDT	6.3%	2	500	0	45 U	46 U	N	37 U	6.3 U	100 U	46 U
alpha-Chlordane	18.8%	4	0.06	3	230 U	230 U	N	180 U	3.3 U	510 U	230 U
Aroclor-1260	6.3%	54	-	NA	450 U	460 U	N	370 U	63 U	1000 U	460 U
Metals (mg/kg)											
Aluminum	100.0%	20900	-	NA	20900	12700 J	N	13500	14900	13900 J	N
Antimony	6.3%	11	-	NA	12.6 U	11.8 U J	N	11.3 U	0.22 U	35.4 U J	N
Arsenic	100.0%	12	5	11	10.5	7.3 J	N	5.7	4.9	9 J	N
Barium	100.0%	227	-	NA	227	120 J	N	81.8	86.9	139 J	N
Beryllium	100.0%	1	-	NA	1.2	0.73 J	N	0.81 J	0.71 J	1.1 J	N
Cadmium	68.8%	4	2.5	6	3.9	2.4 J	N	4.1	0.50 J	2.5 J	N
Calcium	100.0%	229000	-	NA	14200	46900 J	N	42900	70500	105000 J	N
Chromium	100.0%	33	26	4	33.4	21.3 J	N	22.8	23.7	22.6 J	N
Cobalt	93.8%	17	-	NA	12.9	12.5 J	N	17	11.6	12.7 U J	N
Copper	100.0%	59	19	16	43	22.6 J	N	16.7	23.1	24.3 J	N
Iron	100.0%	36800	24,000	10	36400	28200 J	N	36800	27600	23900 J	N
Lead	100.0%	219	27	12	197	37.3 J	N	8.5	20	21.5 J	N
Magnesium	100.0%	14900	-	NA	6400	14900 J	N	7090	12100	6280 J	N
Manganese	100.0%	1050	428	11	999	913 J	N	1050	735	447 J	N
Mercury	75.0%	1	0.11	4	0.07 J	0.05 U J	N	0.04 U	0.05 J	0.12 U J	N
Nickel	100.0%	46	22	16	35.8	27.9 J	N	37.8	32.2	22.8 J	N
Potassium	100.0%	2510	-	NA	2510	1470 J	N	975 J	2340 J	1690 J	N
Selenium	43.8%	1	-	NA	2.1 U	1.8 U J	N	0.27 U	0.37 U	0.95 U J	N
Silver	18.8%	1	-	NA	2 U	1.9 U J	N	1.7 U	0.15 U	5.8 U J	N
Sodium	68.8%	195	-	NA	80.2 J	68.3 U J	N	195 J	134 J	205 U J	N
Thallium	6.3%	1	-	NA	0.69 U	0.6 U J	N	0.45 U	0.35 U	1.6 U J	N
Vanadium	100.0%	31	-	NA	30.7	20.6 J	N	20.3	24.5	29.1 J	N
Zinc	100.0%	834	85	17	600	255 J	N	100	86.6	339 J	N
Cyanide	18.8%	1	-	NA	0.82 U	0.83 U J	N	0.65 U	0.81	1.9 U J	N

TABLE 4 - 9

SUMMARY OF COMPOUNDS DETECTED - SEDIMENT

SENECA ARMY DEPOT ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	NYSDEC SEDIMENT CRITERIA FOR AQUATIC LIFE (1)	NUMBER OF SAMPLES ABOVE NYSDEC SEDIMENT CRITERIA	SW-901 11/15/91	SD-WA 12/09/92	SD-WB 12/09/92	SD-WBRE 12/09/92	SD-WB1 DUPLICATE 12/09/92	SD-WB1RE DUPLICATE 12/09/92
VOCs (µg/kg)										
Acetone	25.0%	19	–	NA	N	16 U	34 U	N	9 J	N
1,1-Dichloroethene	6.3%	18	–	NA	N	16 U	15 J	N	18	N
1,2-Dichloroethene (total)	6.3%	640	–	NA	N	16 U	640	N	590	N
Chloroform	6.3%	6	–	NA	N	4 J	34 U	N	13 U	N
Trichloroethene	6.3%	11	–	NA	N	16 U	11 J	N	7 J	N
Semivolatiles (µg/kg)										
Phenol	6.3%	36	6 (2)	1	930 U	440 U	430 UJ	440 UJ	470 UJ	470 UJ
4-Methylphenol	12.5%	120	6 (2)	1	930 U	440 U	430 UJ	440 UJ	470 UJ	470 UJ
Naphthalene	6.3%	22	–	NA	930 U	440 U	430 UJ	440 UJ	470 UJ	22 J
2-Methylnaphthalene	6.3%	30	–	NA	930 U	440 U	430 UJ	440 UJ	30 J	470 UJ
Acenaphthylene	18.8%	170	–	NA	930 U	440 U	430 UJ	18 J	72 J	30 J
2,4-Dinitrotoluene	6.3%	100	–	NA	930 U	440 U	430 UJ	440 UJ	470 UJ	470 UJ
Fluorene	6.3%	20	–	NA	930 U	440 U	430 UJ	440 UJ	470 UJ	470 UJ
N-Nitrosodiphenylamine	6.3%	55	–	NA	930 U	440 U	430 UJ	440 UJ	470 UJ	470 UJ
Phenanthrene	50.0%	1200	1390	0	99 J	440 U	64 J	86 J	220 J	180 J
Anthracene	31.3%	270	–	NA	930 U	440 U	430 UJ	19 J	62 J	37 J
Carbazole	18.8%	97	–	NA		440 U	430 UJ	440 UJ	45 J	48 J
Di-n-butylphthalate	18.8%	21	1197 (3)	0	930 U	440 U	430 UJ	440 UJ	470 UJ	470 UJ
Fluoranthene	81.3%	7400	–	NA	130 J	440 U	110 J	140 J	440 J	290 J
Pyrene	81.3%	6700	–	NA	140 J	440 U	100 J	160 J	420 J	300 J
Benzo(a)anthracene	62.5%	4900	–	NA	88 J	440 U	48 J	84 J	230 J	160 J
Chrysene	62.5%	5300	–	NA	120 J	440 U	64 J	100 J	300 J	190 J
bis(2-Ethylhexyl)phthalate	18.8%	4300	1197 (3)	0	100 J	440 U	430 UJ	440 UJ	470 UJ	470 UJ
Benzo(b)fluoranthene	56.3%	4500	–	NA	96 J	440 U	47 J	80 J	230 J	150 J
Benzo(k)fluoranthene	56.3%	3700	–	NA	930 U	440 U	52 J	80 J	220 J	150 J
Benzo(a)pyrene	62.5%	3900	–	NA	100 J	440 U	35 J	83 J	190 J	150 J
Indeno(1,2,3-cd)pyrene	43.8%	2400	–	NA	930 U	440 U	36 J	67 J	140 J	120 J
Dibenz(a,h)anthracene	18.8%	1300	–	NA	930 U	440 U	430 UJ	440 UJ	470 UJ	470 UJ
Benzo(g,h,i)perylene	37.5%	2300	–	NA	930 U	440 U	42 J	77 J	170 J	97 J

TABLE 4 - 9

SUMMARY OF COMPOUNDS DETECTED - SEDIMENT

SENECA ARMY DEPOT ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	NYSDEC SEDIMENT CRITERIA FOR AQUATIC LIFE (1)	NUMBER OF SAMPLES ABOVE NYSDEC SEDIMENT CRITERIA	SW-901 11/15/91	SD-WA 12/09/92	SD-WB 12/09/92	SD-WBRE 12/09/92	SD-WB1 DUPLICATE 12/09/92	SD-WB1RE DUPLICATE 12/09/92
Pesticides / PCBs (µg/kg)										
4,4'-DDE	31.3%	63	500	0	45 U	4.5 U	3.5 J	N	2.4 J	N
Endrin	6.3%	2	10.4	0	45 U	4.5 U	4.4 U	N	2.3 J	N
4,4'-DDD	6.3%	2	500	0	45 U	4.5 U	4.4 U	N	4.7 U	N
Endosulfan sulfate	6.3%	3	-	NA	45 U	4.5 U	2.1 J	N	2.7 J	N
4,4'-DDT	6.3%	2	500	0	45 U	4.5 U	4.4 U	N	4.7 UJ	N
alpha-Chlordane	18.8%	4	0.06	3	230 U	2.3 U	2.3 U	N	1.8 J	N
Aroclor-1260	6.3%	54	-	NA	450 U	45 U	44 U	N	47 U	N
Metals (mg/kg)										
Aluminum	100.0%	20900	-	NA	13000	14600	11900	N	11100	N
Antimony	6.3%	11	-	NA	15.4 U	11.6 UJ	8.7 UJ	N	9.5 UJ	N
Arsenic	100.0%	12	5	11	6.6	4.4 J	12.1 J	N	7.5 J	N
Barium	100.0%	227	-	NA	100	81.5	111	N	92.2	N
Beryllium	100.0%	1	-	NA	0.98 J	0.82 J	0.66 J	N	0.55 J	N
Cadmium	68.8%	4	2.5	6	2.6	0.66 U	0.5 U	N	0.55 U	N
Calcium	100.0%	229000	-	NA	24100	4770	12500	N	7640	N
Chromium	100.0%	33	26	4	24.1	22.5	22.6	N	19	N
Cobalt	93.8%	17	-	NA	8.8 J	10 J	9.2	N	8.1 J	N
Copper	100.0%	59	19	16	33.9	26.7	43.5	N	31.4	N
Iron	100.0%	36800	24,000	10	26800	26400	24000	N	18700	N
Lead	100.0%	219	27	12	31.3	19.2	91.9	N	59.4	N
Magnesium	100.0%	14900	-	NA	4920	4090	5050	N	3370	N
Manganese	100.0%	1050	428	11	340	591	429	N	396	N
Mercury	75.0%	1	0.11	4	0.05 J	0.02 U	0.1	N	0.08	N
Nickel	100.0%	46	22	16	28.3	29.4	28.3	N	21.8	N
Potassium	100.0%	2510	-	NA	1710	2110	1260	N	1390	N
Selenium	43.8%	1	-	NA	1.8 U	1 J	0.27 J	N	0.98 J	N
Silver	18.8%	1	-	NA	2.5 U	0.68 U	0.66 J	N	0.56 U	N
Sodium	68.8%	195	-	NA	89 U	63.9 U	90.5 J	N	58.7 J	N
Thallium	6.3%	1	-	NA	0.58 U	0.61 U	0.51 U	N	0.53 U	N
Vanadium	100.0%	31	-	NA	21.6	21.6	20	N	18.6	N
Zinc	100.0%	834	85	17	370	76	834	N	592	N
Cyanide	18.8%	1	-	NA	0.82 U	0.79 U	0.57 U	N	1	N

TABLE 4 - 9

SUMMARY OF COMPOUNDS DETECTED - SEDIMENT

SENECA ARMY DEPOT ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	NYSDEC SEDIMENT CRITERIA FOR AQUATIC LIFE (1)	NUMBER OF SAMPLES ABOVE NYSDEC SEDIMENT CRITERIA	SD-WC 12/09/92	SD-WCRE 12/09/92	SD-WD 12/09/92	SD-WE 12/09/92	SD-WERE 12/09/92	SD-WF 12/09/92
VOCs ($\mu g/kg$)										
Acetone	25.0%	19	-	NA	12 U	N	19	8 J	N	12 U
1,1-Dichloroethene	6.3%	18	-	NA	12 U	N	16 U	15 U	N	12 U
1,2-Dichloroethene (total)	6.3%	640	-	NA	12 U	N	16 U	15 U	N	12 U
Chloroform	6.3%	6	-	NA	12 U	N	16 U	15 U	N	12 U
Trichloroethene	6.3%	11	-	NA	12 U	N	16 U	15 U	N	12 U
Semivolatiles ($\mu g/kg$)										
Phenol	6.3%	36	6 (2)	1	380 UJ	380 UJ	670 U	500 UJ	500 UJ	380 U
4-Methylphenol	12.5%	120	6 (2)	1	380 UJ	380 UJ	670 U	500 UJ	500 UJ	380 U
Naphthalene	6.3%	22	-	NA	380 UJ	380 UJ	670 U	500 UJ	500 UJ	380 U
2-Methylnaphthalene	6.3%	30	-	NA	380 UJ	380 UJ	670 U	500 UJ	500 UJ	380 U
Acenaphthylene	18.8%	170	-	NA	380 UJ	380 UJ	670 U	500 UJ	500 UJ	380 U
2,4-Dinitrotoluene	6.3%	100	-	NA	380 UJ	380 UJ	670 U	500 UJ	100 J	380 U
Fluorene	6.3%	20	-	NA	20 J	380 UJ	670 U	500 UJ	500 UJ	380 U
N-Nitrosodiphenylamine	6.3%	55	-	NA	380 UJ	380 UJ	670 U	500 UJ	55 J	380 U
Phenanthrene	50.0%	1200	1390	0	170 J	28 J	670 U	68 J	260 J	68 J
Anthracene	31.3%	270	-	NA	30 J	380 UJ	670 U	500 UJ	65 J	12 J
Carbazole	18.8%	97	-	NA	32 J	380 UJ	670 U	500 UJ	97 J	380 U
Di-n-butylphthalate	18.8%	21	1197 (3)	0	380 UJ	380 UJ	21 J	500 UJ	500 UJ	16 J
Fluoranthene	81.3%	7400	-	NA	300 J	49 J	30 J	120 J	370 J	140 J
Pyrene	81.3%	6700	-	NA	240 J	56 J	25 J	98 J	410 J	110 J
Benzo(a)anthracene	62.5%	4900	-	NA	130 J	30 J	670 U	53 J	250 J	59 J
Chrysene	62.5%	5300	-	NA	150 J	38 J	670 U	69 J	250 J	84 J
bis(2-Ethylhexyl)phthalate	18.8%	4300	1197 (3)	0	380 UJ	380 UJ	670 U	500 UJ	500 UJ	200 J
Benzo(b)fluoranthene	56.3%	4500	-	NA	140 J	37 J	670 U	60 J	210 J	78 J
Benzo(k)fluoranthene	56.3%	3700	-	NA	140 J	37 J	670 U	61 J	200 J	70 J
Benzo(a)pyrene	62.5%	3900	-	NA	59 J	34 J	0 J	25 J	220 J	35 J
Indeno(1,2,3-cd)pyrene	43.8%	2400	-	NA	91 J	29 J	670 U	42 J	150 J	53 J
Dibenz(a,h)anthracene	18.8%	1300	-	NA	36 J	380 UJ	670 U	500 UJ	500 UJ	380 U
Benzo(g,h,i)perylene	37.5%	2300	-	NA	95 J	380 UJ	670 U	44 J	110 J	53 J

TABLE 4 - 9

SUMMARY OF COMPOUNDS DETECTED - SEDIMENT

SENECA ARMY DEPOT ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	NYSDEC SEDIMENT CRITERIA FOR AQUATIC LIFE (1)	NUMBER OF SAMPLES ABOVE NYSDEC SEDIMENT CRITERIA	SD-WC 12/09/92	SD-WCRE 12/09/92	SD-WD 12/09/92	SD-WE 12/09/92	SD-WERE 12/09/92	SD-WF 12/09/92
Pesticides / PCBs (µg/kg)										
4,4'-DDE	31.3%	63	500	0	4.5	N	6.8 U	4.5 J	N	20
Endrin	6.3%	2	10.4	0	3.8 U	N	6.8 U	4.9 U	N	3.8 U
4,4'-DDD	6.3%	2	500	0	3.8 U	N	6.8 U	4.9 U	N	1.7 J
Endosulfan sulfate	6.3%	3	-	NA	3.8 U	N	6.8 U	4.9 U	N	3.8 U
4,4'-DDT	6.3%	2	500	0	2.4 J	N	6.8 U	4.9 UJ	N	3.8 U
alpha-Chlordane	18.8%	4	0.06	3	3.6 J	N	3.5 U	1.6 J	N	2 U
Aroclor-1260	6.3%	54	-	NA	38 U	N	68 U	49 U	N	54
Metals (mg/kg)										
Aluminum	100.0%	20900	-	NA	12100	N	12400	11700	N	14100
Antimony	6.3%	11	-	NA	9.4 UJ	N	16.5 UJ	8.3 UJ	N	12.8 UJ
Arsenic	100.0%	12	5	11	3.5 J	N	2.2 J	3.5 J	N	5.4 J
Barium	100.0%	227	-	NA	55.1	N	95.8	98.6	N	51.6
Beryllium	100.0%	1	-	NA	0.53 J	N	0.54 J	0.63 J	N	0.61 J
Cadmium	68.8%	4	2.5	6	0.54 U	N	0.94 U	0.48 U	N	0.76 J
Calcium	100.0%	229000	-	NA	34600	N	13200	8940	N	18500
Chromium	100.0%	33	26	4	20.9	N	17.7	22	N	28.5
Cobalt	93.8%	17	-	NA	9.9	N	7.6 J	10.8	N	12.8
Copper	100.0%	59	19	16	27.4	N	26.9	44.1	N	39.1
Iron	100.0%	36800	24,000	10	23400	N	18900	26700	N	28300
Lead	100.0%	219	27	12	32.2	N	23.6	132	N	96.1
Magnesium	100.0%	14900	-	NA	5870	N	4290	4390	N	6680
Manganese	100.0%	1050	428	11	363	N	228 J	355	N	323
Mercury	75.0%	1	0.11	4	0.02 J	N	0.05 J	0.81	N	0.2
Nickel	100.0%	46	22	16	33.1	N	20	33.8	N	45.9
Potassium	100.0%	2510	-	NA	1370	N	1420 J	1050	N	1760
Selenium	43.8%	1	-	NA	0.89 J	N	1 J	0.97 J	N	0.83 J
Silver	18.8%	1	-	NA	0.56 U	N	0.98 U	0.63 J	N	0.76 U
Sodium	68.8%	195	-	NA	89.5 J	N	91.1 U	72 J	N	84.5 J
Thallium	6.3%	1	-	NA	0.56 U	N	0.73 U	0.64 U	N	0.59 U
Vanadium	100.0%	31	-	NA	19.4	N	19.2	18.5	N	21
Zinc	100.0%	834	85	17	155	N	143	200	N	366
Cyanide	18.8%	1	-	NA	0.67 U	N	1.2 U	0.81 U	N	0.67 U

Notes:
1) NYSDEC Sediment Criteria - 1989.
2) NYSDEC 1989 guidelines for total phenols.
3) NYSDEC 1989 guidelines for phthalates (bis(2-Ethylexyl)phthalate).
4) NA = Not Applicable
5) N = Compound not analyzed.
6) U = Compound not detected at the tabulated detection limit.
7) J = The reported value should be considered an estimate.
8) RE = Reextraction

laboratory. The remaining sample location in which volatile organic compounds were detected is SD-WB which was collected in wetland B, located just northeast of the bend-in-the-road area. Duplicate samples collected at this location (samples SD-WB and SD-WB1) contain 1,2-DCE (total) at concentrations of 640 ug/kg and 590 ug/kg, and trace amounts of 1,1-DCE and TCE. These results substantiate the soil vapor survey and soil boring results that showed soil areas near the bend in the road at the Ash Landfill to contain relatively high concentrations of TCE and 1,2-DCE.

4.6.2 Semi-Volatile Organic Compounds

Sixteen sediment locations were sampled and analyzed for semi-volatile organic compounds. One sample, SW-WA, contained no semi-volatiles. One sample, SW-600, which was collected off-site, contained quantifiable amounts of thirteen semi-volatile organics compounds principally polynuclear aromatic compounds. The duplicate sample collected at this location contained 14 semi-volatiles. The concentrations of total semi-volatiles detected at this location were 28,800 and 48,000 ug/kg (two samples analyzed). The source of semi-volatiles may be runoff from the railroad ties along the tracks 200 feet east of this sample location (wetland W-G), or from Smith Farm Road. It is not likely that these semi-volatiles are due to site activities. Trace amounts of semi-volatiles were detected in all of the remaining 14 sediment location samples at estimated concentrations. Nine of those 14 sample locations contained trace amounts of about ten semi-volatile compounds. The other five sample locations contained trace amounts of one to three semi-volatile compounds.

Only one sample, SW-600 (from the off-site sampling location), contained trace amounts of a semi-volatile compound at concentrations exceeding the NYSDEC sediment criteria for aquatic life. The compound, bis(2-ethylhexyl)phthalate was reported at 880 ug/kg and 4,300 ug/kg which averages to be twice the NYSDEC criteria concentration of 1197 ug/kg. Naphthalene was detected at a concentration above the NYSDEC criteria concentration in sample SD-WB1RE a re-extraction of SD-WB1 collected from sample location SD-WB. In three other analyses of the same sediment (SD-WB, SD-WBRE and SD-WB1) naphthalene was not detected.

4.6.3 Pesticides and PCBs

At three of the 16 sample locations quantifiable amounts of the pesticide 4,4'-DDE were detected at concentrations of 63 ug/kg, 4.5 ug/kg and 20 ug/kg. These were detected in samples SW-400 (at ditch along West Smith Farm Road), SD-WC (at Wetland C adjacent to the Ash Landfill) and SD-WF (at Wetland F near the abandoned incinerator building) respectively. These are relatively low concentrations that are one to two orders of magnitude below the NYSDEC criteria concentration for 4,4'-DDE of 500 ug/kg. Trace amounts of other pesticides (4,4'-DDT, 4,4'-DDD and alpha-Chlordane) were also estimated to be present SD-WC and SD-WF. Trace amounts of pesticides (4,4'-DDE, Endrin, Endosulfan sulfate and alpha-Chlordane) were estimated to be present at two other sample locations, SD-WB and SD-WE. These low concentrations are well below the NYSDEC criteria concentrations. The source is likely to be area runoff to these low-lying wetlands.

PCB was detected in one sample location only. The sample SD-WF contained 54 ug/kg of the PCB Aroclor 1260. This is from Wetland F near the abandoned incinerator building.

4.6.4 Herbicides

No herbicides were detected in any of the sediment samples.

4.6.5 Metals and Cyanide

In general, at all of the 16 sample locations the concentrations of aluminum, calcium, iron, magnesium and potassium are reflective of the soil and bedrock chemistry of the site. Of these five metals only iron has a NYSDEC sediment criteria for aquatic life assigned to it. That criteria of 24,000 mg/kg was exceeded at ten of the 16 sample locations (SW-100, SW-600 (off-site), SW-700, SW-800, SW-801, SW-901, SD-WA, SD-WB, SD-WE and SD-WF). In these instances the iron criteria was exceeded by 1 to 50 percent, with an average exceedance of 20 percent. The highest concentration was detected at the off-site location. The metals arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc that have NYSDEC criteria were exceeded to some extent in all 16 sample locations. Most of the excursions were relatively low, that is by a factor of two. However, some of the lead, and zinc excursions were up to 8 and 9 times the NYSDEC criteria. This is the case for the off-site sample SW-600 (lead at 219 mg/kg) and SD-WB (zinc at 834 mg/kg). No NYSDEC sediment criteria exist for the metals antimony, barium, beryllium, cobalt, selenium, silver, sodium, thallium and vanadium. No anomalous concentrations of this group of metals were observed and therefore no further consideration has been give to these metals in the sediment samples.

A trace concentration of cyanide was detected in one of the SW-100 samples (at a concentration near the detection limit) and undetected in the duplicate, and therefore this compound is not considered further at this time.

4.7 DUST WIPES

4.7.1 Semi-Volatile Organic Compounds

Only two estimated concentrations of two semi-volatile organic compounds were detected in the samples. Benzoic acid (3 ug/wipe) and dimethylphthalate (16 ug/wipe) were detected in DW1206-1 and dimethylphthlate (7 ug/wipe) was detected in DW1206-2 (Table 4-10). A two square foot area was wiped to collect these samples.

4.7.2 Pesticides and PCBs

No pesticides or PCBs were detected in either of the samples (Table 4-10). A two square foot area was wiped to collect these samples.

4.7.3 Metals

Metals results are presented in Table 4-10. Elevated (relative to the other sample) concentrations of antimony and lead are present in DW1206-1. Additionally, DW1206-2 contained elevated barium, copper, iron, manganese, silver and sodium. A one square foot area was wiped to collect these samples.

TABLE 4 – 10

SUMMARY OF COMPOUNDS DETECTED
DUST WIPE

SENECA ARMY DEPOT
ASH LANDFILL

	FREQUENCY OF DETECTION	MAXIMUM DETECTED	WIPE 12/07/91 DW1206-1	WIPE 12/07/91 DW1206-2
Semivolatiles ($\mu g/wp$)				
Benzoic acid	100.0%	3	3 J	
Dimethylphthalate	100.0%	16	16 J	7 J
Metals ($\mu g/wp$)				
Aluminum	100.0%	23400	10600	23400
Antimony	50.0%	90	90	11.2 U
Arsenic	100.0%	4.3	4.3	3.9
Barium	100.0%	351	64.2	351
Cadmium	100.0%	14.9	14.9	10.6
Calcium	100.0%	21700	17500	21700
Chromium	100.0%	65.2	44.8	65.2
Cobalt	100.0%	11.6	6 J	11.6
Copper	100.0%	190	67	190
Iron	100.0%	11600	2070	11600
Lead	100.0%	3020	3020	454
Magnesium	100.0%	3900	2340	3900
Manganese	100.0%	888	104	888
Mercury	100.0%	1.8	0.75	1.8
Nickel	100.0%	29.5	10.6	29.5
Potassium	100.0%	3960	1540	3960
Selenium	100.0%	1.8	1.8	0.4 J
Silver	100.0%	8.2	1.6 J	8.2
Sodium	100.0%	4990	716 J	4990
Vanadium	100.0%	22	7.7 J	22
Zinc	100.0%	1340	1340	1150

U = Compound not detected at tabulated detection limit.
J = The reported value should be considered estimated.

5.0 CONTAMINANT FATE AND TRANSPORT

5.1 CONCEPTUAL SITE MODEL

5.1.1 Physical Site Characterization

The 130-acre Ash Landfill site is located in the southwest portion of SEDA. The site currently consists of an abandoned incinerator building and stack, a former cooling pond, an Ash Landfill, and a nearby Non-Combustible Fill Landfill. The site is bounded on the north by Cemetery Road, on the east by a SEDA railroad line, on the south by undeveloped SEDA land, and on the west by the depot's boundary. Beyond the depot's western boundary are farm residences on Smith Farm Road and along Route 96A. Sampson State Park near Seneca Lake is further to the west.

The Ash Landfill was previously used by the Army for disposal of ash produced from the incineration of solid waste (trash) at the depot. A separate, abandoned Non-Combustible Fill Landfill, which is part of the site, is located east of the incinerator building across West Smith Farm Road. The Non-Combustible Fill Landfill was the repository of materials which could not be combusted in the incinerator. Annual rainfall is approximately 30 inches and surface water drainage flows eastward into Seneca Lake via several drainage ditches and small creeks, including Kendaia Creek. Overall site relief is low, approximately 40 feet in 1,800 feet (approximately 2%).

The surficial geologic deposits at the site are composed of glacial till. The till has a high clay percentage and a variable distribution of sand and gravel present within it. The thickness of the till does not exceed 20 feet anywhere at the site. The till ranges in composition from a dense, clay rich till to a sandy gravel till although there does not appear to be any consistent pattern to this variation in geology across the site. This variation in composition also leads to variable hydraulic conductivities at the site.

Black fissile shale (±500 feet thick), with small interbedded limestone layers, is the bedrock. The shale has been relatively unaffected by tectonic events as evidenced by the shallow dip of bedding of approximately 35 feet per mile towards the south. Generally, the upper 3 to 5 feet of shale is highly weathered as a result of glaciation and normal erosion. At other nearby sites where bedrock was cored, the RQD's for core samples taken from the upper 5 to 8 feet of shale were generally less than 5%. The tectonically undisturbed nature of the shales in this area reduces the potential of vertical migration of shallow groundwater into deeper (> 100 feet) aquifers.

Two distinct geologic units exist in the Ash Landfill area which store and transmit groundwater. These include the glacial till, including the weathered shale immediately below the till, and the underlying competent shales and limestone. The glacial till and the weathered shale behave as a single unconfined hydrological unit. Groundwater flow within the shallow, unconfined aquifer present within the glacial till and weathered shale tends to follow surface water drainage which moves westward towards Seneca Lake as described in Section 3. Measured hydraulic conductivities of the glacial tills and the weathered shale fall within a broad range, indicative of the poorly sorted nature of these deposits. The groundwater at the Ash Landfill has been classified by NYSDEC as GA. The best usage of class GA waters is as a source of potable water supply. Class GA waters are fresh groundwater found in the saturated zone of unconsolidated deposits and consolidated rock or bedrock.

The fate and transport of the constituents of concern is influenced by the interaction with precipitation, the recharge to groundwater and the migration with groundwater. Moisture content in the vadose zone of soil can also influence the rate of biological decomposition and the rate of volatilization. Accordingly, understanding the water balance of the site is helpful in evaluating the contaminant fate and transport at the Ash Landfill. A water balance was developed for this site using the rational method described in *Use of the Water Balance Method for Predicting Leachate Generation from Solid Waste Disposal Sites* (EPA, 1975). This procedure calculates the percolation of pore water to groundwater as recharge. Recharge is the difference between the amount of water that infiltrates into the ground minus the actual evapotranspiration and any changes in soil moisture. Infiltration is the difference between precipitation and runoff. The results of these calculations are summarized in Table 5-1.

The potential evapotranspiration (PET), was estimated using the procedure described by C.W. Thornthwaite and J.R. Mather in *Publications In Climatology, Volume X, Number 3; Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance, (1957).* Evapotranspiration is an estimate of the amount of water which is released from the site through both evaporation and plant uptake (transpiration). The methodology begins by determining the Heat Index, which is obtained from either Table 1 or 2 of the Thornthwaite and Mather document. Mean monthly temperature data was obtained from the nearby meteorological station, the Aurora Research Farm, which is operated by Cornell University.

TABLE 5 – 1

MONTHLY WATER BALANCE

SENECA ARMY DEPOT
ASH LANDFILL

Line #	*Parameter*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
1	**Mean Temp. (°F)**	22.5	23.4	32.0	44.8	54.5	64.6	69.1	66.9	60.6	50.4	39.4	27.9	46.3
2	**Heat Index**	0	0	0	1.7	4.0	7.0	8.5	7.8	5.8	2.9	0.7	0.0	38.4
3	**Unadj. PET (in)**	0.000	0.000	0.000	0.039	0.079	0.118	0.134	0.126	0.102	0.063	0.024	0.000	
4	**Corr. Factor**	24.6	24.6	30.9	33.6	37.8	38.1	38.4	35.7	31.2	28.5	24.6	23.7	
5	**Adj. PET (in)**	0.0	0.0	0.0	1.3	3.0	4.5	5.1	4.5	3.2	1.8	0.6	0.0	24.0
6	**P (in)**	1.88	2.16	2.45	2.86	3.17	3.70	3.46	3.18	2.95	2.80	3.15	2.57	34.3
7	**Corr. P (in)**	0	0	7.1	4.8	3.2	3.7	3.5	3.2	3.0	2.8	3.2	0	34.3
8	**C R/O**	0.22	0.22	0.22	0.22	0.20	0.18	0.18	0.18	0.18	0.18	0.20	0.22	
9	**R/O (in)**	0.0	0.0	1.6	1.1	0.6	0.7	0.6	0.6	0.5	0.5	0.6	0.0	6.8
10	**I (in)**	0.0	0.0	5.5	3.8	2.5	3.0	2.8	2.6	2.4	2.3	2.5	0.0	27.5
11	**I−PET(in)**	0.0	0.0	5.5	2.5	−0.4	−1.5	−2.3	−1.9	−0.8	0.5	1.9	0.0	3.5
12	**neg (I−PET)**					−0.4	−1.9	−4.2	−6.1	−6.9				
13	**ST (in)**	3.1	3.1	3.9	3.9	3.5	2.4	1.3	0.8	0.7	1.2	3.1	3.1	
14	**delta ST (in)**	0.0	0.0	0.8	0.0	−0.4	−1.1	−1.1	−0.5	−0.1	0.5	1.9	0.0	
15	**AET (in)**	0.0	0.0	0.0	1.3	3.0	4.1	3.9	3.1	2.5	1.8	0.6	0.0	20.4
16	**PERC (in)**	0.0	0.0	4.7	2.5	0.0	0.0	0.0	0.0	−0.0	0.0	0.0	0.0	7.1

References:

1. Thornthwaite and Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance.
2. EPA, 1975. Use of the Water Balance Method for Predicting Leachate Generation from Solid Waste Disposal Sites.

Notes:

1. Mean temperatures (from Table 3.1, Section 3, of this report)
2. Heat index values (from Tables 1 and 2 of Thornthwaite and Mather, 1957)
3. PET = Potential Evapotranspiration (from Tables 3 and 4 of Thornthwaite and Mather, 1957)
4. Correction factors (from Table 6 of Thornthwaite and Mather, 1957)
5. Adj. PET = Unadj. PET times Correction Factor
6. P = Precipitation (from Table 3.1, Section 3, of this report)
7. Corr. P = Corrected precipitation (rain + melting snow)
8. C R/O = Surface Runoff Coefficient (from EPA, 1975)
9. R/O = Surface Runoff
10. I = Infiltration
11. I−PET = Infiltration minus Potential Evapotranspiration
12. neg (I−PET) = Accumulated Potential Water Loss
13. ST = Soil Moisture Storage (Maximum value of 3.9" obtained from Table 10 of Thrornthwaite and Mather, 1957., Other values obtained from Table 9 of EPA, 1975.)
14. delta ST = Change in Storage
15. AET = Actual evapotranspiration
16. PERC = Percolation

The data is shown on Line 1 on Table 5-1. The monthly Heat Indexes are shown on Line 2 of Table 5-1. Heat Indexes are zero when the mean monthly temperature is less than 32°F. From the sum of the monthly Heat Indexes, the unadjusted potential evapotranspiration is obtained from either Table 3 or 4 of the Thornthwaithe and Mather document. The unadjusted potential evapotranspiration values are presented on Line 3 of Table 5-1. To change the unadjusted values of potential evapotranspiration into the adjusted monthly potential evapotranspiration, multiply the unadjusted values by a correction factor. The correction factor is expressed in terms of a 12-hour day, which provides an indication of the duration of sunlight for a particular month. Correction factors for the unadjusted potential evapotranspiration are obtained from Table 6 of the same document and depend upon the latitude of the site. This value is presented on Line 4 of Table 5-1. The adjusted Potential Evapotranspiration (PET) is then calculated as the product of Lines 3 and 4 of Table 5-1.

Although site specific precipitation data was not available, monthly precipitation values from the Aurora Research Farm was used. A comprehensive discussion of the weather data is presented in Table 3-1, and discussed in Section 3 of this report.

When the mean monthly temperatures are below 32° F the monthly precipitation values were then corrected to account for precipitation as snowfall in the months of December through March. It was assumed that all of the snowfall remained on the ground as snow, with no evaporation, infiltration, or runoff until March when the snow began to melt. It was also assumed that 60% of the snow (the total precipitation for December, January, and February) melted in March, and therefore entered the water balance as precipitation in addition to the normal monthly precipitation for March. The remaining 40% of the accumulated snowfall was assumed to melt in April.

The total monthly precipitation was then adjusted to account for the percent of water which runs off as overland flow. Line 8, in Table 5-1, contains the Runoff Coefficient, C_{RO}. This coefficient is a measure of the amount of precipitation that will runoff from any given area, and will depend on the soils, vegetation, and slopes found at a site. Generally, C_{RO} values range from 0.05 to 0.35 (EPA, 1975). At the Ash Landfill, the surface soils are primarily silty clay loams, as described in Section 1. Much of the area is covered with native grasses, though some of the road areas have no vegetative cover. The site slopes generally range from 1 to 3%. For these conditions, the C_{RO} values range from 0.13 (less than 2% slope) to 0.22 (2-7% slopes). Following EPA guidance (1975), a higher C_{RO} (0.22) was used for the cooler months, and a lower value (0.18) was used for the warmer months. For the transitional months, (May and November), a value of 0.20 was used.

Infiltration (I), Line 10, is calculated as the difference between the monthly corrected precipitation values, Line 7, and the calculated runoff values, Line 9. Infiltration (Line 10) minus the adjusted potential evapotranspiration values, Line 5, yields I-PET, Line 11. This value was used to assess periods of time when the soil moisture is decreasing. A positive value of I-PET indicates the amount which is available to increase soil moisture or percolate to groundwater. Negative values indicates that potential evapotranspiration exceeds infiltration and there is a net decrease in the soil moisture.

Soil moisture (ST) is a measurement of the available field moisture and is related to soil type. The available moisture is obtained as the difference between the field capacity, i.e. the point at which water will drain by gravity, and the wilting point, i.e. the point at which water is unavailable for plant uptake. For this site, the available soil maps, shown in Section 1 of this report, indicate the soil type to be a silty loam. From Table 10 of the Thornthwaite and Mather document. The field capacity for a silty loam is approximately 3.6 inches per foot of root zone. The wilting point for a silty loam is approximately 1.2 inches per foot of root zone. The available soil moisture (ST) is the difference of 3.6 and 1.2 inches per foot or 2.4 inches per foot of root zone. The *Soil Survey of Seneca County, New York,* (April 1972) indicates that the root zone for this area generally ranges from 18 to 24 inches. This analysis used 1.62 feet (19.4 inches) as the root zone, therefore, the ST value used in these calculations was 3.9 inches as shown on Line 13, which was the product of 2.4 inches per foot of root zone and 1.62 feet of root zone. This initial value is assigned to the last month having a positive value of I-PET, which is the month of April. In other words, the last month that the field capacity of the soil was achieved and drainage occurred was April and the value of 3.9 was set for this month. The water balance then proceeded to calculate the ST for the remaining months.

The Actual Evapotranspiration (AET), Line 15, is a calculated value only when the change in soil moisture is negative. The change is soil moisture is presented on Line 14. If the Heat Index, Line 2 is zero then the AET is also zero. In other words when the temperature is below freezing there is no AET. If the ST, Line 13, is equal to the field capacity, which is the maximum value ST can be, then the AET equals the Adjusted PET, Line 5. In other words, the AET is greatest when the soil moisture is maximum. When the change is soil moisture is negative, i.e. the soil moisture is decreasing, the AET is calculated as:

$$AET=PET+(I-PET-\Delta ST)$$

where: AET = Actual Evapotranspiration, Line 15,
PET = Adjusted Potential Evapotranspiration, Line 5,
I-PET = Infiltration minus Adjusted Potential Evapotranspiration, Line 11 and
Delta ST = Change in Soil Moisture, Line 14.

Percolation (PERC), Line 16, which is recharge to the groundwater, is calculated as the remainder when the change in soil moisture, Line 14, and the AET, Line 15, is subtracted from I, Line 10.

The results of the water balance analysis indicates that much of the runoff and almost all of the percolation (groundwater recharge) occur in March and April, during the snow melt period. There is continued runoff throughout the time period when the temperature stays above freezing, however, recharge is eliminated by the large amount of water that is released to the atmosphere through evapotranspiration. These estimates are consistent with observations made at the site regarding runoff and groundwater. During field operations, runoff was observed following any major rainfall event. This observation is consistent with expectations since the dense clay rich till soils prevent rapid infiltration. With respect to the groundwater, water levels measured in the spring have historically been the highest, with the levels dropping substantially throughout the summer months. Changes in water levels of three (3) to four (4) have been observed. During the late summer and early fall, the groundwater table is the lowest, in some instances the water level appears close to the top of the competent bedrock. Water levels measured in the winter have also been lower than those in the spring, indicating little or no recharge in the summer and fall.

Using the values developed from the water balance for annual runoff, 6.8 inches, and the surface area of the site, which is approximately 130 acres, the total annual amount of potential runoff is 74 acre-feet (24 million gallons) per year. Much of this flow is captured and diverted away from the site by the surface drainage swales which line the edges of the roads surrounding the site, while some is retained on-site in the freshwater wetlands and low spots.

5.1.2 Chemical Characterization

SEDA, constructed in 1941, has been owned by the United States Government and operated by the Department of the Army since this time. Prior to construction of the depot, the site was used for agricultural purposes.

From 1941 to 1974, trash was burned in a series of designated burning areas, east of the abandoned incinerator building (Building 2207). According to the interim final report, *Groundwater Contamination Survey No. 38-26-0868-88 (July 1987)*, during approximately this same period of time (1941 until the late 1950's or early 1960's) the ash from the refuse burning area was buried in the landfill.

The incinerator was built in 1974. Between 1974 and 1979, materials intended for disposal were transported to the incinerator. The incinerator was a multiple chamber, batch-fed 2,000 lb/hour capacity unit which burned rubbish and garbage.

Nearly all of the approximately 18 tons of refuse generated per week on the depot were incinerated. The source for the refuse was domestic waste from depot activities and family housing. Large items which could not be burned were disposed of at the non-combustible fill landfill.

Ashes and residues from the incinerator were temporarily disposed of in an unlined cooling pond immediately north of the incinerator building. The cooling pond consisted of an unlined depression approximately 50 feet in diameter and approximately 6 to 8 feet deep. When the pond filled (approximately every 18 months), the fly ash and residues were removed, transported, and buried in the adjacent landfill east of the cooling pond. The refuse was dumped in piles and occasionally spread and compacted. The active area of the Ash Landfill extended at least 500 north at the incinerator building near a bend in a dirt road, according to an undated aerial photograph taken of the incinerator during operation and presented in the *Installation Assessment of Seneca Army Depot, Report Number 157 (January 1980)*. Parallel grooves at the northernmost extent of the filled area are visible in the aerial view of the incinerator and adjacent fill area during active operation and indicate that the fill was spread using a bulldozer or similar equipment. The incinerator was destroyed by a fire on May 8, 1979, and the landfill was subsequently closed. The landfill was capped with native soils of various thicknesses but has not been closed with an engineered cover or cap.

Investigation of the Ash Landfill involving soil gas surveys, soil borings and monitoring wells indicates that the soil and groundwater has been impacted primarily by volatile organic compounds, PAHs and metals. The Ash Landfill soils contain volatiles, primarily TCE (up to 540,000 ug/kg) with lesser amounts of 1,2-DCE and vinyl chloride, PAHs (primarily at the surface, 0-2 feet), and several metals including copper (up to 146 mg/kg), lead (up to 669 mg/kg), mercury (up to 0.81 mg/kg) and zinc (up to 6,290 mg/kg). Groundwater in the area of the bend in the road at the north end of Ash Landfill contains up to 132,360 ug/L of total chlorinated volatile organic compounds. This area, as well as the area near well PT-18, are the source areas for the volatile organics detected in groundwater.

Several suspected solvent dumping areas immediately west of the Ash Landfill were identified as possible source areas of contamination on-site. None of these areas correspond to the exact locations of the sources identified in the Ash Landfill, but these areas were found to contain some volatile organics. They do not appear to be the main source areas based on the soil gas surveys, and the soil and groundwater analytical data.

Small burning pits located to the east of the incinerator building were identified as possible sources of contamination on-site. No evidence of contamination was found near these burning pits.

Several debris piles located to the north and northeast of the Ash Landfill were suspected to be sources of contamination on-site. These debris piles were areas where burning occurred and they were found to be impacted primarily at the surface by PAHs (up to one order of magnitude or more above the TAGM at the western most pile) and the metals copper (up to 836 mg/kg), lead (up to 2,890 mg/kg), mercury (up to 1.1 mg/kg), and zinc (up to 55,700 mg/kg).

A grease pit disposal area near the eastern boundary of the site was used for disposal of cooking grease. Subsurface investigation of this area involving soil borings and soil sampling did not provide evidence of contamination.

The approximately 2-acre Non-Combustible Fill Landfill southeast of the incinerator building (immediately south of the SEDA railroad line) was used as a disposal site for non-combustible materials including construction debris from 1969 until 1977. Subsurface investigation of this landfill using soil borings and soil sampling indicate that the landfill contains primarily PAHs with concentrations up to one order of magnitude more above the TAGM and the metals copper, lead, mercury and zinc at concentrations up to 311 mg/kg, 2,610 mg/kg, 1.2 mg/kg and 3,100 mg/kg, respectively.

5.2 CONTAMINANT PERSISTENCE

5.2.1 Overview

This section addresses the contaminant persistence (fate and transport) and focuses on volatile organic compounds, the primary constituents of concern at the Ash Landfill. Organic chlorinated chemicals associated with the Ash Landfill are TCE and the breakdown products of TCE, including cis- and trans- 1,2-dichloroethene, (1,2-DCE) 1,1-dichloroethene (1,1-DCE) and vinyl chloride. Since vinyl chloride is a gas at ambient temperatures, it is likely that the much of the degradation of TCE ends upon the formation of vinyl chloride, since it would be slowly released into the atmosphere.

The chemical/physical properties of these chemical constituents and the media (soil, sediment, surface water, and groundwater) which have been impacted are necessary to fully evaluate the fate and transport. Meaningful chemical-specific properties are solubility, volatility, degradability, and adsorptivity. These properties are discussed below. Table 5-2 summarizes the chemical specific properties of TCE and its breakdown products. Media specific properties include organic carbon content, porosity, moisture content, bulk density, groundwater velocity, and dispersivity.

Table 5-2 presents the information which will serve as a basis for predicting the likely environmental fate of the chlorinated substances at the Ash Landfill. The most volatile of the chlorinated compounds being examined at this site is vinyl chloride, with a vapor pressure of 2300 millimeters mercury (mm Hg) at 20°C. TCE has a vapor pressure of 59 mm Hg at 20°C. Consequently, volatilization represents a significant environmental pathway, provided that there is an ample amount of air space in the soil through which the vapor can migrate. Volatile constituents enter the air through void spaces in the soil above the saturated zone which may then leave the system through the ground surface.

An important chemical specific property which can be used to understand the potential for chemical migration is Henry's Law. At low concentrations and equilibrium, Henry's Law states that the concentration in the vapor phase is directly proportional to the concentration in the aqueous phase. The Henry's constant is the proportionality factor between the vapor

TABLE 5 – 2

SUMMARY OF FATE AND TRANSPORT PARAMETERS FOR ORGANIC COMPOUNDS OF CONCERN

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	SOLUBILITY (mg/l)	VAPOR PRESSURE (mmHg)	HENRY'S LAW CONSTANT (atm–m³/mol)	Koc (ml/g)	Kow	HALF – LIFE (days)	BCF
Volatile Organic Compounds							
1,2–Dichloroethene (total)	6300	5.3	6.60E–03	5.90E+01	1.23E+02		4.5
Trichloroethene	1100	75	9.10E–03	1.26E+02	2.40E+02	3–300	13–39
Vinyl Chloride	2670	2300	8.19E–02	5.70E+01	2.40E+01		
1,1–dichlorethene	2250	500	3.40E–02	6.50E+01	6.92E+01	53	
Semivolatile Organic Compounds							
Phenol	93000	0.341	4.54E–07	1.42E+01	2.88E+01	3–5	1.4–2
2–Methylphenol	25000	0.24	1.50E–06	2.74E+02	8.91E+01	1–3	
4–Methylphenol		0.11	4.43E–07	2.67E+02	8.51E+01	1–3	
2,4–Dimethylphenol	4200	0.0573	2.38E–06	2.22E+02	2.63E+02	1–3	9.5–150
Benzoic Acid	2700			2.48E+02	7.41E+01		
Naphthalene	31.7	0.23	1.15E–03	1.30E+03	2.76E+03	1–110	44–95
2–Methylnaphthalene	25.4	0.0083	5.80E–05	8.50E+03	1.30E+04	1–3	
2–Chloronaphthalene	6.74	0.017	4.27E–04	4.16E+03	1.32E+04		
2,6–Dinitrotoluene	1320	0.018	3.27E–06	9.20E+01	1.00E+02	4	4.6
Acenaphthene	3.42	0.00155	9.20E–05	4.60E+03	1.00E+04		
Dibenzofuran				4.16E+03	1.32E+04		
2,4–Dinitrotoluene	240	0.0051	5.09E–06	4.50E+01	1.00E+02	5	
Diethylphthalate	896	0.0035	1.14E–06	1.42E+02	3.16E+02	1–3	14–117
Fluorene	1.69	0.00071	6.42E–05	7.30E+03	1.58E+04		
N–Nitrosodiphenylamine	113		1.40E–06	6.50E+02	1.35E+03	4	65–217
Hexachlorobenzene	0.006	0.000019	6.81E–04	3.90E+03	1.70E+05		
Phenanthrene	1	0.00021	1.59E–04	1.40E+04	2.88E+04	1–200	
Anthracene	0.045	0.000195	1.02E–03	1.40E+04	2.82E+04		
Di–n–butylphthalate	13	0.00001	2.82E–07	1.70E+05	3.98E+05	1–3	89–1800
Fluoranthene	0.206	0.0177	6.46E–06	3.80E+04	7.94E+04	140–440	
Pyrene	0.132	2.50E–06	5.04E–06	3.80E+04	7.59E+04	9–1900	
Butylbenzylphthalate	2.9	8.60E–06	1.20E–06	2.84E+04	5.89E+04		663
Benzo(a)anthracene	0.0057	1.50E–07	1.16E–06	1.38E+06	3.98E+05	240–680	
Chrysene	0.0018	6.30E–09	1.05E–06	2.00E+05	4.07E+05	160–1900	
Bis(2–Ethylhexyl)phthalate	0.285	2.00E–07	3.61E–07	5.90E+03	9.50E+03	Neg. Deg.	
Di–ni–octylphthalate	3			2.40E+06	1.58E+09		
Benzo(b)fluoranthene	0.014	5.00E–07	1.19E–05	5.50E+05	1.15E+06	360–610	
Benzo(k)fluoranthene	0.0043	5.10E–07	3.94E–05	5.50E+05	1.15E+06	910–1400	
Benzo(a)pyrene	0.0012	0.000568	1.55E–06	5.50E+06	1.15E+06	220–530	
Indeno(1,2,3–cd)pyrene	0.00053	1.00E–10	6.86E–08	1.60E+06	3.16E+06	600–730	
Dibenz(a,h)anthracene	0.0005	5.20E–11	7.33E–08	3.30E+06	6.31E+06	750–940	
Benzo(g,h,i)perylene	0.0007	1.03E–10	5.34E–08	1.60E+06	3.24E+06	590–650	

TABLE 5 – 2

SUMMARY OF FATE AND TRANSPORT PARAMETERS FOR ORGANIC COMPOUNDS OF CONCERN

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	SOLUBILITY (mg/l)	VAPOR PRESSURE (mmHg)	HENRY'S LAW CONSTANT (atm–m³/mol)	Koc (ml/g)	Kow	HALF – LIFE (days)	BCF
Pesticides/PCBs							
beta–BHC	0.24	2.80E–07	4.47E–07	3.80E+03	7.94E+03		
gamma–BHC (Lindane)	7.8	0.00016	7.85E–06	1.08E+03	7.94E+03	Neg. Deg.	250
Heptachlor	0.18	0.0003	8.19E–04	1.20E–04	2.51E+04	Neg. Deg.	3600–37000
Aldrin	0.18	6.00E–06	1.60E–05	9.60E+04	2.00E+05	Neg. Deg.	3890–12260
Endosulfan I	0.16	0.00001	3.35E–05	2.03E+03	3.55E+03		
Heptachlor epoxide	0.35	0.0003	4.39E–04	2.20E+02	5.01E+02	Neg. Deg.	851–66000
Dieldrin	0.195	1.78E–07	4.58E–07	1.70E+03	3.16E+03	Neg. Deg.	3–10000
4,4'–DDE	0.04	6.50E–06	6.80E–05	4.40E+06	1.00E+07	Neg. Deg.	110000
Endrin	0.024	2.00E–07	4.17E–06	1.91E+04	2.18E+05	Neg. Deg.	1335–49000
Endosulfan II	0.07	0.00001	7.65E–05	2.22E+03	4.17E+03		
4,4'–DDD	0.16	2.00E–09	3.10E–05	2.40E+05	3.60E+05		
Endosulfan sulfate	0.16			2.33E+03	4.57E+03		
4,4'–DDT	0.005	5.50E–06	5.13E–04	2.43E+05	1.55E+06	Neg. Deg.	38642–110000
Endrin aldehyde							
alpha–Chlordane	0.56	0.00001	9.63E–06	1.40E+05	2.09E+03	Neg. Deg.	400–38000
Aroclor–1254	0.012	0.00008	2.70E–03	4.25E+04	1.07E+06	42	10E4–10E6
Aroclor–1260	0.0027	0.000041	7.10E–03	1.30E+06	1.38E+07	Neg. Deg.	10E4–10E6

Notes:
Koc = organic carbon partition coefficient
Kow = octanol–water partition coefficient
BCF = bioconcentration factor
Neg. Deg. = Negligible Biodegradation

References:
1. IRP Toxicology Guide
2. Basics of Pump–and–Treat Ground–Water Remediation Technology (EPA, 1990).
3. Handbook of Environmental Fate and Exposure Data (Howard, 1989).
4. Soil Chemistry of Hazardous Materials (Dragun, 1988)
5. Hazardous Waste Treatment, Storage, and Disposal Facilities, Air Emissions Models (EPA, 1989).
6. USATHAMA, 1985
7. Values for Koc not found were estimated by: logKoc = 0.544logKow + 1.377 (Dragun, 1988).

and liquid phase concentrations. Henry's constants for the major compounds detected at the Ash Landfill are presented in Table 5-2. Generally, for compounds with a Henry's constant less than 5×10^{-3} atm-m^3/mole, volatilization is not expected to be a significant environmental pathway (Dragun, 1988). TCE and its four breakdown products all have Henry's Constants greater than 5×10^{-3} atm-m^3/mole which suggests that volatilization will be a significant mechanism in the partitioning of these volatile chlorinated compounds at the Ash Landfill.

Compounds in soil are only mobile in the aqueous and air phases. Compounds enter the groundwater as precipitation migrates through the soil and mixes with these materials, eventually recharging to groundwater. The solubilities for these compounds range from 1,100 mg/l for TCE to 6,300 mg/l for trans 1,2 DCE which is sufficient to cause impacts to the groundwater. A review of the melting points and boiling points indicate that vinyl chloride is a gas at ambient temperatures, and TCE and the DCE isomers are liquids at room temperature.

The affinity of a compound to sorb to the organic fraction of soil is estimated from the organic carbon partition coefficient (K_{oc}). The K_{oc} is the ratio of the amount of the compound present in the organic fraction to that present in the aqueous fraction, at equilibrium. K_{oc} values are presented in Table 5-2 for TCE and its breakdown products. Table 5-3 describes the relationship between K_{oc} and mobility. Compounds with a K_{oc} between 500 mL/g and 2,000 ml/g are generally considered low mobility compounds and those with a K_{oc} value greater than 2,000 ml/g are considered to be immobile (Dragun, 1988). TCE, the DCE isomers and vinyl chloride all have K_{oc} values less than 500 mL/g and are therefore considered to be mobile. K_{oc} values are generally determined by experiment, but are often estimated using octanol-water partition coefficients (K_{ow}). Octanol-water partition coefficients are determined in the laboratory and then converted to K_{oc} via empirical relationships.

Understanding the type of soils present is useful for estimating the mobility of compounds. The site soils, clay loams, generally have low permeabilities and high water retention capacities. Therefore dissolved materials tend to move much slower through clay soils than sandy soils. Since adsorption of solutes on soils is controlled by the amount of organic carbon in the soil, soils with a higher organic content will adsorb more organics than soils which are low in carbon but rich in clay. Generally, surface soils, i.e. soils in the agricultural A horizon, have a higher organic content than deeper soils, i.e. soils in the B and C horizon, due to the presence of decomposing plant matter at the surface. In general, the larger the amount of organic matter in the soil, the less mobile the compounds of concern will be.

TABLE 5-3

RELATIVE RELATIONSHIPS BETWEEN K_{oc} AND MOBILITY

K_{oc}	Mobility Class
>2000	I - Immobile
500-2000	II - Low Mobility
150-500	III - Intermediate Mobility
50-150	IV - Mobile
<50	V - Very Mobile

K_{oc} - Organic carbon partition coefficient

Source: <u>The Soil Chemistry of Hazardous Materials</u>; James Dragun, Ph.D; The Hazardous Materials Control Research Institute; 1988.

Compounds degrade through a variety of mechanisms including biodegradation, hydrolysis, photodecomposition, and are converted to other organic degradation products. Biodegradation is considered to be the most likely transformation pathway for TCE at the Ash Landfill, since the reaction kinetics are the fastest of the mechanisms considered. Many of the degradation products present at the site are known biological breakdown products of TCE. The degradation rate, which is a measure of how fast a compound degrades, is influenced by several factors including: solubility, which determines the availability of the compound to the bacteria, temperature, oxygen concentrations, moisture content, substrate concentrations and toxicity, which is a measure of how toxic the compound is to the bacteria. For estimating simplicity, degradation has been assumed to be a first order reaction, which will allow degradation rates to be expressed as first order rate constants or half lives. A half-life refers to the time it would take for half of the mass of the organic constituent to degrade to either an intermediate compound or to carbon dioxide and water. A detailed analysis of biodegradation would evaluate the complete pathway. Half-lives for some of the organic compounds detected at SEDA are shown in Table 5-2. The first order degradation rate is often assumed to be independent of the mass of the constituent present in order to facilitate modeling, but in reality, as the mass of a compound decreases, the degradation rate will also decrease.

5.2.2 Contaminant Fate

Following a release, source materials partition into the three (3) environmental media, i.e. soil, water and air. Estimations of phase partitioning at the source can be used to understand the expected fate of the released materials. The fate of the chlorinated chemicals found at the Ash Landfill was determined by Level I equilibrium partitioning calculations following procedures developed by MacKay and Paterson, (1981).

The partitioning model is based on the concept of fugacity, a thermodynamic property of a chemical. Fugacity is often considered as the tendency of a chemical to escape from one phase into another. Using known chemical/physical properties of the chemicals of interest, i.e. the Henry's constant and the K_{oc}, and the physical properties of the media which these chemicals are released into, i.e. the soil porosity and the moisture content, it is possible to calculate a fugacity value, described as the f term, for each media. Generally, the units of fugacity, f, are expressed in units of pressure, i.e. atmospheres. The basic premise of the approach described by Mackay is that, at equilibrium, the fugacity of the chemicals in each media (subcompartment) are equal. Secondly, the concentration of each chemical in each media is related to the fugacity by a proportionality constant, Z. The units of Z are in moles/m^3-atm. Since only three media are involved, it is possible to ratio the Z terms for each media to the sum of all the Z values. This provides a percent partitioning ratio which is indicative of the degree that each chemical will partition into each environmental phase. The analysis has the advantage that it is independent of the actual mass of a chemical in the media. The results represent the relative amounts of a chemical, at equilibrium, which would be expected in a subcompartment. The subcompartments are the soil, water or air phase of the compartment in question.

For this analysis two compartments were considered. One compartment, the unsaturated (vadose) zone of soil, and the second compartment considered was saturated zone of soil. The analysis was performed separately for each compartment.

The Level I partitioning estimation technique, developed by Mackay, is considered to be a batch type analysis. In other words, chemicals are not allowed to pass beyond a defined control volume being considered. It does not account for various dynamic processes, such as biodegradation, but is useful in estimating the fate of released chemicals within the source area. The model does not account for separate phase liquids which may displace moisture within the pore spaces. It is intended to provide an indication of the behavior of the chlorinated organics in the soil under theoretical conditions.

The model involves three basic assumptions:

1. There is no chemical or biological degradation.

2. Chemicals are at equilibrium within the total environmental compartment and each subcompartment.

3. Since equilibrium is assumed, there is no unbalanced net flux into or out of subcompartments nor is there any release from the compartment as a whole, i.e. volatilization or leaching.

The compartments chosen were the vadose zone and the saturated deep soil. The only air volume considered was that air in the pores of the vadose zone. The atmospheric air above the compartment was excluded.

Mackay's equilibrium partitioning model was used to predict the partitioning of TCE, trans-1,2-DCE, and vinyl chloride among soil-solids, soil-water, and soil-air. The porosity of the soil at Seneca was estimated to be 37.3% (USAEHA Hazardous Waste Study No. 37-26-0479-85, August 1984). Since the moisture content of the soils at Seneca vary during the year, two scenarios were considered, a wet season (23.3 % moisture content in the vadose zone) (USAEHA, 1984) and a dry season (9.4% moisture content in the vadose zone) (Metcalf and Eddy, October 1989). The vadose zone consists of the soil phase, the soil-water phase, and the soil air phase. By definition, saturated soils contains no soil-air phase. A discussion of the model results follows.

The fugacity calculation begins by establishing the control volume. The control volume for the vadose zone compartment was established by considering one (1) square foot of soil extending (1) foot into the unsaturated zone. The control volume for the saturated zone was established by considering one (1) square foot of soil extending one (1) foot into the water table.

The amount of water in the upper, unsaturated control volume during the wet season is:

$$\%Water=MC$$

where: MC = Moisture Content during the wet season, (0.233)

The amount of solids in the control volume during the wet season was estimated as:

$$\%Solids=1-\Phi$$

where: Φ = Soil Porosity, (0.373)

The amount of air estimated in the control volume during the wet season was estimated as:

$$\%Air=1-(\%Solids+\%Water)$$

From these estimates, the subcompartment volumes, expressed as percent of the total volume, during the wet season was calculated as:

- Volume of Solids - 62.7%
- Volume of Water - 23.3% and
- Volume of Air - 14% .

During the dry season, the moisture content of the unsaturated zone was estimated to be 9.4%, the same analysis yielded subcompartment volumes of:

- Volume of Solids (V_{soil}) - 62.7%
- Volume of Water (V_{gw}) - 9.4% and
- Volume of Air (V_{air}) - 27.9%

The soil pore spaces for the lower saturated soil compartment does not contain any air spaces and therefore the volume of the water in this compartment is equal to the soil porosity, 0.373. The remainder of the soil volume is soil solids. The subcompartment volumes are defined as follows:

- Volume of Solids (V_{soil}) - 62.7%
- Volume of Water (V_{gw}) - 37.3%

Two chemical specific inputs are required:

H = Henry's Law Constant (atm m^3/mol) and
K_{oc} = organic carbon partition coefficient.

The media specific inputs are:

- Soil organic carbon content - 0.1%
- Bulk density of soil - 1.8 g/cm^3
- Soil temperature - 20°C

The next step is to calculate the proportionality constant Z, for each phase, where:

$C_i = Z_i f_i$

and

C_i = the concentration in a given phase (mol/m^3)
Z_i = the proportionality constant for a given phase (mol/m^3-atm)
f_i = the fugacity of a given phase (atm).

The following equations can be used to calculate Z.

1) $Z_{air} = 1/RT$
2) $Z_{gw} - 1/H$
3) $Z_{soil} = 10^{-8} (oc_{soil}) K_{oc} P_{soil})/H$

where:

R = universal gas constant = 8.2 x 10^{-5} m^3-atm/mol-°K
T = Temperature (°K)
H = Henry's Law Constant (atm-m^3/mol)
oc_{soil} = soil organic carbon content (%)
K_{oc} = organic carbon partition coefficient
P_{soil} = soil bulk density (g/m^3)

Next, the fraction (F) in each phase is calculated by the following equations:

$$F_{air} = \frac{V_{air} Z_{air}}{V_{air} Z_{air} + V_{gw} Z_{gw} + V_{soil} Z_{soil}}$$

$$F_{gw} = \frac{V_{gw} Z_{gw}}{V_{air} Z_{air} + V_{gw} Z_{gw} + V_{soil} Z_{soil}}$$

$$F_{soil} = \frac{V_{soil}\, Z_{soil}}{V_{air}\, Z_{air} + V_{gw}\, Z_{gw} + V_{soil}\, Z_{soil}}$$

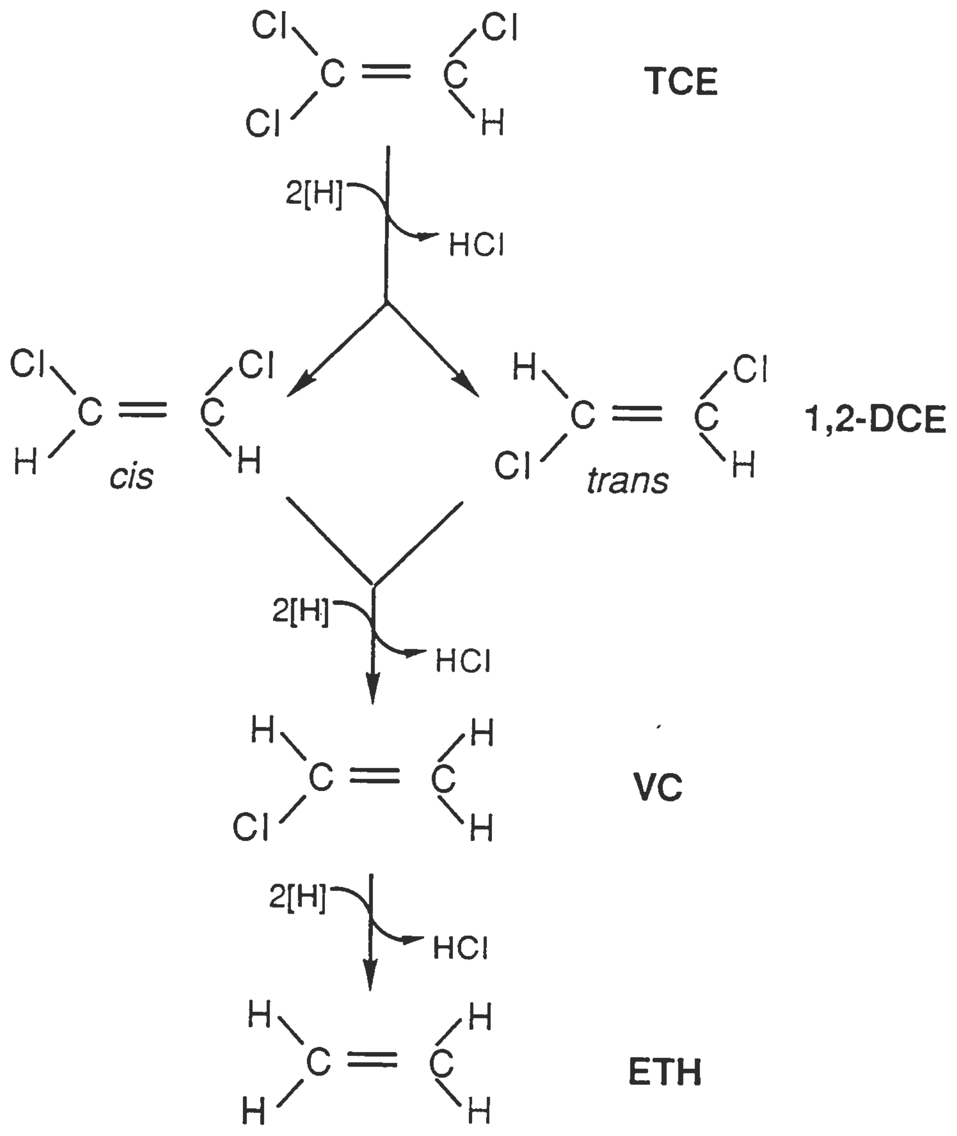
For the two compartment calculations the air terms are ignored.

Table 5-4 contains the results of the partitioning model. In the vadose zone, TCE is expected to partition in the soil-water phase from 27.5% to 54.5%, depending on the season. The partitioning of TCE in the soil-air phase is from 12.4% to 30.9%. As expected, TCE partitions more in the soil-water phase during the wet season than the dry season. Conversely, during the dry season, when there is more vapor space in the soils there is more TCE in the soil-air phase. The amount of TCE remaining in the soil ranges from 33.1% to 41.6%. In the saturated soil the partitioning percentage of TCE is 27.6% in the soil with the remainder in the soil water phase (72.4%).

The partitioning model also considered trans-1,2-DCE, a TCE breakdown product, and vinyl chloride, a breakdown product of DCE. It was determined that in unsaturated soils, a significant amount (39.7% to 69.1%) of DCE will be present in the soil-water phase. In the saturated soils as much as 84.9% of the DCE is expected to be in the soil-water phase. Since vinyl chloride is a gas at room temperature a much greater percentage of vinyl chloride was found in the soil-air phase, 85.7% during the wet season and 61.5% during the dry season.

The results of these partitioning analyses indicates that the fate of the chlorinated solvents found at the site will be partitioned into the soil-water and the soil-airspace.

The previous analysis did not consider degradation of these chemicals. Figure 5-1 provides a summary of the identified breakdown products resulting from the environmental biodegradation of TCE. Dechlorination and methane production are carried out by anaerobic microbes. Anaerobic conditions are likely to exist in the soils and therefore anaerobic degradation is a likely degradation pathway. Research indicates that under methanogenic conditions TCE is sequentially reduced by dechlorination to DCE isomers, then to vinyl chloride, and eventually to ethene. At each step a chlorine is replaced by hydrogen, and hydrogen chloride is produced. Of the three possible DCE isomers, the cis- and trans- 1,2-dichloroethene isomers are much more prevalent than 1,1-dichloroethene. Both an energy source and an electron, or an electron donor source appear to be necessary for this



ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING	NO. 720447-03000

FIGURE 5-1

BIODEGRADATION PATHWAY OF TCE BY REDUCTIVE DECHLORINATION

SCALE NTS

TABLE 5 – 4

SUMMARY OF FUGACITY CALCULATIONS

SENECA ARMY DEPOT
ASH LANDFILL

VADOSE ZONE – WET SEASON

1) Chemical Name	**Trichloroethene**	**trans–1,2–dichloroethene**	**Vinyl chloride**
Assumptions:			
2) % soil	62.7%	62.7%	62.7%
3) % water	23.3%	23.3%	23.3%
4) %air	14.0%	14.0%	14.0%
5) oc=% organic carbon in soil	0.10	0.10	0.10
6) bulk density (g/m³)	1.80E+06	1.80E+06	1.80E+06
7) Koc	126	59	57
8) Henry's Law Constant	9.10E–03	6.56E–03	8.19E–02
9) Temperature (°K)	293	293	293
Calculations:			
Z(soil)	24.92	16.19	1.25
Z(water)	109.89	152.44	12.21
Z(air)	41.62	41.62	41.62
Estimated % of Total Mass Of Chemical in Each Compartment			
Results:			
F(soil)	33.2%	19.7%	8.3%
F(water)	54.4%	69.0%	30.1%
F(air)	12.4%	11.3%	61.6%

TABLE 5 – 4

SUMMARY OF FUGACITY CALCULATIONS

SENECA ARMY DEPOT
ASH LANDFILL

SATURATED WET SOIL – WET SEASON

1) Chemical Name	**Trichloroethene**	**trans–1,2–dichloroethene**	**Vinyl chloride**
Assumptions:			
2) % soil	62.7%	62.7%	62.7%
3) % water	37.3%	37.3%	37.3%
5) oc=% organic carbon in soil	0.10	0.10	0.10
6) bulk density (g/m^3)	1.80E+06	1.80E+06	1.80E+06
7) Koc	126	59	57
8) Henry's Law Constant	9.10E–03	6.56E–03	8.19E–02
9) Temperature (°K)	293	293	293
Calculations:			
Z(soil)	24.92	16.19	1.25
Z(water)	109.89	152.44	12.21
Estimated % of Total Mass Of Chemical in Each Compartment			
Results:			
F(soil)	27.6%	15.1%	14.7%
F(water)	72.4%	84.9%	85.3%

TABLE 5 – 4

SUMMARY OF FUGACITY CALCULATIONS

SENECA ARMY DEPOT
ASH LANDFILL

VADOSE ZONE – DRY SEASON

1) Chemical Name	**Trichloroethene**	**trans–1,2–dichloroethene**	**Vinyl chloride**
Assumptions:			
2) % soil	62.7%	62.7%	62.7%
3) % water	9.4%	9.4%	9.4%
4) %air	27.9%	27.9%	27.9%
5) oc=% organic carbon in soil	0.10	0.10	0.10
6) bulk density (g/m^3)	1.80E+06	1.80E+06	1.80E+06
7) Koc	126	59	57
8) Henry's Law Constant	9.10E–03	6.56E–03	8.19E–02
9) Temperature (°K)	293	293	293
Calculations:			
Z(soil)	24.92	16.19	1.25
Z(water)	109.89	152.44	12.21
Z(air)	41.62	41.62	41.62
Estimated % of Total Mass Of Chemical in Each Compartment			
Results:			
F(soil)	41.6%	28.1%	5.8%
F(water)	27.5%	39.7%	8.5%
F(air)	30.9%	32.2%	85.7%

TABLE 5 – 4

SUMMARY OF FUGACITY CALCULATIONS

SENECA ARMY DEPOT
ASH LANDFILL

SATURATED DEEP SOIL – DRY SEASON

1) Chemical Name	**Trichloroethene**	**trans–1,2–dichloroethene**	**Vinyl chloride**
Assumptions:			
2) % soil	62.7%	62.7%	62.7%
3) % water	37.3%	37.3%	37.3%
5) oc=% organic carbon in soil	0.10	0.10	0.10
6) bulk density (g/m³)	1.80E+06	1.80E+06	1.80E+06
7) Koc	126	59	57
8) Henry's Law Constant	9.10E–03	6.56E–03	8.19E–02
9) Temperature (°K)	293	293	293
Calculations:			
Z(soil)	24.92	16.19	1.25
Z(water)	109.89	152.44	12.21
Estimated % of Total Mass Of Chemical in Each Compartment			
Results:			
F(soil)	27.6%	15.1%	14.7%
F(water)	72.4%	84.9%	85.3%

Notes:

1) Henry's Law Constants and K(oc) values are from Table A–1 of Basics of Pump and Treat Groundwater Remediation Technology (EPA March 1990).

2) The moisture content (wet season) was obtained from USAEHA Hazardous Waste Study No. 37–26–0479–85 (1984).

transformation to take place. Compounds with a greater degree of halogenation are more likely to undergo dehalogenation, suggesting that vinyl chloride, with one remaining chlorine is not as likely to degrade to ethene as TCE is to degrade to DCE.

The products of biodegradation at the site suggests that biodegradation mechanism is the more rapid mechanism, since TCE was detected in 54% of the soil samples and 33% of the groundwater samples and 1,2-DCE (total) was detected in 39% of the soil samples and 32% of the groundwater samples. 1,1-DCE, not a significant intermediate, was detected in only 6% of the soil samples and 2% of the groundwater samples. Vinyl chloride was detected in 6.4% of the soil samples and 7% of the groundwater samples. The high vaporization potential of vinyl chloride may account for the low percentage of soil and water samples found to contain vinyl chloride.

An important item to note regarding degradation, is that TCE was not detected in the downgradient wells along the site fenceline, while DCE was detected. This suggests that biodegradation of TCE is occurring along the groundwater transport pathway and TCE is transformed to DCE before groundwater migrates to the downgradient locations. Although little or no vinyl chloride was found in the downgradient wells, a known breakdown product of DCE, based upon the previous discussion of partitioning, it is likely that the vinyl chloride is released as vapor.

TCE is relatively mobile and will partition in the water of the soil-groundwater system especially in soils with a low organic content. As discussed earlier, volatilization may also be a significant pathway for TCE near the surface or in the soil-air phase. Hydrolysis is not expected to be significant in natural soils due to slow reaction mechanisms.

DCE and Vinyl chloride are also considered to be mobile in soil/groundwater systems and volatilization is also considered to be significant near the surface. However, unlike TCE and DCE, partitioning of vinyl chloride in the soil-air phase dominates the expected partitioning pathways and most of the vinyl chloride will likely be volatilized from the surface of the soil.

5.3 CONTAMINANT TRANSPORT

The two modes of transport of the volatile chlorinated organics of concern at the Ash Landfill are volatilization to the air and groundwater transport. Groundwater samples collected during the RI confirm that dissolution of these materials in the groundwater has occurred. Once these materials have entered the groundwater system they will migrate with the groundwater flow regime.

The transport of dissolved materials in the groundwater was evaluated using a groundwater transport model, obtained from the document *Groundwater Transport: Handbook of Mathematical Models, (1984) published by the American Geophysical Union*. The model called ODAST considers convection, dispersion, decay, and adsorption in a porous media and utilizes an analytical solution, presented by *Van Genuchten and Alves (1982)*, for the one-dimensional groundwater transport of constituents from the source. The model assumes an infinitely long homogeneous isotropic porous medium in a steady uniform flow. It includes two function type subroutines, one calculates the product of the exponential, exp(A) and the other the complementary error function, erfc(B). This model allows for a rapid, preliminary analysis of groundwater contamination at the site. The modelling focused on both TCE and 1-2-DCE because 1-2-DCE, a breakdown product of TCE, increases due to biodegradation away from the source.

This program calculates the ratio C/C_o for any given point downstream from the source of contamination (x) and at any given time (t) as a function of average pore water velocity (v), the dispersion coefficient (D), the retardation factor (R), the decay factor of the solute (λ), and the decay factor of the source (α). For this analysis, the source was assumed not to change relative to the groundwater system and therefore, α was assumed to equal zero. The one dimensional analytical solution used to model this system is:

$$\frac{C}{C_o}(x,t) = \frac{v}{v + U} \exp\left[\frac{x(v - U)}{2D}\right] erfc\left[\frac{Rx - Ut}{2(DRt)^{1/2}}\right]$$

$$+ \frac{v}{v - U} \exp\left[\frac{x(v + U)}{2D}\right] erfc\left[\frac{Rx + Ut}{2(DRt)^{1/2}}\right]$$

$$+ \frac{v^2}{2DRX} \exp\left[\frac{vx}{D} - Xt\right] erfc\left[\frac{Rx + vt}{2(DRt)^{1/2}}\right]$$

where:

The input parameters to the program was as follows:

C = concentration at x,t

$$U = [v^2 + 4DR(\lambda - \alpha)]^{1/2}$$

C_o = concentration at source
v = pore water velocity (m/day)
D = coefficient of dispersion (m^2/day)
R = Retardation factor
To = total period of waste recharge (years)
λ = decay factor of the solute (day^{-1})
α = decay factor of the source (day^{-1})
x = distances from the source (m)
t = time elapsed since the beginning of the operation (year)

The potential migration of both TCE and 1,2-DCE onsite was evaluated using the above-mentioned analytical groundwater flow model. The evaluation incorporated a sensitivity analysis for TCE and 1,2-DCE by varying the pore water velocity at the Ash Landfill site, thereby evaluating their behavior under two sets of conditions. In the first condition a low velocity was used and in the second condition a high velocity was used.

For the low velocity condition a pore water velocity of 18.1 ft/yr or 0.05 ft/day (0.015 m/day) was used. The velocity calculation incorporates an effective porosity of 0.15 and a hydraulic conductivity of 0.35 ft/day as it is suspected that the lower conductivites onsite will be the rate-limiting factor for groundwater flow, even if more conductive pockets are present onsite. A longitudinal dispersivity of 30 feet was used. This value was obtained from a recent article entitled *Extraction of TCE-Contaminated Ground Water by Subsurface Drains and a Pumping Well, Groundwater, Vol. 28, No.1, January-February 1990*. The geologic conditions of the site described in this article are similar to the conditions at the Ash Landfill. This value is consistent with values used in other transport simulations (Anderson, 1979). A retardation factor of 1.5 was used for TCE (which was obtained from the same article), and is consistent with literature values for the soil type at SEDA. For 1,2-DCE a lower retardation factor of 1.21 was used. The retardation factor was calculated using the following equation (Freeze and Cherry 1979):

$$R.F. = 1 + \frac{P_b}{n} x \ K_d$$

where: P_b = bulk density of soil
n = total porosity
K_d = distribution coefficient = (K_{oc} x F_{oc})
K_{oc} = organic carbon partitioning coefficient
F_{oc} = fraction of organic carbon

The retardation factor for 1,2-DCE was determined by back-calculating the F_{oc} using a retardation factor of 1.5 for TCE (which was obtained from the literature), a P_b of 1.65g/cm^3, 72 of 0.33 and a K_{oc} of 126ml/g for TCE. Once the F_{oc} was calculated (0.00079) the same equation was used to solve for the retardation factor of 1,2-DCE (54 ml/g), but this time the K_{oc} for 1,2-DCE was used. A retardation factor of 1.21 is consistent with retardation factors calculated using published values of K_d for 1,2-DCE.

The product of the dispersivity (30 ft) and the groundwater velocity (18.1 ft/yr) is the coefficient of dispersion, 543 ft^2/year (0.138 m^2/day). A time period of up to 200 years was used to determine if TCE and/or 1,2-DCE would ever get to the farmhouse wells and also to determine when the concentration ratios would cease to change, or reach steady-state.

To evaluate plume conditions that may prevail using a higher pore water velocity a conservative velocity was calculated for the second condition. This velocity calculation included the use of a hydraulic conductivity of 1.5 ft/day while the other parameters in the velocity equation remained the same as in the first condition. The input parameters for the groundwater model under both conditions are included in the notes below the tables that summarize the results of the modelling (Tables 5-5 through 5-8). For the second condition a new coefficient of dispersion was calculated using a dispersivity of 30 feet and a groundwater velocity of 77.8 ft/yr.

For the purpose of this initial modelling scenario the locations of the TCE and 1,2-DCE source areas are different. The TCE concentration at PT-18 was assumed to be the source concentration term, (C_o) for TCE. PT-18 was chosen as the source instead of MW-44 for several reasons. First, historical monitoring data has shown that the concentration of TCE in PT-18 has remained fairly constant. Second, the four wells downgradient of the source that were part of the modelling array; PT-12, which is 200 ft. (61 m) from PT-18, PT-22, which is 390 ft. (119 m) from PT-18 , MW-29, which is 850 ft. (259 m) from PT-18, and MW-56, which is 1,165 ft. (355 m) from PT-18, are essentially along the centerline of the groundwater plume, which meets a boundary condition of the modelling. Also, a downgradient location 2,510 ft. (766 m) from

TABLE 5 – 5

SUMMARY OF GROUNDWATER MODELING RESULTS FOR TCE
AT A VELOCITY OF 0.05 FT/DAY

SENECA ARMY DEPOT
ASH LANDFILL

TIME (years)	Predicted Concentration Ratio (C/Co), Predicted Conc. and Actual Measured Conc. for TCE														
	PT–12 200 feet (2)			PT–22 390 feet			MW–29 850 feet			MW–56 1165 feet			FARMHOUSE 2510 feet		
	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)
5	0.02436	292.32		3.03E–09	0.00		0	0.00		0.00E+00	0.00		0	0	
10	0.02668	320.16		0.00006	0.77		0	0.00		0.00E+00	0.00		0	0	
15	0.04230	507.60		0.00093	11.12		1.28E–12	0.00		0.00E+00	0.00		0	0	
20	0.04676	561.12		0.00233	27.97		1.67E–09	0.00		0.00E+00	0.00		0	0	
25	0.04775	573.00		0.00321	38.56		7.44E–08	0.00		1.58E–13	0.00		0	0	
30	0.04795	575.40		0.00356	42.72		6.23E–07	0.01		2.25E–11	0.00		0	0	
35	0.04799	575.88		0.00367	44.00		2.07E–06	0.02		5.29E–10	0.00		0	0	
40	**0.04800**	**576.00**	**575 (3)**	0.00370	44.34		4.01E–06	0.05		4.09E–09	0.00		0	0	
60	0.04800	576.00		**0.00370**	**44.45**	**89 (3)**	7.41E–06	0.09		7.99E–08	0.00		0	0	
100	0.04800	576.00		0.00370	44.45		**7.53E–06**	**0.09**	**2 (3)**	**1.08E–07**	**0.00**	**<0.5 (3)**	**0**	**0**	**<0.5 (3)**
150	0.04800	576.00		0.00370	44.45		7.53E–06	0.09		1.08E–07	0.00		0	0	
200	0.04800	576.00		0.00370	44.45		7.53E–06	0.09		1.08E–07	0.00		0	0	

Notes:

1) Input parameters:
  Velocity = 0.05 feet/day (Calculated using a gradient of 0.0213 ft/ft, an effective porosity of 0.15, and a K of 0.35 ft/day)
  Dispersion coefficient = 1.5 ft^2/day (based on a dispersivity of 30 ft)
  Retardation factor = 1.5 (dimensionless)
  Lambda (plume degradation rate constant) = 0.000622/day
  Alpha (source degradation rate constant) = 0.000/day
2) Indicates distance from PT–18, The PT–18 TCE concentration is 12,000 ug/L, which is Co
3) Boldface indicates steady–state achieved

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TABLE 5 – 6

SUMMARY OF GROUNDWATER MODELING RESULTS FOR TOTAL 1,2-DCE AT A VELOCITY OF 0.05 FT/DAY

SENECA ARMY DEPOT
ASH LANDFILL

TIME (years)	Predicted Concentration Ratio (C/Co), Predicted Conc. and Actual Measured Conc. for 1,2-DCE											
	PT-22 190 feet			MW-29 650 feet			MW-56 965 feet			FARMHOUSE 2310 feet		
	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)
5	0.01602	12.82		0.00E+00	0.00		0.00E+00	0.00		0.00E+00	0	
10	0.09799	78.39		7.54E-09	0.00		0.00E+00	0.00		0.00E+00	0	
15	0.14020	112.16		8.95E-06	0.01		4.55E-12	0.00		0.00E+00	0	
20	0.15230	121.84		0.0001889	0.15		1.00E-08	0.00		0.00E+00	0	
25	0.15530	124.24		0.0008192	0.66		6.51E-07	0.00		0.00E+00	0	
30	0.15600	124.80		0.001683	1.35		7.36E-06	0.01		0.00E+00	0	
35	0.15610	124.88		0.00237	1.90		3.13E-05	0.03		0.00E+00	0	
40	**0.15620**	**124.96**	**125 (3)**	0.002761	2.21		7.37E-05	0.06		0.00E+00	0	
60	0.15620	124.96		0.003044	2.44		1.96E-04	0.16		3.29E-14	0	
100	0.15620	124.96		**0.003048**	**2.44**	**84 (3)**	**2.06E-04**	**0.16**	**0.2 (3)**	8.65E-10	0	
150	0.15620	124.96		0.003048	2.44		2.06E-04	0.16		2.06E-09	0	
200	0.15620	124.96		0.003048	2.44		2.06E-04	0.16		**2.07E-09**	**0**	**<0.5 (3)**

Notes:

1) Input parameters:

Velocity = 0.05 feet/day (Calculated using a gradient of 0.0213 ft/ft, an effective porosity of 0.15, and a K of 0.35 ft/day)
Dispersion coefficient = 1.5 ft^2/day (based on a dispersivity of 30 ft)
Retardation factor = 1.21 (dimensionless)
Lambda (plume degradation rate constant) = 0.000699/day
Alpha (source degradation rate constant) = 0.000/day

2) Indicates distance from PT-12, The PT-12 total 1,2-DCE concentration is 800 ug/L, which is Co

3) Boldface indicates steady-state achieved

TABLE 5 – 7

SUMMARY OF GROUNDWATER MODELING RESULTS FOR TCE AT A VELOCITY OF 0.213 FT/DAY

SENECA ARMY DEPOT ASH LANDFILL

TIME (years)	Predicted Concentration Ratio (C/Co), Predicted Conc. and Actual Measured Conc. for TCE														
	PT–12 200 feet (2)			PT–22 390 feet			MW–29 850 feet			MW–56 1165 feet			FARMHOUSE 2510 feet		
	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)
5	0.34080	4089.60		0.05337	640.44		2.69E–07	0.00		4.04E–14	0.00		0	0.00	
10	0.40690	4882.80		0.1796	2155.20		0.003613	43.36		1.24E–05	0.15		0	0.00	
15	0.40890	4906.80		0.1936	2323.20		0.0223	267.60		1.58E–03	18.90		0	0.00	
20	**0.40900**	**4908.00**	575 (3)	**0.1943**	**2331.60**	**89** (3)	0.03078	369.36		6.35E–03	76.15		1.86E–11	0.00	
25	0.40900	4908.00		0.1943	2331.60		0.03199	383.88		8.81E–03	105.74		2.61E–08	0.00	
30	0.40900	4908.00		0.1943	2331.60		0.03209	385.08		9.29E–03	111.53		1.29E–06	0.02	
35	0.40900	4908.00		0.1943	2331.60		**0.0321**	**385.20**	**2** (3)	9.35E–03	112.19		1.01E–05	0.12	
40	0.40900	4908.00		0.1943	2331.60		0.0321	385.20		9.35E–03	112.24		2.71E–05	0.32	
60	0.40900	4908.00		0.1943	2331.60		0.0321	385.20		**9.35E–03**	**112.25**	**<0.5** (3)	4.83E–05	**0.58**	
100	0.40900	4908.00		0.1943	2331.60		0.0321	385.20		9.35E–03	112.25		**4.84E–05**	0.58	**<0.5** (3)
150	0.40900	4908.00		0.1943	2331.60		0.0321	385.20		9.35E–03	112.25		4.84E–05	0.58	
200	0.40900	4908.00		0.1943	2331.60		0.0321	385.20		9.35E–03	112.25		4.84E–05	0.58	

Notes:

1) Input parameters:
   Velocity = 0.213 feet/day (Calculated using a gradient of 0.0213 ft/ft, an effective porosity of 0.15, and a K of 1.5 ft/day)
   Dispersion coefficient = 6.39 ft^2/day (based on a dispersivity of 30 ft)
   Retardation factor = 1.5 (dimensionless)
   Lambda (plume degradation rate constant) = 0.000622/day
   Alpha (source degradation rate constant) = 0.000/day
2) Indicates distance from PT–18, The PT–18 TCE concentration is 12.000 ug/L, which is Co
3) Boldface indicates steady–state achieved

TABLE 5 – 8

SUMMARY OF GROUNDWATER MODELING RESULTS FOR TOTAL 1,2–DCE AT A VELOCITY OF 0.213 FT/DAY

SENECA ARMY DEPOT
ASH LANDFILL

TIME (years)	Predicted Concentration Ratio (C/Co), Predicted Conc. and Actual Measured Conc. for total 1,2–DCE											
	PT–22 190 feet			MW–29 650 feet			MW–56 965 feet			FARMHOUSE 2310 feet		
	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)
5	0.5428	434.24		0.003793	3.03		6.39E–07	0.00		0	0.00	
10	0.5598	447.84		0.1367	109.36		1.14E–02	9.10		0	0.00	
15	0.601	480.80		0.2004	160.32		7.07E–02	56.56		9.45E–09	0.00	
20	**0.6011**	**480.88**	**125 (3)**	0.2062	164.96		9.59E–02	76.72		4.95E–06	0.00	
25	0.6011	480.88		**0.2065**	**165.20**	**84 (3)**	9.91E–02	79.27		2.67E–04	0.21	
30	0.6011	480.88		0.2065	165.20		**9.93E–02**	**79.46**	**0.2 (3)**	1.62E–03	1.30	
35	0.6011	480.88		0.2065	165.20		9.93E–02	79.46		3.31E–03	2.65	
40	0.6011	480.88		0.2065	165.20		9.93E–02	79.46		4.12E–03	3.30	
60	0.6011	480.88		0.2065	165.20		9.93E–02	79.46		**4.37E–03**	**3.49**	**<0.5 (3)**
100	0.6011	480.88		0.2065	165.20		9.93E–02	79.46		4.37E–03	3.49	
150	0.6011	480.88		0.2065	165.20		9.93E–02	79.46		4.37E–03	3.49	
200	0.6011	480.88		0.2065	165.20		9.93E–02	79.46		4.37E–03	3.49	

Notes:

1) Input parameters:
   Velocity = 0.213 feet/day (Calculated using a gradient of 0.0213 ft/ft, an effective porosity of 0.15, and a K of 1.5 ft/day)
   Dispersion coefficient = 6.39 ft^2/day (based on a dispersivity of 30 ft)
   Retardation factor = 0.75 (dimensionless)
   Lambda (plume degradation rate constant) = 0.000699/day
   Alpha (source degradation rate constant) = 0.000/day
2) Indicates distance from PT–12, The PT–12 total 1,2–DCE concentration is 800 ug/L, which is Co
3) Boldface indicates steady–state achieved

TABLE 5 – 9

SUMMARY OF GROUNDWATER MODELING RESULTS FOR TCE (at MW–44) AT A VELOCITY OF 0.05 FT/DAY

SENECA ARMY DEPOT ASH LANDFILL

TIME (years)	Predicted Concentration Ratio (C/Co), Predicted Conc. and Actual Measured Conc. for TCE														
	PT–12 310 feet (2)			PT–22 500 feet			MW–29 960 feet			MW–56 1275 feet			FARMHOUSE 2590 feet		
	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)
5	0.00000	0.12		1.51E–14	0.00		0	0.00		0.00E+00	0.00		0	0	
10	0.00131	57.82		0.00000	0.01		0	0.00		0.00E+00	0.00		0	0	
15	0.00587	258.41		0.00003	1.52		0	0.00		0.00E+00	0.00		0	0	
20	0.00916	403.00		0.00023	10.19		8.07E–12	0.00		0.00E+00	0.00		0	0	
25	0.01041	458.04		0.00051	22.58		1.38E–09	0.00		0.00E+00	0.00		0	0	
30	0.01076	473.44		0.00071	31.09		2.78E–08	0.00		2.30E–13	0.00		0	0	
35	0.01085	477.40		0.00079	34.96		1.67E–07	0.01		1.28E–11	0.00		0	0	
40	0.01086	477.84		0.00083	36.34		4.86E–07	0.02		1.87E–10	0.00		0	0	
60	**0.01087**	**478.28**	**575 (3)**	0.00084	36.90		0.0000162	0.71		1.33E–08	0.00		0	0	
100	0.01087	478.28		**0.00084**	**36.91**	**89 (3)**	**1.70E–06**	**0.07**	**2 (3)**	**2.44E–08**	**0.00**	**<0.5 (3)**	**0**	**0**	**<0.5 (3)**
150	0.01087	478.28		0.00084	36.91		1.70E–06	0.07		2.44E–08	0.00		0	0	
200	0.01087	478.28		0.00084	36.91		1.70E–06	0.07		2.44E–08	0.00		0	0	

Notes:

1) Input parameters:
   Velocity = 0.05 feet/day (Calculated using a gradient of 0.0213 ft/ft, an effective porosity of 0.15, and a K of 0.35 ft/day)
   Dispersion coefficient = 1.5 ft^2/day (based on a dispersivity of 30 ft)
   Retardation factor = 1.5 (dimensionless)
   Lambda (plume degradation rate constant) = 0.000622/day
   Alpha (source degradation rate constant) = 0.000/day
2) Indicates distance from MW–44, The MW–44 TCE concentration is 44,000 ug/L, which is Co
3) Boldface indicates steady–state achieved

TABLE 5 – 10

SUMMARY OF GROUNDWATER MODELING RESULTS FOR TOTAL 1,2–DCE (at MW–44) AT A VELOCITY OF 0.05 FT/DAY

SENECA ARMY DEPOT ASH LANDFILL

TIME (years)	Predicted Concentration Ratio (C/Co), Predicted Conc. and Actual Measured Conc. for 1,2–DCE														
	PT–12 310 feet			PT–22 500 feet			MW–29 960 feet			MW–56 1275 feet			FARMHOUSE 2590 feet		
	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)	Predicted Conc. Ratio	Predicted Conc. (ug/L)	Actual Conc. (ug/L)
5	0.0000489	4.96		1.85E–11	0.00		0.00E+00	0.00		0.00E+00	0.00		0.00E+00	0	
10	0.00556	564.75		9.38E–06	0.95		0.00E+00	0.00		0.00E+00	0.00		0.00E+00	0	
15	0.01581	1604.72		0.0003509	35.62		2.97E–12	0.00		0.00E+00	0.00		0.00E+00	0	
20	0.02063	2093.95		0.001292	131.14		4.09E–09	0.00		0.00E+00	0.00		0.00E+00	0	
25	0.02191	2223.87		0.002082	211.32		1.80E–07	0.02		2.92E–12	0.00		0.00E+00	0	
30	0.02227	2260.41		0.002443	247.96		1.45E–06	0.15		2.86E–10	0.00		0.00E+00	0	
35	0.02233	2266.50		0.002562	260.04		4.58E–06	0.47		5.03E–09	0.00		0.00E+00	0	
40	**0.02234**	**2267.51**	**1400 (3)**	0.002594	263.29		8.47E–06	0.86		3.08E–08	0.00		0.00E+00	0	
60	0.02234	2267.51		**0.002604**	**264.31**	**150 (3)**	1.42E–05	1.44		3.43E–07	0.03		0.00E+00	0	
100	0.02234	2267.51		0.002604	264.31		**1.44E–05**	**1.46**	**97 (3)**	**4.07E–07**	**0.04**	**0.2 (3)**	3.69E–14	0	
150	0.02234	2267.51		0.002604	264.31		1.44E–05	1.46		4.07E–07	0.04		**1.01E–13**	**0**	**<0.5 (3)**
200	0.02234	2267.51		0.002604	264.31		1.44E–05	1.46		4.07E–07	0.04		1.01E–13	0	<0.5 (3)

Notes:

1) Input parameters:
Velocity = 0.05 feet/day (Calculated using a gradient of 0.0213 ft/ft, an effective porosity of 0.15, and a K of 0.35 ft/day)
Dispersion coefficient = 1.5 ft^2/day (based on a dispersivity of 30 ft)
Retardation factor = 1.21 (dimensionless)
Lambda (plume degradation rate constant) = 0.000699/day
Alpha (source degradation rate constant) = 0.000/day
2) Indicates distance from MW–44. The MW–44 total 1,2–DCE concentration is 101,500 ug/L, which is Co
3) Boldface indicates steady–state achieved

PT-18 was examined, since it is approximately the distance of the farmhouse wells from PT-18. For 1,2-DCE, the concentration at PT-12 was assumed to be 1,2-DCE source concentration term, (C_o). PT-12 was chosen because this well is near the source area and contained the highest concentration of 1,2-DCE of the wells chosen for the model. Three downgradient monitoring wells (PT-22, MW-29, and MW-56) and the farmhouse well (FH-S) were included in the model for reasons cited above for TCE. Their respective distances from the 1,2-DCE source at PT-12, are 190 ft. (58m), 650 ft. (198m), 965 ft. (294m), and 2,310 ft. (705m). Various times from 5 to 200 years were examined for each of the compounds.

For the two pore water velocity conditions, the model was calibrated by comparing the model output to actual data from one well (PT-12) followed by adjusting one variable, the decay factor of the solute (λ), until the output, the TCE concentration ratio (C/C_o) for PT-12, matched the actual field well data. The final delay factors used to calibrate the model for TCE under low and high pore water velocity conditions were compared to literature data to determine if the decay factors used in this model were similar to that found at other sites. In order to determine the validity of the value of λ, values were obtained from the article *In Situ Biodegradation of TCE Contaminated Groundwater", Environmental Progress, Vol. 9, No. 3, August 1990,* which presented a graphical description of time vs. TCE concentration before and after in-situ treatment. The slope of the line before treatment was determined to be -0.241 ppb degraded/day. Using the initial concentration, the rate was used to calculate a concentration after 250 days. Assuming a first order rate equation, a rate constant was calculated to be 0.0006 day^{-1} which compared well with the value of 0.000622 day^{-1} used in the modelling of TCE under the low velocity condition. The λ used to calibrate the model for the high velocity condition 0.002 did not correlate well with the value calculated from data presented in the literature.

Once the final calibration was performed for the low velocity condition by matching the (C/C_o) for PT-12, the output was also compared to the actual C/C_o values for other wells and found to be reasonably close. The actual TCE concentrations were 12,000 ug/l at PT-18, 575 ug/l at PT-12, 89 ug/l at PT-22, 2 ug/l at MW-29, and 0 ug/l at MW-56. From these values actual concentration ratios were determined to be 0.048 for PT-12/PT-18, 0.0074 for PT-22/PT-18, 0.00017 for MW-29/PT-18 and 2.06×10^{-7} for MW-56/PT-18. The decay factor of the source was assumed to be zero, suggesting that the source sink of TCE is large enough so that it is not being depleted rapidly enough that the input source strength relative to downgradient wells changed significantly. The calibrated value for the solute degradation term λ of 0.000622 day^{-1} yielded the best results (Tables 5-4 through 5-7.).

Therefore, for TCE the decay factor of 0.000622 was chosen to best represent conditions at the site because it is supported by the decay factor calculated using data represented in the literature, and it correlates well with the field data. For this reason a λ of 0.000622 was used to model both low and high velocity conditions for TCE.

A similar procedure was used to calibrate the model for 1,2-DCE. Because the low velocity condition was determined to best represent the site for TCE, this condition was used to calibrate the model for 1,2-DCE. Again, calibration was performed in a similar manner to that used for TCE. The decay factor for 1,2-DCE was determined to be 0.000699, which is consistent with that used for TCE.

Using these input parameters, the model was performed until the groundwater system reached steady-state for the first well downgradient of PT-18, which is PT-12. Since the source term was assumed to be constant, the maximum concentration predicted by the model occurs when steady state is achieved. Consequently, this situation is of interest in understanding if the TCE and 1,2-DCE will be expected to reach beyond the limits of the site boundary.

The results of the low and high velocity modelling are shown in Tables 5-5 through 5-8. The results of the analytical modelling for the lower pore water velocity condition (0.05 ft./day) closely match the field data for the monitoring wells chosen for the model. The results indicate that steady-state conditions are achieved in the wells. For TCE in PT-12 this condition occurs 40 years for the time the solvent spill impacted the groundwater and the concentration produced by the model (576 mg/L) agrees well with the actual concentration measured in this well (575 mg/L). Historical quarterly groundwater monitoring indicates that the concentration of TCE in PT-12 has been variable, however, the average concentration since January 1990 is 846 mg/L which is close to the concentration produced by the model under the low velocity condition. Monitoring well PT-22 reaches steady state in approximately 60 years, MW-29 in 100 years and MW-56 also reaches steady state in 100 years.

The exact timeframes for the release of solvents at the Ash Landfill is not known, however, it is likely that the releases occurred over a period of years beginning approximately 40 years ago. According to the model's prediction the spill would have occurred a minimum of 40 years ago. This is consistent with the suspected early operating dates of the Ash Landfill area.

The results of the modelling using the high pore water velocity (0.213 ft/day) are not likely to be representative of current or future site conditions. Instead, the model predicts conditions that are not consistent with the data from the wells used in the model, considering plausible time frames under which the release of solvents may have occurred. For example, the model indicates that steady-state conditions in PT-12 are met 20 years after the release, when TCE stabilized at 4,908 mg/L. This concentration is much greater that the concentration currently measured in the well (575 mg/L) and well above the average TCE concentration for this well since January 1990 (846 ug/L). More significantly, the model predicts that 5 years after the release, the concentration of TCE on PT-12 was 4,089 mg/L. This concentration is not consistent with the historical data from this well given the plausible time frame for the release of the solvents; the release is suspected to have occurred as long as 40 years ago. Similar inconsistencies hold true for PT-22 under these high velocity aquifer conditions.

Previously, in the initial modeling scenario, the model predicted concentrations for an array of wells using PT-18 for the source concentration term (C_o) for TCE, and PT-12 for the C_o for 1,2-DCE. MW-44, the well with the highest concentrations of TCE and 1,2-DCE was not used. To evaluate a second plausible scenario, the model was run using MW-44 as the C_o for TCE and 1,2-DCE. Using this scenario, the centerline of the plume is not a straight line, which is one of the boundary conditions of the model. However, because this source area (MW-44) contains the highest concentrations of TCE and 1,2-DCE on the site, modeling of this scenario is warranted.

This modeling was performed using the concentrations of TCE and 1,2-DCE at MW-44 as the source concentration terms (C_o), while maintaining the same parameters and assumptions used for the initial modeling scenario. However, new distances from the source area (MW-44) for the wells in the modelling array were calculated. Under this scenario, distances between the source concentration term (C_o) and the downgradient wells increased.

Results of the model runs for TCE and 1,2-DCE in MW-44 are shown on Tables 5-9 and 5-10, respectively. For TCE, the model results indicate that steady-state concentrations in the downgradient wells are generally similar to the actual concentrations determined by the laboratory. For 1,2-DCE, the results are also generally similar to actual concentrations, however, 1,2-DCE concentrations predicted by the model are higher in wells closer to the source area (MW-44) and are lower in the further downgradient wells; the shift occurs between wells PT-22 and MW-29.

Thus, the results of modelling two contaminant transport scenarios show that degradation is a significant factor affecting the fate and transport of the TCE/1,2-DCE plume and suggests that the plume may have reached a steady state condition.

5.4 HEAVY METALS

The behavior of heavy metals in soil is unlike organic compounds in many aspects. For example, volatilization of metals from soil is not considered a realistic mechanism for contaminant migration and is not considered here. However, leaching and sorption will be considered.

Leaching of heavy metals from soil is controlled by numerous factors. The most important consideration for leaching of heavy metals is the chemical form (base metal or cation) present in the soil. The leaching of metals from soils is substantial if the metal exists as a soluble salt. In general, metal oxides are considered less likely to leach metallic ions than metallic salts. Upon contact with surface water or precipitation, the heavy metals can be solubilized, eventually leaching to the groundwater.

Oxidation and reduction involves the change of the valence state of the metals and has a large influence on the other fate mechanisms. A good example of the variation in contamination fate due to oxidation and reduction changes is chromium. Chromium (Cr) normally exists in one of two valence states, +3 and +6 [Cr(III) and Cr(VI)]. Cr(VI) generally exists in groundwater as CrO_2^{-2}, which is far more soluble than Cr(III), the dominant environmental form of Cr(III), and therefore represents a greater threat to human health or the environment. Cr(VI) is the dominant form of chromium under oxidizing conditions, while

Cr(III) would be more prevalent under reducing conditions. The redox state may also affect the toxicity of a compound.

One property of the soil which is often correlated with potential metal migration is soil pH. If the soil pH is greater than 6.5, most metals, especially those normally present as cations, are fairly immobile. At higher pH values, metals form insoluble carbonate and hydroxide complexes. Metals would be most mobile in highly acidic soils, i.e. those with a pH of less than 5.

The surface soils at the Ash Landfill have pH values ranging from 5 to 8.4 (SCS, 1972). Subsurface soils have even higher pHs, with the data indicating values ranging from 7 to 9.

Therefore, metals at the OB grounds would be expected to be present primarily in insoluble forms.

Metals, such as, copper, lead, and zinc, are considered the metals of concern at this site, and merit a more detailed evaluation.

Copper is dispersed throughout the atmosphere primarily as a result of anthropogenic activities. Environmental fate processes may transform one copper compound to another; however, copper itself is not degraded. Most of the copper in the atmosphere occurs in the aerosol form, and long-distance transport may occur. Wet or dry deposition is expected to be the primary fate process in air.

Several processes determine the fate of copper in aquatic environments, these being: formation of complexes, especially with humic substances; sorption to hydrous metal oxides, clays, and organic materials; and bioaccumulation. Organic complexes of copper are more easily adsorbed on clay and other surfaces than the free form. The aquatic fate of copper is highly dependent on factors such as pH, oxidation-reduction potential, concentration of organic matter, and the presence of other metals. With regard to the latter, it has been demonstrated that coprecipitation of copper with hydrous oxides of iron effectively scavenges copper from solution, although in most surface waters organic materials prevail over inorganic ions in complexing copper.

Generally, copper is considered to be among the more mobile of the heavy metals in surface environments. Seasonal fluctuations have been observed in surface water copper concentrations, with higher levels in fall and winter, and lower levels in the spring and summer. Copper is not expected to volatilize from water. Since copper is an essential nutrient, it is strongly accumulated by all plants and animals, but is probably not biomagnified.

The degree of persistence of copper in soil depends on the soil characteristics and the forms of copper present. For example, in soils of low organic content, soluble copper compounds may move into groundwater at a significant rate. On the other hand, the presence of organic complexing agents may restrict movement in soil, and copper may be immobilized in the form of various inorganic complexes. Copper is not expected to volatilize from soil.

Lead is extremely persistent in both water and soil. Environmental fate processes may transform one lead compound to another; however, lead is generally present in the +2 oxidation state, and will form lead oxides, although lead itself is not degraded. It is largely associated with suspended solids and sediments in aquatic systems, and it occurs in relatively immobile forms in soil. Lead which has been released to soils may become airborne as a result of fugitive dust generation.

Elemental zinc is a bluish-white, lustrous metal having a distorted hexagonal close-packed structure. It is stable in dry air, but upon exposure to moist air will form a white coating composed of basic carbonate. Zinc loses electrons (oxidizes) in aqueous environments. In the environment, zinc is found primarily in the +2 oxidation state. Elemental zinc is insoluble; most zinc compounds show negligible solubility as well, with the exception of elements (other than fluoride) from Group VIIa of the Periodic Table compounded with zinc (i.e., $ZnCl_2$, ZnI_2) showing a general 4:1 compound to water solubility level. In contaminated waters, zinc often complexes with a variety of organic and inorganic ligands. Therefore, the overall mobility of zinc in an aqueous environment, or through moist-to-wet soils, may be accelerated by compounding/complexing reactions.

Zinc has a tendency to adsorb to soils and to sediment and suspended solids in waters. Adsorption to sediments and suspended solids is the primary fate for zinc in aqueous environments, and will greatly limit the amount of solubilized zinc. Zinc is an essential element and, therefore, is accumulated by all organisms. Zinc concentrations in air are relatively low except near industrial sources. Volatilization is not an important process from soil or water.

5.5 OTHER ORGANIC COMPOUNDS

A number of other organic compounds were detected at the Ash Landfill during the RI. Volatile fuel related organics, such as xylene, were found. Also detected were several semivolatile organic compounds including PAHs and phthalates, pesticides, and PCBs.

Volatile fuel related organics were detected in only a few of the samples collected at the Ash Landfill, and are not considered a major threat to human health and the environment. These compounds have higher vapor pressures, and Henry's Law constants, and would tend to biodegrade rapidly and migrate through volatilization. There is no data available to evaluate the air pathway, but since the soil concentrations of these compounds are so low, it is unlikely that measurable concentrations would be present in the air at the site. Substantial surface water and groundwater data were collected during the two phases of the RI, and there is no evidence that these compounds have migrated though either of these pathways.

The semivolatile organics, pesticides, and PCBs are characterized by low vapor pressures and Henry's Law constants, indicating little potential for volatilization. High sorption coefficients (7,500 mL/g) indicate that these chemicals will be tightly bound up in the soil, and would tend to migrate only in conjunction with the soil itself. Most PAHs have K_{oc} values greater than 2,000 mL/g, indicating that they are immobile.

6.0 BASELINE RISK ASSESSMENT

6.1 INTRODUCTION

6.1.1 Overview

The primary mandate of the Superfund program is to protect both human health and the environment from current and potential threats posed by uncontrolled hazardous substance releases. As part of the RI/FS at the Ash Landfill, an evaluation of potential risks to human health and the environment is provided in this baseline risk assessment. The goal of this baseline risk assessment is to provide a framework for developing and presenting the necessary risk information to assist in remedial action decisions at the Ash Landfill. The Ash Landfill comprises a single operable unit. Therefore, the decision was made to evaluate it as a single site for the baseline risk assessment.

The objectives of the baseline risk assessment are: to help determine whether additional response actions are necessary at the site; to provide a basis for determining residual chemical levels that are adequately protective of human health and the environment; to provide a basis for comparing potential health impacts of various remedial alternatives; and to help support selection of the "No Action" remedial alternative, where appropriate. To meet these objectives, the *Risk Assessment Guidance for Superfund* (RAGS) (USEPA, 1989a) was followed when possible and applicable. However, as stated in the guidance document, "The Human Health Evaluation Manual (also referred to as RAGS) admittedly cannot address all site circumstances." Technical judgment, consultation with USEPA staff, and specific state of New York requirements were all considered and used in the development of the baseline risk assessment.

The baseline risk assessment is divided into two basic components: the human health evaluation and the ecological risk assessment evaluation. Separate risk calculations are presented for current offsite and future onsite residential land-use scenarios. Included as appendices are the chemical profiles and risk assessment data base.

6.1.2 Site Description

SEDA is an active military facility located near Romulus, New York. The facility is located in an uplands area, at an elevation of approximately 600 feet Mean Sea Level (MSL), that forms a divide separating two of the New York Finger Lakes, Cayuga Lake on the east and Seneca Lake on the west. Sparsely populated farmland covers most of the surrounding area. New York State Highways 96 and 96A adjoin SEDA on the east and west boundaries, respectively. The Ash Landfill site is situated on the western flank of the topographic high between Cayuga and Seneca Lakes. The Ash Landfill site encompasses approximately 130 acres of the 10,587 acre SEDA. The site consists of an abandoned incinerator building and tower (Building 2207), a former cooling pond, an Ash Landfill, a Non-Combustible Fill Landfill and several debris piles. The site is bounded on the north by Cemetery Road, on the east by a SEDA railroad line, on the south by undeveloped SEDA land, and on the west by the depot's boundary. Beyond the depot's western boundary are farmland and residences on Smith Farm Road and along Route 96A. Sampson State Park near Seneca Lake is further to the west.

6.1.3 General Site History

SEDA was constructed in 1941 and has been owned by the United States Government and operated by the Department of the Army since this time. Since its inception SEDA's primary mission has been the receipt, storage, maintenance, and supply of military items. Prior to construction of the depot, the site was used for farming.

From 1941 to 1974, uncontaminated trash was burned in a series of burn pits east of the abandoned incinerator building and the ash from the refuse burning pits was buried in an Ash Landfill. The incinerator was built in 1974. Between 1974 and 1979, rubbish and garbage generated at the depot were disposed in the incinerator. Ashes and other residues from the incinerator were temporarily disposed of in an unlined cooling pond immediately north of the incinerator building. When the pond filled (approximately every 18 months), the fly ash and residues were removed, transported, and buried in the adjacent Ash Landfill east of the cooling pond. The ash was dumped in piles and occasionally spread and compacted. No daily or final cover was applied. The incinerator was destroyed by a fire on May 8, 1979, and the landfill was subsequently closed. The landfill was apparently covered with native soils of various thicknesses.

A grease pit disposal area near the eastern boundary of the site was used for disposal of cooking grease. Evidence of burning of debris in several nearby piles is evidenced by the areas of blackened soil, charred debris and areas of stressed or dead vegetation. The approximately 2-acre Non-Combustible Fill Landfill southeast of the incinerator building (immediately south of the SEDA railroad line) was used as a disposal site for non-combustible materials including construction debris from 1969 until 1977.

6.1.4 Local Area Well Survey

Based on information obtained from the Town of Romulus, eleven private homes with drinking water wells were identified within a one-mile radius of the abandoned incinerator building. The wells are all located west of the depot. The nearest wells are at a farmhouse located approximately 2,400 feet west of the incinerator building (1600 feet from the westernmost boundary of the site) on West Smith Farm Road. The house has three wells on the premises including: 1) a deep farmhouse well, 2) a shallow farmhouse well, and 3) a barn well. Another off-site well is located approximately 4,000 feet southwest of the incinerator building near the Seneca Army Airfield. The remaining homes with wells within a one-mile radius are located approximately 5,000 feet northwest of the incinerator building along Route 96A.

6.1.5 General Sampling Locations and Media

During the RI and previous investigations samples of soil gas, soil, groundwater, surface water and sediment were collected. Soil gas samples were collected at suspected source areas of volatile organics in soil and at geophysical anomalies. Soil samples were collected from the Ash Landfill the Non-Combustible Fill Landfill and the debris piles. Surface water and sediment samples were collected from on-site wetlands and drainage ditches and from Kendaia Creek. A network of monitoring wells was installed in and downgradient of the Ash Landfill to measure groundwater quantity.

Following the collection, validation and screening of this database, a subset of this collected data was utilized to establish the Exposure Point Concentrations (EPCs) used in the health risk assessment. The selection of the data used as the EPC was based upon consideration of the sample media and the location and the depth of the sample, consistent with the identified exposure scenarios.

EPCs for the following exposure scenarios were considered for this risk assessment:

1. Dermal Contact to Surface Water and Sediments while Wading in Kendaia Creek (Current and Future Land Use Scenarios)

2. Ingestion of Groundwater (Current and Future Land Use Scenarios)

3. Inhalation and Dermal Contact with Groundwater while Showering/Bathing (Current and Future Land Use Scenarios)

4. Incidental Ingestion and Dermal Contact to On-site Soils (Future Land Use Scenario)

5. Inhalation of Volatile Organics in Ambient Air (Current and Future Land Use Scenarios).

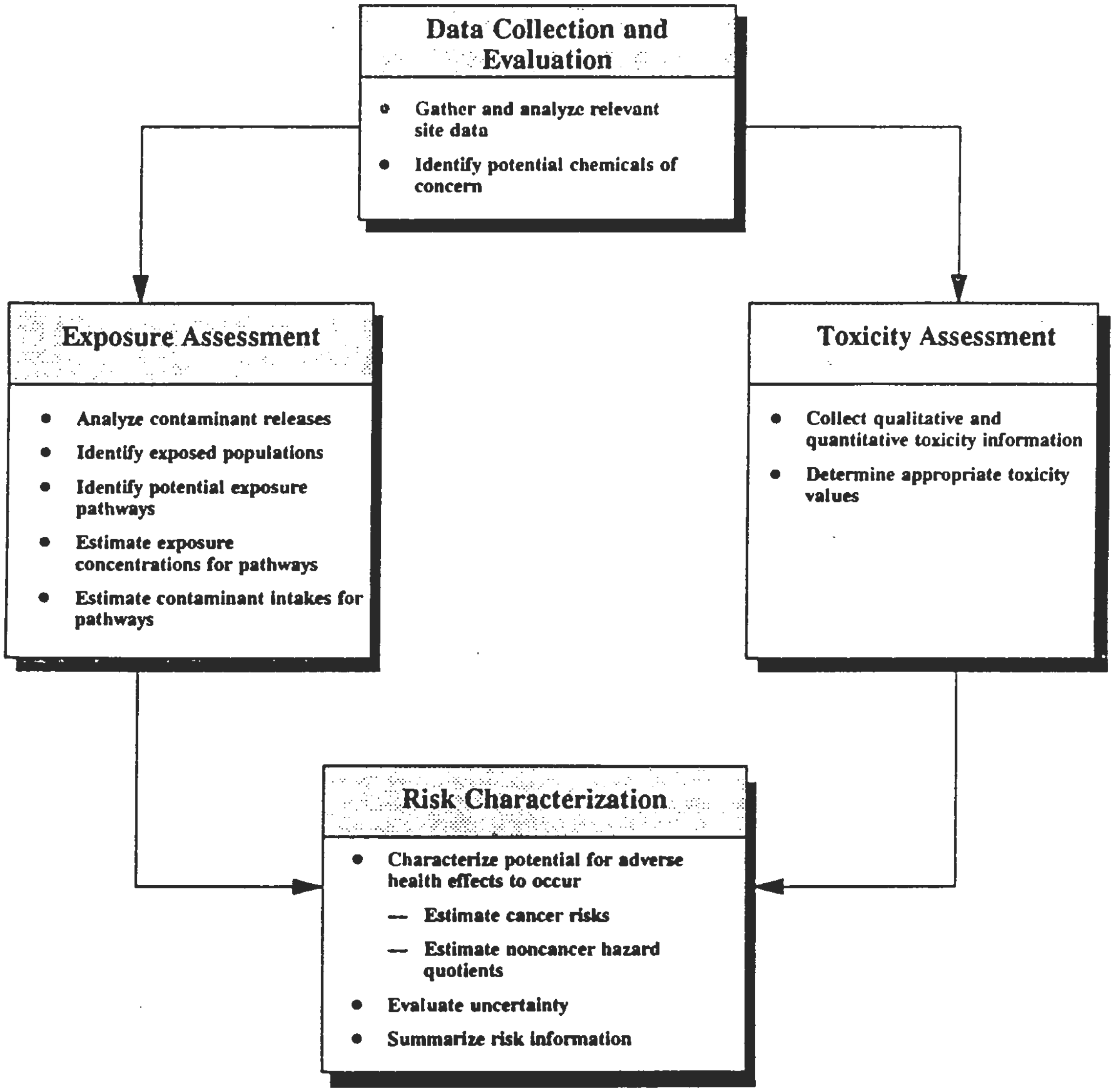
All on-site and off-site surface water and sediment data collected from the on-site wetlands and Kendaia Creek were used to estimate the EPC for both the current and future land scenarios. This is conservative estimate because it is unlikely that wading in the on-site wetlands would occur in the current land use exposure scenario. The on-site groundwater data was used to estimate the EPC for the future residential exposure scenario. The data from the three off-site farmhouse wells were used to estimate the EPC for the current exposure to groundwater. Currently, ingestion of on-site groundwater is not a completed exposure pathway. The same groundwater databases were used to estimate the current and future EPCs for the exposure due to inhalation and dermal contact to showering/bathing. All on-site surface soil samples from the 0-to-2 foot range were used in estimating the EPC due to on-site dermal exposure and soil ingestion. All soil samples were used in estimating the EPC for soil ingestion and dermal exposure for construction workers. The soil samples from the volatile organic "hot spot" at the "bend in the road area" were used as input to a model to estimate ambient air concentrations of volatile organics.

6.1.6 Methodology and Organization of Document

The methodology employed for this baseline risk assessment follows USEPA guidance. The relationships of the major steps involved are presented in flowchart form in Figure 6-1. This section contains seven major subsections, as follows:

1. Identification of Chemicals of Concern (Section 6.2)

This section provides site-related data including both on- and off-site source related chemical data, along with background chemical data. Detailed summaries and statistical analyses of



Source:EPA, 1989a

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-01000

FIGURE 6-1

BASELINE RISK ASSESSMENT PROCESS

SCALE

these data are provided in this section. All chemicals with validated detections in the applicable environmental media were evaluated in the risk assessment. The relevant exposure pathway risks were calculated for each detected chemical. Also included in the Data Evaluation section is an evaluation of site background data. Relevant background data are presented and, where appropriate, statistical analyses performed to allow for comparing on-site chemical concentrations with available background data.

2. Exposure Assessment (Section 6.3)

This section includes derivation and presentation of the applicable exposure point concentrations used in the human health risk assessment. Exposure point concentrations for the baseline risk assessment are based on analytical data and modeling results. Exposure point concentrations are provided for both current offsite and future onsite land-use scenarios, and correspond to the applicable exposure pathways for the baseline risk assessment.

For the current off-site land-use scenario, the exposed population or receptors considered are nearby residents. The calculated risk values for the current off-site land-use scenario do not apply to a specific individual, but rather represent risk to a reasonable maximum exposed (RME) individual based on Superfund guidance. These risk values are dictated by the environmental sampling data collected from the various sampling locations. For the future on-site land-use scenario, on-site residents and construction workers are the relevant exposed populations. In these scenarios, the calculated risk values apply to a hypothetical RME individual living or working on the site, and the risk values are dictated by the collected environmental sampling data used in the risk assessment. In both land-use scenarios, children (ages 1 to 6) and adults (ages 7 to 31) are considered, and either a 30-year residential or 25-year industrial exposure duration is used. Another exposure scenario, which encompasses both current and future conditions is the on-site hunter. In this scenario the calculated risks apply to a hypothetical RME who hunts on the site.

The three primary exposure routes ingestion, inhalation, and dermal contact are all considered in the baseline risk assessment. Chemical intake values for both current and future land use are calculated based on exposure pathways, specific exposure values, and assumptions. Equations used to calculate intakes for all applicable exposure pathways are presented in this section.

3. Toxicity Assessment (Section 6.4)

This section presents oral, inhalation, and dermal toxicity values used in the human health risk calculations. Appropriate data sources and, when necessary, calculation rationale are provided to support the toxicity values.

4. Risk Characterization (Section 6.5)

This section presents the risk calculations for all human health exposure pathways for current and future land use. This includes summary tables by pathway for non-carcinogenic and carcinogenic risk values. Total hazards and risks are also presented by environmental medium and by individual chemical.

5. Ecological Risk Assessment (Section 6.6)

This section provides an identification and characterization of potential risks posed to environmental receptors. Included is an assessment of the ecological communities and dominant flora and fauna in the vicinity of the Ash Landfill, and an identification of potential pathways for receptor exposure.

6. Uncertainty (Section 6.7)

This section discusses the potential uncertainties of the methodology, assumptions, judgments, and data used in the risk assessment.

7. Summary (Section 6.8)

In this, the final section, all conclusions and results are summarized for the human health and ecological risk assessments.

6.2 IDENTIFICATION OF CHEMICALS OF CONCERN

The usability of site-related chemical data is a critical factor in assessing the human health effects of chemical contamination. The usability of these data depends on their availability, defensibility, and quality. Data availability depends on sampling history, while data defensibility depends on documentation, analytical methods, detection and reporting limits, and data validation. Data quality is measured via precision, accuracy, representativeness, completeness, and comparability.

Site-related chemical data must be managed and manipulated in order to determine representative concentrations of contaminants. Elements of data manipulation include combining multiple analyses of individual samples, incorporating results from the analyses of blind field duplicates, and addressing non-detected analytes in computing pertinent statistics. This section discusses these issues along with summarizing detected chemicals in environmental media and background.

Data collected during the RI were evaluated for suitability of use in the risk assessment as discussed in RAGS (EPA, 1989a). These decisions were based on analytical methods, quantitation limits, qualifiers, and blank contamination. The suitable RI data were then evaluated to determine chemicals of potential concern, for which an exposure assessment, a toxicity assessment, and a risk characterization were performed.

6.2.1 General Site-specific Data Collection Considerations

6.2.1.1 Detailed Historical Information Relevant to Data Collection

A substantial volume of data is available for the Ash Landfill. Soil, groundwater, surface water, and sediment have been sampled under various investigative programs conducted at the Ash Landfill. Information is available on all of the affected media. The historical information was used to plan the RI, but this risk assessment uses only data collected during the RI and data collected during recent quarterly monitoring events.

A number of reports have provided historical data on the Ash Landfill. These are described in Section 1, and include:

Army Pollution Abatement Program Study (USAEHA 1979)

Installation Assessment Report (USATHAMA 1980)

Evaluation of SWMU's (USAEHA 1987)

Quarterly Groundwater Monitoring (1987-1991)

Geohydrologic Study (USAEHA 1987)

RI/FS (USATHAMA - 1989)

6.2.1.2 Background Sampling

A total of 15 background soil samples were compiled for this RI. Only inorganic constituents have been evaluated. Anthropogenic organic constituents have not been considered. This has produced a more conservative risk assessment since all organic constituents have been assumed to be present due to previous site activities. The results are discussed in Section 3.0 and have been presented for review in Table 3-2. Soil samples from the Ash Landfill and the OB Grounds site, located approximately 3 miles north of the Ash Landfill, have been combined into the background database. This was done so that the statistical evaluation of the data would be representative of the variations in the site soil. Geologically, the material is identical, having been deposited from the same source. This fact justifies combining the background soil chemical composition data from these two sites into one larger database.

Two overburden (MW-34 and MW-37) and three bedrock (PT-10, MW-41D and MW-42D) monitoring wells, all upgradient or side gradient of the Ash Landfill were installed to determine the background water quality. Well locations are shown on Figure 2-8.

6.2.1.3 Sampling Locations and Media

Four media were sampled during the Ash Landfill RI, soil, groundwater, surface water, and sediment. When possible, grab surface water and sediment samples were collected from the same locations. The majority of these samples were taken from nearby drainage channels, wetlands and Kendaia Creek. As part of the RI twenty-five monitoring wells were installed and sampled in addition to the twenty-one existing wells at the Ash Landfill. A total of thirty borings were installed and surface and subsurface soil samples were collected from these borings during the RI Phases I and II. The locations of all samples are shown on Figures 2-6, 2-8, 2-9, and 2-11. The rationale for use of these data in calculating exposure point concentrations for different exposure scenarios is presented in Section 6.1.5.

6.2.1.4 Sampling Methods

Detailed sampling methods are described in Section 2 , however a brief description of the sampling of the four media, surface water, sediment, soil, and groundwater, is provided below.

Surface water samples were collected from several locations on the site by directly filling the appropriate sample containers or when the water depth was relatively shallow, sample containers were filled by bailing water into sample containers with a decontaminated glass beaker. Sediment samples were collected by scooping sediment into a decontaminated stainless steel bowl with a decontaminated trowel. Volatile organic analyte (VOA) samples were taken first, prior to any mixing of the sediments. Then, the bowl was refilled with additional sediment, if required, thoroughly mixed and the appropriate sample containers filled with sediment.

Soil borings were performed using a drilling rig equipped with 4.25-inch hollow stem augers. All borings were advanced to refusal on competent bedrock. During drilling, soil samples were collected continuously at 2-foot intervals using a decontaminated 2 or 1.5 foot split spoon sampler according to the method described in ASTM-D 1586-84. Up to four soil samples were collected for level IV anlayses within each boring. Samples were collected from the surface (0 to 2 feet), at an intermediate zone (3 to 4 feet), from the top of the water table to one foot above the water table, and from the weathered shale zone at the interval from the competent shale unit to two feet above the competent shale unit, except where geologic or water table conditions prevented the collection of these samples.

For Phase I groundwater sampling, the wells were purged of at least three well volumes using a decontaminated Teflon bailer until indicator parameters (pH, temperature and specific conductance) were observed to vary by less than 10 percent and the turbidity was less than 50 NTUs. While stabilization of indicator parameters was achieved, water samples with turbidities less than 50 NTUs were rarely obtained. If during the purging process the well went to near dryness, purging was stopped and the well was allowed to recover to 80 percent of the original water column before additional water was removed. If the well went near dryness again, purging was stopped. Sampling occurred within three hours of purging for high yield wells. For low yield wells groundwater was removed from the well as permitted to fill the appropriate sample containers. Samples were collected using a decontaminated Teflon bailer. The samples were collected in the following order: volatiles, semivolatiles, pesticides and PCBs, herbicides, metals and cyanide. In Phase I, if the turbidity for a well was greater than 50 NTUs, both total and dissolved (filtered) metals were collected.

The groundwater sampling procedure changed significantly from Phase I to Phase II due to the high turbidity of the groundwater. Phase II data consists only of unfiltered samples collected according to the new procedure (only data from unfiltered groundwater samples were used in the baseline risk assessment). The revised procedure involved less surging of the well to produce lower turbidities and included three steps: 1) removal of silt, 2) purging the water standing with a peristaltic pump in the well, and 3) sampling the water. At least three well volumes were removed from the well. Additional volumes were removed until the pH, temperature, and specific conductance were observed to vary less than 10 percent and the turbidity was less than 50 NTUs. Groundwater was sampled with a Teflon bailer or peristaltic pump with Teflon tubing.

6.2.1.5 QA/QC Methods

QA/QC samples were analyzed for the purpose of assessing the quality of the sampling effort and the analytical data. The QA/QC samples included splits, replicates, field equipment blanks, trip blanks, and matrix spike/matrix spike duplicates. Split samples were analyzed by an EPA contract laboratory and the Corps of Engineers Missouri River Division (MRD) to assess the quality of the analytical data. One replicate sample was collected per batch of 20 or fewer samples per matrix. A field equipment blank was collected at a rate of one in twenty for each matrix sampled to detect possible sources of contamination introduced from field sampling equipment or from carry over from one sample to the next. One trip blank was collected per day of water sampling and analyzed for VOCs to determine if samples were contaminated during transit or sample collection. The use of matrix spikes gives insight to the analytical proficiency and efficiency of the analytical methods.

6.2.1.6 Analytical Methods

NYSDEC CLP statement of work methods were used for the analysis of organic and inorganic constituents in soil, sediment, groundwater, and surface water. Herbicides were analyzed using EPA Method 8150.

6.2.1.7 Data Developed through Modelling

An inhalation exposure model was used to estimate the concentration of compounds released in the air while showering. A flux model was used to estimate emissions of volatile organics from soils to ambient air. These results were coupled with a dispersion model which was used to estimate receptors concentrations of volatile organics in ambient air. A discussion of the models and data used are presented in the exposure assessment section.

6.2.2 Data Usability

The data usability criteria of documentation, analytical methods, data validation, precision, accuracy, representativeness, comparability, and completeness are discussed in this section. The data was sorted by medium: soil, surface water, sediment, and groundwater. The RI data was collected over two time periods, Phase I and Phase II. Phase I began in September 1991, and ended in January 1992. Phase II began in January 1993 and ended in June 1993.

6.2.2.1 Documentation

Documentation of sample collection and laboratory analysis is essential in order to authenticate conclusions derived from data. Standard operating procedures (SOPs) for field collection of samples are in Appendix A of the Project Workplan, and were followed during sample collection. Formal chain-of-custody records that included sample IDs, date sampled, sample collector, analyses and methods required, matrix, preservation per analysis, and comments were maintained.

Laboratory SOPs were used for all analyses required. Deviations from these SOPs were documented in case narratives per sample delivery group (SDG). Deviations from these SOPs were minor and did not adversely affect data quality.

6.2.2.2 Evaluation of Analytical Methods

All data used in the risk assessment is level IV CLP data. Although level I field screening data were collected as part of the RI, it was not used in the quantitative risk assessment. Since the RI/FS ultimately requires decisions regarding future site remedial actions the data collected must be of sufficient quantity to support this decision making process. The CLP was developed to ensure that consistent QA/QC methods are used when evaluating Superfund site samples. This does not mean that all CLP data is automatically of sufficient quality and reliability for use in the quantitative risk assessment.

The data was validated in compliance with EPA Region II validation guidelines. The following parameters and the results of the QA/QC samples were considered and used to validate the data: data completeness, holding times, GC/MS tuning, calibration, blanks, surrogate recoveries, matrix spike/matrix spike duplicates, field duplicates, internal standard performance, compound identification, compound quantitation, spike sample recovery for metals, laboratory duplicates for metals, interference for metals, and qualifiers. Steps were taken to ensure that the data was appropriate and reliable for use in the risk assessment. These steps, such as evaluation of quantitation limits, are discussed in the following sections.

6.2.2.3 Evaluation of Quantitation Limits and Data Reduction

Five points were considered when evaluating methods and reducing data based on sample quantitation limits (SQLs). These were SQLs and their relation to reference concentrations, unusually high SQLs, when only some samples in a medium test positive for a chemical, when SQLs are not available, and when chemicals are not detected in any sample in a medium. Each of these points are discussed below.

To ensure that volatile organic analyses of groundwater could be compared to reference standards, NYS Drinking Water Standards, whenever the Phase I results from a given well had a majority of compounds not detected, then the Phase II sample from that well was analyzed using Method 524.2 with a level IV data package to attain the lower sample quantitation limits necessary.

The data for each medium were evaluated to determine if there were any unusually high SQLs. The mean and standard deviation for each compound in each of the four media and the 95th percentile upper confidence limit (95th UCL) of the mean were calculated as follows:

$$95th\ UCL = \bar{x} + t\frac{s}{\sqrt{n-1}}$$

where:

$\bar{x}$ = the mean concentration
s = the standard deviation of the sample results
n = the number of samples
t = the statistic for a one tailed t-test at the 95th confidence level

The 95th UCL is the value for which there is 95 percent confidence that the site mean will not exceed this value. If any unusually high SQLs caused this value to exceed the actual maximum detected value these high SQLs were eliminated. The 95th UCL was then recalculated and the comparison repeated until no SQLs caused the 95th UCL to exceed the maximum detected value. According to RAGS (Section 5.3.2), unusually high SQLs that would "cause the calculated exposure concentration to exceed the maximum detected concentration should be eliminated" (EPA, 1989a).

Sometimes only some samples in a medium tested positively for a chemical. In the other samples the chemical was not measured above the quantitation limit. The chemical could of course be present just below the quantitation limit or it may not be there at all. To account for this possibility non-detected results were included in the risk assessment at one-half the SQL.

SQLs were provided by the laboratory for every compound that was not detected so no adjustment had to be made for non-detects without SQLs.

If for a given compound in a medium, the validated results were all non-detects or rejected (qualifier = U, UJ, UR, or R) that chemical was eliminated from the risk assessment for that particular medium.

6.2.2.4 Evaluation of Qualified and Coded Data

Qualifiers are attached to data by laboratories conducting analyses and by data validation personnel. These qualifiers often pertain to QA/QC problems and may indicate questions concerning chemical identity, chemical concentration, or both. The qualifiers used are as follows:

U	The analyte was not detected.
UJ	The analyte was not detected; however, the associated reporting limit is approximate.
J	The analyte was positively identified; however, QC results indicate that the reported concentration may not be accurate and is therefore an estimate.
R	The analyte was rejected due to laboratory QC deficiencies, sample preservation problems, or holding time exceedance. The presence or absence of the analyte cannot be determined.

Before data was used in the quantitative risk assessment all qualifiers were addressed. This was done according to the prescribed data validation procedures. The end result of the data validation was four possible situations: 1) the data was rejected by either laboratory or data validation personnel and considered unusable (R), 2) the compound was analyzed for but was not detected (U), 3) the data was an estimated value (J), or 4) the data was unqualified. Data that was determined to be not detected by the laboratory (U) and was assigned a J by the data validator, is considered a non-detect for the risk assessment (UJ).

6.2.2.5 Chemicals in Blanks

Blanks are QC samples analyzed in the same manner as environmental samples, and provide a means of identifying possible contamination of environmental samples. Sources of contamination include the laboratory, the sampling environment, and the sampling equipment. To address contamination, three types of blanks were analyzed: method blanks, trip blanks, and equipment rinseates.

Method blanks consisted of laboratory reagent water or pre-purified and extracted sand taken through the same analytical process as environmental samples. Trip blanks, consisted of distilled water poured into a 40-milliliter glass vial and sealed with a Teflon septum. The trip blanks accompanied sample bottles to the field during sample collection. Trip blanks were not opened during sample collection. Equipment rinseates consisted of deionized water poured into or pumped through sampling devices and then transferred to sample bottles.

According to the data validation guidelines, if the blank contained detectable levels of a common laboratory contaminant, then the sample results were considered positive results (unqualified hit) only if the concentration in the sample exceeded ten times the maximum amount detected in any blank. If the concentration in the sample was less than ten times the maximum amount detected in the blank, it was concluded that the chemical was not detected. Common laboratory contaminants are acetone, 2-butanone, methylene chloride, toluene, and phthalate esters. If the blank contained detectable levels of a chemical that is not a common laboratory contaminant, then the sample results were considered positive results (unqualified hit) only if the concentration in the sample exceeded five times the maximum amount detected in any blank. If the concentration in the sample was less than five times the maximum amount detected in the blank, it was concluded that the chemical was not detected. This procedure was performed as part of the data validation.

6.2.2.6 Precision

The term precision is used to describe the reproducibility of results. It can be defined as the agreement between the numerical values of two or more measurements resulting from the same process. In the case of chemical analyses, precision is determined through the analyses of duplicate environmental samples. Duplicate sample analyses include matrix spikes, blank spikes, blind field duplicates, and replicate instrumental analyses of individual environmental samples.

Matrix spikes involve the introduction of compounds or elements to samples of known concentrations. The assumption is that these introduced compounds will be recovered from environmental samples to the same degree as in matrix spikes. Blank spikes involve the introduction of compounds or elements to laboratory reagent water or pre-purified and extracted sand. Blank spikes eliminate the possibility of matrix interferences or contributions, thereby monitoring analytical performance from sample preparation to analysis. Blind field duplicates are samples labeled with a fictitious sample ID taken from an existing sampling location. They are collected simultaneously with a properly labeled sample and provide the most legitimate means of assessing precision.

Precision estimates were obtained using the relative percent difference (RPD) between duplicate analyses. Overall precision, as well as precision control limits, were estimated using a weighted combination of RPDs from spikes and duplicate analyses. Precision and RPD were acceptable.

6.2.2.7 Accuracy

Accuracy is the degree to which a measurement represents the true value of that parameter. Estimates of accuracy are more difficult to obtain than precision since accuracy requires knowledge of the quantity desired. In the case of chemical analyses, accuracy is determined through the introduction of compounds or elements to samples of known concentrations, or analytical spikes. The assumption is that compounds will be recovered from environmental samples to the same degree as in analytical spikes.

Two types of compounds were added to environmental samples for assessing accuracy: surrogate compounds and matrix spike compounds. Surrogates are compounds that closely approximate target analytes in structure, but are not target analytes. Surrogate compounds generally are added to samples in the preparation stages and monitor the effectiveness of the preparation process. Matrix spike compounds are target analytes that are added based upon expectations of matrix interferences, that impede analyte detection. Laboratory method blank samples were spiked with surrogate compounds, per analysis day, as an additional means of estimating accuracy.

The accuracy of chemical analyses was estimated using the percent recovery (PR) of compounds or elements that were added to analytical spikes. Accuracy and PR were acceptable.

6.2.2.8 Representativeness

Representativeness expresses the extent to which sample data characterize the population or environmental media. Factors influencing representativeness include sample collection, selection of sampling locations representative of site conditions, and use of appropriate chemical methods for sample analyses. Chemical methods are addressed in Section 6.2.2.2. Sampling from locations representative of site conditions was achieved through implementation of the approved field sampling plan. Blind field duplicates were collected and analyzed in order to assess the influence of sample collection on representativeness. Approximately 5 percent of field samples were collected in duplicate. Representativeness was estimated using the RPD between blind field duplicates and was acceptable.

6.2.2.9 Comparability

Comparability is a data characteristic that measures the ability to compare data from a laboratory with data from others. Comparability factors include the use of standard analytical methodologies, data reported in standard or consistent units, appropriate frequency of applicable QC analyses, and laboratory participation in appropriate performance evaluation studies. All data were reported in appropriate and acceptable units. The laboratory performing the CLP inorganic and organic analyses participated in the quarterly USEPA blind performance evaluation program and the MRD performance evaluation program. Their performance in this program was acceptable.

6.2.2.10 Completeness

Completeness measures the amount of usable data relative to the amount of samples collected and analyzed. The completeness goal in the project workplan was 90 percent. Completeness was acceptable.

6.2.2.11 Tentatively Identified Compounds

Tentatively identified compounds (TICs) are compounds not specified on the Target Analyte List for quantification but were identified in the sample. TICs were grouped into two major classes: identified compounds and unknown compounds. Chromatographic peaks determined by the laboratory to be a unique compound were identified and quantified. Chromatographic peaks were identified through mass spectral library searches during sample analyses. Chromatographic peaks that failed absolute identification through mass spectral library searches were categorized into general classes by the laboratory. Although a significant number of TIC's were detected in the soil samples, they are predominantly petroleum hydrocarbon compounds and are not included in the quantitative risk assessment but are generally discussed in Section 6.5.1.3.

6.2.3 Site-specific Data Evaluation Considerations

The first step in evaluating the data from the Ash Landfill RI consisted of the creation of four separate databases, one for each medium sampled; soil, groundwater, surface water, and sediments. Data for each of the four media was evaluated separately.

The data used in the quantitative risk assessment was validated as described previously. The initial reduction in the list of analytes consisted of eliminating the compounds in a medium that were not detected in any sample in that medium. The RAGs states "generally eliminate those chemicals that have not been detected in any samples of a particular medium"(EPA, 1989a). Table 6-1 summarizes this database inspection and lists the chemicals that were eliminated in each of the four media. A compound was determined to be non-detected if its qualifier was a U or UJ.

An intermediate step which did not reduce the list of analytes any further but did eliminate data that would have "caused the calculated exposure concentration to exceed the maximum detected concentration" (EPA, 1989a), is discussed in Section 6.2.2.4. It is the procedure by which samples that had quantitation limits that were unusually high were eliminated.

At this stage all qualifiers were eliminated from the database. Any result with either no qualifier or a J qualifier was taken at full value. Any non-detect (U or UJ qualifier) was taken at half of the value. The resulting database contained only values. The average, standard deviation, and coefficient of variance (CV) was calculated for each analyte in each of the four media. The coefficient of varience is the ratio of the Standard deviation over the mean. A coefficient of variance greater than one indicates that the data is non-normally distributed.

TABLE 6-1

LIST OF CHEMICALS ANALYZED FOR BUT NOT DETECTED SOIL SAMPLES

SENECA ARMY DEPOT ASH LANDFILL

Volatile Organic Compounds

- Chloromethane
- Bromomethane
- Chloroethane
- Methylene Chloride
- 1,1-Dichloroethane
- 1,1,1-Trichloroethane
- Carbon Tetrachloride
- Vinyl Acetate
- Bromodichloromethane
- 1,2-Dichloropropane
- cis-1,3-Dichloropropene
- Dibromochloromethane
- 1,1,2-Trichloroethene
- trans-1,3-Dichloropropene
- Bromoform
- 4-Methyl-2-Pentanone
- 2-Hexanone
- 1,1,2,2-Tetrachloroethane
- Styrene

Semivolatiles

- bis(2-Chloroethyl) ether
- 2-Chlorophenol
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- Benzyl Alcohol
- 1,2-Dichlorobenzene
- 2-Methylphenol
- bis(2-Chloroisopropyl) ether
- 4-Methylphenol
- N-Nitroso-di-n-propylamine
- Hexachloroethane
- Nitrobenzene
- Isophorone
- 2,4-Dimethylphenol
- bis(2-Chloroethoxy) methane
- 2,4-Dichlorophenol
- 1,2,4-Trichlorobenzene
- 4-Chloroaniline
- Hexachlorobutadiene
- 4-Chloro-3-methylphenol
- Hexachlorocyclopentadiene
- 2,4,6-Trichlorophenol
- 2,4,5-Trichlorophenol
- 2-Chloronaphthalene
- 2-Nitroaniline
- Dimethylphthalate
- 2,6-Dinitrotoluene
- 3-Nitroaniline
- 2,4-Dinitrophenol
- Diethylphthalate
- 4-Chlorophenyl-phenylether
- 4-Nitroaniline
- 4,6-Dinitro-2-methylphenol
- 4-Bromophenyl-phenylether
- Hexachlorobenzene
- Pentachlorophenol
- Carbazole
- 3,3'-Dichlorobenzidine

Pesticides/PCBs

- alpha-BHC
- beta-BHC
- delta-BHC
- gamma-BHC (Lindane)
- Aldrin
- Heptachlor epoxide
- Endosulfan I
- Endrin
- Endosulfan II
- Endosulfan sulfate
- Methoxychlor
- Endrin ketone
- Endrin aldehyde
- alpha-Chlordane
- gamma-Chlordane
- Toxaphene
- Aroclor-1016
- Aroclor-1221
- Aroclor-1232
- Aroclor-1248
- Aroclor-1254

Herbicides

- 2,4-D
- 2,4,5-T
- Dalapon
- Dicamba
- Dichloroprop
- Dinoseb
- MCPA

Metals

- Thallium

TABLE 6-1

LIST OF CHEMICALS ANALYZED FOR
BUT NOT DETECTED
SEDIMENT SAMPLES

SENECA ARMY DEPOT
ASH LANDFILL

Volatile Organic Compounds

Chloromethane
Bromomethane
Vinyl Chloride
Chloroethane
Methylene Chloride
Carbon Disulfide
1,1-Dichloroethane
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride
Vinyl Acetate
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-Dichloropropene
Dibromochloromethane
1,1,2-Trichloroethane
Benzene
trans-1,3-Dichloropropene
Bromoform
4-Methyl-2-Pentanone
2-Hexanone
Tetrachloroethene
1,1,2,2-Tetrachloroethane
Toluene
Chlorobenzene
Ethylbenzene
Styrene
Xylene (total)

Semivolatiles

Phenol
bis(2-Chloroethyl) ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl Alcohol
1,2-Dichlorobenzene
2-Methylphenol
bis(2-Chloroisopropyl) ether
N-Nitroso-di-n-propylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic acid
bis(2-Chloroethoxy) methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-methylphenol
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethylphthalate
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
Diethylphthalate
4-Chlorophenyl-phenylether
4-Nitroaniline
4,6-Dinitro-2-methylphenol
4-Bromophenyl-phenylether
Hexachlorobenzene
Pentachlorophenol
Butylbenzylphthalate
3,3'-Dichlorobenzidine
Di-n-octylphthalate

Pesticides/PCBs

alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
Heptachlor
Aldrin
Heptachlor epoxide
Endosulfan I
Dieldrin
Endosulfan II
Methoxychlor
Endrin ketone
Endrin aldehyde
gamma-Chlordane
Toxaphene
Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254

Herbicides

2,4-D
2,4-DB
2,4,5-T
2,4,5-TP (Silvex)
Dalapon
Dicamba
Dichloroprop
Dinoseb
MCPA
MCPP

TABLE 6-1

LIST OF CHEMICALS ANALYZED FOR
BUT NOT DETECTED
GROUNDWATER SAMPLES

SENECA ARMY DEPOT
ASH LANDFILL

Volatile Organic Compounds

Chloromethane
Bromomethane
Chloroethane
Methylene Chloride
Acetone
Carbon Disulfide
2-Butanone
Carbon Tetrachloride
Vinyl Acetate
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-Dichloropropene
Dibromochloromethane
1,1,2-Trichloroethane
trans-1,3-Dichloropropene
Bromoform
2-Hexanone
1,1,2,2-Tetrachloroethane
Chlorobenzene
Styrene

Volatile Organic Compounds(524.2)

Dichlorodifluoromethane
Chloromethane
Vinyl Chloride
Bromomethane
Chloroethane
Trichlorofluoromethane
1,1-Dichloroethene
Acetone
Carbon Disulfide
Methylene Chloride
trans-1,2-Dichloroethene
1,1-Dichloroethane
2,2-Dichloropropane
cis-1,2-Dichloroethene
2-Butanone
Bromochloromethane
Chloroform
1,1,1-Trichloroethane
Carbon Tetrachloride
1,1-Dichloropropene
Benzene
1,2-Dichloroethane
Trichloroethene
1,2-Dichloropropane
Dibromomethane
Bromodichloromethane
cis-1,3-Dichloropropene
4-Methyl-2-Pentanone
Toluene
trans-1,3-Dichloropropene
1,1,2-Trichloroethane
Tetrachloroethene
1,3-Dichloropropane
2-Hexanone
Dibromochloromethane
1,2-Dibromoethane
Chlorobenzene
1,1,1,2-Tetrachloroethane
Ethylbenzene
Styrene
Bromoform
Isopropylbenzene
Bromobenzene
1,1,2,2-Tetrachloroethane
1,2,3-Trichloropropane
n-Propylbenzene
2-Chlorotoluene
4-Chlorotoluene
1,3,5-Trimethylbenzene
tert-Butylbenzene
1,2,4-Trimethylbenzene
sec-Butylbenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
p-Isopropyltoluene
1,2-Dichlorobenzene
n-Butylbenzene
1,2-Dibromo-3-Chloropropane
1,2,4-Trichlorobenzene
Hexachlorobutadiene
Naphthalene
1,2,3-Trichlorobenzene
Xylene (total)

Semivolatiles

2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl Alcohol
1,2-Dichlorobenzene
2-Methylphenol
bis(2-Chloroisopropyl) ether
N-Nitroso-di-n-propylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic acid
bis(2-Chloroethoxy) methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-methylphenol
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethylphthalate
Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
4-Chlorophenyl-phenylether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-methylphenol
N-Nitrosodiphenylamine (1)
4-Bromophenyl-phenylether
Hexachlorobenzene
Phenanthrene
Anthracene
Carbazole
Fluoranthene
Pyrene
Butylbenzylphthalate
3,3'-Dichlorobenzidine
Benzo(a)anthracene
Chrysene
bis(2-Ethylhexyl)phthalate
Di-n-octylphthalate
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

Pesticides/PCBs

alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
Heptachlor
Aldrin
Heptachlor epoxide
Endosulfan I
Dieldrin
4,4'-DDE
Endrin
Endosulfan II
4,4'-DDD
Endosulfan sulfate
4,4'-DDT
Methoxychlor
Endrin ketone
Endrin aldehyde
alpha-Chlordane
gamma-Chlordane
Toxaphene
Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260

Herbicides

2,4-D
2,4-DB
2,4,5-T
2,4,5-TP (Silvex)
Dichloroprop
Dinoseb
MCPA
MCPP

Metals

Thallium

TABLE 6-1

LIST OF CHEMICALS ANALYZED FOR
BUT NOT DETECTED
SURFACE WATER SAMPLES

SENECA ARMY DEPOT
ASH LANDFILL

Volatile Organic Compounds

Chloromethane
Bromomethane
Vinyl Chloride
Chloroethane
Methylene Chloride
Acetone
Carbon Disulfide
1,1-Dichloroethene
1,1-Dichloroethane
1,2-Dichloroethene (total)
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride
Vinyl Acetate
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-Dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-Trichloroethane
Benzene
trans-1,3-Dichloropropene
Bromoform
4-Methyl-2-Pentanone
2-Hexanone
Tetrachloroethene
1,1,2,2-Tetrachloroethane
Toluene
Chlorobenzene
Ethylbenzene
Styrene
Xylene (total)

Semivolatiles

Phenol
bis(2-Chloroethyl) ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl Alcohol
1,2-Dichlorobenzene
2-Methylphenol
bis(2-Chloroisopropyl) ether
4-Methylphenol
N-Nitroso-di-n-propylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic acid
bis(2-Chloroethoxy) methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-methylphenol
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethylphthalate
Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
Diethylphthalate
4-Chlorophenyl-phenylether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-methylphenol
N-Nitrosodiphenylamine (1)
4-Bromophenyl-phenylether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Carbazole
Di-n-butylphthalate
Fluoranthene
Pyrene
Butylbenzylphthalate
3,3'-Dichlorobenzidine
Benzo(a)anthracene
Chrysene
bis(2-Ethylhexyl)phthalate
Di-n-octylphthalate
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

Pesticides/PCBs

alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
Heptachlor
Aldrin
Heptachlor epoxide
Endosulfan I
Dieldrin
4,4'-DDE
Endrin
Endosulfan II
4,4'-DDD
Endosulfan sulfate
4,4'-DDT
Methoxychlor
Endrin ketone
Endrin Aldehyde
alpha-Chlordane
gamma-Chlordane
Toxaphene
Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260

Herbicides

2,4-D
2,4-DB
2,4,5-T
2,4,5-TP (Silvex)
Dalapon
Dicamba
Dichloroprop
Dinoseb
MCPA
MCPP

Metals

Cadmium
Silver
Thallium
Cyanide

The second step in the reduction of the list of analytes was elimination of analytes, that although were detected at the site, were shown to be statistically the same as the background dataset. This analysis applied only to inorganics in soil and groundwater. The Student's *t*-Test is the statistical method that was used to compare the on-site soil and groundwater datasets to the background datasets to determine the significance of change between background and subsequent parameter values. Guidance is currently not available for performing the data set comparison between background and site soils, however, guidance is available for groundwater datasets. The basis for this statistical comparison was obtained from the EPA Guidance document *Groundwater Monitoring Guidance for Owners and Operators of Interim Status Facilities*. Although no site-specific EPA approval was granted to apply the t-test in this situation, the use of the t-test as a statistical method to determine if there is a difference between contaminant concentrations in background areas and on-site is believed to be appropriate. This form of evaluation is consistent with guidance cited in RAGS (EPA 1989a). The first step in this statistical comparison was to determine if the datasets were distributed normally, as the *t*-Test assumes a normal data distribution. The CV was calculated for the on-site dataset. If the CV was greater than 1, the data for that compound was considered to be non-normally distributed. In soil, eleven compounds were determined to be non-normally distributed in the on-site population. These were antimony, arsenic, cadmium, calcium, copper, iron, mercury, nickel selenium, silver, and zinc. In groundwater, eighteen compounds were determined to be non-normally distributed in the on-site population. These were aluminum, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, selenium, sodium, vanadium and zinc. To use the *t*-Test, the non-normal data was log transformed, for both the on-site and background datasets.

The Student's *t*-test comparison is made by first calculating a t-statistic (t^*) as follows:

$$t^* = \frac{\bar{x}_{(m)} - \bar{x}_{(b)}}{\sqrt{\frac{s_{(m)}^2}{n_{(m)}} + \frac{s_{(b)}^2}{n_{(b)}}}}$$

where:

t^* = calculated t-statistic
$n_{(m)}$ = number of samples in the population
$\overline{x}_{(m)}$ = mean of the population
$S_{(m)}$ = standard deviation of the population
$n_{(b)}$ = number of samples in the background
$\overline{x}_{(b)}$ = background mean
$S_{(b)}$ = background standard deviation

The analysis involved the calculation of the t-statistic (t^*) followed by a comparison of this value with the t-statistic for a given confidence interval and degrees of freedom. From a comparison between the two it was then determined if there was a statistically significant change in the parameter value. The t-statistic used for comparison (t^c) with the calculated t-statistic was obtained for the 95% confidence interval. The degrees of freedom are the number of measurements minus one. Using these two parameters, a comparison t-statistic was obtained from a reference table. A t-statistic of 1.645 was used for comparison with all of the calculated t-values. If the calculated t-value was less than 1.645, it was concluded that there was no statistically significant difference, at the 95% confidence level, between the on-site dataset and the background dataset and that particular constituent was eliminated from further consideration in the risk analysis. Eight of the metals analyzed in soils were not eliminated from the baseline risk assessment. They are, cadmium, chromium, copper, lead, potassium, silver, sodium, and zinc. For groundwater thirteen metals were not eliminated from the baseline risk assessment. They are aluminum, arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, vanadium and zinc. Table 6-2 presents the results of this statistical analysis. Section 5.7 of RAGS provides the guidance for this analysis. Table 6-3 summarizes the results of these first two steps. It lists the chemicals of potential concern for the baseline human health and ecological risk assessments in all on-site soils, in surface soils (0 to 2 feet) only, in surface water, in sediments, in on-site monitoring wells and in off-site farmhouse wells. This table presents the number of analyses in the database, the maximum detected concentration, the 95th UCL on the mean, the mean, the standard deviation, the coefficient of variation, whether the data is normally or lognormally distributed and the resulting exposure point concentration. When the data were normally distributed the 95th UCL was calculated using the t-statistic as described in Section 6.2.2.3. When the data were lognormally distributed, the data were log transformed and the 95th UCL calculated using the following equation:

TABLE 6-2

STATISTICAL COMPARISON OF METALS IN SAMPLES TO BACKGROUND SOILS

SENECA ARMY DEPOT
ASH LANDFILL

	BACKGROUND			POPULATION					
METALS(b)	N(m) COUNT	X(m) AVERAGE	S(m) STD.DEV.	N(m) COUNT	X(m) AVERAGE	S(m) STD.DEV.	T(calc.)	T(stastic)(a)	ELIMINATED IN RISK ASSESSMENT
Aluminum	15	15796.00	3771.19	163	15705.89	3569.72	-0.09	1.645	yes
Antimony*	15	0.65	0.11	163	0.65	0.20	-0.13	1.645	yes
Arsenic*	15	0.68	0.15	163	0.69	0.20	0.12	1.645	yes
Barium	15	86.92	32.89	163	98.27	91.34	1.02	1.645	yes
Beryllium	15	0.89	0.23	142	0.80	0.24	-1.43	1.645	yes
Cadmium*	15	-0.18	0.57	163	0.10	0.57	1.78	1.645	no
Calcium*	15	4.08	0.67	163	4.30	0.48	1.25	1.645	yes
Chromium	15	24.05	5.56	163	26.73	7.66	1.73	1.645	no
Cobalt	15	13.75	3.36	163	13.01	3.16	-0.82	1.645	yes
Copper*	15	1.33	0.09	162	1.47	0.29	4.23	1.645	no
Iron*	15	4.47	0.10	163	4.51	0.17	1.61	1.645	yes
Lead	15	1.06	0.16	147	1.39	0.61	4.98	1.645	no
Magnesium	15	7555.33	3348.83	163	7925.34	3211.70	0.41	1.645	yes
Manganese	15	855.40	464.80	162	723.43	327.64	-1.08	1.645	yes
Mercury*	14	-1.29	0.28	154	-1.27	0.47	0.21	1.645	yes
Nickel*	15	1.55	0.13	163	1.58	0.18	1.05	1.645	yes
Potassium	15	1371.67	348.81	163	1765.73	1444.22	2.73	1.645	no
Selenium*	15	-0.81	0.34	163	-0.67	0.41	1.41	1.645	yes
Silver*	15	-0.43	0.31	163	-0.24	0.30	2.23	1.645	no
Sodium	15	63.30	28.92	149	114.22	113.98	4.26	1.645	no
Vanadium	15	23.17	5.12	159	23.12	4.88	-0.03	1.645	yes
Zinc*	15	1.89	0.10	163	2.21	0.51	6.69	1.645	no
Cyanide	15	0.33	0.04	163	0.36	0.21	1.57	1.645	yes

NOTE: a) A t-Statistic which represents a confidence level of 95% was used as the criteria to eliminate the chemical from the Risk Assessment.
b) Log transformed data was used when required to normalize data(*).

TABLE 6-2

STATISTICAL COMPARISON OF METALS IN SAMPLES TO BACKGROUND GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

METALS(b)	BACKGROUND N(m) COUNT	BACKGROUND X(m) AVERAGE	BACKGROUND S(m) STD.DEV.	POPULATION N(m) COUNT	POPULATION X(m) AVERAGE	POPULATION S(m) STD.DEV.	T(calc.)	T(stastic)(a)	ELIMINATED IN RISK ASSESSMENT
Aluminum*	11	5.89	2.37	84	7.93	2.60	2.66	1.645	no
Antimony	10	26.38	1.62	72	30.10	21.68	1.43	1.645	yes
Arsenic	11	1.27	0.55	84	1.88	1.64	2.48	1.645	no
Barium*	11	4.90	0.52	83	4.99	0.87	0.50	1.645	yes
Beryllium*	5	-0.81	0.01	50	-0.27	0.88	4.32	1.645	no
Cadmium*	11	0.36	0.02	84	0.65	0.70	3.86	1.645	no
Calcium*	11	11.57	0.75	83	11.80	0.72	0.96	1.645	yes
Chromium*	11	1.29	1.12	84	2.25	1.63	2.52	1.645	no
Cobalt*	11	1.80	0.82	84	2.12	1.07	1.14	1.645	yes
Copper*	11	1.72	0.81	84	2.28	1.28	1.98	1.645	no
Iron*	9	6.72	2.33	82	8.43	2.57	2.08	1.645	no
Lead*	11	0.003	1.33	79	0.90	1.80	1.99	1.645	no
Magnesium*	10	10.13	0.32	83	10.01	0.61	-0.96	1.645	yes
Manganese*	11	5.42	1.46	84	5.82	1.70	0.84	1.645	yes
Mercury*	5	-3.10	0.00	54	-2.84	0.89	2.17	1.645	no
Nickel*	11	2.01	0.81	84	2.70	1.40	2.39	1.645	no
Potassium	11	4263.64	3423.68	84	5145.88	4810.44	0.76	1.645	yes
Selenium*	11	-0.70	0.00	84	-0.26	0.62	6.43	1.645	no
Silver	11	3.72	0.95	83	2.83	1.04	-2.90	1.645	yes
Sodium*	11	10.26	0.67	84	10.09	0.86	-0.75	1.645	yes
Vanadium*	11	2.04	0.79	84	2.60	1.25	2.06	1.645	no
Zinc*	8	2.65	0.95	59	3.89	1.74	3.08	1.645	no
Cyanide	11	5.56	1.87	81	4.10	1.78	-2.45	1.645	yes

Notes: a) A t-Statistic which represents a confidence level of 95% was used as the criteria to eliminate the chemical from the Risk Assessment.
b) Log transformed data was used when required to normalize data(*).

TABLE 6-3
VALIDATED DATA (PHASES I & II)
POTENTIAL CHEMICALS OF CONCERN
SOIL ANALYSIS RESULTS

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	units	COUNT	MAXIMUM	95th UCL of the mean	MEAN	STD.DEV	COEF OF VARIATION	NORMAL/ LOGNORMAL	EXPOSURE POINT CONC.
Volatile Organics									
Vinyl Chloride	ug/Kg	169	14,500	62.47	172.65	1,134.49	6.57	LOGNORMAL	62.47
Chloroethane	ug/Kg	1	3	3.00	3.00	0.00	0.00	NORMAL	3.00
Acetone	ug/Kg	169	4,200	58.80	105.68	388.79	3.68	LOGNORMAL	58.80
Carbon Disulfide	ug/Kg	168	700	26.02	47.58	140.04	2.94	LOGNORMAL	26.02
1,1-Dichloroethene	ug/Kg	168	700	28.78	49.17	140.37	2.85	LOGNORMAL	28.78
1,2-Dichloroethene (total)	ug/Kg	169	79,000	1,712.18	1,989.32	8,287.73	4.17	LOGNORMAL	1,712.18
Chloroform	ug/Kg	153	32	6.34	5.62	5.39	0.96	NORMAL	6.34
1,2-Dichloroethane	ug/Kg	168	700	24.32	44.40	132.50	2.98	LOGNORMAL	24.32
2-Butanone	ug/Kg	153	32	8.81	8.01	6.04	0.75	NORMAL	8.81
1,1,1-Trichloroethane	ug/Kg	1	3	3.00	3.00	0.00	0.00	NORMAL	3.00
Trichloroethene	ug/Kg	169	540,000	2,267.98	9,373.25	57,446.25	6.13	LOGNORMAL	2,267.98
Benzene	ug/Kg	84	6	2.94	2.86	0.44	0.15	NORMAL	2.94
Tetrachloroethene	ug/Kg	83	7	3.09	2.97	0.67	0.23	NORMAL	3.09
Toluene	ug/Kg	169	5,700	36.69	103.88	538.12	5.18	LOGNORMAL	36.69
Chlorobenzene	ug/Kg	169	7,000	31.13	89.81	553.96	6.17	LOGNORMAL	31.13
Ethylbenzene	ug/Kg	169	2,000	31.95	68.80	237.34	3.45	LOGNORMAL	31.95
Xylene (total)	ug/Kg	169	17,000	64.04	289.81	1,746.82	6.03	LOGNORMAL	64.04
Semivolatiles									
Phenol	ug/Kg	164	14,000	399.29	439.88	1,107.22	2.52	LOGNORMAL	399.29
bis(2-Chloroethyl) ether	ug/Kg	1	9	9.00	9.00	0.00	0.00	NORMAL	9.00
2-Nitrophenol	ug/Kg	164	3,500	402.31	362.44	310.42	0.86	NORMAL	402.31
Benzoic acid	ug/Kg	5	1,500	2,041.82	514.80	576.14	1.12	LOGNORMAL	1,500.00
Naphthalene	ug/Kg	164	2,500	413.98	368.54	353.69	0.96	NORMAL	413.98
2-Methylnaphthalene	ug/Kg	164	3,600	441.35	393.12	483.00	1.23	LOGNORMAL	441.35
Acenaphthylene	ug/Kg	105	510	265.48	248.15	107.92	0.43	NORMAL	265.48
Acenaphthene	ug/Kg	164	14,000	443.23	430.95	1,106.71	2.57	LOGNORMAL	443.23
4-Nitrophenol	ug/Kg	83	1,700	847.85	755.73	510.16	0.68	NORMAL	847.85
Dibenzofuran	ug/Kg	164	7,000	397.55	373.26	567.61	1.52	LOGNORMAL	397.55
2,4-Dinitrotoluene	ug/Kg	164	3,500	419.61	374.33	352.48	0.94	NORMAL	419.61
Fluorene	ug/Kg	164	12,000	436.17	420.99	952.12	2.26	LOGNORMAL	436.17
N-Nitrosodiphenylamine	ug/Kg	66	450	218.28	208.26	49.52	0.24	NORMAL	218.28
Phenanthrene	ug/Kg	164	43,000	657.71	882.10	3,692.96	4.19	LOGNORMAL	657.71
Anthracene	ug/Kg	164	15,000	492.67	468.24	1,229.59	2.63	LOGNORMAL	492.67
Di-n-butylphthalate	ug/Kg	164	3,500	389.60	347.64	326.66	0.94	NORMAL	389.60
Fluoranthene	ug/Kg	164	29,000	770.89	901.11	3,101.34	3.44	LOGNORMAL	770.89
Pyrene	ug/Kg	164	24,000	698.06	784.45	2,485.84	3.17	LOGNORMAL	698.06
Butylbenzylphthalate	ug/Kg	4	300	242.66	146.00	117.52	0.80	NORMAL	242.66
Benzo(a)anthracene	ug/Kg	164	9,600	520.48	531.23	1,142.51	2.15	LOGNORMAL	520.48
Chrysene	ug/Kg	164	9,900	544.82	532.07	1,132.45	2.13	LOGNORMAL	544.82
bis(2-Ethylhexyl)phthalate	ug/Kg	164	230,000	714.92	2,050.95	17,994.65	8.77	LOGNORMAL	714.92
Di-n-octylphthalate	ug/Kg	66	430	205.26	192.15	64.72	0.34	NORMAL	205.26
Benzo(b)fluoranthene	ug/Kg	164	9,500	498.22	513.04	1,067.70	2.08	LOGNORMAL	498.22
benzo(k)fluoranthene	ug/Kg	164	6,700	468.90	447.89	759.06	1.69	LOGNORMAL	468.90
Benzo(a)pyrene	ug/Kg	164	9,000	490.78	486.21	999.89	2.06	LOGNORMAL	490.78
Indeno(1,2,3-cd)pyrene	ug/Kg	164	4,800	430.56	396.93	543.49	1.37	LOGNORMAL	430.56
Dibenz(a,h)anthracene	ug/Kg	164	2,900	410.55	367.55	334.76	0.91	NORMAL	410.55
Benzo(g,h,i)perylene	ug/Kg	164	5,000	431.19	392.32	526.56	1.34	LOGNORMAL	431.19
Herbicides									
2,4-DB	ug/Kg	163	410	38.07	39.62	51.02	1.29	LOGNORMAL	38.07
2,4,5-TP (Silvex)	ug/Kg	163	10	3.03	2.95	0.60	0.20	NORMAL	3.03
MCPP	ug/Kg	163	24,000	3,536.80	3,247.55	2,244.92	0.69	NORMAL	3,536.80
Pesticides/PCBs									
Heptachlor	ug/Kg	164	14	6.56	6.06	3.92	0.65	NORMAL	6.56
Dieldrin	ug/Kg	164	46	13.27	12.21	8.23	0.67	NORMAL	13.27
4,4'-DDE	ug/Kg	164	290	28.76	22.42	37.59	1.68	LOGNORMAL	28.76
4,4'-DDD	ug/Kg	164	350	25.12	19.37	36.31	1.88	LOGNORMAL	25.12
4,4'-DDT	ug/Kg	164	260	22.70	18.06	30.55	1.69	LOGNORMAL	22.70
Aroclor-1242	ug/Kg	164	260	74.03	68.88	40.13	0.58	NORMAL	74.03
Aroclor-1260	ug/Kg	164	770	157.24	143.06	110.40	0.77	NORMAL	157.24
Metals									
Cadmium	mg/kg	163	43.1	3.84	2.47	3.74	1.51	LOGNORMAL	3.84
Chromium	mg/kg	163	62	27.72	26.73	7.66	0.29	NORMAL	27.72
Copper	mg/kg	162	836	40.46	43.64	83.14	1.91	LOGNORMAL	40.46
Lead	mg/kg	147	2,890	90.05	115.46	387.31	3.35	LOGNORMAL	90.05
Potassium	mg/kg	163	19,000	1,951.81	1,765.73	1,444.22	0.82	NORMAL	1,951.81
Silver	mg/kg	163	10.5	0.80	0.78	1.07	1.36	LOGNORMAL	0.80
Sodium	mg/kg	149	1,010	129.58	114.22	113.98	1.00	NORMAL	129.58
Zinc	mg/kg	163	55,700	409.06	860.14	4,887.01	5.68	LOGNORMAL	409.06

TABLE 6-3
VALIDATED DATA (PHASES I & II)
POTENTIAL CHEMICALS OF CONCERN
SURFACE SOIL ANALYSIS RESULTS

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	units	COUNT	MAXIMUM	95th UCL of the mean	MEAN	STD.DEV	COEF OF VARIATION	NORMAL/ LOGNORMAL	EXPOSURE POINT CONC.
Volatile Organics									
Vinyl Chloride	ug/Kg	52	750	16.02	33.24	135.04	4.06	LOGNORMAL	16.02
Acetone	ug/Kg	52	750	17.39	34.00	134.97	3.97	LOGNORMAL	17.39
Carbon Disulfide	ug/Kg	52	650	11.13	23.80	102.04	4.29	LOGNORMAL	11.13
1,1-Dichloroethene	ug/Kg	52	650	11.13	23.80	102.04	4.29	LOGNORMAL	11.13
1,2-Dichloroethene (total)	ug/Kg	52	38,000	584.27	1,545.47	6,723.14	4.35	LOGNORMAL	584.27
Chloroform	ug/Kg	50	18	5.13	4.52	2.60	0.58	NORMAL	5.13
1,2-Dichloroethane	ug/Kg	52	370	9.45	15.34	57.72	3.76	LOGNORMAL	9.45
2-Butanone	ug/Kg	50	21	7.21	6.57	2.75	0.42	NORMAL	7.21
Trichloroethene	ug/Kg	52	150,000	1,592.88	5,564.81	25,733.88	4.62	LOGNORMAL	1,592.88
Benzene	ug/Kg	30	4	3.04	3.00	0.13	0.04	NORMAL	3.04
Tetrachloroethene	ug/Kg	31	7	3.38	3.16	0.75	0.24	NORMAL	3.38
Toluene	ug/Kg	52	650	11.61	27.34	117.01	4.28	LOGNORMAL	11.61
Chlorobenzene	ug/Kg	52	650	11.13	23.80	102.04	4.29	LOGNORMAL	11.13
Ethylbenzene	ug/Kg	52	650	11.73	27.79	118.80	4.28	LOGNORMAL	11.73
Xylene (total)	ug/Kg	52	2,900	16.03	72.45	409.70	5.65	LOGNORMAL	16.03
Semivolatiles									
Phenol	ug/Kg	53	1,250	398.03	356.51	183.73	0.52	NORMAL	398.03
2-Nitrophenol	ug/Kg	53	1,250	398.03	356.51	183.73	0.52	NORMAL	398.03
Benzoic acid	ug/Kg	2	120	128.39	107.00	18.38	0.17	NORMAL	120.00
Naphthalene	ug/Kg	53	2,400	446.10	369.17	340.48	0.92	NORMAL	446.10
2-Methylnaphthalene	ug/Kg	53	1,250	360.05	318.57	183.61	0.58	NORMAL	360.05
Acenaphthylene	ug/Kg	25	510	251.08	209.08	127.67	0.61	NORMAL	251.08
Acenaphthene	ug/Kg	53	2,200	538.62	387.94	408.16	1.05	LOGNORMAL	538.62
4-Nitrophenol	ug/Kg	21	1,700	711.54	573.14	385.55	0.67	NORMAL	711.54
Dibenzofuran	ug/Kg	53	1,400	407.83	352.36	245.51	0.70	NORMAL	407.83
2,4-Dinitrotoluene	ug/Kg	53	2,000	444.44	379.15	288.95	0.76	NORMAL	444.44
Fluorene	ug/Kg	53	2,000	464.37	379.94	373.63	0.98	NORMAL	464.37
N-Nitrosodiphenylamine	ug/Kg	19	450	232.90	210.26	59.99	0.29	NORMAL	232.90
Phenanthrene	ug/Kg	53	15,000	1,047.87	998.34	2,719.96	2.72	LOGNORMAL	1,047.87
Anthracene	ug/Kg	53	4,200	790.88	454.81	724.19	1.59	LOGNORMAL	790.88
Di-n-butylphthalate	ug/Kg	53	1,100	373.55	330.43	190.83	0.58	NORMAL	373.55
Fluoranthene	ug/Kg	53	22,000	1,397.46	1,273.83	3,608.57	2.83	LOGNORMAL	1,397.46
Pyrene	ug/Kg	53	16,000	1,320.91	1,107.36	2,787.37	2.52	LOGNORMAL	1,320.91
Butylbenzylphthalate	ug/Kg	1	140	140.00	140.00	0.00	0.00	NORMAL	140.00
Benzo(a)anthracene	ug/Kg	53	9,600	915.76	741.85	1,776.98	2.40	LOGNORMAL	915.76
Chrysene	ug/Kg	53	9,900	889.20	743.81	1,735.48	2.33	LOGNORMAL	889.20
bis(2-Ethylhexyl)phthalate	ug/Kg	53	230,000	987.69	4,749.60	31,537.13	6.64	LOGNORMAL	987.69
Di-n-octylphthalate	ug/Kg	19	430	227.36	205.79	57.16	0.28	NORMAL	227.36
Benzo(b)fluoranthene	ug/Kg	53	9,500	833.22	744.38	1,748.59	2.35	LOGNORMAL	833.22
benzo(k)fluoranthene	ug/Kg	53	6,700	711.51	595.21	1,216.61	2.04	LOGNORMAL	711.51
Benzo(a)pyrene	ug/Kg	53	9,000	876.03	702.87	1,656.08	2.36	LOGNORMAL	876.03
Indeno(1,2,3-cd)pyrene	ug/Kg	53	4,800	635.36	493.98	872.65	1.77	LOGNORMAL	635.36
Dibenz(a,h)anthracene	ug/Kg	53	2,000	466.15	385.94	354.97	0.92	NORMAL	466.15
Benzo(g,h,i)perylene	ug/Kg	53	5,000	680.92	506.77	850.67	1.68	LOGNORMAL	680.92
Herbicides									
2,4-DB	ug/Kg	53	250	41.14	34.28	30.34	0.89	NORMAL	41.14
2,4,5-TP (Silvex)	ug/Kg	53	10	3.35	3.13	0.99	0.32	NORMAL	3.35
MCPP	ug/Kg	53	24,000	4,905.18	4,038.68	3,834.81	0.95	NORMAL	4,905.18
Pesticides/PCBs									
Heptachlor	ug/Kg	53	14	7.73	6.83	4.00	0.59	NORMAL	7.73
Dieldrin	ug/Kg	53	46	16.05	14.02	9.00	0.64	NORMAL	16.05
4,4'-DDE	ug/Kg	53	250	42.86	30.04	46.82	1.56	LOGNORMAL	42.86
4,4'-DDD	ug/Kg	53	260	29.42	19.73	34.70	1.76	LOGNORMAL	29.42
4,4'-DDT	ug/Kg	53	260	36.45	25.54	41.44	1.62	LOGNORMAL	36.45
Aroclor-1242	ug/Kg	53	185	82.68	74.32	37.00	0.50	NORMAL	82.68
Aroclor-1260	ug/Kg	53	340	161.11	141.39	87.30	0.62	NORMAL	161.11
Metals									
Cadmium	mg/kg	53	43.1	5.53	3.22	5.98	1.85	LOGNORMAL	5.53
Chromium	mg/kg	53	62	30.55	28.34	9.80	0.35	NORMAL	30.55
Copper	mg/kg	53	836	71.55	69.80	133.04	1.91	LOGNORMAL	71.55
Lead	mg/kg	48	2,890	264.93	208.08	539.35	2.59	LOGNORMAL	264.93
Potassium	mg/kg	53	2,930	1,900.35	1,786.60	503.40	0.28	NORMAL	1,900.35
Silver	mg/kg	53	10.5	1.05	0.91	1.44	1.58	LOGNORMAL	1.05
Sodium	mg/kg	49	424	122.42	103.14	82.02	0.80	NORMAL	122.42
Zinc	mg/kg	53	55,700	1,579.68	2,111.63	8,449.48	4.00	LOGNORMAL	1,579.68

TABLE 6-3
VALIDATED DATA (PHASES I & II)
POTENTIAL CHEMICALS OF CONCERN
SURFACE WATER ANALYSIS RESULTS

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	UNITS	COUNT	MAXIMUM	95th UCL of the mean	MEAN	STD. DEV.	COEF OF VARIATION	NORMAL/ LOGNORMAL	EXPOSURE POINT CONC.
Volatile Organics									
Chloroform	ug/L	1	2.00	2.00	2.00	0.00	0.00	NORMAL	2.00
Metals									
Aluminum	ug/l	7	2,410.00	96,163.98	818.34	1,091.20	1.33	LOGNORMAL	2,410.00
Antimony	ug/l	7	141.00	74.34	43.56	42.97	0.99	NORMAL	74.34
Arsenic	ug/l	7	2.90	2.23	1.86	0.51	0.27	NORMAL	2.23
Barium	ug/l	7	113.00	81.49	59.40	30.84	0.52	NORMAL	81.49
Beryllium	ug/l	7	1.20	0.81	0.56	0.35	0.64	NORMAL	0.81
Calcium	ug/l	7	165,000.00	125,906.34	97,742.86	39,321.15	0.40	NORMAL	125,906.34
Chromium	ug/l	7	7.60	5.64	4.05	2.21	0.55	NORMAL	5.64
Cobalt	ug/l	2	6.90	8.87	4.70	3.11	0.66	NORMAL	6.90
Copper	ug/l	6	21.70	15.86	11.04	6.23	0.56	NORMAL	15.86
Iron	ug/l	7	8,750.00	6,010,767,197.35	2,021.92	3,209.51	1.59	LOGNORMAL	8,750.00
Lead	ug/l	6	42.30	3,485.81	8.08	16.85	2.09	LOGNORMAL	42.30
Magnesium	ug/l	7	16,700.00	14,350.52	10,655.21	5,159.30	0.48	NORMAL	14,350.52
Manganese	ug/l	7	941.00	1,252,204,630.09	328.59	429.63	1.31	LOGNORMAL	941.00
Mercury	ug/l	7	0.15	0.08	0.05	0.04	0.78	NORMAL	0.08
Nickel	ug/l	2	11.20	21,343,177,843.23	6.48	6.68	1.03	LOGNORMAL	11.20
Potassium	ug/l	7	4,690.00	3,267.84	2,191.29	1,503.06	0.69	NORMAL	3,267.84
Selenium	ug/l	7	3.40	1.91	1.20	0.99	0.82	NORMAL	1.91
Sodium	ug/l	7	2,180,000.00	70,257,288.93	342,552.86	810,941.38	2.37	LOGNORMAL	2,180,000.00
Vanadium	ug/l	3	16.30	93,306,647.95	7.52	7.88	1.05	LOGNORMAL	16.30
Zinc	ug/l	6	187.00	2,235.23	59.85	79.47	1.33	LOGNORMAL	187.00

TABLE 6-3
VALIDATED DATA (PHASES I & II)
POTENTIAL CHEMICALS OF CONCERN
SEDIMENT ANALYSIS RESULTS

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	UNITS	COUNT	MAXIMUM	95 th UCL of the mean	MEAN	STD.DEV.	COEF OF VARIATION	NORMAL/ LOGNORMAL	EXPOSURE POINT CONC.
Volatile Organics									
Acetone	ug/Kg	16	19.00	10.77	9.13	3.77	0.41	NORMAL	10.77
1,1-Dichloroethene	ug/Kg	17	18.00	8.39	6.65	4.12	0.62	NORMAL	8.39
1,2-Dichloroethene (total)	ug/Kg	17	640.00	144.94	77.06	202.67	2.63	LOGNORMAL	144.94
Chloroform	ug/Kg	3	6.00	5.87	4.33	1.53	0.35	NORMAL	5.87
Trichloroethene	ug/Kg	14	11.00	6.29	5.29	2.15	0.41	NORMAL	6.29
Semivolatiles									
4-Methylphenol	ug/Kg	1	100.00	100.00	100.00	0.00	0.00	NORMAL	100.00
Naphthalene	ug/Kg	1	22.00	22.00	22.00	0.00	0.00	NORMAL	22.00
2-Methylnaphthalene	ug/Kg	1	30.00	30.00	30.00	0.00	0.00	NORMAL	30.00
Acenaphthylene	ug/Kg	4	170.00	151.82	95.00	65.08	0.69	NORMAL	151.82
2,4-Dinitrotoluene	ug/Kg	1	100.00	100.00	100.00	0.00	0.00	NORMAL	100.00
Fluorene	ug/Kg	1	20.00	20.00	20.00	0.00	0.00	NORMAL	20.00
N-Nitrosodiphenylamine (1)	ug/Kg	1	55.00	55.00	55.00	0.00	0.00	NORMAL	55.00
Phenanthrene	ug/Kg	18	1,200.00	499.46	379.78	290.83	0.77	NORMAL	499.46
Anthracene	ug/Kg	8	270.00	187.01	124.13	101.87	0.82	NORMAL	187.01
Carbazole	ug/Kg	3	97.00	93.14	59.00	33.87	0.57	NORMAL	93.14
Di-n-butylphthalate	ug/Kg	2	21.00	22.87	18.50	3.54	0.19	NORMAL	21.00
Fluoranthene	ug/Kg	18	7,400.00	2,522.41	956.78	2,037.32	2.13	LOGNORMAL	2,522.41
Pyrene	ug/Kg	18	6,700.00	2,176.24	850.28	1,766.17	2.08	LOGNORMAL	2,176.24
Benzo(a)anthracene	ug/Kg	18	4,900.00	1,696.30	698.44	1,281.71	1.84	LOGNORMAL	1,696.30
Chrysene	ug/Kg	18	5,300.00	1,634.52	752.83	1,388.91	1.84	LOGNORMAL	1,634.52
bis(2-Ethylhexyl)phthalate	ug/Kg	18	4,300.00	732.91	537.22	952.71	1.77	LOGNORMAL	732.91
Benzo(b)fluoranthene	ug/Kg	18	4,500.00	1,609.62	692.56	1,171.92	1.69	LOGNORMAL	1,609.62
Benzo(k)fluoranthene	ug/Kg	18	3,700.00	1,424.29	602.78	937.38	1.56	LOGNORMAL	1,424.29
Benzo(a)pyrene	ug/Kg	17	3,900.00	1,658.39	621.35	1,034.81	1.67	LOGNORMAL	1,658.39
Indeno(1,2,3-cd)pyrene	ug/Kg	18	2,400.00	1,263.37	513.83	601.69	1.17	LOGNORMAL	1,263.37
Dibenz(a,h)anthracene	ug/Kg	18	1,300.00	537.25	423.61	276.14	0.65	NORMAL	537.25
Benzo(g,h,i)perylene	ug/Kg	18	2,300.00	971.19	508.72	567.24	1.12	LOGNORMAL	971.19
Pesticides/PCBs									
4,4'-DDE	ug/Kg	18	63.00	27.20	20.42	16.47	0.81	NORMAL	27.20
Endrin	ug/Kg	1	2.30	2.30	2.30	0.00	0.00	NORMAL	2.30
4,4'-DDD	ug/Kg	1	1.70	1.70	1.70	0.00	0.00	NORMAL	1.70
Endosulfan sulfate	ug/Kg	2	2.70	2.92	2.40	0.42	0.18	NORMAL	2.70
4,4'-DDT	ug/Kg	1	2.40	2.40	2.40	0.00	0.00	NORMAL	2.40
alpha-Chlordane	ug/Kg	7	3.60	2.31	1.72	0.89	0.52	NORMAL	2.31
Aroclor-1260	ug/Kg	6	54.00	36.90	27.58	13.07	0.47	NORMAL	36.90
Metals									
Aluminum	mg/Kg	18	20,900.00	15,013.53	13,763.33	3,037.87	0.22	NORMAL	15,013.53
Antimony	mg/Kg	11	10.80	6.51	5.54	1.85	0.33	NORMAL	6.51
Arsenic	mg/Kg	18	12.10	7.40	6.23	2.84	0.45	NORMAL	7.40
Barium	mg/Kg	18	227.00	123.30	105.96	42.14	0.40	NORMAL	123.30
Beryllium	mg/Kg	17	1.20	0.89	0.79	0.24	0.30	NORMAL	0.89
Cadmium	mg/Kg	18	4.10	2.49	1.92	1.38	0.72	NORMAL	2.49
Calcium	mg/Kg	18	229,000.00	60,107.10	35,833.89	53,754.34	1.50	LOGNORMAL	60,107.10
Chromium	mg/Kg	18	33.40	24.62	22.83	4.35	0.19	NORMAL	24.62
Cobalt	mg/Kg	18	17.00	11.19	10.09	2.67	0.27	NORMAL	11.19
Copper	mg/Kg	18	58.60	39.69	34.59	12.37	0.36	NORMAL	39.69
Iron	mg/Kg	18	36,800.00	28,305.15	26,027.78	5,533.83	0.21	NORMAL	28,305.15
Lead	mg/Kg	18	219.00	95.63	70.48	61.11	0.87	NORMAL	95.63
Magnesium	mg/Kg	18	14,900.00	7,356.25	6,226.11	2,746.14	0.44	NORMAL	7,356.25
Manganese	mg/Kg	18	1,050.00	675.43	562.94	273.32	0.49	NORMAL	675.43
Mercury	mg/Kg	18	0.81	0.20	0.12	0.18	1.55	LOGNORMAL	0.20
Nickel	mg/Kg	18	45.90	32.05	29.41	6.41	0.22	NORMAL	32.05
Potassium	mg/Kg	18	2,510.00	1,788.70	1,605.28	445.69	0.28	NORMAL	1,788.70
Selenium	mg/Kg	15	1.00	0.77	0.62	0.34	0.55	NORMAL	0.77
Silver	mg/Kg	7	0.69	0.59	0.47	0.19	0.40	NORMAL	0.59
Sodium	mg/Kg	18	195.00	94.86	77.25	42.79	0.55	NORMAL	94.86
Thallium	mg/Kg	3	0.52	0.50	0.33	0.16	0.49	NORMAL	0.50
Vanadium	mg/Kg	18	30.70	23.86	21.94	4.68	0.21	NORMAL	23.86
Zinc	mg/Kg	18	834.00	455.05	365.39	217.88	0.60	NORMAL	455.05
Cyanide	mg/Kg	18	1.00	0.59	0.50	0.22	0.44	NORMAL	0.59

TABLE 6-3

VALIDATED DATA (PHASES I & II)
POTENTIAL CHEMICALS OF CONCERN
GROUNDWATER ANALYSIS RESULTS

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	UNITS	COUNT	MAXIMUM	95th UCL of the mean	MEAN	STD.DEV.	COEF OF VARIATION	NORMAL/ LOGNORMAL	EXPOSURE POINT CONC.
Volatile Organics									
Vinyl Chloride	ug/L	106	23,000.00	59.81	648.56	3,776.54	5.82	LOGNORMAL	59.81
1,1-Dichloroethene	ug/L	106	2,100.00	10.29	27.12	205.38	7.57	LOGNORMAL	10.29
1,1-Dichloroethane	ug/L	106	2,100.00	10.27	26.59	204.97	7.71	LOGNORMAL	10.27
1,2-Dichloroethene (total)	ug/L	106	130,000.00	845.01	2,656.02	16,023.82	6.03	LOGNORMAL	845.01
Chloroform	ug/L	106	2,100.00	11.17	29.13	207.56	7.13	LOGNORMAL	11.17
1,2-Dichloroethane	ug/L	75	2,100.00	35.92	29.41	242.33	8.24	LOGNORMAL	35.92
1,1,1-Trichloroethane	ug/L	106	2,100.00	10.20	27.66	206.75	7.47	LOGNORMAL	10.20
Trichloroethene	ug/L	106	51,000.00	605.60	1,431.20	7,180.04	5.02	LOGNORMAL	605.60
Benzene	ug/L	106	2,100.00	10.13	26.65	205.04	7.69	LOGNORMAL	10.13
4-Methyl-2-Pentanone	ug/L	106	2,100.00	8.97	30.96	208.27	6.73	LOGNORMAL	8.97
Tetrachloroethene	ug/L	42	2,100.00	1.76	50.30	323.99	6.44	LOGNORMAL	1.76
Toluene	ug/L	106	2,100.00	13.14	40.43	236.03	5.84	LOGNORMAL	13.14
Ethylbenzene	ug/L	106	2,100.00	9.83	25.83	204.58	7.92	LOGNORMAL	9.83
Xylene (total)	ug/L	106	2,100.00	12.53	34.34	217.19	6.33	LOGNORMAL	12.53
Semivolatiles									
Phenol	ug/L	4	5.00	3.85	5.00	0.00	0.00	NORMAL	3.85
bis(2-Chloroethyl) ether	ug/L	4	5.00	1.77	3.90	2.20	0.56	NORMAL	1.77
4-Methylphenol	ug/L	6	6.00	4.03	4.50	1.38	0.31	NORMAL	4.03
Naphthalene	ug/L	87	66.00	6.40	6.60	9.09	1.38	LOGNORMAL	6.40
2-Methylnaphthalene	ug/L	87	13.00	5.50	5.38	1.15	0.21	NORMAL	5.50
Diethylphthalate	ug/L	5	5.00	1.83	3.60	1.95	0.54	NORMAL	1.83
Pentachlorophenol	ug/L	87	74.00	21.11	19.61	10.11	0.52	NORMAL	21.11
Di-n-butylphthalate	ug/L	87	18.00	5.48	5.17	2.37	0.46	NORMAL	5.48
Herbicides									
Dalapon	ug/L	81	6.40	1.40	1.31	0.67	0.51	NORMAL	1.40
Dicamba	ug/L	79	0.18	0.05	0.05	0.01	0.28	NORMAL	0.05
Metals									
Aluminum	ug/L	87	306,000.00	254,061.90	20,713.04	44,047.83	2.13	LOGNORMAL	254,061.90
Arsenic	ug/L	87	8.60	2.10	1.84	1.62	0.88	NORMAL	2.10
Beryllium	ug/L	53	11.70	1.75	1.21	1.85	1.53	LOGNORMAL	1.75
Cadmium	ug/L	87	64.60	3.09	3.03	7.22	2.39	LOGNORMAL	3.09
Chromium	ug/L	87	418.00	62.23	31.04	63.02	2.03	LOGNORMAL	62.23
Copper	ug/L	87	412.00	30.26	24.67	54.90	2.22	LOGNORMAL	30.26
Iron	ug/L	85	610,000.00	348,083.05	34,668.12	81,834.60	2.36	LOGNORMAL	348,083.05
Lead	ug/L	82	147.00	21.10	10.76	24.83	2.31	LOGNORMAL	21.10
Mercury	ug/L	57	2.30	0.11	0.11	0.31	2.72	LOGNORMAL	0.11
Nickel	ug/L	87	622.00	56.73	42.61	92.31	2.17	LOGNORMAL	56.73
Selenium	ug/L	87	6.50	1.06	1.03	1.22	1.19	LOGNORMAL	1.06
Silver	ug/L	86	7.20	2.91	2.74	1.12	0.41	NORMAL	2.91
Vanadium	ug/L	87	358.00	41.77	30.10	55.08	1.83	LOGNORMAL	41.77
Zinc	ug/L	62	1,750.00	441.98	157.35	283.97	1.80	LOGNORMAL	441.98

TABLE 6-3

VALIDATED DATA (PHASES I & II)
POTENTIAL CHEMICALS OF CONCERN
FARMHOUSE WELLS QUARTERLY MONITORING RESULTS

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	UNITS	COUNT	MAXIMUM	95th UCL of the mean	MEAN	STD.DEV.	COEF OF VARIATION	NORMAL/ LOGNORMAL	EXPOSURE POINT CONC.
Volatile Organics									
Vinyl chloride	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
1,1-Dichloroethene	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
1,1-Dichloroethane	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
1,2-Dichloroethene (total)	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
Chloroform	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
1,2-Dichloroethane	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
1,1,1-Trichloroethane	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
Trichloroethene	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
Benzene	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
4-Methyl-2-Pentanone	ug/L	0	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
Toluene	ug/L	8	1.00	0.56	0.41	0.27	0.65	NORMAL	0.56
Ethylbenzene	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
Xylene (total)	ug/L	8	0.25	0.25	0.25	0.00	0.00	NORMAL	0.25
Semivolatiles									
Phenol	ug/L	0	NA	NA	NA	NA	NA	NA	
bis(2-Chloroethyl) ether	ug/L	0	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol	ug/L	0	NA	NA	NA	NA	NA	NA	NA
Naphthalene	ug/L	8	1.00	1.01	0.81	0.35	0.43	NORMAL	1.00
2-Methylnaphthalene	ug/L	0	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	ug/L	0	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	ug/L	0	NA	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	ug/L	0	NA	NA	NA	NA	NA	NA	NA
									0.00
Herbicides									
Dalapon	ug/L	0	NA	NA	NA	NA	NA	NA	
Dicamba	ug/L	0	NA	NA	NA	NA	NA	NA	NA
									0.00
Metals									
Aluminum	ug/L	5	324.00	36,413.76	112.14	134.93	1.20	LOGNORMAL	324.00
Arsenic	ug/L	5	0.60	0.56	0.48	0.11	0.23	NORMAL	0.56
Beryllium	ug/L	5	0.39	0.31	0.23	0.11	0.49	NORMAL	0.31
Cadmium	ug/L	5	1.55	1.48	1.34	0.19	0.14	NORMAL	1.48
Chromium	ug/L	5	1.65	1.65	1.39	0.36	0.26	NORMAL	1.65
Copper	ug/L	3	1.05	1.04	0.98	0.06	0.06	NORMAL	1.04
Iron	ug/L	5	723.00	923,611.15	221.90	295.50	1.33	LOGNORMAL	723.00
Lead	ug/L	5	4.00	2.61	1.54	1.46	0.95	NORMAL	2.61
Mercury	ug/L	5	0.05	0.05	0.04	0.01	0.26	NORMAL	0.05
Nickel	ug/L	5	4.15	4.16	3.19	1.31	0.41	NORMAL	4.15
Selenium	ug/L	5	1.40	1.00	0.72	0.38	0.53	NORMAL	1.00
Silver	ug/L	5	1.60	1.54	1.42	0.16	0.12	NORMAL	1.54
Vanadium	ug/L	5	3.90	3.15	2.16	1.34	0.62	NORMAL	3.15
Zinc	ug/L	3	501.00	523.58	302.27	233.03	0.77	NORMAL	501.00

$$95th\ UCL = e\left(\bar{x} + 0.5S^2 + \frac{HS}{\sqrt{n-1}}\right)$$

where:

$\bar{x}$ = the mean of the log transformed data
s = the standard deviation of the log transformed data
n = the number of data points
H = the H-statistic at the 95th confidence level

Values for the H-statistic were obtained from Gilbert (1987) and the vary as a function of both n and s. When the calculated 95th UCL was less than the maximum detected concentration, the exposure point concentration was taken as the 95th UCL. However, when the calculated 95th UCL was greater than the maximum detected concentration, the exposure point concentration was taken as the maximum detected concentration.

Additional screening was performed to further reduce the list of chemicals to be included in the human health baseline risk assessment so that only the chemicals of greatest significance are included. If a chemical was detected in less than 5 percent of all analyses for a given media, the maximum detected value was compared to the ARARs and TBCs. If the maximum value was less than the ARAR or TBC and the chemical was not detected in any other media, then it was eliminated from the baseline human health risk assessment. The results of this screening are presented in Table 6-4. Three volatile organic compounds, six semivolatiles, three pesticide/PCB's and three herbicides in soils were eliminated. One volatile, one semivolatile and two herbicides in groundwater were eliminated. No chemicals were eliminated from the surface water or sediment data bases.

Next the five chemicals that are essential human nutrients were screened. These are calcium, iron, magnesium, potassium, and sodium. After the background screening of soil and groundwater, the only nutrients remaining were potassium and sodium in soil and iron in groundwater and these constituents were less than twice background. Therefore, it was not believed that they would pose a significant health risk and they were eliminated from the risk assessment databases. Although insufficient background data exists to perform a statistical evaluation of these nutrients in surface water and sediment media, a review of the data indicates that the downgradient concentrations are generally in the same range as the background sample. Therefore, those five nutrients were eliminated from the surface water sediment data sets.

TABLE 6-4

CHEMICALS DETECTED IN LESS THAN 5 PERCENT OF THE SAMPLES
SURFACE SOILS

SENECA ARMY DEPOT
ASH LANDFILL

Compound	Number of Samples	Number of Detections	Frequency of Detection	Maximum Value Detected (ug/Kg)	Potential ARAR (ppb) (a)	Detected In Other Media (b)	Passed Screening
Volatile Organic Compounds							
Carbon Disulfide	52	0	0.0%	0	2,700	None	No
1,2-Dichloroethane	52	1	1.9%	210	100	GW	Yes
Benzene	52	0	0.0%	0	60	GW	No
Tetrachloroethene	52	2	3.8%	7	1,400	GW	Yes
Chlorobenzene	52	0	0.0%	0	1,700	None	No
Semivolatiles							
Phenol	53	0	0.0%	0	30	GW	No
2-Nitrophenol	53	0	0.0%	0	330	None	No
Benzoic acid	53	0	0.0%	0	2,700	None	No
4-Nitrophenol	53	1	1.9%	81	100	None	No
2,4-Dinitrotoluene	53	1	1.9%	2000	1000(c)	SD	Yes
N-Nitrosodiphenylamine	53	1	1.9%	450	50000(d)	SD	Yes
Butylbenzylphthalate	53	1	1.9%	140	50000(d)	None	No
Di-n-octylphthalate	53	2	3.8%	430	50000(d)	None	No
Pesticides/PCBs							
Heptachlor	53	1	1.9%	14	100	None	No
Dieldrin	53	1	1.9%	46	44	None	No
Aroclor-1242	53	1	1.9%	45	1,000	None	No
Herbicides							
2,4-DB	53	1	1.9%	250	500	None	No
2,4,5-TP (Silvex)	53	1	1.9%	10	700	None	No
MCPP	53	2	3.8%	24000	NA	None	No

Notes: a) ARAR = New York recommended soil cleanup objectives from Appendix A, Table 1 from TAGM dated Nov. 16, 1992
b) SW = Surface water, SD = Sediment, GW = Groundwater
c) Value for 2,6-Dinitrotoluene.
d) Value for individual semivolatile of 50 ppm.

TABLE 6-4

CHEMICALS DETECTED IN LESS THAN 5 PERCENT OF THE SAMPLES
SEDIMENT

SENECA ARMY DEPOT
ASH LANDFILL

Compound	Number of Samples	Number of Detections	Frequency of Detection	Maximum Value Detected (ug/Kg)	ARAR (ug/kg) (a)	Detected In Other Media (b)	Passed Screening
Semivolatiles							
4-Methylphenol	24	1	4.2%	100	6 (c)	GW	Yes
Naphthalene	24	1	4.2%	22	NA	GW, S	Yes
2-Methylnaphthalene	24	1	4.2%	30	NA	GW, S	Yes
2,4-Dinitrotoluene	24	1	4.2%	100	1 (d)	S	Yes
Fluorene	24	1	4.2%	20	NA	S	Yes
N-Nitrosodiphenylamine	24	1	4.2%	55	NA	S	Yes

Notes: a) ARAR = NYSDEC 1989 Guidelines for Sediment, lowest value of Aquatic toxicity, human health, and wildlife residue basis.
b) SW = Surface water, GW = Groundwater, S = Soils
c) Value for total phenols.
d) Value for 2,6-Dinitrotoluene.

TABLE 6-4

CHEMICALS DETECTED IN LESS THAN 5 PERCENT OF THE SAMPLES
GROUNDWATER

SENECA ARMY DEPOT
ASH LANDFILL

Compound	Number of Samples	Number of Detections	Frequency of Detection	Maximum Value Detected (ug/L)	ARAR (ug/L) (a)	Detected In Other Media (b)	Passed Screening
Volatile Organic Compounds							
1,1-Dichloroethene	86	4	4.7%	200	5	S, SD	Yes
1,1-Dichloroethane	86	2	2.3%	160	5	None	Yes
Chloroform	86	4	4.7%	210	7	SW, S, SD	Yes
1,2-Dichloroethane	86	2	2.3%	6	5	S	Yes
1,1,1-Trichloroethane	86	2	2.3%	72	5	S	Yes
4-Methyl-2-Pentanone	86	1	1.2%	77	NA	None	No
Tetrachloroethene	86	1	1.2%	2	5	S	Yes
Toluene	86	3	3.5%	900	5	S	Yes
Ethylbenzene	86	2	2.3%	130	5	S	Yes
Xylene (total)	86	3	3.5%	590	5	S	Yes
Semivolatiles							
Phenol	88	1	1.1%	5	1	S	Yes
bis(2-Chloroethyl) ether	88	1	1.1%	0.6	1	S	Yes
4-Methylphenol	88	3	3.4%	6	1	SD	Yes
Naphthalene	88	2	2.3%	66	10	S, SD	Yes
2-Methylnaphthalene	88	2	2.3%	13	NA	S, SD	Yes
Diethylphthalate	88	2	2.3%	2	50	None	No
Pentachlorophenol	88	2	2.3%	74	1	None	Yes
Herbicides							
Dalapon	79	3	3.8%	6.4	50	None	No
Dicamba	77	1	1.3%	0.18	0.44	None	No

Notes: a) ARAR = NYSDEC, 1991 Standards for Class GA groundwater
b) SW = Surface water, SD = Sediment, GW = Groundwater

TABLE 6-5

CONCENTRATION-TOXICITY SCREENING
SOIL DATA

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Max. Conc.	RfD mg/kg/day	Rank Wt. of Evidence	Carc. Slope Oral mg/kg/day-1	Carc. Slope Inh mg/kg/day-1	Conc.-Tox Value (Non-Carc.)	Conc.-Tox Value (Carcinogenic)	Conc.-Tox % (Non-Carc.)	Conc.-Tox % (Carcinogenic)	Passed Screening
Volatile Organics-ug/kg										
Vinyl Chloride	7.5E+02	NA	A	1.90E+00	2.94E-01		1.4E+03		1.1583%	yes
Acetone	7.5E+02	1.00E-01	D	NA	NA	7.5E+03		0.0023%		no
Dichloroethene, 1,1-	6.5E+02	9.00E-03	C	6.00E-01	1.75E-01	7.2E+04	3.9E+02	0.0222%	0.3170%	no
Dichloroethene, 1,2- (total)	3.8E+04	9.00E-03	NA	NA	NA	4.2E+06		1.2957%		yes
Chloroform	1.8E+01	1.00E-02	B2	6.10E-03	8.05E-02	1.8E+03	1.4E+00	0.0006%	0.0012%	no
Dichloroethane, 1,2-	3.7E+02	NA	B2	9.10E-02	9.10E-02		3.4E+01		0.0274%	no
Butanone, 2-	2.1E+01	6.00E-01	D	NA	NA	3.5E+01		0.0000%		no
Trichloroethene	1.5E+05	NA	NA	1.10E-02	6.00E-03		1.7E+03		1.3412%	yes
Tetrachloroethene	7.0E+00	1.00E-02	D	5.00E-02	2.00E-03	7.0E+02	3.5E-01	0.0002%	0.0003%	no
Toluene	6.5E+02	2.00E-01	D	NA	NA	3.3E+03		0.0010%		no
Ethylbenzene	6.5E+02	1.00E-01	D	NA	NA	6.5E+03		0.0020%		no
Xylene (total)	2.9E+03	2.00E+00	D	NA	NA	1.5E+03		0.0004%		no
Total Voc's						**4.3E+06**	**3.5E+03**	**1.3%**	**2.8%**	
Semi-volatiles-ug/kg										
Naphthalene	2.4E+03	4.00E-02	D	NA	NA	6.0E+04		0.0184%		no
Methylnaphthalene, 2-	1.3E+03	NA	NA	NA	NA					yes
Acenaphthylene	5.1E+02	NA	NA	NA	NA					yes
Acenaphthene	2.2E+03	6.00E-02	NA	NA	NA	3.7E+04		0.0113%		no
Dibenzofuran	1.4E+03	NA	D	NA	NA					yes
Dinitrotoluene, 2,4-	2.0E+03	2.00E-03	B2	NA	NA	1.0E+06		0.3069%		no
Fluorene	2.0E+03	4.00E-02	D	NA	NA	5.0E+04		0.0153%		no
N-Nitrosodiphenylamine	4.5E+02	NA	B2	4.90E-03	NA		2.2E+00		0.0018%	no
Phenanthrene	1.5E+04	NA	NA	NA	NA					yes
Anthracene	4.2E+03	3.00E-01	D	NA	NA	1.4E+04		0.0043%		no
Di-n-butylphthalate	1.1E+03	1.00E-01	D	NA	NA	1.1E+04		0.0034%		no
Fluoranthene	2.2E+04	4.00E-02	D	NA	NA	5.5E+05		0.1688%		no
Pyrene	1.6E+04	3.00E-02	NA	NA	NA	5.3E+05		0.1637%		no
Benzo(a)anthracene	9.6E+03	NA	B2	1.06E+00	NA		1.0E+04		8.2596%	yes
Chrysene	9.9E+03	NA	D	3.21E-02	NA		3.2E+02		0.2585%	no
bis(2-Ethylhexyl)phthalate	2.3E+05	2.00E-02	B2	1.40E-02	NA	1.2E+07	3.2E+03	3.5292%	2.6173%	yes
Benzo(b)fluoranthene	9.5E+03	NA	B2	1.02E+00	NA		9.7E+03		7.8917%	yes
Benzo(k)fluoranthene	6.7E+03	NA	B2	4.82E-01	NA		3.2E+03		2.6238%	yes
Benzo(a)pyrene	9.0E+03	NA	B2	7.30E+00	NA		6.6E+04		53.4023%	yes
Indeno(1,2,3-cd)pyrene	4.8E+03	NA	B2	1.69E+00	NA		8.1E+03		6.6076%	yes
Dibenz(a,h)anthracene	2.0E+03	NA	B2	8.10E+00	NA		1.6E+04		13.1726%	yes
Benzo(g,h,i)perylene	5.0E+03	NA	NA	NA	NA					yes
Total Semi-Voa's						**1.4E+07**	**1.2E+05**	**4.2%**	**94.8%**	
Pesticides/PCB's-ug/kg										
DDE, 4,4'-	2.5E+02	NA	B2	3.40E-01	3.40E-01		8.5E+01		0.0691%	no
DDD, 4,4'-	2.6E+02	NA	B2	2.40E-01	NA		6.2E+01		0.0507%	no
DDT, 4,4'-	2.6E+02	5.00E-04	B2	3.40E-01	3.40E-01	5.2E+05	8.8E+01	0.1596%	0.0719%	no
Arocior-1260	3.4E+02	NA	NA	7.70E+00	NA		2.6E+03		2.1280%	yes
Total Pesticides						**5.2E+05**	**2.9E+03**	**0.2%**	**2.3%**	
Metals-mg/kg										
Cadmium	4.3E+01	5.00E-04	B1	NA	6.30E+00	8.6E+07		26.4533%		yes
Chromium	6.2E+01	5.00E-03	A	NA	4.20E+01	1.2E+07		3.8053%		yes
Copper	8.4E+02	4.00E-02	D	NA	NA	2.1E+07		6.4138%		yes
Lead	2.9E+03	NA	B2	NA	NA					yes
Silver	1.1E+01	5.00E-03	NA	NA	NA	2.1E+06		0.6445%		no
Zinc	5.6E+04	3.00E-01	D	NA	NA	1.9E+08		56.9779%		yes
Total Metals						**3.1E+08**	**0.0E+00**	**94.3%**	**0.0%**	
Total Compounds						**3.3E+08**	**1.2E+05**	**100.00%**	**100.00%**	

TABLE 6-5

CONCENTRATION-TOXICITY SCREENING
SEDIMENT DATA

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Max. Conc.	RfD mg/kg/day	Rank Weight of Evidence	Carc. Slope Oral mg/kg/day-1	Carc. Slope Inh mg/kg/day-1	Conc.-Tox Value (Non-Carc.)	Conc.-Tox Value (Carcinogenic)	Conc.-Tox % (Non-Carc.)	Conc.-Tox % (Carcinogenic)	Passed Screening
Volatile Organics-ug/Kg										
Acetone	1.9E+01	1.00E-01	D	NA	NA	1.9E+02		0.0001%		no
Dichloroethene, 1,1-	1.8E+01	9.00E-03	C	6.00E-01	1.75E-01	2.0E+03	1.1E+01	0.0006%	0.0132%	no
Dichloroethene, 1,2- (total)	6.4E+02	9.00E-03	NA	NA	NA	7.1E+04		0.0226%		no
Chloroform	6.0E+00	1.00E-02	B2	6.10E-03	2.30E-02	6.0E+02	3.7E-02	0.0002%	0.0000%	no
Trichloroethene	1.1E+01	NA	NA	1.10E-02	6.00E-03		1.2E-01		0.0001%	no
Total VOC 's						7.4E+04	1.1E+01	0.0%	0.0%	
Semi-volatiles-ug/Kg										
Methylphenol, 4-	1.0E+02	5.00E-03	C	NA	NA	2.0E+04		0.0064%		no
Naphthalene	2.2E+01	4.00E-02	D	NA	NA	5.5E+02		0.0002%		no
Methylnaphthalene, 2-	3.0E+01	NA	NA	NA	NA					yes
Acenaphthylene	1.7E+02	NA	NA	NA	NA					yes
Dinitrotoluene, 2,4-	1.0E+02	2.00E-03	B2	NA	NA	5.0E+04		0.0159%		no
Fluorene	2.0E+01	4.00E-02	D	NA	NA	5.0E+02		0.0002%		no
N-Nitrosodiphenylamine	5.5E+01	NA	B2	4.90E-03	NA		2.7E-01		0.0003%	no
Phenanthrene	1.2E+03	NA	NA	NA	NA					yes
Anthracene	2.7E+02	3.00E-01	D	NA	NA	9.0E+02		0.0003%		no
Carbazole	9.7E+01	NA	B2	2.00E-02	NA		1.9E+00		0.0024%	no
Di-n-butylphthalate	2.1E+01	1.00E-01	D	NA	NA	2.1E+02		0.0001%		no
Fluoranthene	7.4E+03	4.00E-02	D	NA	NA	1.9E+05		0.0589%		no
Pyrene	6.7E+03	3.00E-02	NA	NA	NA	2.2E+05		0.0711%		no
Benzo(a)anthracene	4.9E+03	NA	B2	1.06E+00	NA		5.2E+03		6.3520%	yes
Chrysene	5.3E+03	NA	D	3.21E-02	NA		1.7E+02		0.2085%	no
bis(2-Ethylhexyl)phthalate	4.3E+03	2.00E-02	B2	1.40E-02	NA	2.1E+05	6.0E+01	0.0685%	0.0737%	no
Benzo(b)fluoranthene	4.5E+03	NA	B2	1.02E+00	NA		4.6E+03		5.6323%	yes
Benzo(k)fluoranthene	3.7E+03	NA	B2	4.82E-01	NA		1.8E+03		2.1832%	yes
Benzo(a)pyrene	3.9E+03	NA	B2	7.30E+00	NA		2.8E+04		34.8887%	yes
Indeno(1,2,3-cd)pyrene	2.4E+03	NA	B2	1.69E+00	NA		4.1E+03		4.9779%	yes
Dibenzo(a,h)anthracene	1.3E+03	NA	B2	8.10E+00	NA		1.1E+04		12.9007%	yes
Benzo(g,h,i)perylene	2.3E+03	NA	NA	NA	NA					yes
Total Semi-Voa's						7.0E+05	5.5E+04	0.2%	67.2%	
			B2							
Pesticides/PCB's-ug/Kg			D							
DDE, 4,4'-	6.3E+01	NA	B2	3.40E-01	3.40E-01		2.1E+01		0.0262%	no
Endrin	2.3E+00	3.00E-04	D	NA	NA	7.7E+03		0.0024%		no
DDD, 4,4'-	1.7E+00	NA	B2	2.40E-01	NA		4.1E-01		0.0005%	no
Endosulfan Sulfate	2.7E+00	5.00E-05	NA	NA	NA	5.4E+04		0.0172%		no
DDT, 4,4'-	2.4E+00	5.00E-04	B2	3.40E-01	3.40E-01	4.8E+03	8.2E-01	0.0015%	0.0010%	no
alpha-Chlordane	3.6E+00	6.00E-05	NA	NA	NA	6.0E+04		0.0191%		no
Aroclor-1260	5.4E+01	NA	NA	7.70E+00	NA		4.2E+02		0.5092%	no
Total Pesticides						1.3E+05	4.4E+02	0.0%	0.5%	
Metals-mg/Kg										
Aluminum	2.1E+05	NA	NA	NA	NA					yes
Antimony	1.1E+01	4.00E-04	NA	NA	NA	2.7E+07		8.5963%		yes
Arsenic	1.2E+01	3.00E-04	A	1.75E+00	1.51E+01	4.0E+07	2.1E+04	12.8414%	25.8326%	yes
Barium	2.3E+02	7.00E-02	NA	NA	NA	3.2E+06		1.0325%		yes
Beryllium	1.2E+00	5.00E-03	B2	4.30E+00	8.40E+00	2.4E+05	5.2E+03	0.0764%	6.3184%	yes
Cadmium	4.1E+00	5.00E-04	B1	NA	6.30E+00	8.2E+06		2.6107%		yes
Chromium	3.3E+01	5.00E-03	A	NA	4.20E+01	6.7E+06		2.1268%		yes
Cobalt	1.7E+01	NA	NA	NA	NA					yes
Copper	5.9E+01	4.00E-02	D	NA	NA	1.5E+06		0.4664%		no
Lead	2.2E+02	NA	B2	NA	NA					yes
Manganese	1.1E+03	5.00E-03	D	NA	NA	2.1E+08		66.8801%		yes
Mercury	8.1E-01	3.00E-04	NA	NA	NA	2.7E+06		0.8596%		no
Nickel	4.6E+01	NA	NA	NA	8.40E-01					yes
Selenium	1.0E+00	5.00E-03	NA	NA	NA	2.0E+05		0.0637%		no
Silver	6.9E-01	5.00E-03	NA	NA	NA	1.4E+05		0.0439%		no
Thallium	5.2E-01	9.00E-05	NA	NA	NA	5.8E+06		1.8385%		yes
Vanadium	3.1E+01	7.00E-03	D	NA	NA	4.4E+06		1.3963%		yes
Zinc	8.3E+02	3.00E-01	D	NA	NA	2.8E+06		0.8851%		no
Cyanide	1.0E+00	2.00E-02	D	NA	NA	5.0E+04		0.0159%		no
Total Metals						3.1E+08	2.6E+04	99.7%	32.3%	
Total Compounds						3.1E+08	8.2E+04	100.00%	100.00%	

TABLE 6-5

CONCENTRATION-TOXICITY SCREENING
GROUNDWATER DATA

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Max. Conc.	RfD mg/kg/day	Rank Weight of Evidence	Carc. Slope		Conc.-Tox Value (Non-Carc.)	Conc.-Tox Value (Carcinogenic)	Conc.-Tox % (Non-Carc.)	Conc.-Tox % (Carcinogenic)	Passed Screening
				Oral mg/kg/day-1	Inh mg/kg/day-1					
<u>Volatile Organics-ug/L</u>										
Vinyl Chloride	2.3E+04	NA	A	1.90E+00	2.94E-01		4.4E+04		98.5655%	yes
Dichloroethene, 1,1-	2.0E+02	9.00E-03	C	6.00E-01	1.75E-01	2.2E+04	1.2E+02	0.2582%	0.2707%	no
Dichloroethane, 1,1-	1.7E+02	1.00E-01	NA	NA	NA	1.7E+03		0.0192%		no
Dichloroethene, 1,2- (total)	7.4E+04	9.00E-03	NA	NA	NA	8.2E+06		95.5223%		yes
Chloroform	3.6E+02	1.00E-02	B2	6.10E-03	8.05E-02	3.6E+04	2.9E+01	0.4124%	0.0645%	no
Dichloroethane, 1,2-	6.0E+00	NA	B2	9.10E-02	9.10E-02		5.5E-01		0.0012%	no
Trichloroethane, 1,1,1-	3.6E+02	NA	D	NA	NA					yes
Trichloroethene	3.7E+04	NA	NA	1.10E-02	6.00E-03		4.1E+02		0.9180%	yes
Benzene	1.7E+02	NA	A	2.90E-02	2.91E-02		4.9E+00		0.0111%	no
Tetrachloroethene	2.0E+00	1.00E-02	D	5.00E-02	2.00E-03	2.0E+02	1.0E-01	0.0023%	0.0002%	no
Xylene (total)	5.9E+02	2.00E+00	D	NA	NA	3.0E+02		0.0034%		no
Total Voc's						**8.3E+06**	**4.4E+04**	**96.2%**	**99.8%**	
<u>Semi-volatiles-ug/L</u>										
Phenol	5.0E+00	6.00E-01	D	NA	NA	8.3E+00		0.0001%		no
bis(2-Chloroethyl)ether	6.0E-01	NA	NA	1.00E+00	1.00E+00		6.0E-01		0.0014%	no
Methylphenol, 4-	6.0E+00	5.00E-03	C	NA	NA	1.2E+03		0.0139%		no
Naphthalene	6.6E+01	4.00E-02	D	NA	NA	1.7E+03		0.0192%		no
Methylnaphthalene, 2-	1.3E+01	NA	NA	NA	NA					yes
Pentachlorophenol	7.4E+01	3.00E-02	B2	1.20E-01	NA	2.5E+03	8.9E+00	0.0287%	0.0200%	no
Di-n-butylphthalate	1.8E+01	1.00E-01	D	NA	NA	1.8E+02		0.0021%		no
Total Semi-Voa's						**5.5E+03**	**9.5E+00**	**0.1%**	**0.0%**	
<u>Metals-ug/L</u>										
Aluminum	3.1E+05	NA	NA	NA	NA					yes
Arsenic	8.6E+00	3.00E-04	A	1.75E+00	1.51E+01	2.9E+04	1.5E+01	0.3330%	0.0339%	no
Beryllium	1.2E+01	5.00E-03	B2	4.30E+00	8.40E+00	2.3E+03	5.0E+01	0.0272%	0.1135%	no
Cadmium	6.5E+01	5.00E-04	B1	NA	6.30E+00	1.3E+05		1.5010%		yes
Chromium	4.2E+02	5.00E-03	A	NA	4.20E+01	8.4E+04		0.9712%		yes
Copper	4.1E+02	4.00E-02	D	NA	NA	1.0E+04		0.1197%		no
Lead	1.5E+02	NA	B2	NA	NA					yes
Mercury	2.3E+00	3.00E-04	NA	NA	NA	7.7E+03		0.0891%		no
Nickel	6.2E+02	NA	NA	NA	8.40E-01					yes
Selenium	6.5E+00	5.00E-03	NA	NA	NA	1.3E+03		0.0151%		no
Vanadium	3.6E+02	7.00E-03	D	NA	NA	5.1E+04		0.5942%		no
Zinc	1.8E+03	3.00E-01	D	NA	NA	5.8E+03		0.0678%		no
Total Metals						**3.2E+05**	**6.5E+01**	**3.7%**	**0.1%**	
Total Compounds						**8.6E+06**	**4.4E+04**	**100.0%**	**100.0%**	

TABLE 6-5

CONCENTRATION-TOXICITY SCREENING
SURFACE WATER DATA

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Max. Conc.	RfD mg/kg/day	Rank Weight of Evidence	Carc. Slope		Conc.-Tox Value (Non-Carc.)	Conc.-Tox Value (Carcinogenic)	Conc.-Tox % (Non-Carc.)	Conc.-Tox % (Carcinogenic)	Passed Screening
				Oral mg/kg/day-1	Inh mg/kg/day-1					
Volatile Organics-ug/L										
Chloroform	2.0E+00	1.00E-02	B2	6.10E-03	8.05E-02	2.0E+02	1.6E-01	0.0358%	1.5487%	yes
Total VOC 's						2.0E+02	1.6E-01	0.0%	1.5%	
Metals-ug/L										
Aluminum	2.4E+03	NA	NA	NA	NA					yes
Antimony	1.4E+02	4.00E-04	NA	NA	NA	3.5E+05		63.1025%		yes
Arsenic	2.9E+00	3.00E-04	A	1.75E+00	1.51E+01	9.7E+03	5.1E+00	1.7305%	48.8169%	yes
Barium	1.1E+02	7.00E-02	NA	NA	NA	1.6E+03		0.2890%		no
Beryllium	1.2E+00	5.00E-03	B2	4.30E+00	8.40E+00	2.4E+02	5.2E+00	0.0430%	49.6345%	yes
Chromium	7.6E+00	5.00E-03	A	NA	4.20E+01	1.5E+03		0.2721%		no
Cobalt	6.9E+00	NA	NA	NA	NA					yes
Copper	2.2E+01	4.00E-02	D	NA	NA	5.4E+02		0.0971%		no
Lead	4.2E+01	NA	B2	NA	NA					yes
Manganese	9.4E+02	5.00E-03	D	NA	NA	1.9E+05		33.6904%		yes
Mercury	1.5E-01	3.00E-04	NA	NA	NA	5.0E+02		0.0895%		no
Nickel	1.1E+01	NA	NA	NA	8.40E-01					yes
Selenium	3.4E+00	5.00E-03	NA	NA	NA	6.8E+02		0.1217%		no
Vanadium	1.6E+01	7.00E-03	D	NA	NA	2.3E+03		0.4168%		no
Zinc	1.9E+02	3.00E-01	D	NA	NA	6.2E+02		0.1116%		no
Total Metals						**5.6E+05**	**1.0E+01**	**100.0%**	**98.5%**	
Total Compounds						**5.6E+05**	**1.0E+01**	**100.0%**	**100.0%**	

TABLE 6-6

LIST OF CHEMICALS QUANTIFIED IN HUMAN HEALTH RISK ASSESSMENT

SENECA ARMY DEPOT
ASH LANDFILL

ANALYTE	SOILS	SEDIMENT	SURFACE WATER	GROUNDWATER
Volatile Organics				
Vinyl chloride	X			X
Dichloroethene, 1,2- (total)	X			X
Chloroform			X	
Trichloroethane, 1,1,1-				X
Trichloroethene	X			X
Semivolatiles				
Methylnaphthalene, 2-	X	X		X
Acenaphthylene	X	X		
Dibenzofuran	X			
Phenanthrene	X	X		
Benzo(a)anthracene	X	X		
bis(2-Ethylhexyl)phthalate	X			
Benzo(b)fluoranthene	X	X		
Benzo(k)fluoranthene	X	X		
Benzo(a)pyrene	X	X		
Indeno(1,2,3-cd)pyrene	X	X		
Dibenz(a,h)anthracene	X	X		
Benzo(g,h,i)perylene	X	X		
Pesticides/PCB's				
Aroclor-1260	X			
Metals				
Aluminum		X	X	X
Antimony		X	X	
Arsenic		X	X	
Barium		X		
Beryllium		X	X	
Cadmium	X	X		X
Chromium	X	X	X(1)	X
Cobalt		X	X	
Copper	X	X(1)	X(1)	X(1)
Lead	X	X	X	X
Manganese		X	X	
Nickel		X	X	X
Thallium		X		
Vanadium		X		
Zinc	X	X(1)	X(1)	X(1)

NOTES: 1) Metals that did not pass Concentration-Toxicity screening but were retained in the risk assessment.

The final step was a concentration-toxicity screening in which the maximum detected concentration of each analyte in each media was divided by the RfD and carcinogenic slope factor to arrive at a concentration-toxicity value. These values were then summed and the percentage contribution of each analyte calculated. Any analyte that contributed less than 1 percent of the total concentrtion-toxicity value was eliminated from the baseline risk assessment. If an analyte did not have a RfD or carcinogenic slope factor, it was retained in the baseline risk assessment. The results of the concentration-toxicity screening are presented on Table 6-5.

Table 6-6 shows the compounds remaining after this screening process that were quantified in the baseline human health risk assessment. Several metals that did not pass the concentration toxicity screening were nonetheless retained in the risk assessment. The three metals retained were chromium in surface water and copper and zinc in sediment, surface water and groundwater. These metals were determined to be statistically above background in soils and, thus are the most likely to have impacted the Ash Landfill and downgradient environment. Therefore, they are retained in these media to assure a conservative risk evaluation.

6.3 EXPOSURE ASSESSMENT

6.3.1 Overview and Characterization of Exposure Setting

The objective of the exposure assessment was to estimate the type and magnitude of exposures to the chemicals of potential concern that are present at, or migrating from, the site. A completed exposure pathway has the following four elements:

- a source and mechanism for chemical release,
- an environmental transport medium,
- an exposure point, and
- a human receptor and a feasible route of exposure at the exposure point.

A pathway cannot be completed unless each of these elements is present. The sources and mechanisms for release of chemicals and the environmental transport mediums are described in Section 5, contaminate Fate and Transport.

An exposure point concentration is the concentration of chemical(s) in a given medium to which an actual or hypothetical receptor may be exposed at a specific location, known as the "exposure point." Exposure point concentrations can be based on analytical data obtained from on-site sampling, estimated through modeling, or based on a combination of the two.

For purposes of this baseline risk assessment, two types of potentially exposed populations were considered. Under the current off-site land-use scenario, the exposed population included close proximity child and adult residents. Under the future onsite land-use scenario, child and adult residents were considered to live on or adjacent to the site and represent the hypothetical exposed population. In both land-use scenarios, the child and adult were considered the same individual for the 30-year residential duration. For each land-use scenario, the calculated 30-year residential exposure was equal to the sum of six years of child exposure and 24 years of adult exposure.

The exposure assessment is the determination or estimation of the magnitude, duration, frequency, and route of exposure. This component of the risk assessment can be performed on either a qualitative or quantitative basis with the quantitative being the more preferred method given the availability of the toxicity factors necessary to characterize a compound of concern (quantitatively).

The exposure assessment consists of three steps (USEPA, 1989a):

1). **Characterize Exposure Setting:** Contained within this step is general information concerning the physical characteristics of the site as it pertains to potential considerations affecting exposure. The physical setting involves climate, vegetation, soil characteristics, surface and groundwater hydrology. All potentially exposed populations and subpopulations therein (receptors) are assessed relative to their potential for exposure. Additionally, locations relative to the site along with the current and potential future land use of the site are considered. This step is a qualitative one aimed at providing a general site perspective and offering insight on the surrounding population.

2). **Identify Exposure Pathways:** All exposure pathways, ways in which receptors can be exposed to contaminants that originate from the source, are reviewed in this step. Chemical source and mechanisms for release along with its subsequent fate and transport are investigated. Exposure points of human contact and exposure routes are discussed before quantifying the exposure pathways in step 3.

3). **Quantify Exposure:** In this final process, the exposure concentrations for the various exposure pathways are calculated using the *Standard Default Exposure Factors* (USEPA, 1991), as a guideline for all assumptions and projections inclusive of intake variables for each pathway-specific exposure.

The graphical description of this process is shown in Figure 6-2.

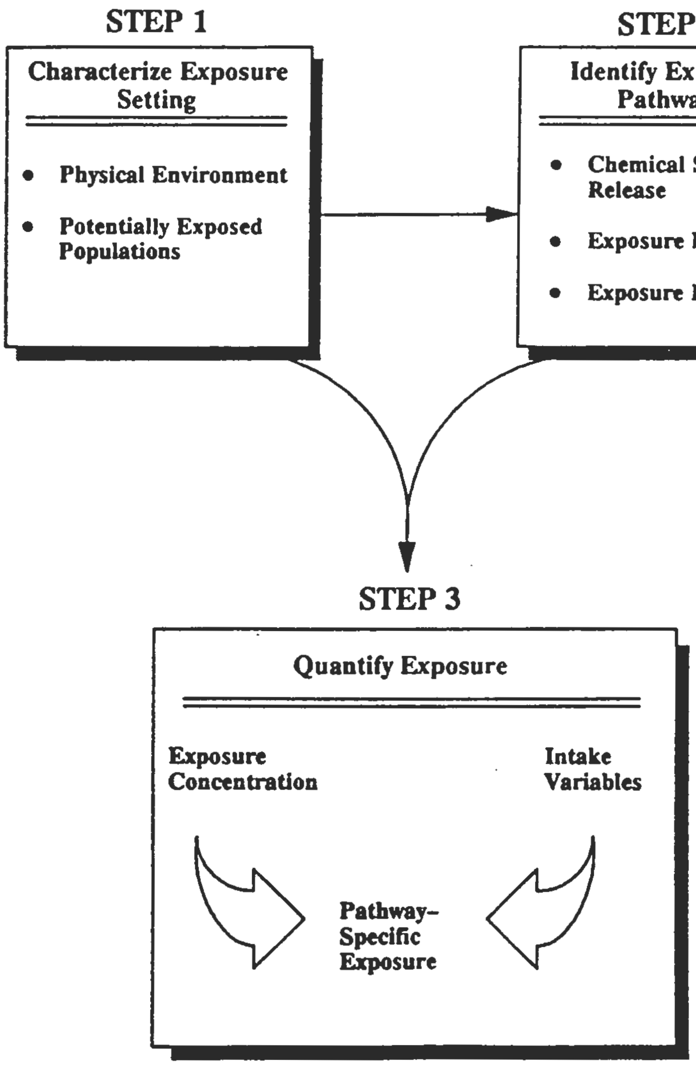
6.3.2 Physical Setting

SEDA lies on the western side of a series of north to south trending rock terraces which separate Cayuga Lake on the east and Seneca Lake on the west. The rock terraces range in elevation from 490 feet above MSL in northern Seneca County to as much as 1,600 feet above MSL at the southern end of the lakes. Elevations on SEDA range from 450 feet above MSL on the western boundary to 760 feet above MSL in the southeast corner. The Depot's land surface generally slopes to the west and north.

The Ash Landfill area is located on gently sloping terrain along the western boundary of SEDA, immediately east of the magazine area. The majority of the site, which slopes downward to the west-southwest, is vegetated with grasses and occasional brush thickets. Surface runoff from the area is collected in drainage ditches along the east-west roadway (West Smith Farm Road) and the north-south roadway (West Patrol Road).

6.3.2.1 Climate

A cool climate exists in the locality of SEDA with temperatures ranging from an average of 23°F in January to 69°F in July. Marked temperature differences are found between daytime highs and nighttime lows during the summer and portions of the transitional seasons. Precipitation is well-distributed, averaging approximately 3 inches per month. The annual average snowfall is approximately 100 inches. Wind velocities are moderate, but during the winter months, there are numerous days with sufficient winds to cause blowing and drifting snow. Daily precipitation data measured at the Aurora Research Farm in Aurora, New York for the period (1957-1991) were obtained from the Northeast Regional Climate Center at Cornell University. The maximum 24-hour precipitation measured at this station during this period was 3.91 inches on September 26, 1975. Values of 35 inches mean annual pan evaporation and 28 inches for annual lake evaporation were reported. An independent value of 27 inches for mean annual evaporation from open water surfaces was estimated from an isoplethic figure found in "*Water Atlas of the United States*" (Water Information Center, 1973).



Source:EPA, 1989a

ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING

NO. 720447-01000

FIGURE 6-2

THE EXPOSURE ASSESSMENT PROCESS

SCALE

SEDA is located in the Genessee-Finger Lakes Air Quality Control Region (AQCR). The AQCR is designated as non-attainment for ozone and attainment or unclassified for all other criteria pollutants. Data for existing air quality in the immediate area surrounding SEDA, however, can not be obtained since the nearest state air quality stations are 40 to 50 miles away from the army depot.

6.3.2.2 Vegetation

The major vegetative communities in the 0.5-mile study area are primarily upland cover types. Some freshwater wetlands occur, principally on the Ash Landfill area. The upland cover types in the study area include old field vegetation, shrubland, deciduous forests and agricultural fields. Old field vegetation and shrublands are the dominate cover types on the Ash Landfill area and adjacent environs. The old field vegetation are comprised of a mixture of herbaceous and shrub plant species with some small trees. Queen Anne's-lace, panic grass, teasel, goldenrods, asters and field thistle are the most abundant species in these fields. Shrublands are comprised primarily of shrubs and small trees with some herbaceous species. Gray-stemmed dogwood, raspberry and blackberry, multiflora rose, buckhorn, black locust, sumacs and wild grape are the most common shrubs and vines in this cover type. Prior to becoming part of the SEDA in 1941, most of the old fields and shrublands were active farmland. When they became part of the depot and left fallow, these croplands succeeded to old field vegetation and shrubland and were maintained in these cover types by periodic strip mowing and brush cutting for wildlife habitat improvement. The ammunition storage area to the east of the Ash Landfill area, as well as the roadsides, are mowed to maintain the low cover for security purposes.

Agricultural fields are the next most prevalent cover type in the study area. However, all occur on the privately owned farms west of the site. Crops typically grown in these cropfields surrounding the Depot include corn, wheat, soybeans, and various hay mixtures. Deciduous forests comprise a relatively minor cover type in the study area and occur as woodlots and tree rows which line the fields and roads. Various oaks, sugar maple, hickory, black locust, black cherry, and aspens are the major overstory trees in these woodlots and tree rows.

Several small freshwater emergent wetlands are located on the Ash Landfill area (W-A, W-B, W-D, W-E, W-F). Some of these emergent wetlands may have been created by landfill excavation operations. Several drainage ditches were also constructed to catch surface water run-off from the Ash Landfill area and roads. These ditches are also vegetated with emergent wetland plants. Common reed (Phragmites australis) is the most abundant and widely distributed emergent plant species, comprising 40 to 95 percent cover. Purple loosestrife (Lythrum salicara), rush (Juncus sp.), broad-leaved cattail (Typha latifolia), sedge (Carex sp.)

and spike-rush (Eleocharis sp.) also have wide distribution, but are not as abundant (10 to 50 percent cover). No standing water was observed in these wetlands when they were surveyed.

6.3.2.3 Geologic Setting and Soil Classification

The site geology is characterized by gray Devonian shale with a thin weathered zone where it contacts the overlying mantle of Pleistocene glacial till. This stratigraphy is consistent over the entire site and in the site vicinity. Gray competent shale was encountered between 6 and 14 feet below the land surface in all existing and newly performed borings on the site and in off-site surrounding areas. A bedrock topographic map shows that topography shapes consistently to the west from an elevation of 720 feet in the eastern portion of the site to 614 feet in the western portion of the site. Bedrock topographic gradients are steepest in the eastern portion of the site (as is land surface topography) and in the southwestern portion of the site where they shift slightly to the southwest.

A thin (1.5 to 12 feet thick) zone of gray weathered shale was encountered in almost all locations drilled on-site. This zone is characterized by fissile shale with a large amount of brown intersticial silt and clay. An isopach map for the weathered shale indicates that thickness varies throughout the site, with the greatest thickness occurring approximately 260 feet west of the incinerator building and the least thick area occurring approximately 400 feet north of the incinerator building. Differential weathering through geologic time is likely responsible for the variable thicknesses. A small weathered shale trough with a northeast-southeast oriented axis is located south of the ash landfill incinerator building area and culminates at the thickest portion of the weathered shale near PT-20. The transition from the competent weathered shale is sharp based on drilling characteristics. No outcrops of weathered or competent shale are exposed on the site.

A 2 to 11 foot thick mantle of dense glacial till covers the shale on-site. The till is generally characterized by brown to gray-brown silt, clay and fine sand with few fine to coarse gravel-sized inclusions of weathered shale. Larger diameter weathered shale clasts (as large as 6-inches in diameter) are more prevalent in basal portions of the till and are probably ripped-up clasts removed by the once active glacier. The general Unified Soil Classification System description of the till on-site is as follows: Clay-silt, brown; slightly plastic, small percentage of fine to medium sand, small percentage of fine to coarse gravel-sized gray shale clasts, dense and mostly dry in place, till, (ML).

Darian silt-loam soils, 0 to 18 inches thick, are developed over the till on-site, however, in some locations till is exposed at the surface. The surficial soils are somewhat poorly drained and have a silt clay loam and clay sub soil. In general, the topographic relief associated with these soils is 3-8%.

Several artificially filled areas exist on the site. These include the Ash Landfill, debris piles and the Non-Combustible Fill Landfill. The Ash Landfill is approximately 600 x 300 foot in area and it overlies glacial till. This ash fill is defined by the slightly higher elevation in this area. The three debris piles north and northeast of the ash landfill and are at slightly higher elevations relative to the surrounding areas; this is especially evident at the easternmost debris pile. The Non-Combustible Fill Landfill, located across West Smith Farm Road, is a wedge of fill that originates south of B6-91 and thickens to the west to a point approximately 150 feet beyond B7-91. It is well defined by the topographic expression of the fill which has a total relief of about 14 feet at the western toe.

6.3.2.4 Surface Water Hydrology

Surface water drains into several wetland areas on-site. Based on topographic expression, several of these wetland areas (W-B, W-D, W-E, and W-F) drain mostly into two small, but clearly developed, drainage swales south of the Ash Landfill and incinerator building. These swales drain into a drainage ditch along West Patrol Road. Surface water, when present, drains to the north along West Patrol Road. Wetland W-F also drains into the ditch along West Patrol Road. Drainage along West Patrol Road, and along Cemetery Road, is to the west based on topography.

6.3.2.5 Groundwater Hydrology

The hydrogeologic properties of the site were characterized in accordance with the investigation programs described in Section 2.0. A groundwater contour map of the shallow aquifer was constructed based on depth to water measurements made on January 7, 1992. The map indicates that the general direction of groundwater flow in the shallow aquifer is to the west toward Seneca Lake roughly mimicking surface topography. Shallow aquifer elevations are approximately 655 feet in the eastern portion of the site and drop to a low of 630 feet in the western portion of the site. The groundwater gradient between wells PT-18 and PT-17 was calculated to be 2.13×10^{-2} feet per foot. Groundwater flow contours indicate that there is a consistent gradient over the entire site.

A groundwater contour map was also constructed for the competent shale aquifer. While control is not as good as for the shallow aquifer due to the limited number of wells, it could be determined that groundwater elevations in deep wells are higher in the eastern portion of the site (between approximately 680 and 686 feet) than they are in the western portion of the site (between approximately 630 and 634 feet) suggesting that a west-southwesterly direction of flow in the deep aquifer is likely.

The average linear velocity of groundwater flowing through the aquifer was calculated. Velocities were determined based upon average hydraulic conductivities of 4.5×10^{-4} cm/sec in the glacial till/weathered shale and 3.73×10^{-5} cm/sec in the competent shale. Using Darcy's Law, the average linear velocity of groundwater flow, based upon the hydraulic conductivity, the assumed porosity, and the horizontal gradient of the groundwater surface was 18.1 ft/year in the till/weathered shale and 7.3 ft/year in the competent shale. These calculated velocities are considered slow and reflect the fine grained nature and associated low hydraulic conductivities of both the glacial till and competent shale units. These low velocities also suggest that contaminants present within the groundwater are, on average, moving at slow rates.

There is no current use of groundwater at the Ash Landfill. A farmhouse located approximately 2,400 feet west of the Ash Landfill current uses groundwater for drinking water. Potential onsite groundwater use will be considered only as a future onsite residential exposure.

6.3.3 Potentially Exposed Populations and Subpopulations

6.3.3.1 Offsite Receptors (Romulus & Varick Townships)

The area surrounding SEDA is sparsely populated farmland. The population density in the two towns which surround the SEDA facility, Romulus and Varick, is 67 people per square mile based on the 1990 U.S. Census. Any recreators such as waders who may use downstream portions of Kendaia Creek on a seasonal basis are potential offsite receptors. The nearest sensitive subgroup (receptor) location is the Central School in Romulus Village, approximately 3 miles northeast of the Ash Landfill. Additionally, recreational activities take place at Sampson State Park approximately 1 radial mile from the Ash Landfill. The park has a boat landing and waterfront access to Seneca Lake. Typically,picnics, outdoor exercise, and other summer activities take place here.

Residential communities surrounding the depot use potable water wells for drinking water supplies, which, however unlikely, could be a possible route of exposure to any contaminants released as a result of the Ash Landfill activities. Children, pregnant women, and elderly people in this area may constitute sensitive receptors along the depot's western boundary. This is due to the increased sensitivity to environmental influences at each of the respective life cycles. It is important to point out, however, that these individuals would represent high profile receptors in any location where the potential for exposure is possible. These potential potable well water supplies are more than likely bedrock wells rather than overburden wells. If so, this would further reduce the potential impacts of future contamination from the Ash Landfill.

6.3.3.2 Current Land Use

On-Site Receptors

The Ash Landfill is no longer active and is in a remote area of the depot. Base residents and facility workers are not considered to be potential receptors due to the distances between the location of the buildings where people work and reside and the Ash Landfill. The site is occasionally patrolled by site security personel who drive along West Smith Farm Road, which is adjacent to the Ash Landfill. The site is occasionally patrolled by site security personnel who drive along West Smith Farm Road, which is adjacent to the Ash Landfill. However, these security personel do not leave the vehicle. As a result, ES believes that the most reasonable current on-site land use is deerhunting. Deerhunting is conducted during the fall season in a controlled manner at assigned locations that include the site. The exposures occurring during hunting have been evaluated in the risk assessment.

Off-Site Receptors

Land use adjacent to and off-site of the southwestern corner of SEDA is sparse residential areas with some farmland. Records provided by the Town of Varick show approximately 7 residences adjacent to the western border of SEDA that are within 1 mile of the Ash Landfill. This includes the farmhouse located approximately 2,400 feet west of the landfill. These residences all obtain drinking water from private water wells. However, detailed information regarding construction of these wells was not available.

6.3.3.3 Potential Future Land Uses

EPA guidance for determining future land uses recommends that, if available, master plans, which include future land uses, Bureau of Census projections and established land use trends in the general area should be utilized to establish future land use trends. Since the Ash Landfill is located in Romulus, the Romulus Town Clerk was contacted to determine if any master plans exist for this area or if any land use restrictions could apply to the future use of the Ash Landfill. No zoning maps or master plans were found to exist for the site or surrounding areas in the town of Romulus. Consequently, the use of this area for light industrial or residential uses is not restricted by local zoning laws and either use could be permitted. The existing land use surrounding the Ash Landfill is generally agricultural with sparse housing. Large tracts of undeveloped land are widely available for future development. The area is not experiencing a high degree of growth nor is it expected to. There is no pressure to develop land in this area, nor will there likely be the need to develop the Ash Landfill for residential purposes. Section 6.2.2 of RAGS discusses future land uses and states: "If the site is industrial and is located in a very rural area with a low population density and projected low growth, future residential use would probably bne unlikely. In this case, a more likely alternate future land use may be recreational. At some sites, it may be most reasonable to assume that the land use will not change in the future."

The intended future use of the Ash Landfill is as an undeveloped abandoned former incinerator. The Army has no plans to change the use of this facility or to transfer the onwership. If the property is to change ownership, CERCLA, Section 120 (h)(1),(2) and (3), requires that the prospective owner must be notified that hazardous substances were stored on the parcel. This will include the quantity and type of the substances that were stored. The content of the deed must also include a covenant warranting that all remedial actions necessary to protect human health and the environment with respect to any such hazardous substances remaining of the property have been taken before the date of the transfer. If a property transfer is contemplated by the Army, this information, under penalty of the law, must be supplied to the prospective owner. Should the actual future use of the parcel be residential, then the Army will perform any additional remedial activities to ensure that human health and the environment, under residential scenario, are protected.

In this human health assessment, for the purposes of worst case considerations, the future land use of the Ash Landfill, was considered to be residential. The possibility of this actually occurring is remote since the Army intents to continue using this parcel for munitions destruction. Although the risk due to future residential land use will be calculated in this BRA the decision to perform a remedial action will be based upon an intended (current) land use scenario. At such time that the property is intended to be transferred in accordance with CERCLA, the Army will notify all appropriate regulatory agencies and will perform any additional investigations and remedial actions to assure that the change in the intended land use is protective of human health and the environment.

6.3.4 Identification of Exposure Pathways

Within each exposure pathway, a clear identification of all the possibilities of human exposure at the Ash Landfill is specifically introduced. "The focus lies in relationships between the sources, locations, and types of environmental releases of contamination given the surrounding population and subsequent activity patterns of that population" (USEPA, 1989a). In this light, the targeted exposures and ideal scenarios are assembled for quantitative assessment of lifetime human health risk.

The exposure pathways usually consist of four components:

- source and mechanism of release,
- transport medium,
- exposure points (potential point of human contact with contamination), and
- exposure route (e.g., inhalation, ingestion, dermal contact).

In some cases the transport medium is negligible due to the fact that the source of contamination acts as an exposure point and no transport medium is taken into consideration (e.g, open drum).

6.3.4.1 Sources and Receiving Media

The contaminant source areas involved in the assessment of the Ash Landfill area consist of the Ash Landfill, the Non-Combustible Fill Landfill and the debris piles. As discussed previously, these are three areas where disposal activities occurred in the past and where RI data have shown elevated levels of chemicals in the environment. As evidenced by the RI data, these source areas have since spread to include contaminated surface soil, and sediment, in the surrounding area. The contaminated soil and sediment may serve as both a release source and an exposure point. The contaminant levels in the soil and groundwater in the Ash

Landfill area (bend in the road) current constitute the most significant source area, as shown by the data.

6.3.4.2 Fate and Transport in Release Media

The environmental fate associated with constituents disposed of at the Ash Landfill are discussed in detail in Section 5. The expected behavior of the ash and the residuals that remain following the burning of trash, and dumping of waste compounds are of particular concern due to their presence at the site.

6.3.4.2.1 Volatiles

The major volatiles detected at the Ash Landfill are trichloroethene (TCE) 1,2-dichloroethene, (1,2-DCE) and vinyl chloride (VC). 1,2-DCE and VC are degradation breakdown products of TCE. Fugacity modeling and groundwater transport modeling were performed to predict the anticipated partitioning of these three constituents among the environmental media (air, water, soil) and their downgradient transport.

6.3.4.2.2 Semi-Volatiles

The principal semi-volatile compounds found in the Ash Landfill are PAH's, phthalates pesticides, PCBs and herbicides. Generally these constituants are less mobile and more persistant in the environment than the voltiles. This was verified by the RI sampling programs, which measured elevated concentrations of these constituants in the soil, but not in the groundwater.

6.3.4.2.2 Metals

The behavior of metals in soil is unlike organic compounds in many aspects. For example, volatilization of metals from soil is not considered a realistic mechanism for pollutant migration and was not considered. However, leaching and sorption were considered in the fate and transport evaluation. Leaching of metals from soil is controlled by numerous factors. Most importantly is its chemical form (base metal or cation) in the soil. The leaching of metals from soils is substantial if the metal exists as a soluble salt. Upon contact with surface water or precipitation, the metals, either as metal oxides or metal salts, can be solubilized, eventually leaching to the groundwater. In general, elevated concentrations of metals were not measured in the on-site monitoring wells.

6.3.4.3 Exposure Points

The exposure point describes and attempts to highlight that specific point of interface between an organism, in this case a human receptor, and a chemical at its source or via a transport medium. The exposure points that may exist at the Ash Landfill are:

1. The groundwater supply to the current residences adjacent to the depot's western perimeter or future on-site residences who rely on potable well water may be an exposure point at the interface between the sink or shower and the human receptor.

2. Kendaia Creek, a small surface water body that flows off-site, may serve not only as a receiving and transport medium but also as an exposure point to a current or future wader downstream.

3. The Ash Landfill may serve as a exposure point between contaminated surface soil and potential future receptors.

4. Current off-site and future on-site residents may be exposed to volatile organics in the ambient air that have been volatilized from the soil.

6.3.4.4 Exposure Routes

The exposure route attempts to classify the means in which the contaminate comes in contact with a organism, in this case, a human or biologic receptor. Not all exposure routes will exist at every site. Exposure pathways that will be evaluated at the Ash Landfill are discussed below.

6.3.4.5 Integration of Exposure Pathways

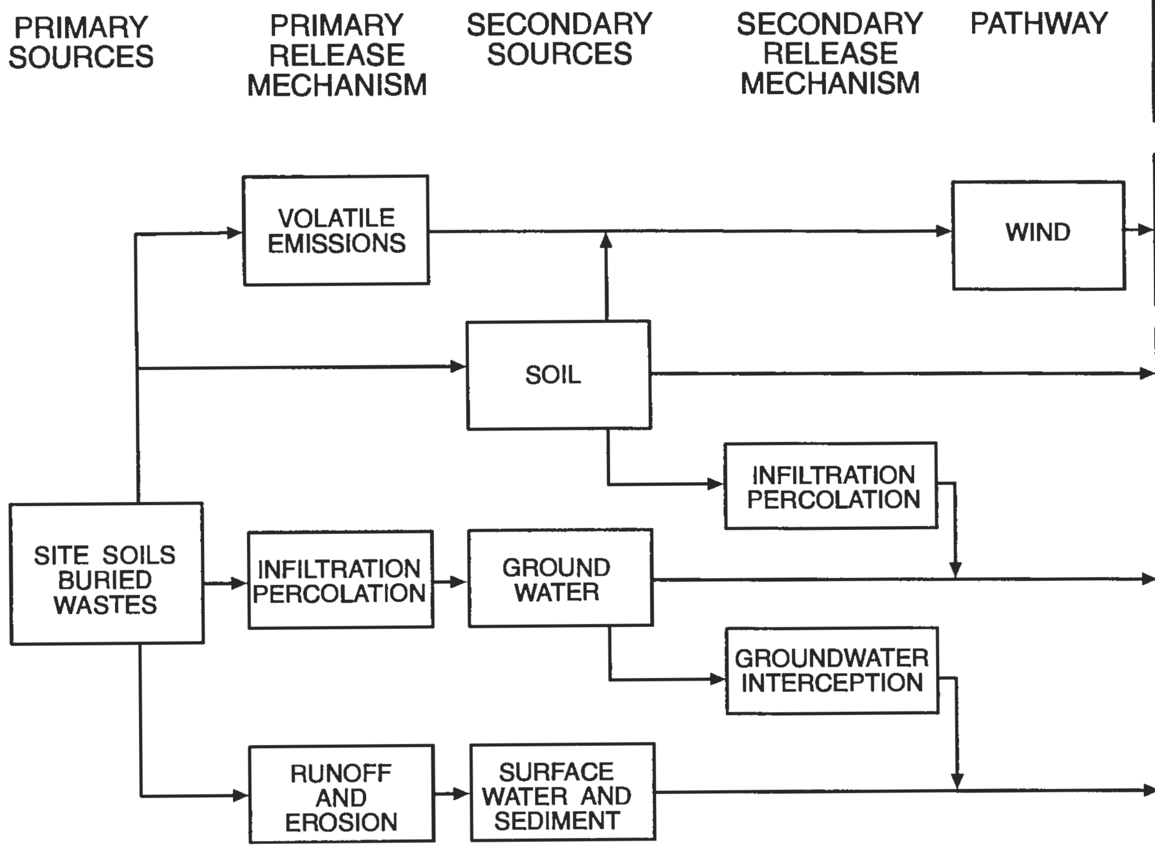
In this section, the final assembly of the components required to accurately construct an exposure pathway is performed. As described earlier the proper framework of an exposure pathway involves a source, transport medium, exposure point, and an exposure route. The pertinent exposure pathways for the Ash Landfill are summarized in Figure 6-3. According to the RAGS (USEPA, 1989a), a pathway is considered incomplete if one or more of these components is not present with the exception of the transport medium, which may be absent in the case of direct exposures. Hence, the conclusion, if there is not a complete pathway, there can be no risk resulting from that theoretical pathway. For the purposes of this baseline risk assessment (BRA), 22 current and future human exposure pathways have been identified as potential pathways which meet the criteria for an exposure pathway (exposure to surface water and sediment are counted separately). A current on-site exposure scenario is a deer hunter. For this scenario, ingestion and dermal contact with on-site soils, dermal contact to surface water and sediment while wading, and inhalation of volatile organics in ambient air are considered.

For the current off-site resident six exposure pathways are quantified. These are ingestion, dermal contact and inhalation of groundwater, dermal contact to surface water and sediment while wading, and inhalation of volatile organics in ambient air. The groundwater data used to evaluate current off-site residential exposure was obtained from the off-depot farmhouse wells that are currently a source of potable water. For the future on-site residents, two additional pathways are quantified. These are ingestion and dermal contact with on-site soils. Also, the on-site groundwater quality was used in the future residential groundwater pathways. For the future on-site worker, dermal contact with and ingestion of on-site soils and inhalation of volatile organics in ambient air are also considered.

The other potential pathways were not quantified based on the following rationale:

1. Exposure via wind erosion is not considered due to the vegetative ground cover that exists on the Ash Landfill and adjoining properties. A dispersion analysis of the PM_{10} at two downwind receptors (48m and 730m) was performed using an estimate of wind erosion after Skidmore and Woodruff (Wind Erosion Forces in the United States and their use in predicting soil loss, USDA Handbook No. 346) and SCREEN2 modeling. The results of the Modeling are contained in Appendix O. Concentrations derived from the SCREEN2 Modeling were low. It is also assumed that future residences, if any, will also have sufficient groundcover such that the potential for significant exposure from fugitive dust via air transport is unlikely.

2. The ecological demographics identified during the ecological assessment indicate that human exposure pathways through biotic intake under current land use is inappropriate. The only current significant biotic intake that could be considered is deerhunting. The conclusion of a study performed by the Army at the Joliet Army Ammunition Plant (JAAP) suggests that the risks due to the ingestion of deer meat does not contribute to the overall site risk. Based upon this study and



EXPOSURE ROUTE	RECEPTOR					
	HUMAN				BIOTA	
	CURRENT OFF-SITE RESIDENT	ON-SITE FUTURE RESIDENT	FUTURE SITE WORKERS	CURRENT HUNTER	TERR.	AQUATIC
INGESTION	X	X	X	X	X	X
INHALATION	●	●	●	●	X	X
DERMAL CONTACT	X	X	X	X	X	X
INGESTION	X	●	●	●	●	X
DERMAL CONTACT	X	●	●	●	●	X
INGESTION	●	●	X	X	X	X
INHALATION	●	●	X	X	X	X
DERMAL CONTACT	●	●	X	X	X	X
INGESTION	X	X	X	X	●	●
DERMAL CONTACT	●	●	X	●	●	●

● PATHWAY CONSIDERED TO POSE POTENTIAL RISK

X PATHWAY DISCOUNTED AS SIGNIFICANT RISK

ES
ENGINEERING-SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
REMEDIAL INVESTIGATION/FEASABILITY STUDY
ASH LANDFILL

DEPT. ENVIRONMENTAL ENGINEERING
NO. 720447-01000

FIGURE 6-3

EXPOSURE PATHWAY SUMMARY

SCALE N/A

the ability of deer to roam throughout the depot, not just the Ash Landfill, it is unlikely that the ingestion of deer meat would contribute to the site risk and has not been considered in this assessment. A draft copy of the JAAP deer study is provided in Appendix N.

Future on-site residents could be exposed through biotic intake pathways, such as the ingestion of garden vegetables. It is believed that this pathway would represent a minor incremental increase in uptake for future residents when compared to the more direct exposure pathways such as ingestion of groundwater.

3. Ingestion and dermal contact from surface water and sediment while swimming were considered to be an unrealistic current and future pathways of exposure because of the depth of Kendaia Creek is only a few inches and would prevent a receptor from swimming.

4. Ingestion and dermal contact to soil by current offsite area residents was eliminated from the risk assessment based on the unlikely occurance of a trespasser at the Ash Landfill. Security on the depot remains in place which prohibits no entrance to the grounds without authorization.

The most realistic current on-site exposure scenario is considered to be the hunter scenario.

6.3.4.6 Summary of Exposure Pathways to be Quantified

The pathways presented reflect the current offsite use and the projected future onsite use of the Ash Landfill. In this section, a justification for selecting these exposure pathways is described. Each exposure pathway current and future, is intended for residential exposure.

6.3.4.6.1 Dermal Contact to Surface Water and Sediments While Wading

In general, surface water and sediment exposures occur simultaneously because of the logistics involving both media. The distribution of contaminant to any available surface water body and surrounding sediment is assumed to be via surface runoff and sediment transport. The most likely receptor in this scenario would be a current off-site or future on-site resident or onsite deer hunter who makes contact with contaminated surface water and/or sediments after a rain incident through recreational wading. A child may also be exposed while wading in the downstream section of Kendaia Creek during recreational activities. Because of the limited size and depth of Kendaia Creek, swimming was not deemed a potential exposure scenario. Under current conditions, no other receptors have been identified using this exposure pathway with surface runoff as the transport mechanism for surficial contaminants. Exposure to surface water and sediments are considered separately. These pathways will be quantified for the current off-site and future on-site residential exposure scenarios, and the deer hunter exposure scenario.

6.3.4.6.2 Ingestion of Groundwater

The groundwater beneath the Ash Landfill is not currently used as a drinking water source. However, a farmhouse 2,400 feet west of the Ash Landfill is currently using groundwater as a potable water source. This is the closest current use of groundwater. Therefore, ingestion of groundwater is considered a currently completed pathway. To accurately assess this current exposure pathway risk, samples were collected from the farmhouse wells and analyzed for the potential constituents of concern. For the future exposure pathway, it was assumed that future on-site residents would install wells on-site for potable water. Therefore, data from the on-site wells are used to calculated exposure concentrations.

6.3.4.6.3 Inhalation and Dermal Contact with Groundwater while Showering/Bathing

The current off-site and potential future on-site residential populations necessitate consideration of this pathway. Given a contaminant migrational pathway via groundwater, acting as a transport medium for the chemicals of concern, an exposure point between the human receptor and the contaminant occurs at the faucet and/or the bathtub. As discussed above the current exposure pathway utilized sampling data from the farmhouse wells while the future exposure pathway uses data from on-site wells.

6.3.4.6.4 Incidental Ingestion and Dermal Contact to On-Site Surface Soils

The laboratory analysis of the Ash Landfill soils shows the presence of volatile organics, semi-volatile organics, pesticides/PCBs and herbicides. During the course of daily activities, an on-site child or adult resident will come into contact with these surface soils and may involuntarily ingest and have their skin exposed to them. Therefore, a quantitative assessment pathway for both dermal contact and soil ingestion was established for possible future residential exposures, deer hunter exposure, and future construction worker exposure.

6.3.4.6.5 Inhalation of Volatile Organics in Ambient Air

The fate and transport discussion presented in Section 5 indicated that volatilization to the ambient air is a major fate of volatile organics in soil. Therefore, exposure of nearby off-site and future on-site residents must be evaluated. The ambient air concentrations were estimated using a flux model to determine the release rate from soils to air and a dispersion model to estimate downwind concentrations. The current exposure point is to a nearby farmhouse. The future exposure point is a resident immediately adjacent to the volatile organic "hot spot" in soil (the bend-in-the-road area). This pathway will also be quantified for the deer hunter and future construction worker exposure scenarios.

6.3.5 Quantification of Exposure

As stated in the Ash Landfill workplan, when the respective scenarios apply, all quantitative assumptions will be made using the *Standard Default Exposure Factors* (USEPA, 1991). In the event a particular exposure pathway is not considered in the supplemental guidance, the methodologies contained within RAGS, (USEPA, 1989a) were used. The purpose of the supplemental guidance is "to encourage a consistent approach to assessing exposures when there is a lack of site-specific data or consensus on which parameter value to choose, given a range of possibilities". "Accordingly, the exposure factors presented in this document are generally considered most appropriate and should be used in baseline risk assessments unless alternate or site-specific values can be clearly justified by supporting data" (USEPA, 1991). Because the Standard Default Exposure Factors document supersedes the *Exposure Factors Handbook* (USEPA, 1989b), the supporting data for the exposure parameters involved in this baseline risk assessment are specific to this reference and the *Exposure Factors Handbook* is only referenced if data is not available in the SDEF.

EPCs were estimated for all pathways selected for quantitative evaluation, and pathway-specific human intakes were quantified. Exposure-point concentrations were multiplied by human intake variables to obtain chronic daily intake values or absorbed doses. For chemicals carried over to the quantitative risk assessment for which there are no toxicity values, no intake values were calculated. These concentrations are based on measured values (for soil, sediment, surface water, and groundwater) or on modeling results (for air). For this assessment, exposure concentrations for inhalation of volatile organics in groundwater during showers (current and future residential) and for inhalation of volatile organics in ambient air are based on a model. All other pathways used measured exposure point concentrations respective to the media specific pathway. Steady-state conditions were assumed. Therefore, current and future chemical concentrations were assumed to be identical. This assumption may tend to overestimate long-term exposure concentrations because chemical concentrations are likely to decrease over time from natural processes such as dispersion, attenuation and dilution occurring during migration to potential receptors.

Estimations of pathway-specific human intakes for each chemical involve making assumptions about patterns of human exposure to contaminated media. These assumptions are integrated with exposure-point concentrations to calculate intakes. Intakes are normally expressed as the amount of chemical at the exchange boundary in milligrams per kilogram of body weight per day (mg/kg-day), which represents an intake normalized for body weight over time. The total exposure is divided by the time period of interest to obtain an average exposure. The averaging time is a function of the toxic endpoint: For noncarcinogenic effects, it is the exposure time (usually 30 years), and for the carcinogenic effects, it is lifetime (70 years).

The emphasis in Superfund risk assessments is on chronic exposures unless specific conditions warrant a short-term or an acute assessment. In this evaluation, long-term exposure to relatively low chemical concentrations is the greatest concern. Short-term (i.e., subchronic) and acute exposures were not evaluated.

The 22 exposure pathways to be quantified are set up in this section and supplemented by a mathematical table which follows each pathway-specific scenario through to calculate intake or absorbed dose associated with that specific exposure pathway. These doses are used in the risk characterization section to assess overall carcinogenic and non-carcinogenic risk. This comes in the form of a Hazard Quotient (Nc) or a Carcinogenic Risk (C) where an Rfd or Slope Factor is used, respectively, to establish a risk estimate.

The RME, was calculated using conservative intake variables in each exposure pathway allowing for a reasonable estimate of the maximum exposure expected from each exposure pathway. For chemical exposure the 95th UCL values were used in the intake calculations to best estimate the overall RME (USEPA, 1989a). For pathways involving ingestion, dermal contact and inhalation of groundwater and dermal contact to surface water and sediment, only adult receptors were used. It is assumed that the adult would be at greatest risk through these pathways. For pathways involving soils a combined child/adult receptor was used which corresponds to a 6 year/24 year breakdown over a 30 year exposure period. All these assumptions serve to provide the best estimate of the RME. Detailed intake calculations by media and exposure routes are presented in the following subsections.

Estimates of exposure concentration relative to the five media (air, surface water, sediment, groundwater, and soil), are established and discussed prior to quantification in the representative exposure pathways. Table 6-7 shows the maximum and 95th UCL concentrations for each contaminant found on the Ash Landfill respective to the media which was sampled. For most exposure pathways involving soil, only surface soil data from the 0 to

2 foot depth interval were used. The exception is the future construction worker scenario, in which all soil data were used. When the calculated 95th UCL is less than the maximum detected concentration, then the 95th UCL was used as the EPC. However, when the 95th UCL exceeded the maximum detected value, then the maximum detected value was used as the EPC. The exposure pathways for inhalation of groundwater while showering, and for inhalation of volatile organics in ambient air, both used EPA recommended models to estimate the exposure point concentrations.

6.3.5.1 Dermal Contact to Surface Water while Wading (current & future land use)

The land use considerations regarding surface water, like sediment, are not assumed to change with time. Therefore, the absorbed doses calculated for current conditions are also used for the future absorbed doses. In reality, any concentration of contaminant within the surface water media will go down with time. The exposure to surface water contamination is assumed to be through wading which is a seasonal-recreational activity. Like all water sports, the most prevalent time is the summer which consists of intermittent use and is subject to the weather.

6.3.5.1.1 Exposure Concentrations for Surface Water while Wading

The 95th UCLs of all surface water data collected from the sampling programs during Phase I and Phase II of the RI were calculated for each chemical of concern in the surface water medium. For the current off-site resident this is a conservative assumption, since current exposure is only to Kendaia Creek downgradient of the site and these concentrations are considerably lower than the on-site concentrations.

TABLE 6-7

EXPOSURE POINT CONCENTRATIONS-CHEMICALS OF CONCERN
SOIL ANALYSIS RESULTS
VALIDATED DATA (PHASES I & II)

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	UNITS	NYSDEC TAGM	MAXIMUM	95th UCL of the mean	MEAN	EXPOSURE POINT CONC.
Volatile Organics						
Vinyl Chloride	ug/kg	200	14,500	62.47	172.65	62.47
1,2-Dichloroethene (total)	ug/kg	300	79,000	1,712.18	1,989.32	1,712.18
Trichloroethene	ug/kg	700	540,000	2,267.98	9,373.25	2,267.98
Semivolatiles						
2-Methylnaphthalene	ug/kg	36,400	3,600	441.35	393.12	441.35
Acenaphthylene	ug/kg	41,000	510	265.48	248.15	265.48
Dibenzofuran	ug/kg	6,200	7,000	397.55	373.26	397.55
Phenanthrene	ug/kg	50,000	43,000	657.71	882.10	657.71
Benzo(a)anthracene	ug/kg	220 or MDL	9,600	520.48	531.23	520.48
bis(2-Ethylhexyl)phthalate	ug/kg	50,000	230,000	714.92	2,050.95	714.92
Benzo(b)fluoranthene	ug/kg	1,100	9,500	498.22	513.04	498.22
benzo(k)fluoranthene	ug/kg	1,100	6,700	468.90	447.89	468.90
Benzo(a)pyrene	ug/kg	61 or MDL	9,000	490.78	486.21	490.78
Indeno(1,2,3-cd)pyrene	ug/kg	3,200	4,800	430.56	396.93	430.56
Dibenz(a,h)anthracene	ug/kg	14 or MDL	2,900	410.55	367.55	410.55
Benzo(g,h,i)perylene	ug/kg	50,000	5,000	431.19	392.32	431.19
Pesticides/PCBs						
Aroclor-1260	ug/kg	1,000	770	157.24	143.06	157.24
Metals						
Cadmium	mg/kg	1.74	43.1	3.84	2.47	3.84
Chromium	mg/kg	26.49	62	27.72	26.73	27.72
Copper	mg/kg	25	836	40.46	43.64	40.46
Lead	mg/kg	30	2,890	90.05	115.46	90.05
Zinc	mg/kg	88.89	55,700	409.06	860.14	409.06

TABLE 6-7

EXPOSURE POINT CONCENTRATIONS-CHEMICALS OF CONCERN
SURFACE SOIL ANALYSIS RESULTS
VALIDATED DATA (PHASES I & II)

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	UNITS	NYSDEC TAGM	MAXIMUM	95th UCL of the mean	MEAN	Exposure Point Concentration
Volatile Organics						
Vinyl Chloride	ug/kg	200	750	16.02	33.24	16.02
1,2-Dichloroethene (total)	ug/kg	300	38000	584.27	1,545.47	584.27
Trichloroethene	ug/kg	700	150000	1,592.88	5,564.81	1,592.88
Semi-volatiles						
2-Methylnaphthalene	ug/kg	36,400	1250	360.05	318.57	360.05
Acenaphthylene	ug/kg	41,000	510	251.08	209.08	251.08
Dibenzofuran	ug/kg	6,200	1400	407.83	352.36	407.83
Phenanthrene	ug/kg	50,000	15000	1,047.87	998.34	1,047.87
Benzo(a)anthracene	ug/kg	220 or MDL	9600	915.76	741.85	915.76
bis(2-Ethylhexyl)phthalate	ug/kg	50,000	230000	987.69	4,749.60	987.69
Benzo(b)fluoranthene	ug/kg	1,100	9500	833.22	744.38	833.22
Benzo(k)fluoranthene	ug/kg	1,100	6700	711.51	595.21	711.51
Benzo(a)pyrene	ug/kg	61 or MDL	9000	876.03	702.87	876.03
Indeno(1,2,3-cd)pyrene	ug/kg	3,200	4800	635.36	493.98	635.36
Dibenz(a,h)anthracene	ug/kg	14 or MDL	2000	466.15	385.94	466.15
Benzo(g,h,i)perylene	ug/kg	50,000	5000	680.92	506.77	680.92
Pesticides/PCB's						
Aroclor-1260	ug/kg	1,000	340	161.11	141.39	161.11
Metals						
Cadmium	mg/kg	1.74	43.1	5.53	3.22	5.53
Chromium	mg/kg	26.49	62	30.55	28.34	30.55
Copper	mg/kg	25	836	71.55	69.80	71.55
Lead	mg/kg	30	2890	264.93	208.08	264.93
Zinc	mg/kg	88.89	55700	1,579.68	2,111.63	1,579.68

TABLE 6-7

EXPOSURE POINT CONCENTRATIONS - CHEMICALS OF CONCERN
SEDIMENT ANALYSIS RESULTS
VALIDATED DATA (PHASES I & II)

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	UNITS	NYSDEC CRITERIA	MAXIMUM	95 th UCL of the mean	MEAN	Exposure Point Concentration
Semivolatiles						
2-Methylnaphthalene	ug/kg	NA	30.00	30.00	30.00	30.00
Acenaphthylene	ug/kg	NA	170.00	151.82	95.00	151.82
Phenanthrene	ug/kg	1,390	1,200.00	499.46	379.78	499.46
Benzo(a)anthracene	ug/kg	130	4,900.00	1,696.30	698.44	1,696.30
Benzo(b)fluoranthene	ug/kg	130	4,500.00	1,609.62	692.56	1,609.62
Benzo(k)fluoranthene	ug/kg	130	3,700.00	1,424.29	602.78	1,424.29
Benzo(a)pyrene	ug/kg	130	3,900.00	1,658.39	621.35	1,658.39
Indeno(1,2,3-cd)pyrene	ug/kg	130	2,400.00	1,263.37	513.83	1,263.37
Dibenz(a,h)anthracene	ug/kg	NA	1,300.00	537.25	423.61	537.25
Benzo(g,h,i)perylene	ug/kg	NA	2,300.00	971.19	508.72	971.19
Metals						
Aluminum	mg/kg	NA	20,900.00	15,013.53	13,763.33	15,013.53
Antimony	mg/kg	NA	10.80	6.51	5.54	6.51
Arsenic	mg/kg	5	12.10	7.40	6.23	7.40
Barium	mg/kg	NA	227.00	123.30	105.96	123.30
Beryllium	mg/kg	NA	1.20	0.89	0.79	0.89
Cadmium	mg/kg	0.8	4.10	2.49	1.92	2.49
Chromium VI	mg/kg	26	33.40	24.62	22.83	24.62
Cobalt	mg/kg	NA	17.00	11.19	10.09	11.19
Copper	mg/kg	19	58.60	39.69	34.59	39.69
Lead	mg/kg	27	219.00	95.63	70.48	95.63
Manganese	mg/kg	428	1,050.00	675.43	562.94	675.43
Nickel	mg/kg	22	45.90	32.05	29.41	32.05
Thallium	mg/kg	NA	0.52	0.50	0.33	0.50
Vanadium	mg/kg	NA	30.70	23.86	21.94	23.86
Zinc	mg/kg	85	834.00	455.05	365.39	455.05

TABLE 6-7

EXPOSURE POINT CONCENTRATIONS - CHEMICALS OF CONCERN
SURFACE WATER ANALYSIS RESULTS
VALIDATED DATA (PHASES I & II)

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	UNITS	NYSDEC AWQS	MAXIMUM	95th UCL of the mean	MEAN	Exposure Point Concentration
Volatile Organics						
Chloroform	ug/L	NA	2.00	2.00	2.00	2.00
Metals						
Aluminum	ug/L	NA	2,410.00	96,163.98	818.34	2,410.00
Antimony	ug/L	NA	141.00	74.34	43.56	74.34
Arsenic	ug/L	360	2.90	2.23	1.86	2.23
Beryllium	ug/L	NA	1.20	0.81	0.56	0.81
Chromium	ug/L	NA	7.60	5.64	4.05	5.64
Cobalt	ug/L	110	6.90	8.87	4.70	6.90
Copper	ug/L	65.4	21.70	15.86	11.04	15.86
Lead	ug/L	477.8	42.30	3,485.81	8.08	42.30
Manganese	ug/L	NA	941.00	636.3	328.59	636.31
Nickel	ug/L	5,289.7	11.20	15.4	6.48	11.20
Zinc	ug/L	1,015.3	187.00	2,235.23	59.85	187.00

TABLE 6-7

EXPOSURE POINT CONCENTRATIONS - CHEMICALS OF CONCERN GROUNDWATER ANALYSIS RESULTS VALIDATED ON-SITE DATA (PHASES I & II)

SENECA ARMY DEPOT ASH LANDFILL

COMPOUND	UNITS	NYSDEC AWQS	MAXIMUM	95th UCL of the mean	MEAN	Exposure Point Concentration
Volatile Organics						
Vinyl Chloride	ug/L	2	23,000.00	59.81	648.56	59.81
1,2-Dichloroethene (total)	ug/L	5	130,000.00	845.01	2,656.02	845.01
1,1,1-Trichloroethane	ug/L	5	2,100.00	10.20	27.66	10.20
Trichloroethene	ug/L	5	51,000.00	605.60	1,431.20	605.60
Semi-volatiles						
2-Methylnaphthalene	ug/L	NA	13.00	5.58	5.38	5.58
Metals						
Aluminum	ug/L	NA	306,000.00	254,061.90	20,713.04	254,061.90
Cadmium	ug/L	10	64.60	3.09	3.03	3.09
Chromium	ug/L	50	418.00	62.23	31.04	62.23
Copper	ug/L	200	412.00	30.26	24.67	30.26
Lead	ug/L	25	147.00	21.10	10.76	21.10
Nickel	ug/L	NA	622.00	56.73	42.61	56.73
Zinc	ug/L	300	1,750.00	441.98	157.35	441.98

TABLE 6-7

EXPOSURE POINT CONCENTRATIONS - CHEMICALS OF CONCERN
FARMHOUSE WELLS QUARTERLY MONITORING RESULTS
VALIDATED ON-SITE DATA (PHASES I & II)

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	UNITS	NYSDEC AWQS	MAXIMUM	95th UCL of the mean	MEAN	Exposure Point Concentration
Volatile Organics						
Vinyl chloride	ug/L	2	0.25	0.25	0.25	0.25
1,2-Dichloroethene (total)	ug/L	5	0.25	0.25	0.25	0.25
1,1,1-Trichloroethane	ug/L	5	0.25	0.25	0.25	0.25
Trichloroethene	ug/L	5	0.25	0.25	0.25	0.25
Semi-volatiles						
2-Methylnaphthalene	ug/L	NA	NA	NA	NA	NA
Metals						
Aluminum	ug/L	NA	324	36413.76	112.14	324.00
Cadmium	ug/L	10	1.55	1.48	1.34	1.48
Chromium	ug/L	50	1.65	1.65	1.39	1.65
Copper	ug/L	200	1.05	1.04	0.98	1.04
Lead	ug/L	25	4	2.61	1.54	2.61
Nickel	ug/L	NA	4.15	4.16	3.19	4.15
Zinc	ug/L	300	501	523.58	302.27	501.00

6.3.5.1.2 Quantification of exposure from Surface Water while Wading

The quantitative assessment of this exposure pathway includes current and future uses. The equation for the absorbed dose, based on RAGS, (USEPA, 1989a) is as follows:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{DA \times SA \times EF \times ED \times CF}{BW \times AT}$$

Where:

DA = Absorbed Dose per event (mg/cm^2 - event)
SA = Skin Surface Area Available for Contact (cm^2)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
CF = Conversion Factor for Water (1 liter/1000 cm^3)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged -- days)

The absorbed dose per event (DA) was calculated as described in EPAs "Dermal Exposure Assessment, Principles and Applications," 1992. For organics DA was calculated by:

$$K_p$$

$$DA = K_p \times CW \left[\frac{ET}{1+B} + 2\tau \left(\frac{1+3B}{1+B}\right)\right]$$

where:

K_p = Dermal permeability coefficient (cm/hr)
CW = Chemical Concentration in Water (mg/l)
ET = Exposure Time (hours)
τ,B = Compound Specific Factors

For inorganics, DA was calculated by:

$$DA = K_p \times CW \times ET$$

The exposure calculation are summarized in Table 6-8.

The body surface area used in considering surface water contact while wading is 8,620 cm^2 reflective of the 50th percentile for body surface area for an adults legs, feet, arms and hands according to the *Exposure Factors Handbook* (EPA, 1989b). Using this 50th percentile is highly recommended because of the relative proportionality to the 70 kilogram bodyweight used as the average adult male within a population such as Romulus and Varick.

USEPA in the Dermal Exposure Assessment & Guidelines (USEPA, 1992) has developed recommended Dermal Permeability Coefficients for a number of organic and inorganic chemicals. These recommended values were used in this quantification of exposure calculation.

In 1973, the United States Department of Interior conducted some data evaluations concerning outdoor recreation. From this report, assuming that the Romulus/Varick population is similar, an Exposure Time of 2.6 hours/day and an Exposure Frequency of 7 days/year were adopted for use in the surface water pathway. This value is probably conservative, since the surface waters are small and do not support recreation. The overall Exposure Duration will be 30 years which is the 90th percentile for residency at one location according to the *Exposure Factors Handbook* (EPA, 1989b).

All Exposure Pathways have an averaging time (AT) which is the result of multiplying the Exposure Duration, usually 30 years for non-carcinogenic compounds, by the number of days in the year (365). It is important to note that in considering carcinogenic compounds, a 70 year exposure duration is used regardless of the exposure duration in order to accurately apply the Carcinogenic Slope Factors.

6.3.5.2 Dermal Exposure to Sediment while Wading (current & future land use)

The land use depicted in this scenario considers both current and future land use together. The values selected for current conditions are assumed to be steady-state while, in reality, the concentrations will diminish with time. When determining future risk, the absorbed dose is the same as they are for current conditions.

TABLE 6-8

CALCULATION OF ABSORBED DOSE FROM DERMAL CONTACT TO SURFACE WATER (WHILE WADING) RESIDENTIAL AND HUNTER EXPOSURES (CURRENT AND FUTURE LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Absorbed Dose (Nc) (mg/kg-day)	Absorbed Dose (Car) (mg/kg-day)	95th UCL Surface Water (mg/L)	Absorbed Dose/Event (mg-cm² /event)	Skin Surface Area Contact (cm²)	Permeability Coefficient (cm/hr)	Exposure Time (hours/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Volumetric Conv. Factor (1 liter/1000 cm³)	B	Tau	Body Weight (kg)	Averaging Time (days)	
														Nc	Car
Volatile Organics															
Chloroform	1.5E-07	1.1E-12	2.00E-03	6.29E-05	8,620	8.9E-03	2.6	7	30	1.0E-03	9.3E-03	0.47	70	10,950	25,550
Metals															
Aluminum			2.41E+00	6.27E-03	8,620	1.0E-03	2.6	7	30	1.0E-03			70	10,950	25,550
Antimony	4.6E-07		7.43E-02	1.93E-04	8,620	1.0E-03	2.6	7	30	1.0E-03			70	10,950	25,550
Arsenic	1.4E-08		2.23E-03	5.80E-06	8,620	1.0E-03	2.6	7	30	1.0E-03			70	10,950	25,550
Beryllium	5.0E-09	2.1E-09	8.11E-04	2.11E-06	8,620	1.0E-03	2.6	7	30	1.0E-03			70	10,950	25,550
Chromium VI	3.5E-08		5.64E-03	1.47E-05	8,620	1.0E-03	2.6	7	30	1.0E-03			70	10,950	25,550
Cobalt			6.90E-03	7.18E-06	8,620	4.0E-04	2.6	7	30	1.0E-03			70	10,950	25,550
Copper	9.7E-08		1.59E-02	4.12E-05	8,620	1.0E-03	2.6	7	30	1.0E-03			70	10,950	25,550
Lead			4.23E-02	4.40E-07	8,620	4.0E-06	2.6	7	30	1.0E-03			70	10,950	25,550
Manganese	3.9E-06		6.36E-01	1.65E-03	8,620	1.0E-03	2.6	7	30	1.0E-03			70	10,950	25,550
Nickel	6.9E-09		1.12E-02	2.91E-06	8,620	1.0E-04	2.6	7	30	1.0E-03			70	10,950	25,550
Zinc	6.9E-07		1.87E-01	2.92E-04	8,620	6.0E-04	2.6	7	30	1.0E-03			70	10,950	25,550

Absorbed Dose (mg/kg-day) =

$$\frac{DA \times SA \times EF \times ED \times CF}{BW \times AT}$$

Variables:	Assumptions:
DA = Absorbed Dose per Event (mg-cm²/event)	Calculated from EPA, 1992
SA = Surface Area Contact (cm²)	8,620
Kp = Permeability Coefficient (cm/hour)	Compound Specific, EPA, 1992
B, Tau = Compound-Specific Constant	From EPA, 1992
ET = Exposure Time (hours/day)	2.6

Variables:	Assumptions:
EF = Exposure Frequency (days/year)	7
ED = Exposure Duration (years)	30
CF = Vol. Conv. Factor (1 L/1000 cm³)	0.001
BW = Bodyweight (kg)	70

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6.3.5.2.1 Exposure Concentrations for Sediment while Wading

In determining the exposure concentrations for each contaminant found in sediment, the average concentration for each compound for all on-site and off-site sampling locations was used in the quantitative exposure pathway. The result was the use of a 95th UCL concentration. This was done to reduce the level of uncertainty associated with estimation of the RME concentration. As with the surface water exposure pathway, this results in a conservative exposure assessment for the current land uses scenario.

6.3.5.2.2 Quantification of Exposure from Sediment while Wading

The quantitative assessment of this exposure pathway includes both current and future uses. The equation for the absorbed dose, taken from RAGS, (USEPA, 1989a) is as follows:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS = Chemical Concentration in Sediment (mg/kg-sediment)
CF = Conversion Factor (10^{-6} kg/mg)
SA = Skin Surface Area Available for Contact (cm^2)
AF = Soil to Skin Adherence Factor (mg/cm^2)
ABS = Absorption Factor (unitless)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged -- days)

The results of the calculations are shown in Table 6-9.

In calculating the RME, values for the skin surface area are in the 50th percentile. "The rationale here is that bodyweight of a typical male (70 kg) is closely correlated to the 50th percentile for the skin surface area" (USEPA,1989a). The skin surface area available for contact (SA) to sediment is 8,620 cm^2. This is representative of the surface area of an adults legs, feet, arms and hands that can be exposed while wading.

The sediment adherence factor (AF) is the mass (mg) of sediment per cm^2 of skin surface area being exposed. The same set of conditions apply to the onsite soils pathway. EPA (USEPA, 1989a) gives a range of soil adherence factors of 0.2 to 1.0 mg $soil/cm^2$. A value of 1.0 mg $soil/cm^2$ will be used. This variable is used in this assessment as the adherence factor of soil and sediment in water activities.

A dermal adsorption factor (ABS) of 0.01 is used for cadmium (EPA, 1992).

The values for frequency, exposure duration, body weight and averaging time are the same as presented previously for dermal contact to surface water.

6.3.5.3 Groundwater Ingestion (Current and Future Land Use)

The water supply within the Depot boundaries is not from the aquifer under the site. All water used at the SEDA is piped up from nearby Seneca Lake. Nearby offsite resident exposures are considered under current land use and, in the future, the residential exposures from on-site usage of groundwater are quantified.

6.3.5.3.1 Exposure Concentrations for Groundwater Ingestion

The Phase I and II groundwater sampling program performed during the RI and the quarterly monitoring program sampling results were used as the foundation to establish exposure concentrations for all groundwater chemicals of concern. The 95th UCL was used for all compounds to be assessed quantitatively. For the current land use exposure scenario, the 95th UCL was calculated on three rounds of quarterly monitoring data (January 1993, April 1993 and July 1993) collected from the three farmhouse wells. For the future land use scenario, the data from Phase I and Phase II of the RI for all on-site wells was used to calculate the 95th UCL.

6.3.5.3.2 Quantification of Exposure from Groundwater Ingestion

The quantitative assessment of this groundwater ingestion exposure pathway includes both current and future uses. The equation for the intake, taken from RAGS (USEPA, 1989a) is as follows:

TABLE 6-9

CALCULATION OF ABSORBED DOSE
FROM DERMAL CONTACT TO SEDIMENT (WHILE WADING)
RESIDENTIAL AND HUNTER EXPOSURES (CURRENT AND FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Absorbed Dose (Nc) (mg/kg-day)	Absorbed Dose (Car) (mg/kg-day)	95th UCL Sediment (mg/kg)	Conversion Factor (kg/mg)	Skin Surface Area Contact (cm²/event)	Adherence Factor (mg soil/cm²)	Absorption Factor (unitless)	Exposure Frequency (events/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
											Nc	Car
Semivolatiles												
Metals												
Cadmium	5.9E-08		2.49E+00	1.0E-06	8,620	1.0	0.01	7	30	70	10,950	25,550

EQUATION: Absorbed Dose (mg/kg-day) =

$$\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Variables:	Assumptions:
CS = Chemical Concentration in Soil (mg/kg-sediment)	95th UCL Sed. Data
CF = Conversion Factor (10-6 kg/mg)	10-6
SA = Surface Area Contact (cm²)	8,620
AF =Soil to Skin Adherence Factor (mg/cm²)	1.0
ABS = Absorption Factor (unitless)	0.01 EPA, 1992
EF = Exposure Frequency (events/year)	7 events/year
ED = Exposure Duration (years)	30 years
BW = Bodyweight (kg)	70 kg
AT = Averaging Time (days)	30 x 365 (NC) 70 x 365 (C)

$$\text{Intake (mg/kg-day)} = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

Where:

CW = Chemical Concentration in Water (mg/liter)
IR = Ingestion Rate (liters/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Bodyweight (kg)
AT = Averaging time (days)

The exposure calculations are summarized in Table 6-10 and 6-11.

In calculating the RME, all standard defaults were assumed in accordance with achieving a good estimate of maximal upper level exposures. Using the 70 kg male, a 30 year residency period, 350 day/year exposure, and 2 liters/day drinking water ingestion rate, the scenario produces an intake dose that is representative of the reasonable maximum exposure via this groundwater pathway as seen in RAGS Exhibit 6-11.

6.3.5.4 Dermal Contact to Groundwater while Showering/Bathing (current and future land use)

As stated in the previous section current and future land use is considered for exposure to groundwater. However, data from different wells are being used to calculate the 95th UCL concentration for the current and future exposure scenarios.

6.3.5.4.1 Exposure Concentrations for Dermal Contact to Groundwater

Groundwater monitoring data from Phase I and Phase II of the RI and from the quarters of the quarterly monitoring program were compiled and the exposure concentrations are the 95th UCL on the mean of the measured concentrations. These exposure concentrations are used in groundwater exposure, dermal, ingestion, and inhalation pathways.

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TABLE 6-10

CALCULATION OF INTAKE
FROM INGESTION OF GROUNDWATER (DAILY)
RESIDENTIAL EXPOSURE (CURRENT LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Intake (Nc) (mg/kg-day)	Intake (Car) (mg/kg-day)	95th UCL Groundwater (mg/l)	Ingestion Rate (liters/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
								Nc	Car
Volatile Organics									
Vinyl Chloride		2.9E-06	2.50E-04	2	350	30	70	10,950	25,550
1,2-Dichloroethene(total)	6.8E-06		2.50E-04	2	350	30	70	10,950	25,550
1,1,1-Trichloroethane			2.50E-04	2	350	30	70	10,950	25,550
Trichloroethene		2.9E-06	2.50E-04	2	350	30	70	10,950	25,550
Semi-volatiles									
2-Methlynaphthalene				2	350	30	70	10,950	25,550
Metals									
Aluminum			3.24E-01	2	350	30	70	10,950	25,550
Cadmium	4.1E-05		1.48E-03	2	350	30	70	10,950	25,550
Chromium VI	4.5E-05		1.65E-03	2	350	30	70	10,950	25,550
Copper	2.8E-05		1.04E-03	2	350	30	70	10,950	25,550
Lead			2.61E-03	2	350	30	70	10,950	25,550
Nickel	1.1E-04		4.15E-03	2	350	30	70	10,950	25,550
Zinc	1.4E-02		5.01E-01	2	350	30	70	10,950	25,550

EQUATION: **Intake (mg/kg-day) =** $\frac{CW \times IR \times EF \times ED}{BW \times AT}$

Variables:	**Assumptions:**
CW = Chemical Concentration in Water (mg/liter)	**95th UCL Groundwater Data**
IR = Ingestion Rate (liters/day)	**2**
EF = Exposure Frequency (days/year)	**350**
ED = Exposure Duration (years)	**30**
BW = Bodyweight (kg)	**70**
AT = Averaging Time (days)	**30 x 365(Nc) 70 x 365(C)**

TABLE 6-11

CALCULATION OF INTAKE
FROM INGESTION OF GROUNDWATER (DAILY)
RESIDENTIAL EXPOSURE (FUTURE LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Intake (Nc) (mg/kg-day)	Intake (Car) (mg/kg-day)	95th UCL Groundwater (mg/l)	Ingestion Rate (liters/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
								Nc	Car
Volatile Organics									
Vinyl Chloride		7.0E-04	5.98E-02	2	350	30	70	10,950	25,550
1,2-Dichloroethene(total)	2.3E-02		8.45E-01	2	350	30	70	10,950	25,550
1,1,1-Trichloroethane			1.02E-02	2	350	30	70	10,950	25,550
Trichloroethene		7.1E-03	6.06E-01	2	350	30	70	10,950	25,550
Semi-volatiles									
2-Methlynaphthalene			5.58E-03	2	350	30	70	10,950	25,550
Metals									
Aluminum			2.54E+02	2	350	30	70	10,950	25,550
Cadmium	8.5E-05		3.09E-03	2	350	30	70	10,950	25,550
Chromium VI	1.7E-03		6.22E-02	2	350	30	70	10,950	25,550
Copper	8.3E-04		3.03E-02	2	350	30	70	10,950	25,550
Lead			2.11E-02	2	350	30	70	10,950	25,550
Nickel	1.6E-03		5.67E-02	2	350	30	70	10,950	25,550
Zinc	1.2E-02		4.42E-01	2	350	30	70	10,950	25,550

EQUATION: Intake (mg/kg-day) =

$$\frac{CW \times IR \times EF \times ED}{BW \times AT}$$

Variables:	Assumptions:
CW = Chemical Concentration in Water (mg/liter)	95th UCL Groundwater Data
IR = Ingestion Rate (liters/day)	2
EF = Exposure Frequency (days/year)	350
ED = Exposure Duration (years)	30
BW = Bodyweight (kg)	70
AT = Averaging Time (days)	30 x 365(Nc) 70 x 365(C)

6.3.5.4.2 Quantification of Exposure from Groundwater while Showering/Bathing

The quantitative assessment of this exposure pathway includes future uses. The equation for the absorbed dose, taken from RAGS (USEPA, 1989a) is as follows:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{DA \times SA \times EF \times ED \times CF}{BW \times AT}$$

Where:

DA = Absorbed Dose per event
CW = Chemical Concentration in Water (mg/liter)
SA = Skin Surface Area Available for Contact (cm^2)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
CF = Conversion Factor for Water (1 liter/1000 cm^3)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged (days)

The absorbed dose per event (DA) was calculated as described in EPAs "Dermal Exposure Assessment, Principles and Applications" (USEPA, 1992). For organics DA was calculated by:

$$DA = 2\, K_p \times CW\, (6\tau \times ET/\pi)^{1/2}$$

where:

K_p = Dermal permeability coefficient (cm/hr)
CW = Chemical concentration in water (mg/l)
ET = Exposure Time (hours)
τ = Compound specific factor

For inorganics, DA was calculated by DA = Kp x CW x ET

The exposure calculations are summarized in Table 6-12 and 13.

TABLE 6-12

CALCULATION OF ABSORBED DOSE
FROM DERMAL CONTACT TO GROUNDWATER (WHILE SHOWERING/BATHING)
RESIDENTIAL EXPOSURE (CURRENT LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Absorbed Dose (Nc) (mg/kg-day)	Absorbed Dose (Car) (mg/kg-day)	95th UCL Groundwater (mg/l)	Absorbed Dose/Event (mg-cm²/event)	Skin Surface Area Contact (cm²)	Permeability Coefficient (cm/hr)	Exposure Time (hours/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Volumetric Conv. Factor (1 liter/1000 cm³)	B	Tau	Body Weight (kg)	Averaging Time (days)	
														Nc	Car
Volatile Organics															
Vinyl Chloride		1.2E-07	2.50E-04	1.13E-06	19,400	7E-03	0.2	350	30	1E-03	2.30E-03	0.21	70	10,950	25,550
1,2-Dichloroethene(total)	4.8E-07		2.50E-04	2.22E-06	19,400	1E-02	0.2	350	30	1E-03	7.20E-03	0.34	70	10,950	25,550
1,1,1-Trichloroethane			2.50E-04	5.96E-06	19,400	2E-02	0.2	350	30	1E-03	3.10E-02	0.57	70	10,950	25,550
Trichloroethene		4.2E-07	2.50E-04	5.40E-06	19,400	2E-02	0.2	350	30	1E-03	2.60E-02	0.55	70	10,950	25,550
Semi-volatiles															
2-Methlynaphthalene					19,400	7E-02	0.2	350	30	1E-03	1.30E+00	0.64	70	10,950	25,550
Metals															
Aluminum			3.24E-01	6.48E-05	19,400	1E-03	0.2	350	30	1E-03			70	10,950	25,550
Cadmium	7.9E-08		1.48E-03	2.96E-07	19,400	1E-03	0.2	350	30	1E-03			70	10,950	25,550
Chromium VI	8.8E-08		1.65E-03	3.30E-07	19,400	1E-03	0.2	350	30	1E-03			70	10,950	25,550
Copper	5.5E-08		1.04E-03	2.08E-07	19,400	1E-03	0.2	350	30	1E-03			70	10,950	25,550
Lead			2.61E-03	2.09E-09	19,400	4E-06	0.2	350	30	1E-03			70	10,950	25,550
Nickel	2.2E-08		4.15E-03	8.30E-08	19,400	1E-04	0.2	350	30	1E-03			70	10,950	25,550
Zinc	1.6E-05		5.01E-01	6.01E-05	19,400	6E-04	0.2	350	30	1E-03			70	10,950	25,550

$$\text{Absorbed Dose (mg/kg-day)} = \frac{DA \times SA \times EF \times ED \quad CF}{BW \times AT}$$

Variables:	**Assumptions:**
DA = Absorbed Dose per Event (mg/cm²-event)	Calculated from EPA, 1992
SA = Surface Area Contact (cm²)	19400
Kp = Permeability Coefficient (cm/hr)	Compound Specific, EPA, 1992
EF = Exposure Frequency (days/year)	350
B, Tau = Compound-Specific Constants	From EPA, 1992

Variables:	**Assumptions:**
ED = Exposure Duration (years)	30
BW = Body Weight (kg)	70
CF = Volumetric Conv. Factor	0.001
AT = Averaging Time (days)	30 x 365 (Nc) 70 x 365 (Car)

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TABLE 6-13

CALCULATION OF ABSORBED DOSE
FROM DERMAL CONTACT TO GROUNDWATER (WHILE SHOWERING/BATHING)
RESIDENTIAL EXPOSURE (FUTURE LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Absorbed Dose (Nc) (mg/kg-day)	Absorbed Dose (Car) (mg/kg-day)	95th UCL Groundwater (mg/l)	Absorbed Dose/Event (mg/cm²/event)	Skin Surface Area Contact (cm²)	Permeability Coefficient (cm/hr)	Exposure Time (hours/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Volumetric Conv. Factor (1 liter/1000 cm³)	B	Tau	Body Weight (kg)	Averaging Time (days)	
														Nc	Car
Volatile Organics															
Vinyl Chloride		2.8E-05	5.98E-02	2.71E-04	19,400	7E-03	0.2	350	30	1E-03	2.30E-03	0.21	70	10,950	25,550
1,2-Dichloroethene(total)	1.6E-03		8.45E-01	7.51E-03	19,400	1E-02	0.2	350	30	1E-03	7.20E-03	0.34	70	10,950	25,550
1,1,1-Trichloroethane			1.02E-02	2.43E-04	19,400	2E-02	0.2	350	30	1E-03	3.10E-02	0.57	70	10,950	25,550
Trichloroethene		1.0E-03	6.06E-01	1.31E-02	19,400	2E-02	0.2	350	30	1E-03	2.60E-02	0.55	70	10,950	25,550
Semi-volatiles															
2-Methlynaphthalene			5.58E-03	1.08E-03	19,400	7E-02	0.2	350	30	1E-03	1.30E+00	0.64	70	10,950	25,550
Metals															
Aluminum			2.54E+02	5.08E-02	19,400	1E-03	0.2	350	30	1E-03			70	10,950	25,550
Cadmium	1.6E-07		3.09E-03	6.18E-07	19,400	1E-03	0.2	350	30	1E-03			70	10,950	25,550
Chromium VI	3.3E-06		6.22E-02	1.24E-05	19,400	1E-03	0.2	350	30	1E-03			70	10,950	25,550
Copper	1.6E-06		3.03E-02	6.05E-06	19,400	1E-03	0.2	350	30	1E-03			70	10,950	25,550
Lead			2.11E-02	1.69E-08	19,400	4E-06	0.2	350	30	1E-03			70	10,950	25,550
Nickel	3.0E-07		5.67E-02	1.13E-06	19,400	1E-04	0.2	350	30	1E-03			70	10,950	25,550
Zinc	1.4E-05		4.42E-01	5.30E-05	19,400	6E-04	0.2	350	30	1E-03			70	10,950	25,550

Absorbed Dose (mg/kg-day) = $$\frac{DA \times SA \times EF \times ED\ \ CF}{BW \times AT}$$

Variables:	Assumptions:
DA = Absorbed Dose per Event (mg/cm²-event)	Calculated from EPA, 1992
SA = Surface Area Contact (cm²)	19400
Kp = Permeability Coefficient (cm/hr)	Compound Specific, EPA, 1992
EF = Exposure Frequency (days/year)	350
B, Tau = Compound-Specific Constants	From EPA, 1992

Variables:	Assumptions:
ED = Exposure Duration (years)	30
BW = Body Weight (kg)	70
CF = Volumetric Conv. Factor	0.001
AT = Averaging Time (days)	30 x 365 (Nc) 70 x 365 (Car)

The physical design of the exposure pathway is in accordance with Exhibit 6-13 in the RAGS document. The total body surface area used in considering groundwater contact while showering/bathing is 19,400 cm^2 reflective of the 50th percentile for total body surface is according to the Exposure Factors Handbook (EPA, 1989b). Using this 50th percentile is highly recommended because of the relative proportionality to the 70 kilogram bodyweight used as the average adult male within a population such as Romulus and Varick.

As with dermal contact to surface water (described previously), USEPA recommended dermal permeability coefficients (USEPA, 1992), were used to quantify dermal exposures to groundwater.

The exposure time for showering is assumed to be 12 minutes/day (0.2 hr/day) which is the 90th percentile taken from the *Exposure Factors Handbook* (EPA, 1989b). The Exposure Frequency is assumed to be 350 days/year, allowing an average of two weeks vacation for the population as recommended by the Standard Default Exposure Factors Supplemental Guidance (EPA, 1991).

6.3.5.5 Inhalation of Groundwater while Showering/Bathing (current and future land use)

As stated in the previous section both current and future land use is considered for this exposure pathway. This means that a steady-state situation is being assumed for future conditions that the population is being potentially exposed to.

6.3.5.5.1 Exposure Concentrations for Inhalation of Groundwater

The same groundwater concentrations that were used in the two previous exposure scenarios were used in this scenario. These groundwater concentrations were converted to air concentrations inside the shower using a model developed by Andelman (Andelman, J.B. 1984, Andelman, J.B., 1985a, Andelman, J.B., 1985b). This model assumes that the concentration of the air inside the shower is in equilibrium between the rate of release from the shower water and the rate of air exchange between the shower and the bathroom. The empirical constants in the model were obtained from the observed efficiency of volatilization for TCE in model showers and from several homes with contaminated water where measurements have been made. The efficiency of release for chemicals other than TCE is obtained as the product of the ratio of the Henry's Law constant for that compound to the Henry's Law constant for TCE and the efficiency factor for TCE.

The average concentration of a volatile compound in the shower air over a period of t_s minutes is:

$C_s = C_{inf}\,[1+(1/(kt_s))(\exp(-kt_s)\ -1)]$

for $t_s > 0$

C_s = average concentration of a volatile compound in the shower air over a duration of t_s minutes (mg/m^3)

C_{inf} = asymptotic concentration in air if shower ran for a long time (much longer than 12 minutes), calculated below (mg/m^3)

t_s = time in shower, typical value for an adult is 12 minutes (min)

k = rate constant for exponential function, defined below (1/min)

$C_{inf} = [(E)(F_w)(C_t/1000)]F_a$

$k = F_a/V_b$

F_w = flow rate of water in shower, typical value is 8 L/min (L/min)

C_t = concentration in shower water, determined case by case; C_t is the concentration of contaminant in groundwater where domestic water is provided by a well (ug/L or ppb)

F_a = flow rate of air in shower, typical value is 2.4 m^3/min

V_b = volume of bathroom, typical value is 12 m^3 (m^3)

$E = (E_{TCE})(H)/(H_{TCE})$

E = efficiency of release of a compound from water to air; $0 \leq E \leq 1$; if E has a calculated value greater than 1, then E must be set equal to 1 (unitless)

E_{TCE} = efficiency of release of TCE from water to air, $E_{TCE} = 0.6$ is a typical value (unitless)

H = Henry's law constant for an organic compound, see Appendix F for references which will provide values (m^3-atm/mol)

H_{TCE} = Henry's law constant for TCE, typical value is $H_{TCE} = 9.10E\text{-}03$ (m^3- atm/mol)

The calculated average concentrations in the air in the shower are presented in Tables 6-14 and 6-15 for the current and future land uses scenarios.

6.3.5.5.2 Quantification of Exposure from Inhalation of Groundwater while Showering/Bathing

The quantitative assessment of this exposure pathway includes future uses.

The equation for the intake, taken from RAGS (USEPA, 1989a) is as follows:

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

Where:

CA = Chemical Concentration in Air (mg/cu.m)
IR = Inhalation Rate (cu.m/hr)
EF = Exposure Frequency (hrs/yr)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged -- days)

The exposure calculations are summarized in Table 6-16 and 17.

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TABLE 6-14

CALCULATION OF AIR CONCENTRATION IN SHOWER FROM VOLATILIZATION OF GROUNDWATER (DAILY) RESIDENTIAL EXPOSURE (CURRENT LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	95th UCL Air Off-Site Wells (mg/m^3)	Time of Shower -Ts (min)	Flow Rate of Shower - Fw (L/min)	95th UCL Groundwater-Ct (ug/l)	Flow Rate of Air in Shower-Fa (m^3/min)	Volume of Bathroom-Vb (m^3)	Henry Laws Constant-H (m^3-atm/mol)	Asymptotic Air Conc.-Cinf (mg/m^3)	Rate Constant-K (1/min)	Efficiency of Release-E (unitless)	Efficiency of Release for TCE E-TCE	Henry Laws Constant-TCE (m^3-atm/mol)
Volatile Organics												
Vinyl Chloride	5.2E-04	12	8	2.50E-01	2.4	12	8.19E-02	8.33E-04	0.20	1.00	0.6	0.0091
1,2-Dichloroethene(total)	2.2E-04	12	8	2.50E-01	2.4	12	6.56E-03	3.60E-04	0.20	0.43	0.6	0.0091
1,1,1-Trichloroethane	4.9E-04	12	8	2.50E-01	2.4	12	1.44E-02	7.91E-04	0.20	0.95	0.6	0.0091
Trichloroethene	3.1E-04	12	8	2.50E-01	2.4	12	9.10E-03	5.00E-04	0.20	0.60	0.6	0.0091
Semi-volatiles												
2-Methlynaphthalene	0.0E+00	12	8	0.00E+00	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Metals												
Aluminum	0.0E+00	12	8	3.24E+02	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Cadmium	0.0E+00	12	8	1.48E+00	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Chromium VI	0.0E+00	12	8	1.65E+00	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Copper	0.0E+00	12	8	1.04E+00	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Lead	0.0E+00	12	8	2.61E+00	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Nickel	0.0E+00	12	8	4.15E+00	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Zinc	0.0E+00	12	8	5.01E+02	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091

EQUATIONS:

Concentration in Air (mg/m^3) = C-inf[1+(1/(kTs)(exp(-kTs)-1)]

Asymptotic Air Conc. - Cinf (mg/m^3) = [(E)(Fw)(Ct/1000)]/Fa

Rate Constant - k (L/min) = Fa/Vb

Efficiency of Release - E (unitless) = (E-tce)(H)/(H-tce)

TABLE 6-15

CALCULATION OF AIR CONCENTRATION IN SHOWER FROM VOLATILIZATION OF GROUNDWATER (DAILY) RESIDENTIAL EXPOSURE (FUTURE LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	95th UCL Air All-Site Wells (mg/m^3)	Time of Shower -Ts (min)	Flow Rate of Shower - Fw (L/min)	95th UCL Groundwater-Ct (ug/l)	Flow Rate of Air in Shower-Fa (m^3/min)	Volume of Bathroom-Vb (m^3)	Henry Laws Constant-H (m^3-atm/mol)	Asymptotic Air Conc.-Cinf (mg/m^3)	Rate Constant-K (1/min)	Efficiency of Release-E (unitless)	Efficiency of Release for TCE E-TCE	Henry Laws Constant-TCE (m^3-atm/mol)
Volatile Organics												
Vinyl Chloride	1.2E-01	12	8	5.98E+01	2.4	12	8.19E-02	1.99E-01	0.20	1.00	0.6	0.0091
1,2-Dichloroethene(total)	7.6E-01	12	8	8.45E+02	2.4	12	6.56E-03	1.22E+00	0.20	0.43	0.6	0.0091
1,1,1-Trichloroethane	2.0E-02	12	8	1.02E+01	2.4	12	1.44E-02	3.23E-02	0.20	0.95	0.6	0.0091
Trichloroethene	7.5E-01	12	8	6.06E+02	2.4	12	9.10E-03	1.21E+00	0.20	0.60	0.6	0.0091
Semi-volatiles												
2-Methlynaphthalene	0.0E+00	12	8	5.58E+00	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Metals												
Aluminum	0.0E+00	12	8	2.54E+05	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Cadmium	0.0E+00	12	8	3.09E+00	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Chromium VI	0.0E+00	12	8	6.22E+01	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Copper	0.0E+00	12	8	3.03E+01	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Lead	0.0E+00	12	8	2.11E+01	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Nickel	0.0E+00	12	8	5.67E+01	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091
Zinc	0.0E+00	12	8	4.42E+02	2.4	12		0.00E+00	0.20	0.00	0.6	0.0091

EQUATIONS:

Concentration in Air (mg/m^3) = C-inf[1+(1/(kTs)(exp(-kTs)-1)]

Asymptotic Air Conc. - Cinf (mg/m^3) = [(E)(Fw)(Ct/1000)]/Fa

Rate Constant - k (L/min) = Fa/Vb

Efficiency of Release - E (unitless) = (E-tce)(H)/(H-tce)

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TABLE 6-16

CALCULATION OF INTAKE
FROM INHALATION OF GROUNDWATER (DAILY)
RESIDENTIAL EXPOSURE (CURRENT LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Intake (Nc) (mg/kg-day)	Intake (Car) (mg/kg-day)	95th UCL Air (mg/m³)	Inhalation Rate (m³/hr)	Exposure Frequency (hrs/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
								Nc	Car
Volatile Organics									
Vinyl Chloride		3.6E-07	5.18E-04	0.6	70	30	70	10,950	25,550
1,2-Dichloroethene(total)	3.7E-07		2.24E-04	0.6	70	30	70	10,950	25,550
1,1,1-Trichloroethane			4.91E-04	0.6	70	30	70	10,950	25,550
Trichloroethene		2.2E-07	3.11E-04	0.6	70	30	70	10,950	25,550
Semi-volatiles									
2-Methlynaphthalene			0.00E+00	0.6	70	30	70	10,950	25,550
Metals									
Aluminum			0.00E+00	0.6	70	30	70	10,950	25,550
Cadmium		0.0E+00	0.00E+00	0.6	70	30	70	10,950	25,550
Chromium VI		0.0E+00	0.00E+00	0.6	70	30	70	10,950	25,550
Copper			0.00E+00	0.6	70	30	70	10,950	25,550
Lead			0.00E+00	0.6	70	30	70	10,950	25,550
Nickel		0.0E+00	0.00E+00	0.6	70	30	70	10,950	25,550
Zinc			0.00E+00	0.6	70	30	70	10,950	25,550

EQUATION: Intake (mg/kg-day) = $\frac{CA \times IR \times EF \times ED}{BW \times AT}$

Variables:	Assumptions:
CA = Chemical Concentration in Air (mg/m³)	95th UCL Groundwater Data
IR = Inhalation Rate (m³/hr)	0.6
EF = Exposure Frequency (hrs/year)	70
ED = Exposure Duration (years)	30
BW = Bodyweight (kg)	70
AT = Averaging Time (days)	30 x 365(Nc) 70 x 365(C)

TABLE 6-17

CALCULATION OF INTAKE FROM INHALATION OF GROUNDWATER (DAILY) RESIDENTIAL EXPOSURE (FUTURE LAND USE)

SENECA ARMY DEPOT ASH LANDFILL

Analyte	Intake (Nc) (mg/kg-day)	Intake (Car) (mg/kg-day)	95th UCL Air (mg/m³)	Inhalation Rate (m³/hr)	Exposure Frequency (hrs/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
								Nc	Car
Volatile Organics									
Vinyl Chloride		8.7E-05	1.24E-01	0.6	70	30	70	10,950	25,550
1,2-Dichloroethene(total)	1.2E-03		7.57E-01	0.6	70	30	70	10,950	25,550
1,1,1-Trichloroethane			2.01E-02	0.6	70	30	70	10,950	25,550
Trichloroethene		5.3E-04	7.52E-01	0.6	70	30	70	10,950	25,550
Semi-volatiles									
2-Methlynaphthalene			0.00E+00	0.6	70	30	70	10,950	25,550
Metals									
Aluminum			0.00E+00	0.6	70	30	70	10,950	25,550
Cadmium		0.0E+00	0.00E+00	0.6	70	30	70	10,950	25,550
Chromium VI		0.0E+00	0.00E+00	0.6	70	30	70	10,950	25,550
Copper			0.00E+00	0.6	70	30	70	10,950	25,550
Lead			0.00E+00	0.6	70	30	70	10,950	25,550
Nickel		0.0E+00	0.00E+00	0.6	70	30	70	10,950	25,550
Zinc			0.00E+00	0.6	70	30	70	10,950	25,550

EQUATION:

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

Variables:	Assumptions:
CA = Chemical Concentration in Air (mg/m³)	95th UCL Groundwater Data
IR = Inhalation Rate (m³/day)	2
EF = Exposure Frequency (hours/year)	70
ED = Exposure Duration (years)	30
BW = Bodyweight (kg)	70
AT = Averaging Time (days)	30 x 365(Nc) 70 x 365(C)

The Chemical Concentrations in the air were developed using the model described previously. An inhalation rate of 0.6 m^3/hr as a RME was taken from the *Exposure Factor's Handbook* (EPA, 1989b).

The Exposure Frequency for showering is assumed to be 12 minutes/day for 350 days per year which is the 90th percentile taken from the *Exposure Factors Handbook* (EPA, 1989b). This is equal to 70 hours/year. The Exposure Duration is 30 years. The calculated life time exposure duration is therefore 2,200 hours population as recommended by the Standard Default Exposure Factors Supplemental Guidance (EPA, 1991).

6.3.5.6 Incidental Ingestion of Soil (current and future land use)

Due to the present limited access to the Ash Landfill, the ingestion of on-site soils is specifically limited to a deer hunter and a future residential land use scenarios. A conservative assumption is that the Depot will be closed and the land will be used for residential purposes. Part of the future residential land use scenario is a construction worker exposure pathway.

6.3.5.6.1 Exposure Concentration for the Incidental Ingestion of Soil onsite

The soil data collected from the Phase I and Phase II field operations of the RI were compiled and the 95th UCL concentration was calculated for each compound. For the future residential and deer hunter exposures, only surface soil data collected from the 0- to 2- foot interval were used in this analysis. For the construction worker exposure, all soil data were used.

6.3.5.6.2 Quantification of Exposure to Incidental Ingestion of Soil

The quantitative assessment of this exposure pathway includes the deer hunter, future residential and future construction worker exposures. The equation for the intake is taken from the RAGS (USEPA, 1989a) and the pathway variables were taken from the *Standard Default Exposure Factors* (EPA, 1991).

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Where:

CS = Chemical Concentration in Soil (mg/kg soil)
IR = Ingestion Rate (mg soil/day)

CF = Conversion Factor (1 Kg/10^6 mg)
FI = Fraction Ingested from Contaminated Source (unitless)
EF = Exposure Frequency (days/years)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged -- days)

The results of these calculations are shown in Tables 6-18 through 6-20.

For the future residential use, the exposure period was broken up into 6 years of childhood and 24 years of adulthood for a total of 30 years. Table 6-18 is divided into two periods to reflect this assumption. The time weighted averages of the two intakes were added to arrive at the 30-year intake for the carcinogenic risks. Noncarcinogenic risks were calculated separately for the 6- and 24-year periods. For the deer hunter and construction worker exposure, the exposure periods were 30 and 25 years, respectively.

An IR of 200 mg soil/day was assumed for children, and 100 mg soil/day for adults (EPA, 1991). The EF for the residential scenario was assumed to be 350 days/year. An EF of 350 days/year is for the residential scenario is conservative and based on the resident being away from the home on vacation for 15 days a year. For the deer hunter the EF is 10 days/year and for the construction worker the EF is 7 days/year. The deer hunter EF is based on the duration of the hunting season as SEDA. The construction worker EF is again conservative and is based on a scenario where the worker is involved in the reapir or maintenance of an underground utility. The Fraction Ingested (FI) was conservatively assumed to be 1, as incidental soil ingestion is an event-based phenomenon. The assumed child body weight is 15 kg and the adult body weight is 70 kg. The remaining values are the same as presented previously.

6.3.5.7 Dermal Contact to onsite soils (future land use)

The site residential activities under future land use conditions, current deer hunting, and future construction activities manifest dermal contact point between the RME and the Ash Landfill soils. This point of contact can be considered an exposure point.

6.3.5.7.1 Exposure Concentrations for Dermal Contact to onsite soils

As with the previous scenarios, the 95th UCL of the soils from the 0- to 2-foot depth was taken as the exposure concentration for the residential and deer hunter exposures, while the 95th UCL of all soils was used as the exposure concentration for the construction worker scenario.

TABLE 6-18
CALCULATION OF INTAKE (ONSITE)
FROM INGESTION OF SOIL (DAILY)
RESIDENTIAL EXPOSURE (FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	30 Year Intake (Car) (mg/kg-day)	Child Intake (Nc) (mg/kg-day)	Child Intake (Car) (mg/kg-day)	Adult Intake (Nc) (mg/kg-day)	Adult Intake (Car) (mg/kg-day)	95th UCL Soil (mg/kg)	Child Ingestion Rate (mg soil/day)	Adult Ingestion Rate (mg soil/day)	Conv. Factor (kg/mg)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Child Exposure Duration (years)	Adult Exposure Duration (years)	Child Body Weight (kg)	Adult Body Weight (kg)	Averaging Time (days)		
																Child(Nc)	Adult(Nc)	Car
Volatile Organics																		
Vinyl Chloride	2.5E-08		1.8E-08		7.5E-09	1.60E-02	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Dichloroethene, 1,2- (total)		7.5E-06		8.0E-07		5.84E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Trichloroethene	2.5E-06		1.7E-06		7.5E-07	1.59E+00	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Semi-volatiles																		
Methylnaphthalene, 2-						3.60E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Acenaphthylene						2.51E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Dibenzofuran						4.08E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Phenanthrene						1.05E+00	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Benzo(a)anthracene	1.4E-06		1.0E-06		4.3E-07	9.16E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
bis(2-Ethylhexyl)phthalate	1.5E-06	1.3E-05	1.1E-06	1.4E-06	4.6E-07	9.88E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Benzo(b)fluoranthene	1.3E-06		9.1E-07		3.9E-07	8.33E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Benzo(k)fluoranthene	1.1E-06		7.8E-07		3.3E-07	7.12E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Benzo(a)pyrene	1.4E-06		9.6E-07		4.1E-07	8.76E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Indeno(1,2,3-cd)pyrene	9.9E-07		7.0E-07		3.0E-07	6.35E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Dibenzo(a,h)anthracene	7.3E-07		5.1E-07		2.2E-07	4.66E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Benzo(g,h,i)perylene						6.81E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Pesticides/PCB's																		
Aroclor-1260	2.5E-07		1.8E-07		7.6E-08	1.61E-01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Metals																		
Cadmium		7.1E-05		7.6E-06		5.53E+00	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Chromium VI		3.9E-04		4.2E-05		3.06E+01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Copper		9.1E-04		9.8E-05		7.16E+01	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Lead						2.65E+02	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550
Zinc		2.0E-02		2.2E-03		1.58E+03	200	100	1.0E-06	1	350	6	24	15	70	2,190	8,760	25,550

EQUATION:

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Variables:	**Assumptions:**
CS = Chemical Concentration in Soil (mg soil/kg)	95th UCL Soil Data
IR = Ingestion Rate (mg soil/day)	100 (Adult)/ 200 (Child)
CF = Conversion Factor (10-6 kg/mg)	10-6
FI = Fraction Ingested (unitless)	1
EF = Exposure Frequency (days/years)	350 events/year
ED = Exposure Duration (years)	30 years
BW = Bodyweight (kg)	70 (Adult male)/ 15 (Child 6-7)
AT = Averaging Time (days)	6 x 365 Child 24 x 365 Adult (NC) 70 x 365 (C)

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TABLE 6-19
CALCULATION OF INTAKE (ONSITE)
FROM INGESTION OF SOIL (DAILY)
HUNTER EXPOSURE (CURRENT AND FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	30 Year Intake (Nc) (mg/kg-day)	30 Year Intake (Car) (mg/kg-day)	95th UCL Soil (mg/kg)	Ingestion Rate (mg soil/day)	Conv. Factor (kg/mg)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
										Nc	Car
Volatile Organics											
Vinyl Chloride		2.7E-10	1.60E-02	100	1.0E-06	1	10	30	70	10,950	25,550
Dichloroethene, 1,2- (total)	2.3E-08		5.84E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Trichloroethene		2.7E-08	1.59E+00	100	1.0E-06	1	10	30	70	10,950	25,550
Semi-volatiles											
Methylnaphthalene, 2-			3.60E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Acenaphthylene			2.51E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Dibenzofuran			4.08E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Phenanthrene			1.05E+00	100	1.0E-06	1	10	30	70	10,950	25,550
Benzo(a)anthracene		1.5E-08	9.16E-01	100	1.0E-06	1	10	30	70	10,950	25,550
bis(2-Ethylhexyl)phthalate	3.9E-08	1.7E-08	9.88E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Benzo(b)fluoranthene		1.4E-08	8.33E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Benzo(k)fluoranthene		1.2E-08	7.12E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Benzo(a)pyrene		1.5E-08	8.76E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Indeno(1,2,3-cd)pyrene		1.1E-08	6.35E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Dibenzo(a,h)anthracene		7.8E-09	4.66E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Benzo(g,h,i)perylene			6.81E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Pesticides/PCB's											
Aroclor-1260		2.7E-09	1.61E-01	100	1.0E-06	1	10	30	70	10,950	25,550
Metals											
Cadmium	2.2E-07		5.53E+00	100	1.0E-06	1	10	30	70	10,950	25,550
Chromium VI	1.2E-06		3.06E+01	100	1.0E-06	1	10	30	70	10,950	25,550
Copper	2.8E-06		7.16E+01	100	1.0E-06	1	10	30	70	10,950	25,550
Lead			2.65E+02	100	1.0E-06	1	10	30	70	10,950	25,550
Zinc	6.2E-05		1.58E+03	100	1.0E-06	1	10	30	70	10,950	25,550

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Variables:	Assumptions:
CS = Chemical Concentration in Soil (mg soil/kg)	95th UCL Soil Data
IR = Ingestion Rate (mg soil/day)	100 (Adult)
CF = Conversion Factor (10-6 kg/mg)	10-6
FI = Fraction Ingested (unitless)	1
EF = Exposure Frequency (days/years)	10 events/year
ED = Exposure Duration (years)	30 years
BW = Bodyweight (kg)	70 (Adult male)
AT = Averaging Time (days)	30 x 365 (Nc) 70 x 365 (Car)

TABLE 6-20
CALCULATION OF INTAKE (ONSITE)
FROM INGESTION OF SOIL (DAILY)
CONSTRUCTION WORKER EXPOSURE (FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	30 Year Intake (Nc) (mg/kg-day)	30 Year Intake (Car) (mg/kg-day)	95th UCL Soil (mg/kg)	Ingestion Rate (mg soil/day)	Conv. Factor (kg/mg)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
										Nc	Car
Volatile Organics											
Vinyl Chloride		6.1E-10	6.25E-02	100	1.0E-06	1	7	25	70	9,125	25,550
Dichloroethene, 1,2- (total)	4.7E-08		1.71E+00	100	1.0E-06	1	7	25	70	9,125	25,550
Trichloroethene		2.2E-08	2.27E+00	100	1.0E-06	1	7	25	70	9,125	25,550
Semi-volatiles											
Methylnaphthalene, 2-			4.41E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Acenaphthylene			2.65E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Dibenzofuran			3.98E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Phenanthrene			6.58E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Benzo(a)anthracene		5.1E-09	5.20E-01	100	1.0E-06	1	7	25	70	9,125	25,550
bis(2-Ethylhexyl)phthalate	2.0E-08	7.0E-09	7.15E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Benzo(b)fluoranthene		4.9E-09	4.98E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Benzo(k)fluoranthene		4.6E-09	4.69E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Benzo(a)pyrene		4.8E-09	4.91E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Indeno(1,2,3-cd)pyrene		4.2E-09	4.31E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Dibenzo(a,h)anthracene		4.0E-09	4.11E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Benzo(g,h,i)perylene			4.31E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Pesticides/PCB's											
Aroclor-1260		1.5E-09	1.57E-01	100	1.0E-06	1	7	25	70	9,125	25,550
Metals											
Cadmium	1.1E-07		3.84E+00	100	1.0E-06	1	7	25	70	9,125	25,550
Chromium VI	7.6E-07		2.77E+01	100	1.0E-06	1	7	25	70	9,125	25,550
Copper	1.1E-06		4.05E+01	100	1.0E-06	1	7	25	70	9,125	25,550
Lead			9.00E+01	100	1.0E-06	1	7	25	70	9,125	25,550
Zinc	1.1E-05		4.09E+02	100	1.0E-06	1	7	25	70	9,125	25,550

EQUATION:

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Variables:	Assumptions:
CS = Chemical Concentration in Soil (mg soil/kg)	95th UCL Soil Data (all soils)
IR = Ingestion Rate (mg soil/day)	100 (Adult)
CF = Conversion Factor (10-6 kg/mg)	10-6
FI = Fraction Ingested (unitless)	1
EF = Exposure Frequency (days/years)	150 events/year
ED = Exposure Duration (years)	25 years
BW = Bodyweight (kg)	70 (Adult male)
AT = Averaging Time (days)	25 x 365 (Nc) 70 x 365 (Car)

6.3.5.7.2 Quantification of exposure from Dermal Contact to onsite soils

The equation for the absorbed dose was taken from RAGS (USEPA, 1989a).

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS = Chemical Concentration in Soil (mg/kg soil)
CF = Conversion Factor (10^{-6} kg/mg)
SA = Skin Surface Area Available for Contact (cm^2)
AF = Soil to Skin Adherence Factor (mg/cm^2)
ABS = Absorption Factor (unitless)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged -- days)

This equation is consistent with current EPA guidance because the terms SC, AF, and ABS represent the absorbed dose per event described in the latest guidance.

The exposure calculations are summarized in Table 6-21 through 6-23.

In calculating the RME, values for the skin surface area are in the 50th percentile. "The rationale here is that bodyweight of a typical male (70 kg) is closely correlated to the 50th percentile for the skin surface area: (USEPA, 1989a). The skin surface area available for contact (SA) in the residential exposure to soil is 5,000 cm^2 and 2,165 cm^2 (adult & child) respectively (EPA, 1992). This is representative of the surface area involved with the hands, arms, legs, neck and head. The child value is based on the 50th percentile for 6 to 7-year old children. For the future construction worker, 5000 cm^2 was used for exposure area. For the deer hunter, a value of 2000 cm^2 was used, which is representative of the hands and head since it was assumed that the other portions of of the body would be covered by clothing. The soil adherence factor (AF) is a mass weight (mg) of soil per cm^2 of skin surface area being exposed under the exposure pathway scenario. A factor of 1.0 mg soil/cm^2 (EPA, 1992) is used as the adherence factor for direct contact with soil and sediment throughout this assessment. The same dermal absorption factors (ABS) that were used for dermal contact to sediment were also used for exposure to soils. For PCBs, an absorption factor of 6 percent (0.06) was used, which is at the high end of the range recommended by EPA, 0.6 to 6 percent

(EPA, 1992). Values for exposure frequency (EF), exposure duration (ED), and averaging time (AT) are the same as discussed previously.

TABLE 6-21
CALCULATION OF ABSORBED DOSE (ONSITE)
FROM DERMAL CONTACT TO SOIL (DAILY)
RESIDENTIAL EXPOSURE (FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	30 Year Dose (Car) (mg/kg-day)	Child Absorbed Dose (Nc) (mg/kg-day)	Child Absorbed Dose (Car) (mg/kg-day)	Adult Absorbed Dose (Nc) (mg/kg-day)	Adult Absorbed Dose (Car) (mg/kg-day)	95th UCL Soil (mg/kg)	Conv. Factor (kg/mg)	Child Skin Surface Area Contact (cm²)	Adult Skin Surface Area Contact (cm²)	Adherence Factor (mg soil/cm²)	Absorption Factor (unitless)	Exposure Frequency (days/year)	Child Exposure Duration (years)	Adult Exposure Duration (years)	Child Body Weight (kg)	Adult Body Weight (kg)	Averaging Time (days)		
																	Child(Nc)	Adult(Nc)	Car
Volatile Organics																			
Semi-volatiles																			
Pesticides/PCB's																			
Aroclor-1260	3.4E-07		1.1E-07		2.3E-07	1.61E-01	1.0E-06	2,165	5,000	1.0	0.06	350	6	24	15	70	2,190	8,760	25,550
Metals																			
Cadmium	0.0E+00	7.7E-06		3.8E-06		5.53E+00	1.0E-06	2,165	5,000	1.0	0.01	350	6	24	15	70	2,190	8,760	25,550

EQUATION:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Variables:	Assumptions:	Variables:	Assumptions:
CS = Chemical Concentration in Soil (mg soil/kg)	95th UCL Soil Data	EF = Exposure Frequency (days/year)	350 events/year
CF = Conversion Factor (10-6 kg/mg)	10-6	ED = Exposure Duration (years)	30 years
SA = Surface Area Contact (cm²)	2165(C)/5000(A)	BW = Bodyweight (kg)	15 kg (child) 70 kg (adult)
AF =Soil to Skin Adherence Factor (mg/cm²)	1.00	AT = Averaging Time (days)	6 x 365 Child 24 x 365 Adult (Nc)
ABS = Absorption Factor (unitless)	varies EPA, 1992		70 x 365 (Car)

TABLE 6-22
CALCULATION OF ABSORBED DOSE (ONSITE) FROM DERMAL CONTACT TO SOIL (DAILY)
HUNTER EXPOSURE (CURRENT AND FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	30 Year Dose (Nc) (mg/kg-day)	30 Year Dose (Car) (mg/kg-day)	95th UCL Soil (mg/kg)	Conv. Factor (kg/mg)	Skin Surface Area Contact (cm²)	Adherence Factor (mg soil/cm²)	Absorption Factor (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
											Nc	Car
Volatile Organics												
Semi-volatiles												
Pesticides/PCB's												
Aroclor-1260		3.2E-09	1.61E-01	1.0E-06	2,000	1.0	0.06	10	30	70	10,950	25,550
Metals												
Cadmium	4.3E-08		5.53E+00	1.0E-06	2,000	1.0	0.01	10	30	70	10,950	25,550

EQUATION:

$$\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Variables:	**Assumptions:**	**Variables:**	**Assumptions:**
CS = Chemical Concentration in Soil (mg soil/kg)	95th UCL Soil Data	EF = Exposure Frequency (days/year)	10 events/year
CF = Conversion Factor (10-6 kg/mg)	10-6	ED = Exposure Duration (years)	30 years
SA = Surface Area Contact (cm²)	2000 cm² (Adult)	BW = Bodyweight (kg)	70 kg (adult)
AF =Soil to Skin Adherence Factor (mg/cm²)	1	AT = Averaging Time (days)	30 x 365 (Nc) 70 x 365 Adult (Car)
ABS = Absorption Factor (unitless)	varies, EPA, 1992		

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TABLE 6-23
CALCULATION OF ABSORBED DOSE (ONSITE) FROM DERMAL CONTACT TO SOIL (DAILY)
CONSTRUCTION WORKER EXPOSURE (FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	30 Year Dose (Nc) (mg/kg-day)	30 Year Dose (Car) (mg/kg-day)	95th UCL Soil (mg/kg)	Conv. Factor (kg/mg)	Skin Surface Area Contact (cm²)	Adherence Factor (mg soil/cm²)	Absorption Factor (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days) Nc	Averaging Time (days) Car
Volatile Organics												
Semi-volatiles												
Pesticides/PCB's												
Aroclor-1260		4.7E-09	1.61E-01	1.0E-06	5,000	1.0	0.06	7	25	70	9,125	25,550
Metals												
Cadmium	7.6E-08		5.53E+00	1.0E-06	5,000	1.0	0.01	7	25	70	9,125	25,550

EQUATION: Absorbed Dose (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables:	Assumptions:	Variables:	Assumptions:
CS = Chemical Concentration in Soil (mg soil/kg)	95th UCL Soil Data (all soils)	EF = Exposure Frequency (days/year)	150 events/year
CF = Conversion Factor (10-6 kg/mg)	10-6	ED = Exposure Duration (years)	25 years
SA = Surface Area Contact (cm²)	5000(A)	BW = Bodyweight (kg)	70 kg (adult)
AF =Soil to Skin Adherence Factor (mg/cm²)	1.00	AT = Averaging Time (days)	25 x 365 (Nc) 70 x 365 (Car)
ABS = Absorption Factor (unitless)	varies EPA, 1992		

6.3.5.8 Inhalation of Volatile Organics in Ambient Air

This pathway consists of volatile organics being released from soils to the air and then being transported via wind dispersion to the residential receptors. As discussed in the fate and transport sections, volatilization of organics in soil is an important mechanism for the fate of these chemicals.

6.3.5.8.1 Exposure Concentrations for Inhalation of Volatile Organics in Ambient Air

The exposure concentrations for Inhalation of Volatile Organics in ambient air were derived from a flux equation estimating E_i, the emission rate of the organics from the soil "hot spot" area. The soil data that constitute the "hot spot" area are from borings B2, B10, B15, B17, B20, B27, B28, B29, B30, B31, B32, B33, B34, B35, B36, B37, B38, B39, B45, B46, B47 and B48. The first step in the modelling was to calculate the saturation concentration for all volatile constituents using the EPA methodologies. All saturation concentrations exceeded the bulk soil concentration (Table 6-24). Therefore, E_i was calculated using the 95th UCL concentration taken from the soil analysis of the "hot spot" area with the following equation, which is valid when the bulk soil concentrations are less than the saturation concentrations.

$$\text{average emission rate } (g/s) = \Sigma_i = \frac{A \times 2 \times D_{ei} \times \epsilon \times K_{as} \times C_i}{\sqrt{\Pi \times a \times t}}$$

where:

E_i = average emission rate of component i for exposure interval t, g/s.

D_{ei} = Effective diffusion coefficient i, cm^2/s

= $(Di \times Pa^{10/3}/Pt^2)$

D_i = Molecular diffusion coefficient i in air, cm^2/s

$$= \frac{0.001 T^{1.75} \sqrt{\frac{1}{MW_i} + \frac{1}{MW_a}}}{P_{ab}[(\Sigma V_i)^{1/3} + (\Sigma V_a)^{1/3}]^2}$$

MW_i; MW_a = Molecular weight of component i and air (28.8), respectively, g/mole

P_{ab} = Absolute Pressure, atm

$\sum V_i; \sum V_a$ = Molecular diffusion volumes of component i and air (20.1), respectively, cm^3/mole
K_{as} = Soil/air partition coefficient, g/cm^3
= (H/K_d) x 41
H = Henry's Law Constant of Component i, atm-m^3/mole
K_d = Soil/water partition coefficient, mL/g
= K_{oc} x F_{oc}
K_{oc} = organic carbon partition coefficient, L/Kg
F_{oc} = Fraction of organic carbon in soil, mg/mg
= 0.02 = default value
C_i = Bulk-soil concentration of component i, g/g
t = Exposure interval, s (exposure time x exposure frequency x exposure duration in seconds)
ϵ = Soil porosity, dimensionless
= $P_t = 1 - \beta/\rho$
β = Soil bulk density, g/cm^3 (1.65 g/cm^3)
ρ = Particle density, g/cm^3 (2.65 g/cm^3)
A = Exposure surface area, cm^2

$$a = \frac{D_{ei}\epsilon}{\epsilon + \rho(1-\epsilon)/K_{as}}$$

Pa = air filled porosity, dimensionless
$Pa = P_t - (O_m\ B)$
P_t = total soil porosity; dimensionless, (38%)
O_m = soil moisture content cm^3-water/g-soil (15%)
B = soil bulk density g/cm^3 (1.65 g/cm^3).

In calculating the average emission rate (Ei), several assumptions were made: The exposure frequency was assumed to be 350 days/year, exposure time 24 hours/day, exposure duration was 30 years. The soil porosity was calculated to be 0.38. Molecular diffusion volumes (V_i, V_a) were estimated per EPA guidance by summing all atomic diffusion volumes for each compound.

The Screen 2 program was used to model hot spots at the ash landfill as a single square area source with an area equal to 73,400 square feet (6,819 sq. meters). Emissions were assumed to occur at ground level. Concentrations in micrograms per cubic meter were predicted at two downwind receptor locations in an attempt to characterize a future on-site resident at 48 meters just beyond the edge of the square area source and a current off-site resident, 730 meters from the center of the source (farmhouse). While the 48 meters represents the closest that the SCREEN2 Model can get to the area source of the size modeled, it is in close proximity to the "hot spot" and is believed to represent a good approximation of a maximumly exposed individual. Flat terrain was assumed in the modelling, but a receptor height of 1.75 meters above the ground elevation was assumed in an attempt to best simulate a typical breathing zone height.

The Screen 2 output lists the maximum predicted 1-hour concentration at each receptor in units of micrograms per cubic meter. In order to convert these to concentrations applicable to a given pollutant, the concentration was multiplied by the pollutant-specific emission rate (E_i^A) in units of grams per second per square meter. Because the emission rate was given initially in grams per second for the whole area source, the emission rate (E_i) was divided by the area (6,819 sq. meters) to get (E_i^A) prior to multiplying in the two specific model concentration values to achieve the respective values for the future on-site resident and current off-site resident.

The maximum 1 - hour concentration at each receptor was predicted to occur during light wind (1 m/s), stable atmospheric conditions. These conditions may occur at night but would not be expected to occur during the daytime when solar heating would erode any surface based inversion and lead to neutral or even unstable atmospheric conditions. In assuming a long term concentration, such as in the future on-site receptor, it is assumed that emissions and meterology (wind speed, stability, and wind direction) remain constant over the longer-term period of interest. This assumption must be made due to the steady-state conditions that the Screen 2 model runs on. In reality, variations in meteorological conditions would lead to lower concentrations for longer averaging periods. The results of these modelled values is presented in Table 6-24. Details of the SCREEN2 Modeling are presented in Appendix O. Table 6-24 also includes the NYSDEC Annual Guideline Concentrations for ambient air.

6.3.5.8.2 Quantification of Exposure for Inhalation of Volatile Organics in Ambient Air

The quantification of this exposure pathway includes both current off-site and future on-site use. The equation for the intake is as follows (EPA,1989a):

$$\text{Intake (mg/kg/day)} = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

where:

CA = Chemical concentration in air (mg/m^3) (modelled value)
IR = Inhalation Rate (m^3/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Bodyweight (kg)
AT = Averaging Time (days)

The results of these calculations are shown in Tables 6-25 through 6-28. In calculating the intake, the following values were used in this equation. The chemical (organic) concentrations (CA) were values modelled using the flux equation and the Screen 2 model. All volatile organic compounds detected in soil during the sampling program were modelled

TABLE 6-24

CALCULATION OF VOLATILE ORGANIC COMPOUNDS IN AMBIENT AIR RESIDENTIAL EXPOSURE (CURRENT LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

COMPOUND	NYSDEC AGC's ug/m^3	Off-Site Conc. ug/m^3	On-Site Conc. ug/m^3	Average Emission Rate Ei g/s	Effective Diffusion Coefficient Dei cm^2/s	Diffusion Coefficient Di cm^2/s	Bulk Soil Concentration Ci g/g	Saturation Concentration Csat g/g	Exposure Interval t sec.	Soil Porosity (total) ε	Constant a	Soil/Air Partition Coef. Kas g/cm^3
Volatile Organics												
Vinyl Chloride	0.02	0.040	0.168	5.7620E-05	0.0008408	0.1021025	4.4463E-07	8.5707E-04	9.10E+08	0.38	3.38E-04	2.95
Chloroethane	NA	0.000	0.000	4.7359E-08	0.0008156	0.099037	3.0000E-09	1.1537E-03	9.10E+08	0.38	1.36E-05	0.07
Acetone	NA	0.002	0.008	2.6756E-06	0.0008072	0.0980229	3.3695E-07	1.5660E-01	9.10E+08	0.38	3.53E-06	0.02
Carbon Disulfide	7	0.004	0.015	5.2523E-06	0.0008638	0.1048905	1.2350E-07	9.1728E-04	9.10E+08	0.38	8.33E-05	0.47
1,1-Dichloroethene	0.02	0.006	0.026	9.0334E-06	0.0007145	0.0867578	1.4530E-07	7.7625E-04	9.10E+08	0.38	1.41E-04	1.07
1,2-Dichloroethene (total)	1900	1.095	4.617	1.5844E-03	0.0007145	0.0867578	6.0135E-05	2.0601E-03	9.10E+08	0.38	3.54E-05	0.23
Chloroform	23	0.000	0.001	1.9251E-07	0.00078	0.094722	9.5379E-09	2.3862E-03	9.10E+08	0.38	2.17E-05	0.13
1,2-Dichloroethane	0.039	0.002	0.007	2.2425E-06	0.0006984	0.084803	1.0962E-07	1.6358E-03	9.10E+08	0.38	2.21E-05	0.14
2-Butanone	300	0.000	0.000	7.3422E-08	0.0007014	0.0851728	1.2310E-08	4.3818E-02	9.10E+08	0.38	2.00E-06	0.01
1,1,1-Trichloroethane	NA	0.000	0.000	0.0000E+00	0.0006249	0.075889	0.0000E+00	9.0900E-04	9.10E+08	0.38	2.66E-05	0.19
Trichloroethene	0.45	1.061	4.473	1.5349E-03	0.0006366	0.0773059	7.7248E-05	5.8080E-04	9.10E+08	0.38	2.09E-05	0.15
Benzene	0.12	0.000	0.000	6.6652E-08	0.000683	0.0829402	3.3573E-09	6.9825E-04	9.10E+08	0.38	2.09E-05	0.14
Tetrachloroethene	0.075	0.000	0.000	6.6802E-08	0.0005815	0.0706139	3.5449E-09	1.8630E-03	9.10E+08	0.38	1.88E-05	0.15
Toluene	0.062	0.002	0.007	2.3048E-06	0.0006146	0.0746374	2.2028E-07	5.6175E-03	9.10E+08	0.38	6.06E-06	0.04
Chlorobenzene	20	0.001	0.004	1.3512E-06	0.000608	0.0738333	1.7862E-07	1.4022E-03	9.10E+08	0.38	3.20E-06	0.02
Ethylbenzene	1000	0.001	0.003	9.4022E-07	0.000563	0.068364	1.7960E-07	5.2440E-04	9.10E+08	0.38	1.54E-06	0.01
Xylene (total)	300	0.004	0.017	5.9761E-06	0.000563	0.068364	5.0680E-07	1.7226E-04	9.10E+08	0.38	7.64E-06	0.06

Note:

1) Saturation concentration (Csat.) calculated using equation on page 8 of Guidline for Predictive Baseline Emissions Estimation Procedures for Superfund Sites, Interim Final, prepared by Environmental Quality Management, Inc. for U.S. EPA Region II, January 1992.

TABLE 6-25

CALCULATION OF INTAKE (OFF-SITE) FROM INHALATION OF VOLATILE ORGANICS IN AMBIENT AIR RESIDENTIAL EXPOSURE (CURRENT LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Intake (Nc) (mg/kg-day)	Intake (Car) (mg/kg-day)	95th UCL Air (ug/m³)	Inhalation Rate (m³/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
								Nc	Car
Volatile Organics									
Vinyl Chloride		4.7E-06	3.98E-02	20	350	30	70	10,950	25,550
Chloroethane	9.0E-09		3.27E-05	20	350	30	70	10,950	25,550
Acetone			1.85E-03	20	350	30	70	10,950	25,550
Carbon Disulfide	9.9E-07		3.63E-03	20	350	30	70	10,950	25,550
1,1-Dichloroethene		7.3E-07	6.24E-03	20	350	30	70	10,950	25,550
1,2-Dichloroethene (total)	3.0E-04		1.09E+00	20	350	30	70	10,950	25,550
Chloroform		1.6E-08	1.33E-04	20	350	30	70	10,950	25,550
1,2-Dichloroethane	4.2E-07	1.8E-07	1.55E-03	20	350	30	70	10,950	25,550
2-Butanone	1.4E-08		5.07E-05	20	350	30	70	10,950	25,550
1,1,1-Trichloroethane			0.00E+00	20	350	30	70	10,950	25,550
Trichloroethene		1.2E-04	1.06E+00	20	350	30	70	10,950	25,550
Benzene		5.4E-09	4.61E-05	20	350	30	70	10,950	25,550
Tetrachloroethene		5.4E-09	4.62E-05	20	350	30	70	10,950	25,550
Toluene	4.4E-07		1.59E-03	20	350	30	70	10,950	25,550
Chlorobenzene	2.6E-07		9.34E-04	20	350	30	70	10,950	25,550
Ethylbenzene	1.8E-07		6.50E-04	20	350	30	70	10,950	25,550
Xylene (total)			4.13E-03	20	350	30	70	10,950	25,550

EQUATION: Intake (mg/kg-day) = $\frac{CA \times IR \times EF \times ED}{BW \times AT}$

Variables:	Assumptions:
CA = Chemical Concentration in Air (mg/m³)	95th UCL Air Model Data
IR = Inhalation Rate (m³/day)	20
EF = Exposure Frequency (days/yr)	350
ED = Exposure Duration (years)	30
BW = Bodyweight (kg)	70
AT = Averaging Time (days)	30 x 365 (Nc) 70 x 365 (Car)

TABLE 6-26

CALCULATION OF INTAKE (ONSITE) FROM INHALATION OF VOLATILE ORGANICS IN AMBIENT AIR RESIDENTIAL EXPOSURE (FUTURE LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Intake (Nc) (mg/kg-day)	Intake (Car) (mg/kg-day)	95th UCL Air (ug/m³)	Inhalation Rate (m³/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
								Nc	Car
Volatile Organics									
Vinyl Chloride		2.0E-05	1.68E-01	20	350	30	70	10,950	25,550
Chloroethane	3.8E-08		1.38E-04	20	350	30	70	10,950	25,550
Acetone			7.80E-03	20	350	30	70	10,950	25,550
Carbon Disulfide	4.2E-06		1.53E-02	20	350	30	70	10,950	25,550
1,1-Dichloroethene		3.1E-06	2.63E-02	20	350	30	70	10,950	25,550
1,2-Dichloroethene (total)	1.3E-03		4.62E+00	20	350	30	70	10,950	25,550
Chloroform		6.6E-08	5.61E-04	20	350	30	70	10,950	25,550
1,2-Dichloroethane	1.8E-06	7.7E-07	6.53E-03	20	350	30	70	10,950	25,550
2-Butanone	5.9E-08		2.14E-04	20	350	30	70	10,950	25,550
1,1,1-Trichloroethane			0.00E+00	20	350	30	70	10,950	25,550
Trichloroethene		5.3E-04	4.47E+00	20	350	30	70	10,950	25,550
Benzene		2.3E-08	1.94E-04	20	350	30	70	10,950	25,550
Tetrachloroethene		2.3E-08	1.95E-04	20	350	30	70	10,950	25,550
Toluene	1.8E-06		6.72E-03	20	350	30	70	10,950	25,550
Chlorobenzene	1.1E-06		3.94E-03	20	350	30	70	10,950	25,550
Ethylbenzene	7.5E-07		2.74E-03	20	350	30	70	10,950	25,550
Xylene (total)			1.74E-02	20	350	30	70	10,950	25,550

EQUATION: Intake (mg/kg-day) = $\frac{CA \times IR \times EF \times ED}{BW \times AT}$

Variables:	Assumptions:
CA = Chemical Concentration in Air (mg/m³)	95th UCL Air Model Data
IR = Inhalation Rate (m³/day)	20
EF = Exposure Frequency (days/yr)	350
ED = Exposure Duration (years)	30
BW = Bodyweight (kg)	70
AT = Averaging Time (days)	30 x 365 (Nc) 70 x 365 (Car)

09/27/94

TABLE 6-27

CALCULATION OF INTAKE (ONSITE) FROM INHALATION OF VOLATILE ORGANICS IN AMBIENT AIR HUNTER EXPOSURE (CURRENT LAND USE)

SENECA ARMY DEPOT ASH LANDFILL

Analyte	Intake (Nc) (mg/kg-day)	Intake (Car) (mg/kg-day)	95th UCL Air (ug/m³)	Inhalation Rate (m³/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	
								Nc	Car
Volatile Organics									
Vinyl Chloride		2.3E-07	1.68E-01	8	10	30	70	10,950	25,550
Chloroethane	4.3E-10		1.38E-04	8	10	30	70	10,950	25,550
Acetone			7.80E-03	8	10	30	70	10,950	25,550
Carbon Disulfide	4.8E-08		1.53E-02	8	10	30	70	10,950	25,550
1,1-Dichloroethene		3.5E-08	2.63E-02	8	10	30	70	10,950	25,550
1,2-Dichloroethene (total)	1.4E-05		4.62E+00	8	10	30	70	10,950	25,550
Chloroform		7.5E-10	5.61E-04	8	10	30	70	10,950	25,550
1,2-Dichloroethane	2.0E-08	8.8E-09	6.53E-03	8	10	30	70	10,950	25,550
2-Butanone	6.7E-10		2.14E-04	8	10	30	70	10,950	25,550
1,1,1-Trichloroethane			0.00E+00	8	10	30	70	10,950	25,550
Trichloroethene		6.0E-06	4.47E+00	8	10	30	70	10,950	25,550
Benzene		2.6E-10	1.94E-04	8	10	30	70	10,950	25,550
Tetrachloroethene		2.6E-10	1.95E-04	8	10	30	70	10,950	25,550
Toluene	2.1E-08		6.72E-03	8	10	30	70	10,950	25,550
Chlorobenzene	1.2E-08		3.94E-03	8	10	30	70	10,950	25,550
Ethylbenzene	8.6E-09		2.74E-03	8	10	30	70	10,950	25,550
Xylene (total)			1.74E-02	8	10	30	70	10,950	25,550

EQUATION: Intake (mg/kg-day) =

$$\frac{CA \times IR \times EF \times ED}{BW \times AT}$$

Variables:	Assumptions:
CA = Chemical Concentration in Air (mg/m³)	95th UCL Air Model Data
IR = Inhalation Rate (m³/day)	8
EF = Exposure Frequency (days/yr)	10
ED = Exposure Duration (years)	30
BW = Bodyweight (kg)	70
AT = Averaging Time (days)	30 x 365 (Nc) 70 x 365 (Car)

09/21/94

TABLE 6-28

CALCULATION OF INTAKE (ONSITE) FROM INHALATION OF VOLATILE ORGANICS IN AMBIENT AIR CONSTRUCTION WORKER EXPOSURE (FUTURE LAND USE)

SENECA ARMY DEPOT ASH LANDFILL

Analyte	**Intake (Nc)** (mg/kg-day)	**Intake (Car)** (mg/kg-day)	**95th UCL Air** (ug/m^3)	**Inhalation Rate** (m^3/day)	**Exposure Frequency** (days/year)	**Exposure Duration** (years)	**Body Weight** (kg)	**Averaging Time** (days)	
								Nc	Car
Volatile Organics									
Vinyl Chloride		6.6E-05	1.58E+00	20	150	25	70	9,125	25,550
Chloroethane	1.5E-07		1.29E-03	20	150	25	70	9,125	25,550
Acetone			7.32E-02	20	150	25	70	9,125	25,550
Carbon Disulfide	1.7E-05		1.44E-01	20	150	25	70	9,125	25,550
1,1-Dichloroethene		1.0E-05	2.47E-01	20	150	25	70	9,125	25,550
1,2-Dichloroethene (total)	5.1E-03		4.33E+01	20	150	25	70	9,125	25,550
Chloroform		2.2E-07	5.26E-03	20	150	25	70	9,125	25,550
1,2-Dichloroethane	7.2E-06	2.6E-06	6.13E-02	20	150	25	70	9,125	25,550
2-Butanone	2.4E-07		2.01E-03	20	150	25	70	9,125	25,550
1,1,1-Trichloroethane			0.00E+00	20	150	25	70	9,125	25,550
Trichloroethene		1.8E-03	4.20E+01	20	150	25	70	9,125	25,550
Benzene		7.6E-08	1.82E-03	20	150	25	70	9,125	25,550
Tetrachloroethene		7.7E-08	1.83E-03	20	150	25	70	9,125	25,550
Toluene	7.4E-06		6.30E-02	20	150	25	70	9,125	25,550
Chlorobenzene	4.3E-06		3.69E-02	20	150	25	70	9,125	25,550
Ethylbenzene	3.0E-06		2.57E-02	20	150	25	70	9,125	25,550
Xylene (total)			1.63E-01	20	150	25	70	9,125	25,550

EQUATION: Intake (mg/kg-day) = $\frac{CA \times IR \times EF \times ED}{BW \times AT}$

Variables:	Assumptions:
CA = Chemical Concentration in Air (mg/m^3)	95th UCL Air Model Data
IR = Inhalation Rate (m^3/day)	20
EF = Exposure Frequency (days/yr)	150
ED = Exposure Duration (years)	25
BW = Bodyweight (kg)	70
AT = Averaging Time (days)	30 x 365 (Nc) 70 x 365 (Car)

and subsequent concentration (CA) predicted for the current off-site receptor and all on-site receptors as discussed previously. The inhalation rate (IR) was 20 m^3/day, the average adult inhalation rate (EPA, 1989a). The exposure frequency (EF) was assumed to be 350 days/year for both current and future residential receptors. This is based on the average length of vacation for the family (receptor) to be two weeks. During this time, it is assumed that they will be away from their primary residence. The exposure duration (ED) was assumed to be 30 years for both scenarios. This is representative of the national upper-bound time (90th percentile) that a receptor will remain at one residence (EPA, 1989a). For deer hunters, an EF of 10 days/year was assumed and for construction workers, an EF of 150 days/year was assumed. For body weight, (BW) a value of 70 kg was used, which reflects the average for an adult male (EPA, 1989a). The averaging time (AT) used for noncarcinogenic substances was 10,950 days for the residential and deer hunter exposures. For the construction worker, the averaging time was 9,125 days. For carcinogenic substances, an AT of 25,500 days was used for both scenarios.

6.4 TOXICITY ASSESSMENT

The objective of the toxicity assessment is to weigh available evidence regarding the potential of the chemicals to cause adverse effects in exposed individuals, and to provide, where possible, an estimate of the relationship between the extent of exposure to a chemical and the increased likelihood and/or severity of adverse effects. The types of toxicity information considered in this assessment include the reference dose (RfD) and reference concentration (RfC) used to evaluate noncarcinogenic effects, and the slope factor and unit risk to evaluate carcinogenic potential.

Most toxicity information used in this evaluation was obtained from the Integrated Risk Information System (IRIS) (June 23-25, 1993). If values were not available from IRIS, the *Health Effects Assessment Summary Tables* (HEAST) (USEPA, 1993a) were consulted. Finally, the USEPA Region II was consulted to provide any additional values not included in these two sources. Updated information was provided by USEPA Region II in their comment on the Draft Risk Assessment. The toxicity factors used in this evaluation are summarized in Table 6-29 for both noncarcinogenic and carcinogenic effects.

6.4.1 Toxicity Assessment Noncarcinogenic Effects

For chemicals that exhibit noncarcinogenic (i.e., systemic) effects, authorities consider

TABLE 6-29
TOXICITY VALUES

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Oral RfD (mg/kg-day)		Inhalation RfD (mg/kg-day)		Carc. Slope Oral (mg/kg-day)-1		Rank Wt. of Evidence	Carc. Slope Inhalation (mg/kg-day)-1		Dermal RfD (mg/kg-day)		Carc. Slope Dermal (mg/kg-day)-1	
Volatile Organics													
Vinyl Chloride	NA	e	NA	e	1.90E+00	b	A	2.94E-01	b	NA	g	2.11E+00	h
Chloroethane	2.00E-02	e	2.90E+00	e	NA	e	NA	NA	e	2.00E-02	g	NA	h
Acetone	1.00E-01	a	NA	e	NA	e	D	NA	e	1.00E-01	g	NA	h
Carbon Disulfide	1.00E-01	a	2.86E-03	b	NA	e	NA	NA	e	1.00E-01	g	NA	h
Dichloroethene, 1,1-	9.00E-03	a	NA	e	6.00E-01	a	C	1.20E+00	a	9.00E-03	g	6.00E-01	h
Dichloroethane, 1,1-	1.00E-01	b	1.43E-01	b	NA	e	C	NA	e	1.00E-01	g	NA	h
Dichloroethene, 1,2- (total)	9.00E-03	b	1.20E+00	a	NA	e	NA	NA	e	9.00E-03	g	NA	h
Chloroform	1.00E-02	a	NA	e	6.10E-03	a	B2	8.05E-02	a	1.00E-02	g	6.10E-03	h
Dichloroethane, 1,2-	NA	e	2.90E-03	e	9.10E-02	a	B2	9.10E-02	a	NA	g	9.10E-02	h
Butanone, 2-	6.00E-01	a	2.86E-01	a	NA	e	D	NA	e	6.00E-01	g	NA	h
Trichloroethane, 1,1,1-	NA	e	NA	e	NA	e	D	NA	e	NA	g	NA	h
Trichloroethene	NA	e	NA	e	1.10E-02	e	NA	6.00E-03	e	NA	g	1.10E-02	h
Benzene	NA	e	NA	e	2.90E-02	a	A	2.91E-02	a	NA	g	2.90E-02	h
4-Methyl-2-Pentanone	5.00E-02	b	2.00E-02	b	NA	e	NA	NA	e	5.00E-02	g	NA	h
Tetrachloroethene	1.00E-02	a	NA	e	5.00E-02	e	D	2.00E-03	e	1.00E-02	g	5.00E-02	h
Toluene	2.00E-01	a	1.14E-01	a	NA	e	D	NA	e	2.00E-01	g	NA	h
Chlorobenzene	2.00E-02	a	5.00E-03	b	NA	e	D	NA	e	2.00E-02	g	NA	h
Ethylbenzene	1.00E-01	a	2.86E-01	a	NA	e	D	NA	e	1.00E-01	g	NA	h
Xylene (total)	2.00E+00	a	NA	e	NA	e	D	NA	e	2.00E+00	g	NA	h
Semivolatiles													
Phenol	6.00E-01	a	NA	e	NA	e	D	NA	e	6.00E-01	g	NA	h
bis(2-Chloroethyl) ether	NA	e	NA	e	1.00E+00	a	B2	1.00E+00	e	NA	g	1.00E+00	h
Methylphenol, 4-	5.00E-03	b	NA	e	NA	e	C	NA	e	5.00E-03	g	NA	h
Nitrophenol, 2-	NA	e	NA	e	NA	e	NA	NA	e	NA	g	NA	h
Benzoic acid	4.00E+00	a	NA	e	NA	e	D	NA	e	4.00E+00	g	NA	h
Naphthalene	NA	e	NA	e	NA	e	D	NA	e	NA	g	NA	h
Methylnaphthalene, 2-	NA	e	NA	e	NA	e	NA	NA	e	NA	g	NA	h
Dimethylphthalate	1.00E+01	e	NA	e	NA	e	D	NA	e	1.00E+01	g	NA	h
Acenaphthylene	NA	e	NA	e	NA	e	D	NA	e	NA	g	NA	h
Acenaphthene	6.00E-02	a	NA	e	NA	e	NA	NA	e	6.00E-02	g	NA	h
Nitrophenol,4-	NA	e	NA	e	NA	e	NA	NA	e	NA	g	NA	h
Dibenzofuran	NA	e	NA	e	NA	e	D	NA	e	NA	g	NA	h
Dinitrotoluene, 2,4-	2.00E-03	a	NA	e	NA	e	B2	NA	e	2.00E-03	g	NA	h
Diethylphthalate	8.00E+00	b	NA	e	NA	e	D	NA	e	8.00E+00	g	NA	h
Fluorene	4.00E-02	a	NA	e	NA	e	D	NA	e	4.00E-02	g	NA	h
N-Nitrosodiphenylamine	NA	e	NA	e	4.90E-03	a	B2	NA	e	NA	g	4.90E-03	h
Pentachlorophenol	3.00E-02	a	NA	e	1.20E-01	a	B2	NA	e	3.00E-02	g	1.20E-01	h
Phenanthrene	NA	e	NA	e	NA	e	D	NA	e	NA	g	NA	h
Anthracene	3.00E-01	a	NA	e	NA	e	D	NA	e	3.00E-01	g	NA	h
Carbazole	NA	e	NA	e	2.00E-02	b	B2	NA	e	NA	g	2.00E-02	h
Di-n-butylphthalate	1.00E-01	a	NA	e	NA	e	D	NA	e	1.00E-01	g	NA	h
Fluoranthene	4.00E-02	a	NA	e	NA	e	D	NA	e	4.00E-02	g	NA	h
Pyrene	3.00E-02	a	NA	e	NA	e	NA	NA	e	3.00E-02	g	NA	h
Butylbenzylphthalate	2.00E+00	b	NA	e	NA	e	C	NA	e	2.00E+00	g	NA	h
Benzo(a)anthracene	NA	e	NA	e	7.30E-01	c	B2	NA	e	NA	g	7.30E-01	h
Chrysene	NA	e	NA	e	7.30E-02	c	B2	NA	e	NA	g	7.30E-02	h
bis(2-Ethylhexyl)phthalate	2.00E-02	a	NA	e	1.40E-02	a	B2	NA	e	2.00E-02	g	1.40E-02	h
Di-n-octylphthalate	2.00E-02	b	NA	e	NA	e	NA	NA	e	2.00E-02	g	NA	h
Benzo(b)fluoranthene	NA	e	NA	e	7.30E-01	c	B2	NA	e	NA	g	7.30E-01	h
Benzo(k)fluoranthene	NA	e	NA	e	7.30E-01	c	B2	NA	e	NA	g	7.30E-01	h
Benzo(a)pyrene	NA	e	NA	e	7.30E+00	a	B2	NA	e	NA	g	7.30E+00	h
Indeno(1,2,3-cd)pyrene	NA	e	NA	e	7.30E-01	c	B2	NA	e	NA	g	7.30E-01	h
Dibenz(a,h)anthracene	NA	e	NA	e	7.30E+00	c	B2	NA	e	NA	g	7.30E+00	h
Benzo(g,h,i)perylene	NA	e	NA	e	NA	e	D	NA	e	NA	g	NA	h

TABLE 6-29
TOXICITY VALUES

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Oral RfD (mg/kg-day)		Inhalation RfD (mg/kg-day)		Carc. Slope Oral (mg/kg-day)-1		Rank Wt. of Evidence	Carc. Slope Inhalation (mg/kg-day)-1		Dermal RfD (mg/kg-day)		Carc. Slope Dermal (mg/kg-day)-1	
Pesticides/PCBs													
Heptachlor	5.00E-04	a	NA	e	4.50E+00	a	B2	4.55E+00	a	5.00E-04	g	4.50E+00	h
Dieldrin	5.00E-05	a	NA	e	1.60E+01	a	B2	1.61E+01	a	5.00E-05	g	1.60E+01	h
DDE, 4,4'-	NA	e	NA	e	3.40E-01	a	B2	3.40E-01	a	NA	g	3.40E-01	h
Endrin	3.00E-04	b	NA	e	NA	e	D	NA	e	3.00E-04	g	NA	h
DDD, 4,4'-	NA	e	NA	e	2.40E-01	a	B2	NA	e	NA	g	2.40E-01	h
Endosulfan sulfate	5.00E-05	b	NA	e	NA	e	NA	NA	e	5.00E-05	g	NA	h
DDT, 4,4'-	5.00E-04	a	NA	e	3.40E-01	a	B2	3.40E-01	a	5.00E-04	g	3.40E-01	h
alpha-Chlordane	6.00E-05	b	NA	e	1.30E+00	a	B2	NA	e	6.00E-05	g	1.30E+00	h
Aroclor-1242	NA	e	NA	e	7.70E+00	f	NA	NA	e	NA	g	8.11E+00	h
Aroclor-1260	NA	e	NA	e	7.70E+00	e	B2	NA	e	NA	g	8.11E+00	h
Herbicides													
2,4-DB	8.00E-03	a	NA	e	NA	e	NA	NA	e	8.00E-03	g	NA	h
2,4,5-TP (Silvex)	8.00E-03	a	NA	e	NA	e	D	NA	e	8.00E-03	g	NA	h
MCPP	1.00E-03	a	NA	e	NA	e	NA	NA	e	1.00E-03	g	NA	h
Dalapon	3.00E-02	a	NA	e	NA	e	NA	NA	e	3.00E-02	g	NA	h
Dicambra	NA	e	NA	e	NA	e	NA	NA	e	NA	g	NA	h
Metals													
Aluminum	NA	e	NA	e	NA	e	NA	NA	e	NA	g	NA	h
Antimony	4.00E-04	b	NA	e	NA	e	NA	NA	e	4.00E-04	g	NA	h
Arsenic	3.00E-04	a	NA	e	1.75E+00	d	A	1.51E+01	a	2.94E-04	g	1.79E+00	h
Barium	7.00E-02	a	1.43E-04	b	NA	e	NA	NA	e	7.00E-03	g	NA	h
Beryllium	5.00E-03	a	NA	e	4.30E+00	a	B2	8.40E+00	a	5.00E-06	g	4.30E+03	h
Cadmium	5.00E-04	a	NA	e	NA	e	B1	6.30E+00	a	3.00E-05	g	NA	h
Calcium	NA	e	NA	e	NA	e	NA	NA	e	NA	g	NA	h
Chromium	5.00E-03	a	NA	e	NA	e	A	4.20E+01	a	2.50E-04	g	NA	h
Cobalt	NA	e	NA	e	NA	e	NA	NA	e	NA	g	NA	h
Copper	4.00E-02	b	NA	e	NA	e	D	NA	e	2.00E-02	g	NA	h
Iron	NA	e	NA	e	NA	e	D	NA	e	NA	g	NA	h
Lead	NA	e	NA	e	NA	e	B2	NA	e	NA	g	NA	h
Magnesium	NA	e	NA	e	NA	e	D	NA	e	NA	g	NA	h
Manganese	5.00E-03	a	1.14E-04	a	NA	e	D	NA	e	5.00E-03	g	NA	h
Mercury	3.00E-04	b	8.57E-05	b	NA	e	D	NA	e	3.00E-04	g	NA	h
Nickel	2.00E-02	a	NA	e	NA	e	A	8.40E-01	b	1.00E-03	g	NA	h
Potassium	NA	e	NA	e	NA	e	NA	NA	e	NA	g	NA	h
Selenium	5.00E-03	b	NA	e	NA	e	NA	NA	e	5.00E-03	g	NA	h
Silver	5.00E-03	a	NA	e	NA	e	D	NA	e	5.00E-03	g	NA	h
Sodium	NA	e	NA	e	NA	e	NA	NA	e	NA	g	NA	h
Thallium	7.00E-05	b	NA	e	NA	e	NA	NA	e	7.00E-05	g	NA	h
Vanadium	7.00E-03	b	NA	e	NA	e	D	NA	e	7.00E-03	g	NA	h
Zinc	3.00E-01	a	NA	e	NA	e	D	NA	e	1.50E-01	g	NA	h
Cyanide	2.00E-02	a	NA	e	NA	e	D	NA	e	2.00E-02	g	NA	h

a = Taken from the Integrated Risk Information System (IRIS)
Online June 23-25, 1992
b = Taken from HEAST
c = Calculated using TEF
d = Calculated from proposed oral unit risk value
e = Provided by USEPA - October 1993
f = Value used is that of Aroclor-1260
g = Calculated from oral RFD value
h = Calculated from oral slope factor
NA = Not Available

organisms to have repair and detoxification capabilities that must be exceeded by some critical concentration (threshold) before the health effect is manifested. For example, an organ can have a large number of cells performing the same or similar functions that must be significantly depleted before the effect on the organ is seen. This threshold view holds that a range of exposures from just above zero to some finite value can be tolerated by the organism without an appreciable risk of adverse effects.

Health criteria for chemicals exhibiting noncarcinogenic effects for use in risk assessment are generally developed using USEPA RfDs and RfCs developed by the RfD/RfC Work Group and included in the IRIS. In general, the RfD/RfC is an estimate of an average daily exposure to an individual (including sensitive individuals) below which there will not be an appreciable risk of adverse health effects. The RfD/RfC is derived using uncertainty factors (e.g., to adjust from animals to humans and to protect sensitive subpopulations) to ensure that it is unlikely to underestimate the potential for adverse noncarcinogenic effects to occur. The purpose of the RfD/RfC is to provide a benchmark against which the sum of other doses (i.e, those projected from human exposure to various environmental conditions) might be compared. Doses that are significantly higher that the RfD/RfC may indicate that an inadequate margin of safety could exist for exposure to that substance and that an adverse health effect could occur. The chemicals of potential concern may affect different target organs in the body.

6.4.1.1 Toxicity Values for Oral and Inhalation Exposure

The types of toxicity values used to evaluate the noncarcinogenic effects of chemicals include RfDs for oral exposure, and RfCs for inhalation exposure. The chronic RfD or RfC for a chemical is ideally based on studies where either animal or human populations were exposed to a given chemical by a given route of exposure for the major portion of the life span (referred to as a chronic study). Various effect levels may be determined in a study; however, the preferred effect level for calculating noncarcinogenic toxicity values is the no-observed-adverse-effect level, or NOAEL. Second to the NOAEL is the lowest-observed-adverse-effect level, or LOAEL. RfDs and RfCs represent thresholds for toxicity. They are derived such that human lifetime exposure to a given chemical via a given route at levels at or below the RfD or RfC, as appropriate, should not result in adverse health effects, even for the most sensitive members of the population.

The RfD is an oral value that is derived by determining dose-specific effect levels from all the available quantitative studies, and applying uncertainty factors and/or a modifying factor to the most appropriate effect level in order to determine a chronic RfD for humans. Uncertainty factors are intended to account for 1) the variation in sensitivity among members of the human population, 2) the uncertainty in extrapolating animal data to the case of humans, 3) the uncertainty in extrapolating from data obtained in a study that is less than lifetime exposure, 4) the uncertainty in using LOAEL data rather than NOAEL data, and 5) the uncertainty resulting from inadequacies in the data base. The modifying factor may be used to account for uncertainties not covered by the uncertainty factors such as inadequacy of the number of animals in the critical study. Usually each of these uncertainty factors is set equal to 10, while the modifying factor varies between one and 10. RfDs are reported as doses in milligrams of chemical per kilogram body weight per day (mg/kg-day).

RfCs are inhalation values that are derived by determining concentration-specific effect levels from all of the available literature and transforming the most appropriate concentration to a human RfC. Transformation usually entails converting the concentration and exposure duration used in the study to an equivalent continuous 24-hour exposure, transforming the exposure-adjusted value to account for differences in animal and human inhalation, and then applying uncertainty factors and/or a modifying factor to the adjusted human exposure concentration to arrive at an RfC. The uncertainty factors potentially used are the same ones used to arrive at an RfD (see above). RfCs are reported as concentrations in milligrams of chemical per cubic meter of air (mg/m^3). To make use of the RfC's in calculating risks, they first had to be converted to inhalation reference doses in units of milligrams of chemical per kilogram of body wieght per day (mg/kg/day). This conversion was made by assuming an inhalation rate of 20 m^3/day and an adult body weight of 70 kg. Thus:

$$\mathit{Inhalation\ reference\ dose\ (mg/kg/day)} = RFC\left(\frac{mg}{m^3}\right) x \frac{20m^3}{day} x \frac{1}{70kg}$$

6.4.1.2 Toxicity Values for Dermal Exposure

It should be noted that USEPA has not derived toxicity values for all routes of exposure. Most of the available toxicity values are for oral exposure. Many inhalation values are also available. No values are currently available for dermal exposure. This is due to the lack of scientific studies available to quantify dermal toxicity and carcinogenic potential for the vast majority of priority pollutants. In addition, until recently, scientists have assumed that the hazards due to dermal exposures were minimal in comparison with those due to oral exposure. However, it appears that in many instances the hazards due to dermal exposure may be as great or greater.

In the absence of dermal reference toxicity values, USEPA has suggested (USEPA, 1989a) that in some cases it is appropriate to modify an oral RfD so it can be used to estimate the hazard incurred by dermal exposure. This requires that the toxic endpoints observed are the same for both oral and dermal exposure, and that one have quantitative estimates of both dermal and oral absorption of the chemical. This information is generally not available for most priority pollutants, and oral toxicity values are nevertheless often used to quantify risks associated with dermal exposure. As a consequence, any valuation of the contribution of dermal exposure to the overall hazard needs to be viewed as highly tentative at best.

USEPA RAGS (1989a) provides guidance for use of oral toxicity values in determining dermal toxicity. RfDs are expressed as the amount of substance administered per unit time and unit body weight (administered-dose), whereas exposure estimates for the dermal route of exposure are expressed as the amount of substance absorbed into the body per unit time and unit body weight (absorbed-dose). Thus, for dermal exposure to contaminants in water or in soil, it is necessary to adjust an oral toxicity value from an administered to an absorbed dose. Where oral absorption efficiencies were available (Owen, 1990), the oral RfD was converted to a dermal RfD by multiplying by the ratio of the oral absorption efficiency over the dermal absorption efficiency (conservatively estimated to be 100 percent). The following values were used:

Compound	Oral Absorption Efficiency
Vinyl Chloride	0.9
Aroclor 1242	0.95
Aroclor 1260	0.95
Arsenic	0.98
Berylium	0.001
Barium	0.1
Cadmium	0.06
Chromium	0.05
Copper	0.5
Nickel	0.05
Zinc	0.5

In the absence of any information on absorption for the substance or chemically related substances, an oral absorption efficiency of 100 percent was assumed. Assuming 100 percent absorption in an oral administration study that serves as the basis for an RfD could underestimate risk for dermal exposure to contaminants in water or soil. This is because the true absorbed dose might be lower than 100 percent and thus the adverse effects are actually occurring at a dose lower than that associated with 100 percent absorption. The effect of using this assumption is discussed in the uncertainty assessment of this section.

6.4.1.3 Exposure Periods

As mentioned earlier, chronic RfDs and RfCs are intended to be set at levels such that human lifetime exposure at or below these levels should not result in adverse health effects, even for the most sensitive members of the population. These values are ideally based on chronic exposure studies in humans or animals. "Chronic exposure" is really not a precise term as used here, but typically would mean exposure of humans for seven years or more, or exposure of rodents for one year or more.

6.4.2 Health Criteria for Carcinogenic Effects

For chemicals that exhibit carcinogenic effects, most authorities recognize that one or more molecular events can evoke changes in a single cell or a small number of cells that can lead to tumor formation. This is the non-threshold theory of carcinogenesis which purports that any level of exposure to a carcinogen can result in some finite possibility of generating the disease. Generally, regulatory agencies assume the non-threshold hypothesis for carcinogens in the absence of information concerning the mechanisms of action for the chemical of concern.

USEPA's Carcinogen Risk Assessment Verification Endeavor (CRAVE) has developed slope factors and unit risks (i.e., dose-response values) for estimating excess lifetime cancer risks associated with various levels of lifetime exposure to potential human carcinogens. The carcinogenic slope factors can be used to estimate the lifetime excess cancer risk associated with exposure to a potential carcinogen. Risks estimated using slope factors are considered unlikely to underestimate actual risks, but they may overestimate actual risks. Excess lifetime cancer risks are generally expressed in scientific notation and are probabilities. An excess lifetime cancer risk of 1×10^{-6} (one in a million), for example, represents the probability of an individual developing cancer over a lifetime as a result of exposure to the specific carcinogenic chemical. USEPA considers total excess lifetime cancer risks within the range of 10^{-4} (one in ten thousand) to 10^{-6} (USEPA, 1989a) to be acceptable when developing remedial alternatives for cleanup of Superfund Sites.

In practice, slope factors are derived from the results of human epidemiology studies or chronic animal bioassays. The data from animals studies are fitted to the linearized, multistage model and a dose-response curve is obtained. The upper limit of the 95th percentile confidence-interval slope of the dose-response curve is subjected to various adjustments, and an interspecies scaling factor is applied to conservatively derive the slope factor for humans. Thus, the actual risks associated with exposure to a potential carcinogen quantitatively evaluated based on animal data are not likely to exceed the risks estimated using these slope factors, but they may be much lower. Dose-response data derived from human epidemiological studies are fitted to dose-time-response curves on an ad-hoc basis. These models provide rough but plausible estimates of the upper limits on lifetime risk. Slope factors based on human epidemiological data are also derived using very conservative assumptions and, as such, they too are considered unlikely to underestimate risks. In summary, while the actual risks associated with exposures to potential carcinogens are unlikely to be higher than the risks calculated using a slope factor, they could be considerably lower. It should be emphasized that the linearized multistage procedure leads to a plausible upper limit of the risk that is consistent with some proposed mechanisms of carcinogenesis.

In addition, there are varying degrees of confidence in the weight of evidence for carcinogenicity of a given chemical. The USEPA system involves characterizing the overall weight of evidence for a chemical's carcinogenicity based on availability of animal, human, and other supportive data. The weight-of-evidence classification is an attempt to determine the likelihood that the agent is a human carcinogen, and thus qualitatively affects the estimation of potential health risks. Three major factors are considered in characterizing the overall weight of evidence for carcinogenicity: (1) the quality of evidence from human studies and (2) the quality of evidence from animal studies, which are combined into a characterization of the overall weight of evidence for human carcinogenicity; and (3) other supportive information which is assessed to determine whether the overall weight of evidence should be modified. No uncertainty values are associated with carcinogenic toxicity values because the uncertainty is reflected by the category to which the chemical is assigned. USEPA's final classification of the overall weight of evidence includes the following five categories:

Group A - Human Carcinogen - This category indicates that there is sufficient evidence from epidemiological studies to support a causal association between an agent and cancer.

Group B - Probable Human Carcinogen - This category generally indicates that there is at least limited evidence from epidemiological studies of carcinogenicity to humans (Group B1) or that, in the absence of adequate data on humans, there is sufficient evidence of carcinogenicity in animals (Group B2).

Group C - Possible Human Carcinogen - This category indicates that there is limited evidence of carcinogenicity in animals in the absence of data on humans.

Group D - Not Classified - This category indicates that the evidence for carcinogenicity in animals is inadequate.

Group E - No Evidence of Carcinogenicity to Humans - This category indicates that there is no evidence for carcinogenicity in at least two adequate animal tests in different species, or in both epidemiological and animal studies.

Slope factors and unit risks are developed by the USEPA based on epidemiological or animal bioassay data for a specific route of exposure, either oral or inhalation. For some chemicals, sufficient data are available to develop route-specific slope factors for inhalation and ingestion. For chemicals with only one route-specific slope factor but for which carcinogenic effects may also occur via another route, the available value may be used by the USEPA to evaluate risks associated with potential routes of exposure (USEPA, 1989b).

A number of the chemicals of potential concern have been classified as carcinogens or potential carcinogens by USEPA, and each of these has also been assigned a carcinogenicity weight-of-evidence category (Table 6-29). These chemicals are:

Group A - Human Carcinogens
Arsenic
Benzene
Chromium VI
Nickel
Vinyl Chloride

Group B - Probable Human Carcinogens

Chloroform
1,2-Dichloroethane
bis(2-Chloroethyl)ether
2,4-Dinitrotoluene
N-Nitrosodiphenylamine
Pentachlorophenol
Carbazole
Benzo(a)anthracene
Chrysene
bis(2-Ethylhexyl)phthalate
Benzo(b)fluoranthene

Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Heptachlor
Dieldrin
DDE, 4,4'-
DDD, 4,4'-
DDT, 4,4'-
alpha-chlordane
Aroclor-1260
Lead
Beryllium
Cadmium

Group C - Possible Human Carcinogens

1,1-Dichloroethane
1,1-Dichloroethene
4-Methylphenol
Butylbenzylphthalate

All remaining chemicals of concern are either not found to have weight of evidence rankings or are Group D or E. Group D classification means that the data are insufficient to make a determination regarding carcinogenic potential while Group E classification means there is no carcinogenic likelihood from exposure to these chemicals. All potential carcinogenic effects and slope factors for chemicals of potential concern are identified at the Ash Landfill are shown in Table 6-29.

6.4.2.1 Toxicity Values for Oral and Inhalation Exposure

The types of toxicity values used to evaluate the carcinogenic effects of chemicals include slope factors (SFs) for oral exposure, and unit risk factors (URFs) for inhalation exposure. Slope factors and unit risk factors are route-specific values derived only for chemicals that have been shown to cause an increased incidence of tumors in human and/or animal studies. Slope factors and unit risk factors are used to calculate the 95 percent upper confidence limits on lifetime risk and are determined by low-dose extrapolation from human or animal studies. When an animal study is used, the final slope factor or unit risk factor has been adjusted to account for extrapolation of animal data to humans. If the studies used to derive the slope factor or unit risk factor were conducted for less than the life span of the test organism, the final slope factor has been adjusted to reflect risk associated with lifetime exposure. Oral slope factors are reported as risk per dose $(mg/kg\text{-}day)^{-1}$. Inhalation unit risk factors are reported in units of risk per concentration $(mg/m^3)^{-1}$. To make use of the unit risk factors in calculating risks they first had to be converted to inhalation slope factors in units of (mg/kg-day). This conversion was made by assuming an inhalation rate of 20 m^3/day and an adult bodyweight of 70 kg. Thus:

$$\text{Inhalation slope factor } (mg/kg\text{-}day)^{-1} =$$

$$UnitRisk\left(\frac{ug}{m^3}\right)^{-1} x \frac{day}{20m^3} x\ 70kg\ x \frac{1000ug}{mg}$$

When slope factors and unit risks were not available for all potentially carcinogenic members of a chemical class, toxicity values were calculated using toxicity equivalency factors (TEFs). TEFs are values that compare the carcinogenic potential of a given chemical in a class to the carcinogenic potential of a chemical in the class that has a verified slope factor and/or unit risk. USEPA has provided TEFs for PAHs (USEPA, 1993b). TEF values are as follows:

PAH	TEF
Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Dibenzo(a,h)anthracene	1.0
Chrysene	0.01
Indeno(1,2,3-cd)pyrene	0.1

To calculate a slope factor or unit risk for a given PAH the appropriate TEF value is multiplied by the slope factor or unit risk for benzo(a)pyrene.

6.4.2.2 Toxicity Values for Dermal Exposure

As discussed above, USEPA has not derived toxicity values for the dermal route of exposure. In the absence of dermal reference toxicity values, USEPA has suggested (USEPA, 1989a) that, in some cases, it is appropriate to modify an oral slope factor so it can be used to estimate the risk incurred by dermal exposure. The oral slope factors were converted to dermal slope factors by multiplying by the ratio of the dermal absorption efficiency (100%) over the oral absorption effeciency (Owen, 1990). The same values presented in Section 6.4.1.2 were used, however, if chemical specific modification factors were unavailable, oral values are used without adjustment. As discussed previously any valuation of the contribution of dermal exposure to the overall risk needs to be viewed as highly tentative at best. This is particularly true for PAH's which are carcinogens at the point of contact, i.e., to skin.

6.5 RISK CHARACTERIZATION

6.5.1 Introduction

To characterize risk, toxicity and exposure assessments were summarized and integrated into quantitative and qualitative expressions of risk. To characterize potential noncarcinogenic effects, comparisons were made between projected intakes of substances and toxicity values. To characterize potential carcinogenic effects, probabilities that an individual will develop cancer over a lifetime of exposure are estimated from projected intakes and chemical-specific dose-response information. Major assumptions, scientific judgments, and, to the extent possible, estimates of the uncertainties embodied in the assessment are also presented.

6.5.1.1 Noncarcinogenic Effects

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period with an RfD derived for a similar exposure period. This ratio of exposure to toxicity is called a hazard quotient according to the following equation:

$$\textit{Noncancer Hazard Quotient} = E/RfD$$

Where:

E = Exposure level or intake (mg/kg-day), and
RfD = Reference Dose (mg/kg-day)

The noncancer hazard quotient assumes that there is a level of exposure (i.e., an RfD) below which it is unlikely for even sensitive populations to experience adverse health effects. If the exposure level (E) exceeds the threshold (i.e., If E/RfD exceeds unity) there may be concern for potential noncancer effects.

To assess the overall potential for noncarcinogenic effects posed by more than one chemical, a hazard index (HI) approach has been developed by the USEPA. This approach assumes that simultaneous sub-threshold exposures to several chemicals could result in an adverse health effect. It also assumes that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures to respective acceptable exposures.

This is expressed as:

$$HI = E_1/RfD_1 + E_2/RfD_2 + \ldots + E_i/RfD_i$$

Where:

E_i = the exposure level or intake of the i^{th} toxicant, and
RfD_i = reference dose for the i^{th} toxicant.

While any single chemical with an exposure level greater that the toxicity value will cause the HI to exceed unity, for multiple chemical exposures, the HI can also exceed unity even if no single chemical exposure exceeds its RfD. The assumption of dose additivity reflected in the HI is best applied to compounds that induce the same effects by the same mechanisms. Applying the HI to cases where the known compounds do not induce the same effect may overestimate the potential for effects. To assess the overall potential for noncarcinogenic effects posed by several exposure pathways, the total HI for chronic exposure is the sum of the HI's for each pathway, for each receptor.

6.5.1.2 Carcinogenic Effects

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen (i.e., excess individual lifetime cancer risk). The slope factor converts estimated daily intakes averaged over a lifetime of exposure directly to incremental risk of an individual developing cancer. It can generally be assumed that the dose-response relationship will be linear in the low-dose portion of the multistage model dose-response curve. Under this assumption, the slope factor is a constant, and risk will be directly related to intake. Thus, the following linear low-dose equation was used in this assessment:

$$Risk = CDI \times SF$$

Where:

Risk = A unitless probability of an individual developing cancer,
CDI = Chronic Daily Intake over 70 years (mg/kg-day), and
SF = Slope Factor $(mg/kg\text{-}day)^{-1}$

Because the slope factor is often an upper 95th-percentile confidence limit of the probability of a response and is based on animal data used in the multistage model, the carcinogenic risk will generally be an upper-bound estimate. This means that the "true risk" is not likely to exceed the risk estimate derived through this model and is likely to be less than predicted.

For simultaneous exposure to several carcinogens, the USEPA assumes that the risks are additive. That is to say:

$$Risk_T = \Sigma\ Risk_i$$

Where:

$Risk_T$ = Total cancer risk, expressed as a unitless probability, and
$Risk_i$ = Risk estimate for the ith substance.

Addition of the carcinogenic risks is valid when the following assumptions are met:

- doses are low,
- no synergistic or antagonistic interactions occur, and
- similar endpoints are evaluated.

According to guidance in the National Contingency Plan, the target overall lifetime carcinogenic risks from exposures for determining clean-up levels should range from 10^{-4} to 10^{-6}.

6.5.1.3 Tentatively Identified Compounds

In general, TICs are not believed to be a major source of risks at this site. TIC concentrations are fairly low, with the exception of several borings in the "bend-in-the-road" area. As shown in Table 4-4, borings B-2, B-15, B-30, and B-36 all had high concentrations of TICs. These same borings (see Table 4-3) tended to have elevated concentrations of the TAL and TCL chemicals, which indicated a risk from these soils. It is likely that there is some risk added by the TICs at the site, but this risk is likely not significant when compared to the risk presented by the TAL and TCL chemicals.

6.5.2 Current Land Use - Off-site Residents

6.5.2.1 Exposure Pathway Hazard Quotients

Chemical-specific hazard quotients and the total hazard index for each current residential exposure pathway are presented in Tables 6-30 to 6-35.

Dermal Exposure to Surface Water while Wading

The current land-use scenario for dermal exposure to surface water is defined as dermal exposure to surface water by off-site residents or deer hunters. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-30. The pathway hazard index of 0.003, is well below the USEPA-defined target of unity and, is primarily the result of potential exposure to beryllium (HQ = 0.001), and antimony (HQ = 0.0011).

Dermal Exposure to Sediment while Wading

The current land-use scenario for dermal exposure to sediment is defined as dermal exposure to sediment by off-site residents and deer hunters. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-31. The pathway hazard index of 0.002 is well below the USEPA-defined target of unity and is the result of potential exposure to cadmium.

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TABLE 6-30

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS FROM DERMAL CONTACT TO SURFACE WATER (WHILE WADING) RESIDENTIAL AND HUNTER EXPOSURES (CURRENT AND FUTURE LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	CDI (Nc) (mg/kg)	CDI (Car) (mg/kg)	Dermal RfD (mg/kg/day)	Dermal Slope Factor (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Volatile Organics						
Chloroform	1.5E-07	1.1E-12	1.0E-02	6.1E-03	1.5E-05	6.9E-15
Metals						
Aluminum			NA	NA		
Antimony	4.6E-07		4.0E-04	NA	1.1E-03	
Arsenic	1.4E-08	5.9E-09	2.9E-04	1.8E+00	4.7E-05	1.0E-08
Beryllium	5.0E-09	2.1E-09	5.0E-06	4.3E+03	1.0E-03	9.2E-06
Chromium VI	3.5E-08		2.5E-04	NA	1.4E-04	
Cobalt			NA	NA		
Copper	9.7E-08		2.0E-02	NA	4.9E-06	
Lead			NA	NA		
Manganese	3.9E-06		5.0E-03	NA	7.8E-04	
Nickel	6.9E-09		1.0E-03	NA	6.9E-06	
Zinc	6.9E-07		1.5E-01	NA	4.6E-06	
Totals - HQ & CR					**3.1E-03**	**9.2E-06**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic)/Reference Dose (oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (oral)

TABLE 6-31

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS FROM DERMAL CONTACT TO SEDIMENT WHILE WADING RESIDENTIAL AND HUNTER EXPOSURES (CURRENT AND FUTURE LAND USE) SENECA ARMY DEPOT ASH LANDFILL

Analyte	CDI (Nc) (mg/kg-day)	CDI (Car) (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal Slope Factor (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Semivolatiles						
Metals						
Cadmium	5.9E-08		3.0E-05	NA	2.0E-03	
Totals - HQ & CR					**2.0E-03**	**0.0E+00**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic) / Reference Dose (Oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (Oral)

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TABLE 6-32

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS
FROM INGESTION OF GROUNDWATER (DAILY)
RESIDENTIAL EXPOSURE (CURRENT LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	**CDI (Nc)** (mg/kg/day)	**CDI (Car)** (mg/kg/day)	**RfD** (mg/kg/day)	**Oral Slope Factor** (mg/kg-day)-1	**Hazard Quotient**	**Cancer Risk**
Volatile Organics						
Vinyl Chloride		2.9E-06	NA	1.9E+00		5.6E-06
1,2-Dichloroethene(total)	6.8E-06		9.0E-03	NA	7.6E-04	
1,1,1-Trichloroethane			NA	NA		
Trichloroethene		2.9E-06	NA	1.1E-02		3.2E-08
Semi-volatiles						
2-Methlynaphthalene			NA	NA		
Metals						
Aluminum			NA	NA		
Cadmium	4.1E-05		5.0E-04	NA	8.1E-02	
Chromium VI	4.5E-05		5.0E-03	NA	9.0E-03	
Copper	2.8E-05		4.0E-02	NA	7.1E-04	
Lead			NA	NA		
Nickel	1.1E-04		2.0E-02	NA	5.7E-03	
Zinc	1.4E-02		3.0E-01	NA	4.6E-02	
Totals - HQ & CR					**1.4E-01**	**5.6E-06**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic) /Reference Dose (oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (oral)

TABLE 6-33

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS FROM DERMAL CONTACT TO GROUNDWATER (DAILY) RESIDENTIAL EXPOSURE (CURRENT LAND USE) SENECA ARMY DEPOT ASH LANDFILL

Analyte	CDI (Nc) (mg/kg/day)	CDI (Car) (mg/kg/day)	Dermal RfD (mg/kg/day)	Dermal Slope Factor (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Volatile Organics						
Vinyl Chloride		1.2E-07	NA	2.1E+00		2.5E-07
1,2-Dichloroethene(total)	4.8E-07		9.0E-03	NA	5.3E-05	
1,1,1-Trichloroethane			NA	NA		
Trichloroethene		4.2E-07	NA	1.1E-02		4.6E-09
Semi-volatiles						
2-Methlynaphthalene			NA	NA		
Metals						
Aluminum			NA	NA		
Cadmium	7.9E-08		3.0E-05	NA	2.6E-03	
Chromium VI	8.8E-08		2.5E-04	NA	3.5E-04	
Copper	5.5E-08		2.0E-02	NA	2.8E-06	
Lead			NA	NA		
Nickel	2.2E-08		1.0E-03	NA	2.2E-05	
Zinc	2.7E-05		1.5E-01	NA	1.8E-04	
Totals - HQ & CR					**3.2E-03**	**2.5E-07**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic) /Reference Dose (oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (oral)

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TABLE 6-34

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS
FROM INHALATION OF GROUNDWATER (DAILY)
RESIDENTIAL EXPOSURE (CURRENT LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	**CDI (Nc)** (mg/kg/day)	**CDI (Car)** (mg/kg/day)	**RfC** (mg/kg/day)	**Inhalation Slope Factor** (mg/kg-day)-1	**Hazard Quotient**	**Cancer Risk**
Volatile Organics						
Vinyl Chloride		3.6E-07	NA	2.9E-01		1.1E-07
1,2-Dichloroethene(total)	3.7E-07		1.2E+00	NA	3.1E-07	
1,1,1-Trichloroethane			NA	NA		
Trichloroethene		2.2E-07	NA	6.0E-03		1.3E-09
Semi-volatiles						
2-Methlynaphthalene			NA	NA		
Metals						
Aluminum			NA	NA		
Cadmium		0.0E+00	NA	6.3E+00		0.0E+00
Chromium VI		0.0E+00	NA	4.2E+01		0.0E+00
Copper			NA	NA		
Lead			NA	NA		
Nickel		0.0E+00	NA	8.4E-01		0.0E+00
Zinc			NA	NA		
Totals - HQ & CR					**3.1E-07**	**1.1E-07**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic) /Reference Dose (Inhalation)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (Inhalation)

TABLE 6-35

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS FROM INHALATION OF VOLATILE ORGANICS IN AMBIENT AIR RESIDENTIAL EXPOSURE (CURRENT LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	CDI (Nc) (mg/kg-day)	CDI (Car) (mg/kg-day)	RfC (mg/kg-day)	Carc. Slope Inhalation (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Volatile Organics						
Vinyl Chloride		4.7E-06	NA	2.9E-01		1.4E-06
Chloroethane	9.0E-09		2.9E+00	NA	3.1E-09	
Acetone			NA	NA		
Carbon Disulfide	9.9E-07		2.9E-03	NA	3.5E-04	
1,1-Dichloroethene		7.3E-07	NA	1.2E+00		8.8E-07
1,2-Dichloroethene (total)	3.0E-04		1.2E+00	NA	2.5E-04	
Chloroform		1.6E-08	NA	8.1E-02		1.3E-09
1,2-Dichloroethane	4.2E-07	1.8E-07	2.9E-03	9.1E-02	1.5E-04	1.7E-08
2-Butanone	1.4E-08		2.9E-01	NA	4.9E-08	
1,1,1-Trichloroethane			NA	NA		
Trichloroethene		1.2E-04	NA	6.0E-03		7.5E-07
Benzene		5.4E-09	NA	2.9E-02		1.6E-10
Tetrachloroethene		5.4E-09	NA	2.0E-03		1.1E-11
Toluene	4.4E-07		1.1E-01	NA	3.8E-06	
Chlorobenzene	2.6E-07		5.0E-03	NA	5.1E-05	
Ethylbenzene	1.8E-07		2.9E-01	NA	6.2E-07	
Xylene (total)			NA	NA		
Total HQ & CR					**8.0E-04**	**3.0E-06**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic) / Reference Concentration
Cancer Risk = Chronic Daily Intake (Cancinogenic) x Inhalation Slope Factor

Ingestion of Drinking Water

The current land-use scenario for ingestion of drinking water is defined as ingestion of drinking water from nearby off-site wells by current off-site residents. Chemical-specific hazard quotients and the total hazard index for this pathway are presented in Table 6-32. The pathway hazard index of 0.14 is below the USEPA defined target of unity and is primarily the result of potential exposure to cadmium (HQ = 0.081), and zinc (HQ = 0.046).

Dermal Exposure to Water while Showering

The current land-use scenario for dermal exposure to water is defined as dermal exposure of current off-site residents to nearby off-site well water while showering or bathing. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-33. The pathway hazard index of 0.0032 is well below the USEPA-defined target of unity and is primarily the result of potential exposure to cadmium (HQ = 0.0026).

Inhalation of Volatiles in Water while Showering

The current land-use scenario for inhalation of volatiles in water is defined as inhalation of volatiles by current off-site residents to nearby off-site well water while showering. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-34. The pathway hazard index is 3.1×10^{-7} is entirely due to potential exposure to trichloroethane.

Inhalation of Volatiles in Ambient Air

The current land use scenario for inhalation of volatile organics in ambient air is defined as inhalation of volatile organics that are emitted from the soil and transported downwind to current off-site residents. The chemical specific hazard quotients and total hazardous index for this pathway are presented in Table 6-35. The pathway hazard index of 0.0008 is below the USEPA-defined target of unity and is primarily the result of potential exposure to carbon disulfide (HQ=0.00035), 1,2-dichloroethene (HQ=0.00025) and 1,2-dichloroethane (HQ = 0.00015).

Hazard Index Summary

The current land-use hazard index summary and total hazard index are presented in Table 6-48. The total hazard index of 0.15 is below the USEPA defined target of unity and is primarily due to ingestion of groundwater (HI = 0.14). The hazard index of 0.15 indicates that this exposure scenario is not likely to result in non-carcinogenic health effects.

Medium-specific Hazard Indices

For the current surface-water pathways, a total hazard index of 0.0003 was determined due to dermal exposure to surface water. This hazard indiced for these pathways were driven primarily by beryllium and antimony. The surface water hazard index of 0.003 is well below the USEPA-defined target of unity.

For the current sediment pathways, a total hazard index of 0.002 was determined due to dermal exposure to sediment. The hazard index for this pathway is due exclusively to cadmium. The sediment hazard index of 0.002 is well below the USEPA-defined target of unity.

For the current groundwater pathways, a total hazard index of 0.14 was determined. This total was almost wholly driven by the ingestion-of-drinking-water pathway, which was driven primarily by the ingestion of the metals cadmium and zinc. The groundwater hazard index of 0.14 is below the USEPA-defined target of unity.

For the current soil/air pathway a total hazard index of 0.0008 was determined. This total was due solely to inhalation of volatile organics in ambient air that are emitted from soil, which was driven primarily by the inhalation of carbon disulfide, 1,2-dichloroethene and 1,2-dichloroethane. The soil/air total hazard index of 0.0008 is below the USEPA defined target of unity.

Chemical-specific Hazard Indices

The total hazard index resulting from exposure via all relevant current land-use pathways of 0.15 is primarily the result of exposure to the metals cadmium (HI = 0.083) and zinc (HI = 0.046).

6.5.2.2 Exposure Pathway Cancer Risks

Chemical-specific cancer risks and the total cancer risk for each current exposure pathway are presented in Tables 6-30 to 6-35. The land-use scenarios for each exposure pathway are the same as described for the noncarcinogenic pathways.

Dermal Exposure to Surface Water while Wading

Chemical-specific cancer risks and total pathway risk for dermal exposure to surface water are presented in Table 6-30. The total pathway risk of 9.2×10^{-6} is within the USEPA-defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to beryllium (risk $= 9.2 \times 10^{-6}$).

Dermal Exposure to Sediment while Wading

Chemical-specific cancer risks and the total pathway risk for dermal exposure to sediment are presented in Table 6-31. No cancer risk was calculated because there is no published oral slope factor for cadmium.

Ingestion of Drinking Water

Chemical-specific cancer risks and the total pathway risk for the ingestion of drinking water are presented in Table 6-32. The total pathway risk of 5.6×10^{-6} falls within the USEPA-defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to vinyl chloride (risk $= 5.6 \times 10^{-6}$) and trichloroethene (risk $= 3.2 \times 10^{-8}$). Neither of these compounds was detected in the farmhouse wells above the sample quantitation limit of 0.5 ug/l. Therefore, the calculated risks are based on an estimated concentration of one-half the detection limit and may thus overstate actual risks.

Dermal Exposure to Water During Showering

Chemical-specific cancer risks and total pathway risk for dermal contact with water during showering are presented in Table 6-33 The total pathway risk of 2.5×10^{-7} is below the USEPA-defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to vinyl chloride (risk $= 2.5 \times 10^{-7}$) and trichloroethene (risk $= 4.6 \times 10^{-9}$).

Inhalation of Volatiles in Water During Showering

Chemical-specific cancer risks and total pathway risk for inhalation of volatiles in water during showering are presented in Table 6-34. The total pathway risk of 1.1×10^{-7} is below the USEPA-defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to vinyl chloride (risk 1.1×10^{-7}).

Inhalation of Volatiles in Ambient Air

Chemical-specific cancer risks and total pathway risk for inhalation of volatiles in ambient air are presented in Table 6-35. The total pathway risk of 3.0×10^{-6} falls within the USEPA defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to vinyl chloride (risk = 1.4×10^{-6}), trichloroethene (risk = 7.5×10^{-7}) and 1,1-dichloroethene (risk = 8.8×10^{-7}).

Cancer Risk Summary

The total excess cancer risk for the current land-use scenario is presented in Table 6-48. The total excess cancer risk of 1.8×10^{-5} is within the USEPA-defined target range of 10^{-6} to 10^{-4} and is primarily due to inhalation of volatile organics in ambient air (risk = 3.0×10^{-6}) dermal contact to surface water (risk = 9.2×10^{-6}), and ingestion of groundwater (risk = 5.6×10^{-6}).

Medium-specific Cancer Risks

For the current surface-water pathways, a total cancer risk of 9.2×10^{-6} was determined due to dermal contact with surface water. The cancer risks were driven by beryllium. The surface water cancer risk of 9.2×10^{-6} is within the USEPA-defined target range of 10^{-6} to 10^{-4}.

No cancer risk was calculated for the current sediment pathways.

For the current ground-water pathways, a total cancer risk of 5.9×10^{-6} was determined. This total was almost wholly driven by the ingestion-of-drinking-water pathway, which was driven primarily by ingestion of vinyl chloride and trichloroethene. The cancer risk of 5.9×10^{-6} falls within the target range of 10^{-6} to 10^{-4}.

For the current soil/ambient air pathway a total cancer risk of 3.0×10^{-6} was determined due to inhalation of volatiles in ambient air emitted from soil. The cancer risk for this pathway was driven primarily by chlorinated volatile organics. The cancer risk of 3.0×10^{-6} is within the USEPA defined target range of 10^{-6} to 10^{-4}.

Chemical-specific Cancer Risks

The total cancer risk of 1.8×10^{-5} is primarily the result of exposure to vinyl chloride (risk $= 1.5 \times 10^{-5}$) and trichloroethene (risk $= 7.5 \times 10^{-7}$).

6.5.3 Future Land Use On-Site Resident

6.5.3.1 Exposure Pathway Hazard Quotients

Chemical-specific hazard quotients and the total hazard index for the future exposure pathway are presented in Tables 6-30 to 6-31 and 6-36 to 6-41. A summary of the total hazard index for the future land-use scenario is presented in Table 6-48.

Ingestion of Soil

The future land-use scenario for ingestion of soil is defined as ingestion of soil by future on-site residents. The chemical-specific hazard quotients and the total hazard index for this pathway are presented in Table 6-36. The pathway hazard index of 0.034 is below the USEPA-defined target of unity, and is primarily the result of potential exposure to cadmium (HQ = 0.16), chromium (HQ = 0.086) and zinc (HQ = 0.075).

Dermal Exposure to Soil

The future land-use scenario for dermal exposure to soil is defined as dermal exposure to soil by future on-site residents. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-37. The pathway hazard index of 0.38 is below the USEPA-defined target of unity and is the result of potential exposure to cadmium (HQ = 0.38).

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TABLE 6-36

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS
FROM INGESTION OF SOIL (DAILY)
RESIDENTIAL EXPOSURE (FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	Adult CDI (Nc) (mg/kg-day)	Child CDI (Nc) (mg/kg-day)	CDI (Car) (mg/kg-day)	RfD (mg/kg-day)	Oral Slope Factor (mg/kg-day)-1	Adult Hazard Quotient	Child Hazard Quotient	Hazard Quotient	Cancer Risk
Volatile Organics									
Vinyl Chloride			2.5E-08	NA	1.9E+00				4.8E-08
Dichloroethene, 1,2- (total)	8.00E-07	7.5E-06		9.0E-03	NA	8.9E-05	8.3E-04	9.2E-04	
Trichloroethene			2.5E-06	NA	1.1E-02				2.7E-08
Semi-volatiles									
Methylnaphthalene, 2-				NA	NA				
Acenaphthylene				NA	NA				
Dibenzofuran				NA	NA				
Phenanthrene				NA	NA				
Benzo(a)anthracene			1.4E-06	NA	7.3E-01				1.0E-06
bis(2-Ethylhexyl)phthalate	1.35E-06	1.3E-05	1.5E-06	2.0E-02	1.4E-02	6.8E-05	6.3E-04	7.0E-04	2.2E-08
Benzo(b)fluoranthene			1.3E-06	NA	7.3E-01				9.5E-07
Benzo(k)fluoranthene			1.1E-06	NA	7.3E-01				8.1E-07
Benzo(a)pyrene			1.4E-06	NA	7.3E+00				1.0E-05
Indeno(1,2,3-cd)pyrene			9.9E-07	NA	7.3E-01				7.3E-07
Dibenzo(a,h)anthracene			7.3E-07	NA	7.3E+00				5.3E-06
Benzo(g,h,i)perylene				NA	NA				
Pesticides/PCB's									
Aroclor-1260			2.5E-07	NA	7.7E+00				1.9E-06
Metals									
Cadmium	7.58E-06	7.1E-05		5.0E-04	NA	1.5E-02	1.4E-01	1.6E-01	
Chromium VI	4.19E-05	3.9E-04		5.0E-03	NA	8.4E-03	7.8E-02	8.6E-02	
Copper	9.80E-05	9.1E-04		4.0E-02	NA	2.5E-03	2.3E-02	2.5E-02	
Lead				NA	NA				
Zinc	2.16E-03	2.0E-02		3.0E-01	NA	7.2E-03	6.7E-02	7.5E-02	
Totals - HQ & CR								**3.4E-01**	**2.1E-05**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic)/ Reference Dose (Oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (Oral)

TABLE 6-37

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS FROM DERMAL CONTACT TO SOIL (DAILY) RESIDENTIAL EXPOSURE (FUTURE LAND USE) SENECA ARMY DEPOT ASH LANDFILL

Analyte	Adult CDI (Nc) (mg/kg-day)	Child CDI (Nc) (mg/kg-day)	CDI (Car) (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal Slope Factor (mg/kg-day)-1	Adult Hazard Quotient	Child Hazard Quotient	Hazard Quotient	Cancer Risk
Volatile Organics									
Semi-volatiles									
Pesticides/PCB's									
Aroclor-1260			5.7E-07	NA	8.1E+00				4.6E-06
Metals									
Cadmium	3.8E-06	7.7E-06	0.0E+00	3.0E-05	NA	1.3E-01	2.6E-01	3.8E-01	
Totals - HQ & CR								**3.8E-01**	**4.6E-06**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic)/ Reference Dose (Oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (Oral)

Dermal Exposure to Surface Water while Wading

The future land-use scenario for dermal exposure to surface water is defined as dermal exposure to on-site surface water while wading. The pathway hazard index of 0.003 is presented in Table 6-30 and is well below the USEPA defined target of unity.

Dermal Exposure to Sediment while Wading

The future land-use scenario for dermal exposure to sediment is defined as dermal exposure to on-site sediments while wading. The pathway hazard index of 0.002 is presented in Table 6-31 and is well below the USEPA defined target of unity.

Ingestion of Drinking Water

The future land-use scenario for ingestion of drinking water is defined as ingestion of drinking water from on-site wells by future on-site residents. Chemical-specific hazard quotients and the total hazard index for this pathway are presented in Table 6-38. The pathway hazard index of 3.2 is primarily the result of potential exposure to 1,2-dichloroethene (HQ = 2.6). The balance of the hazard index results mainly from potential exposure to chromium (HQ = 0.34), and cadmium (HQ = 0.17). The hazard index exceeds the USEPA-defined target of unity indicating the potential for non-carcinogenic health risks from this exposure pathway.

Dermal Exposure to Water while Showering

The future land-use scenario for dermal exposure to water is defined as dermal exposure of future on-site residents to on-site well water while showering. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-39. The pathway hazard index of 0.20 is below the USEPA-defined target of unity and is primarily the result of potential exposure to 1,2-dichloroethene (HQ = 0.18).

Inhalation of Volatiles in Water while Showering

The future land-use scenario for inhalation of volatiles in water is defined as exposure of future on-site residents to on-site well water while showering. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-40. The pathway hazard index of 0.001 is entirely due to potential exposure to 1,2-dichloroethene. The significance of this pathway hazard index (0.001) is that it is 1000 times below the EPA total hazard index of 1.

TABLE 6-38

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS
FROM INGESTION OF GROUNDWATER (DAILY)
RESIDENTIAL EXPOSURE (FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	**CDI (Nc)** (mg/kg/day)	**CDI (Car)** (mg/kg/day)	**RfD** (mg/kg/day)	**Oral Slope Factor** (mg/kg-day)-1	**Hazard Quotient**	**Cancer Risk**
Volatile Organics						
Vinyl Chloride		7.0E-04	NA	1.9E+00		1.3E-03
1,2-Dichloroethene(total)	2.3E-02		9.0E-03	NA	2.6E+00	
1,1,1-Trichloroethane			NA	NA		
Trichloroethene		7.1E-03	NA	1.1E-02		7.8E-05
Semi-volatiles						
2-Methlynaphthalene			NA	NA		
Metals						
Aluminum			NA	NA		
Cadmium	8.5E-05		5.0E-04	NA	1.7E-01	
Chromium VI	1.7E-03		5.0E-03	NA	3.4E-01	
Copper	8.3E-04		4.0E-02	NA	2.1E-02	
Lead			NA	NA		
Nickel	1.6E-03		2.0E-02	NA	7.8E-02	
Zinc	1.2E-02		3.0E-01	NA	4.0E-02	
Totals - HQ & CR					**3.2E+00**	**1.4E-03**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic) /Reference Dose (oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (oral)

TABLE 6-39

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS FROM DERMAL CONTACT TO GROUNDWATER (DAILY) RESIDENTIAL EXPOSURE (FUTURE LAND USE) SENECA ARMY DEPOT ASH LANDFILL

Analyte	CDI (Nc) (mg/kg/day)	CDI (Car) (mg/kg/day)	Dermal RfD (mg/kg/day)	Dermal Slope Factor (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Volatile Organics						
Vinyl Chloride		2.8E-05	NA	2.1E+00		5.9E-05
1,2-Dichloroethene(total)	1.6E-03		9.0E-03	NA	1.8E-01	
1,1,1-Trichloroethane			NA	NA		
Trichloroethene		1.0E-03	NA	1.1E-02		1.1E-05
Semi-volatiles						
2-Methlynaphthalene			NA	NA		
Metals						
Aluminum			NA	NA		
Cadmium	1.6E-07		3.0E-05	NA	5.5E-03	
Chromium VI	3.3E-06		2.5E-04	NA	1.3E-02	
Copper	1.6E-06		2.0E-02	NA	8.0E-05	
Lead			NA	NA		
Nickel	3.0E-07		1.0E-03	NA	3.0E-04	
Zinc	2.3E-05		1.5E-01	NA	1.6E-04	
Totals - HQ & CR					**2.0E-01**	**7.1E-05**

Hazard Quotient = **Chronic Daily Intake (Noncarcinogenic) /Reference Dose (oral)**
Cancer Risk = **Chronic Daily Intake (Carcinogenic) x Slope Factor (oral)**

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TABLE 6-40

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS
FROM INHALATION OF GROUNDWATER (DAILY)
RESIDENTIAL EXPOSURE (FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	**CDI (Nc)** (mg/kg/day)	**CDI (Car)** (mg/kg/day)	**RfC** (mg/kg/day)	**Inhalation Slope Factor** (mg/kg-day)-1	**Hazard Quotient**	**Cancer Risk**
Volatile Organics						
Vinyl Chloride		8.7E-05	NA	2.9E-01		2.6E-05
1,2-Dichloroethene(total)	1.2E-03		1.2E+00	NA	1.0E-03	
1,1,1-Trichloroethane			NA	NA		
Trichloroethene		5.3E-04	NA	6.0E-03		3.2E-06
Semi-volatiles						
2-Methlynaphthalene			NA	NA		
Metals						
Aluminum			NA	NA		
Cadmium		0.0E+00	NA	6.3E+00		0.0E+00
Chromium VI		0.0E+00	NA	4.2E+01		0.0E+00
Copper			NA	NA		
Lead			NA	NA		
Nickel		0.0E+00	NA	8.4E-01		0.0E+00
Zinc			NA	NA		
Totals - HQ & CR					**1.0E-03**	**2.9E-05**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic) /Reference Dose (Inhalation)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (Inhalation)

Inhalation of Volatiles in Ambient Air

The future land use scenario for inhalation of volatiles in ambient air is defined as exposure of future on-site residents to volatile organics emitted from soil to ambient air. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-41. The pathway hazard index of 0.0034 is below the USEPA-defined target of unity and is primarily the result of potential exposure to carbon disulfide (HQ = 0.0015), 1,2-dichloroethene (HQ = 0.0011) and 1,2-dichloroethane (HQ = 0.00062).

Hazard Index Summary

The future land-use hazard index summary and total hazard index are presented in Table 6-48. The total hazard index of 4.2 is almost entirely due to the ingestion of drinking water pathway (HI = 3.2). The chemical primarily responsible for the elevated hazard index is 1,2-DCE in the drinking water. The hazard index indicates that these pathways of exposure may result in noncarcinogenic health effects.

Medium-specific Hazard Indices

For the future soil/ambient air pathways, a total hazard index of 0.72 was determined. This total was driven by both ingestion and dermal exposure to soil. The hazard indices for these pathways were driven by the metals cadmium, chromium and zinc. The hazard index of 0.72 is below the USEPA-defined target of unity.

For the future surface-water pathways, a total hazard index of 0.003 was determined due to dermal contact with surface water. The hazard index of 0.003 is well below the USEPA-defined target of unity.

For the future sediment pathways, a total hazard index of 0.002 was determined due to dermal exposure to sediment. The hazard index of 0.002 is well below the USEPA-defined target of unity.

For the future ground-water pathways, a total hazard index of 3.4 was determined. This total was almost wholly driven by the ingestion-of-drinking-water pathway, which was driven primarily by the ingestion of 1,2-dichloroethene. The hazard index of 3.4 indicates that exposure to on-site ground water may result in noncarcinogenic health effects.

TABLE 6-41

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS FROM INHALATION OF VOLATILE ORGANICS IN AMBIENT AIR RESIDENTIAL EXPOSURE (FUTURE LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	CDI (Nc) (mg/kg-day)	CDI (Car) (mg/kg-day)	RfC (mg/kg-day)	Carc. Slope Inhalation (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Volatile Organics						
Vinyl Chloride		2.0E-05	NA	2.9E-01		5.8E-06
Chloroethane	3.8E-08		2.9E+00	NA	1.3E-08	
Acetone			NA	NA		
Carbon Disulfide	4.2E-06		2.9E-03	NA	1.5E-03	
1,1-Dichloroethene		3.1E-06	NA	1.2E+00		3.7E-06
1,2-Dichloroethene (total)	1.3E-03		1.2E+00	NA	1.1E-03	
Chloroform		6.6E-08	NA	8.1E-02		5.3E-09
1,2-Dichloroethane	1.8E-06	7.7E-07	2.9E-03	9.1E-02	6.2E-04	7.0E-08
2-Butanone	5.9E-08		2.9E-01	NA	2.1E-07	
1,1,1-Trichloroethane			NA	NA		
Trichloroethene		5.3E-04	NA	6.0E-03		3.2E-06
Benzene		2.3E-08	NA	2.9E-02		6.6E-10
Tetrachloroethene		2.3E-08	NA	2.0E-03		4.6E-11
Toluene	1.8E-06		1.1E-01	NA	1.6E-05	
Chlorobenzene	1.1E-06		5.0E-03	NA	2.2E-04	
Ethylbenzene	7.5E-07		2.9E-01	NA	2.6E-06	
Xylene (total)			NA	NA		
Total HQ & CR					**3.4E-03**	**1.3E-05**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic) / Reference Concentration
Cancer Risk = Chronic Daily Intake (Cancinogenic) x Inhalation Slope Factor

Chemical-specific Hazard Indices

The total hazard index of 4.2 is almost wholly the result of exposure to 1,2-DCE (HI = 2.4) and the metals chromium (HI = 0.36) and cadmium (HI = 0.59).

6.5.3.2 Exposure Pathway Cancer Risks

Chemical-specific excess cancer risks and the total excess cancer risk for each future exposure pathway are presented in Tables 6-30 to 6-31 and 6-36 to 6-41. A summary of the total cancer risk for the future use scenario is presented in Table 6-48. The land-use scenarios for each exposure pathway are the same as described for the future noncarcinogenic pathways.

Ingestion of Soil

Chemical-specific cancer risks and the total pathway risk for the ingestion of soil are presented in Table 6-36. The total pathway risk of 2.1×10^{-5} falls within the USEPA-defined target range of 10^{-6} to 10^{-4} and primarily the result of potential exposure to the PAHs dibenzo(a,h)anthracene (risk = 5.3×10^{-6}), benzo(a)pyrene (risk = 1.0×10^{-5}), indeno (1,2,3-cd)pyrene (risk = 7.3×10^{-7}), benzo(a)anthracene (risk = 1.0×10^{-6}), and benzo(b)fluoranthene (risk = 9.5×10^{-7}) and Aroclor-1260 (risk = 1.9×10^{-6}).

Dermal Exposure to Soil

Chemical-specific cancer risks and the total pathway risk for dermal contact with soil are presented in Table 6-37. The total pathway risk of 2.8×10^{-6} is within the USEPA-defined target range of 10^{-6} to 10^{-4} and is entirely the result of potential exposure to Aroclor-1260 (risk = 2.8×10^{-6}).

Dermal Exposure to Surface Water while Wading

Chemical-specific cancer risks and total pathway risk for dermal exposure to surface water is presented in Table 6-30. The total pathway risk of 9.2×10^{-6} is within the USEPA-defined target range of 10^{-6} to 10^{-4}.

Dermal Exposure to Sediment During Wading

Chemical specific cancer risks and total pathway risk for dermal exposure to sediment were not calculated.

Ingestion of Drinking Water

Chemical-specific cancer risks and the total pathway risk for the ingestion of drinking groundwater are presented in Table 6-38. The total pathway risk of 1.4×10^{-3} is above the USEPA-defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to the volatiles vinyl chloride (risk = 1.3×10^{-3}) and trichloroethene (risk = 7.8×10^{-5}).

Dermal Exposure to Water During Showering

Chemical-specific cancer risks and total pathway risk for dermal contact with water during showering are presented in Table 6-39. The total pathway risk of 7.1×10^{-5} is within the USEPA-defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to vinyl chloride (risk = 5.9×10^{-5}) and trichloroethene (risk = 1.1×10^{-5}).

Inhalation of Volatiles in Water During Showering

Chemical-specific cancer risks and total pathway risk for inhalation of volatiles in water during showering are presented in Table 6-40. The total pathway risk of 2.9×10^{-5} is within the USEPA-defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to vinyl chloride (risk = 2.6×10^{-5}) and TCE (risk = 3.2×10^{-6}).

Inhalation of Volatiles in Ambient Air

Chemical-specific cancer risks and the total pathway risk for inhalation of volatiles in ambient air are presented on Table 6-41. The total pathway risk of 1.3×10^{-5} is within the USEPA defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to vinyl chloride (risk = 5.8×10^{-6}), TCE (risk = 3.2×10^{-6}) and 1,1-dichloroethene (risk = 3.7×10^{-6}).

Cancer Risk Summary

The future land use cancer risk summary is presented in Table 6-48. The total cancer risk of 1.6×10^{-3} is above the USEPA target range of 10^{-6} to 10^{-4} and is primarily due to the ingestion of drinking water from on-site wells (risk = 1.4×10^{-3}). The chemicals primarily responsible for the elevated cancer risk are vinyl chloride and TCE in the drinking water.

Media-specific Cancer Risks

For the future soil/ambient air pathways, a total cancer risk of 6.2×10^{-5} was determined. This total was primarily driven by inhalation of volatiles in ambient air. The cancer risk of 6.2×10^{-5} is within the USEPA defined target range of 10^{-6} to 10^{-4}.

For the future surface-water pathways, a total cancer risk of 9.2×10^{-6} was determined due to dermal contact with surface water. The cancer risk of 9.2×10^{-6} is within the USEPA-defined target range of 10^{-6} to 10^{-4}.

No cancer risk was calculated for the future sediment pathways.

For the future ground-water pathways, a total cancer risk of 1.4×10^{-3} was determined. This total was almost wholly driven by the ingestion-of-drinking-water pathway, which was driven primarily by ingestion of vinyl chloride and TCE. The cancer risk of 1.4×10^{-3} is above USEPA-defined target range of 10^{-6} to 10^{-4}.

Chemical-specific Cancer Risks

The total cancer risk of 1.6×10^{-3} is primarily the result of exposure to vinyl chloride (risk = 1.3×10^{-3}) and TCE (risk = 1.2×10^{-4}). Both of these chemicals exceed the USEPA- defined target range of 10^{-6} to 10^{-4}. Chemicals which fall within the USEPA-defined range are the PAH's benzo(a)pyrene (risk = 1.0×10^{-5}), dibenzo(a,h)anthracene (risk = 5.3×10^{-6}), benzo(a)anthracene (risk = 1.0×10^{-6}), and Aroclor-1260 (risk = 1.9×10^{-6}).

6.5.4 Current and Future Land Use On-Site Hunter

6.5.4.1 Exposure Pathway Hazard Quotients

Chemical-specific hazard quotients and the total hazard index for the future exposure pathway are presented in Tables 6-30, 6-31, and Tables 6-42 through 6-44. A summary of the total hazard index for the on-site scenario is presented in Table 6-48.

Dermal Exposure to Surface Water while Wading

The on-site hunter scenario for dermal exposure to surface water is defined as dermal exposure to on-site surface water while wading. The pathway hazard index of 0.003 is presented in Table 6-30 and is well below the USEPA defined target of unity.

Dermal Exposure to Sediment while Wading

The on-site hunter scenario for dermal exposure to sediment is defined as dermal exposure to on-site sediments while wading. The pathway hazard index of 0.002 is presented in Table 6-31 and is well below the USEPA defined target of unity.

Ingestion of Soil

The on-site hunter scenario for ingestion of soil is defined as ingestion of soil by on site hunters. The chemical-specific hazard quotients and the total hazard index for this pathway are presented in Table 6-42. The pathway hazard index of 0.00095 is well below the USEPA-defined target of unity, and is primarily the result of potential exposure to cadmium (HQ = 0.00043), chromium (HQ = 0.00024) and zinc (HQ = 0.00021).

Dermal Exposure to Soil

The current on-site hunter scenario for dermal exposure to soil is defined as dermal exposure to soil by current on-site hunters. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-43. The pathway hazard index of 0.0014 is below the USEPA-defined target of unity and is the result of potential exposure to cadmium.

Inhalation of Volatiles in Ambient Air

The future land use scenario for inhalation of volatiles in ambient air is defined as exposure of on-site hunters to volatile organics emitted from soil to ambient air. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-44. The pathway hazard index of 0.00036 is below the USEPA-defined target of unity and is primarily the result of potential exposure to carbon disulfide (HQ = 0.00016) and 1,2-dichloroethane (HQ = 0.00011).

<u>Hazard Index Summary</u>

The on-site hunter hazard index summary and total hazard index are presented in Table 6-48.

TABLE 6-42

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS
FROM INGESTION OF SOIL (DAILY)
HUNTER EXPOSURE (CURRENT AND FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	CDI (Nc) (mg/kg-day)	CDI (Car) (mg/kg-day)	RfD (mg/kg-day)	Oral Slope Factor (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Volatile Organics						
Vinyl Chloride		2.7E-10	NA	1.9E+00		5.1E-10
Dichloroethene, 1,2- (total)	2.3E-08		9.0E-03	NA	2.5E-06	
Trichloroethene		2.7E-08	NA	1.1E-02		2.9E-10
Semi-volatiles						
Methylnaphthalene, 2-			NA	NA		
Acenaphthylene			NA	NA		
Dibenzofuran			NA	NA		
Phenanthrene			NA	NA		
Benzo(a)anthracene		1.5E-08	NA	7.3E-01		1.1E-08
bis(2-Ethylhexyl)phthalate	3.9E-08	1.7E-08	2.0E-02	1.4E-02	1.9E-06	2.3E-10
Benzo(b)fluoranthene		1.4E-08	NA	7.3E-01		1.0E-08
Benzo(k)fluoranthene		1.2E-08	NA	7.3E-01		8.7E-09
Benzo(a)pyrene		1.5E-08	NA	7.3E+00		1.1E-07
Indeno(1,2,3-cd)pyrene		1.1E-08	NA	7.3E-01		7.8E-09
Dibenzo(a,h)anthracene		7.8E-09	NA	7.3E+00		5.7E-08
Benzo(g,h,i)perylene			NA	NA		
Pesticides/PCB's						
Aroclor-1260		2.7E-09	NA	7.7E+00		2.1E-08
Metals						
Cadmium	2.2E-07		5.0E-04	NA	4.3E-04	
Chromium VI	1.2E-06		5.0E-03	NA	2.4E-04	
Copper	2.8E-06		4.0E-02	NA	7.0E-05	
Lead			NA	NA		
Zinc	6.2E-05		3.0E-01	NA	2.1E-04	
Totals - HQ & CR					**9.5E-04**	**2.2E-07**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic)/ Reference Dose (Oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (Oral)

TABLE 6-43

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS
FROM DERMAL CONTACT TO SOIL (DAILY)
HUNTER EXPOSURE (CURRENT AND FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	CDI (Nc) (mg/kg-day)	CDI (Car) (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal Slope Factor (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Volatile Organics						
Semi-volatiles						
Pesticides/PCB's						
Aroclor-1260		5.4E-09	NA	8.1E+00		4.4E-08
Metals						
Cadmium	4.3E-08		3.0E-05	NA	1.4E-03	
Totals - HQ & CR					**1.4E-03**	**4.4E-08**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic)/ Reference Dose (Oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (Oral)

TABLE 6-44

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS FROM INHALATION OF VOLATILE ORGANICS IN AMBIENT AIR HUNTER EXPOSURE (CURRENT LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	CDI (Nc) (mg/kg-day)	CDI (Car) (mg/kg-day)	RfC (mg/kg-day)	Carc. Slope Inhalation (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Volatile Organics						
Vinyl Chloride		2.3E-07	NA	2.9E-01		6.6E-08
Chloroethane	4.3E-10		2.9E+00	NA	1.5E-10	
Acetone			NA	NA		
Carbon Disulfide	4.8E-08		2.9E-03	NA	1.7E-05	
1,1-Dichloroethene		3.5E-08	NA	1.2E+00		4.2E-08
1,2-Dichloroethene (total)	1.4E-05		1.2E+00	NA	1.2E-05	
Chloroform		7.5E-10	NA	8.1E-02		6.1E-11
1,2-Dichloroethane	2.0E-08	8.8E-09	2.9E-03	9.1E-02	7.1E-06	8.0E-10
2-Butanone	6.7E-10		2.9E-01	NA	2.3E-09	
1,1,1-Trichloroethane			NA	NA		
Trichloroethene		6.0E-06	NA	6.0E-03		3.6E-08
Benzene		2.6E-10	NA	2.9E-02		7.6E-12
Tetrachloroethene		2.6E-10	NA	2.0E-03		5.2E-13
Toluene	2.1E-08		1.1E-01	NA	1.8E-07	
Chlorobenzene	1.2E-08		5.0E-03	NA	2.5E-06	
Ethylbenzene	8.6E-09		2.9E-01	NA	3.0E-08	
Xylene (total)			NA	NA		
Total HQ & CR					**3.9E-05**	**1.5E-07**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic) / Reference Concentration
Cancer Risk = Chronic Daily Intake (Cancinogenic) x Inhalation Slope Factor

The total hazard index of 0.0075 is due primarily to dermal contact to surface water (HI = 0.003) sediment (HI = 0.002) and on-site soils (HI = 0.0014). The total hazard index for the on-site hunter is below the USEPA defined target of unity.

Medium-Specific Hazard Indices

For the on-site hunter soil/ambient air pathways, a total hazard index of 0.0015 was determined. For the on-site hunter surface water pathway a total hazard index of 0.003 was determined. For the on-site hunter sediment pathway, a total hazard index of 0.002 was determined.

All medium-specific hazard indices are below the USEPA-defined target of unity.

Chemical-Specific Hazard Indices

The main contributers to the total hazard index for the on-site hunter are antimony (HI = 0.0011, beryllium (HI = 0.001) and cadmium (HI = 0.0036).

6.5.4.2 Exposure Pathway Cancer Risks

Chemical-specific excess cancer risks and the total excess cancer risk for each future exposure pathway are presented in Tables 6-30, 6-31, and Tables 6-42 through 6-44. A summary of the total cancer risk for the on-site hunter scenario is presented in Table 6-48. The land-use scenarios for each exposure pathway are the same as described for the on-site hunter non-carcinogenic pathways.

Dermal Exposure to Surface Water while Wading

Chemical-specific cancer risks and total pathway risk for dermal exposure to surface water is presented in Table 6-30. The total pathway risk of 9.2×10^{-6} is within the USEPA-defined target range of 10^{-6} to 10^{-4}.

Dermal Exposure to Sediment During Wading

Chemical specific cancer risks and total pathway risk for dermal exposure to sediment were not calculated.

Ingestion of Soil

Chemical-specific cancer risks and the total pathway risk for the ingestion of soil are presented in Table 6-42. The total pathway risk of 2.2 x 10^{-7} is below the USEPA-defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to the PAHs dibenzo(a,h)anthracene (risk = 5.7 x 10^{-8}), benzo(a)pyrene (risk = 1.1 x 10^{-7}), indeno (1,2,3-cd)pyrene (risk = 7.8 x 10^{-9}), benzo(a)anthracene (risk = 1.1 x 10^{-8}, and benzo(b)fluoranthene (risk = 1.0 x 10^{-8}) and Aroclor-1260 (risk = 2.1 x 10^{-8}).

Dermal Exposure to Soil

Chemical-specific cancer risks and the total pathway risk for dermal contact with soil are presented in Table 6-43. The total pathway risk of 2.6 x 10^{-8} is below the USEPA-defined target range of 10^{-6} to 10^{-4} and is entirely the result of potential exposure to Aroclor-1260.

Inhalation of Volatiles in Ambient Air

Chemical-specific cancer risks and the total pathway risk for inhalation of volatiles in ambient air are presented on Table 6-44. The total pathway risk of 1.5 x 10^{-7} is below the USEPA defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to vinyl chloride (risk = 6.6 x 10^{-8}) TCE (risk = 3.6 x 10^{-8}) and 1,1-dichloroethene (risk = 4.2 x 10^{-8}).

Cancer Risk Summary

The future land use cancer risk summary is presented in Table 6-48. The total cancer risk of 9.6 x 10^{-6} which is within the USEPA target range of 10^{-6} to 10^{-4} and is primarily due to dermal contact with surface water (risk = 9.2 x 10^{-6}). The chemicals primarily responsible for the elevated cancer risk are beryllium in water.

Media-specific Cancer Risks

For the on-site hunter soil/ambient air pathways a total excess cancer risk of 4.0 x 10^{-7} was determined. This value is below the USEPA target range of 10^{-6} to 10^{-4}.

For the on-site hunter surface water pathway a total excess cancer risk of 9.2×10^{-6} was determined. This value is within the USEPA target range of 10^{-6} to 10^{-4}. No excess cancer risk was calculated for the on-site hunter sediment pathway.

Chemical-specific Cancer Risks

The main contributors to the on-site hunter cancer risk are beryllium (risk = 9.2×10^{-6}), vinyl chloride (risk = 6.2×10^{-7}), trichloroethene (risk = 3.4×10^{-7}) and 1,1-dichloroethene (risk = 4.0×10^{-7}).

6.5.5 Future Land Use On-Site Construction Worker

6.5.5.1 Exposure Pathway Hazard Quotients

Chemical-specific hazard quotients and the total hazard index for the future exposure pathway are presented in Tables 6-45 through 6-47. A summary of the total hazard index for the on-site construction worker scenario is presented in Table 6-48.

Ingestion of Soil

The future land-use scenario for ingestion of soil is defined as ingestion of soil by future on-site construction workers. The chemical-specific hazard quotients and the total hazard index for this pathway are presented in Table 6-45. The pathway hazard index of 0.00043 is below the USEPA-defined target of unity and is primarily the result of potential exposure to cadmium (HQ = 0.00021), chromium (HQ = 0.00015) and zinc (HQ = 0.000028).

Dermal Exposure to Soil

The future land-use scenario for dermal exposure to soil is defined as dermal exposure to soil by future on-site construction workers. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-46. The pathway hazard index of 0.0025 is below the USEPA-defined target of unity and is the result of potential exposure to cadmium.

TABLE 6-45

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS
FROM INGESTION OF SOIL (DAILY)
CONSTRUCTION WORKER EXPOSURE (FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	**CDI (Nc)** (mg/kg-day)	**CDI (Car)** (mg/kg-day)	**RfD** (mg/kg-day)	**Oral Slope Factor** (mg/kg-day)-1	**Hazard Quotient**	**Cancer Risk**
Volatile Organics						
Vinyl Chloride		6.1E-10	NA	1.9E+00		1.2E-09
Dichloroethene, 1,2- (total)	4.7E-08		9.0E-03	NA	5.2E-06	
Trichloroethene		2.2E-08	NA	1.1E-02		2.4E-10
Semi-volatiles						
Methylnaphthalene, 2-			NA	NA		
Acenaphthylene			NA	NA		
Dibenzofuran			NA	NA		
Phenanthrene			NA	NA		
Benzo(a)anthracene		5.1E-09	NA	7.3E-01		3.7E-09
bis(2-Ethylhexyl)phthalate	2.0E-08	7.0E-09	2.0E-02	1.4E-02	9.8E-07	9.8E-11
Benzo(b)fluoranthene		4.9E-09	NA	7.3E-01		3.6E-09
Benzo(k)fluoranthene		4.6E-09	NA	7.3E-01		3.3E-09
Benzo(a)pyrene		4.8E-09	NA	7.3E+00		3.5E-08
Indeno(1,2,3-cd)pyrene		4.2E-09	NA	7.3E-01		3.1E-09
Dibenzo(a,h)anthracene		4.0E-09	NA	7.3E+00		2.9E-08
Benzo(g,h,i)perylene			NA	NA		
Pesticides/PCB's						
Aroclor-1260		1.5E-09	NA	7.7E+00		1.2E-08
Metals						
Cadmium	1.1E-07		5.0E-04	NA	2.1E-04	
Chromium VI	7.6E-07		5.0E-03	NA	1.5E-04	
Copper	1.1E-06		4.0E-02	NA	2.8E-05	
Lead			NA	NA		
Zinc	1.1E-05		3.0E-01	NA	3.7E-05	
Totals - HQ & CR					**4.3E-04**	**9.1E-08**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic)/ Reference Dose (Oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (Oral)

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TABLE 6-46

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS FROM DERMAL CONTACT TO SOIL (DAILY)
CONSTRUCTION WORKER EXPOSURE (FUTURE LAND USE)
SENECA ARMY DEPOT
ASH LANDFILL

Analyte	CDI (Nc) (mg/kg-day)	CDI (Car) (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal Slope Factor (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Volatile Organics						
Semi-volatiles						
Pesticides/PCB's						
Aroclor-1260		4.7E-09	NA	8.1E+00		3.8E-08
Metals						
Cadmium	7.6E-08		3.0E-05	NA	2.5E-03	
Totals - HQ & CR					**2.5E-03**	**3.8E-08**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic)/ Reference Dose (Oral)
Cancer Risk = Chronic Daily Intake (Carcinogenic) x Slope Factor (Oral)

TABLE 6-47

CALCULATION OF NONCARCINOGENIC AND CARCINOGENIC RISKS FROM INHALATION OF VOLATILE ORGANICS IN AMBIENT AIR CONSTRUCTION WORKER EXPOSURE (FUTURE LAND USE)

SENECA ARMY DEPOT
ASH LANDFILL

Analyte	CDI (Nc) (mg/kg-day)	CDI (Car) (mg/kg-day)	RfC (mg/kg-day)	Carc. Slope Inhalation (mg/kg-day)-1	Hazard Quotient	Cancer Risk
Volatile Organics						
Vinyl Chloride		3.3E-07	NA	2.9E-01		9.7E-08
Chloroethane	7.6E-10		2.9E+00	NA	2.6E-10	
Acetone			NA	NA		
Carbon Disulfide	8.4E-08		2.9E-03	NA	2.9E-05	
1,1-Dichloroethene		5.2E-08	NA	1.2E+00		6.2E-08
1,2-Dichloroethene (total)	2.5E-05		1.2E+00	NA	2.1E-05	
Chloroform		1.1E-09	NA	8.1E-02		8.8E-11
1,2-Dichloroethane	3.6E-08	1.3E-08	2.9E-03	9.1E-02	1.2E-05	1.2E-09
2-Butanone	1.2E-09		2.9E-01	NA	4.1E-09	
1,1,1-Trichloroethane			NA	NA		
Trichloroethene		8.8E-06	NA	6.0E-03		5.3E-08
Benzene		3.8E-10	NA	2.9E-02		1.1E-11
Tetrachloroethene		3.8E-10	NA	2.0E-03		7.6E-13
Toluene	3.7E-08		1.1E-01	NA	3.2E-07	
Chlorobenzene	2.2E-08		5.0E-03	NA	4.3E-06	
Ethylbenzene	1.5E-08		2.9E-01	NA	5.3E-08	
Xylene (total)			NA	NA		
Total HQ & CR					**6.7E-05**	**2.1E-07**

Hazard Quotient = Chronic Daily Intake (Noncarcinogenic) / Reference Concentration
Cancer Risk = Chronic Daily Intake (Cancinogenic) x Inhalation Slope Factor

Inhalation of Volatiles in Ambient Air

The future land use scenario for inhalation of volatiles in ambient air is defined as exposure of future on-site construction workers to volatile organics emitted from soil to ambient air. The chemical-specific hazard quotients and total hazard index for this pathway are presented in Table 6-47. The pathway hazard index of 0.000067 is below the USEPA-defined target of unity and is primarily the result of potential exposure to carbon disulfide (HQ = 0.000029, 1,2-dichloroethane (HQ = 0.000012) and 1,2-dichloroethene (HQ = 0.000021).

Hazard Index Summary

The future land-use hazard index summary and total hazard index are presented in Table 6-48. The total hazard index of 0.003 is below the USEPA-defined target of unity.

Medium-specific Hazard Indices

For the construction worker soil/ambient air pathways, a total hazard index of 0.003 was determined.

Chemical-specific Hazard Indices

The total hazard index of 0.077 is due primarily to exposure to cadmium (0.0027).

6.5.5.2 Exposure Pathway Cancer Risks

Chemical-specific excess cancer risks and the total excess cancer risk for the construction worker exposure pathway are presented in Tables 6-45 to 6-47. A summary of the total cancer risk for the future use scenario is presented in Table 6-48. The land-use scenarios for each exposure pathway are the same as described for the noncarcinogenic pathways.

Ingestion of Soil

Chemical-specific cancer risks and the total pathway risk for the ingestion of soil are presented in Table 6-45. The total pathway risk of 9.1×10^{-8} is below the USEPA-defined

TABLE 6-48
CALCULATION OF TOTAL NONCARCINOGENIC AND CARCINOGENIC RISKS

SENECA ARMY DEPOT
ASH LANDFILL

RECEPTOR	EXPOSURE ROUTE	EXPOSURE ASSESSMENT Table Number	RISK CHARACTERIZATION Table Number	HAZARD INDEX	CANCER RISK
CURRENT RESIDENTIAL					
CURRENT OFF-SITE RESIDENTS	Dermal Contact to Surface Water while Wading	Table 6-8	Table 6-30	3.1E-03	9.2E-06
	Dermal Contact to Sediment while Wading	Table 6-9	Table 6-31	2.0E-03	0.0E+00
	Ingestion of Groundwater	Table 6-10	Table 6-32	1.4E-01	5.6E-06
	Dermal Contact to Groundwater	Table 6-12	Table 6-33	3.2E-03	2.5E-07
	Inhalation of Groundwater while Showering	Table 6-16	Table 6-34	3.1E-07	1.1E-07
	Inhalation of Volatile Organics in Ambient Air	Table 6-25	Table 6-35	8.0E-04	3.0E-06
TOTAL RECEPTOR RISK (Nc & CAR)				1.5E-01	1.8E-05
FUTURE RESIDENTIAL					
FUTURE ON-SITE RESIDENTS	Ingestion of Onsite Soils	Table 6-18	Table 6-36	3.4E-01	2.1E-05
	Dermal Contact to Onsite Soils	Table 6-21	Table 6-37	3.8E-01	2.8E-06
	Dermal Contact to Surface Water while Wading	Table 6-8	Table 6-30	3.1E-03	9.2E-06
	Dermal Contact to Sediment while Wading	Table 6-9	Table 6-31	2.0E-03	0.0E+00
	Ingestion of Groundwater	Table 6-11	Table 6-38	3.2E+00	1.4E-03
	Dermal Contact to Groundwater	Table 6-13	Table 6-39	2.0E-01	7.1E-05
	Inhalation of Groundwater while Showering	Table 6-17	Table 6-40	1.0E-03	2.9E-05
	Inhalation of Volatile Organics in Ambient Air	Table 6-26	Table 6-41	3.4E-03	1.3E-05
TOTAL RECEPTOR RISK (Nc & CAR)				4.2E+00	1.6E-03
CURRENT AND FUTURE ON SITE					
ON-SITE HUNTERS	Dermal Contact to Surface Water while Wading	Table 6-8	Table 6-30	3.1E-03	9.2E-06
	Dermal Contact to Sediment while Wading	Table 6-9	Table 6-31	2.0E-03	0.0E+00
	Ingestion of Onsite Soils	Table 6-19	Table 6-42	9.5E-04	2.2E-07
	Dermal Contact to Onsite Soils	Table 6-22	Table 6-43	1.4E-03	2.6E-08
	Inhalation of Volatile Organics in Ambient Air	Table 6-27	Table 6-44	3.9E-05	1.5E-07
TOTAL RECEPTOR RISK (Nc & CAR)				7.5E-03	9.6E-06
FUTURE ON-SITE CONSTRUCTION WORKERS	Ingestion of Onsite Soils	Table 6-20	Table 6-45	4.3E-04	9.1E-08
	Dermal Contact to Onsite Soils	Table 6-23	Table 6-46	2.5E-03	3.8E-08
	Inhalation of Volatile Organics in Ambient Air	Table 6-28	Table 6-47	6.7E-05	2.1E-07
TOTAL RECEPTOR RISK (Nc & CAR)				3.0E-03	3.4E-07

target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to the PAHs dibenzo(a,h)anthracene (risk = 3.1×10^{-9}), benzo(a)pyrene (risk = 3.3×10^{-9}), indeno (1,2,3-cd)pyrene (risk = 3.5×10^{-8}), benzo(a)anthracene (risk = 3.7×10^{-9}), and benzo(b)fluoranthene (risk = 3.6×10^{-9}) and Aroclor-1260 (risk = 1.2×10^{-8}).

Dermal Exposure to Soil

Chemical-specific cancer risks and the total pathway risk for dermal contact with soil are presented in Table 6-46. The total pathway risk of 3.8×10^{-8} is below the USEPA-defined range of 10^{-6} to 10^{-4} and is entirely the result of potential exposure to Aroclor-1260.

Inhalation of Volatiles in Ambient Air

Chemical-specific cancer risks and the total pathway risk for inhalation of volatiles in ambient air are presented on Table 6-47. The total pathway risk of 2.1×10^{-7} is below the USEPA defined target range of 10^{-6} to 10^{-4} and is primarily the result of potential exposure to vinyl chloride (risk = 9.7×10^{-8}), TCE (risk = 5.3×10^{-8}) and 1,1-dichloroethene (risk = 6.2×10^{-8}).

Cancer Risk Summary

The construction worker cancer risk summary is presented in Table 6-48. The total cancer risk of 3.4×10^{-7} is below the USEPA target range of 10^{-6} to 10^{-4} and primarily due to the inhalation of volatile organics in ambient air (risk = 2.1×10^{-7}). The chemicals primarily responsible for the elevated cancer risk are vinyl chloride, TCE and 1,1-dichloroethene.

Media-specific Cancer Risks

For the construction worker soil/ambient air pathways the total excess cancer risk is 3.4×10^{-7}.

Chemical-specific Cancer Risks

The main contributors to the construction worker cancer risk are vinyl chloride (risk = 9.7×10^{-8}), trichloroethene (risk = 5.3×10^{-8}) and 1,1-dichloroethene (risk = 6.2×10^{-8}).

6.6 ECOLOGICAL RISK ASSESSMENT

6.6.1 Introduction

6.6.1.1 Objectives and Overview

The objective of the RI is to provide sufficient information to quantify pollutant concentrations, determine the nature and extent of impacts and evaluate the potential risk to human health and the environment. Additionally, the RI will be used to support follow-on activities including feasibility studies for remedial actions. This Ecological Risk Assessment (ERA) is part of these RI activities.

The ERA at the Ash Landfill at the SEDA was undertaken to determine if hazardous substances released during landfill operations may have resulted in ecological risks. The ERA contributes to the overall characterization of the sites and serves as part of the baseline used to develop, evaluate, and select appropriate remedial alternatives. The primary objective of the ERA is to identify and characterize the potential risks posed to environmental receptors as a result of the hazardous substance releases. Secondary ERA objectives are to assess the ecological communities and the dominant flora and fauna in the vicinity of the sites; to determine the contaminants of concern being released from the sites; to identify potential pathways for receptor exposure; and to determine the extent, if any, response action is necessary at the site.

The statutory authority for this ERA is found in CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA). Through this authority, the USEPA seeks to protect wildlife, fisheries, endangered and threatened species, and critical habitats. These statutes also require that remedial actions selected for National Priorities List (NPL) (i.e., Superfund) sites be sufficient to protect both human health and the environment. This ERA has been conducted in parallel with a human health risk assessment.

6.6.1.2 Scope of Investigation

This ERA is based on site field and laboratory data collected during the Phase I and Phase II RI and available literature on the toxicology of chemicals of potential concern to plant and animal species in the Ash Landfill vicinity. This study was conducted in accordance with the Risk Assessment Guidance For Superfund, Volume II, Environmental Evaluation Manual

(USEPA, 1989c); Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference (USEPA, 1989d); and the Draft NYSDEC TAGM, Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (NYSDEC, 1991).

The following steps were completed for the ERA:

- Qualitative and quantitative characterization of ecological communities and dominant nondomesticated plant and animal species in the area of the Ash Landfill,
- Selection of receptor species,
- Identification of chemicals of potential concern for ecological receptors,
- Identification of exposure pathways from the Ash Landfill to target species,
- Assessment of exposure of receptors to chemicals of potential concern,
- Assessments of the toxicity of chemicals of potential concern for each receptor group or species,
- Characterization of risk,
- Estimation of risk uncertainty.

During the Phase I RI program, quantitative characterization of the ecological communities was performed to determine the species frequency, dominance, diversity and productivity of the biological population or community at the site. The Phase I program was performed to determine the need for performing chemical analysis of biological or plant material at the site. The results of the Phase I data collection did not indicate stressed biological or plant communities and so concentrations of chemicals were not measured in biological or plant material during the Phase II program. However, chemical analyses were performed on environmental media, including soil, sediment, surface water, and ground water. Therefore, the conclusions derived from this study focuses on identifying potential adverse risks to species, habitats, and populations in the environment, and is not a quantitative determination of risk.

The ERA addresses potentially significant risks to the following biological groups and special-interest resources associated with the site: vascular vegetation, wildlife, aquatic life (including both fish and aquatic macroinvertebrates), endangered and threatened species, and wetlands. The ERA focus is in the area of the Ash Landfill and the immediately surrounding vicinity, including Kendaia Creek. The Ash Landfill has been evaluated as a single site, with references being made to specific locations as appropriate. The aquatic study area included Kendaia Creek and intermittent drainage swales/wetlands at the Ash Landfill site. The terrestrial study area included the Ash Landfill and an area approximately 2 miles from the site perimeter. Within the 2 mile radius, significant resources such as NYSDEC significant habitats, habitats supporting endangered, threatened and rare species, species of concern and state regulated wetlands were identified. Within a smaller 0.5 mile radius, the major vegetative communites, wildlife species associated with each cover type and the value of the habitats to the associated wildlife were identified. Trapping of small mammals was performed within a 0.5 mile radius to evaluate the diversity and abundance of species within an area closer to the actual site.

As preceding sections of this RI have indicated, a substantial site-specific data base of chemical and physical information was developed to characterize the types, locations, and concentrations of chemicals in soils, sediments, surface water, and ground water. Physical media samples were collected upgradient and downgradient from the Ash Landfill, and from on-site and off-site (for soils) background reference stations. Multiple rounds of media sampling were conducted over the course of the two phases of investigation fieldwork. Physical media samples were chemically analyzed for a broad range of more than 150 analytes, including inorganics, herbicides, PCBs/pesticides, VOCs and SVOCs. Field measurements including dissolved oxygen, pH, specific conductivity and temperature were made for surface waters. Turbidity, pH and specific conductivity were measured for each groundwater sample. Validated chemical analytical results were used in all ecological risk analyses. Contaminants' acute and chronic concentrations toxic to individual species and general biological groups (e.g., fish) were derived from the technical literature rather than from field investigations. The literature researched is reflected in the chemical profiles presented in Appendix K. Site ecological characterization activities included a site reconnaissance, terrestrial trapping, fish captures, qualitative evaluation of plant communities, macroinvertebrate sampling, quantitative sorting of the macroinvertebrate data, and identification and descriptions of visible evidence of environmental stresses.

6.6.2 Site Characterization

Ecological site characterization of the Ash Landfill is based on compilation of existing ecological information and on-site reconnaissance activities conducted in the fall of 1992. The methods used to characterize the ecological resources included site walkovers for the evaluation of existing wildlife and vegetative communities; interviews with local, state, and SEDA resource personnel; and review of environmental data obtained from previous Army reports. SEDA has a strong wildlife management program that is reviewed and approved by the New York Fish and Game Agency. The depot manages an annual white-tailed deer (Odocoileus virginiana) harvest and has constructed a large wetland called the "duck pond" in the northeastern portion of the facility to provide a habitat for migrating waterfowl. Winter deer counts estimate the herd size at approximately 600 animals, between 250-300 animals are harvested each fall. Sources of environmental data include past wetland evaluation project reports prepared by the Army Environmental Hygiene Agency (AEHA), an Environmental Impact Statement (EIS) prepared by DeLeuw, Cather Co. for permitting of the U.S. Coast Guard Loran Transmitting Station, located in the southwestern portion of the depot, a land use report issued by Cornell Univerisity and information provided by state wildlife resource agencies.

The methods used to characterize the natural resources at the site has focused on aquatic and terrestrial resources at the Ash Landfill and the surrounding area within a 2-mile radius. The 2-mile-radius study area was selected to address ecological resources that may be potentially at risk from constituents should they migrate beyond the site boundaries. This area was surveyed for ecological characterization of major plant communities and land uses, as well as any protected, significant, or special-interest ecological resources.

To secure as much existing ecological information as possible for the site, phone contacts with SEDA personnel were made prior to site reconnaissance activities. Additionally, local and state resource personnel were contacted for specific information on resources at the depot, within the 2-mile radius study area. Site-specific information obtained included the presence of state and federal threatened and endangered species, species of special concern, and wildlife and fisheries resources data. Information on unique and special-concern habitats, preserves, and natural areas within the general vicinity, and information on wild, scenic, and recreational rivers also were obtained. Aerial photographs of the site and the surrounding area also were reviewed for historical site features and land uses. Soil classification maps and soil characterization data were obtained from the Soil Conservation Service.

Ecological reconnaissance surveys of the Ash Landfill and the surrounding area were conducted in October and November 1992, by ES field biologists. Field trapping of small mammals and fish netting yielded information regarding the number and type of biological ecological resources at the site. Sampling of sediments and macroinvertebrate identification and counting was used to identify the macroinvertebrate biological community. The study area was primarily observed on foot, although some areas were observed with slow drive-throughs. The primary survey objective was to collect qualitative information on the types, quantities, and locations of biological resources at the Ash Landfill and the surrounding area. This was done as follows:

- Dominant plant species were identified, and reference specimens were collected.
- Plant communities were defined based on dominant species observed.
- Observations of fauna were made. Mammals were identified by tracks, scat, burrows, and actual sightings in addition to trapping. Bird, reptile, and aquatic invertebrate identifications were made by actual individual sightings and examination of sediment. Fish in Kendaia Creek were trapped and field identified.
- Areas were examined for vegetative stress, including plants displaying stunted growth, poor foliage growth, tissue discoloration, and a loss of leaf coverage.

The purpose of these activities was to identify potential representative receptors, observe any impacts and determine likely exposure scenarios for the risk assessment.

6.6.3 Environmental Setting

SEDA is situated between Seneca Lake and Cayuga Lake and encompasses portions of Romulus Township and Varick Township. Land use in this region of New York is largely agricultural, with some forestry and public land (school, recreational and state parks). The most recent land use report is that issued by Cornell University. This report classifies in further detail land uses and environments of this region (Cornell 1967). Agricultural land use is categorized as inactive and active use. Inactive agricultural land consists of land committed to eventual forest regeneration, land waiting to be developed, or land presently under construction. Active agricultural land surrounding SEDA consists of largely cropland and cropland pasture. The U.S. Geologic Survey (USGS) quadrangle maps for the Towns of Ovid and Dresden, New York (1970), New York State Department of Transportation (DOT) quadrangles for Romulus, New York (1978) and Geneva South, New York (1978) do not indicate land designated for dairy production in the vicinity of SEDA.

6.6.3.1 Aquatic Assessment Program

6.6.3.1.1 Benthic Invertebrate Community

Based on the results of the macroinvertebrate Surber sampling program at three stations (SW-800, SW-801, and SW-802), the benthic community of Kendaia Creek is dominated by insects. Insects comprised approximately 72 percent of the 356 organisms collected, whereas the remaining 28 percent was a combination of worms (Turbellaria and Oligochaeta), leeches (Hirudinea), snails (Gastropoda), clams (Bivalvia), seed shrimp (Ostracoda), aquatic sow bugs (Isopoda) and scuds (Amphipoda). Insects collected included stoneflies (Plecoptera), caddisflies (Trichoptera), hellgramites (Megaloptera), beetles (Coleoptera), and true flies (Diptera). The fauna collected are characteristic of a stoney habitat with equal amounts of pools and riffles such as Kendaia Creek (Hynes 1979).

The combined relative abundance of all organisms collected indicates that the beetles dominated the collection (35.1 percent), closely followed by true flies (28.9 percent). Subdominate groups, in order of abundance include snails (12.6 percent), aquatic earthworms (7.3 percent), scuds (6.5 percent) and caddisflies (4.9 percent). The remaining six groups collected (flatworms, clams, seed shrimp, aquatic sow bugs, stoneflies, and hellgramites) comprised a total of 4.8 percent of the overall collection. Thus, as frequently occurs in streams of this nature, the benthic macroinvertebrate taxa in Kendaia Creek are unevenly distributed.

As shown in Figure 2-11, surface water from the Ash Landfill is collected by drainage ditches that exist downstream and perpendicular to the site. These ditches run along both the eastern and western portions of the West Patrol Road. The eastern side of the West Patrol Road would divert drainage from the site, which is south of Kendaia Creek, approximately 5,000 feet away. Kendaia Creek is the nearest surface water body that has flow for a good portion of the year. Flow in the drainage ditches are intermittent and occur mainly during periods of high precipitation, eventually reaching Kendaia Creek. Other areas between the Ash Landfill and Kendaia Creek are also drained by this ditch and will contribute to the flow into Kendaia Creek. Samples of macroinvertebrates were collected at locations upstream and downstream of the confluence the drainage ditch along the West Patrol Road and Kendaia Creek to observe the possible impacts of surface water runoff to Kendaia Creek.

The relative abundance of taxa identified at the station most likely to receive surface water run-off from the areas influenced by the Ash Landfill site (SW-800), and the downstream station (SW-802), were similar to the reference station (SW-801), in that, insects comprised the majority of the collection (58.0 percent at SW-800), (79.8 percent at SW-802) and 75.0 percent at SW-801). However, the distribution of dominant insect taxa at the three stations differed slightly. At stations SW-801 and SW-802 true flies were highest in relative abundance (33.3 percent and 39.4 percent, respectively) followed by beetles (16.7 percent and 31.9 percent, respectively). This relationship is reversed at station SW-800 (beetles are 42 percent and true flies are 11.5 percent). Similarly, at stations SW-801 and SW-802 caddisflies followed beetles as the third most common insect collected (16.7 percent at station SW-801 and 6.6 percent at station SW-802). Stoneflies replaced caddisflies as the third most common insect group at station SW-800 (3.1 percent).

For the remaining major taxonomic groups collected, snails accounted for approximately 16 percent of all organisms collected at both stations SW-801 and SW-802. At station SW-800, snails represented only 6.9 percent of the collection. No other trends or obvious differences were noted among the three stations.

Species richness between the three stations sampled in Kendaia Creek was variable. Overall 27 different taxa were identified at these stations. The highest number of taxa were identified at station SW-800 (24) followed by station SW-802 (13) and lastly station SW-801 (9). The variability of species identified at these three stations may be attributed to several factors. Among them are natural variability, decreased habitat diversity, and differences in water quality. Any one or a combination of these factors may contribute to the depressed number of species collected at station SW-801. If adverse effects to the macroinvertebrate community were resulting from impacts in Kendaia Creek emanating from the Ash Landfill site, a lowered species richness would be expected at station SW-800, the sampling location most likely to be affected, rather than SW-801, which is the reference station. To the contrary, the highest number of organisms were reported at station SW-800.

The distribution of taxa in Kendaia Creek was also variable. Some of the differences among the three stations are the apparent lack of worms (flatworms and earthworms), scuds and stoneflies at station SW-801, whereas these groups were present at the other two stations.

In addition, there was a depressed number of both beetles and true flies at station SW-801 (2 and 4, respectively) when compared to both stations SW-800 (55 and 15, respectively) and SW-802 (68 and 84, respectively). The number of individuals collected at three stations in Kendaia Creek was also highly variable. Combining three replicates per each station, resulted in a range of individuals collected from a low value of 12 at station SW-801, to a midrange value of 131 at station SW-800 and a high of 213 at station SW-802. Overall 356 organisms were collected.

From the field information collected it is possible to discuss guild structure in Kendaia Creek in a generalized manner. Trophic relationships of all insect families identified are presented earlier in Table 3-8 of Section 3 of the RI document. The functional feeding groups of insect families in Kendaia Creek appear varied and incorporate virtually all types of feeding mechanisms. This overall hierarchy (including scrapers, herbivores, detritivores, predators and piercers) suggest that no apparent vacancies in trophic relationships exist in Kendaia Creek.

The macroinvertebrate community in Kendaia Creek is composed of first and second order consumers. These species form the basis for the aquatic food chain. The primary value of the macrobenthic community in Kendaia Creek is as prey items to aquatic species, especially fish. Larval aquatic forms and emergent adult forms of macrobenthos are also primary prey items to certain birds and some small mammals (e.g., water shrew and bats). The macroinvertebrate community in Kendaia Creek within the proximity of the Ash Landfill site offers little direct value to humans since they are not consumed by man. Many of the taxa collected in Kendaia Creek are consumed by fish but, the fish species that occur in the studied stream reaches are generally not sought by anglers. The restricted access to the depot further reduces the value of the fisheries to the general public. However, the benthic community of Kendaia Creek would seem to offer sufficient dietary abundance and diversity to support those fish found in the stream.

The presence or absence of "indicator species" is commonly used to assess adverse effects to ecological communities. Pollution tolerance values for each of the aquatic arthropods identified in Kendaia Creek (Crustacea and Insecta combined) is given in Table 3-9 of Section 3. The pollution tolerance of the arthropods identified in Kendaia Creek is wide and ranges from pollution tolerant organisms such as the Asellidae, with a tolerance value of 8, to pollution intolerant organisms such as Chloroperlidae and Nemouridae, with a tolerance values of 1 and 2 respectively. However, most of the individuals identified, are within the facultative classification (4 to 6). These are organisms that have a wide range of tolerance and are often associated with moderate levels of organic contamination (USEPA, 1990a). The presence of intolerant groups, specifically Chloroperlidae and Nemouridae, at station SW-800, provides evidence of favorable water quality at this location. The absence of this taxa at stations SW-801 and SW-802 does not necessarily imply degraded water quality at these locations. If the water quality at a specific location were consistently degraded, tolerant taxa such as Asellidae would be expected to be especially common. Such was not the case at any Kendaia Creek station. Most healthy benthic communities have a mixture of tolerant, facultative and intolerant organisms suggesting a normal species diversity.

An additional measure of pollution sensitivity is the presence and/or absence of mayflies, (Ephemeroptera), stoneflies, (Plecoptera), and caddisflies (Tricoptera) (EPT), because these organisms are generally sensitive or facultative and are often first to suffer in a polluted environment (USEPA, 1990a, USEPA 1989c). The presence of two of these groups (Plecoptera and Tricoptera) in Kendaia Creek is suggestive of good water quality. The total number of taxa within these groups generally increases with improving water quality (USEPA, 1990a). Only two EPTs were collected at the reference station, SW-801. The relative abundance of EPTs compared to the generally tolerant Chironomidae is also used as a measure of biotic conditions. Chironomids tend to increase in relative abundance along a gradient of increasing enrichment or heavy metals concentration (USEPA 1990). There is no clearly defined trend of EPTs compared to chironomids at the three Kendaia Creek stations based on the limited data collected in 1991.

6.6.3.1.2 Fish Community

Based on the results of the aquatic sampling program, the fish community of Kendaia Creek is dominated by minnows. Three of the four species collected were minnows. A single banded killifish was the only non-minnow collected. As is frequently the case in small streams, most of the fish were relatively small. The majority of fish collected were from 30 to 102 mm (1 to 4 inches) in length, the largest fish being a 139 mm (5 inch) creek chub. Overall, central stonerollers were the dominant species in Kendaia Creek, comprising 40.5 percent of the total catch. Creek chubs and blacknose dace comprised 29.7 and 27.0 percent of the total catch, respectively, and were the only species present in every collection. The most fish (23 in number) were collected at the reference station (SW-801). This was also the only station where all four species of fish were captured. This station has a fairly deep (3 to 4 feet) plunge pool below a large culvert that passes under a road, affording cover to resident fish. This culvert forms a barrier to the movement of fish upstream of this location. Such obstructions often cause fish to concentrate below them, which may be the case at this station. The least number of species (2) and individuals (3 per collection) was collected at station SW-800. Since the total catch of fish was relatively low (37), conclusions regarding the abundance and the species richness at specific stations are uncertain.

Based on published dietary information, the four fish species collected in Kendaia Creek typically are found at lower trophic levels; they are usually secondary consumers. Creek chubs and banded killifish are considered to be omnivorous, with the size of prey limited by the relatively small size of the predator. Creek chubs, the only species in Kendaia Creek that can be considered to be piscivorous (fish eating), also consumes insects, cladocerans, and crayfish (Smith, 1955, Lee, et al. 1989). At times, creek chubs consume algae and other plant tissue (Smith, 1985). Blacknose dace also consume aquatic insects, especially midge larvae, as well as diatoms and desmoids during the fall (Smith 1985). Central stonerollers, are specialized feeders, scraping algae and small invertebrates from the surface of rocks (Smith, 1985). Most likely, predation on the population of these four species is minimal. Small fish may occasionally be consumed by large creek chubs and all four species would probably eat fish eggs if they were encountered. Habitat availability, rather than predation, is likely to limit the size of fish populations in Kendaia Creek.

Any abnormalities in the fish collected were documented. There was a degree of subjectivity in these observations, since the time spent examining each fish was, by necessity, brief in an effort to quickly return collected fish to the stream. The blacknose dace was the only species showing an abnormality, i.e., tumors which are associated with endoparasitic cysts. Tumors were observed on one of three blacknose dace collected at station SW-802 and two of four blacknose dace collected at reference station SW-801. Since fish with tumors were encountered at the upstream reference location, SW801, its unlikely that there is a correlation between these tumors and any constituents which may have originated from the Ash Landfill site. Many fish at all the sampling stations had varying degrees of infestations of "black spot," thought to be the "black grub" phase of parasitic trematodes. This is a fairly common phenomena in many aquatic ecosystems (Hynes, 1970).

The results of this assessment indicate that the fish species in Kendaia Creek are predominantly minnows. No species collected would be considered to be sport fish. Most, if not all, have fairly localized home ranges. Localized movements of all species collected are expected in response to environmental factors such as low flow conditions or mid-summer heat (movement to pools and/or areas of groundwater discharge). Groundwater from the areas at the Ash Landfill do not discharge directly into Kendaia Creek.

The significance of the fisheries resources of Kendaia Creek should be considered in terms of its value to associated fauna and its value to humans. It is clear from the species of fish collected, that the community in the evaluated stream segment is essentially non-piscivorous, relying mostly on other food sources. Although small fish may occasionally migrate to downstream stream reaches where more carnivorous fish may be present, it is unlikely that they contribute substantially to the diet of such fish. The primary value of the fish community in Kendaia Creek near the Ash Landfill site is to fish-eating wildlife. Examples of wildlife that could consume the fish in Kendaia Creek, as well as other aquatic organisms, include the northern water snake, various turtles, wading birds, such as herons and egrets, and occasional ducks that may use pools on this portion of the creek. No sport fish were collected during the survey. The lower reaches of Kendaia Creek may support a limited fishery (SEDA, 1992), although no data are available to support this. Dip netting for smelt near the Route 125 bridge (adjacent to Seneca Lake) is reported by local residents to occur during the spring spawning run.

6.6.3.2 Terrestrial Assessment Program

6.6.3.2.1 Significant Resources and Resources Used by Humans

Significant Resources

Based on the New York state regulated wetland maps (Geneva South, Romulus, Ovid, and Dresden quads), there are six regulated wetlands within the 2-mile study area, but none are in close proximity to the site perimeter. The closest wetland is OV-9 which is approximately 2,000 feet (0.4 mile) northeast of the site perimeter. The other five regulated wetlands are over one mile from the site perimeter. GS-3 and GS-4 are to the north, RO-19 is to the northeast, while OV-7 and OV-8 are to the southeast. None of the eight regulated wetlands are believed to be hydrologically connected to the Ash Landfill area.

The only other significant terrestrial resource known to occur in the 2-mile study area is the population of the white-tailed deer which inhabits the fenced SEDA (Buffington, 1991). The depot maintains a deer herd of approximately 650 animals, approximately 300 are brown-pelaged and 350 are white-pelaged. During this evaluation, the white deer were not observed at the Ash Landfill area, but were sighted many times in adjacent environments. However, other field personnel have observed deer at the Ash Landfill site. Several deer tracks and bedding areas were noted on the Ash Landfill area, so undoubtedly both the white- and brown-pelaged deer utilize the Ash Landfill area for resting and feeding.

Resources Used by Humans

In the 2-mile study area, agricultural crops and deciduous forests comprise the vegetative resources used by humans. Although no crops are grown on the depot, farmland is one of the predominant land uses in the surrounding private lands. Crops, including corn, wheat, oats, beans and hay mixtures, are grown primarily for livestock feed. Active agricultural fields are near and to the west of the Ash Landfill area. There are grape vineyards to the north of the Ash Landfill area, but not within the study area (Seneca Chamber of Commerce, 1991).

Deciduous forestland on the depot and surrounding private lands is under active forest management (Morrison 1992, SEDA, 1992). Timber and firewood are harvested from the private woodlots (Morrison, 1992), however, presently no timber harvesting occurs on the depot (SEDA, 1992). The forestlands off the depot appear to be in a normal and healthy condition with no apparent impacts.

Within the 2-mile study area, there are several wildlife species which are hunted and trapped on private lands. Game species hunted include the eastern cottontail, white-tailed deer, ruffed grouse, ring-necked pheasant and waterfowl (Canada goose, mallard and wood duck). Gray squirrel and wild turkey are hunted to a lesser extent due to the lack of appropriate wooded habitat. Furbearing species trapped in this study area include red and gray fox and raccoon. Muskrat and beaver are trapped to a lesser extent (Woodruff, 1992), but neither would probably occur in or near the Ash Landfill area due to lack of aquatic habitat. On the depot, deer, waterfowl and small game (squirrel, rabbit) hunting is allowed but regulated by SEDA. The designated waterfowl hunting area is outside the study area. A permitted deer harvest is performed annually during October and November. Trapping is also permitted (SEDA, 1992).

Low populations of waterfowl (mallard, wood duck) are expected in the Ash Landfill area. The same holds true for the populations of squirrel, gray fox, and ruffed grouse which are not expected to be high due to the limited forest habitat, all of which is outside the Ash Landfill area. The eastern cottontail, red fox and ring-necked pheasant would utilize the habitats (old fields and shrubland) present on the Ash Landfill area, although pheasant populations on the depot are low (SEDA, 1992). Raccoon would be found in all habitats on and adjacent to the Ash Landfill area. Muskrat and beaver may occur in the wetlands and creek habitats within the 2-mile study area. Although deer have an average home range of one square mile (640 acres), the cottontail and raccoon have usually more localized or smaller home ranges. The cottontail's home range is 5 to 20 acres and the raccoon's is usually less than a square mile, while the red fox's is normally greater than a square mile (Dalrymple, 1978).

There are several beehives located off the depot less than 1,000 feet southwest from the Ash Landfill southern boundary. The landfill area could possibly be part of the bee's foraging habitat.

6.6.3.2.2 Vegetative Resources

The major vegetative communities in the 0.5-mile study area are primarily upland cover types. Some freshwater wetlands occur, principally on the Ash Landfill area. Figure 3-7 of Section 3 shows the location of the major cover types in the study area.

Upland Cover Types

The upland cover types in the study area include old fields, shrubland, deciduous forests and agricultural fields. Old fields and shrublands are the dominate cover types on the Ash Landfill area and adjacent environs. The old fields are comprised of a mixture of herbaceous and shrub plant species with some small trees. Queen Anne's-lace, panic grass, teasel, goldenrods, asters and field thistle are the most abundant species in these fields. Shrublands are comprised primarily of shrubs and small trees with some herbaceous species. Gray-stemmed dogwood, raspberry and blackberry, multiflora rose, buckhorn, black locust, sumacs and wild grape are the most common shrubs and vines in this cover type. Prior to becoming part of the SEDA in 1941, most of the old fields and shrublands were active farmland. When they became part of the depot and left fallow, these croplands succeeded to old fields and shrubland and were maintained in these cover types by periodic strip mowing and brush cutting for wildlife habitat improvement. The ammunition storage area to the east of the Ash Landfill area, as well as the roadsides, are mowed to maintain the low cover for security purposes (SEDA, 1992).

Agricultural fields are the next most prevalent cover type in the study area, however, all occur on the privately owned farms west of the site. Crops typically grown in these cropfields surrounding the depot include corn, wheat, soybeans, and various hay mixtures.

Deciduous forests comprise a relatively minor cover type in the study area and occur as woodlots and tree rows that line the fields and roads. Various oaks, sugar maple, hickory, black locust, black cherry, and aspens are the major overstory trees in these woodlots and tree rows.

Wetland Cover Types

Several small freshwater emergent wetlands are located at the Ash Landfill area. Some of these emergent wetlands may have been created by landfill excavation operations. Several drainage ditches were also constructed to catch surface water run-off from the Ash Landfill area and roads. These ditches are also vegetated with emergent wetland plants. Common reed (Phragmites australis) is the most abundant and widely distributed emergent plant species, comprising 40 to 95 percent cover. Purple loosestrife (Lythrum salicara), rush (Juncus sp.), broad-leaved cattail (Typha latifolia), sedge (Carex sp.) and spike-rush (Eleocharis sp.) also have wide distribution, but are not as abundant (10 to 50 percent cover). No standing water was observed in these wetlands when they were surveyed. There are several other small wetlands in the study area, including a common reed stand, which was the reference wetland. None of the other wetlands were large enough to be mapped.

6.6.3.2.3 Wildlife Resources

The wildlife species expected to inhabit the 0.5-mile study area would be those typically occurring in the central New York region including some 17 species of amphibians, 13 species of reptiles, 162 species of birds, and 44 species of mammals. The most prevalent wildlife would be upland species, particularly those preferring old fields and shrublands, since these are abundant habitats in the study area. Such wildlife species would include the American toad, eastern garter snake, northern cardinal, and woodchuck. The mixture of these habitats with small woodlots and tree rows provides ideal habitat for the white-tailed deer that is common throughout the depot. This combination of habitats is present within the study area, so it is expected that deer populations in the area would be high; numerous deer tracks and several deer bedding areas in the Ash Landfill area and nearby provided evidence of their existence. The mixture of these upland habitats is also excellent for other wildlife such as the red-tailed hawk and raccoon. The agricultural fields outside the depot would serve as a source of food (grain, vegetation, insects) to many wildlife species, including deer, raccoon, mourning dove, common grackle and ring-billed gull. Since woodland habitat is relatively limited in the study area, populations of strictly forest-dwelling species such as the gray squirrel, blue jay and four-toed salamander would not be overly abundant. However, species richness (total species) is usually high in forested habitats. The series of small emergent wetlands in the study area do not comprise significant wildlife habitat due to their size and quality. Frogs, salamanders, small mammals and a few ducks would use the study area's wetlands. Much larger, higher quality wetland habitats occur on and off the depot and would provide a greater attraction for waterfowl and other waterbirds.

Overall, the mixture of old fields, shrublands, woodlots, tree rows, and agricultural fields provides valuable wildlife habitat in the study area, although similar habitats are abundant on and surrounding the depot. Expected wildlife species diversity would be relatively high in the study area due to the variety of habitats present. The numbers and species of wildlife observed during the late fall surveys were actually low, but this was undoubtedly due to the time of year, since many mammals, reptiles and amphibians would have gone into hibernation and only winter resident birds were present. The total survey observation time was limited, as well. During the surveys, the only reptiles observed were a red-bellied snake (roadkill) and garter snakes; no amphibians were noted. White-tailed deer, woodchuck, and mice and voles (Cricetidae) were the only mammals observed or suspected to be present on-site due to signs of their existence. The white-footed mouse and meadow vole were live-trapped in old field/shrubland and wetlands on the Ash Landfill area, whereas the deer mouse (same habitats) and house mouse (old field/shrubland only) were caught in the nearby reference area off the depot. The trapping success at the two areas was similar (0.07 catch per trap-night for the Ash Landfill area and 0.11 catch per trap-night at the reference area). Only 16 bird species were noted. Many small bird nests were found in the shrublands south of the Ash Landfill area.

6.6.3.2.4 Stressed or Altered Terrestrial Biota

No signs of stressed or altered terrestrial biota (vegetation and wildlife species) were observed during the surveys in the 0.5-mile study area. Due to late fall period of the surveys, many of the plant species had naturally lost their leaves or had been killed by frost and cold. However, there was no indications of unnatural die-off or stunted vegetation.

6.6.3.2.5 Potential Terrestrial Receptors

The results of the Phase I terrestrial assessment indicate that five vegetative communities (old fields, shrubland, deciduous woods, agricultural fields, wetlands) are on or nearby the study area. The old fields, shrubland and small wetlands, as well as some drainage ditches, presently occupy the Ash Landfill area and would have the highest potential for being impacted by the site. The other vegetative communities, including deciduous woodlots and tree rows, and agricultural fields (off the depot), as well as other old fields, shrublands, and small wetlands, would be less likely to be receptors due to their distance from the site. However, a field reconnaissance indicated that the existing vegetative communities are all visibly healthy and appear normal in terms of species composition and density; no community that should be present was missing.

State regulated wetlands are the only significant vegetative resource in the vicinity of the Ash Landfill area. It is unlikely that these wetlands would be impacted by the site due to the distance away (0.4 miles or greater). This is also likely to be the case for the agricultural crops, one of the two vegetative resources used by man. The other, deciduous woods in the study area, are under SEDA and private forest management, but also appear to be in a healthy, normal condition.

The wildlife communities inhabiting the vegetative communities also appear to be normal. Although no intensive sampling program was conducted, the observations made in the late fall indicated that the seasonal (fall) wildlife species composition and density for the habitats present were normal.

The vegetative and wildlife species inhabiting the old fields, shrublands, wetlands and ditches on the Ash Landfill area would have the highest potential for being impacted by the site. Those having the lowest potential would be the plants and wildlife species inhabiting the deciduous forest and tree rows, and agricultural fields, shrublands, as well as other old fields and small wetlands, beyond the Ash Landfill area. The white-tailed deer is the only big game species hunted in the study area, as well as being the only significant wildlife resource in its white-pelaged form. Deer utilize all habitat types in the study area, including those on the Ash Landfill area. Observations of the deer herd in the study area showed this game population to be in healthy condition. Waterfowl and other small game species are hunted on the depot, although waterfowl are not hunted in or near the Ash Landfill area. In addition, waterfowl usage of the Ash Landfill area and vicinity would be limited due to the lack of waterfowl habitat (large wetlands and streams). The eastern cottontail, red fox, and raccoon are the small game and furbearing species with the most potential as receptors since they would inhabit the Ash Landfill area. Other game and furbearing species with less potential for being impacted include the ruffed grouse, wild turkey, ring-necked pheasant, gray squirrel, muskrat and beaver since these wildlife species would occur in habitats outside the Ash Landfill area. Many non-game wildlife species are potential receptors, in particular those that are permanent residents and have localized (small) home ranges such as amphibians, reptiles, small mammals (e.g., mice), and some small non-migratory birds. Based on the fall 1991 surveys, none of the floral and faunal species observed in the Ash Landfill area and adjacent habitats showed any visible signs of stress or alteration. The Ash Landfill area may also be used by honey bees from nearby beehives.

Generally, there is no evidence that the Ash Landfill area has any outward (visible) adverse affect on the terrestrial biota at the community or individual level.

6.6.4 Ecological Risk Assessment

Potential biological effects of chemical releases into the environment are analyzed and described in this section. The assessment focuses on evaluating the effects on vegetation, wildlife, aquatic life, and wetlands. Threatened and endangered species, including any currently proposed for listing, do not require evaluation because site characterization activities indicated the absence of such species at or near the Ash Landfill and the surrounding study area.

The risk assessment determines which chemicals found in physical media pose potential adverse risks to biological resources, identifies exposure routes, evaluates toxicological effects resulting from exposure, and identifies reasons some chemicals are not of concern. The assessment begins with identification of chemicals of potential environmental concern, proceeds through systematic evaluations of potential risks posed by these chemicals to each major biological group occurring on or near the Ash Landfill and concludes with determinations of those chemicals that represent significant environmental risks to site and nearby biota.

6.6.4.1 Selection of Chemicals of Potential Concern

The objective of this phase of the ERA was to initially identify those chemicals that pose a potential hazard to plants or animals at the Ash Landfill site and thus require detailed risk analyses by subsequent evaluation phases. The process begins with identification of the sources, types, locations, distribution, and approximate quantities of chemicals present in physical media. After proceeding through a screening process, this phase concludes with identifying a list of chemicals of potential concern for the site's biological receptors and resources.

For the purposes of this risk analysis, a chemical of concern is defined as a substance that can cause adverse toxicological effects to plants or animals at concentrations recorded at a site. Chemicals of concern were identified through a modest screening process. The screening process was applied to the initial list of 150 chemicals identified in the scope of work for analysis in one or more of the three relevant media (soil, sediment, and surface water) examined during this investigation. The screening was designed to eliminate constituents that did not have at least one measured concentration during the investigation. The details of the screening process are described in the previous Section 6.2 and the list of constituents of potential concern in the ERA is presented in Table 6-3. The chemicals of potential concern for each biological group are discussed below and are summarized in Section 6.6.4.3. The tables are divided into two media groups, one related to soils-sediments and other related to surface waters. A potential ecological receptor is then evaluated for each of the two media groups.

6.6.4.2 Receptor and Endpoint Selection

The objective of this analysis phase was to select a group of receptors and risk evaluation endpoints to represent the focus of the site-specific assessment. The assessment of potential effects on receptors addresses potential chemical effects on the selected receptor species, and on the habitats of these species, as appropriate.

Evaluation of ecological risks is complex for several reasons. These include the large number of species typically present at a hazardous waste site; significant differences in biological reactions to the same chemical concentration among different species; multiple factors regulating chemical bioavailability; and multiple levels of ecological organization (e.g., population or ecosystem) susceptible to contaminant effects. To practically address these complexities and constraints, guidance (USEPA, 1989c) allows use of specific indicator receptors to represent larger assemblages of species that share many common characteristics. Similarly, ecological risks should be expressed in terms of a definite endpoint, because the most objective evaluation of magnitude, probability, type of effect, and duration of a risk results from analyzing effects on a preselected or particular biological level or receptor. Thus, analytical endpoints are required. Receptors and endpoints selected for this ERA and the bases for their selections are discussed below.

The receptor species concept was used for evaluating potential biological risks for two reasons. First, evaluating a limited number of receptor species minimizes data interpretation difficulties created by the inherent differences in the ways various species react to the same contaminants. Second, evaluating receptor species provides a practical alternative to evaluating all of the several hundred species present on site. Receptor species were selected based on the likelihood that they would be present at the site.

Site biota were organized into five major groups, with one or two receptors selected for each group. Major groups of aquatic/wetland biota were vertebrates (fish), invertebrates, and vegetation. Major groups of terrestrial biota were vertebrates (small mammals and birds) and vegetation. The selection factors used to evaluate candidate species are listed in Table 6-49.

The selected receptors and their associated biological groups are summarized in Table 6-50. Characteristics of each receptor are listed in Table 6-51. Selection factors were used to identify species that offered the most favorable combination of characteristics for determining the implications of on-site contaminants. The factors were: 1) limited site mobility; 2) role in local nonhuman food chains; 3) potential high abundance and wide distribution on-site; 4) sufficient toxicological information available in the literature for comparative and interpretive purposes; 5) readily sampled; 6) availability in reference area; 7) separate populations present at or near waste disposal sites; 8) likely recurrence after site remediation; and 9) suitability for long-term monitoring, if necessary.

6.6.4.2.1 <u>Vegetation</u>

Receptor species representing upland grasses and old field vegetation are brome. This grass is a common member of grasslands and fields that occur in the Ash Landfill area. This species is relatively short lived and closely linked to upland conditions, which make them good indicators of short-term soil conditions. Cattail is the receptor species representing vegetation of wetlands and communities occurring on low, moist soils. The cattail was selected because it is an aquatic, vascular plant that typically occurs in the area on a permanent basis.

TABLE 6-49

SELECTION FACTORS FOR EVALUATING CANDIDATE RECEPTOR SPECIES

FACTOR	CONSIDERATION
Limited site mobility	• Reflect effects of site contaminant concentrations • Establish completed pathways
Food chain role	• Address biomagnification risks • Address hazards to consumers • Determine exposure pathways
Adequate abundance and distribution	• Can reflect food chain linkages • Reflect site differences in contaminant mobility and accumulation
Available toxicologic data	• Support interpretaiton of sample information • Establish possible reasons for abundance of species on site • Determine exposure pathways
Readily sampled for confirmation studies	• Acquire sufficient data to achieve study objective • Time and cost efficiencies
Reference area presence	• Establish comparative baseline for data analysis and interpretation • Identify background concentrations
Present at different sites	• Address potential site influences without interference from species differences • Address remedial action effectiveness without interference from species differences
Present after remediation	• Monitor and measure responses to remediation • Available for monitoring after cleanup • Sampling requirements are cost-effective and reasonable
Long-term monitoring	• Estimate effectiveness of remedial actions • Reflects changes in site conditions

TABLE 6-50

ERA RECEPTOR SPECIES

SPECIES	DESCRIPTION
Aquatic/Wetland Species	
Cattail (Typha latifolia)	Vascular herbaceous plant, predominant biomass.
Blacknose dace (Rhinichthys atrarulus)	Vertebrate, water column species, plankton food base.
Creek Chub (Semotilus atromaculatus)	Vertebrate, carnivore food base, water column species.
Caddisfly (Trichoptera Hydrosychidae)	Invertebrate, phytoplankton food base.
Terrestrial Species	
Brome (Bromus spp.)	Vascular plant, abundant biomass, a forage-food grass.
Mallard (Anas platyrhynchos)	Vertebrate, omnivore food base; wetland associate; transitional aquatic and terrestrial species.
White-footed deer mouse (Peromyscus leucopus)	Vertebrate, omnivore food base, upland habitats.

TABLE 6-51

CHARACTERISTICS OF RECEPTORS

RECEPTOR	CHARACTERISTIC
Vegetation	
Cattail (Typha latifolia)	• Widespread, present at or near all aquatic sites. • Important aquatic plant and nutrient source. • Comparative toxicological data available. • Reference plants and data available. • Perennial species.
Brome/Bluegrass (Bromus/Poa spp.)	• Widespread, present at or on most terrestrial sites. • Food plants for rodents. • Can be restored after remedial action. • Perennial species.
Invertebrates	
Caddisfly (Trichoptera Hydrosychidae)	• Aquatic phytoplankton consumer. • Water-column dwelling species. • Important in aquatic foodchains. • Comparative toxicological data available. • Sensitive to toxins.
Fish	
Creek chub (Semotilus atromaculatus)	• Second-order aquatic carnivore. • Water-column dwelling species. • Comparative toxicological data available. • Available on site.
Blacknose dace (Rhinichthys atrarulus)	• Base of several aquatic and terrestrial foodchains. • Limited mobility. • Abundant interpretive data available. • First-order aquatic consumer (plankton). • Probably present on site. • Can be established for monitoring after cleanup.

TABLE 6-51
(Con't)

CHARACTERISTICS OF RECEPTORS

RECEPTOR	CHARACTERISTIC
Bird	
Mallard (<u>Anas</u> <u>platyrhynchos</u>)	• Occurs on-site with limited reproduction. • Potential human consumption linkage. • Comparative interpretive information available. • Wetland associate.
Mammal	
White-footed deer mouse (<u>Peromyscus</u> <u>leucopus</u>)	• Can be established for monitoring after cleanup. • First-order terrestrial omnivore. • Basis of several food chains. • Comparative interpretive information available. • Present on-site. • Limited mobility. • Uses several upland habitats. • Toxicological data available.

6.6.4.2.2 Wildlife

The receptor species representing terrestrial wildlife is the deer mouse. The deer mouse has a relatively limited radius of mobility. It is abundant and a common associate of upland grasslands, riparian forests, wetlands, and many other cover types present at the Ash Landfill. It feeds primarily on plant materials, and also constitutes the primary prey for many predators. These characteristics make it a good indicator of potential effects on primary consumers due to contaminants in soils and plants, as well as an ideal indicator of potential food chain biomagnification effects. The abundant toxicological dosage data compiled for the laboratory mouse and rat may be transferred to the deer mouse with reasonable confidence. The mallard has been selected as the wildlife receptor species that would receive exposure from the small on-site wetlands. The mallard is present on the depot at the "duck ponds" and represents wildlife affiliated with wetlands, creeks, and small ponds of the study area. It is a consumer both of terrestrial and aquatic plants and aquatic macroinvertebrates, which makes it a good indicator of potential cumulative contaminant effects through both ecosystems. Abundant toxicological dose data are available for the mallard, especially for inorganic contaminants.

6.6.4.2.3 Wetlands

Wetland systems will be represented by the combined characteristics of the wetland-affiliated species mentioned above. All major biological groups typically associated with wetlands are represented by the receptors chosen for this ERA. The ability to make inferences about contaminant effects on wetland systems was a factor influencing the selection of receptors. The primary receptors are the mallard and cattail. Both species occur on site either on a permanent (cattail) or seasonal (mallard) basis. Toxicological data are available for both species. The cattail represents a typical, short-lived, aquatic vascular plant; the mallard represents a semi-aquatic species that forages seasonally for either aquatic macroinvertebrates or aquatic plants.

6.6.4.2.4 Aquatic Life

Receptor species representing the fish component of the aquatic community are the creek chub and the blacknose dace. Both species can occupy stream and pond environments and both are present in Kendaia Creek. The creek chub is the receptor representing predatory fish species, while the blacknose dace represents first-order consumers dependent on phytoplankton and zooplankton. These fish also represent potential forage fish for wildlife predators. Receptor species representing the aquatic macroinvertebrate component is the caddisfly. The caddisfly is associated predominantly with the water column and is an important component of the aquatic food chain. This receptor represents a fundamental prey population for many aquatic and wetland food chains.

6.6.4.2.5 Endpoint Selection

In each major biological group, the risk assessment endpoints selected for this ERA focus on lethal and sublethal effects at the species and population levels, with habitats being addressed through effects to major species or physical media that characterize that habitat. Assessment endpoints for the species receptors include death, reduced survival, and reduced growth or productivity. Assessment endpoints for wetlands are the likely presence of contaminated sediments and surface waters with contaminant concentrations high enough to induce adverse effects in the receptors specifically chosen to represent wetland plants and animals. As was noted above, wetland-associated receptors include the mallard, caddisfly, cattail, and blacknose dace. These endpoints were selected because experience in conducting ERAs indicates that sufficient technical and toxicological information are available to evaluate risks for these endpoints. Experience and research demonstrate that the ability to confidently separate contaminant-induced effects from other normal environmental regulating factors is most refined at the species and population levels of organization.

6.6.4.3 Risk Evaluation Criteria

ARARs are available for limited sectors of the diverse biological environment. Federal and state ARARs, based on the Clean Water Act and reflecting acute and chronic aquatic life standards, are generally used to establish freshwater aquatic life protection requirements. Risks to the remaining biological groups are evaluated by comparing site chemical concentrations to toxicological response data derived from laboratory and field testing and as reported in technical literature. In some situations, USEPA and NYSDEC have issued advisories or guidelines addressing acceptable concentrations of chemicals of concern in specific physical media. These recommendations are considered TBCs and are generally intended as interim planning or evaluation guidelines for avoiding or minimizing potential adverse effects from food chain biomagnification, bioaccumulation, or chronic exposures. The recommendations are usually chemical specific. Environmental risks are derived from several ARARs and TBCs. They are discussed separately for the applicable receptor groups.

6.6.4.3.1 Vegetation

Primary media of concern for terrestrial vegetation are soils and shallow (less than 8 feet deep) ground water. There are no established federal or NYSDEC ARARs relating specific chemical concentrations in these media directly to toxic effects on vegetation. However, there are toxicological data that relate soil concentrations of numerous inorganic chemicals to adverse effects on many agriculturally-important plants and to some common native plant species. USEPA (1983) has published guidelines addressing recommended maximum soil concentrations of some inorganic chemicals to avoid direct phytotoxic effects to plants and indirect food chain effects on wildlife and livestock foraging on plants grown in these soils. These guidelines are used as TBCs to evaluate potential risks to vegetation from inorganic chemicals of concern and are presented in Table 6-52.

Available data relating organic chemicals to toxic effects on terrestrial plant species are very limited. Historically, organic chemicals other than herbicides have not been a major cause of plant mortality or stress, nor are they naturally occurring in unpolluted environments. Consequently, there are no formal organic chemical guidelines or recommended safety thresholds that are widely recognized as applicable for this type of impact evaluation.

Toxicological threshold and phytotoxic concentrations are applied to the extent they were available in the literature.

6.6.4.3.2 Wildlife

There are no promulgated or established federal or NYSDEC ARARs relating specific chemical concentrations in soils or sediments, directly to toxic effects on wildlife species. There are NYSDEC guidelines to protect wildlife that consume aquatic life that is in contact with contaminated sediments (NYSDEC, 1991). There are toxicological testing data that relate known chemical dosages in either food or surface water to acute and chronic effects on specific species. These dosage values are important as reference points. However, dosage values cannot be used as absolute measurements of risk because other sophisticated site measurements required to credibly apply the dosage data (e.g.,proportion of a species' annual diet derived from the site) involve analyses of food chain dynamics beyond the scope of this

TABLE 6-52
SENECA ARMY DEPOT
ASH LANDFILL
ECOLOGICAL RISK ASSESSMENT

CHEMICALS OF POTENTIAL CONCERN TO TERRESTRIAL VEGETATION IN SOILS

COMPOUND	EXPOSURE POINT CONCENTRATION (a)	REGULATORY GUIDELINES (b)	NORMAL CONCENTRATIONS (c)	PHYTOTOXIC CONCENTRATIONS
Volatile Organic Compounds (ug/kg)				
Vinyl Chloride	16.0	NA	NA	200,000 d
Chloroethane	0.0	NA	NA	NA
Acetone	17.4	NA	NA	NA
Carbon Disulfide	11.1	NA	NA	NA
1,1-Dichloroethene	11.1	NA	NA	NA
1,2-Dichloroethene (total)	584.3	NA	NA	NA
Chloroform	5.1	NA	NA	NA
1,2-Dichloroethane	9.5	NA	NA	NA
2-Butanone	7.2	NA	NA	NA
1,1,1-Trichloroethane	0.0	NA	NA	> 20,000 e
Trichloroethene	1,592.9	NA	NA	NA
Benzene	3.0	NA	NA	525,000 d
Tetrachloroethene	3.4	NA	NA	> 20,000 e
Toluene	11.6	NA	NA	> 20,000 e
Chlorobenzene	11.1	NA	NA	> 20,000 e
Ethylbenzene	11.7	NA	NA	190,000,000 d
Xylene (total)	16.0	NA	NA	> 20,000 e
Semivolatiles (ug/kg)				
Phenol	398.0	NA	NA	1580 e
2-Nitrophenol	398.0	NA	NA	NA
Benzoic acid	128.4	NA	NA	NA
Naphthalene	446.1	NA	NA	2000 e
2-Methylnaphthalene	360.1	NA	NA	NA
Acenaphthylene	251.1	NA	NA	NA
Acenaphthene	538.6	NA	NA	500 e
4-Nitrophenol	711.5	NA	NA	NA
Dibenzofuran	407.8	NA	NA	NA
2,4-Dinitrotoluene	444.4	NA	NA	NA
Fluorene	464.4	NA	NA	NA
N-Nitrosodiphenylamine	232.9	NA	NA	NA
Phenanthrene	1,047.9	NA	NA	NA
Anthracene	790.9	NA	NA	NA
Di-n-butylphthalate	373.6	NA	NA	> 20,000 e
Fluoranthene	1,397.5	NA	NA	NA
Pyrene	1,320.9	NA	NA	NA
Butylbenzylphthalate	140.0	NA	NA	NA
Benzo(a)anthracene	915.8	NA	NA	NA
Chrysene	889.2	NA	NA	NA
bis(2-Ethylhexyl)phthalate	987.7	NA	NA	> 20,000 e
Di-n-octylphthalate	227.4	NA	NA	NA
Benzo(b)fluoranthene	833.2	NA	NA	NA
Benzo(k)fluoranthene	711.5	NA	NA	NA
Benzo(a)pyrene	876.0	NA	NA	NA
Indeno(1,2,3-cd)pyrene	635.4	NA	NA	NA
Dibenz(a,h)anthracene	466.2	NA	NA	NA
Benzo(g,h,i)perylene	680.9	NA	NA	NA

TABLE 6-52
SENECA ARMY DEPOT
ASH LANDFILL
ECOLOGICAL RISK ASSESSMENT

CHEMICALS OF POTENTIAL CONCERN TO TERRESTRIAL VEGETATION IN SOILS

COMPOUND	EXPOSURE POINT CONCENTRATION (a)	REGULATORY GUIDELINES (b)	NORMAL CONCENTRATIONS (c)	PHYTOTOXIC CONCENTRATIONS
Herbicides (ug/kg)				
2,4-DB	41.1	NA	NA	NA
2,4,5-TP (Silvex)	3.4	NA	NA	NA
MCPP	4,905.2	NA	NA	NA
Pesticides/PCBs (ug/kg)				
Heptachlor	7.7	NA	NA	NA
Dieldrin	16.1	NA	NA	NA
4,4'-DDE	42.9	NA	NA	NA
4,4'-DDD	29.4	NA	NA	NA
4,4'-DDT	36.4	NA	NA	NA
Aroclor-1242	82.7	NA	NA	NA
Aroclor-1260	161.1	NA	NA	NA
Metals (mg/kg)				
Cadmium	5.5	3	0.6-15	2.5-5.0 d
Chromium	30.6	1000	53-120	100-500 d
Copper	71.6	250	20-50	70-640 d
Lead	264.9	1,000	<1-120	150-1,000 d
Potassium	1,900.4	NA	23,000	NA
Silver	1.0	NA	<0.5	25-50 d
Sodium	122.4	NA	12,000	NA
Zinc	1,579.7	500	44-220	500-2,000 d

NOTES:

a) The 95th Upper Confidence Limit (UCL) or maximum detected as calculated from the validated data.
Non-detects were taken at half value and detects at full value.
Rejected data was eliminated. Metals not statistically different, at the 90th % UCL, were deleted from further consideration.
Any compound with no detects in a given media was eliminated from the assessment of that media.
NA = Not Available

b) Source: USEPA, 1983.

c) Concentrations reported as normal or background in soils in technical literature. Sources include Swaine, 1955; Bowen, 1966; Allaway, 1968; Gough et al., 1979; Richardson, 1987; and Bower, 1990.

d) Concentrations reported as phtotoxic in soils in technical literature. Sources include Gough et al., 1979; USEPA, 1983; and Beyer, 1990.

e) Value is 2% of the EC50 for lettuce. Source: Hulzebos et al, 1993.

study. For potential wildlife risks encountered through diet, toxic contaminant concentrations and resulting effects reported for laboratory animals, such as ducks and mice, are used as appropriate. These comparative values are summarized in Table 6-53 for chemicals of potential concern reported in soils and sediments on or near the Ash Landfill. The concentrations in soil that would result in chronic toxicity effects in wildlife were estimated.

Soil and sediment concentrations considered to be protective of wildlife receptor species exposed to on-site soil or on-site wetland sediment have been estimated and used to compare the 95th UCL soil and sediment concentrations with the calculated concentrations. These protective soil and sediment concentrations were derived in the following manner. First, a No Observed Effect Level (NOEL) representative of the chronic toxicity threshold were estimated as 1.5% of LD_{50}. The LD_{50}s were obtained from either literature articles or a search of the TOMES toxicity database. The LD_{50}s used were either for rats/mice or for ducks. Layton et.al (1987) reviewed acute and chronic toxicity data for 41 differenct organic chemicals and determined the overall geometric mean of the ratio of the NOEL and the LD_{50} as 0.015. The NOEL has units of mg of pollutant per Kg of body weight per day. Using this value and equating the NOEL to the Average Daily Dose the following equation can be solved to estimate the concentration in soil that would be equivalent to an allowable level, protective of wildlife. This equation, obtained from the EPA wildlife Exposure Factors Handbook (Dec. 1993), is:

$$C_{ALLOW} = \frac{Add \cdot BW}{FS \cdot IR \cdot FR}$$

where:

C_{ALLOW} = Allowable soil concentration (mg/Kg).

Add = Average Daily Dose = NOEL (mg/Kg·day), estimated from 0.015 x LD_{50}, Layton et.al (1987).

TABLE 6-53
SENECA ARMY DEPOT
ASH LANDFILL
ECOLOGICAL RISK ASSESSMENT

CHEMICALS OF POTENTIAL CONCERN TO WILDLIFE IN SEDIMENT AND SOILS

	EXPOSURE POINT CONCENTRATION(a)		SEDIMENT	NOEL – mg/Kg-day (c)		Est. Conc. causing Chronic Toxicity(d) Soil	Sediment	Ref. for Mouse Data	Ref. for Mallard Data
COMPOUND	SOIL	SEDIMENT	GUIDELINE (b)	DEER MOUSE	MALLARD	DEER MOUSE	MALLARD		
Volatile Organics (ug/kg)									
Vinyl Chloride	16.0			7.50	NA	5,000,000	NA	(1)	
Chloroethane				NA	NA	NA	NA		
Acetone	17.4	10.8	NA	84.00	30.00	56,000,000	11,090,000	(1)	(1)
Carbon Disulfide	11.1			478.20	NA	318,800,000	NA	(1)	
1,1-Dichloroethene	11.1	8.4	NA	3.00	NA	2,000,000	NA	(1)	
1,2-Dichloroethene (total)	584.3	144.9	NA	NA	NA	NA	NA		
Chloroform	5.1	5.9	NA	28.13	NA	18,750,000	NA	(1)	
1,2-Dichloroethane	9.5			10.05	NA	6,700,000	NA	(1)	
2-Butanone	7.2			40.50	NA	27,000,000	NA	(1)	
1,1,1-Trichloroethane				144.00	NA	96,000,000	NA	(1)	
Trichloroethene	1,592.9	6.3	NA	1,077.00	NA	718,000,000	NA	(1)	
Benzene	3.0			75.00	NA	50,000,000	NA	(1)	
Tetrachloroethene	3.4			39.44	NA	26,290,000	NA	(1)	
Toluene	11.6			9.54	NA	6,360,000	NA	(1)	
Chlorobenzene	11.1			34.35	NA	22,900,000	NA	(1)	
Ethylbenzene	11.7			52.50	NA	35,000,000	NA	(1)	
Xylene (total)	16.0			64.50	NA	43,000,000	NA	(1)	
Semivolatiles (ug/kg)									
Phenol	398.0			7.95	NA	5,300,000	NA	(1)	
bis (2-chloroethyl) ether				1.13	NA	750,000	NA	(1)	
4-Methylphenol		100.0	NA	27.00	NA	18,000,000	NA	(1)	
2-Nitrophenol	398.0			19.46	NA	12,970,000	NA	(1)	
Benzoic acid	128.4			25.50	NA	17,000,000	NA	(1)	
Naphthalene	446.1	22.0	NA	7.35	NA	4,900,000	NA	(1)	
2-Methylnaphthalene	360.1	30.0	NA	24.45	NA	16,300,000	NA	(1)	
Acenaphthylene	251.1	151.8	NA	NA	NA	NA	NA		
Acenaphthene	538.6			NA	NA	NA	NA		
4-Nitrophenol	711.5			5.25	NA	3,500,000	NA	(1)	
Dibenzofuran	407.8			NA	NA	NA	NA		
2,4-Dinitrotoluene	444.4	100.0	NA	40.20	NA	26,800,000	NA	(1)	
Fluorene	464.4	20.0	NA	NA	NA	NA	NA		

TABLE 6-53
SENECA ARMY DEPOT
ASH LANDFILL
ECOLOGICAL RISK ASSESSMENT

CHEMICALS OF POTENTIAL CONCERN TO WILDLIFE IN SEDIMENT AND SOILS

COMPOUND	EXPOSURE POINT CONCENTRATION(a)		SEDIMENT GUIDELINE (b)	NOEL – mg/Kg-day (c)		Est. Conc. causing Chronic Toxicity(d)		Ref. for Mouse Data	Ref. for Mallard Data
	SOIL	SEDIMENT		DEER MOUSE	MALLARD	Soil DEER MOUSE	Sediment MALLARD		
N-Nitrosodiphenylamine	232.9	55.0	NA	7.20	NA	4,800,000	NA	(1)	
Phenanthrene	1,047.9	499.5	NA	25.50	NA	17,000,000	NA	(1)	
Anthracene	790.9	187.0	NA	12.75	NA	8,500,000	NA	(1)	
Carbazole		93.1	NA	75.00	NA	50,000,000	NA	(1)	
Di-n-butylphthalate	373.6	22.9	NA	18.00	3.75	12,000,000	1,386,250	(1)	(1)
Fluoranthene	1,397.5	2,522.4	NA	30.00	NA	20,000,000	NA	(1)	
Pyrene	1,320.9	2,176.2		40.50	NA	27,000,000	NA	(1)	
Butylbenzylphthalate	140.0		NA	349.95	NA	233,300,000	NA	(1)	
Benzo(a)anthracene	915.8	1,696.3	NA	NA	NA	NA	NA		
Chrysene	889.2	1,634.5	NA	NA	NA	NA	NA		
bis(2-Ethylhexyl)phthalate	987.7	732.9	NA	459.00	NA	306,000,000	NA	(1)	
Di-n-octylphthalate	227.4			390.00	NA	260,000,000	NA	(1)	
Benzo(b)fluoranthene	833.2	1,609.6	NA	NA	NA	NA	NA		
Benzo(k)fluoranthene	711.5	1,424.3	NA	NA	NA	NA	NA		
Benzo(a)pyrene	876.0	1,658.4	NA	15.00	NA	10,000,000	NA	(1)	
Indeno(1,2,3-cd)pyrene	635.4	1,263.4	NA	NA	NA	NA	NA		
Dibenz(a,h)anthracene	466.2	537.3	NA	0.01	NA	8,000	NA	(1)	
Benzo(g,h,i)perylene	680.9	971.2	NA	NA	NA	NA	NA		
Herbicides (ug/kg)									
2,4-DB	41.1			29.40	3.75	19,600,000	1,386,250	(1)	(1)
2,4,5-TP (Silvex)	3.4			9.75	3.38	6,500,000	1,247,625	(1)	(1)
MCPP	4,905.2			13.95	3.75	9,300,000	1,386,250	(1)	(1)
Pesticides/PCBs (ug/kg)									
Heptachlor	7.7			1.35	0.34	900,000	124,763	(1)	(1)
Dieldrin	16.1			0.56	0.11	370,000	42,419	(1)	(1)
4,4'-DDE	42.9	27.2	NA	NA	2.68	NA	990,337		(1)
Endrin		2.3	8	0.11	0.0042	70,000	1,553	(1)	(7)
4,4'-DDD	29.4	1.7	10	NA	3.61	NA	1,334,682		(1)
Endosulfan sulfate		2.9	NA	NA	NA	NA	NA		
4,4'-DDT	36.4	2.4	10	1.70	0.0004	1,130,000	139	(1)	(1)
alpha-Chlordane		2.3	NA	5.03	0.90	3,350,000	332,700	(2)	(7)
Aroclor-1242	82.7			NA	2.39	NA	882,210		(1)
Aroclor-1260	161.1	36.9	NA	NA	1.48	NA	547,569		(1)

TABLE 6-53
SENECA ARMY DEPOT
ASH LANDFILL
ECOLOGICAL RISK ASSESSMENT

CHEMICALS OF POTENTIAL CONCERN TO WILDLIFE IN SEDIMENT AND SOILS

COMPOUND	EXPOSURE POINT CONCENTRATION(a)		SEDIMENT GUIDELINE (b)	NOEL - mg/Kg-day (c)		Est. Conc. causing Chronic Toxicity(d) Soil	Est. Conc. causing Chronic Toxicity(d) Sediment	Ref. for Mouse Data	Ref. for Mallard Data
	SOIL	SEDIMENT		DEER MOUSE	MALLARD	DEER MOUSE	MALLARD		
Metals (mg/kg)									
Aluminum		15,013.5	NA	150.00	NA	100,000	NA	(3)	
Antimony		6.5	NA	105.00	NA	70,000	NA	(1)	
Arsenic		7.4	NA	11.45	3.75	7,630	1,386	(1)	(5)
Barium		123.3	NA	12.00	NA	8,000	NA	(4)	
Beryllium		0.9	NA	1.29	NA	860	NA	(1)	
Cadmium	5.5	2.5	NA	0.34	0.15	225	55	(3)	(6)
Calcium		60,107.1	NA	NA	NA	NA	NA		
Chromium	30.6	24.6	NA	3.75	NA	2,500	NA	(3)	
Cobalt		11.2	NA	0.15	0.08	100	28	(4)	(1)
Copper	71.6	39.7	NA	1.80	NA	1,200	NA	(5)	
Iron		28,305.2	NA	450.00	NA	300,000	NA	(1)	
Lead	264.9	95.6	NA	1.20	0.38	800	139	(1)	(5)
Magnesium		7,356.3	NA	NA	NA	NA	NA		
Manganese		675.4	NA	15.00	36.00	10,000	13,308	(3)	(3)
Mercury		0.2	NA	6.00	0.0005	4,000	0.18	(3)	(1)
Nickel		32.0	NA	30.00	NA	20,000	NA	(3)	
Potassium	1,900.4	1,788.7	NA	NA	NA	NA	NA		
Selenium		0.8	NA	NA	NA	NA	NA		
Silver	1.0	0.6	NA	NA	NA	NA	NA		
Sodium	122.4	94.7	NA	0.75	NA	500	NA	(1)	
Thallium		0.5	NA	0.24	NA	158	NA	(1)	
Vanadium		23.9	NA	0.19	0.08	125	27.73	(1)	(1)
Zinc	1,579.7	455.1	NA	37.50	NA	25,000	NA	(5)	
Cyanide		0.6	NA	NA	0.01	NA	3.88		(1)

NOTES:

a) The 95th % Upper Confidence Limit (UCL) or maximum detected as calculated from the validated data.
Non-detects were taken at half value and detects at full value.
Rejected data was eliminated. Metals not statistically different from background, at the 95 % UCL, were deleted.
Any compound with no detects in a given media was eliminated from the assessment of that media.

b) NYSDEC 1989 guidelines to protect wildlife that consumes aquatic life that is in contact with contaminated sediments.

c) NOEL values calculated as 0.015 x LD50 (Layton,et al 1987). Sources for LD50s include:Ref.(1) Micromedex, Inc.(1993); Ref.(2) Eisler, (1990); Ref.(3) Gough et al., 1979; Ref.(4) McKee and Wolf,(1963); Ref.(5) CH2M Hill, Inc. (1989); Ref.(6) Synder and Synder, (1984); Ref.(7) Hudson et al., (1985).

d) Concentration in soil that represent the estimated chronic concentration for the species. Chronic toxicity concentrations were calculated using wildlife oral dose equation in Wildlife Exposure Factors Handbook, EPA 1993.

e) NA = Not Available.

FS = Fraction of soil in diet (as a percentage of diet on a day-weight basis divided by 100; unitless), estimated from Beyer et.al (1994) as 0.02 for the mouse and 0.033 for the mallard.

IR = Food ingestion rate on a dry-weight basis (Kg/day), estimated from Sax and Lewis, (1984) as 15 g/day for the mouse and 250 g/day for the mallard.

FR = Fraction of total food intake (unitless), assumed to be one for both the mouse and the mallard.

BW = Body weight (Kg), estimated from Sax and Lewis (1984) as 0.2 Kg for the mouse and 2.5 Kg for the mallard.

Using this procedure, the soil/sediment concentration protective of wildlife for each constituent of concern was estimated and are presented in Table 6-53. Since the White Footed Deer Mouse was chosen as the terrestrial species receptor, the LD_{50}s for the mouse or the rat were used as the basis to estimate the NOEL. The mallard was chosen as the wetland species receptor and the LD_{50}s for the duck was used as the basis to estimate the NOEL.

For surface-water risks to wildlife, aquatic water quality criteria to protect wildlife from adverse effects of drinking contaminated surface water (NAS 1926) were used in this risk assessment. Guidelines are presented in Table 6-54.

6.6.4.3.3 Wetlands

Wetland communities are not specifically protected by chemical-specific ARARs; instead, they are protected by a location-specific ARAR. If a wetland is considered to be under the jurisdictional review of the Clean Water Act, its damage or loss from discharges of dredged or fill materials is regulated under provisions of Section 404 of the Clean Water Act. Under these provisions, impacts to wetland acreages, functions, and values are to be avoided to the fullest extent possible, and mitigated if impacts are inevitable. Both the U.S. Army Corps of Engineers and USEPA are charged with enforcing provisions of Section 404. Because it appears that jurisdictional wetlands may occur on the site, Section 404 regulatory provisions are used as evaluation criteria.

TABLE 6-54
ASH LANDFILL
SENECA ARMY DEPOT
ECOLOGICAL RISK ASSESSMENT
CHEMICALS OF POTENTIAL CONCERN TO WILDLIFE IN SURFACE WATER

COMPOUND	EXPOSURE POINT CONCENTRATION (a)	RECOMMENDED LIMIT (b)
Volatile Organic Compounds (ug/l)		
Chloroform	2.00	NA
Metals (ug/l)		
Aluminum	2,410.0	5000
Antimony	74.3	NA
Arsenic(III)	2.2	200
Barium	81.5	NA
Beryllium	0.8	NA
Calcium	125,906.3	NA
Chromium(III)	5.6	1000
Cobalt	6.9	1000
Copper	15.9	500
Iron	8,750.0	NA
Lead	42.3	100
Magnesium	14,350.5	NA
Manganese	941.0	NA
Mercury	0.1	10
Nickel	11.2	NA
Potassium	3,267.8	NA
Selenium	1.9	50
Sodium	2,180,000.0	NA
Vanadium	16.3	100
Zinc	187.0	25,000

NOTES:

a) The 95th % Upper Confidence Limit (UCL) or maximum detected as calculated from the validated data. Non-detects were taken at half value and detects, including estimated values, were taken at full value. Rejected data was eliminated.
Any compound with no detects was eliminated from the assessment of that media.

b) NAS and NAE (1972).

c) NA = Not Available.

Section 404(b)(1) guidelines specify conditions permitting wetland alterations. These guidelines specifically prohibit activities that cause or contribute to violations of any applicable state water quality standard or that cause significant adverse effects to aquatic life or wildlife from the spread of pollutants through physical, chemical, or biological processes. A benefit evaluation involves deciding whether the environmental effects of altering a wetland to remove or prevent contamination outweigh the benefits of leaving the contaminated wetlands intact. Consequently, the risk assessment will be substantially influenced by findings of the aquatic life, wildlife, and vegetation assessments and the proposed remedial action alternative, especially those elements that could involve excavation and/or filling of wetland areas.

General risks to the mallard, cattail, caddisfly and other wetland-associated receptors are used as indicators of possible population-level and habitat-level impacts from chemicals of potential concern. There are no chemical-specific ARARs established for the receptor species linking chemical concentrations in physical media (soils, sediments, or surface waters) directly to acute or chronic toxicological effects.

6.6.4.3.4 Aquatic Life

Under the authority of the Clean Water Act, USEPA has developed federal water-quality criteria (WQC), including criteria for protection of aquatic life, for more than 120 inorganic and organic compounds. Numerical ambient WQC are provided to protect freshwater animals and nonvascular plants from chronic and acute toxicities (USEPA, 1991g). These criteria, as well as analogous aquatic life protection criteria established by the State of New York State AWQC (NYSDEC, 1991), are used as chemical-specific ARARs for receptors in the aquatic life group. These ARARs are listed in Table 6-55 for chemicals of potential concern.

Additionally, federal and state reference guidelines have been established for protection of aquatic life in sediments and are used as chemical-specific TBCs for ecological receptors in the aquatic life group (USEPA, 1991b,c,d,e and f)(NYSDEC, 1991) (NOAA, 1991). These TBCs are listed in Table 6-56 for chemicals of potential concern. The NYSDEC sediment criteria were calculated by assuming an organic carbon content of 1% in the sediment.

6.6.4.4 Exposure Pathways to Biological Receptors

This section identifies potential pathways of exposure of contaminants of potential concern to biota. The concepts of bioaccumulation and biomagnification are used throughout this

TABLE 6-55
ASH LANDFILL
SENECA ARMY DEPOT
ECOLOGICAL RISK ASSESSMENT
CHEMICALS OF POTENTIAL CONCERN TO AQUATIC LIFE IN SURFACE WATER

COMPOUND	EXPOSURE POINT CONCENTRATION (a)	REGULATORY STANDARD (b) FEDERAL ACUTE	REGULATORY STANDARD (b) FEDERAL CHRONIC	NYSDEC CLASS C AWQC (c)	NYSDEC CLASS D AWQC (c)
Volatile Organic Compounds (ug/l)					
Chloroform	2.00	NA	NA	NA	NA
Metals (ug/l)					
Aluminum	2,410.0	750	87	100	NA
Antimony	74.3	88	30	NA	NA
Arsenic	2.2	360	190	190	360
Barium	81.5	NA	NA	NA	NA
Beryllium	0.8	130	5.3	1100	NA
Calcium	125,906.3	NA	NA	NA	NA
Chromium	5.6	4270	509	509	4270
Cobalt	6.9	NA	NA	5	NA
Copper	15.9	65.4	38.7	30	50
Iron	8,750.0	NA	1000	300	300
Lead	42.3	332	13	13	332
Magnesium	14,350.5	NA	NA	NA	NA
Manganese	941.0	NA	NA	NA	NA
Mercury	0.1	2.4	0.012	0.2	0.2
Nickel	11.2	4251	220	220	4251
Potassium	3,267.8	NA	NA	NA	NA
Selenium	1.9	20	5	1.0	NA
Sodium	2,180,000.0	NA	NA	NA	NA
Vanadium	16.3	NA	NA	14	190
Zinc	187.0	296	268	30	800

NOTES:

a) The 95th % Upper Confidence Limit (UCL) or maximum detected as calculated from the validated data.
Non-detects were taken at half value and detects at full value.
Rejected data was eliminated.
Any compound with no detects in a given media was eliminated from the assessment of that media.

b) Based on a calculated water hardness of 300 mg/L CaCO3, a mean pH of 7.8, and a water temperature of 20 degrees C. Sources: USEPA, 1991a.

c) NYSDEC, 1991 based on current water quality stream classification of "D" and proposed classification of "C" for Kendaia Creek.

TABLE 6-56
SENECA ARMY DEPOT
ASH LANDFILL
ECOLOGICAL RISK ASSESSMENT
CHEMICALS OF POTENTIAL CONCERN TO AQUATIC LIFE IN SEDIMENTS

COMPOUND	EXPOSURE POINT CONCENTRATION (a)	REFERENCE GUIDELINES AQUATIC LIFE				
		NYSDEC (b)		NOAA (c)		PROPOSED FEDERAL (e)
		CRITERIA	LOT (d)	ER-L	ER-M	
Volatile Organic Compounds (ug/kg)						
Acetone	10.8	NA	NA	NA	NA	NA
1,1-Dichloroethene	8.4	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	144.9	NA	NA	NA	NA	NA
Chloroform	5.9	NA	NA	NA	NA	NA
Trichloroethene	6.3	NA	NA	NA	NA	NA
Semivolatiles (ug/kg)						
4-Methylphenol	100.0	6 (f)	NA	NA	NA	NA
Naphthalene	22.0	NA	NA	340	2100	1200 (g)
2-Methylnaphthalene	30.0	NA	NA	65	670	NA
Acenaphthylene	151.8	NA	NA	NA	NA	1400
2,4-Dinitrotoluene	100.0	NA	NA	NA	NA	NA
Fluorene	20.0	NA	NA	35	640	1200 (g)
N-Nitrosodiphenylamine (1)	55.0	NA	NA	NA	NA	NA
Phenanthrene	499.5	1390	NA	225	1380	1200 (g)
Anthracene	187.0	NA	NA	85	960	1200 (g)
Carbazole	93.1	NA	NA	NA	NA	NA
Di-n-butylphthalate	22.9	1197 (h)	NA	NA	NA	NA
Fluoranthene	2,522.4	NA	NA	600	3600	1200 (g)
Pyrene	2,176.2	NA	NA	350	2200	1200 (g)
Benzo(a)anthracene	1,696.3	NA	NA	230	1600	1200 (g)
Chrysene	1,634.5	NA	NA	400	2800	1200 (g)
bis(2-Ethylhexyl)phthalate	732.9	1197 (h)	NA	NA	NA	NA
Benzo(b)fluoranthene	1,609.6	NA	NA	NA	NA	1200 (g)
Benzo(k)fluoranthene	1,424.3	NA	NA	NA	NA	1200 (g)
Benzo(a)pyrene	1,658.4	NA	NA	400	2500	1200 (g)
Indeno(1,2,3-cd)pyrene	1,263.4	NA	NA	NA	NA	1200 (g)
Dibenz(a,h)anthracene	537.3	NA	NA	60	260	1200 (g)
Benzo(g,h,i)perylene	971.2	NA	NA	NA	NA	1200 (g)
Pesticides/PCBs (ug/kg)						
4,4'-DDE	27.2	500	NA	2	15	NA
Endrin	2.3	8	NA	0.02	45	40
4,4'-DDD	1.7	500	NA	2	20	NA
Endosulfan sulfate	2.9	NA	NA	NA	NA	NA
4,4'-DDT	2.4	500	NA	1	7	NA
alpha-Chlordane	2.3	0.06	NA	0.5	6	NA
Aroclor-1260	36.9	NA	NA	NA	NA	NA

TABLE 6-56
SENECA ARMY DEPOT
ASH LANDFILL
ECOLOGICAL RISK ASSESSMENT
CHEMICALS OF POTENTIAL CONCERN TO AQUATIC LIFE IN SEDIMENTS

COMPOUND	EXPOSURE POINT CONCENTRATION (a)	REFERENCE GUIDELINES AQUATIC LIFE				
		NYSDEC (b)		NOAA (c)		PROPOSED FEDERAL (e)
		CRITERIA	LOT (d)	ER-L	ER-M	
Metals (mg/kg)						
Aluminum	15,013.5	NA	NA	NA	NA	NA
Antimony	6.5	NA	NA	2	25	NA
Arsenic	7.4	5	33	33	85	NA
Barium	123.3	NA	NA	NA	NA	NA
Beryllium	0.9	NA	NA	NA	NA	NA
Cadmium	2.5	0.8	10	5	9	NA
Calcium	60,107.1	NA	NA	NA	NA	NA
Chromium	24.6	26	111	80	145	NA
Cobalt	11.2	20	NA	NA	NA	NA
Copper	39.7	19	114	70	390	NA
Iron	28,305.1	24000	40000	NA	NA	NA
Lead	95.6	27	250	35	110	NA
Magnesium	7,356.2	NA	NA	NA	NA	NA
Manganese	675.4	428	1100	NA	NA	NA
Mercury	0.2	0.11	2	0.15	1.3	NA
Nickel	32.0	22	90	30	50	NA
Potassium	1,788.7	NA	NA	NA	NA	NA
Selenium	0.8	NA	NA	NA	NA	NA
Silver	0.6	NA	NA	1	2.2	NA
Sodium	94.9	NA	NA	NA	NA	NA
Thallium	0.5	NA	NA	NA	NA	NA
Vanadium	23.9	NA	NA	NA	NA	NA
Zinc	455.1	85	800	120	270	NA
Cyanide	0.6	NA	NA	NA	NA	NA

NOTES:

a) The 95th % Upper Confidence Limit (UCL) or maximum detected as calculated from the validated data.
Non-detects were taken at half value and detects at full value.
Rejected data was eliminated.
Any compound with no detects in a given media was eliminated from the assessment of that media.

b) NYSDEC 1989 Guideline values calculated assuming an organic carbon content of 1%.

c) National Oceanic and Atmospheric Administration

d) LOT = limit of tolerance. Represents point at which significant toxic effects on benthic species occur. (NYSDEC,1989)

e) Sources: USEPA , 1991b; 1991c; 1991d; 1991e; 1991f.

f) NYSDEC (1989) guidelines for total phenols.

g) Used lowest proposed USEPA criterion for PAHs (phenanthrene).

h) Used NYSDEC (1989) guideline for phthalates (bis(2-Ethylhexyl)phthalate).

report. Because these concepts have been historically applied in several ways, the following definitions describe their application in this study. Bioaccumulation is considered to be a process by which toxic substances are absorbed by organisms from the surrounding physical environment (e.g., fish absorbing mercury from water) or through consumption of another organism. Biomagnification refers to the resultant total process, by which tissue concentrations of bioaccumulated toxic substances increase as the substances pass up through two or more trophic levels (adapted from Brunge and Mount, 1978).

Chemical analyses of physical media samples suggest potential pathways exist between contaminant sources at the Ash Landfill and terrestrial, wetland, and aquatic receptors. Ecological exposure pathways for biota may be direct or indirect. Direct exposure pathways include dermal contact, absorption, inhalation, and ingestion. Examples of direct exposure include animals incidentally ingesting contaminated soil or sediment or inhaling airborne contaminants (e.g., during burrowing or dust-bathing activities); plants absorbing contaminants by uptake from contaminated sediments or soils; and dermal contact of aquatic organisms with contaminated surface water. Indirect exposure pathways for biota can occur when terrestrial or aquatic fauna consume previously-contaminated biota. Examples of indirect exposure include higher-order animals consuming plants or other animals that bioaccumulate.

Contamination of biota could result from exposure to one or more chemicals of potential concern at the Ash Landfill. Chemical bioavailability is an important contaminant characteristic that regulates a receptor's reaction to contaminant exposure. Bioavailable chemicals are in a chemical form that a receptor can accumulate and react to. Bioavailability, which is regulated by several physical and chemical environmental factors, is a concern with many inorganic chemicals, especially the metals. Pathway evaluations must account for this characteristic. In addition to bioavailability, exposure pathways for contaminants consist of four components: 1) source and mechanism of contaminant release, 2) transport medium, 3) potential receptors, and 4) exposure route. All components were evaluated during this study. If either contaminant bioavailability or the exposure pathway between contaminated media and the receptors are not complete, then contaminants in those media do not constitute an environmental risk at the Ash Landfill.

Potential sources of contaminants include surface soils, surface water runoff and sediments. Mechanisms for release of contaminants include fugitive dust generation/deposition, surface water runoff, tracking, and burrowing. Primary transport media at the facility include surface water, sediment, soil, and biota. Exposure routes for chemicals of concern include ingestion (active and incidental), dermal contact, inhalation, and uptake (absorption of chemicals by flora). These pathway components are discussed below as they relate to the transport media sampled during the site investigation. Biota (i.e., indirect food chain) pathways are not addressed because this medium was not within the scope of the sampling program.

6.6.4.4.1 Soil

On-site soil represents a potential transport medium for the chemicals of concern. Potential sources include surface deposited waste, deposition of airborne contaminants, and migrating chemicals in surface water. The release mechanisms for chemicals in soil include leaching, surface runoff, tracking, and fugitive dust generation/deposition. Potential receptors in soil are terrestrial flora and fauna. Exposure routes include dermal contact by birds, mammals, and invertebrates; uptake by plants; and incidental ingestion or inhalation by birds and mammals while foraging and grooming. Consumption of contaminated biota by higher-order predators in the food chain can provide an indirect exposure pathway for some soil chemicals.

Soil exposure pathways are potentially important for terrestrial plants and wildlife at the Ash Landfill. Plants are directly exposed to contaminants in soil by absorption and assimilation of soluble chemical forms through the root system. This pathway would be the primary exposure route for vegetation at the site. Chemicals may be accumulated in different plant tissues, at different rates, or not at all depending on the specific chemical and plant species involved and prevailing soil chemical and physical conditions. In addition, environmental conditions such as soil moisture, soil pH, and cation exchange capacities significantly influence whether potential soil contaminants remain chemically bound in the soil matrix or whether they can be chemically mobilized (in a bioavailable form) and released for plant absorption. Generally, neutral to alkaline soils (soil pH of 6.5 or greater) restrict the absorption of toxic metals, making pathway completion to plants difficult. This appears to be the case at the site. Chemical data from analysis of soil samples indicate some on-site soils have become contaminated with VOCs, SVOCs, and heavy metals.

6.6.4.4.2 Sediment

Sediment consists of materials precipitated or settled out of suspension in surface waters. Sediment represents a potential transport medium for contaminants from the Ash Landfill. Potential chemical sources for sediment include surface soils and contaminated surface water. The release mechanisms include surface-water run-off and airborne deposition. Potential receptors of chemicals in contaminated sediment include aquatic flora and fauna. Direct exposure routes for contaminated sediment include dermal contact by aquatic fauna, uptake by aquatic flora, and ingestion by aquatic fauna. Indirect exposure pathways from sediment include consumption by other consumers in the food chain of plants or animals in which contaminants have bioaccumulated. Chemical bioavailability of many nonpolar organic compounds, including VOCs and SVOCs is decreased with increasing concentrations of TOC in the sediment. Given the presence of SVOCs in the sediments, this factor becomes an important exposure consideration.

6.6.4.4.3 Surface Water

Surface water represents a potential transport medium for the chemicals of concern. Potential sources for contaminated surface water include contaminated soils. The release mechanisms include surface runoff. Potential receptors of contaminated surface water include terrestrial and aquatic fauna and aquatic flora. Exposure routes for contaminated surface water include dermal contact, ingestion, and absorption. Specific exposure routes for contaminated surface water include ingestion by terrestrial fauna, uptake by aquatic flora, and dermal contact and ingestion by aquatic fauna. Consumption by other animals of flora or fauna in which contaminants have bioaccumulated constitutes a potential indirect exposure pathway for faunal receptors. Chemical bioavailability of some metals and other chemicals is controlled by water hardness and pH.

6.6.4.4.4 Ground Water

Contaminant transport along the shallow ground-water pathway is considered a possible exposure route to aquatic life, wetlands, and some wildlife where the ground water mixes with surface water. This pathway is of importance to receptors located hydraulically downgradient from the Ash Landfill. The adjacent drainage ditches, creeks, tributaries, and wetlands may be linked to this pathway. Receptors linked to surface water pathways are also indirectly affected by this pathway where the surface and groundwater systems mix.

6.6.4.5 Toxicological Effects of Chemicals of Potential Concern

This section compares detected concentrations of chemicals reported for various physical media at the Ash Landfill to ARARs, TBCs, and toxic doses for the biological groups and receptor species. The toxic effects of various chemicals on receptors and biological groups are evaluated. Detailed toxicological profiles for additional chemicals discussed below are presented in Appendix K.

6.6.4.5.1 Vegetation

This section discusses the toxicological effects of chemicals found in soils at the Ash Landfill on vegetation based not only on their concentrations, but also on other factors, such as bioavailability. Typically, in order for inorganic chemicals to produce toxic effects in terrestrial vegetation, the chemicals must be present in the soil matrix as soluble, plant-available forms, and must occur in concentrations many times greater than ambient or background concentrations. Plant-available forms are assimilated by a plant's root system and translocated to specific plant tissues (e.g., the leaves) where the actual toxic effect occurs. Chemicals of potential concern for vegetation that were analyzed in detail are summarized on Table 6-52.

Metals - Information is available on the effects of metals, many of which were found in soils at the Ash Landfill, on terrestrial plants. This information supported formulation of regulatory guidelines (USEPA, 1983) for maximum allowable soil metals concentrations. These guidelines are considered TBCs for protection of terrestrial vegetation from metals in soil. Comparisons of soil metals concentrations to these guidelines and to background concentrations in uncontaminated soils indicate that cadmium and zinc exceeded levels considered detrimental or toxic to terrestrial plants. Therefore, cadmium and zinc detected in soils at the Ash Landfill are considered to represent potential chemicals of concern.

Volatile and Semivolatile Organics (VOCs and SVOCs) - Seventeen VOCs, twenty-nine SVOCs three herbicides and seven pesticides/PCBs were detected in soils from the Ash Landfill though phytotoxicity data were only available for 13 of these. Of the organics, only acenaphthene was present in a concentration (538 ug/kg) that exceeded a potentially phytotoxic concentration (500 ug/kg). In general, the phytotoxic concentrations for organics were much greater than the exposure point concentrations.

6.6.4.5.2 Wildlife

Because plant and animal tissue samples were not collected and chemically analyzed as part of this RI, inferences regarding wildlife toxicity were made from sediment, soil, and surface-water chemical data. The following evaluations are organized first by the type of medium, and second by major class of chemical. The discussion focuses on the individual chemicals that required detailed evaluation to resolve potential toxicological impacts.

Soil

The chemicals of potential concern for wildlife are summarized on Table 6-53. Chronic toxicity values in soil were computed for the rat and mallard by taking 1.5 percent of the reported acute LC_{50} dietary value as the chronic toxicity value and by assuming that 20 percent of their dietary intake is contaminated soil.

Metals - Lead slightly exceeded the soil concentrations estimated to cause chronic toxic effects in the mallard. (265 mg/kg versus estimated chronic toxicity concentration of 250 mg/kg). No chemicals exceeded the reported safe dietary level for the rat (NAS, 1972).

Volatile and Semi-volatile Organics - The exposure point soil concentrations at the Ash Landfill are all well below the soil concentrations estimated to induce chronic toxic effects. Thus, it is anticipated that these compounds do not represent a risk to wildlife.

Sediment

Chemicals of potential concern for wildlife are summarized in Table 6-53. A discussion of each chemical group is presented below.

Metals - Recommendations and guidelines to specifically protect wildlife from sediments contaminated with metals were not located by this investigation. Instead, a comparison was made between the measured sediment concentrations and the estimated soil concentration that cause chronic toxicity in the aquatic wildlife receptor, the mallard. No metals exceeded the calculated chronic toxicity concentrations in soil for the mallard.

Volatile and Semi-Volatile Organics - None of the compounds belonging to these two chemical classes were present in the sediments at concentrations calculated to cause chronic toxicity to the rat or the mallard. Estimated toxic concentrations in soil were usually several orders of magnitude greater than the chemical concentrations reported from sediment samples. Pesticides are addressed in the NYSDEC (1989) guidelines for protecting wildlife. None of these guidelines were exceeded by the measured on-site sampling.

Surface Water

Chemicals of potential concern that survived the surface-water screening for wildlife are summarized on Table 6-54.

Metals - All on-site measured metal concentrations are below protective recommendations proposed by the NAS and NAE (1972) standards established to protect wildlife consuming aquatic life.

Volatile and Semi-volatile Organics - Only chloroform was measured in on-site surface water at a very low concentration that does not exceed any applicable guideline or standard.

6.6.4.5.3 Wetlands

This toxicity evaluation addresses the small on-site wetlands. These represent worst-case toxicological conditions for wetlands on or near the Ash Landfill. The state regulated wetlands were not considered an exposure point because these wetlands are not hydraulically connected to potentially contaminated surface or ground waters from the Ash Landfill. Analytical results for sediment samples from the on-site wetlands of the Ash Landfill indicate the presence of VOCs, SVOCs, Pesticides/PCBs and metals in the sediments. As discussed previously, no chemicals exceeded the concentrations calculated to cause chronic toxic effects to waterfowl (mallard) receptors. When the sediment exposure point concentrations are compared to NYSDEC (1989) sediment guidelines for protecting benthic biota (Table 6-56), arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel and zinc slightly exceed the criteria concentration but none exceed the limit of tolerance.

6.6.4.5.4 Aquatic Life

The following paragraphs describe projected toxicological effects on aquatic life from chemicals of potential concern in surface water and sediments. Toxicological evaluations consider surface water and sediment concentrations, bioavailability and biomagnification factors, and inherent chemical toxicity to selected aquatic life receptor species. The evaluation focuses on only the chemicals that survived the screening processes described earlier, and for which completed exposure pathways are likely. The chemicals that passed the screening process are summarized in Tables 6-55 and 6-56. USEPA and NYSDEC have established acute and chronic aquatic-life protective water quality criteria for a number of the chemicals of potential concern (USEPA, 1991g; NYSDEC, 1991) (Table 6-55). Proposed federal (USEPA, 1991b,c,d,e,f)and NYSDEC (1991), sediment guidelines for the protection of aquatic life were used in the sediment evaluations (Table 6-56). If contaminant at the exposure point concentrations in the media of concern were below the most stringent applicable criteria, then the aquatic receptors were not considered to be at risk for toxic effects from a specific chemical.

Surface Water

Chemicals of potential concern to aquatic receptors in surface water are summarized in Table 6-55. The evaluation considered potential toxic effects from two perspectives for contaminants that possess food chain biomagnification properties. The first approach compared contaminant concentrations to listed USEPA (1991g) acute and chronic standards for protecting aquatic life. The second approach compared contaminant concentrations to chronic toxicity values for specifically protecting aquatic life (i.e., aquatic life-based criteria)(NYSDEC 1991).

Metals/Inorganics - Only 1 metal, aluminum, had an exposure point concentration greater than the Federal acute criteria. This was due primarily to the samples collected in Wetland E and in the on-site drainage ditch. These areas tend to be completely dry in the summer, and do not typically support aquatic life. The exposure point concentrations of five metals, aluminum, antimony, iron, lead, and mercury exceeded the Federal surface water criteria established for chronic toxicity. These exceedances were observed only in the on-site wetlands, as none of these 5 metals were detected in Kendaia Creek.

Only one metal, iron, exceeded the NYSDEC ambient water quality criteria for Class D waters, which is the current classification of Kendaia Creek. Seven metals, aluminum, cobalt, iron, lead, selenium, vanadium, and zinc had exposure point concentrations exceeding the NYSDEC Class "C"standards, the proposed classification of Kendaia Creek. None of these metals were detected in Kendaia Creek.

Volatiles and Semivolatile Organics - No VOCs or SVOCs exceeded the water quality criteria.

Sediment

Chemicals of potential concern that survived the sediment screening process are summarized in Table 6-56. The NYSDEC guideline criteria for sediments represent an intermediate value between the no-effect and LOEL concentrations for several benthic species. A limit of tolerance (LOT) concentration establishes a sediment concentration that would be detrimental to the majority of species, potentially eliminating most (NYSDEC, 1991). If the LOT value is exceeded in significant portions of the ecosystem of concern, it is highly likely that benthic biota are impaired and remediation should be considered. NYSDEC LOT concentrations are available for metals only.

Metals - No metals had an exposure point concentration that exceeded its respective LOT. The exposure point concentrations of arsenic, cadmium, copper, iron, lead, manganese, nickel, mercury and zinc slightly exceeded their respective recommended NYSDEC guideline criteria.

Volatiles and Semivolatile Organics - The concentration of 4-methylphenol exceeded the NYSDEC guideline criteria for total phenols. However, this chemical was detected in only one of the sediment samples and is not believed to represent a significant risk. A number of PAH's, fluoranthene, pyrene, Benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene and indeno(1,2,3-cd)pyrene exceeded the proposed USEPA criterion for PAH's (phenanthrene). However, a review of the data indicates that at only one sediment sampling location do the measured PAH concentrations exceed the EPA criterion. This location, SW-600, is located off the depot to the west in a tilled field. This location is not connected via surface water drainage pathways to the Ash Landfill. Therefore, it is believed that the PAH's at this location do not originate from the Ash Landfill and that PAH's are not chemicals of concern in sediments.

6.6.4.6 Risk Assessment

This section describes potential risks to receptors, the major biological groups they represent, habitats of special interest, wetlands, and endangered and threatened species. Risk estimates are based on the preceding evaluation of exposure pathways, toxic concentrations and characteristics, and chemical concentrations in the physical media.

6.6.4.6.1 Vegetation

No areas of stressed vegetation were observed at this site. Comparison of concentrations considered toxic to plant life and above background indicates that only cadmium and zinc are of concern and may exhibit some degree of risk.

6.6.4.6.2 Wildlife

Ecological risks to wildlife were evaluated by examining a combination of surface-water, sediment, and soil exposure pathways and applying guidelines, recommendations, and toxicological dose results as TBCs. Surface water was evaluated by applying NYSDEC and NAS guidelines. Soils were evaluated by considering chemical quantities required to cause chronic effects in receptor or similar species and by using 10 percent of the LC_{50} concentration as a general and conservative chronic threshold value. Sediments were evaluated by considering proposed protective guidelines for wildlife interactions with contaminated sediments developed by NYSDEC.

Results of these evaluations suggest that no wildlife species are at risk from elevated concentrations of contaminants in surface waters if used as sources of drinking water. None of the surface-water analytes are considered environmental risks to wildlife because their concentrations are less than acute and chronic toxic concentrations acquired through either oral doses or from dietary exposure routes. For soils, only lead, is considered a potential environmental risk or hazard to wildlife. The exposure point concentration for lead in soils exceeded the estimated soil concentrations for chronic toxicity for the mallard that were used to evaluate the small mammal and bird components. Exposure pathway and toxicity analyses of sediment contaminants indicate no potential indirect and direct risks to wildlife species associated with streams and other aquatic elements of the site.

6.6.4.6.3 Endangered, Threatened, and Special-Concern Species

The Ash Landfill does not support any known uses by designated federal or state endangered or threatened species of plants, wildlife, or fish. Nor does the Ash Landfill support designated critical habitats for such species according to the January 1980, Installation Assessment of Seneca Army Depot, Report No. 157, January 1980, prepared by USATHAMA. Among the state and federally protected animals found in New York State, only the Indiana Bat (Myotis sodalis) and the American osprey (Pandion haliaetus carolinensis) are likely to be found at SEDA. However, none of these species would be anticipated to associate with locations on or near the Ash Landfill. State-designated species, the bog turtle (Clemmys muhlenbergi), could occur north of Kendaia Creek, in the "Duck Ponds" however, the habitat at the Ash Landfill is not expected to support this species.

Biological reconnaissance of the Ash Landfill area did not identify any biological communities of special interest other than wetlands (which are addressed separately), or communities of exceptional quality that might be at risk from chemicals of potential concern. Therefore, risks from chemicals of potential concern to these components of the environment do not exist.

6.6.4.6.4 Wetlands

Wetlands occur at a number of locations on and near the Ash Landfill. The jurisdictional status of these sites has not been formally determined. Although the current wetland vegetation and hydrology would probably satisfy wetland designation criteria, soils (consisting probably of clay materials) may not satisfy wetland soil criteria causing any future jurisdictional wetland determinations to be considered as atypical situations. In addition to their small individual and cumulative sizes, the locations of these stands would probably meet the isolated wetland criterion, thereby exempting them from regulatory permitting and mitigation requirements under Section 404 of the Clean Water Act. Isolated wetlands are nontidal waters of the United States that are not part of a surface tributary system to interstate or navigable waters and not adjacent to such tributary waterbodies. Wetlands losses of less than a total of 1 acre do not require notification of the local U.S. Army Corps of Engineers representative for potential authorization through the Section 404 permit program.

The potential risk to these Ash Landfill cattail stands from chemical contamination is considered to be slight. A number of the on-site wetlands were sampled for chemical analyses. Comparing the measured sediment concentrations obtained in the on-site wetlands to the sediment guidelines for benthic organisms indicates that there were no samples above the limit of tolerance concentrations.

6.6.4.6.5 Aquatic Life

In surface waters, low potential risks to aquatic life may exist. The exposure point concentrations are below federal acute standards for all metals except aluminum. Aluminum is the most common metallic element in the earth's crust and accumulates in the lungs of man but is almost non-toxic to man (EPA, 1978). Aluminum is amphoteric and the solubility is highly pH dependent. The Water Quality Criteria Report of NAS/NAE (1972) reported that no sublethal effects of dissolved aluminum at 0.05 mg/L were reported. However, the suspended precipitate of ionized aluminum is considered to be toxic. The NAS/NAE study also recommended that aluminum may exert a greater toxicity than was reported and further study is warranted. The toxicity and fate of aluminum in the environment is not well understood. It has been reported that lake trout in New York contain aluminum residues ranging from 140 to 300 ug/g of fish tissue (EPA, 1978), supporting the possibility that aluminum may bioaccumulate in fish. The review of the Registry of Toxic Effects Chemical Substances (RTECS) toxicity database indicated that because aluminum is only sparingly absorbed from the gut, LD_{50} values for aluminum ingestion are unavailable, since death occurs from intestinal blockage due to precipitated aluminum species rather than systemic aluminum toxicity. Chronic oral aluminum studies for rats demonstrated protein kinase effects. Most standard methods of mutagenic assays were negative and therefore aluminum is non-mutagenic. Although the exposure concentration for surface water does exceed the recently promulgated EPA surface water AWQC, the risk is not considered to be substantial. This is because the exposure concentrations was considered to be the maximum value detected. This value was detected in one on-site surface water sample location at SW-300. This location was along the northern portion of the West Smith Farm Road drainage ditch. Another surface water sample collected from the on-site wetland W-E also contained aluminum concentrations above the acute federal AWQC. All remaining samples were below the acute AWQC. Surface water at these two locations are seasonal and do not support aquatic species. Therefore, although the acute aluminum AWQC was exceeded at these two locations the effects would not be manifested in a receptor since the drainage ditch and the wetland W-E do not support aquatic life due to the intermittent nature of the surface water. However, five metals, aluminum, antimony, iron, lead, and mercury are slightly over the federal chronic toxicity guidelines, seven exceed the proposed NYSDEC Class "C" criteria, and one metal, iron, exceeded the current NYSDEC ambient water quality criteria for Class D waters. However, these high values were found exclusively in the on-site wetlands, which tend to dry out in summer. Kendaia Creek, which supports aquatic life year round had substantially lower concentrations of these metals.

On-site sediments represent a low potential risk to aquatic receptors. Nine metals of potential concern (arsenic, cadmium, copper, iron, lead, manganese, nickel, zinc and mercury) and one semi-volatile organic (4-methylphenol) exceeded the recommended NYSDEC guideline criteria by small amounts. However, none of these chemicals exceeded the respective LOT values proposed by NYSDEC for protection of benthic species.

6.6.4.7 Summary

This section summarizes the significant ecological impacts and risks posed by the Ash Landfill. Comments are based on the ERA findings discussed throughout the preceding sections. The risks potentially posed to the receptor species and biological groups at the Ash Landfill are summarized by the chemicals of potential concern. The preceding discussions provide the findings and rationales that support conclusions regarding the probabilities and magnitudes of biological risks.

The Ash Landfill ERA accomplished several objectives. These objectives include:

- Characterizing the biological and ecological properties of the Ash Landfill and the surrounding vicinity;
- Determining the presence, concentrations, and composition of chemicals of concern to receptor species and biological groups found on site;
- Identifying primary contaminant exposure pathways from existing Ash Landfill sites to the receptor species and biological groups; and
- Determining the general level of biological risk associated with the Ash Landfill and contaminants.

The results of achieving these objectives are summarized as follows.

6.6.4.7.1 Biological Characteristics

A combined literature review, site reconnaissance, biota characterization, and field sampling program was completed in July 1993, based on a USEPA-approved work plan. The program resulted in the ecological characterization of Ash Landfill, the immediate vicinity, and a 2-mile-wide buffer zone around the Ash Landfill. The characterization addressed plant cover types, wildlife, aquatic resources, wetlands, threatened and endangered species, and special-interest resources. A total of seven sediment and surface sampling stations and one upstream background station, were established and investigated. Samples of soil, sediment, and surface water were collected from these locations to evaluate environmental risks and exposure pathways.

Site biological characterization activities revealed a mosaic of terrestrial, aquatic, and wetland communities. Terrestrial communities are represented by northern hardwood forest of maple, oak, and beech; and old fields and ruderal communities. Aquatic communities near the Ash Landfill are represented by small, shallow swales and drainage ditches with intermittent flows that combine, and flow into Kendaia Creek. Aquatic communities are warmwater systems dominated by minnow species. Wetland communities are represented by cattail stands scattered throughout the property. There were no federal- and/or state-designated threatened or endangered species identified as being associated with the Ash Landfill or the immediate vicinities. Designated critical habitats for threatened or endangered species were not located on or within the near vicinity of the Ash Landfill. Except for wetlands previously discussed, there were no resources or habitats of special interest associated with the Ash Landfill.

Receptor species were selected to represent major biological groups of the Ash Landfill areas for the ERA. The vegetative species included cattail, and brome, as representative of vascular vegetation. The mallard and deer mouse were chosen to represent wetland wildlife and terrestrial wildlife, respectively. The blacknose dace, creek chub, and caddisfly were selected to represent several trophic levels of fish and invertebrate aquatic biota.

6.6.4.7.2 Chemicals of Potential Concern

Over one-hundred fifty chemicals were initially considered as candidate substances potentially linked to biological or ecological risks. The candidate chemicals were identified based on previous site work, chemical composition of waste products, and SEDA's interest in determining the current environmental status of these chemicals. The initial list of chemicals was evaluated using a series of environmental screening criteria and toxicity thresholds values that were compared to chemical concentrations reported from biological and physical media samples collected on site. The purpose of the screening process was to identify and eliminate those chemicals that were not detected in any sample on the site or was below background levels. Chemicals retained for more detailed evaluation following the screening process were designated as chemicals of potential concern. Following this screen each chemical's 95th percentile UCL concentration was compared to medium-specific federal and state promulgated standards, proposed criteria, and guidelines established to be protective of the environment.

6.6.4.7.3 Exposure Pathways

Transport and exposure pathways were evaluated to determine how chemicals of potential concern might be endangering biota. Transport of these chemicals from the Ash Landfill into surrounding areas was reviewed. Primary direct exposure pathways involve the transfer of chemicals of concern from physical media to biota associated with the site. Indirect exposure pathways involved the potential transfer of chemicals through initially contaminated biota (i.e., plants, fish, invertebrates, or wildlife associated with the waste site) to higher levels in the terrestrial or aquatic food chains.

Exposure pathway analyses indicated that primary routes of exposure varied according to the specific biological group, individual site area and medium characteristics, and whether the site area is terrestrial or aquatic. The primary exposure pathways for terrestrial plants and animals at terrestrial or upland sampling stations are through soils. Primary exposure pathways at aquatic stations are through sediments and surface waters contaminated with stormwater run-off or snowmelt. Aquatic plants are exposed primarily through the sediment pathway. Most fish are exposed primarily through the surface-water pathway. Bottom-dwelling invertebrates, semi-aquatic wildlife, and fish are exposed through both sediment and surface water pathways. Upland plants, such as brome, can act as contamination pathways for transfer of some contaminants from soil into species of wildlife that feed primarily on plants, without the plants themselves becoming affected. However, reported soil and sediment concentrations suggest that concentrations of contaminants of this type are within typical ranges and represent little risk to wildlife through this exposure pathway.

6.6.4.7.4 Significant Biological Risks

The risk assessment involved a qualitative and quantitative appraisal of the actual or potential toxic effects of hazardous waste sites on aquatic, wetland, and terrestrial biota. The risk assessment considered plant and animal exposures to acute chemical concentrations, chronic concentrations leading to potential lethal and sublethal effects, and food chain transfers of chemicals possessing biomagnification potential. Plants and animals that are or in the future could be experiencing lethal and sublethal effects from exposure to toxic substances were considered.

Risk evaluations were based on comparing the onsite chemical concentrations to background concentrations from local areas that are presumably unaffected by the Ash Landfill; federal and state criteria and promulgated water quality standards; sediment (NYSDEC, 1989) and general soil (USEPA, 1983) guidelines; and to toxic thresholds described in the technical literature.

Vegetation

Soil concentrations reported in the scientific literature to be toxic to plants were reviewed. For the organic compounds of concern at this site a limited amount of information was available. Constituents with no information available were eliminated from further evaluation. Much more information was available for inorganic constituents and a phytotoxic range was provided based upon this database.

A total of 64 chemicals reported in soils were evaluated for potential risks to vegetation. These chemicals were retained for detailed evaluation because they were determined to be present at concentrations statistically different from background concentration or were detected in at least one sample. Based on the evaluation, the heavy metals cadmium, lead, zinc and the organic compound, acenaphthene, exceeded concentrations that are considered to be potentially phytotoxic to plants. Of these constituents, cadmium was only slightly above the concentration range reported to be phytotoxic. Lead and zinc were within the range reported to be phytotoxic but did not exceed the upper range. Acenaphthene was only slightly above the only reported value considered to be phytotoxic. Although 3 metals and one organic did exceed the value considered to be phytotoxic, the exceedances were either slight or were within the range of reported values, therefore, these chemicals in soils are not considered to be a source of significant risk.

Wildlife

A total of 21 chemicals retained for surface water, 64 chemicals for soil, and 58 chemicals for sediment samples were evaluated for potential risks to wildlife. In soils only lead was present at an exposure point concentration estimated to exhibit chronic toxicity to the mallards. No metals in surface water at the exposure point exceeded the NAS and NAE guidelines for protecting wildlife that consume surface water. Exposure and toxicity analyses of sediment contaminants suggest that there are no potential indirect risks to the aquatic food resources of wildlife receptor species associated with streams and other aquatic areas.

Endangered and Threatened Species

Endangered and threatened species of plants, wildlife, and aquatic life are not at risk from Ash Landfill contaminants or remediation actions. The Ash Landfill and the immediate surroundings do not support any of these species, and there are no apparent completed exposure pathways to state-designated or candidate species (e.g., the bog turtle) that may occur within a 1-mile radius of the Ash Landfill.

Wetlands

Wetlands on or in the immediate proximity of the Ash Landfill are limited to several small areas. Formal wetland jurisdictional determinations have not been conducted for these wetlands. State regulated wetlands do not exist within the Ash Landfill. Minimum NYSDEC wetland areas are approximately 12 acres, thereby excluding these on-site wetlands from consideration. Comparisons of sediment contaminant concentrations to acute and chronic thresholds for plant, wildlife, and aquatic life receptors suggest that potential risks to wetland receptor species (i.e., cattail or mallard) from the contaminants are low. Risk to other aquatic receptors are addressed below.

Aquatic Life

A total of 21 different chemicals detected in surface water and 58 chemicals detected in sediment were evaluated for potential risks to warmwater fish (blacknose and creek chub) and aquatic invertebrates (caddisfly). At the exposure point concentration only aluminum exceeded the federal acute criterion, and five metals, aluminum, antimony, iron, lead, and mercury exceeded the federal water quality standard to protect aquatic life at concentrations reported to produce chronic toxic effects. Of these only aluminum and iron concentrations substantially exceeded the criterion. The elevated aluminum and iron concentrations on-site may suggest an increased risk; however, elevated aluminum and iron concentrations were not detected in Kendaia Creek. The measured concentrations of iron in surface water in Kendaia Creek was 17 ug/l, which is less than the chronic criterion. Aluminum was not detected in Kendaia Creek surface water. The only two surface water samples that contained elevated aluminum and iron concentrations were sampling stations SW-300 and SW-WE, from on-site wetland and drainage ditches and these are most likely the result of increased turbidities in the samples.

In sediments, nine metals and one semi-volatile exceeded the NYSDEC criteria for safe concentrations (arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel, zinc and 4-methylphenol). However, no chemicals exceeded the state Limits of Tolerance Guidelines to protect aquatic life. Therefore, the risk posed by these chemicals are estimated to be low.

Results of comparing the site's ecological characteristics with the results of the chemical screening process, pathway evaluation, and toxicity and uncertainty analyses, suggest that although a number of metals were measured in soil, surface water and sediment at concentrations that may represent slight adverse ecological risks to one or more biotic groups of the Ash Landfill area, none of these chemicals are believed to pose substantial environmental risks.

6.7 UNCERTAINTY ASSESSMENT

All risk assessments involve the use of assumptions, judgements, and imperfect data to varying degrees. This results in uncertainty in the final estimates of risk. There are several categories of uncertainties associated with risk assessments. One is the initial selection of substances used to characterize exposures and risk on the basis of the sampling data and available toxicity information. Other sources of uncertainty are inherent in the toxicity values for each substance used to characterize risk. Uncertainties are also inherent in the exposure assessments for individual substances and individual exposures. These uncertainties are usually driven by uncertainty in the chemical monitoring data, but can also be driven by population intake parameters. Finally, additional uncertainties are incorporated into the risk assessment when exposures to several substances across multiple pathways are summed.

6.7.1 Uncertainty in Data Collection and Evaluation

Uncertainties in the data collection/evaluation step of the risk assessment focus on determining whether enough samples were collected to adequately characterize the risk, and if sample analyses were conducted in a qualified manner to maximize the confidence in the results. Results of the sample analyses were used to develop a database which includes a complete list of the chemicals by media and their representative concentrations used in the risk assessment. Because this risk assessment is a part of the larger RI effort, the sampling and analysis plan was developed to meet the objectives of the other disciplines besides the risk assessment. Therefore, the samples were not collected randomly but were collected from areas of the site known to be contaminated, biasing the data collected toward overestimating representative chemical concentrations from the site. The judgmental bias in the sample collection also limits the applicability of statistics to the database. Because the statistics used to calculate the upper limit of the 95th-percentile confidence interval assume that the data represents a randomly distributed population, and the database does not, there is inherent uncertainty in the application of statistics. Collection of non-random, judgmental samples was necessary to adequately characterize the nature and extent of contamination which is an objective of the RI.

The use of data from all site groundwater monitoring wells in determining representative concentrations used in calculating risks versus using only the analytical data collected from a cluster of wells within the most contaminated area of the plume may result in an underestimation of risks to potential future residents.

All soil samples were screened in the field using an Organic Vapor Analyzer. From each boring the highest screened volatile result was analyzed for Level IV volatiles. Thus, the samples with the highest volatile concentrations from each boring are the ones included in the risk assessment database. This bias will tend to overstate the site risk.

All chemicals detected that were potentially site related were retained in this assessment. Chemicals that were never detected were eliminated from the assessment. It is possible, but unlikely, that some chemicals were detected below the SQL and not retained in the assessment. These assumptions may slightly underestimate risks. Since samples were collected at areas where concentrations were expected to be high and the 95th UCLs were used for the assessment, it is very unlikely that any chemicals were present at the site at health-significant levels and not detected in at least one sample. However, if this did occur, this assumption will underestimate risk. The 95th UCLs were used to calculate site-related risks. Since that assumption implies chronic exposure to the 95th UCL concentration, this assumption is likely to overestimate risk.

If a chemical was detected, it was retained in the risk assessment regardless of how frequently it was detected. To calculate the upper limit of the 95th-percentile confidence interval, chemicals were assumed to be present in all samples in a media. When the chemical was not detected in a sample, one-half of the SQL was used. Especially for chemicals that were detected in only a few samples, the upper limit of the 95th-percentile confidence interval probably greatly overestimates the amount of the chemical present and, consequently, the risk from the chemical.

A statistical analysis was performed to compare on-site soil and groundwater chemical concentrations to background conditions. Chemicals not statistically different from background were eliminated from the risk assessment. However, this evaluation was only performed for metals. Certain organic chemicals are often present in the environment from human (non-site) sources. These anthropogenic levels were not considered in this risk assessment.

RAGS guidance (USEPA, 1989a) states that if a small number of TICs are present relative to TCL compounds, they can be eliminated in the risk assessment. This process has the possibility of underestimating risk.

The database also includes a number of data validation flags, indicating uncertainty in the reliability of the performance of the analyses done by the laboratory. Flagged data were retained following RAGS guidance.

6.7.2 Uncertainty in Exposure Assessment

Inherent uncertainties exist in predicting future land uses including future chemical concentrations. Current land uses were used as a basis for predicting future land uses. Current land uses were identified by characterizing the site's physical setting.

A large part of the risk assessment is the estimation of risks that are conditional upon the existence of exposure conditions analyzed. If exposure does not occur, no risks are present. This assessment does not factor in the probability of the exposure occurring. For several pathways, exposure is extremely unlikely. For example, the future pathways implicitly assume the construction of residences on the site and the drilling of private wells in the overburden on the site as a sole source of domestic water. Site hydrogeologic conditions make this extremely unlikely.

Once pathways are identified, exposure point concentrations must be estimated. There is always some doubt as to how well an exposure model approximates the actual conditions receptors will be exposed to at a given site. Key assumptions in estimating exposure point concentrations and exposure assumptions and their potential impact on the assessment are described in the following paragraphs.

Samples collected from both on-site wetlands and off-site in Kendaia Creek were used to calculate exposure point concentrations for surface water and sediment. These exposure point concentrations are appropriate for the future on-site residential exposure scenario since this receptor would potentially be exposed to both on-site and off-site locations. However, for the current off-site resident exposure scenario, they probably overstate the level of risk since this receptor is only exposed to the off-site Kendaia Creek locations and these locations have lower chemical concentrations than the on-site wetlands.

For some pathways, particularly inhalation of volatiles from ambient air and from groundwater while showering, models were used to calculate exposure point concentrations. Use of these models has a degree of uncertainty associated with it which could over- or under-estimate risk.

Dermal exposure also had some further uncertainties. The dermal guidance suggests the use of 95th-percentile skin surface areas for calculating dermal exposure, but RAGS uses 50th-percentile values for area of exposed skin "because surface area and body weight are strongly correlated and 50th-percentile values are most representative of the surface area of individuals of average weight (e.g., 70 kg) which is assumed for this and all other exposure pathways." Further, dermal exposure to soil was based on a soil absorption factor taken from the literature. Several sources were checked and the most conservative value was chosen, so this is expected to over-estimate risk. Dermal exposure to water was based on the assumed permeability constant for water and not on chemical specific values. Unfiltered groundwater samples were used in the baseline risk assessment. However, the use of unfiltered groundwater sampling data to assess risk associated with water borne contaminants may be an overstimate as collidal particles are unlikely to penetrate the skin.

There is also uncertainty associated with using oral toxicity values to calculate dermal risks. As seen in the literature (Owen, 1990), there are differences between oral and inhalation absorption efficiencies. These differences vary and will likely cause either underestimation or overestimation of dermal risks. The efficiencies are generally within 1 order of magnitude of each other, so the uncertainty introduced is less than 1 order of magnitude.

For residential land use exposure scenarios, ingestion and dermal contact to soil used an exposure frequency of 350 days per year. This overstates actual risk since Seneca winters are long, cold and very frequently snow covered so that little to no ingestion or dermal contact can occur during this time.

For the current land use exposure pathways, involving dermal contact to surface water and sediments, the exposure scenario is wading in Kendaia Creek downgradient and off the Depot. However, the data from all on-site and off-site sampling locations was used in calculating the exposure point concentration. Since the on-site concentrations are considerably higher that the off-site Kendaia Creek concentrations, this will have the effect of overestimating risks in the current land use scenario.

6.7.3 Uncertainty in Toxicity Assessment

Of the chemicals of potential concern, a number had no reference dose or slope factors. They are:

- 1,1,1-trichloroethane
- 4-methyl-2-pentanone
- 2-nitrophenol
- 2-methylnaphthalene
- acenaphthylene
- 4-nitrophenol
- dibenzofuran
- phenanthrene
- benzo(g,h,i)perylene
- aluminum
- calcium
- cobalt
- iron
- lead
- magnesium
- potassium
- sodium
- dicambra
- naphthalene

Of these, several have toxicity information such as weight of evidence classification indicating a strong potential for adverse health effects particularly lead. The absence of toxicity values for these chemicals tends to underestimate risks. Although risks from lead were not quantified in the health risk assessment, lead is not believed to be a major contributor to risk at the Ash Landfill based on a comparison of on-site concentrations to ARAR's. For surface soils, the on-site exposure point concentration of 265 mg/kg in surface soils is below the USEPA recommended clean-up goal of 500 to 1,000 mg/kg. For sediments, the exposure point concentration of 95.6 mg/kg is below the NYSDEC LOT value of 250 mg/kg. The surface water exposure point concentration of 42.3 ug/l is below the NYSDEC Class A surface water standard of 50 ug/l. The on-site groundwater exposure point concentration of 24.0 ug/l is below the NYSDEC Class GA groundwater standard of 25 ug/l, though it does exceed the EPA action level of 15 ug/l. The elevated lead concentration is likely an artifact of sample turbities in Phase I, as the filtered samples collected in Phase I, and the samples collected in Phase II using the modified sampling procedure had much lower lead concentrations (see Table 4-5).

For chromium, the valence state (e.g., III or VI) was not specifically determined. The toxicity assessment assumed all chromium to be in the Chromium VI valence state, which is the more toxic. This assumption most likely results in an overstatement of risk.

Some uncertainty is inherent in the toxicity values for the duration of exposure assessed. Many of the studies are based on animals and extrapolated to humans, and in some cases, subchronic studies must be used to assess chronic effects. As stated in the toxicity assessment section, several uncertainties apply in these extrapolations. Because toxicity constants are generally based on the upper limit of the 95th-percentile confidence interval, chemical-specific risks may be overestimated.

Toxicity information was not available for dermal exposure; hence, several assumptions had to be made which may tend to over- or underestimate risk. Oral toxicity values were adjusted to calculate risks from dermal exposure through the use of oral absorption efficiencies for a number of chemicals for which oral absorption efficiencies could be found. Values found in the literature (Owen, 1990) indicate that the uncertainty associated with using oral absorption to estimate dermal absorption is likely less than one order of magnitude. For most chemicals dermal toxicity values were assumed equal to oral toxicity values. This is due to the lack of scientific studies available to quantify dermal toxicity and carcinogenic potential for the vast majority of priority pollutants and because chemical specific information needed to convert ingested dose to absorbed dose is not available.

There is also some uncertainty associated with converting RfCs and unit risk values into inhalation RfDs and slope factors. As described in HEAST, RfCs and unit risk values are presented as concentrations (mg/m^3) not doses (mg/Kg-day), as are ingestion risk values.

Unfortunately risks are calculated using doses, which necessitates the conversion of the RfCs and unit risk values into RfDs and slope factors. This conversion requires certain assumptions to be made, such as the body weight and breathing rate of the exposed individuals. This will likely add an uncertainty of at least one order of magnitude to the calculated risks.

There is also a limited amount of inhalation data. Values for some compounds are available in HEAST. It is not recommended that HEAST users make the conversions themselves, so no additional values may be calculated.

6.7.4 Uncertainty in Risk Characterization

Uncertainties in the toxicity assessment are compounded under the assumption of dose additivity for multiple substance exposure. That assumption ignores possible synergisms and antagonisms among chemicals, and assumes similarity in mechanisms of action and metabolism. Overall, these assumptions would tend to overestimate risk. Similarly, risks summed for chemicals having various weight-of-evidence classifications as well as different target organs may also tend to overestimate risk.

6.7.5 Central Tendency Risk

In addition to the RME risks detailed in previous sections, a central tendency risk was calculated for the exposure scenarios. These results are summarized in Table 6-57. As described by EPA, the central tendency risk approximates the arithmetic mean or median risk, as opposed to the RME risk which describes exposures above the 90th percentile of the population distribution.

The central tendency risk is calculated by replacing some of the 95th percentile exposure parameters with 50th percentile or median values. For example, the 95th percentile value for living in one household, 30 years, is replaced by the median value, 9 years. Other values are replaced as described in the EPA guidance. The EPC values are the 95th UCL concentrations, the same as those used to calculate the RME risks.

The central tendency risk, when compared to the RME risk helps to quantify the uncertainty added by calculating only the RME risks. A comparison of Table 6-48 to 6-57 indicates that the central tendency HI's are approximately 40 to 90% of the RME HI's and the central tendency cancer risks are 15 to 25% of the RME risks. However, as with the RME values, the only values on Table 6-57 that exceeds EPA Target values is the HI and cancer risk future on-site residents at 1.6 and 2.3 x 10^{-4} respectively.

6.8 SUMMARY

6.8.1 Human Health Risk Assessment

Human health risk assessments were calculated for two exposure scenarios:

1) current off-site residents; and
2) future on-site residents.

Potential future residents of the site are the only receptors exhibiting risk of cancer above the USEPA target risk range and a potential for adverse noncarcinogenic health threats. As shown on Table 6-48, the excess cancer risk of 1.5 x 10^{-3}, as well as the hazard index of 3.4, are due primarily to exposure of receptors to groundwater as their sole drinking water source. Current off-site residents do not exhibit risk of cancer in excess of the target risk range or adverse noncarcinogenic health threats as shown in Table 6-48. Risks at 6.1 x 10^{-5} are within the USEPA's target risk range and the hazard index of 0.21 is less than one. Although risks are exhibited by potential future residents using groundwater for drinking, consideration should be given to the likelihood of residential development and groundwater use on the site. If the pathway is not completed, there are no risks.

6.8.2 Ecological Risk Assessment

The Ash Landfill ecological risk assessment has included both a qualitative and quantitative assessment of the ecological status of the Ash Landfill. During Phase I field evaluations included fish trapping and counting, benthic macroinvertibrate sampling and counting and small mammal species sampling and counting. In addition, a vegetation survey was performed, identifying major vegetation and understory types. The conclusions determined from these field efforts indicated a diverse and healthy aquatic and terrestrial environment. No overt acute toxic impacts were evidenced during the field evaluation.

Quantitative soil, sediment and surface water analytical data were compared to USEPA and NYSDEC guidelines for the protection of aquatic and macroinvertebrate life in sediments and surface water. Additionally, as a supplement to specific guidelines, criteria are presented that

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TABLE 6-57
CENTRAL TENDENCY RISKS
CALCULATION OF TOTAL NONCARCINOGENIC AND CARCINOGENIC RISKS

SENECA ARMY DEPOT
ASH LANDFILL

RECEPTOR	EXPOSURE ROUTE	EXPOSURE ASSESSMENT Table Number	RISK CHARACTERIZATION Table Number	HAZARD INDEX	CANCER RISK
CURRENT RESIDENTIAL					
CURRENT OFF-SITE RESIDENTS	Dermal Contact to Surface Water while Wading	Table 6-8	Table 6-30	3.1E-03	2.8E-06
	Dermal Contact to Sediment while Wading	Table 6-9	Table 6-31	3.9E-04	0.0E+00
	Ingestion of Groundwater	Table 6-10	Table 6-32	6.7E-02	7.9E-07
	Dermal Contact to Groundwater	Table 6-12	Table 6-33	1.3E-03	3.9E-08
	Inhalation of Groundwater while Showering	Table 6-16	Table 6-34	2.3E-07	2.4E-08
	Inhalation of Volatile Organics in Ambient Air	Table 6-25	Table 6-35	5.0E-03	5.7E-06
TOTAL RECEPTOR RISK (Nc & CAR)				7.7E-02	9.3E-06
FUTURE RESIDENTIAL					
FUTURE ON-SITE RESIDENTS	Ingestion of Onsite Soils	Table 6-18	Table 6-36	2.0E-02	3.8E-07
	Dermal Contact to Onsite Soils	Table 6-21	Table 6-37	8.7E-03	3.2E-08
	Dermal Contact to Surface Water while Wading	Table 6-8	Table 6-30	3.1E-03	2.8E-06
	Dermal Contact to Sediment while Wading	Table 6-9	Table 6-31	3.9E-04	0.0E+00
	Ingestion of Groundwater	Table 6-11	Table 6-38	1.5E+00	2.0E-04
	Dermal Contact to Groundwater	Table 6-13	Table 6-39	1.0E-01	1.1E-05
	Inhalation of Groundwater while Showering	Table 6-17	Table 6-40	7.7E-04	6.4E-06
	Inhalation of Volatile Organics in Ambient Air	Table 6-26	Table 6-41	2.1E-02	2.4E-05
TOTAL RECEPTOR RISK (Nc & CAR)				1.7E+00	2.4E-04
CURRENT AND FUTURE ON SITE					
ON-SITE HUNTERS	Dermal Contact to Surface Water while Wading	Table 6-8	Table 6-30	3.1E-03	2.8E-06
	Dermal Contact to Sediment while Wading	Table 6-9	Table 6-31	3.9E-04	0.0E+00
	Ingestion of Onsite Soils	Table 6-19	Table 6-42	9.5E-04	6.7E-08
	Dermal Contact to Onsite Soils	Table 6-22	Table 6-43	2.9E-04	2.6E-09
	Inhalation of Volatile Organics in Ambient Air	Table 6-27	Table 6-44	3.6E-04	4.1E-07
TOTAL RECEPTOR RISK (Nc & CAR)				5.1E-03	3.2E-06
FUTURE ON-SITE CONSTRUCTION WORKERS	Ingestion of Onsite Soils	Table 6-20	Table 6-45	9.3E-03	7.1E-07
	Dermal Contact to Onsite Soils	Table 6-23	Table 6-46	1.1E-02	9.9E-08
	Inhalation of Volatile Organics in Ambient Air	Table 6-28	Table 6-47	1.4E-02	8.5E-06
TOTAL RECEPTOR RISK (Nc & CAR)				3.4E-02	9.3E-06

are protective of terrestrial wildlife and vegetation in soils. The quantitative evaluation that involved comparison of the 95th UCL of the mean of site data with the media specific criteria, suggested a slight potential for chronic risk from several heavy metals. The acute effects from these metals have not been observed during fieldwork, i.e. the ecological community appears diverse and normal, however long term chronic impacts are more subtle. For example, calculated chronic toxicity concentrations for aquatic (mallard) wildlife were exceeded by lead in soil at the 95th UCL. For the protection of aquatic life in contact with sediments, the 95th UCL for nine metals (arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel and zinc) exceed the NYSDEC guidelines. However, the LOT criteria for the protection of benthic macroinvertebrates were not exceeded for any metals in sediment. Federal surface water chronic toxicity criteria for the protection of aquatic life were exceeded for five metals aluminum, antimony, iron, lead, and mercury, and NYSDEC criteria were exceeded by iron. However, no metal exceeded Federal acute toxicity criteria for the protection of aquatic life. For protection of terrestrial vegetation, only soil concentrations of cadmium and zinc at the 95th UCL exceeded regulatory guidelines or concentrations estimated to cause phytotoxicity. In summary, on-site soils, surface waters and sediment suggest the site conditions may pose a slightly elevated ecological risk due to the presence of heavy metals.

7.0 SUMMARY AND CONCLUSIONS

7.1 SUMMARY

7.1.1 Nature and Extent of Contamination

The nature and extent of the chemicals of concern at the Ash Landfill were evaluated through a comprehensive field investigation program. Primary media investigated at the Ash Landfill included soil (from soil borings and test pits), surface water and sediment (from Kendaia Creek and on-site wetlands and drainage swales), and groundwater (from monitoring wells). The primary chemicals of concern at the Ash Landfill are volatile organic compounds (primarily chlorinated and aromatic compounds), semivolatile organics (mainly PAHs), and to a lesser degree metals. These are believed to have been released to the environment during former landfilling activities conducted at the Ash Landfill site.

The primary chlorinated volatile organic compounds in soils at the Ash Landfill site are 1,2-dichloroethene (1,2-DCE), trichloroethene (TCE), and vinyl chloride (VC). The highest concentrations of these compounds were measured in a two acre area northwest of the Ash Landfill near the "bend in the road". Concentrations well above the NYSDEC TAGM clean-up guidelines were measured throughout this area at all depths from land surface to the top of the weathered shale. As with the chlorinated compounds, the highest concentrations of volatile aromatic organic compounds occurred northeast of the Ash Landfill. The primary aromatic constituents were xylene and toluene which were measured at concentrations above the NYDEC TAGM clean-up guidelines. The horizontal extent of the aromatics was smaller than that for the chlorinated volatile organics, approximately one-half acre, and the vertical impacts extended from the land surface to 4 feet below the surface (above the water table).

The other compounds of significance measured in the soils were semi-volatile organics and metals. The semi-volatiles of principal concern were polynuclear aromatic hydrocarbons (PAHs). PAHs were measured at concentrations above the NYSDEC TAGM clean-up guidelines in the Ash Landfill, in the Non-Combustible Fill Landfill and in the various debris piles present around the former Ash Landfill. In general, the high PAH samples were detected in the Non-Combustible Fill Landfill and small debris pile surface soils (0 to 2 feet) that contained the residues of incomplete combustion. The metals that were detected at elevated concentrations in soils were copper, lead, mercury and zinc. These elevated concentrations were found in the Ash Landfill, in the Non-Combustible Fill Landfill and in the debris piles. The highest concentrations of metals were detected at the surface soils of the debris piles. These piles are small surface features and do not extend into the subsurface.

The primary impact to the groundwater is a plume of a chlorinated volatile organic solvents (TCE, 1,2-DCE and VC) originating in the area of contaminated soils at the "bend in the road" and Ash Landfill and moving westward to the depot boundary. The maximum detected concentration was 74,000 μg/l which is the sum of TCE, 1,2-DCE, and VC in monitoring well MW-44 located within the source area. The plume is believed to extend approximately 100 feet beyond the depot boundary and contain a total chlorinated concentration of 10 μg/l at this location. Vertically, the plume appears to be restricted to the upper till/weathered shale aquifer and is not present in the deep competent shale aquifer. No significant concentrations of semivolatile organics or metals were detected in groundwater.

No volatile or semi-volatile organic compounds were detected in any of the on-site surface waters or Kendaia Creek. Metals concentrations were also low in surface water with only iron significantly exceeding NYSDEC water quality standards in three on-site wetlands. The sediments of the wetland adjacent to the "bend in the road" Wetland W-B contained elevated concentrations of 1,2-DCE. The sediment from an off-site wetland west of the Ash Landfill, Wetland W-G, contained elevated concentrations of several PAH's. No other sediments contained significant concentrations of volatile or semi-volatile organics. Metals concentrations in several sediments samples exceeded NYSDEC TAGM's with the highest concentrations occurring in wetlands W-B and W-G.

7.1.2 Fate and Transport

Analysis of the fate and transport mechanisms for the chemicals of concern at the Ash Landfill considered site specific factors as well as the chemical/physical properties of the target analytes. Soil, sediment, and surface water samples collected off-site, and downstream of the site showed no evidence of a significant release. Therefore, the only significant transport mechanisms are considered to be soil release to groundwater and subsequent downgradient transport and volatilization to ambient air.

Fugacity modelling was performed to determine the partitioning of the chlorinated organics between the soil, soil-water and soil-airspace phases. This analysis indicated that volatile organic chemicals of concern will partition equally in the soil-water and soil-airspace with the exception of vinyl chloride which will partition mostly into the airspace. Furthermore, the data suggest that the TCE is being biodegraded in the soil to 1,2-DCE and the 1,2-DCE is being further biodegraded to vinyl chloride. Since vinyl chloride is a gas at ambient conditions, it is likely that the vinyl chloride is ultimately released as a vapor. Groundwater transport modelling was performed to compare the downgradient rate of transport of TCE to the rate of biodegradation. This modelling suggests that it is unlikely that the TCE will reach the off-site farmhouse wells since it degrades and disperses before it reaches that point.

7.1.3 Risk Assessment

7.1.3.1 Human Health Risk Assessment

Human health risk assessments were calculated for four potential exposure scenarios:

1) Current off-site residents;
2) Future on-site residents;
3) Current on-site deerhunters, and;
4) Future on-site construction workers.

The current off-site residential exposure scenario involved calculation of risks via six pathways: Dermal contact to surface water in Kendaia Creek while wading; dermal contact to sediments in Kendaia Creek while wading; ingestion of groundwater from off-depot wells; dermal contact to groundwater from off-post wells while showering or bathing; inhalation of volatile organics released from groundwater from off-depot wells while showering; and inhalation of volatile organics in ambient air emitted from on-site soils and transported downwind to the depot fenceline. The calculated excess cancer risks to current off-site residents from these pathways is 1.8×10^{-5} which is within the USEPA defined target range of 10^{-6} to 10^{-4}. The calculated hazard index of 0.15 is less than the USEPA defined non-carcinogenic target risk value of one.

The future on-site residential exposure scenario involved calculation of risks via eight pathways: ingestion of on-site surface soils; dermal contact with on-site surface soils; dermal contact with surface waters in Kendaia Creek and on-site wetlands while wading; dermal contact with sediments in Kendaia Creek and on-site wetlands while wading; ingestion of groundwater from on-site wells; dermal contact with groundwater from on-site wells while showering or bathing; inhalation of volatile organics released from groundwater from on-site wells while showering; and inhalation of volatile organics in ambient air emitted from on-site soils. For this exposure scenario, the calculated excess cancer risk of 1.6×10^{-3} and the hazard index of 4.2 are above the USEPA target risk ranges of 10^{-6} to 10^{-4} and one respectively. These risks are due primarily to potential exposure of receptors to on-site groundwater as their sole drinking water source.

The current on-site deerhunter exposure scenario involved calculation of risks via five pathways: dermal contact with surface water in Kendaia Creek and on-site wetlands while wading; dermal contact with sediments in Kendaia Creek and on-site wetlands while wading; ingestion of on-site surface soils; dermal contact with on-site surface soils, and inhalation of volatile organics in ambient air emitted from on-site soils. The calculated excess cancer risk of 9.6×10^{-6} and hazard index of 0.0075 for current on-site hunters are within or below USEPA defined target limits.

The future on-site construction worker exposure scenario involved calculation of risks from three pathways; ingestion of on-site surface and sub-surface soils; dermal contact with on-site surface and subsurface soils; and inhalation of volatile organics in ambient air emitted from on-site soils. The calculated excess cancer risk at 3.4×10^{-7} is within the USEPA target range and the hazard index at 0.003 is below the USEPA defined target of one.

In summary, potential future on-site residents are the only receptors exhibiting excess risk of cancer above the USEPA target range and a potential for adverse non-carcinogenic health threats. However, consideration should be given to the likelihood of any future residential development and groundwater use on-site. If a pathway is not completed, there are no risks.

7.1.3.2 Ecological Risk Assessment

The Ash Landfill ecological risk assessment included both a qualitative and quantitative assessment of the ecological status of the Ash Landfill. During Phase I and Phase II, field evaluations included fish trapping and counting, benthic macroinvertibrate sampling and counting and small mammal species sampling and counting. In addition, a vegetation survey was performed, identifying major vegetation and understory types. The conclusions determined from these field efforts indicated a diverse and healthy aquatic and terrestrial environment. No overt acute toxic impacts were evidenced during the field evaluation.

Quantitative soil, sediment and surface water analytical data were compared to USEPA and NYSDEC guidelines for the protection of aquatic and macroinvertebrate life in sediments and surface water. Additionally, as a supplement to specific guidelines, criteria were developed to be protective of terrestrial wildlife and vegetation in soils. The quantitative evaluation which involved comparison of the 95th UCL of the mean of site data with the media specific criteria, suggested a slight potential for chronic risk from heavy metals. The acute effects from these metals have not been observed during fieldwork, i.e. the ecological community appears diverse and normal, however long term chronic impacts are more subtle. For example, calculated chronic toxicity concentrations for aquatic (mallard) wildlife were exceeded by lead in soil at the 95th UCL. For the protection of aquatic life in contact with sediments, the 95th UCL for nine metals (arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel and zinc) exceed the NYSDEC guidelines. However, the Limits of Tolerance (LOT) criteria for the protection of benthic macroinvertebrates were not exceeded for any metals in sediments. Federal surface water chronic toxicity criteria for the protection of aquatic life were exceeded for five metals aluminum, antimony, iron, lead, and mercury and NYSDEC criteria were exceeded by iron. However, no metal exceeded the Federal acute toxicity criteria for the protection of aquatic life. For protection of terrestrial vegetation, only soil concentrations of cadmiun and zinc at the 95th UCL exceeded regulatory guidelines or concentrations estimated to cause phytotoxicity. In summary, on-site soils, surface waters and sediment suggest the site conditions may pose a slightly elevated ecological risk due to the presence of heavy metals.

7.2 CONCLUSIONS

This section provides conclusions based upon the previous evaluation of the nature and extent of known impacts and the risk evaluation. Site conditions are generally as expected, the investigation provided both sufficient quality and quantity of data to adequately assess human health and ecological risk. Residual materials from the former activity of landfilling include volatile organics, semi-volatiles organics and heavy metals. These constituents exceed NYSDEC guidelines for groundwater, soil and sediment. Volatiles and semivolatiles contribute to a total site human health risk that exceeds the acceptable range of risk established by the EPA, (i.e. $1x10^{-4}$ to $1x10^{-6}$ for carcinogens and a Hazard Index greater than 1.0 for non-carcinogens) for a potential future receptor, therefore a remedial action appears to be warranted for the site.

This investigation has determined that the majority of residuals are located within three on-site areas. The Ash Landfill, the Non-Combustible Fill Landfill and the debris piles. The only significant off-site transport that is occurring is leaching of chlorinated volatile organics from soils at the "bend in the road" area into groundwater and subsequent downgradient transport and volatilization to ambient air.

7.2.1 Data Limitations and Recommendations for Future Work

Section 4 of this report presents the results from the extensive field investigation program conducted during Phases I and II of the RI. The conclusions indicate that sufficient sampling was performed as part of this investigation to adequately assess the conditions on this site. Further, since all the collected samples were analyzed using NYSDEC CLP protocols and validated following EPA Region 2 Functional Guidelines, the quality of the data meets the requirements established by the project data quality objectives. Accordingly, no further investigatory work is required for this site.

7.2.2 Recommended Remedial Action Objectives

As a prelude to the follow-up feasibility study, remedial action objectives should focus upon mitigating the potential for leaching of chlorinated volatile organics into groundwater. The Army is currently preparing an Action Memorandum to address this issue. The purpose of this Action Memorandum will be to initiate an interim remedial action that will prevent on-going releases of chlorinated volatile organics to the groundwater prior to the completion of the feasibility study and the signing of the Record of Decision.

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