01151

U.S. ARMY ENGINEER DIVISION
HUNTSVILLE, ALABAMA

FINAL

GENERIC INSTALLATION REMEDIAL INVESTIGATION / FEASIBILITY STUDY (RI / FS) WORKPLAN FOR SENECA ARMY DEPOT ACTIVITY

AUGUST 1995

GENERIC INSTALLATION REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) WORK PLAN
SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK

Prepared For:

Seneca Army Depot Activity
Romulus, New York

Prepared By:

Parsons Engineering Science, Inc.
Prudential Center
Boston, Massachusetts

726511

August 1995

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1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

This Generic Installation Remedial Investigation/Feasibility Study (RI/FS) Work Plan is designed to serve as a foundation for RI/FS workplans, and provides generic information that is not specific to any particular site at Seneca Army Depot Activity (SEDA). Site specific information is contained in associated RI/FS Project Scoping Plans that are referenced throughout this Generic Work Plan. The Generic Work Plan and its associated Scoping Plans provide a mechanism for investigating sites (Areas of Concern - AOCs) at SEDA as part of the United States Army Corps of Engineers (USACE) remedial response activities under the Comprehensive Environmental Responsibility, Compensation and Liability Act (CERCLA). SEDA is included on the federal facilities National Priorities List (NPL) and has been listed since July 13, 1989. Where appropriate, information from New York State Department of Environmental Conservation (NYSDEC) Technical Administrative Guidance Memorandum (TAGM) titled, "Phase II Investigation Generic Workplan" (HWR-88-4007, May 1988) was incorporated into this Generic Installation RI/FS Work Plan.

The RI/FS will determine the nature and extent of environmental impacts and evaluate and select appropriate remedial actions. These will be based upon compliance with ARARs and overall risks to human health, welfare and the environment.

As required, this generic workplan will be updated and/or revised to incorporate specific field sampling procedures and/or analytical methodologies or test procedures used for environmental investigation/construction developments at the Seneca Army Depot Activity, in order to comply with location (area or site) specific Data Quality Objectives and ARARs.

1.2 REPORT ORGANIZATION

The remaining sections of this report are organized to describe the overall site conditions, provide a scoping of the RI/FS, and to provide task plans for the RI and FS. Section 2.0 (Site Conditions) presents a description of regional geologic and hydrogeologic site conditions and discusses the results of previous investigations. Section 3.0 discusses scoping of the RI/FS including the conceptual site model, identification of potential receptors and exposure scenarios, scoping of potential remedial action technologies, preliminary identification of ARARs, data quality objectives, and data gaps and needs. The task plans for the RI and FS are discussed in Sections 4.0 and 5.0, respectively. Section 6.0 (Plans and Management) discusses scheduling and staffing. Appendices A through F are included with this report.

1.3 SITE BACKGROUND

Background information for the subject site is described in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

2.0 SITE CONDITIONS

2.1 PHYSICAL SETTING

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 2-1). 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. A plan view of SEDA is presented in Figure 2-2.

2.2 REGIONAL GEOLOGICAL 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 2-3 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 2-4). 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

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FIGURE 2-1

LOCATION MAP

SCALE 1"= 8 MILES APPROX.

DATE JANUARY 1995

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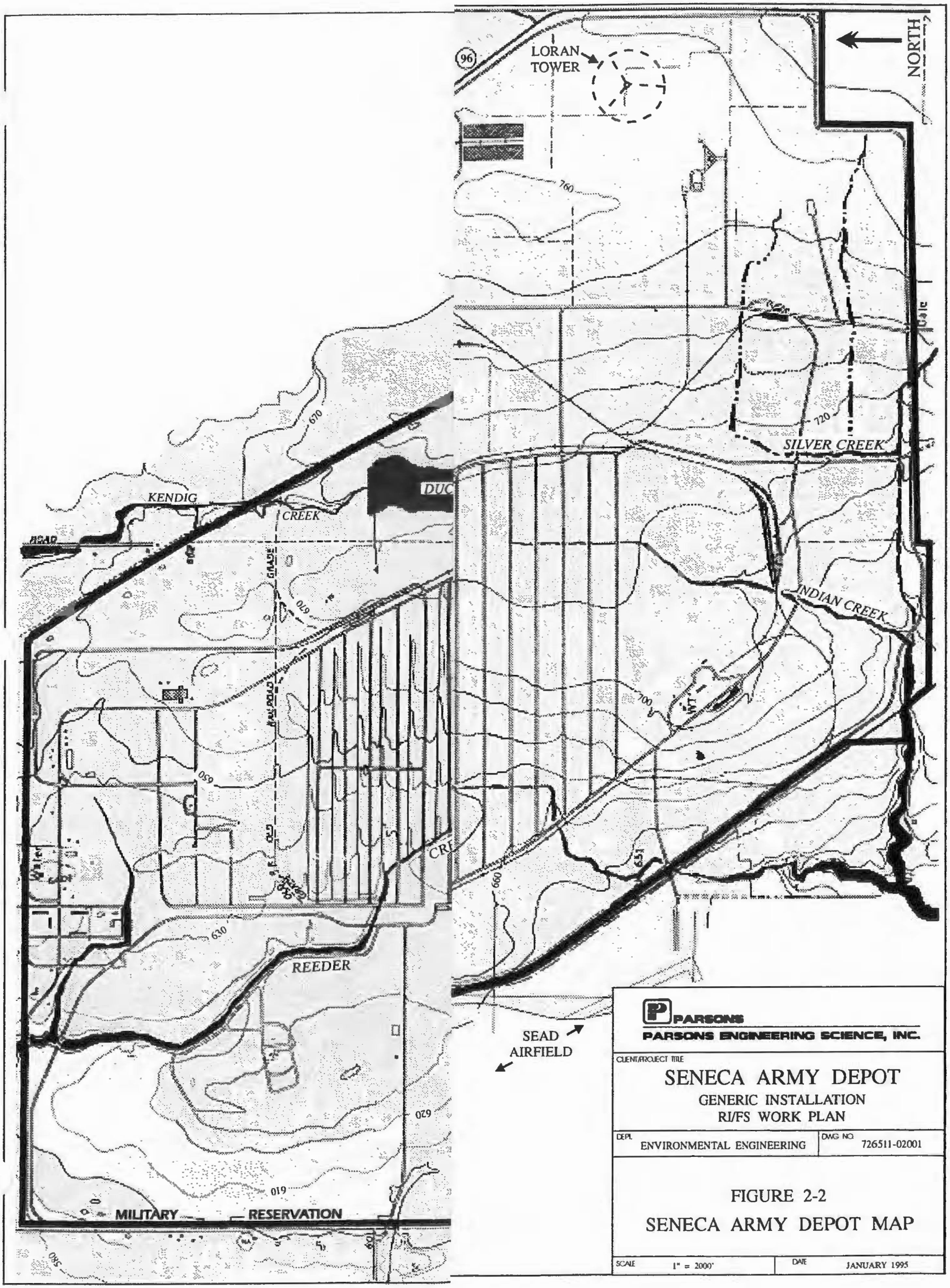

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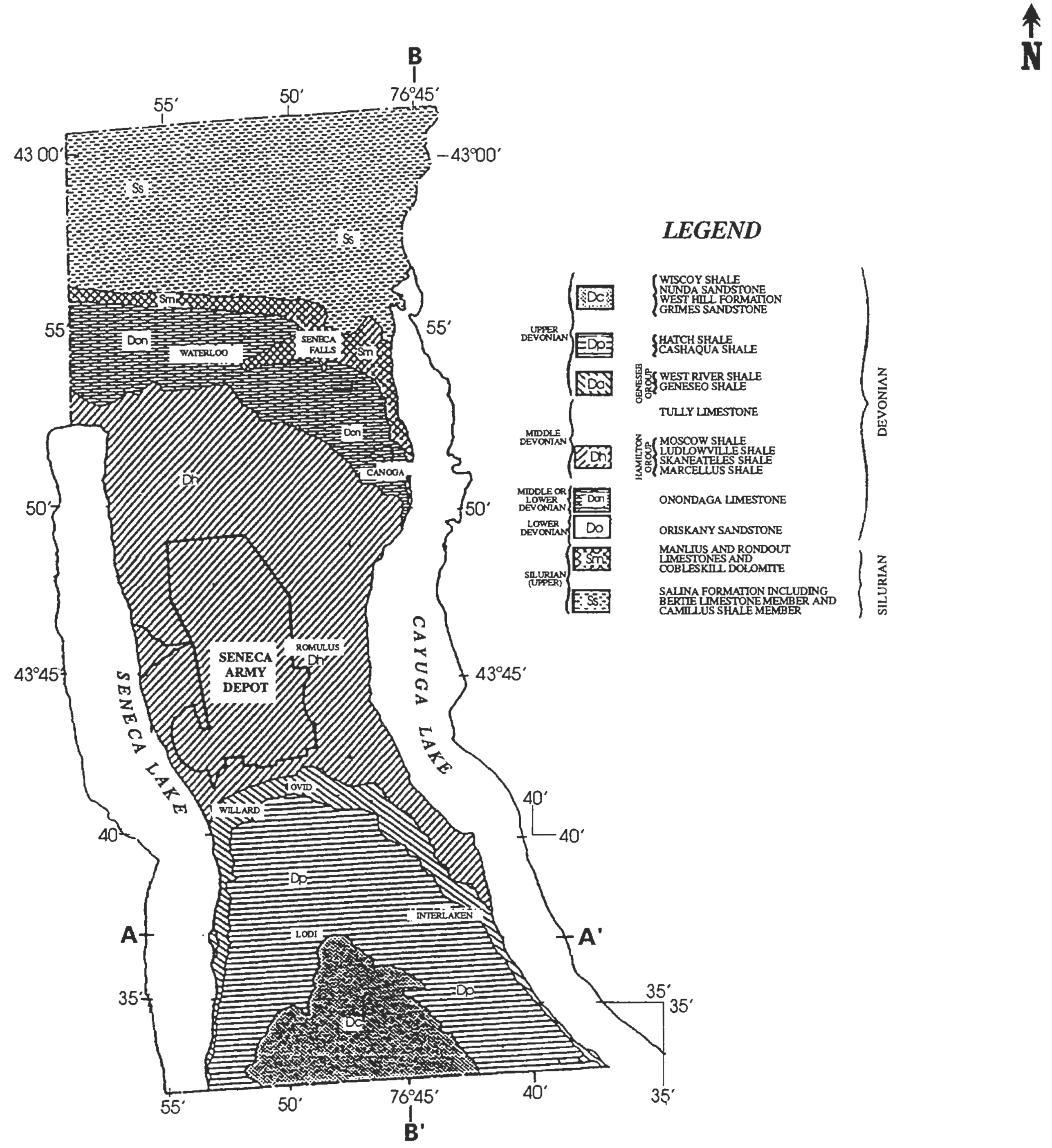
FIGURE 2-2
SENECA ARMY DEPOT MAP

SCALE 1" = 2000'

DATE JANUARY 1995



SOURCE:MODIFIED FROM-THE GROUND WATER RESOURCES
OF SENECA COUNTY, NEW YORK: MOZOLA, A.J.,
BULLETIN GW-26, ALBANY, NY, 1951

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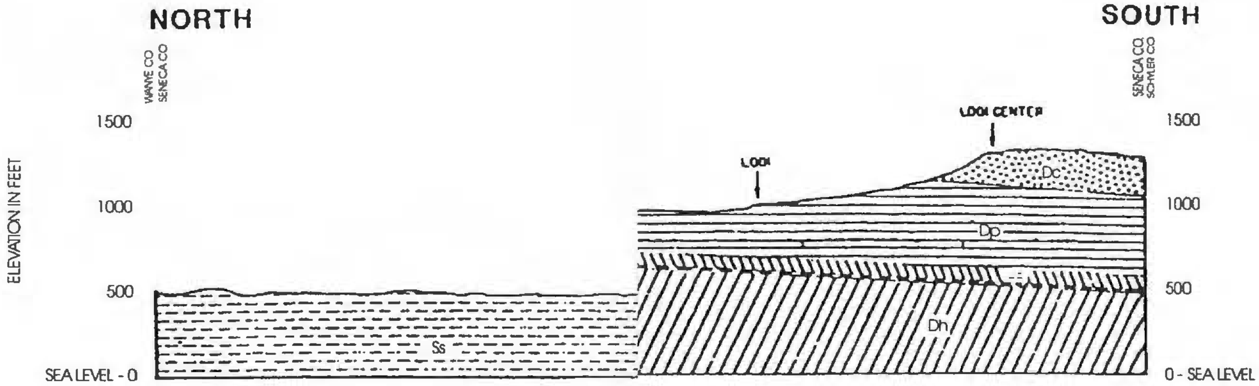
FIGURE 2-3

GEOLOGIC MAP OF
SENECA COUNTY

SCALE 1" = 5 MILES	DATE JANUARY 1995

R:\GRAPHICS\SENECA\GEOLOGIC.CDR(CVM)



3 MILES

SOURCE:MODIFIED FROM-THE GROUND WATER RESOURCES
OF SENECA COUNTY, NEW YORK: MOZOLA, A.J.,
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FIGURE 2-4

REGIONAL GEOLOGIC
CROSS SECTIONS

SCALE 1" = 12,000 MILES APPROXIMATE
DATE JANUARY 1995

R:\GRAPHICS\SENECA\GEOXSEC.CDR(CVM)

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 2-5 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 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 2-6, the physiography of Seneca County, presents an overview of the subsurface sediments present in the area. The site is shown on Figure 2-6 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 minor 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, although in selected locations it is greater than 30 feet thick.

Darien silt-loam soils, 0 to 18 inches thick, have developed over Wisconsinan 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 2-7 presents the U.S. Department of Agriculture General Soil map for Seneca County.

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 2-1 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.

MESOZOIC

Lower Cretaceous

MESOZOIC INTRUSIVES

Kimberlite and alnoite dikes and diatremes.

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 Pipe 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

Lower Silurian

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

Decew Dolostone; Rochester Shale.

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.

Undifferentiated Medina Group and Queenston Formation.

Upper Ordovician

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

Oswego Sandstone.

Pulaski and Whetstone Gulf Formations—siltstone, shale.

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

Middle Ordovician

Utica Shale.

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FIGURE 2-5

BEDROCK STRATIGRAPHIC
COLUMN

SCALE

DATE JANUARY 1995

SOURCE:MODIFIED FROM-THE GROUND WATER RESOURCES
OF SENECA COUNTY, NEW YORK: MOZOLA, A.J.,
BULLETIN GW-26, ALBANY, NY, 1951

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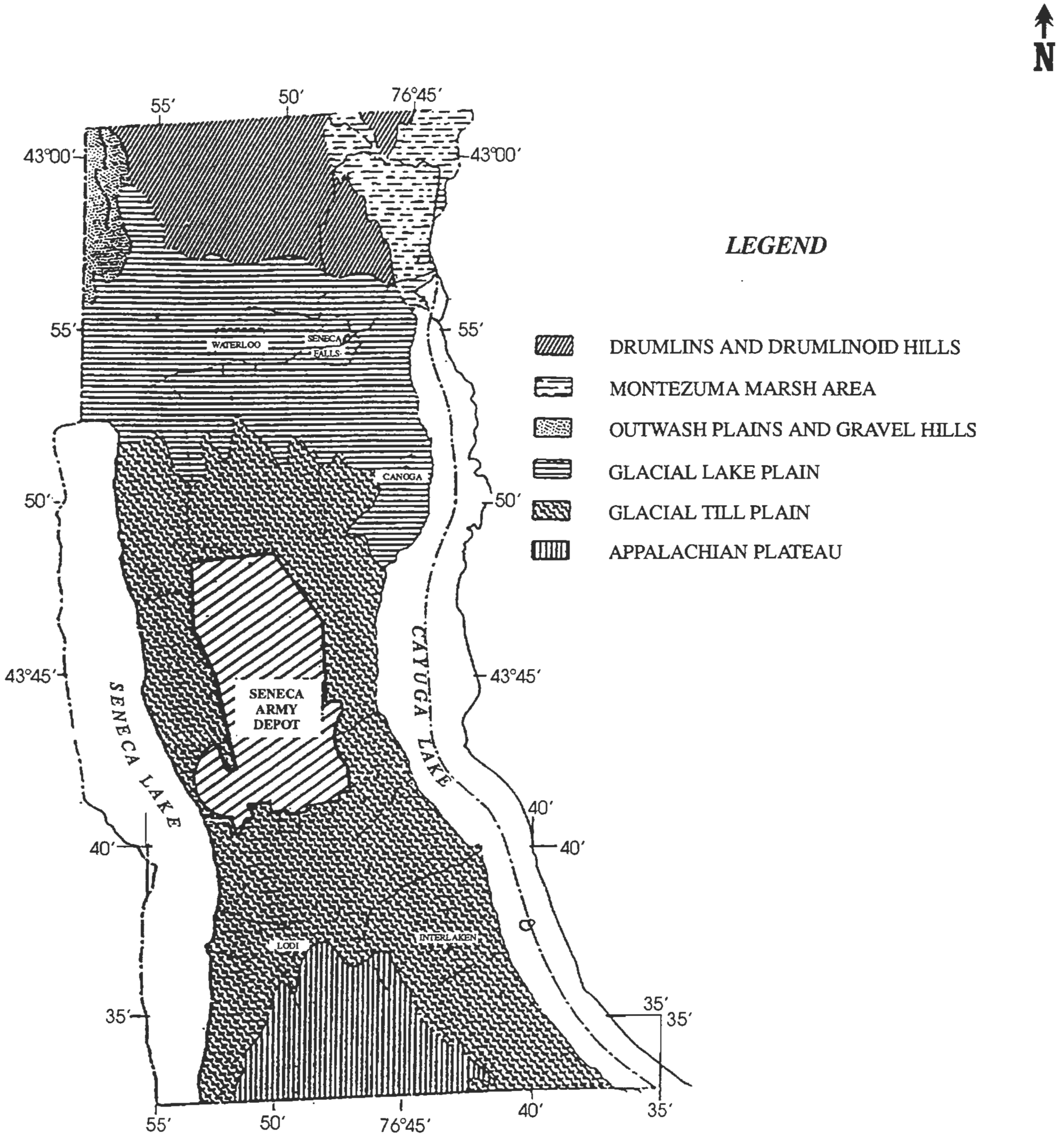

SOURCE:MODIFIED FROM-THE GROUND WATER RESOURCES
OF SENECA COUNTY, NEW YORK: MOZOLA, A.J.,
BULLETIN GW-26, ALBANY, NY, 1951

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FIGURE 2-6

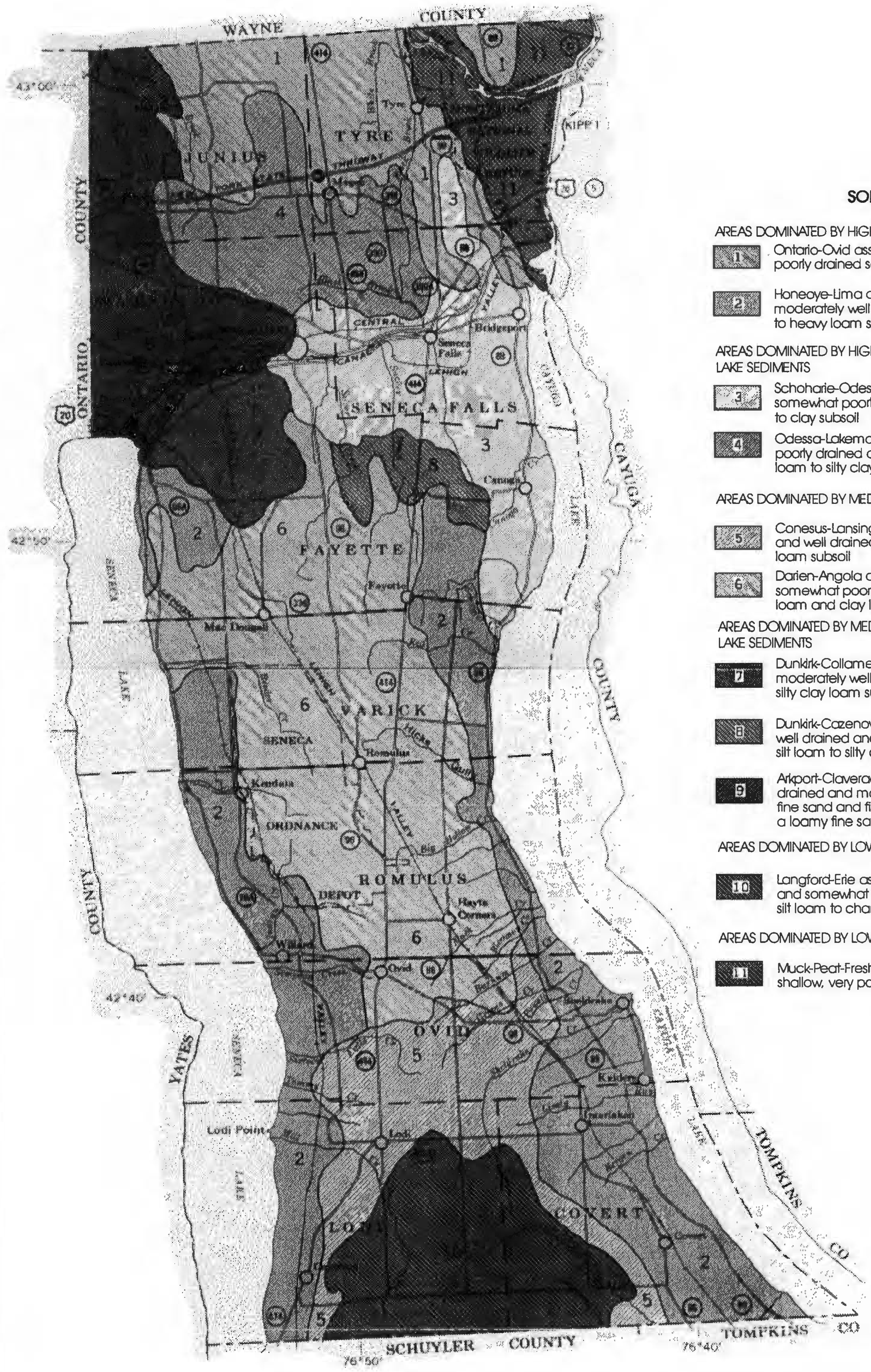
PHYSIOGRAPHIC MAP OF
SENECA COUNTY

SCALE 1" = 5 MILES
DATE JANUARY 1995

R:\GRAPHICS\SENECA\PHYSIO.CDR(CVM)

N

1 0 1 2 3 4
SCALE IN MILES
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 LOW-LIME SOILS DEVELOPED IN ORGANIC MATERIAL

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

FEBRUARY 1971

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

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FIGURE 2-7

GENERAL SOIL MAP
SENECA COUNTY, NEW YORK

SCALE 1" = 2000'
DATE JANUARY 1995

R:\GRAPHICS\SENECA\COLRSOIL.CDR(CWM)

TABLE 2 - 1

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

SENECA ARMY DEPOT

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

TABLE 2 - 1

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

SENECA ARMY DEPOT

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.

2.3 REGIONAL HYDROGEOLOGICAL 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 2-8 shows the distribution of known private wells near SEDA based on information obtained from SEDA and the Town of Romulus. Approximately 95 percent of the wells in the county are used for domestic or farm supply and the average daily withdrawal is approximately 500 gallons, an average rate of 0.35 gallons per minute (gpm). The pumping rates from these wells range from 0.5 to 150 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 located approximately 1,000 feet from the center of the village. Ovid is located approximately 5 miles south of SEDA. Interlaken has one well located 1-1/2 miles northeast of the center of the village from which to obtain its public water supply. Two wells are used as a backup water supply and are located approximately 1-1/2 miles southwest of the village. Interlaken is located approximately 11 miles south of SEDA.

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

LEGEND

△ = *DWELLING WITH DRINKING WATER WELL*

SOURCE: COMPOSITE OF FOUR U.S.G.S 7.5 MINU
QUADRANGLES-DRESDEN, ROMULUS, GENEVA SC
AND OVID, NY - WELL LOCATIONS PROVIDED BY

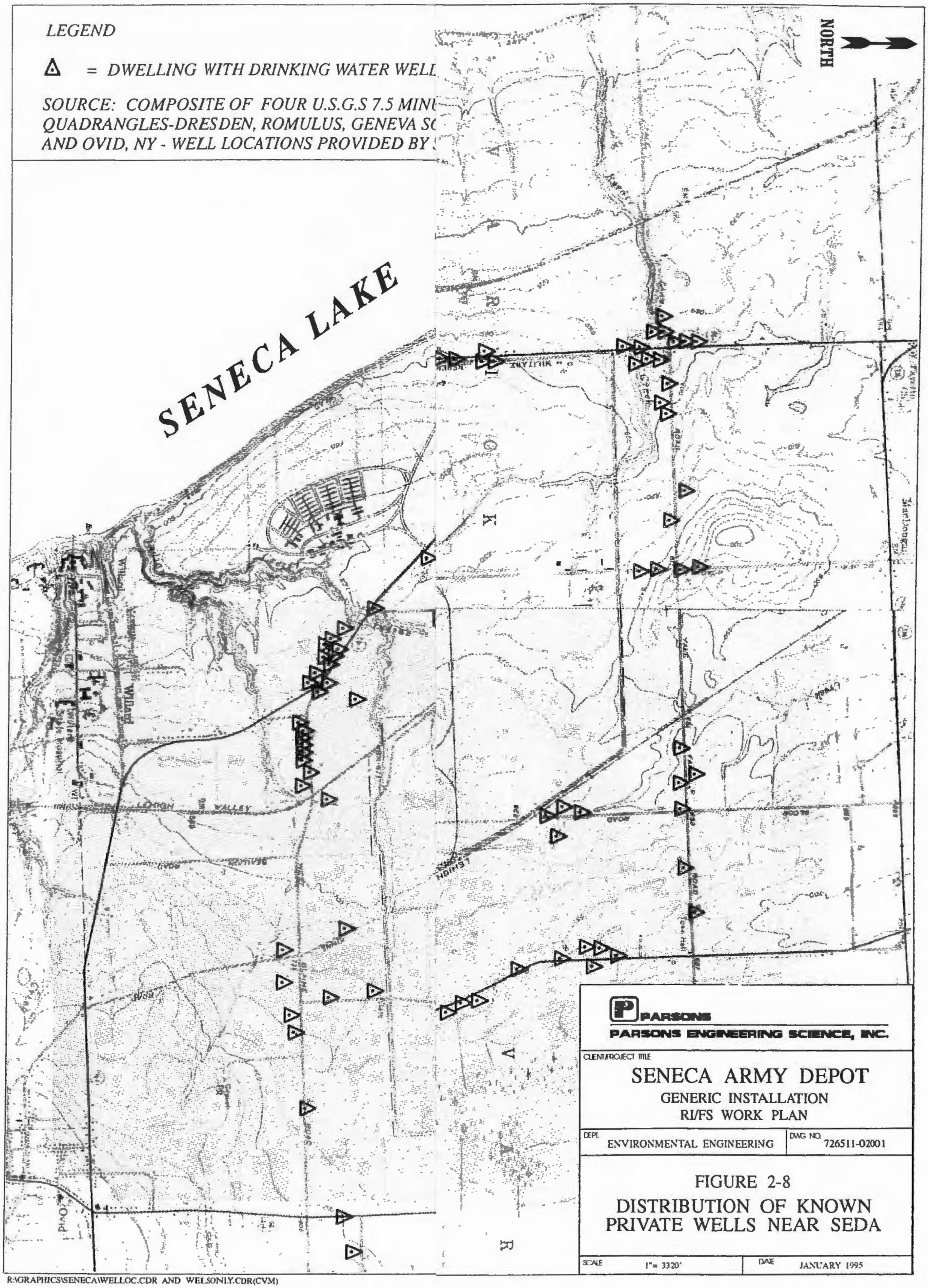

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FIGURE 2-8
DISTRIBUTION OF KNOWN
PRIVATE WELLS NEAR SEDA

SCALE 1"= 3320'	DATE JANUARY 1995

R:\GRAPHICS\SENECA\WELLOC.CDR AND WELSONLY.CDR(CVM) indicates that within the area of SEDA 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 (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.

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 hydraulic conductivity of the till/weathered shale aquifer at SEDA is approximately 6.6×10^{-4} cm/s based on slug tests performed at 22 wells located in the western portion of the Depot (i.e., the Ash Landfill and OB Grounds).

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 (1951) 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.

2.4 RESULTS OF PREVIOUS INVESTIGATIONS

Results of previous investigations for the site are described in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

3.0 SCOPING OF THE RI/FS

The previous sections have presented the current database for the subject site. This section will integrate and interpret the previously presented information yielding a conceptual understanding or model which will define the current conditions at the site. Consistent with this understanding will be the selection of likely potential receptors of pollutants from this site and potential technologies which may be appropriate, should a remedial action be necessary. Finally, Data Quality Objectives (DQO)s will be established which will define the quality and quantity of the data necessary to make decisions regarding this site.

3.1 CONCEPTUAL SITE MODEL

The conceptual site model for the subject site combines both site conditions and expected pollutant behavior into a cohesive understanding of the site. This will serve as the basis for the deciding upon what activities will be performed during the RI. The model was developed by evaluating the following aspects:

1. Physical site characteristics: This considers the physical aspects of environmental conditions and the effect these conditions may have on potential pollutant migration.

2. Environmental fate of constituents: This considers the expected behavior of residual materials in the environment based upon the pollutants' known chemical properties.

3.1.1 Physical Site Characterization

Physical site characterization of the subject site is discussed in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

3.1.2 Environmental Fate of Constituents - An Overview

This section presents a general discussion of contaminant fate and how these fate guidelines will be used to evaluate the contaminants present at SEDA. This discussion will focus on a variety of constituents including volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, herbicides, metals and explosives.

The fate of a constituent refers to the length of time a constituent remains in its present hazardous form. Organic constituents, including explosives, will degrade or decay over time, generally into nonhazardous chemicals. Metal constituents will not degrade, but may be converted into less hazardous or less mobile forms. Properties of both the hazardous constituents and the media (soil, sediment, surface water, and groundwater) are necessary to fully evaluate fate and transport. Examples of meaningful constituent-specific properties are solubility, volatility, degradability, and adsorptivity. These properties are discussed below. Representative indicators of these properties for selected organic compounds of concern at SEDA are shown in Table 3-1. The organic compounds presented in Table 3-1 were those compounds commonly found in investigations conducted to date at SEDA including RIs and ESIs, and those compounds suspected to have been released to the environment based on historical usage of the sites at SEDA. Media-specific properties for soils and sediment include organic carbon content, moisture content, and mineralogy. Media-specific properties for surface water and groundwater include organic content, charge balance, redox condition, and pH.

Volatile constituents will enter the air in void spaces in the soil above the saturated zone. These constituents may then leave the system through the ground surface. The tendency of compound to volatilize is usually expressed in terms of a Henry's Law constant K_H. Henry's Law holds in cases where the solute concentration is very low, which is applicable to most constituents found at hazardous waste sites. Henry's Law states that the concentration of a constituent in the vapor phase is directly proportional to the concentration of that constituent in the aqueous phase. The proportionality factor is the Henry's Law constant. Henry's Law constants for a number of the selected organic compounds of concern at SEDA are shown in Table 3-1. Generally, for compounds with a Henry's Law constant less than 5×10^{-3} atm-m^3/mol, volatilization from the soils will not be a major pathway (Dragun, 1988).

Compounds in soil usually are mobilized by entering the aqueous phase. The compounds may enter meteoric water as runoff during rainfall events, or as it percolates through the soil column to the groundwater. Hazardous constituents present in soils may also dissolve directly into the groundwater during periods of high water tables. In some cases, the contaminants enter the system directly into the water fraction via spills or leaks.

Important soil properties to consider include the fraction of organic carbon, the mineralogy, and the porosity. Many organic compounds and some metals adsorb more strongly to the organic fraction in the soil or sediment. Therefore, the larger the amount of organics in the soil, the less mobile organic constituents will be.

TABLE 3 - 1

SUMMARY OF FATE AND TRANSPORT PARAMETERS FOR SELECTED ORGANIC COMPOUNDS OF CONCERN

SENECA ARMY DEPOT

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							
Methylene Chloride	20000	438	2.03E-03	8.80E+00	2.00E+01	1-3	0.8
Acetone	infinite	288	2.06E-05	2.80E-01	5.75E-01		0.03
1,1,1-Trichloroethane	1500	123	1.44E-02	1.52E+02	3.16E+02	300	5.6-15
1,1,-Dichloroethane	5500	182	4.31E-03	3.00E+01	6.17E+01		2.9
1,1,2,2-Tetrachloroethane	2900	5	3.81E-04	1.18E+02	2.45E+02		
1,2-Dichloroethene (total)	6300	5.3	6.60E-03	5.90E+01	1.23E+02		4.5
2-Hexanone	14000	11.6	2.82E-05				6
4-Methyl-2-Pentanone	17000	20	1.55E-04				
Benzene	1750	95.2	5.59E-03	8.30E+01	1.32E+02	110	6.5
Carbon Disulfide	2940	366	1.32E-02	5.40E+01	1.00E+02		7.9
Chloroform	8200	208	2.87E-03	4.70E+01	9.33E+01		4.5-6
Chloromethane	6500	4310	4.40E-02	3.50E+01	9.50E-01		
Ethylbenzene	152	7	6.43E-03	1.10E+03	1.41E+03	37	68-95
2-Butanone	353000	70.6	4.35E-05	9.40E-01	1.95E+00		0.09-1.86
1,2-Dichloroethane	8520	80	9.78E-04	1.40E+01	3.02E+01	2-18	1.4-2
MTBE	43000						
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		
Stryene	300	4.5	2.05E-03				
1,1-Dichloroethene	2250	500	3.40E-02	6.50E+01	5.30E+01		
Tetrachloroethene	150	19	2.59E-02	3.64E+02	3.98E+02	1-13	49-66
Toluene	535	30	6.37E-03	3.00E+02	5.37E+02	3-39	2.6-27.1
Chlorobenzene	490	8.8	3.46E-03	3.33E+02	6.92E+02		10-33
Xylene (total)	0.3	9	6.91E-03	6.91E+02	1.45E+03		70
Semivolatile Organic Compounds							
Phenol	93000	0.341	4.54E-07	1.42E+01	2.88E+01	3-5	1.4-2
1,4-dichlorobenzene	79	1.18	2.89E-03	1.70E+03	3.98E+03		60-117
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
4-Chloroaniline	3900	0.025	1.07E-05				
Acenaphthylene	3.93	0.029	1.48E-03	2.50E+03	5.01E+03		
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
Carbazole							
Fluorene	1.69	0.00071	6.42E-05	7.30E+03	1.58E+04	32-60	
N-Nitrosodiphenylamine	113		1.40E-06	6.50E+02	1.35E+03	4	65-217
N-Nitroso-di-n-propylamine							
Hexachlorobenzene	0.006	0.000019	6.81E-04	3.90E+03	1.70E+05		
Pentachlorophenol	14	0.00011	2.75E-06	5.30E+04	1.00E+05		13-6300
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	200-460	
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	

TABLE 3 - 1

SUMMARY OF FATE AND TRANSPORT PARAMETERS FOR SELECTED ORGANIC COMPOUNDS OF CONCERN

SENECA ARMY DEPOT

COMPOUND	SOLUBILITY (mg/l)	VAPOR PRESSURE (mmHg)	HENRY'S LAW CONSTANT (atm-m³/mol)	Koc (ml/g)	Kow	HALF - LIFE (days)	BCF
Semivolatile Organic Compounds							
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	
Pesticides/PCBs							
alpha-BHC							
beta-BHC	0.24	2.80E-07	4.47E-07	3.80E+03	7.94E+03	Neg. Deg.	
delta-BHC	31.4	1.70E-05	2.07E-07	6.60E+03	1.26E+04	Neg. Deg.	
gamma-BHC (Lindane)	7.8	0.00016	7.85E-06	1.08E+03	7.94E+03	Neg. Deg.	250
gamma-Chlordane							
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	Neg. Deg.	
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							
Endrin ketone							
alpha-Chlordane	0.56	0.00001	9.63E-06	1.40E+05	2.09E+03	Neg. Deg.	400-38000
Aroclor-1242	0.24	0.00041	5.60E-04		1.29E+04		
Aroclor-1248	0.054	0.00049	3.50E-03		5.62E+05	Neg. Deg.	
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
Herbicides							
2,4-D	620	0.04	1.88E-04	1.96E+01	6.46E+02	208	31
2,4-DB							
Dalapon	502000	0.12	6.43E-08		5.70E+00		
Dicamba	4500	2.0E-05	1.30E-09	2.20E+00	3.00E+00		
Dichloroprop							
MCPA							
MCPP							
2,4,5-T	278	7.5E-07	8.68E-09	6.50E+02			65
2,4,5-TP (Silvex)	238	5.2E-06	1.31E-08	8.01E+01	4.00E+00		170

TABLE 3 - 1

SUMMARY OF FATE AND TRANSPORT PARAMETERS FOR SELECTED ORGANIC COMPOUNDS OF CONCERN

SENECA ARMY DEPOT

COMPOUND	SOLUBILITY (mg/l)	VAPOR PRESSURE (mmHg)	HENRY'S LAW CONSTANT (atm-m³/mol)	Koc (ml/g)	Kow	HALF - LIFE (days)	BCF
Explosives							
HMX	66	3.90E-09		5.08E+02	1.30E-01		
RDX	50	4.10E-09	2.00E-05	5.38E+02	7.80E-01		
1,3,5-Trinitrobenzene	35	2.20E-04	1.30E+00	5.20E+02			
1,3-Dinitrobenzene	470			1.50E+02	4.17E+01		
Tetryl							
2,4,6-Trinitrotoluene	130	0.0001	1.37E-06	5.34E+02	1.90E+00		
4-amino-2,6-Dinitrotoluene							
2-amino-4,6-Dinitrotoluene							
2,6-Dinitrotoluene	182	0.018	3.27E-06	2.49E+02	1.00E+02	4	4.6
2,4-Dinitrotoluene	270	0.0051	5.09E-06	2.01E+02	1.00E+02	5	

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).

Notes:

Koc = organic carbon partition coefficient
Kow = octanol-water partition coefficient
BCF = bioconcentration factor
Neg. Deg. = Negligible Biodegradation

One measure of the affinity of a compound for the organic fraction of the soil is 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. K_{oc} values are presented in Table 3-1 for potential contaminants of concern at SEDA. The units used in Table 3-1 are milliliters per gram (mL/g). Table 3-2 describes the relative relationship between K_{oc} and mobility. As can be seen, compounds with a K_{oc} greater than 500 mL/g are generally considered immobile (Dragun, 1988). As shown in Table 3-1, most of the PAHs and pesticides have K_{oc} values well greater than 500 mL/g, and can be considered immobile. The explosives have K_{oc} values ranging from 45 to 500 mL/g, and therefore may be considered mobile.

Soils with higher organic content will adsorb more organics than soils with more clays. Generally, surface soils will have higher organic content than deeper soils, due to the presence of live and dead plant matter at the surface.

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. Like K_{oc}, K_{ow} values are also presented in Table 3-1. Since these values are a ratio of concentrations, they are dimensionless.

Other compounds adsorb more strongly to the clay fraction of a soil or sediment. Understanding the type and amount of clays present is crucial to estimating the mobility of the compounds. Most of the soils at SEDA are classified as clay loams. These soils generally have low permeabilities and high water retention capabilities. Because of these properties, contaminants tend to move slowly through these soils.

Transport refers to the movement of hazardous constituents at a site. There are three major pathways through which hazardous contaminants may migrate and threaten human health and the environment, and which must be evaluated for every site: air, groundwater, and surface water. At SEDA, the major potential pathways of concern are surface water runoff, the interaction of surface water with surficial soils, groundwater, and the air pathway, primarily through the entrainment of particulates. A potential secondary pathway of concern is ingestion of fish from any surface water body which may contain hazardous constituents.

TABLE 3-2

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: The Soil Chemistry of Hazardous Materials; James Dragun, Ph.D; The Hazardous Materials Control Research Institute; 1988.

This mobilization might take place on different scales i.e.,adsorption of the lead onto organic matter or leaching of metal complexes into surface water during runoff of precipitation. Any evaluation of transport must involve characteristics and data from the total site, and cannot look solely at chemical data or general soil and surface water information. The transport mechanisms must also be understood in terms of small to large-scale phenomena.

The discussion of the fate mechanisms is separated into several groups, organics (VOCs, SVOCs, Pesticides/PCBs, herbicides and explosives) and heavy metals, as the mechanisms are somewhat different for each class. For organic constituents such as explosives, fate is evaluated in terms of degradation or conversion of the compounds. Compounds can biodegrade, hydrolyze,photodegrade, or be converted into other organic compounds. Usually, organic compounds are converted to less hazardous compounds, with carbon dioxide and water being the major end products of aerobic degradation. Occasionally, more hazardous constituents may result from degradation. However, the degradation products of the explosives discussed in Section 3.1.3.6are not more hazardous than the parent compounds. Photodegradation is only important when the organic compounds are present at the surface and exposed to the sun. At SEDA, all of these mechanisms may contribute to the degradation of organics.

Important factors of organics (used to assess the degradation) include the degradation rate which is a measure of how rapidly a compound will biodegrade; solubility, which helps to determine the availability of the compound to the bacteria and to hydrolysis reactions; and toxicity, which is a measure of how toxic the compound is to the bacteria present in the soil. Biodegradation is often assumed to be a first order mechanism, and degradation rates may be expressed as first order rate constants or as half-lives. A half-life refers to the time it would take for half of the mass of the organic constituent to degrade. Half-lives for some of the selected organic compounds of concern at SEDA are shown in Table 3-1. 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.

The major fate mechanisms for metals are complexation, adsorption, precipitation, oxidation and reduction. Complexation and adsorption are very similar. Both involve the bonding of the metal ion with other materials present in the media, such as organic matter or clay minerals. In complexation, metals are bound up by larger molecules present in the aqueous fraction of the system, while adsorption generally refers to the binding up of the metals in the minerals or clays present in the soil or sediment. Metal complexes may still be mobile, while adsorbed metals are not. Precipitation involves the formation of a metal compound which is insoluble. Examples of insoluble compounds are metal hydroxides and metal carbonates.

Another aspect of fate and transport is bioaccumulation, or bioconcentration. A range of bioconcentration factors (BCFs) for some of the constituents is included in Table 3-1. While some of these values indicate a large potential for bioaccumulation, the overall potential at the site is low, since most of the chemicals of concern, both organics and inorganics are present in forms which are not readily available to plants and animals. The organics are primarily adsorbed in the organic matter in the soil (as evidenced by the high K_{oc} values), and the inorganics are present primarily in insoluble forms. Therefore, there will be little plant uptake of the hazardous constituents.

Another common mechanism for bioaccumulation is ingestion of fish which have accumulation of hazardous chemicals. Fish may accumulate these chemicals by swimming in contaminated water or by ingesting contaminated food.

3.1.3 Environmental Fate of Constituents at SEDA

3.1.3.1 Volatile Organic Compounds

Volatile organic compounds tend to have a low residence time in surface soil and surface water environments. These chemicals can be persistent in groundwater. However, there is evidence that non-chlorinated volatile organic compounds may degrade rapidly in the vadose zone above groundwater plumes. (Gas Research Institute, Management of Manufactured Gas Plant Sites, Volume III, Risk Assessment, May 1988, GRI-87/0260.3).

Major exposure routes of interest include the ingestion of groundwater and the inhalation of the gases. The latter can be important in situations involving the excavation of pits or the entrainment of soil gas into buildings.

There is little potential for these chemicals to accumulate in aquatic or terrestrial biota.

Because it is not the intent of this section to discuss the persistence of all volatile organic compounds, only selected volatile organics that are commonly found or are suspected to have been released to the environment at SEDA are discussed below.

This section addresses the contaminant persistence (fate and transport) and focuses on volatile organic compounds, the primary constituents of concern at the SEDA. Volatile organic chlorinated (aliphatic) compounds associated with SEDA 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. Common aromatic volatile organic compounds are benzene, toluene, ethylbenzene and xylenes (BTEX) which are associated with petroleum hydrocarbons, including gasoline.

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 3-1 summarizes the chemical specific properties of TCE and its breakdown products, and BTEX compounds. Media specific properties include organic carbon content, porosity, moisture content, bulk density, groundwater velocity, and dispersivity.

3.1.3.1.1 Aliphatic (chlorinated) Volatile Organics

Table 3-1 presents the information which will serve as a basis for predicting the likely environmental fate of the chlorinated substances at SEDA. 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 and liquid phase concentrations. Henry's constants for selected organic compounds of concern detected are presented in Table 3-1. 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.

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 3-1 for TCE and its breakdown products. The relationship between K_{oc} and mobility is presented in Table 3-2. 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.

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, since the reaction kinetics are the fastest of the mechanisms considered. Known biological breakdown products of TCE include vinyl chloride and 1,2-DCE. 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 selected organic compounds that have a potential to be detected at SEDA are shown in Table 3-1. 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.

3.1.3.1.2 Fate of Chlorinated Aliphatic Volatile Compounds

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 SEDA can be 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 SEDA 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 SEDA 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 3-3 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

TABLE 3 – 3

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/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)	33.2%	19.7%	8.3%
F(water)	54.4%	69.0%	30.1%
F(air)	12.4%	11.3%	61.6%

TABLE 3 – 3

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/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%

TABLE 3 – 3

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 3 – 3

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/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%

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).

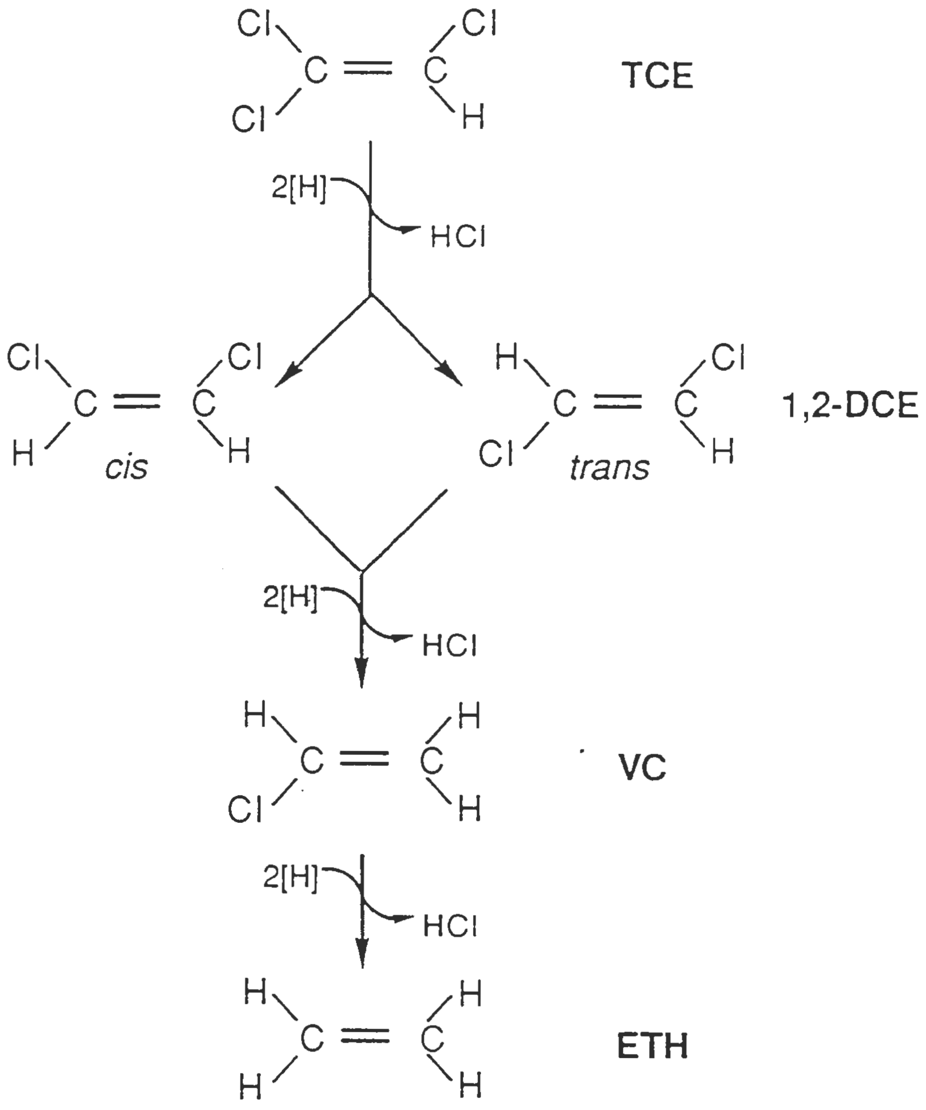
41.6%. In the saturated soil the partitioning percentage of TCE is 27.6% in the soil with the remainder in the soil water phase (72.4%).

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 indicate that chlorinated solvents found at SEDA will be partitioned into the soil-water and the soil-airspace.

The previous analysis did not consider degradation of these chemicals. Figure 3-1 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 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.



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SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

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FIGURE 3-1
BIODEGRADATION PATHWAY OF TCE BY REDUCTIVE DECHLORINATION

SCALE
DATE JANUARY 1995

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.

3.1.3.1.3 Aromatic Volatile Organics

The following information on aromatic volatile organics was obtained from the document, "Installation Restoration Program Toxicology Guide", Volume 1, October 1985, AD-A171095.

Benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds may move through the soil/groundwater system when present at low concentrations (dissolved in water and sorbed on soil) or as a separate organic phase (resulting from a spill of significant quantities of the chemical). In general, transport pathways of low soil concentrations can be assessed by equilibrium partitioning. These calculations predict the partitioning of BTEX compounds among soil particles, soil water and soil air. The portions of BTEX compounds associated with the water and air phases of the soil are more mobile than the adsorbed portions.

Partitioning in the Environment

Benzene: The estimate for an unsaturated topsoil model indicate that most of the benzene (88%) is expected to be sorbed to the soil. A much smaller (yet significant) amount (7%) will be present in the soil water phase and can thus migrate by bulk transport (e.g., the downward movement of infiltrating water), dispersion and diffusion. For the portion of benzene in the gaseous phase of the soil (5%), diffusion through the soil-air pores up to the ground surface, and subsequent removal by wind, will be a significant loss pathway.

In saturated, deep soils (containing no soil air and negligible soil organic carbon), a much higher fraction of the benzene (79%) is likely to be present in the soil water phase and transported with flowing groundwater.

Toluene: The estimates for an unsaturated topsoil model indicate that nearly all of the toluene (97%) is sorbed to the soil. A much smaller amount (2%) will be present in the soil water phase and thus migrate by bulk transport (e.g., the downward movement of infiltrating water), dispersion and diffusion. For the portion of toluene in the gaseous phase of the soil (1.6%), diffusion through the soil pore spaces up to the ground surface, and subsequent removal by wind, will be significant loss pathway. there is no significant difference in the partitioning calculated for 25°C and 10°C.

In saturated, deep soils (containing no soil air and negligible soil organic carbon), a much higher fraction of the toluene (48%) is likely to be present in the soil water phase and transported with flowing groundwater.

Ethyl benzene: The estimates for an unsaturated topsoil model indicate that nearly all of the ethyl benzene (98%) is sorbed to the soil. A much smaller amount (0.75%) is expected to be present in the soil-water phase and can thus migrate by bulk transport (e.g., the downward movement of infiltrating water), dispersion and diffusion. For the portion of ethyl benzene in the gaseous phase of the soil (0.7%), diffusion through the soil air pores up to the ground surface, and subsequent removal by wind, will be a significant loss pathway.

In saturated, deep soils (containing no soil air and negligible soil organic carbon), a much higher fraction of the ethyl benzene (26%) is likely to be present in the soil water phase and transported with flowing groundwater.

Xylene: The estimates for an unsaturated topsoil model indicate that nearly all of the xylene (98.8%) is expected to be sorbed to the soil. A much smaller amount (0.7%) is expected to be present in the soil water phase and thus available to migrate by bulk transport (e.g., the downward movement of infiltrating water), dispersion and diffusion. For the portion of xylene in the gaseous phase of the soil (0.5%), diffusion through the soil-air pores up to the ground surface, and subsequent removal by wind, will be a significant loss pathway.

In saturated, deep soils (containing no soil air and negligible soil organic carbon), a much higher fraction of the xylene (26%) is likely to be present in the soil water phase and transported with flowing groundwater.

Sorption of BTEX on Soils

The mobility of BTEX compounds in the soil/groundwater system (and their eventual migration into aquifers) is strongly affected by the extent of their sorption on soil particles. In general, sorption on soils is expected to:

- increase with increasing soil organic matter content;
- increase slightly with decreasing temperature;
- increase moderately with increasing salinity of the soil water; and
- decrease moderately with increasing dissolved organic matter content of the soil water.

Based upon octanol-water partition coefficients, for the BTEX compounds (135, 537, 1410, and 1450, respectively) the soil sorption coefficients (K_{oc})s are estimated to be 65, 259, 681, and 691, respectively.

Volatilization of BTEX from Soils

Transport of BTEX vapors through the air-filled pores of unsaturated soils is an important transport mechanism for near-surface soils. In general, important soil and environmental properties influencing the rate of volatilization include soil porosity, temperature, convection currents and barometric pressure changes; important physio-chemical properties include the Henry's law constant, the vapor-soil sorption coefficient, and, to a lesser extent, the vapor phase diffusion coefficient.

There are no data from laboratory or field tests showing actual soil volatilization rates. Sorption of the benzene vapors on the soil may slow the vapor phase transport.

The Henry's law constant (H), which provides an indication of a chemical's tendency to volatilize from solution increases significantly with increasing temperature. Moderate increases in H are also observed with increasing salinity due to a decrease in solubility of benzene, toluene and ethyl benzene.

Transformation Processes of BTEX in Soil/Groundwater Systems

The persistence of BTEX compounds in soil/groundwater systems is not well documented. In most cases, it should be assumed that the chemical will persist for months to years (or more). Benzene, toluene and ethyl benzene that has been released into the air will eventually undergo photochemical oxidation; tropospheric lifetime on the order of a few hours to a few days have been estimated for benzene and 15 hours for toluene and ethyl benzene.

BTEX compounds under normal environmental conditions are not expected to undergo hydrolysis. Further, benzene and toluene are not expected to be susceptible to oxidation or reduction reactions in the soil/groundwater environment.

Available data on the biodegradability of benzene are somewhat contradictory. Certain pure and mixed cultures can apparently degrade benzene under environmental conditions, but the chemical must be considered fairly resistant to biodegradation. Available data indicate that toluene and ethyl benzene are biodegradable in the soil/groundwater environment. No information on the biodegradability of xylene in the soil/groundwater environment is available. However, based upon data for other structurally similar chemicals (e.g., toluene, ethyl benzene), it is expected that xylene would be biodegradable. In most soil/groundwater systems aerobic degradation would be of minimal importance because of the low concentration of microorganisms (at depth) and the low dissolved oxygen (anaerobic) conditions. No data are available on the possibility of anaerobic biodegradation.

Primary Routes of Exposure From Soil/Groundwater Systems

The above discussion of fate pathways suggest that benzene is highly volatile, weakly adsorbed by soil and has a limited potential for bioaccumulation. Additionally, toluene is highly volatile from aqueous solutions, moderately sorbed to soil and has a low potential for bioaccumulation. Ethyl benzene and xylene are highly volatile from aqueous solutions, may be moderately adsorbed by soil and have a moderate potential for bioaccumulation. BTEX compounds may volatilize from soil surfaces, but that portion not subject to volatilization is likely to be mobile in groundwater. These fate characteristics suggest several potential exposure pathways.

Volatilization of BTEX compounds from a disposal site, particularly during drilling or restoration activities, could result in inhalation exposures. The potential for groundwater contamination is high, particularly in sand soils.

These results of a USEPA Groundwater Supply Survey indicate that BTEX compounds have the potential for movement in soil/groundwater systems. The compounds may eventually reach surface waters by this mechanism, suggesting several other exposure pathways:

- Surface waters may be used as drinking water supplies, resulting in direct ingestion exposure;
- Aquatic organisms residing in these waters may be consumed, also resulting in ingestion exposure through bioaccumulation;
- Recreational use of these waters may result in dermal exposure; and
- Domestic animals may consume or be dermally exposed to contaminated ground or surface waters; the consumption of meats and poultry could then result in ingestion exposures.

In general, exposures associated with surface water contamination can be expected to be lower than exposures from drinking contaminated groundwater for two reasons. First, the Henry's law constants for BTEX compounds indicate that they will volatilize upon reaching surface waters. Secondly, the bioconcentration factors for benzene and toluene are expected to be low, suggesting limited bioaccumulation in aquatic organisms or domestic animals. For ethyl benzene, the bioconcentration factor suggest moderate bioaccumulation in aquatic organism and domestic animals. The bioaccumulation factor for xylene is not high enough to suggest consumption of aquatic organisms or domestic animals as a significant source of exposure compared to drinking water.

Although BTEX compounds are readily photooxidized in the atmosphere, its volatility suggests that it may be found in air as well.

3.1.3.2 Semi-Volatile Organic Compounds

3.1.3.2.1 PAH Compounds

The following information was obtained from the document, "Management of Manufactured Gas Plant Sites, Volume III, Risk Assessment," GRI, May 1988, GRI-87/0260.3.

PAH compounds have a high affinity for organic matter and low water solubility. Water solubility tends to decrease and affinity for organic material tends to increase with increasing molecular weight. Therefore, naphthalene is much more soluble in water than is benzo(a)pyrene. When present in soil or sediments, PAHs tend to remain bound to the soil particles and dissolve only slowly into groundwater or the overlying water column. Because of the high affinity for organic matter, the physical fate of the chemicals is usually controlled by the transport of particulates. Thus, soil, sediment and suspended particulate matter (in air) represent important media for the transport of the chemicals.

Because of their high affinity for organic matter, PAH compounds are readily taken up (bioaccumulated) by living organisms. However, organisms have the potential to metabolize the chemicals and to excrete the polar metabolites. The ability to do this varies among organisms. Fish appear to have well-developed systems for metabolizing the chemicals. The metabolites are excreted. Shellfish (bi-valves) appear to be less able to metabolize the compounds. As a result, while PAH compounds are seldom high in fish tissues, they can be high in shellfish tissues.

Several factors can degrade PAH compounds in the environment. Biodegradation on soil microorganisms is an important process affecting the concentrations of the chemicals in soils, sediment and water. Volatilization may also occur. This mechanism is effective for the lighter molecular weight compounds. However, the volatilization of higher molecular weight PAH compounds occurs slowly.

3.1.3.2.2 Phenolic Compounds

These compounds are highly water soluble and, therefore, easily leach from soil environments into the underlying groundwater. They are not persistent in surface water environments. Phenolics are not as volatile as benzene, xylene or toluene, but can volatilize at a moderate rate. Therefore, there may be some potential for exposure to gases. Non-chlorinated phenolic compounds are not readily bioaccumulated by terrestrial or aquatic biota (GRI-87/0260.3).

3.1.3.3 Pesticides and PCBs

It is not the intent of this section to discuss the persistence of all pesticides and PCBs, therefore, only selected pesticides and PCBs that are commonly found or are suspected to have been released to the environment at SEDA are discussed below.

Chlordane

The following information was obtained from "Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. III, Pesticides (ed. Philip H. Howard, Lewis Publishers, 1991).

Chlordane has been released in the past into the environment primarily from its application as an insecticide. Technical grade chlordane is a mixture of at least 50 compounds. If released to soil, chlordane may persist for long periods of time. Under field conditions, the mean degradation rate has been observed to range from 4.05-28.33%/yrwith a mean half-life of 3.3 years. Chlordane is expected to be generally immobile or only slightly mobile in soil based on field tests, soil column leaching tests and estimated K_{oc} estimation; however, its detection in various ground waters in NJ and elsewhere indicates that movement to ground water can occur. Adsorption to sediment is expected to be a major fate process based on soil adsorption data, estimated Koc values (24,600-15,500), and extensive sediment monitoring data. The presence of chlordane in sediment core samples suggests that chlordane may be very persistent in the adsorbed state in the aquatic environment.

If released to water, chlordane is not expected to undergo significant hydrolysis, oxidation or direct photolysis. Sensitized photolysis in the water column may be possible, however. The observation that 85% of the chlordane originally present in a sealed glass jar under sunlight and artificial light in a river die-away test remained at the end of two weeks and persisted at that level through week 8 of the experiment; this indicates that chlordane will be very persistent in aquatic environments.

Although sufficient biodegradation data are not available, it has been suggested that chlordane is very slowly biotransformed in the environment which is consistent with the long persistence periods observed under field conditions. Bioconcentration is expected to be important based on experimental BCF values which are generally above 3,200.

If released to the atmosphere, it will be expected to be predominantly in the vapor phase. Chlordane will react in the vapor-phase with photochemically produced hydroxyl radicals at an estimated half-life rate of 6.2 hr suggesting that this reaction is the dominant chemical removal process. Soil volatility tests have found that chlordane can volatilize significantly from soil surfaces on which it has been sprayed, particularly moist soil surfaces; however, shallow incorporation into soil will greatly restrict volatile losses.

The detection of chlordane in remote atmospheres (Pacific and Atlantic Oceans; the Arctic) indicates that long range transport occurs. It has been estimated that 96% of the airborne reservoir of chlordane exists in the sorbed state which may explain why its long range transport is possible without chemical transformation. The detection of chlordane in rainwater and its observed dry deposition at various rural locations indicates that physical removal via wet and dry deposition occurs in the environment.

Lindane

The following information was obtained from "Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. III, Pesticides (ed. Philip H. Howard, Lewis Publishers, 1991).

Lindane is used as an insecticide on hardwood logs and lumber, seeds, vegetables and fruits, woody ornamentals, hardwood forests, livestock and pets, and existing structures. When released to water, lindane is not expected to volatilize significantly. Lindane released to acidic or neutral water is not expected to hydrolyze significantly, but in basic water, significant hydrolysis may occur. At a pH of 9.3, the hydrolysis half-life of lindane in water was measured to be about 4 days (95 hr.). Transport to the sediment should be slow and result predominantly from diffusion rather than settling. Release of lindane to soil will most likely result in volatilization and slow leaching of lindane to ground water. Lindane in the atmosphere is likely to be subject to dry and wet deposition. The estimated half-life for the reaction of vapor phase lindane with atmospheric hydroxyl radicals is 2.3 days. Lindane may slowly biodegrade in aerobic media and will rapidly degrade under anaerobic conditions. Lindane has been reported to photodegrade in water in spite of the lack of a photoreactive center, but photolysis is not considered to be a major environmental fate process. Lindane will bioconcentrate slightly in fish. Monitoring data indicate that lindane is a contaminant in air, water, sediment, soil, fish and other aquatic organisms, wildlife, food, and humans. Human exposure result primarily from food.

Endosulfan

The following information was obtained from "Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. III, Pesticides (ed. Philip H. Howard, Lewis Publishers, 1991).

Endosulfan is used as an insecticide against a variety of insects on a variety of crops. Technical endosulfan is composed of α-endosulfan and β-endosulfan. Release of endosulfan isomers to soil will most likely result in biodegradation and in hydrolysis, especially under alkaline conditions. Endosulfan isomers on the soil surface may photolyze. Volatilization and leaching are not expected to be significant due to the high estimated soil-sorption coefficients of the isomers. When release to water, endosulfan isomers are expected to hydrolyze readily under alkaline conditions, and more slowly at neutral and acidic pH values (α half-lives=35.4 and 150.6 days for pH 7 and 5.5, respectively; β half-lives=37.5 and 187.3 days for pH 7 and 5.5, respectively). Volatilization and biodegradation are also expected to be significant.

Endosulfan released to the atmosphere will react with photochemically generated hydroxyl radicals with an estimated half-life of 1.23 hr. Bioconcentration of endosulfan is expected to be significant. Isomers of endosulfan are contaminants in air, water, sediment, soil, fish and other aquatic organisms, and food. Human exposure results primarily from food, and by occupational exposure.

DDT

The following information was obtained from "The Installation Restoration Program Toxicology Guide," Vol. III, Arthur D. Little, Inc. June 1987.

From 1946 to 1972, DDT was one of the most widely used agricultural insecticides in the world. During this time, DDT played an important role in many phases of agriculture and in the eradication of malaria, typhus and plague. As of January 1, 1973, all uses of DDT in the United States were cancelled with the exception of emergency public health however, it is still used extensively in some tropical countries.

DDT is expected to be highly immobile in the soil/groundwater environment when present at low dissolved concentrations. Bulk quantities of DDT dissolved in an organic solvent could be transported through the unsaturated zone as the result of a spill or improper disposal of excess formulations. However, the extremely low solubility of DDT and its strong tendency to sorb to soils results in a very slow transport rate in soils.

In general transport pathways can be assessed by using an equilibrium-partitioning models. These calculations predict the partitioning of low soil concentrations of DDT among soil particles, soil water, and soil air. Due to its strong tendency to sorb to soil, virtually all of the DDT partitions to the soil particles of unsaturated top soil, with negligible amounts associated with the soil water or air. Even in saturated deep soil, which is assumed to contain no soil air and a smaller organic carbon fraction, almost all of the DDT is retained on the soil.

DDT is characterized by a strong tendency to sorb to organic carbon. Kadeg et. al. report an arithmetic mean K_{oc} of 670,200 for 17 reported values; the corresponding geometric mean was log $K_{oc} = 5.48$. As with all neutral organic chemicals, the extent of sorption is proportional to the soil organic carbon content. In soils with little organic carbon (e.g., clays) the extent of sorption may also depend upon soil properties such as surface area, cation exchange capacity and degree of hydration.

The apparent sorption of DDT to soils and sediments is lessened, and thus its mobility is enhanced by the presence of dissolved organic matter in solution. Caron et. al. found the sorption of DDT to a natural freshwater sediment to be reduced by 75% in the presence of 6.95 mg/L of dissolved organic carbon (in the form of humic acid extracted from another sediment). Using p,p'-DDT, Chiou et al. observed the apparent water solubility to be significantly enhanced (roughly 2-5 times) in the presence of 100 mg/L of humic and fulvic acids. (Sorption will decrease with increasing water solubility). The partitioning of p,p'-DDT between soil-derived humic acid and water was approximately 4 times greater than with soil fulvic acids and 5-7 times greater than with aquatic (freshwater) humic and fulvic acids. These findings indicated that the mobility of DDT in natural waters may be several times greater than predicted (though probably still small) when the effect of dissolved organic matter is present. In waters containing large concentrations of dissolved organic material, such as swamps and bogs, this may be especially important.

The vapor pressure of DDT at 25°C has been given as 2.6×10^{-10} atm with estimates of its Henry's law constant at 25°C ranging from 2.8×10^{-5} to 2.0×10^{-6} $\mathrm{atm \cdot m^3/mol}$. Volatilization is expected to be an important loss process in aquatic environments with the half-life for DDT on the order of several hours to several days. The presence of sediment particles, which would adsorb DDT from solution, would significantly reduce volatilization losses.

In soils, volatilization is much slower. Jury et al. using soil of 1.25% organic carbon to which DDT was applied uniformly to a depth of 1 cm at the rate of 1 kg/hectare, calculated volatilization half-lives of 497 and 432 days when water evaporation rates were 0.0 and 5.0 mm/day, respectively. The corresponding figures when the same quantity of DDT was mixed to a depth of 10 cm were 2300 and 2069 days.

Similar results were obtained by Lichtenstein et al. who studied the persistence of technical DDT (84% p,p', 15% o,p') in agricultural loam soil with crops over a 15 year period. Calculated half-lives for both isomers fell between 4.0 and 4.7 years for DDT applied at 10 pounds/acre; somewhat longer half-lives were measured for applications of 100 pounds/acre. These half-lives should be taken as upper limits of the volatilization rate since other processes such as leaching and degradation contribute to the DDT loss.

In tropical soils, the loss of DDT has been found to be much more rapid. El Zorgani found a half-life of less than three weeks for DDT applied at an initial concentration of 6.65 ppm to the soil surface beneath a cotton crop in the Sudan. The loss of the o,p' isomer was several times greater than for the p,p' isomer; and insignificant fraction of the loss could be accounted for by conversion to p,p'-DDE. A half-life 110 days has been reported for DDT in Kenya where it was found to sublime directly into the atmosphere without conversion to DDE.

The rate at which DDT degrades in the soil/groundwater environment is dependent on the conditions under which it is present. The pH strongly affects the rate of aqueous hydrolysis. Over the pH range typical of natural waters (pH 5-9), Wolfe et al. found the pseudo-first-order rate constant (k_{obs}) at 27°C could be expressed as:

$$k_{obs} = 1.9 \times 10^{-9} + 9.9 \times 10^{-3} \cdot [OH^{-}]$$

where k_{obs} is in s^{-1} and $[OH^{-}]$, the concentration of the hydroxide ion, is in moles/liter. Hydrolysis half-lives of roughly 81 days, 8 years and 12 years at pH 9, 7, and 5, respectively, result from the rate constant obtained from this equation. The hydrolysis product of p,p'-DDT is p,p'-DDE.

A photolysis half-life of 5 days was measured for DDT when it was present in natural water exposed to summer sunlight, although no photolysis was observed when the chemical was present in pure water. Again, p,p'-DDE is a degradation product. Chen et al. observed a similar half-life of 8 days for p,p'-DDT applied as a thin film (0.67 $\mu g/cm^2$) to glass plates and exposed to light of environmentally important wavelengths (maximum intensity at 300 nm). The degradation of DDT by ultraviolet light was found to be more effective when the DDT was present in humus-free soil than in soil containing humus.

DDT has been found to undergo abiotic, reductive dehalogenation to DDD in the presence of Fe(II) porphyrin. It has been suggested that the Fe(III) porphyrin, which results from the oxidation of the Fe(II) porphyrin in this process, is reconverted to the Fe(II) porphyrin in the presence of reduced organic material. Dehydrochlorination of DDT to DDE (removal of a hydrogen and chlorine atom to form a double bond) has also been observed in model systems containing reduced porphyrins and in the natural environment.

Gambrell et al. found the degradation of DDT to be little affected by pH but greatly affected by redox conditions. Under strongly reducing conditions (Eh = 150 mV), over 90% of the DDT was degraded within a few days. The authors note that this is an unusually rapid rate.

The half-life for the decomposition of DDT in aerobic soils has been reported to be in the range of 10-14 years compared to half-lives of 28-33 days in moist soils incubated under anaerobic conditions. DDE is the major degradation product in aerobic soil, and it is believed to be produced predominantly by chemical processes. Under anaerobic conditions DDD is the major metabolite.

The bacterial and fungal cometabolism of DDT has been observed in the laboratory and has been suggested to be potentially important in the field as well. In these reactions, bacteria which are not able to use DDT as their sole carbon source grow on non-chlorinated analogues of DDT, but degrade DDT in the process.

Information on the fate and transport parameters of DDT (i.e., solubility, vapor pressure, Henry's Law Constant, K_{oc}, K_{ow}, half-life and BCF) are provided in Table 3-1.

DDD

The following information was obtained from "The Installation Restoration Program Toxicology Guide," Vol. III, Arthur D. Little, Inc. June 1987.

DDD, no longer manufactured commercially, is still found as an impurity in the pesticide DDT and the miticide dicofol. It is also the major breakdown product of DDT under anaerobic conditions. The p,p' isomer of DDD is the third largest component of the technical DDT product after the two DDT isomers accounting for >4% of the mixture. It is present in somewhat lower concentrations in dicofol. In one study of several dicofol products, DDD was present in amounts ranging from 0.1 to 2.5% of the amount of dicofol.

Like DDT, DDD is expected to be highly immobile in the soil/groundwater environment when present at low dissolved concentrations. Bulk quantities of DDD dissolved in an organic solvent could be transported through the unsaturated zone as a result of a spill or the improper disposal of excess formulations. However, the extremely low solubility of DDD and its strong tendency to sorb to soil organic carbon results in a very slow transport rate in soils.

In general, transport pathways can be assessed by using an equilibrium partitioning models. These calculations predict the partitioning of low soil concentrations of DDD among soil particles, soil water, and soil air. Due to its strong sorption to soil, virtually all of the DDD partitions to the soil particles of unsaturated top soil and negligible amounts to the soil air or water. Even in saturated deep soil, which is assumed to contain no soil air, and a smaller organic carbon fraction, almost all of the DDD is retained on the soil.

DDD, like DDT, is characterized by a strong tendency to sorb to soil organic carbon. While only one measured K_{oc} value for DDD was found ($\log K_{oc} = 5.38$) it is consistent with the value obtained for DDT, as would be expected based on the similarity of their structures and their octanol water partition coefficients (DDD $\log K_{ow} = 5.56$). As with all neutral organic chemicals, the extent of DDD sorption is proportional to the soil organic carbon content. In soils with little organic carbon (e.g., clays) the extent of sorption may also depend upon such soil properties as surface area, cation exchange capacity, and degree of hydration.

The sorption of DDD to soils is lessened and thus its mobility is enhanced by the presence of dissolved organic matter in solution. The apparent solubility of DDT was increased several times in solutions containing humic and fulvic acids. Because the sorption behavior of DDD is expected to be much like that of DDT, its mobility in natural waters may be several times greater than predicted (though probably still small) if dissolved organic matter is present. In waters containing large concentrations of dissolved organic matter, such as swamps and bogs, this may be especially important.

The vapor pressures of the p,p' and o,p' - isomers of DDD at 30°C have been measured as 1.3×10^{-9} and 2.5×10^{-9} atm, respectively. The Henry's law constant estimated by use of the average vapor pressure of the two isomers and an aqueous solubility of 20 ppb is $3.1 \times 10^{-5} \cdot$ atm m^3/mol. This value is almost identical to that for DDT and roughly an order of magnitude less than that for DDE.

Experimental evidence indicates that DDT volatilization from water occurs at about one-third the rate for DDT, which may seem at odds with the similar estimates for the Henry's law constants for these two compounds. Given the uncertainties involved in measuring both the aqueous solubilities and the vapor pressures of these compounds, from which H is estimated, the findings cannot be considered inconsistent. Using a factor of one-third for the difference in the rate of volatilization of DDD and DDT, a volatilization half-life for DDD ranging from a day to less than a month has been estimated.

Volatilization of DDD from soils can be expected to be much slower than from water because of the strong tendency of DDD to sorb to soil. Using wet river bed quartz sand in 15 mm deep petri dishes, Ware et at. measured volatilization losses of p,p'-DDD (present initially at 10 ppm) that corresponded to a volatilization half-life of roughly 170 days, slightly more than twice that for p,p'-DDT under the same conditions. Because these experiments were conducted with a relatively thin layer of soil with a small organic carbon fraction, the actual volatilization rate of DDD in the field would be expected to be lower. If the relative volatilization rates of DDD and DDT in the field were the same as those observed by Ware et al., the volatilization half-life of DDD from soil could be assumed to be double the value of one to several years for DDT.

Hydrolysis of DDD can be expected to be extremely slow under environmental conditions. Over the pH range typical of natural waters (pH 5-9), Wolfe et al. found the pseudo-first-order rate constant (k_{obs}) at 27°C could be expressed as:

$$k_{obs} = 1.1 \times 10^{-10} + 1.4 \times 10^{-3} \cdot [OH^-]$$

where k_{obs} is in s^{-1} and $[OH^-]$, the concentration of the hydroxide ion, in moles/liter. Hydrolysis half-lives of roughly 1.6, 88, and 190 years at pH 9, 7, and 5, respectively, correspond to the rate constant estimated from this equation. These estimates are consistent with the observations of Eichelberger and Lichtenberg that no DDD, initially present in river water at 20 ppb, degraded over an eight week period (within 2.5%).

No information was found on the photolysis of DDD in natural waters. Direct photolysis of DDD (i.e., in pure water) is believed to be slower than that for DDT which is estimated to have a half-life of over 150 years. However, DDT in natural water has been estimated to have a photolysis half-life of 5 days when exposed to sunlight in mid-June; DDD might be expected to have a similar half-life based on the similar structure of the two chemicals.

Data on the biodegradation of DDD are limited. In aquatic systems, biotransformation is believed to be slow, although a model ecosystem study has shown DDD to be more biodegradable than either DDT or DDE. The ketone analogue of DDD (i.e., p,p'-dichlorobenzophenone) has been suggested as the end product of the biodegradation of DDD in the environment. DDD undergoes dehydrochlorination to 2,2-bis-(p-chlorophenyl)-1-chloroethylene, reduction to 2,2-bis-(p-chlorophenyl)-1-chlorethane, dehydrochlorination to 2,2-bis-(p-chlorophenyl)-ethylene, reduction to 1,1-bis-(p-chlorophenyl)-ethane and eventual oxidation to bis-(p-chlorophenyl)-acetic acid (DDA), the ultimate excretory product of higher animals. DDD has also been observed to degrade in anaerobic sewage sludge.

The above discussion of fate pathways suggests that DDD is moderately volatile, very strongly sorbed to soil, and has a high potential for bioaccumulation. Information on the fate and transport parameters (i.e., solubility, vapor pressure, Henry's Law Constant, K_{oc}, K_{ow}, half-life and BCF) are provided in Table 3-1.

DDE

The following information was obtained from "The Installation Restoration Program Toxicology Guide," Vol. III, Arthur D. Little, Inc. June 1987.

The presence of DDE in the environment is primarily the result of the use of the insecticide DDT and the miticide dicofol. DDE is the principal degradation product of DDT under aerobic conditions, and it has been found to equal roughly 1-3% of the weight of dicofol in the technical mixture. Like DDT, DDE exists as both an o,p' and a p,p' isomer, with the o,p' and the p,p' isomers of DDT degrading to the respective DDE isomer. Because technical DDT consists of 65-80% p,p' - DDT and 15-21% o,p' - DDT, the p,p' - DDE isomer might be expected to predominate in the environment. In dicofol, however, the o,p' isomer typically makes up 80-90% of the DDE present. The two isomers of DDE are considered individually below where data are available.

Like DDT, DDE is expected to be highly immobile in the soil/groundwater environment when present at low dissolved concentrations. Bulk quantities of DDE dissolved in an organic solvent (e.g., as a contaminant in dicofol) could be transported through the unsaturated zone as a result of a spill or improper disposal of excess formulations. However, the extremely low solubility of DDE and its strong tendency to sorb to soils would result in a very slow transport rate in soils.

In general, transport pathways can be assessed by using an equilibrium partitioning model. These calculations predict the partitioning of low soil concentrations of DDE among soil particles, soil water and soil air. Due to its strong tendency to sorb to soil, virtually all of the DDE partitions to the soil particles of unsaturated topsoil, with negligible amounts associated with the soil water or air. Even in saturated deep soil, which is assumed to contain no soil air and a smaller organic carbon fraction, almost all of the DDE is retained on the soil.

DDE is characterized by a strong tendency to sorb to organic matter in soils and in sediments. Only one value, log K_{oc} = 5.17 was found in the literature for the soil organic carbon partition coefficient. A log K_{oc} value of roughly 5 has been suggested based on log K_{ow} measurements of 5.69 for the p,p' isomer and 5.78 for the o,p' isomer. Using the geometric mean of these K_{ow} values and a regression equation, a log K_{oc} value of 5.41 is estimated. As with all neutral organic chemicals, the extent of sorption is proportional to the soil organic carbon content. In soils with little organic carbon (e.g., clays), the extent of sorption may also depend upon soil properties such as surface area, cation exchange capacity, and degree of hydration.

The apparent sorption of DDE to soils and sediments (like that of DDT), is lessened, and thus its mobility is enhanced by the presence of dissolved organic matter. DDT concentrations were found to be higher in aqueous solutions containing humic and fulvic acids. Because the sorption behavior of DDE is expected to be much like that of DDT, its mobility in natural waters may be several times greater than predicted (though probably still small) if dissolved organic matter is present. In waters containing large concentrations of dissolved organic matter such as swamps and bogs, this may be especially important.

The vapor pressure of p,p'- isomer of DDE at 20°C has been given as 8.7×10^{-9} atm and that of the o,p' isomer as 8.2×10^{-9} atm. A somewhat lower value of roughly eight times the vapor pressure of DDT has been suggested. Using the average vapor pressures for the two isomers to estimate the Henry's law constant, a value of 1.9×10^{-4} atm $\cdot$ m^3/mol is obtained.

This estimate is roughly an order of magnitude larger than the Henry's law constant for DDT. Because volatilization losses for DDT are expected to be important, the same is also true for DDE. DDE has been found to volatilize from distilled and natural waters five times faster than DDT. Since the volatilization half-life for DDT has been reported to range from several hours to several days (see Section 57.2.1.3) proportionately shorter half-lives would be expected for DDE.

In soils, volatilization of DDE is much slower. Using wet river bed, quartz sand in 15 mm deep petri dishes, Ware et al. measured volatilization losses of p,p'-DDE (present initially at 10 ppm) that corresponded to a half-life of roughly 40 days. This value may be more indicative of an upper limit of the volatilization rate because soils of higher organic matter content would tend to sorb more of the DDE, and the rate of volatilization would be expected to be lower from thicker layers of soil. In the same study and under the same conditions, the o,p' isomer of DDT took 50% longer to reach half its initial concentration; p,p'-DDT took twice as long. This suggests that the volatilization of DDE in the field may occur at a rate somewhat greater than that for DDT, which has been found to have a volatilization half-life of one to several years. The observation that the volatilization rate of DDE from soil is not several times the rate for DDT, given that it has an order of magnitude larger Henry's law constant, may be explained by its strong sorption to soil, which tends to impede volatilization.

DDE is the hydrolysis product of DDT and is quite resistant to further hydrolysis. A hydrolysis half-life of over 120 years at pH 5 and 27°C has been given. Thus, hydrolysis is not expected to be an environmentally significant process.

Several studies have examined the aqueous photolysis of DDE. Zepp and Schlotzhauer found that DDE in the aqueous phase of sediment suspensions exposed to ultraviolet light of wavelength > 300 nm had a half-life of roughly 13 to 17 hours. Under the same conditions, DDE equilibrated with sediment for 60 days (i.e., sorbed to the sediment) photodegraded much more slowly. To reach 25% of its initial concentration, roughly seven half-lives were needed instead of the expected two, and little further degradation occurred. The authors suggested that over time, part of the DDE diffused into the sediment particles and became unavailable for photolysis. Chen et al. found the thin film photodegradation rate of p,p'-DDE to be about 90% of that for p,p'-DDT, and the half-life of DDE in aquatic systems at 40°N latitude has been estimated to range from one day in summer to six days in winter. These findings suggest that photolysis of DDE may be an important loss process, as it is for DDT. However, for photolysis to occur, the chemical must be exposed to sunlight, which often is not the case for a large fraction of the amount sorbed to soils or deep sediments.

The biological degradation of DDE in aquatic environments is believed to occur very slowly if at all. In modeling the fate of DDE in a quarry, Di Toro and Paquin considered biodegradation to be insignificant compared to loss by photolysis and volatilization. The half-life for biodegradation in sediments has also been found to be extremely slow. Using radiolabeled p,p'-DDE mixed with river sediment, Lee and Ryan measured a half-life of 1100 days based on the evolution of CO_2. In short, photolysis appears to be the only degradation process that affects DDE significantly under environmental conditions.

Information on the fate and transport parameters (i.e.,solubility, vapor pressure, Henry's Law Constant, K_{oc}, K_{ow}, half-life and BCF) are provided in Table 3-1.

Aroclor® PCBs 1016, 1242, 1254, 1260

The following information was obtained from "The Installation Restoration Program Toxicology Guide", Vol. II, Arthur D. Little, Inc., June 1987.

This section encompasses a general review of the environmental fate of polychlorinated biphenyl (PCBs) mixtures marketed in the U.S. under the name Aroclor® (Aroclor® 1016, 1242, 1254, and 1260).

Aroclor® compounds are very inert, thermally and chemically stable compounds with dielectric properties. They have been used in nominally closed systems as heat transfer liquids, hydraulic fluids and lubricants, and in open-ended systems in which they came in direct contact with the environment as plasticizers, surface coatings, inks, adhesives, pesticide extenders and for microencapsulation of dyes for carbonless duplicating paper. In 1974, use of PCBs in the United States was limited to closed systems, i.e., approximately 70% of PCBs produced were used in capacitors while the remaining 30% were utilized in transformers (1457).

The environmental behavior of the Aroclor® mixtures is a direct function of their relative composition with respect to the individual chlorinated biphenyl species. It is important to remember that Aroclor® formulations are mixtures and the physical properties and chemical behavior of mixtures cannot be precisely defined. The individual PCBs in a pure state are generally solids at room temperature; however, due to melting point depression, Aroclor® mixtures are oily to resinous liquids at ambient temperatures.

Individual PCBs vary widely in their physical and chemical properties according to the degree of chlorination and position of the chlorines on the biphenyl structure. In general, as chlorine content increases, adsorption increases while transport and transformation processes decrease.

Except for Aroclor® 1016, the last two digits in the Aroclor® number identification denote the approximate chlorine content by weight percent. The specific PCB distribution measured in environmental samples may be distorted and may not correspond to the specific Aroclor® mixture responsible for the contamination. For this reason, most of the fate and transport discussion will focus on the chlorinated biphenyl species rather than the Aroclor® mixtures.

In general, transport pathways can be assessed by using an equilibrium partitioning model. These calculations predict the partitioning of low soil concentrations of the PCB mixtures among soil particles, soil water and soil air; portions associated with the water and air phases of the soil have higher mobility than the adsorbed portion. Estimates for the unsaturated topsoil model indicate that almost all (>99.99%) of the Aroclor® formulations are expected to be associated with the stationary phase. Much less than 1% is expected to partition to the soil-water phase; therefore, only a small portion would be available to migrate by bulk transport (e.g., the downward movement of infiltrating water), dispersion and diffusion. An insignificant portion of the Aroclor® formulations is expected in the gaseous phase of the soil; diffusion of vapors through the soil-air pores up to the ground surface is not expected to be important. In saturated, deep soils (containing no soil air and negligible soil organic carbon), sorption is still expected to be the most significant fate process. Overall, groundwater underlying PCB-contaminated soils is not expected to be vulnerable to contamination.

Adsorption to soils and sediments is the major fate process affecting PCBs in the environment. PCB sorption has been studied and reviewed in a number of reports. In general, the rate of adsorption by soil materials was found to be rapid and conformed to the Freundich adsorption equation; adsorption capacity was highly correlated with organic content, surface area, and clay content of the soil materials; PCBs were reported to be unable to penetrate into the inner surfaces of clay materials. Desorption of sorbed PCB is not expected to be rapid.

Distribution coefficients for PCBs on suspended solids in Saginaw Bay have been reported to range from 4×10^4 to 9×10^4. In general, higher chlorinated isomers are more strongly sorbed; however, preferential adsorption is also dependent on ring position of the substituted chlorine; values for K_{oc} range from approximately 10^5 for dichlorobiphenyl to 10^9 for octachlorobiphenyl.

Experimental studies on the mobility of Aroclor® 1242 and 1254 in soil materials indicate that these PCBs were adsorbed strongly and remained immobile when leached with water or aqueous leachate from a waste disposal site. However, they were found to be highly mobile when leached with carbon tetrachloride. The mobilities of the PCBs were highly correlated with their solubilities in the leaching solvent and the organic content of the soil material. It should be noted that even with carbon tetrachloride, a high percentage of the PCBs were retained on the soil while some moved with the solvent front.

Additional studies were performed using different solvents and varying amounts of water. Relatively small amounts of water (9%) in methanol were shown to significantly reduce the mobility of PCBs compared to the mobility in the pure solvent.

In summary, the available data indicate that sorption of PCBs, particularly the higher chlorinated biphenyls onto soil materials, will be rapid and strong. In the absence of organic solvents, leaching is not expected to be important, and PCBs are expected to be immobile in the soil/groundwater system; PCBs will be much more mobile in the presence of organic solvents. In the case of large spills of PCB/solvent mixtures, the soil and aqueous phases may become saturated resulting in a separate oily phase which may be more mobile.

Transport of PCB vapors through the air-filled pores of unsaturated soils is not expected to be a rapid transport pathway. Modeling results indicate that a very small fraction of PCB loading will be present in the soil-air phase. On the other hand, volatilization (mostly from aqueous systems) and atmospheric transport are thought to account for the widespread, almost ubiquitous, distribution of PCBs in the environment. Several studies have shown that vapor phase, transport can be a significant process for loss of PCBs from water bodies. Adsorption to organic matter, however, has been shown to compete strongly with volatilization. Adsorption onto suspended sediment has been presented as an explanation for the lower rates of volatilization exhibited for natural water bodies compared to estimated rates. Volatilization from soil was reported to be slow compared to volatilization from sand or PCB solution.

Calculated half-lives for the volatilization of Aroclor® 1242, 1248, 1254, and 1260 from 1 mm water column have been reported to range from 9.5 hours to 12.1 hours; other authors have reported half-lives on the order of 3-4 hours for di- and tetrachlorobiphenyls. Volatilization of Aroclor® 1260 from river water was reported to be only 67% after 12 weeks; after addition of sediment, the loss dropped to 34% after 12 weeks. The Henry's law constants and volatilization half-lives do not vary widely with degree of chlorination of the PCBs.

The available data indicate that due to low water solubility, volatilization of water-borne PCBs not sorbed to sediment or suspended solids may be significant; when sorbed to soils/sediments, volatilization will be drastically reduced. However, since other fate and transport processes in the soil environment are relatively slow, volatilization of PCBs sorbed on surface soils may occur. Elevated airborne concentrations of PCBs have been measured near PCB disposal area.

PCBs have been reported to be strongly resistant to chemical degradation by oxidation or hydrolysis. However, they have been shown to be susceptible to photolytic and biological degradation. Baxter and Sutherland have shown that successive biochemical and photochemical processes contribute to the degradation of PCBs in the environment. Experimental results indicate that the highly chlorinated PCBs can be photolytically degraded, resulting in the formation of lower chlorinated species and substituted products, as well as potential formation of biphenylenes and chlorinated dibenzofurans; the presence of oxygen retards the photolytic degradation of PCBs.

There is some doubt as to the applicability of these photolysis experiments to environmental conditions, since they were generally carried out in organic solvents, often in the presence of other additives. However, since the rate of photolytic dechlorination is greatest for the highly chlorinated species (i.e., those species that are most resistant to biodegradation), photolytic degradation, although slow, may be a significant transformation process for these molecules. Furthermore, since they are rapidly adsorbed to soils, these highly chlorinated PCBs may be concentrated in the surface layers and their actual photolysis rates may be higher than expected.

Microbial degradation has been reported to be an important transformation process for PCBs. In general, the lower chlorinated PCBs were more easily degraded than the higher chlorinated species. Position of chlorine substitution on the biphenyl molecule also affected the rate of PCB degradation. Biodegradability of PCBs has been reported to be a function of the number of carbon-hydrogen bonds available for hydroxylation by microbial oxidation; adjacent unchlorinated carbons have been shown to facilitate metabolism through formation of arene oxide intermediates. Both aerobic oxidative biodegradation and anaerobic dechlorination have been identified as PCB transformation processes in Hudson River sediments. Composting studies indicate that aerobic systems exhibited greater PCB reductions than anaerobic systems (42 to 48% vs. 18 to 28% reduction after two weeks).

The biodegradation of Aroclor® 1016, 1242, 1254, and 1260 is a function of their relative content of the lower chlorinated biphenyls. Aroclor® 1016 and 1242 are largely comprised of di-, tri- and tetra-chloro biphenyls, which have been shown to be biodegraded in microbial cultures, aquatic systems, and soils at fairly rapid rates. Aroclor 1254 and 1260 are largely comprised of higher chlorinated species and are expected to be resistant to biodegradation. In fact, Liu reported that an increase of chlorination from monochlorobiphenyls to predominantly trichlorobiphenyls (Aroclor® 1016 and 1242) and pentachlorobiphenyls (Aroclor® 1254) resulted in a corresponding decrease in degradation from 100% to 29% and 19%, respectively; similar results were reported by other authors. In an experiment with reservoir sediment, Aroclor® 1254 was degraded approximately 50% in six weeks. Using an acclimated semi-continuous activated sludge experiment with 48-hour exposure, degradation rates of 33%, 26% and 19% were determined for Aroclor® 1016, 1242, and 1254, respectively.

A study of the fate of Aroclor® 1254 in soil and groundwater after an accidental spill showed essentially no reduction in Aroclor® 1254 concentration due to biodegradation after two years. On the other hand, other authors reported moderate biodegradation of Aroclor® 1254 in soils (40% degraded in 112 days) and no degradation of Aroclor® 1260 (primarily hexa- and hepta-chlorobiphenyls). The presence of the lower chlorinated biphenyls has been shown to actually increase the rate of biodegradation of the higher PCBs through co-metabolism.

In summary, most studies have reported substantial PCB degradation in aqueous solutions; biodegradation rates are greatest for the lower chlorinated species. While adsorption of PCBs by soil and competition by native soil organisms may alter the degradation rate, several authors have reported substantial PCB degradation in soil systems. Mixed cultures of PCB-degrading microbes have been isolated from PCB-contaminated soils, suggesting that PCBs will be degraded to some extent in the environment.

3.1.3.4 Herbicides

It is not the intent of this section to discuss the persistence of all herbicides, therefore, only selected herbicide compounds such as those that are common or are suspected to have been used at SEDA are discussed below. The information on herbicides below was obtained from the "Handbook of Environmental Fate and Exposure Data for Organic Chemicals" (1991, Philip H. Howard, Lewis Publishers, Inc.).

3.1.3.4.1 2,4-D

2,4-D is released into the environment through its use in herbicide formulations and as a hydrolysis product of 2,4-D esters or from spills. If released on land it will probably readily biodegrade (typical half-lives <1 day to several weeks). Its adsorption to soils will depend on organic content and pH of soils (pKa of 2,4-D = 2.64-3.31), but it will not be expected to appreciably adsorb to soils. Leaching to groundwater will likely be a significant process in coarse-grained sandy soils with low organic content or with very basic soils. If released to water it will be lost primarily due to biodegradation (typical half-lives 10 to >50 days). It will be more persistent in oligotrophic waters and in waters where high concentrations are released. Degradation will be rapid in sediments (half-life <1 day). It will not bioconcentrate in aquatic organisms or appreciably adsorb to sediments, especially at basic pHs. If released in air it will be subject to photooxidation (estimated half-life of 1 day) and rainout. Human exposure will be primarily to those workers involved in the manufacture and used of 2,4-D, as well as those who work in and live near fields sprayed and treated with 2,4-D or its mixtures. Exposure may also occur through ingestion of contaminated food products and drinking water.

3.1.3.4.2 2,4,5-T

The amount of 2,4,5-T used annually in the U.S. prior to 1983 was estimated in 1985 to be approximately 204,000 pounds per year. Use of 2,4,5-T has been cancelled or severely restricted in the U.S.,however, since 1985. The USEPA may classify some or all applications as Restricted Use Pesticides. Release of 2,4,5-T to the environment may have occurred during its use as a herbicide and it can form in the environment as a hydrolysis product of its herbicide esters. Other sources of release may have included losses during formulation, packaging or disposal of 2,4,5-T, its esters and the acaracide, tetradifon. Since 2,4,5-T has a pKa of 2.88 it will be found in the dissociated form in all environmental media. If released in soil, 2,4,5-T can biodegrade and its mobility is expected to vary from highly mobile in sandy soil to slightly mobile in muck (due to adsorption of humic acids and other organic matter). Removal by biodegradation apparently limits the extent of leaching, however, and groundwater contamination is likely only by rapid flow through large channels and deep soil cracks. 2,4,5-Trichlorophenol and 2,4,5-trichloranisole are the primary microbial degradation products of 2,4,5-T. Chemical hydrolysis in moist soils and volatilization from dry and moist surfaces should not be significant. The persistence of 2,4,5-T in soil is reported to vary between 14 to 300 days, but usually does not exceed one full growing season regardless of the application rate. Degradation under anaerobic conditions in flooded soils is much slower (half-life less than or equal to 48 weeks) than in field moist soils. The half-lives for 2,4,5-T degradation in six soils ranged from 6.6 to 31 days (average 42 days). The persistence 2,4,5-T may be greater in soil which received large amounts of the herbicide. If released to water, photochemical decomposition, volatilization and biodegradation of 2,4,5-T appear to be the dominant removal mechanisms. The primary degradation product of 2,4,5-T in water is 2,4,5-trichlorophenol. The aquatic near surface half-life for direct photolysis has been calculated to be 15 days during summer at latitude 40°. Humic substances can photosensitize 2,4,5-T and humic induced photoreactions may dominate photodegradation processes when humic substance concentrations exceed 15 mg/L of organic C/L. Primary photodegradation products are 2,4,5-trichlorophenol and 2-hydroxy-4,5-dichlorophenoxyacetic acid. Adsorption of 2,4,5-T to humic acids in suspended solids and sediments may be significant. Oxidation, chemical hydrolysis, volatilization and bioaccumulation should not be significant. If released to atmosphere, 2,4,5-T should exist as fine droplets and adsorbed on airborne particulates. Based upon its vapor pressure, however, 2,4,5-T may be expected to exist primarily adsorbed to the particulate phase. 2,4,5-T has the potential to undergo (a) direct photolysis due to UV absorption at >290 nm, (b) a reaction with photochemically generated hydroxyl radicals (estimated vapor phase half-life = 1.12 days) or (c) be physically removed by settling out or washout in rainfall. The most probable route of exposure to 2,4,5-T would be inhalation and dermal exposure of workers involved in the manufacture, handling or application of 2,4,5-T, related ester compounds or certain tetradifon formulations which contain 2,4,5-T. The general public could potentially be exposed by inhalation of particulate matter or ingestion of fruit, milk or drinking water contaminated with 2,4,5-T.

3.1.3.5 Heavy Metals and Cyanide

Metals and cyanides tend to be persistent and relatively insoluble. There may be some slow rate of photolysis of the complex cyanides. The chemicals are expected to be closely bound to particulate matter and bioavailability is expected to be limited (GRI, May 1987, GRI-87/0260.3).

3.1.3.5.1 Heavy Metals

In general, metals tend to be persistent and relatively insoluble in the environment. 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. Metallic salts have been identified as a component of such items as tracer ammunition, ignitor compositions, incendiary ammunition, flares, colored smoke and primer explosive compositions. In particular, barium nitrate, lead stearate, lead carbonate, and mercury fulminate are potential heavy metal salts or complexes which are components of ammunition that may have been tested or disposed of at SEDA. During the burning of these materials, a portion of these salts oxidize to their metallic oxide forms. 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 salts may be dissolved, increasing their mobility and increasing the potential for leaching to the groundwater.

Heavy metals may also exist in the base metallic form as a component of the projectiles tested or disposed of at SEDA. Bullets are composed mainly of lead, which may contain trace amounts of cadmium and selenium. Metals which exist in metallic form, i.e., as bullets or projectiles, will tend to dissolve more slowly than the metallic salts.

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 iron. Iron (Fe) normally exists in one of two valence states, +2 and +3 [Fe(II) and Fe(III)]. Fe(II) is far more soluble than Fe(III) and therefore has a greater mobility.

Soil pH is often correlated with potential metal migration. 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.

An RI was performed at the Open Burning (OB) Grounds at SEDA in 1992 for which over 50 surface soil samples and over 300 subsurface soil samples were collected. The pH values of the surface soil samples ranged from 5 to 8.4, and the subsurface soil samples had values ranging from 7 to 9. The soil at the OB Grounds is lithologically similar to the soil at the Munitions Washout Facility, therefore, metals in the soil at the Munitions Washout Facility are expected to be primarily present in insoluble forms. A detailed evaluation of select metals (barium, copper, lead and mercury) is given below.

Barium is a highly reactive metal that occurs naturally only in the combined state. Most barium released to the environment from industrial sources is in forms that do not become widely dispersed. Barium in soil may be taken up to a small extent either by vegetation, or transported through soil with infiltration of precipitation. Barium is not very mobile in most soil systems. The higher the level of organic matter, the greater the adsorption. The presence of calcium carbonate will also limit mobility, since barium will form $BaCO_3$, an insoluble carbonate. In aquatic media, barium is likely to precipitate out of solution as an insoluble salt, or adsorb to suspended particulate matter. Sedimentation of suspended solids removes a large portion of the barium from surface waters. Barium in sediment is found largely in the form of barium sulfate. Bioconcentration in freshwater aquatic organisms is minimal.

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 soil 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. 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 co-precipitation 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.

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. It is largely associated with suspended solids and sediment in aquatic systems, and it occurs in relatively immobile forms in soil. Lead which has been released to soil may become airborne as a result of fugitive dust generation.

Elemental mercury is insoluble in water and binds tightly to soil particles giving it a relatively low mobility. Bacterial and fungal organisms in sediment are capable of methylating mercury. Methyl mercury, which is soluble in water, is a mobile substance and can then be ingested or absorbed. Until altered by biological processes, the primary transport method for mercury is the erosion and transportation of soil and sediment. Mercury most likely exists at SEDA in the elemental state as a result of the testing or demolition of munitions containing mercury fuzes. Although a mercury salt, mercury fulminate, was used in the past as a priming explosive, it has not been commonly used since 1925 (Dunstan and Bell, 1972), and its environmental fate will not be considered at the site.

Zinc 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 VII 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 soil, may be accelerated by compounding/complexing reactions.

Zinc has a tendency to adsorb to soil, sediment and suspended solids in water. 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.

3.1.3.5.2 Cyanide

The cyanide ion (CN) is expected to be relatively mobile in the soil/groundwater system when present at low dissolved concentrations. Bulk quantities of solutions containing the ion (e.g., from a spill or improper waste disposal) could be transported down through the unsaturated zone. However, as described below, at low concentrations and under aerobic conditions, cyanide is susceptible to biodegradation.

The cyanide ion acts as a weak base in solution, comparable in strength to ammonia. Its conjugate acid, hydrocyanic acid (HCN), has a pK of 9.21 (25°C, zero ionic strength). This means that below pH 9, most CN will be protonated, and in waters of environmental concern (pH < 8), over 90% will exist as HCN.

Transport pathways for the cyanide ion cannot be assessed as they are for organic species by using an equilibrium partitioning model. These models are based on the sorption and volatilization of non-ionized, neutral organic chemicals, and thus are not applicable to individual inorganic ions (or their parents salts).

Metallic cyanides such as AgCN, CuCN and $Zn(CN)_2$ are used commercially for electroplating their respective metal cation. Sodium and potassium cyanides are also used in plating solutions to increase the solubility of transition metal cyanides. Ferrocyanides and iron blue (a complex ferrocyanide salt) are added to road salts to prevent caking, and thereby enter sewers and deposit on roadsides.

Sorption on Soils

As an anion, the cyanide ion is expected to be only weakly retained by soils. Hydrogen cyanide is not strongly partioned to suspended matter or sediments, due primarily to its high solubility in water. Cyanide salts tend to be highly soluble as well, exceptions being AgCN (pK - 15.66), $Hg_2(CN)_2$ (pK - 39.3) and $Zn(CN)_2$ (pK_{sp} - 5.9). Since neither silver, mercury nor zinc is present in significant concentrations in the soil/groundwater environment, they will not control cyanide solubility, and precipitation of the cyanide salts from groundwater can be expected to be insignificant.

In a study of the mobility of the cyanide ion in several soils (applied as KCN in deionized water) it was found to be most easily leached from a soil having a high pH and high free $CaCO_3$ concentration, although an acid soil had almost as poor retention. The ion was found to be most strongly held by soils having a high concentration of Mn and hydrous oxides of Fe. In general, CN, whose sorption behavior is similar to that of Cl, is very mobile in soils, with enhanced mobility in soils of low pH, low concentration of free iron oxides, and containing little kaolin, chlorite, and gibbsite-type clays (high positive charges).

Cyanide complexed as $Fe(CN)_6^{-3}$ (which, as described below, can form in soil) was also found to be very mobile in soil, with high pH and high free $CaCO_3$ enhancing its mobility. Potassium cyanide added to landfill leachate was found to be less mobile than either $Fe(CN)_6^{-3}$ or CN^- in deionized water due to the precipitation of iron blue.

Sorption isotherm data for CN^-, like other mobile anions, are not available in the literature. In any case, the sorption behavior will depend upon the composition of the soil.

Volatilization from Soils

The cyanide ion is non-volatile.

Transformation Processes in Soil/Groundwater Systems

The cyanide ion undergoes a number of transformation in water. Hydrolysis rate constants for CN^- using sodium cyanide, potassium ferri-cyanide, and cuprous cyanide in sterilized river water at pH 7-8 were found to be 0.002/hr and 0.0033/hr at 10 and 23°C, respectively. These quasi first-order rate constants correspond to half-lives of approximately 15 and 9 days at 10°C and 23°C, respectively. Earlier studies have found HCN hydrolysis to be extremely slow except under very acidic conditions, with a half-life of over a year under alkaline conditions, at 33°C.

The cyanide ion forms complexes of varying stability with a number of metal ions, especially those of zinc, cadmium, mercury, and the transition metals. Under environmental conditions, the most important of these complexes are $Fe(CN_6^{-4}$ and $FE(CN)_6^{-3}$ with overall equilibrium constants of formation of $10^{35.4}$ and $10^{43.6}$, respectively.

The formation of cyanide complexes removes free CN^- from solution, thereby increasing the dissociation of HCN to maintain the equilibrium between HCN and free CN^- and H^+. It also increases the mobility of the metal ion to which it is complexed, Zn^{+2} for example, by preventing the sorptions of the metal to clays.

Iron cyanide complexes are considered stable, but susceptible to photodecomposition by sunlight, releasing free CN^- as they dissociate, but possibly reforming at night. The rate of photodegradation has been found to be rapid.

Both hydrogen cyanide and metallocyanide complexes are susceptible to biodegradation by almost all microorganisms. Cyanide has been found to be degraded in aerobic microbial systems.

The rate of biodegradation is dependent upon environmental conditions such as temperature and the concentrations of microorganisms and cyanide. Half-lives for cyanide biodegradation in river water spiked with NaCN and acclimated microorganisms were found to range from 10 and 60 hours.

At high cyanide concentrations and under aerobic conditions, cyanide toxicity inhibits microbial growth until the microorganisms become acclimated. Under anaerobic conditions, biodegradation may hardly occur since anaerobics are very sensitive to high cyanide concentrations. A limit of 2 mg/L of cyanide has been reported for effective anaerobic degradation.

Primary Routes of Exposure from Soil/Groundwater Systems

The above discussion of fate pathways suggests that the mobility and potential exposure to cyanide is somewhat dependent on the environmental conditions. The cyanide ion is considered to be non-volatile, although HCN is highly volatile. Most forms of cyanide are expected to be relatively mobile in soil/groundwater systems. Cyanide is expected to have a low potential for bioaccumulation, as it can be metabolized. These fate characteristics suggest several potential exposure pathways.

Volatilization of cyanide from a disposal site is not likely to represent an important exposure pathway under most conditions. At lower pH values, the volatilization of HCN may represent an important exposure pathway.

Drinking water contamination resulting from the migration of cyanide is likely to occur, although it is susceptible to both chemical and biological degradation. Field data indicate that cyanide is mobile in soil systems and groundwater contamination may result.

The movement of cyanide in groundwater may result in discharges to surface waters. As a result, ingestion exposures may occur through the use of surface waters as drinking water supplies, and dermal exposures may result from the recreational use of surface waters. The bioaccumulation of cyanide by domestic animals or fish from surface waters is not expected to be an important exposure pathway as cyanide has a low potential for bioaccumulation and may be degraded in surface waters.

3.1.3.6 Explosives

Table 3-1 presents the information which will serve as a basis for understanding the likely environmental fate of explosives at SEDA. The chemical class of the compounds identified in Table 3-1 is considered to be semivolatile. This is based upon the high molecular weights of these compounds and their low vapor pressures, typical of most semivolatile compounds. The most volatile of the five explosives considered at this site is 2,6-dinitrotoluene (2,6 DNT), with a vapor pressure of 0.018 millimeters mercury (mm Hg). Compared to benzene, a volatile compound, which has a vapor pressure of 95.2 mm Hg it is apparent that volatilization of this compound is expected to be low, especially in soils which have a high clay content. Soils with a high clay content generally have a high, i.e. >50%, ratio of water filled to air filled porosity, therefore, there is a small amount of air space through which vapor can migrate. Compounds such as RDX and HMX have extremely low vapor pressures and would not volatilize through the soils. Consequently, volatilization of RDX and HMX are not expected to represent a significant environmental pathway.

The potential for explosives to leach to the groundwater is a complicated consideration and influenced by many factors such as solubility, cation exchange capacity (CEC), clay content and percolation rate. For this evaluation, solubility has been considered as the most representative parameter for leaching potential. Of the six explosives considered, the most soluble of the explosives are the di- and trinitrotoluenes. Their solubilities range from approximately 130 mg/l to 270 mg/l. These are similar to the solubilities of organic hydrocarbons such as toluene, (500 mg/l), or the xylenes, (150 mg/l). This range of solubilities is considered to represent a moderate degree of leaching potential. Compounds which would represent a high degree of leachibility, i.e., high solubility, would be methylene chloride, (20,000 mg/l), benzene (1780 mg/l) and TCE, (1100 mg/l). The solubilities of HMX and RDX are approximately four times less than that for the di- and trinitrotoluenes and therefore represent a smaller potential for leaching.

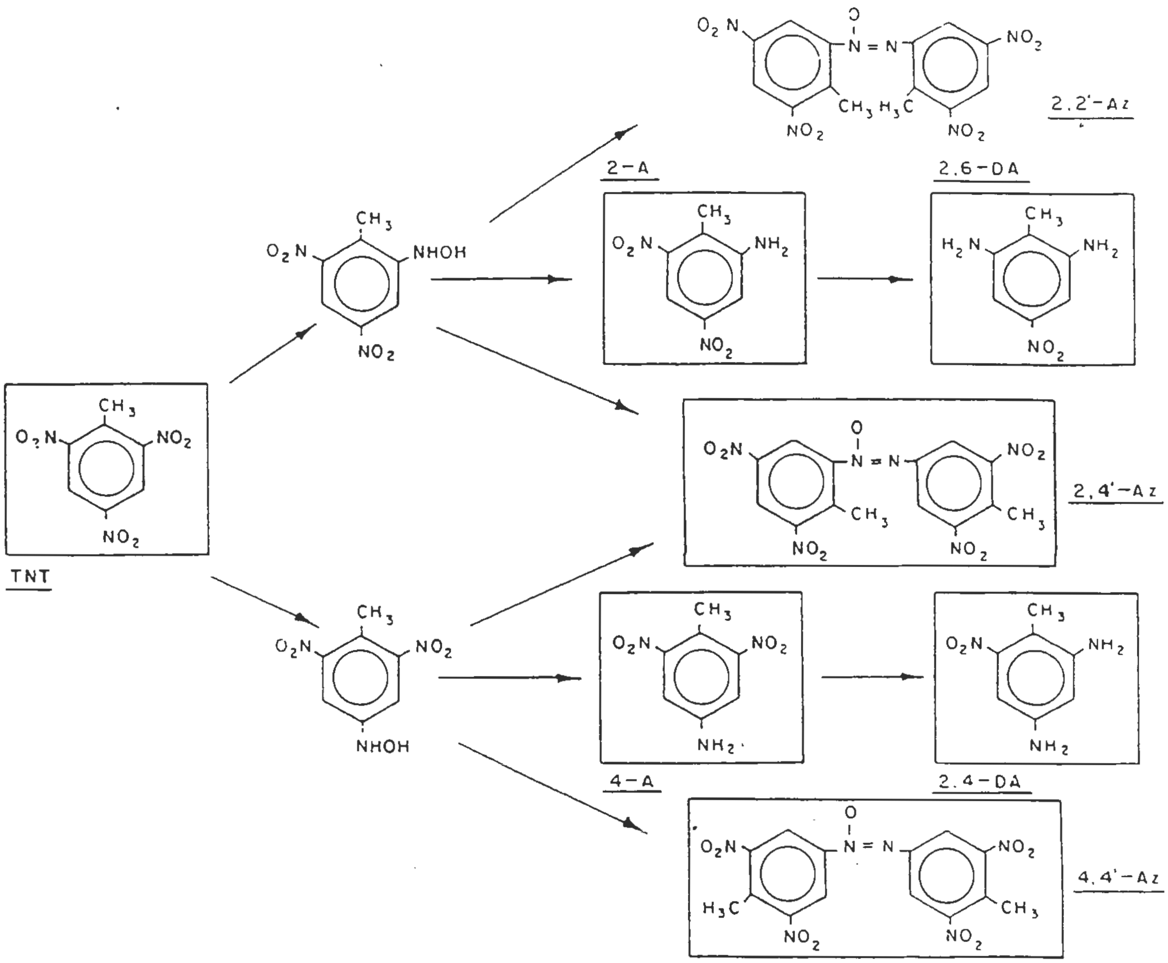
A review of the melting points of these compounds indicates that explosives are solids at room temperature and therefore would not migrate through soil as separate liquid phases. Instead, as precipitation interacts with these solid residues a small portion would dissolve or erode away. Complete leaching would require a long interaction period.

Field studies have confirmed the long-term potential for leaching of explosives into the groundwater. An evaluation of the critical parameters affecting the migration of explosives through soils indicated that at a former propellant manufacturing facility, 2,4-DNT leached from soil contaminated with smokeless powder for over 35 years after cessation of operations (USATHAMA, 1985). At another facility, leaching of 2,4-DNT into groundwater from former burning grounds has been documented to occur for as long as 10 years after operations had been discontinued.

Another factor to examine is the tendency of explosives compounds to adsorb to the soil. The compounds considered in this evaluation show K_{oc} values which range from approximately 100 to 500 mL/g. The SEDA site soils have been shown to possess a high percentage of fines including clay, thereby increasing the sorption potential of these compounds to the soil. As shown in Table 3-2, for the range of K_{oc} exhibited by explosives, i.e., 100-500 mL/g, these compounds would be considered intermediately mobile.

Environmental degradation of these parent organic compounds has been shown to occur by various investigators. The information available on this subject is substantial and a detailed discussion is beyond the scope of this document. However, a review of the available information indicates that nitroaromatics and nitramines are susceptible to environmental transformations. Since some of the byproducts of these transformations may be environmentally persistent, there is a potential for concern.

Much of the available research has been conducted on the environmental transformation of TNT. Figure 3-2 provides a summary of the identified breakdown products resulting from environmental degradation of TNT. Figure 3-3 presents breakdown products which have been identified from the breakdown of 2,4-DNT. The environmental fate of RDX is less defined than that of the other two compounds previously mentioned. Figure 3-4 provides an overview of the expected degradation pathways and the byproducts produced as a result of the environmental degradation of RDX. Clearly, the breakdown byproducts which have been identified are diverse. Analytical methods have only recently been developed which are capable of accurately detecting these compounds. The widespread application of these analytical techniques are greatly limited by the availability of standards which are essential for the analyses. Responding to the need for accurate analytical procedures and recognizing that standards for every breakdown product are not available, USATHAMA has developed Method 8330 (A copy of this method is included in Appendix C). This method is intended for the analysis of explosive residues in water, soils and sediments.



NOMENCLATURE:

2-A - 2-amino-4,6-dinitrotoluene
4-A - 4-amino-2,6-dinitrotoluene
2,2'-AZ - 4,4'-dinitro-2,2'-azoxytoluene
2,4'-AZ - 2'4-dinitro2,4'-azoxytoluene
4,4'-AZ - 2,2'-dinitro-4,4'-azoxytoluene
2,6-DA - 2,6-diamino-4-nitrotoluene
2,4-DA - 2,4-diamino-6-nitrotoluene

SOURCE:

Special Report 90-2; Environmental Transformation Products of Nitroaromatics and Nitramines; Literature Review and Recommendations for Analytical Method Development;

U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Feb. 1990

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

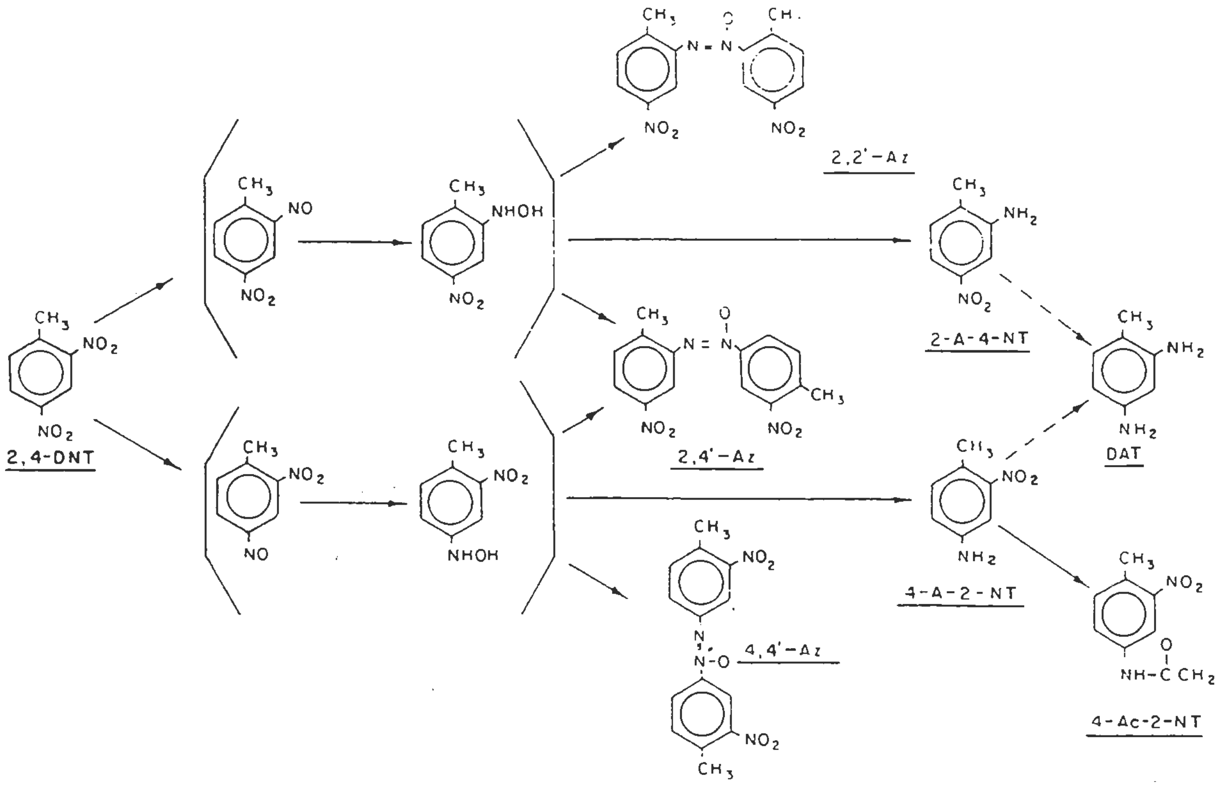
CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 726511-02001

FIGURE 3-2

TRANSFORMATION PATHWAYS
AND PRODUCTS FOR TNT

SCALE
DATE JANUARY 1995



NOMENCLATURE:

2,2'-AZ	- 4,4'-dinitro-2,2'-azoxytoluene
2,4'-AZ	- 2',4-dinitro-2,4'-azoxytoluene
4,4'-AZ	- 2,2'-dinitro-4,4'-azoxytoluene
DAT	- Diaminotoluene
2-A-4-NT	- 2-amino-4-nitrotoluene
4-A-2-NT	- 4-amino-2-nitrotoluene
4-AC-2-NT	- 4-acetamide-2-nitrotoluene

SOURCE:

Special Report 90-2; Environmental Transformation Products of Nitroaromatics and Nitramines; Literature Review and Recommendations for Analytical Method Development;

U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Feb. 1990

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

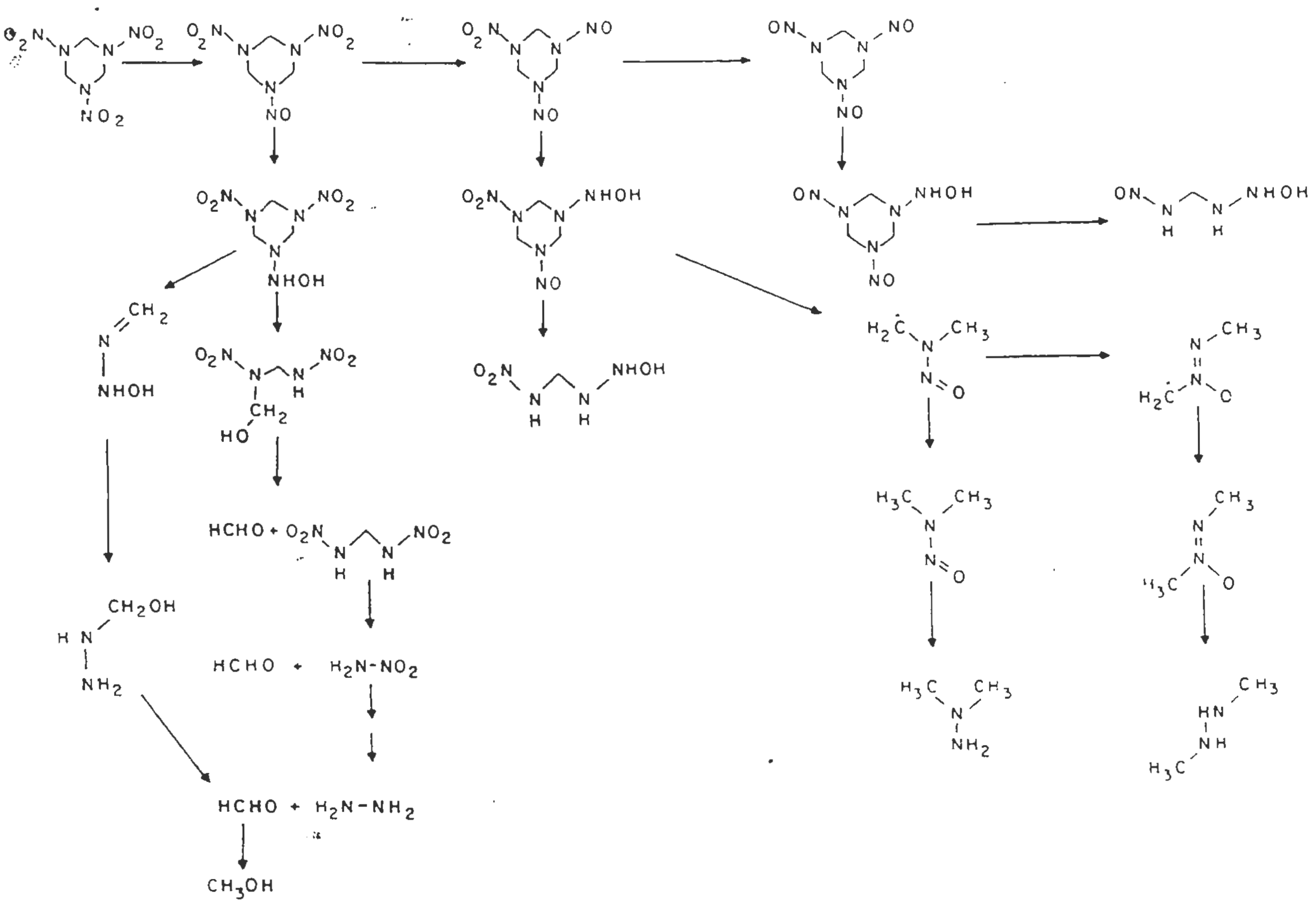
CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 726511-02001

FIGURE 3-3

TRANSFORMATION PATHWAYS AND PRODUCTS FOR 2, 4-DNT

SCALE
DATE JANUARY 1995



SOURCE:

Special Report 90-2; Environmental Transformation Products of Nitroaromatics and Nitramines; Literature Review and Recommendations for Analytical Method Development;

U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Feb. 1990

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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 726511-02001

FIGURE 3-4

TRANSFORMATION PATHWAYS AND PRODUCTS FOR RDX

SCALE
DATE JANUARY 1995

3.1.3.7 Fuel Oils

The following discussion of fuel oils was obtained from the "Installation Restoration Program Toxicity Guide", Volume III, July, 1987.

Fuel oils have various uses for which they are specifically formulated. Fuel oil number 1 is used almost exclusively for domestic heating. Fuel oil number 2 is used as a general purpose domestic or commercial fuel in atomizing type burners. Number 4 oil is used in commercial or industrial burner installations not equipped with preheating facilities. Numbers 5 and 6 are used in furnaces and boilers of utility power plants, ships, locomotives, metallurgical operations and industrial power plants.

Diesel fuel is available in different grades. Number 1-D is used for engines in service requiring frequent speed and load changes. Number 2-D is used for engines in industrial and heavy mobile service while number 4-D is used in low and medium speed engines.

Composition

The discussion of fuel oil in this chapter largely focuses on diesel fuel. Limited information on residual fuel oils, which are generally defined as the product remaining after the removal of the appreciable quantities of the more volatile components is included but environmental fate data are not specifically addressed. Residual fuel oils are expected to be extremely complex in composition, with higher concentrations of the many high molecular weight asphaltic compounds and impurities present in the original crude oils. Available data suggest sulfur values ranging from 0.18 to 4.36% by weight; trace element data indicate that concentrations of many elements vary by one or more orders of magnitude. The environmental transport and transformation of the high molecular weight organics is expected to be minimal and is not addressed in detail.

Diesel fuel is usually that fraction of petroleum that distill after kerosene in the 200°C to 400°C range. Several commercial grades of diesel fuels are obtained by blending various feedstocks to achieve established specifications. Due to differences in feed stocks, refining methods, and blending practices, the composition of diesel fuel samples is expected to be highly variable. Sulfur content has been reported to vary by several orders of magnitude (0-0.57% by weight): similar variations have been documented for a number of trace elements.

Diesel fuel is predominantly a mixture of C_{10} through C_{19} hydrocarbons. Composition by chemical class has been reported to be approximately 64% aliphatic hydrocarbons (straight chain alkanes and cycloalkanes), 1-2% olefinic hydrocarbons and 35% aromatic hydrocarbons, including alkylbenzenes and 2-3 ring aromatics. Petroleum distillates may contain many non-hydrocarbon components in varying concentrations.

Fuel oils also contain a number of additives used as ignition improves, combustion catalysts, antioxidants, flow improves, metal deactivators, detergents and emulsifiers. Many compounds added to fuel oils are similar to those added to gasoline.

Environmental Fate and Exposure Pathways

A discussion of the environmental behavior of fuel oil is limited by the lack of data defining its major components. The environmental behavior of hydrocarbons selected from the major classes will be addressed; however, trace elements and the many diverse additives will not be specifically addressed.

In general, soil/groundwater transport pathways for low concentration of pollutants in soil can be assessed by using an equilibrium partioning model. For the purposes of assessing the environmental transport of diesel fuel, a group of specific hydrocarbons was selected from the dominant hydrocarbon classes, i.e., alkanes, cycloalkanes, and aromatics; there were no available data to confirm the presence of the selected compounds in a typical diesel fuel sample. The hydrocarbon portions associated with water and air phases of the soil are expected to have higher mobility that the adsorbed portion.

Estimates for the unsaturated topsoil indicate that sorption is expected to be an important process for all the dominant hydrocarbon categories. Partioning to the soil-vapor phase is much less important than for other petroleum distillates since many of the lower molecular weight aliphatic hydrocarbons (C_4-C_8) characterized by high vapor pressure and low water solubility are not expected to be major components of diesel fuel. The aromatics have slightly higher water solubilities and transport with infiltrating water may be more important for these compounds; volatilization, on the other hand, is not expected to be important. In saturated, deep soils (containing no soil air and negligible soil organic carbon), a significant percent of the aromatic hydrocarbons is predicted to be present in the soil-water phase and available for transport with flowing ground water. Partitioning to the air and water phases is expected to be even less important for the organic components of residual fuel oils compared to components of diesel oil; sorption to soil particles is expected to be significant.

In interpreting these results, it must be remembered that this model is valid only for low soil concentrations (below aqueous solubility) of the components. Large releases of diesel fuel (spills, leading underground storage tanks) may exceed the sorptive capacity of the soil, thereby filling the pore spaces of the soil with the fuel. In this situation, the hydrocarbon mixture would move as a bulk fluid and the equilibrium partitioning model would not be applicable.

Transport and Transformation Processes

Transport and transformation of individual fuel oil constituents will depend on the physicochemical (and biological) properties of the constituents. Some constituents will dissolve more quickly in the percolating ground waters, be sorbed less strongly on the soils thus being transported more rapidly, and may be more or less susceptible to degradation by chemical or biological action. Thus, the relative concentrations of the constituents of the fuel will vary with time and distance form the site of contamination. This effect is called "weathering". (This term is also used to describe the changes to oil following spills into surface waters where film spreading and breakup, and differential volatilization dissolution and degradation are all involved).

Transport processes have been shown to be more significant than transformation processes in determining the initial fate of lower molecular weight petroleum hydrocarbons released to soil/ground-water systems. However, due to the lower water solubilities and lower vapor pressures of the higher molecular weight hydrocarbons environmental transformation processes may be increasingly significant for hydrocarbons in the C_{10}-C_{19} range characteristic of diesel fuel and in the $> C_{19}$ range expected in residual fuel oils.

Under conditions of limited volatilization (low temperatures, subsurface release or concentrated spill) other transport processes including downward migration into the soil, sorption to soils, and transport to ground water may be important. It has been reported that oil substances released in significant quantities to soils result in a separate organic phase which moves downward through the unsaturated zone to the less permeable layer, the soil/ground-water boundary, where they tend to accumulated and spread horizontally.

The organic layer floating on the ground water is carried in the general direction of ground water flow. At the oil-water interface, some hydrocarbons are leached according to their aqueous solubility. The pollution caused by the hydrocarbon phase is much less extensive than pollution caused by hydrocarbons dissolved in ground water (100s-1000s of meters). Furthermore, the pattern of migration of the hydrocarbon phase may be very different from that of the ground water. Due to fluctuations in ground-water elevation over time, the organic layer on top of the aquifer may be transported into several zones where the components occur in the gaseous phase (able to diffuse in all directions, including upward), liquid phase (adsorbed onto rock particles or sealed under water), or dissolved/emulsified in water.

Migration through soils may be retarded by sorption. Sorption is expected to be significant for higher molecular weight aliphatics, particularly $> C_{20}$. Migration is expected to be fastest through previously contaminated soils where the sorptive sites may be unavailable; on the other hand, soil-water content increases sorption and slows migration of hydrocarbons. In fissured rock, the migration of hydrocarbons is much less uniform than in porous soils. Preferential spreading through crevices, sometimes changing the direction of flow, may occur. Determination of the potential ground-water contamination in fissured rock is thus very difficult.

The water-soluble portion of No. 2 fuel oil (a higher temperature distilling fraction than diesel oil) was shown to be almost entirely aromatic (99%) even though the product itself was 48% aliphatic; the aliphatic fuel oil hydrocarbons have very low water solubility compared with the aromatics. The largest percentage (40%) of the water-soluble fraction of fuel oil was represented by C_{11} - aromatics. In deep, saturated soils with no soil air, the aromatics represent the greatest threat of contamination to ground-water supplies. Solubility in aqueous solution of polar, non-hydrocarbon components of some higher boiling petroleum fractions such as diesel oil and other fuel oils has also been reported.

In summary, the physical distribution of fuel oil contamination affects its impact on, and removal from, the soil environment. Lateral spreading along the surface increases the initial contaminated area while facilitating evaporative removal or sorption of different hydrocarbons. Subsurface release or vertical penetration mediated by gravitation and capillary forces decreases evaporation, reduces the importance of some transformation pathways (see below), and may lead to ground-water contamination.

Photooxidation has been reported to play a significant role in the chemical degradation of petroleum hydrocarbons in the sunlit environment. Alkanes, benzenes, and mono-substituted venzens have been shown to be relatively resistant to photolysis in aqueous systems; xylenes photolyzed slowly while trisubstituted benzenes and naphthalenes photolyzed at rates competitive with volatilization. Anthracene and other polycyclic aromatic hydrocarbons (PAH) in the carbon range of diesel fuel are subject to photochemical oxidation; benzo(a)pyrene is the most susceptible of the PAH compounds, suggesting that the residual fuel oils may be even more affected by photodegradation than diesel oil. Penetration of oil below the soil surface limits exposure to solar radiation while extensive lateral spreading of oil over impermeable or rocky surfaces may promote substantial photooxidative degradation. The oxygenated products of photooxidation are generally more water-soluble than the parent hydrocarbons and are thus more likely to be leached from soil.

Natural ecosystems have considerable exposure to petroleum hydrocarbons form natural emissions, accidental contamination through oil spills and storage tank leaks, and deliberate application to land in waste disposal activities such as land-farming; therefore, their biodegradation of petroleum hydrocarbons, and several extensive reviews and reports are available. An extensive and diverse group of petroleum hydrocarbon degrading bacteria and fungi are widely distributed in the environment. Although the microbiota of most non-contaminated soils include many naturally occurring hydrocarbon-degrading populations, the addition of petroleum selectively enriches that sector able to adapt and utilize the new substrate. Other environmental factors shown to have a major effect in biodegradability are availability of oxygen and moderate temperatures.

The qualitative hydrocarbon content of petroleum mixtures largely determines their degradability. In general, microorganisms exhibit decreasing ability to degrade aliphatic hydrocarbons with increasing chain length; aromatics are generally more rapidly biodegraded than alkanes. The composition of diesel oil suggests that some of the aromatic species will be biodegradable; biodegradation of the high molecular weight aromatics expected to be present in residual oils will be slower.

In summary, biodegradation of the petroleum hydrocarbons comprising diesel and fuel oils may occur under conditions favorable for microbial activity and when fuel components are freely available to the microorganisms. Degradation may be limited and/or slow in environments with few degrading organisms, low pH, low temperature, and high salinity (e.g., arctic environments). It should be mentioned that even under optimum conditions, total and complete biodegradation is not expected to occur except possibly over an extremely long time period.

Primary Routes of Exposure from Soil/Ground-water Systems

The above discussion of fate pathways suggests that pure fuel oils have low vapor pressure but that their components vary in their volatility from water. The components are strongly or very strongly sorbed to soil. The polycyclic aromatic hydrocarbons in fuel oils have a moderate or high potential for bioaccumulation, while the longer-chain aliphatic compounds have low potential for bioaccumulation. These fate characteristics suggest that the various components may have somewhat different potential exposure pathways.

Volatilization of fuel oils from a disposal site or spill would not be expected to result in significant inhalation exposures to workers or residents in the area. Gravity would tend to carry bulk quantities of the oil down towards the water table leaving only a relatively small fraction on the soil surface to volatize. Volatilization of the remaining oil would occur very slowly because of its low vapor pressure, especially for the heavier weight fuel oils, and because of strong sorption to soil.

Groundwater contamination may result from large spills that reach the water table. There, the more soluble components will dissolve in the ground-water or form emulsions with it. The soluble fraction is mainly aromatic and lower molecular weight aliphatic compounds. In one study using No. 2 fuel oil, 40% of the water soluble fraction was made up of aromatic compounds composed of 11 carbon atoms and 25% each of compounds containing 10 and 12 carbon atoms. The hydrocarbons dissolved in the ground water may move hundreds to thousands of meters. By comparison, the undissolved fraction, which floats on the surface of the water table as a separate phase, would be expected to move only tens of meters, unless cracks or fissures were present.

The movement of fuel oil components in ground water may contaminate drinking water supplies, resulting in ingestion exposures. Ground-water discharges to surface water or the movement of contaminated soil particles to surface water drinking water supplies may also result in ingestion exposures and in dermal exposures from the recreational use of these waters. The potential also exists for the uptake of polynuclear aromatic compounds in fuel oil (e.g., naphthalene, methylnaphthalene and higher weight PAHs) by fish and domestic animals, which may also result in human exposures. Exposures to high concentrations of fuel oil components in drinking water and food are expected to be rare because tainting becomes apparent at relatively low concentrations.

Volatilization of fuel oil hydrocarbons in soil is another potential source of human exposure. Despite their relatively low vapor pressure, the more volatile components of fuel oil in soil evaporate, saturating the air in the soil pores, and diffusing in all directions including upward to the surface. The vapors may diffuse into basements of homes or other structures in the area, resulting in inhalation exposures to the building's occupants. Exposures may be more intensive when the soil is contaminated from leaking underground storage tanks and pipes, rather than from surface spills, because the more volatile components do not have an opportunity to evaporate before penetrating the soil. Even then, this exposure pathway is expected to be much less important for fuel oils than for more volatile petroleum products like gasoline.

3.1.4 Data Summary and Conclusions

Groundwater and soil data summary and conclusions for the subject site are discussed in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

3.2 IDENTIFICATION OF POTENTIAL RECEPTORS AND EXPOSURE SCENARIOS

As part of the overall conceptual site model for SEDA, this section presents a general discussion of the source areas, release mechanisms, potential exposure pathways, and likely human and environmental receptors that may be applicable to sites at SEDA. The current understanding of potential receptors and exposure scenarios for sites at SEDA is based upon the data gathered during previous investigations (RIs and ESIs) at SEDA. This information will be used to develop a conceptual understanding of the potential risks to human health and ecological constituents due to the presence of contaminants at the sites. In addition, this information will be used to assess whether sources of contamination, release mechanisms, exposure routes, and receptor pathways developed based on the conceptual site model are valid or if they may be eliminated from further consideration prior to conducting the risk assessment.

This is intended to be a general discussion of potential receptors and exposure scenarios. Site specific scenarios are presented in the appropriate RI/FS Scoping Plans.

3.2.1 Potential Source Areas and Release Mechanisms

Several types of primary source areas were identified at SEDA including but not limited to the following:

1. Suspected or known disposal areas, including landfills and disposal pits which contain suspected and known materials such as construction debris, IRFNA, radioactive materials, paints and solvents, nicotine sulfate, and garbage.
2. Waste piles
3. Fire training and demonstration pads
4. Burning pits
5. Former and active deactivation furnaces
6. Former munitions washout building
7. Demolition area for ammunition
8. Discharge sites
9. Leachfields
10. Settling pond
12. USTs

Primary and secondary release mechanisms for these sources may include surface water runoff, infiltration of precipitation, groundwater, wind, volatilization, and dispersion and deposition of particulates.

Site-specific potential source areas and release mechanisms are discussed in detail in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

3.2.2 Potential Exposure Pathways and Receptors-Current Uses

A preliminary exposure pathway summary was developed for most of the AOCs. The pathway summary combines both site conditions and expected behavior of the detected chemicals in the environment into a preliminary understanding of the sites. The pathways were developed by evaluating the physical aspects of environmental conditions and the effect these conditions may have on the migration potential of the detected chemicals.

Potential exposure pathways from sources to receptors to be considered for sites at SEDA include:

1. Dermal exposure to surface water and sediments due to surface water run-off and soil erosion,
2. Inhalation of fugitive dust emissions and volatile organic emissions from soil and surface water,
3. Incidental ingestion and dermal exposure to on-site soils,
4. Ingestion, dermal contact, and inhalation of volatiles from groundwater,
5. Ingestion of biota from an on-site surface water body,
6. Ingestion of food crops and livestock exposed to fugitive dusts and contaminated irrigation water.

Generally, ingestion of groundwater and ingestion of food crops and livestock are not significant current pathways since on-site groundwater is not a likely source of potable water. However, at sites near SEDA boundaries, there may be significant pathways for off-site receptors.

There are generally three primary receptor populations for potential releases of contaminants from the sites under current uses:

1. Current site workers and hunters;
2. Terrestrial and aquatic biota on or near the sites; and
3. Off-site receptors.

The potential for human exposure is directly affected by the accessibility to the sites with the exception of fugitive dust. Currently human and vehicular access to SEDA is restricted by a chain-link fence with a locking gate, which is part of SEDA's general security provisions.

Terrestrial animals that frequent the sites at SEDA have the same potential for exposure as the on-site workers. In addition, consumption of contaminated vegetation, biota (prey), contaminated surface water, as well as burrowing in the contaminated soils also could contribute to the contaminant uptake in these animals. Aquatic organisms may be considered to be receptor populations for those sites which have stable surface water bodies on-site or nearby. Amphibians and other seasonal animal populations may use vernal pools during springtime. The potential exposure routes could be through ingestion of contaminated water or sediment and biota growing in the contaminated water.

The off-site human receptor population includes residents living in the surrounding off-post area, and individuals using the surface water for recreational purposes such as swimming, wading, and fishing. Contaminated groundwater and surface water from SEDA could potentially migrate to areas off-site of the SEDA boundary. Exposure to the off-site population could occur through direct dermal contact with surface water, incidental ingestion during swimming, and consumption of fish from contaminated surface water.

Potential Exposure Pathways and Receptors under current uses at particular sites are discussed in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

3.2.3 Potential Exposure Pathways and Receptors - Future Uses

For future uses of sites at SEDA, on-site residents and construction workers would be added to the above mentioned receptors. For the ingestion of soil, surface water, and sediment, the most susceptible receptor would be children. Dermal contact with soil is a potential exposure pathway for future residents. Ingestion of groundwater is a potential route of exposure to all future on-site residents assuming on-site groundwater is used as their water supply. Inhalation and dermal contact of fugitive dust is also a potential route of exposure for all on-site future residents.

Potential Exposure Pathways and Receptors for future uses are discussed in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

The future residential scenario will not be considered for remedial activities as the intended future use of SEDA is as a munitions storage depot, however it will be considered for the Baseline Risk Assessment (BRA) calculations. Currently the Army has no plans to change the use of this facility or to transfer the ownership. In early July 1995, the Base Realignment and Closure Act (BRAC) Commission voted to recommend closure of SEDA. Until the BRAC Commission recommendations are voted on by the Congress, the installation will remain open. If Congress approves the recommendations, they will become public law on October 1, 1995. If BRAC applies to SEDA, future use of the sites will be determined by the Army. In accordance with BRAC regulations, the Army will perform any additional investigations and remedial actions to assure that any change in intended land use is protective of human health and the environment.

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.

The possibility of a residential scenario at SEDA is remote since the Army intends to continue using this parcel for munitions destruction. Although the risk due to future residential land use will be calculated in the BRA, the decision to perform a remedial action will be based upon an intended (current) land use scenario for the subject site. 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.

3.2.4 Exposure Pathways and Receptors at SEDA

This section presents exposure pathways from sources to receptors for four types of source areas at SEDA. These exposure pathways are for (1) disposal areas, (2) burning pits and pads, (3) deactivation furnaces, and (4) ordnance detonation, disposal, and burning areas. These exposure scenarios were selected because they represent several of the sites at SEDA.

3.2.4.1 Exposure Pathway and Receptors for Disposal Areas

The complete potential exposure pathway from sources to receptors for disposal areas are shown schematically in Figure 3-5.

The primary source for the disposal areas includes the buried wastes and contaminated soils within the landfills or disposal pits. The primary release mechanisms from the soils and wastes that comprise the disposal areas may include surface water runoff and infiltration of precipitation. Wind may also be a release mechanism, as dusts from impacted soil may be reintroduced into the breathing zone, although this is dependent on amount of vegetation or pavement at a site. Surface water, sediment, and groundwater may be secondary sources. Groundwater interception may be a secondary release mechanism.

Ingestion and Dermal Exposure Due to Surface Water and Sediment

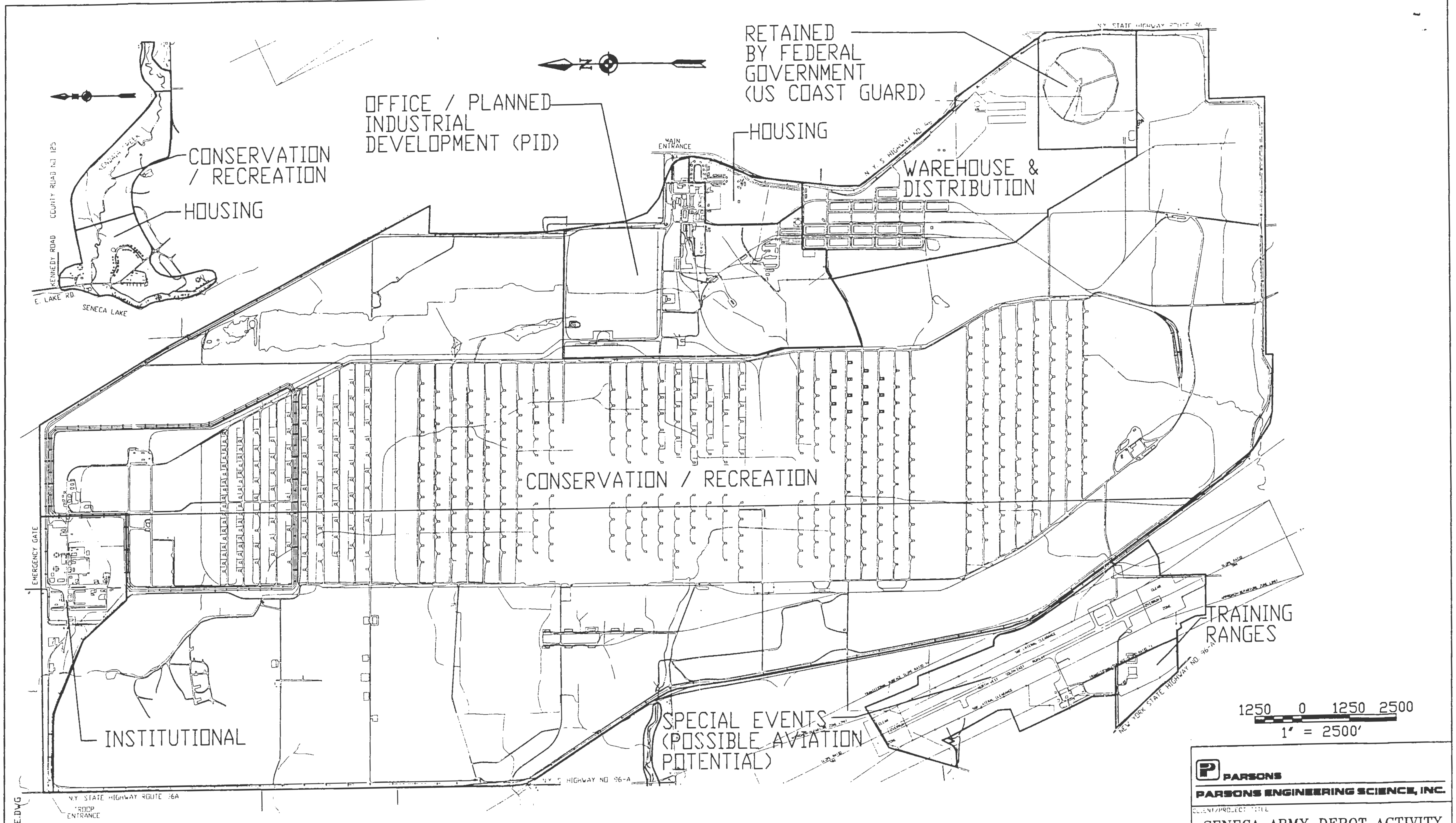
Surface water flow is controlled by the local topography of each site. Depending on the direction of the topographic gradient, surface water flow will be to low areas, drainage swales and ditches and may eventually drain into local creeks, ponds, or streams, which may include Reeder Creek, Indian Creek, Kendaia Creek, and the Duck Pond.

Human receptors of impacted surface water and sediment include current on-site workers, off-site residents or recreators, or future residents who may incidentally ingest or come in contact with the surface water and sediment. Dermal exposure to surface water and sediments and inhalation exposure to potential volatile organic compounds released from surface water represent exposure pathways for persons wading in on- or off-site portions of any surface water body (i.e. stream or creek). Wading in a creek or stream is possible for persons fishing in portions of a creek or stream and for children playing in the creek or stream. Ingestion of edible fish caught in a surface water body could result in human exposure through bioaccumulation and biomagnification of the contaminants in the surface and sediments.

The primary environmental receptors of any impacted surface and sediment are the biota of the low-lying areas, drainage swales, and ponds. Organisms which feed on the biota may be affected due to bioaccumulation of pollutants from the surface water and sediment. Terrestrial biota that drink from and come in contact with impacted surface waters may be affected.

Soil Ingestion and Dermal Contact

Incidental ingestion of waste material and soil is a potential exposure pathway for on-site



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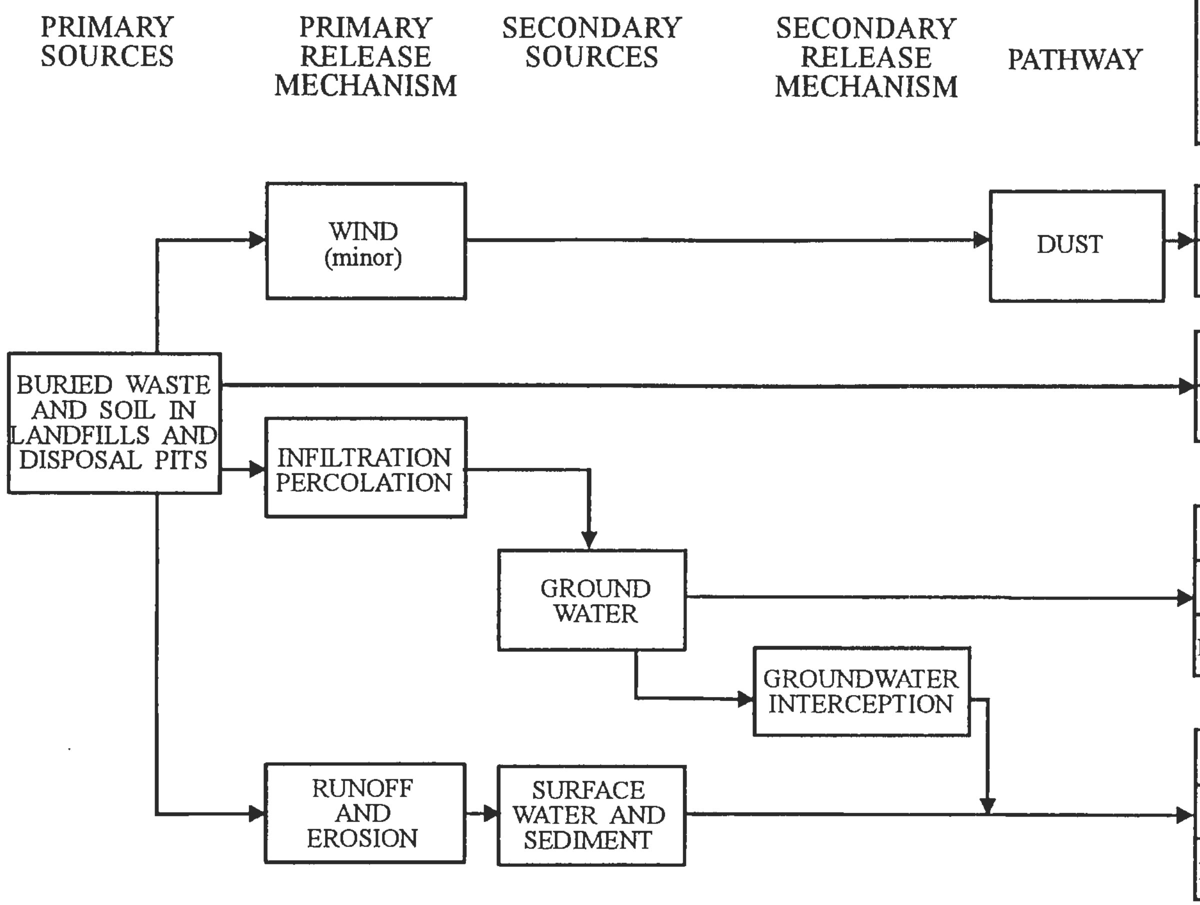
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT ENVIRONMENTAL ENGINEERING
Dwg No 726510-02007

FIGURE 3-4A
FINAL LAND USE PLAN

SCALE 1" = 2500'
DATE JANUARY 1997
A



EXPOSURE ROUTE	RECEPTOR				
	HUMAN			BIOTA	
	FUTURE ON-SITE RESIDENT	OFF SITE RESIDENTS	CURRENT SITE WORKERS AND VISITORS	TERRESTRIAL	AQUATIC
INHALATION	●	NA	●	●	NA
DERMAL CONTACT	●	NA	●	●	NA
INGESTION	●	NA	●	●	NA
DERMAL CONTACT	●	NA	●	●	NA
INGESTION	●	●	NA	NA	NA
INHALATION	●	●	NA	NA	NA
DERMAL CONTACT	●	●	NA	NA	NA
INGESTION	●	●	●	●	●
INHALATION	●	●	●	●	NA
DERMAL CONTACT	●	●	●	●	●

● PATHWAY CONSIDERED TO POSE POTENTIAL RISK

NA NOT APPLICABLE RECEPTOR

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DWG NO

FIGURE 3-5

EXPOSURE PATHWAY SUMMARY FOR DISPOSAL AREAS

SCALE NA
DATE JUNE 1995

H:\ENG\SENECA\GENERIC\TABLES\FIG3-5.CDR

workers, future residents and terrestrial biota. Dermal contact with the waste material and soil is a potential pathway for on-site workers and terrestrial biota.

Groundwater Ingestion, Inhalation, and Dermal Contact

Ingestion of, inhalation of, and dermal contact with groundwater are not potential exposure pathways for on-site workers or terrestrial biota under current uses. The groundwater beneath the sites at SEDA is not used currently as a drinking water source and connection to other potable groundwater aquifers has not been demonstrated. It is not anticipated that there would be direct exposure to the groundwater from the site to on-site workers or terrestrial biota.

Ingestion of, dermal contact, and inhalation of volatiles from groundwater may be a potential route of exposure to all future on-site residents assuming on-site groundwater is used as their water supply.

Ingestion of, dermal contact with, and inhalation of volatiles from groundwater may be potential routes of exposure for off-site residents. Residential communities surrounding the depot use potable water wells for drinking water supplies and irrigation, which however unlikely, could be a possible route of exposure to any contaminants released as a result of the activities on SEDA. 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 SEDA.

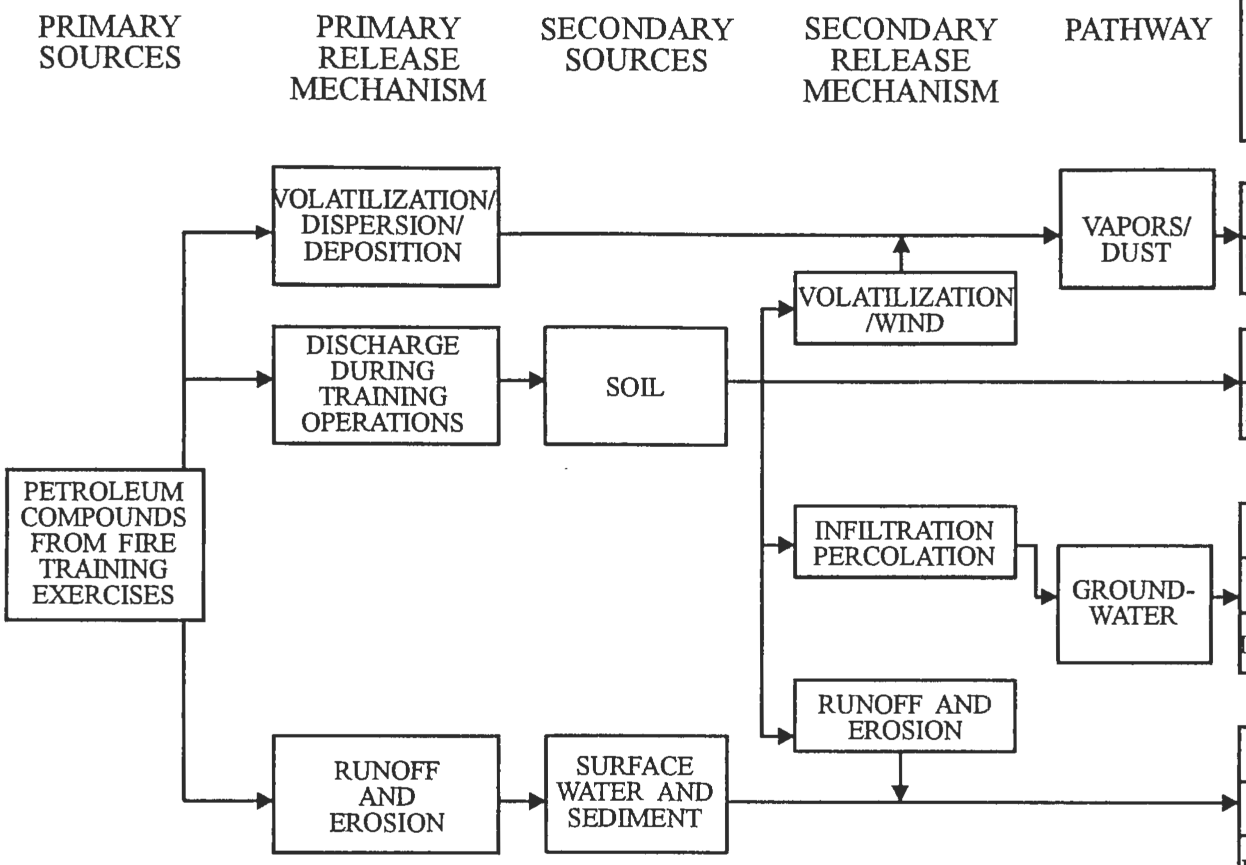
Dust Inhalation and Dermal Contact

Inhalation and dermal contact with impacted dust is a potential exposure pathway for on-site workers, future residents and terrestrial biota depending on the amount of vegetation and/or pavement covering the surface of the site. Fugutive dusts would not be expected to be transported beyond the SEDA boundary.

Surficial soil and dust could become airborne due to vehicular traffic or wind erosion. Persons at or near the site could inhale particulates which have been contaminated with on-site material.

3.2.4.2 Exposure Pathway and Receptors for Burning Pits and Pads

The complete potential exposure pathway from sources to receptors for burning pits and pads are shown schematically in Figure 3-6.



EXPOSURE ROUTE	RECEPTOR				
	HUMAN			BIOTA	
	FUTURE ON-SITE RESIDENT	OFF SITE RESIDENTS	CURRENT SITE WORKERS AND VISITORS	TERRESTRIAL	AQUATIC
INHALATION	●	NA	●	●	NA
DERMAL CONTACT	●	NA	●	●	NA
INGESTION	●	NA	●	●	NA
DERMAL CONTACT	●	NA	●	●	NA
INGESTION	●	●	NA	NA	NA
INHALATION	●	●	NA	NA	NA
DERMAL CONTACT	●	●	NA	NA	NA
INGESTION	●	●	●	●	●
INHALATION	●	●	●	●	NA
DERMAL CONTACT	●	●	●	●	●

● PATHWAY CONSIDERED TO POSE POTENTIAL RISK

NA NOT APPLICABLE RECEPTOR

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FIGURE 3-6

EXPOSURE PATHWAY SUMMARY FOR THE BURNING PITS AND PADS

SCALE NA
DATE JUNE 1995

The primary source areas for the burning pits and pads may include the pad on which burning took place, fire training pit, and areas near the pit or pad which may have been impacted by the activities at the site. These areas may include drum storage areas and other burning or training sites. Soil, surface water, and sediment are secondary sources as well as pathways of exposure. If infiltration of precipitation occurs, then groundwater would also become a pathway.

Primary release mechanisms from the pads or pits are direct deposition of chemicals used during fire training exercises, volatilization, dispersion and deposition of particulates from fires, and surface water runoff and erosion. Secondary release mechanisms are surface water runoff and erosion, infiltration, wind, and volatilization.

Ingestion and Dermal Exposure to Surface Water Runoff and Sediment

Human receptors of impacted surface water and sediment include current on-site workers, off-site residents or recreators, or future residents who may incidentially ingest or come in contact with the surface water and sediment. Dermal exposure to surface water and sediments and inhalation exposure to potential volatile organic compounds released from surface water represent exposure pathways for persons wading in on or off-site portions of any surface water body (i.e. stream or creek). Wading in a creek or stream is possible for persons fishing in portions of a creek or stream and for children playing in the creek or stream. Ingestion of edible fish caught in a surface water body could result in human exposure through bioaccumulation and biomagnification of the contaminants in the surface and sediments.

The primary environmental receptors of any impacted surface and sediment are the biota of the low-lying areas, drainage swales, and ponds. Organisms which feed on the biota may be affected due to bioaccumulation of pollutants from the surface water and sediment. Terrestrial biota that drink from and come in contact with impacted surface waters may be affected.

Soil Ingestion and Dermal Contact

Incidental ingestion of waste material and soil is a potential exposure pathway for on-site workers, future residents, and terrestrial biota. Dermal contact with the waste material and soil is a potential pathway for on-site workers and terrestrial biota.

Groundwater Ingestion, Inhalation, and Dermal Contact

Ingestion of, inhalation of, and dermal contact with groundwater are not potential exposure pathways for on-site workers or terrestrial biota under current uses. The groundwater beneath the sites at SEDA is not used currently as a drinking water source and connection to other potable groundwater aquifers has not been demonstrated. It is not anticipated that there would be direct exposure to the groundwater from the site to on-site workers or terrestrial biota.

Ingestion of, dermal contact, and inhalation of volatiles from groundwater may be a potential route of exposure to all future on-site residents assuming on-site groundwater is used as their water supply.

Ingestion of, dermal contact with, and inhalation of volatiles from groundwater may be potential routes of exposure for off-site residents. Residential communities surrounding the depot use potable water wells for drinking water supplies and irrigation, which however unlikely, could be a possible route of exposure to any contaminants released as a result of the activities on SEDA. 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 SEDA.

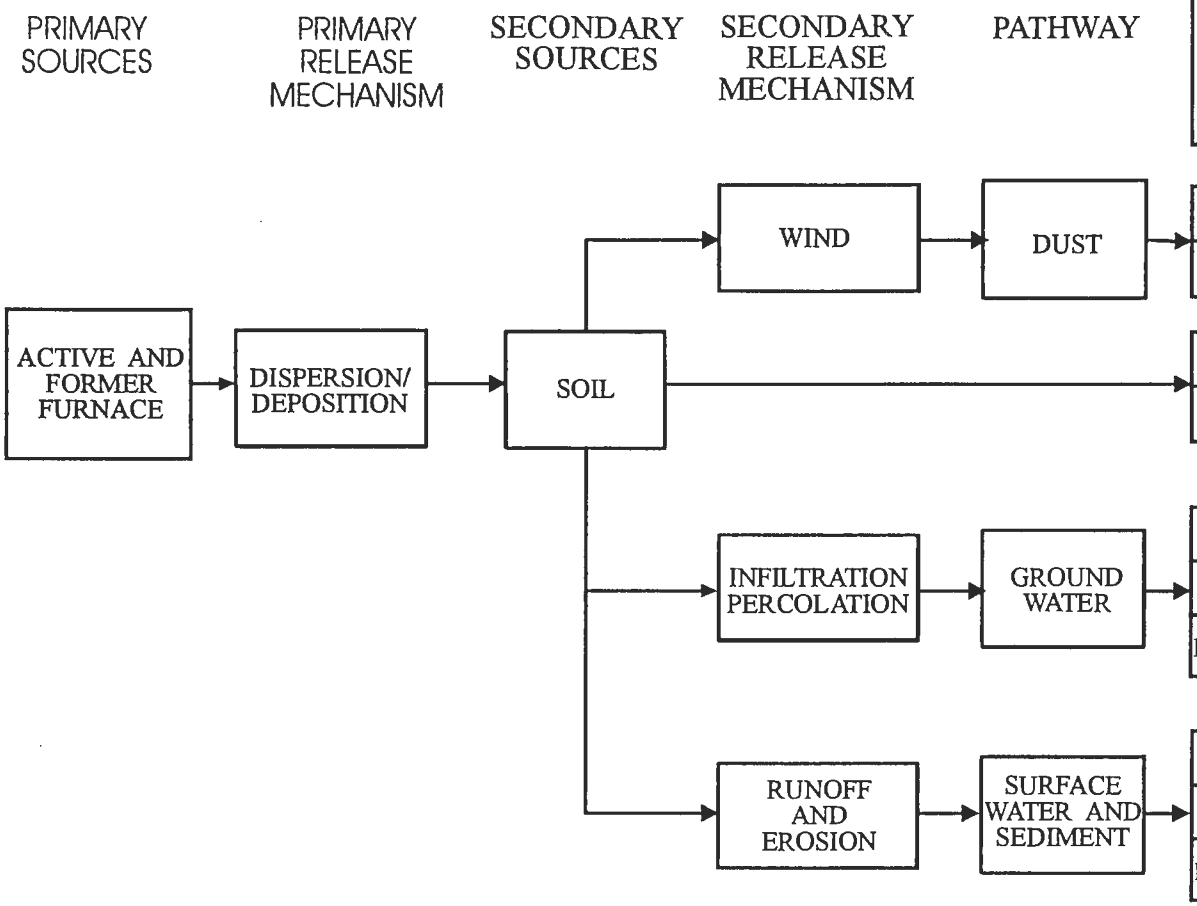
Inhalation of and Dermal Contact with Dust and/or Volatile Emissions

Impacted dust and/or volatile organic compounds may be released from the burning pits and the surrounding area due to wind erosion, vehicle traffic,or periodic burn events. Fugitive dusts would not be expected to be transported beyond the SEDA boundary. As with fugitive dusts, volatile compounds would not be expected to migrate off-site in significant concentrations. Therefore,the dust and /or volatile emissions could be inhaled by or come in contact with future on-site residents, SEDA workers, and terrestrial biota.

3.2.4.3 Exposure Pathway and Receptors for Deactivation Furnaces

The complete potential exposure pathway from sources to receptors for deactivation furnaces are shown schematically in Figure 3-7.

The primary source for the deactivation furnaces includes the deactivation furnace stacks. The primary release mechanism includes particulate emissions from the stacks and the deposition of particulates in the surrounding surface soil. The interior of Building S-311A may be a second primary source. A secondary source may be the surface soil where particulate emissions from the stacks have been deposited. Secondary release mechanisms from the surface soil are runoff and erosion to surface water and sediment,infiltrion to groundwater and fugitive dust emission.



EXPOSURE ROUTE	RECEPTOR				
	HUMAN			BIOTA	
	FUTURE ON-SITE RESIDENT	OFF SITE RESIDENTS	CURRENT SITE WORKERS AND VISITORS	TERRESTRIAL	AQUATIC
INHALATION	●	NA	●	●	NA
DERMAL CONTACT	●	NA	●	●	NA
INGESTION	●	NA	●	●	NA
DERMAL CONTACT	●	NA	●	●	NA
INGESTION	●	●	NA	NA	NA
INHALATION	●	●	NA	NA	NA
DERMAL CONTACT	●	●	NA	NA	NA
INGESTION	●	●	●	●	●
INHALATION	●	●	●	●	NA
DERMAL CONTACT	●	●	●	●	●

● PATHWAY CONSIDERED TO POSE POTENTIAL RISK

NA NOT APPLICABLE RECEPTOR

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORKPLAN

DEPT ENVIRONMENTAL ENGINEERING
DWG NO

FIGURE 3-7

EXPOSURE PATHWAY SUMMARY FOR FURNACES

SCALE NA
DATE JUNE 1995

Ingestion and Dermal Exposure to Surface Water Runoff and Sediment

Human receptors of impacted surface water and sediment include current on-site workers, off-site residents or recreators, or future residents who may incidentially ingest or come in contact with the surface water and sediment. Dermal exposure to surface water and sediments and inhalation exposure to potential volatile organic compounds released from surface water represent exposure pathways for persons wading in on- or off-site portions of any surface water body (i.e. stream or creek). Wading in a creek or stream is possible for persons fishing in portions of a creek or stream and for children playing in the creek or stream. Ingestion of edible fish caught in a surface water body could result in human exposure through bioaccumulation and biomagnification of the contaminants in the surface and sediments.

The primary environmental receptors of any impacted surface and sediment are the biota of the low-lying areas, drainage swales, and ponds. Organisms which feed on the biota may be affected due to bioaccumulation of pollutants from the surface water and sediment. Terrestrial biota that drink from and come in contact with impacted surface waters may be affected.

Soil Ingestion and Dermal Contact

Incidental ingestion of waste material and soil is a potential exposure pathway for on-site workers, future residents, and terrestrial biota. Dermal contact with the waste material and soil is a potential pathway for on-site workers and terrestrial biota.

Groundwater Ingestion, Inhalation, and Dermal Contact

Ingestion of, inhalation of, and dermal contact with groundwater are not potential exposure pathways for on-site workers or terrestrial biota under current uses. The groundwater beneath the sites at SEDA is not used currently as a drinking water source and connection to other potable groundwater aquifers has not been demonstrated. It is not anticipated that there would be direct exposure to the groundwater from the site to on-site workers or terrestrial biota.

Ingestion of dermal contact, and inhalation of volatiles from groundwater may be a potential route of exposure to all future on-site residents assuming on-site groundwater is used as their water supply.

Ingestion of, dermal contact with, and inhalation of volatiles from groundwater may be potential routes of exposure for off-site residents. Residential communities surrounding the depot use potable water wells for drinking water supplies and irrigation, which however unlikely, could be a possible route of exposure to any contaminants released as a result of the activities on SEDA. 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 SEDA.

Inhalation of and Dermal Contact with Dust and/or Volatile Emissions

Impacted dust may be released from the areas due to wind erosion, vehicular traffic through the area , or disturbance of the soil during site use. Inhalation of dust will be considered for SEDA workers and visitors, and terrestrial biota under current scenarios. The strict contrls on access to the facilities limit potenitial exposure of other people to fugitive dust emissions. Fugitive dusts would not be expected to be transported in significant quantities beyond the SEDA boundary.

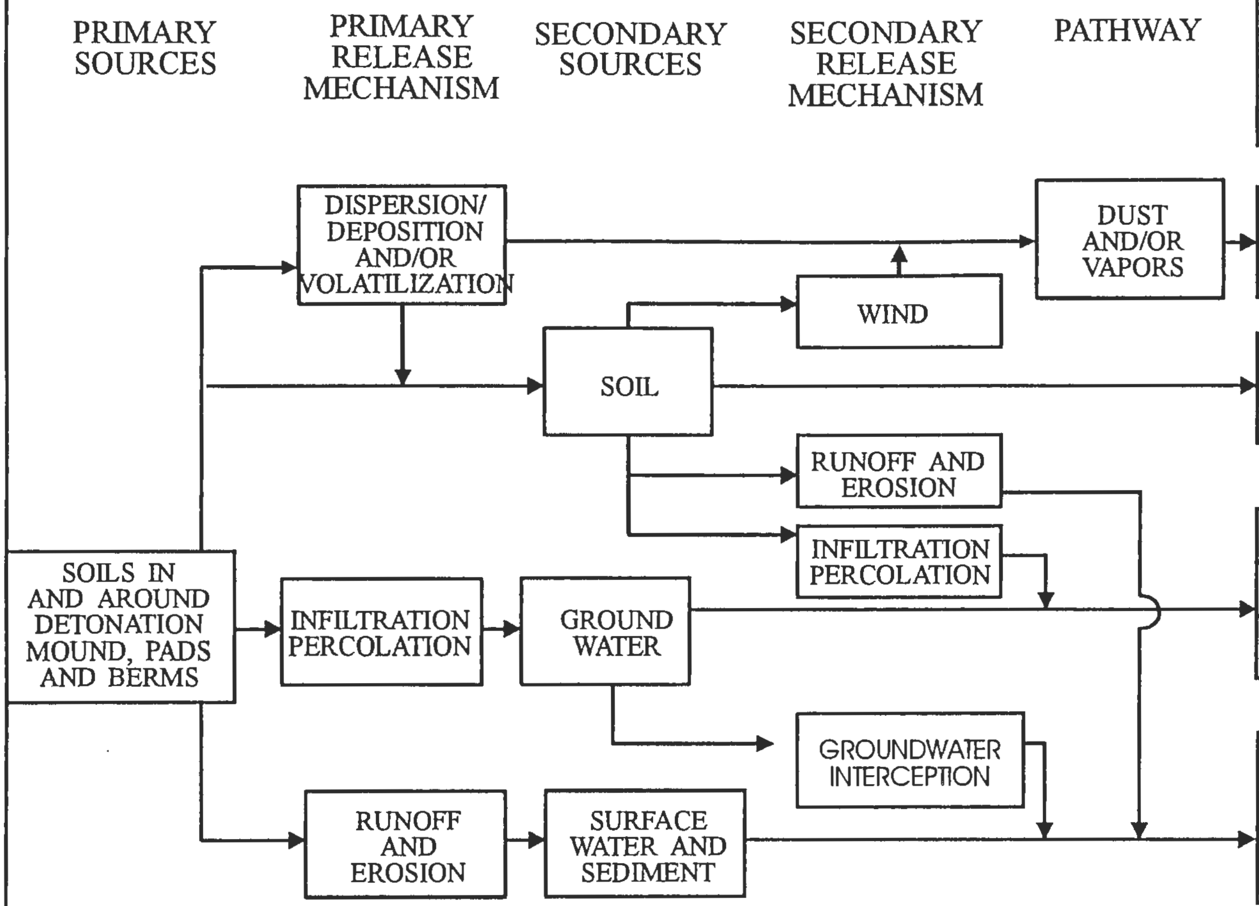
3.2.4.4 Exposure Pathway and Receptors for Open Detonation Grounds, Powder Burning Pits, and Ordnance Disposal Areas

The complete potential exposure pathway from sources to receptors for open detonation grounds, powder burning pits, and ordnance disposal areas are shown schematically in Figure 3-8.

The primary source areas for the open detonation grounds, burning pit, or other ordnance disposal area may include the ordnance, which is detonated within the area used for open detonation operations, burning, or disposal. The soils comprising the detonation mound, berm or pads may also be a primary source. The primary release mechanisms at the sites are dispersion of dust and/or volatiles into the air, infiltration and percolation through the soils, runoff and erosion of the suspected source areas. Depending on the site, secondary sources are the soils, groundwater, and surface water and sediments. Secondary release mechanisms are infiltration and percolation of the secondary source soils, surface water runoff and erosion of secondary source soils, and groundwater. Interception with nearby creeks could also become a secondary release mechanism.

Ingestion and Dermal Exposure to Surface Water Runoff and Sediment

Surface water runoff may flow to low areas, wetlands and drainage swales which may be located on-site. In some cases, the drainage swales may discharge to creeks such as Reeder Creek and Kendaia Creek. Surface soils eroded from the sites may be deposited as sediment within the on-site drainage swales and any wetlands which may be located on the site.



EXPOSURE ROUTE	RECEPTOR				
	HUMAN			BIOTA	
	FUTURE ON-SITE RESIDENT	OFF SITE RESIDENTS	CURRENT SITE WORKERS AND VISITORS	TERRESTRIAL	AQUATIC
INHALATION	●	NA	●	●	NA
DERMAL CONTACT	●	NA	●	●	NA
INGESTION	●	NA	●	●	NA
DERMAL CONTACT	●	NA	●	●	NA
INGESTION	●	●	NA	NA	NA
INHALATION	●	●	NA	NA	NA
DERMAL CONTACT	●	●	NA	NA	NA
INGESTION	●	●	●	●	●
INHALATION	●	●	●	●	NA
DERMAL CONTACT	●	●	●	●	●

● PATHWAY CONSIDERED TO POSE POTENTIAL RISK

NA NOT APPLICABLE RECEPTOR

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORKPLAN

DEPT ENVIRONMENTAL ENGINEERING
DWG NO

FIGURE 3-8
EXPOSURE PATHWAY SUMMARY
FOR ORDINANCE DETONATION
AND DISPOSAL AREAS

SCALE NA
DATE JUNE 1995

H:\ENG\SENECA\GENERIC\TABLES\FIG3-8.CDR

Human receptors of impacted surface water and sediment include on-site workers or future residents who may incidentally ingest or come in contact with the surface water and sediment. Dermal exposure to surface water and sediments and inhalation exposure to potential volatile organic compounds released from surface water represent exposure pathways for persons wading in on- or off-site portions of any surface water body (i.e. Reeder Creek at the Open Detonation Grounds). Wading in a creek or stream is possible for persons fishing in portions of a creek or stream and for children playing in the creek or stream. Ingestion of edible fish caught in a surface water body could result in human exposure through bioaccumulation and biomagnification of the contaminants in the surface and sediments.

The primary environmental receptors of any impacted surface water and sediment are the aquatic biota of the on-site wetlands and drainage swales. For the Open Detonation Grounds, aquatic biota of Reeder Creek are also receptors. Organism which feed on the biota may be affected due to bioaccumulation of pollutants from the surface water and sediments. Terrestrial biota that drink from impacted surface waters and come in contact with surface water and sediment may be affected.

Soil Ingestion and Dermal Contact

Incidental ingestion of waste material and soil is a potential exposure pathway for on-site workers, future residents, and terrestrial biota. Dermal contact with the waste material and soil is a potential pathway for on-site workers and terrestrial biota.

Groundwater Ingestion, Inhalation, and Dermal Contact

Ingestion of, inhalation of, and dermal contact with groundwater are not potential exposure pathways for on-site workers or terrestrial biota. The groundwater beneath the site is not used currently as a drinking water source and connection to other potable groundwater aquifers has not been demonstrated. It is not anticipated that there would be direct exposure to the groundwater from the site to on-site workers or terrestrial biota.

Ingestion of dermal contact, and inhalation of volatiles from groundwater may be a potential route of exposure to all future on-site residents assuming on-site groundwater is used as their water supply.

At the Open Detonation Grounds, groundwater beneath the site flows generally toward Reeder Creek and may be recharging the creek. The potential groundwater contribution to the surface water could result in the exposures identified for surface water and sediments above.

Ingestion of, dermal contact with, and inhalation of volatiles from groundwater may be potential routes of exposure for off-site residents. Residential communities surrounding the depot use potable water wells for drinking water supplies and irrigation, which however unlikely, could be a possible route of exposure to any contaminants released as a result of the activities on SEDA. 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 SEDA.

Inhalation of and Dermal Contact with Dust and/or Volatile Emissions

Impacted dust and/or volatile organic compounds may be released from the areas and the surrounding area due to wind erosion , vehicular traffic,or periodic burn events. Fugitive dusts would not be expected to be transported beyond the SEDA boundary. As with fugitive dusts, volatile compounds would not be expected to migrate off-site in significant concentrations. Therefore,the dust and /or volatile emissions could be inhaled by or come in contact with future on-site residents, SEDA workers, and terrestrial biota.

3.3 SCOPING OF POTENTIAL REMEDIAL ACTION TECHNOLOGIES

In order to scope potential remedial action technologies, remedial action objectives must be established. In general, the objectives of a remedial action are to comply with all ARARs and reduce the overall environmental and human health site risk to an acceptable level. Remedial response objectives for each media of concern are part of Table 3-4, Remedial Action Objectives, General Response Action, Technology Types and Examples of Process Options.

Table 3-4
REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES AND EXAMPLES OF PROCESS OPTIONS

ENVIRONMENTAL MEDIA	REMEDIAL ACTION OBJECTIVES OBJECTIVES (FOR ALL REMEDIAL ACTION OBJECTIVES)	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES (FOR GENERAL RESPONSE ACTIONS)	PROCESS OPTIONS
Soil				
	For Human Health:	No Action/Institutional Actions:		
	Prevent ingestion/direct contact with soils having contaminants both carcinogenic and non-carcinogenic in excess of clean-up goals.	No Action Access/use restrictions	No Action Fences Deed restrictions	None
	Prevent direct contact and handling of soils having unexploded ordnances.	Containment Actions:	Capping Vertical barriers Horizontal barriers Surface controls	Clay caps, Membranes, Slurry wall, Sheetpiling, Liners, Diversion, Collection, Grading, Curtain barriers
	For Environmental Protection:		Sediment barriers, Dust control	
	Prevent migration of contaminants into groundwater.	Excavation, Treatment Actions:	Removal: Excavation	
	Prevent exposure via inadvertant uptake of contaminants by terrestrial biota.	Excavation, Treatment, Disposal, In-situ treatment, Excavation, Disposal	Treatment: Solidification Stabilization Physical Chemical Biological In-situ Thermal	Encapsulation, Pozzolanic Solidification, Soil Washing, Solvent Extraction, Composting, Soil Slurry Bio-Reactor, Bioreclamation Soil Flushing, Incineration, Pyrolysis
			Disposal: On-site or off-site	

Table 3-4 (Continued)
REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES AND EXAMPLES OF PROCESS OPTIONS

ENVIRONMENTAL MEDIA	REMEDIAL ACTION OBJECTIVES OBJECTIVES (FOR ALL REMEDIAL ACTION OBJECTIVES)	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES (FOR GENERAL RESPONSE ACTIONS)	PROCESS OPTIONS
Groundwater	For Human Health: Restore groundwater to acceptable levels according to NYSGWS for class GA waters, or a potable water supply.	No Action/Institutional Controls: No Action Use/Access Restrictions Monitoring Alternate Residential Water Supply	No Action Fences, Deed Restrictions Groundwater Classification Change	None
	Prevent ingestion of, and dermal contact with water having carcinogen(s) or any contaminant in excess of NYSGWS for class GA waters.	Containment:	Capping, Vertical barriers, Horizontal barriers, Hydraulic containment	Clay Cap, Membranes, Slurry Walls, Sheet Pilings, Liners, Groundwater Recirculation Systems
	Prevent inhalation of volatized contaminants.			
	For Environmental Protection: Restore groundwater aquifer to acceptable concentrations contaminants	Removal, Treatment: Collection, Treatment, Discharge, In-situ Groundwater Treatment, Individual Home Treatment	Removal: Groundwater Pumping Diversion, Collection, Drainages Treatment: Physical Chemical In-situ Disposal: Discharge to Surface Water, Discharge to Upgradient Groundwater	Wells, Subsurface Drains or Leachate Collection Drains Ion Exchange, Evap/Dewater, Act. Carbon, Oxidation/Reduction, Precipitation, Chemical Oxidation, Bioremediation

Table 3-4 (Continued)
REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS,
TECHNOLOGY TYPES AND EXAMPLES OF PROCESS OPTIONS

ENVIRONMENTAL MEDIA	REMEDIAL ACTION OBJECTIVES OBJECTIVES (FOR ALL REMEDIAL ACTION OBJECTIVES)	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES (FOR GENERAL RESPONSE ACTIONS)	PROCESS OPTIONS
Sediment				
	For Human Health:	No Action/Institutional Actions:	No Action/Institutional Options:	
	Eliminate exposure pathways which would yield a total excess cancer risk > 10^{-4} to 10^{-7}.	No Action Assess restrictions to monitoring	Fences Deed restrictions Groundwater Classification Change	None
		Excavation Actions:		
	For Environmental Protection:		Removal Technologies:	Sediment excavation
		Excavation		
	Prevent the release of contaminants in sediments that would result in surface water concentrations in excess of ambient water quality standards.	Excavation/Treatment Actions: Removal/Disposal Removal/Treatment/Disposal	Excavation Containment Technologies: Capping Vertical barriers Horizontal barriers Sediment control barriers	Removal with Clay Cap, Multilayer, Asphalt, Slurry wall, Sheet Piling, Liners, Grout Injection, Coffer Dams, Curtain Barriers, Capping Barriers
	Reduce concentrations of pollutants below NYSDEC sediment criteria levels.		Treatment Technologies:	
			Solidification, Fixation, Stabilization Dewatering Physical treatment Chemical treatment Biological treatment In-situ treatment Thermal treatment	Sorption, Pozzolanic agents, Encapsulation Sedimentation, Dewatering and Drying beds, Water/Solids Leaching (with subsequent treatment), Neutralization, Oxidation, Electrochemical, Reduction, Landfarming, Surface Bioreclamation, Incineration, Pyrolysis, Soil Washing, Solvent Extraction

Table 3-4 (Continued)
REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES AND EXAMPLES OF PROCESS OPTIONS

ENVIRONMENTAL MEDIA	REMEDIAL ACTION OBJECTIVES OBJECTIVES (FOR ALL REMEDIAL ACTION OBJECTIVES)	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES (FOR GENERAL RESPONSE ACTIONS)	PROCESS OPTIONS
Surface Water	For Human Health	No Action/Institutional Actions:	No Action/Institutional Options:	
	Prevent ingestion of, and dermal contact with surface water having carcinogens or any ambient water quality standards for New York contaminants in excess of surface water standards.	No Action Access restrictions Monitoring	Fences Deed restrictions	None
		Collection/Treatment:	Collection:	
	Prevent inhalation of volatized contaminants.	Surface Water Run-Off Interception, Treatment	Surface controls	Grading, Diversion, and Collection
			Treatment:	
	For Environmental Protection		Physical Chemical In-situ	Precipitation, Air Stripping Coag/Flocc, Filtration, Ion Exchange, Bioreclamation, Chemical Oxidation
	NYSDEC Classification for Class C and D Surface Waters.		Disposal:	
			Discharge to Surface Water	

Human health objectives would likely be concerned with preventing direct contact or ingestion of soil and surface water impacted with contaminants, either carcinogenic or non-carcinogenic. For groundwater these objectives may include NYSDWS for Class GA waters, which maintains that the groundwater on the site should be useable as a potable water supply. ARARs and TBCs for surface water and soils will have to be achieved.

General response actions specific to each media are part of Table 3-4. Categories of remedial actions include:

1. No action/institutional action,
2. Containment,
3. Excavation or collection, treatment, and disposal.

Treatment technologies include: physical, chemical, or biological treatment processes. The last column of Table 3-4 describes general process options that may be applicable for the containment, treatment, excavation, and disposal of contaminated media (soil, groundwater, sediment and surface water). Detailed descriptions of the technologies for remediation of both soil/sediment (source control) and groundwater (migration control) are provided later in this section.

3.3.1 Identification of Technologies

General remedial action technologies and processes have been identified for consideration as possible remedial options at SEDA. The list of technologies and processes presented below were taken from several sources:

- Standard engineering handbooks;
- Vendors information;
- Best engineering estimates; and
- EPA references:
  -"Handbook on In Situ Treatment of Hazardous Waste - Contaminated Soils" (EPA 1990);
  -"Handbook on Remediation of Contaminated Sediments" (EPA 1991);
  -"The Superfund Innovative Technology Evaluation Program" (EPA 1992); and
  -"Vendor Information System for Innovative Treatment Technologies" (EPA 1993).

This section describes the remedial action technologies that may be applied to soil/sediment and to groundwater. Remedial action technologies, arranged according to categories for general response actions for remediation of soil/sediment (source control), are shown on Table 3-5. Groundwater remedial technologies are arranged in a similar fashion on Table 3-6.

3.3.2 Selected Remedial Technologies for Soil/Sediment (Source Control)

The following remedial technologies process can be considered as soil/sediment (source control) alternatives:

- no action;
- capping in-place;
- excavation/hauling/landfilling;
- low temperature thermal desorption;
- soil vapor extraction;
- solidification/stabilization;
- soil/sediment washing;
- in-situ detoxification and solidification;
- resource reclamation;
- implementation of institutional controls;
- composting;
- excavation/incineration;
- RCRA subtitle D landfill; and
- off-site treatment and disposal

3.3.2.1 No Action

No action may be applicable if it can be demonstrated that no appreciable contamination or risk due to contamination exists at the subject site. Such a program would require that the area remain secured by fences and regular military patrols. A modified no action program could include regular monitoring of the existing wells at the boundaries of the subject site. Samples from existing wells would be collected and analyzed on a routine basis. Statistically significant changes in concentration of any contaminant of concern would then require additional action.

TABLE 3-5
TECHNOLOGY FOR SOIL/SEDIMENT (SOURCE CONTROL)

SOIL/ SEDIMENT GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS	DESCRIPTION
No Action	None	Not applicable	No Action.
Institutional controls	Access Control	Fencing, Security	Access to site restricted by security force at access points. Perimeter patrolled daily.
		Wall and posting	Access to site is restricted by construction of a permanent, low-maintenance wall. Warning signs posted.
		Deed restrictions	Deed for property modified to restrict future sales and land use, or U.S. Government holds deed into perpetuity.
	Monitoring	Soil Monitoring	Periodic sampling soils. Monitors changes in extent of soil/sediment affected by constituents.
	Alternative Water Supply	City water line or bottle water	Extend city supply line to area or provide trucked in water.
Containment	Horizontal barriers	Soil cap	Consolidate all wastes into a landfill as required to meet existing grade. Place two to five feet of clean fill on entire landfill, grade and seed.
		Clay cap	Add one to two foot clay layer beneath soil cap.
		Asphalt cap	Highway-grade base and asphalt pavement over entire site.
Containment (cont)	Vertical barriers	Sheet pile	Steel barrier wall driven into soil in sections using a drop-hammer or vibrating hammer.
	Vertical barriers	Slurry wall	Trench around affected area and fill trench with cement/bentonite or soil/bentonite slurry.
		Grout Curtain	Pressure injection of grout in a regular pattern of drill holes.
		Vibrating beam	Drive steel beam into ground and inject slurry as beam is withdrawn.
In Situ Treatment	Solidification	Pozzolan-portland cement	Pozzolan mixed with soil/sediment using auger type mechanism.
		Pozzolan-lime/flyash	Pozzolan mixed with soil/sediment using auger type mechanism.
		Vitrification	Additives mixed into soil, electrodes placed in-ground and energy applied to electrodes. Soil/sediment and additives form molten glass that cools to a stable non-crystalline solid.
	Extraction	Soil flushing	Constituents are extracted using surfactants, solvent (polar or non-polar) or hotwater.
	Biological	Biodegradation	Cultivate microbes to degrade constituents by controlling moisture content, oxygen, pH, nutrients and temperature. Groundwater or air is recycled through the contaminated soil mass.

TABLE 3-5
TECHNOLOGY FOR SOIL/SEDIMENT (SOURCE CONTROL)
(Cont.)

SOIL/ SEDIMENT GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS	DESCRIPTION
In Situ Treatment (Con't)	Soil Vapor extraction	Vacuum extraction	Apply negative pressure to vadose zone well system and treat soil vapor off-gas (via carbon filter, biofilter, catalytic incinerator or thermal oxidizer.
		Radiowave volatilization	Apply radio frequency to soil, extract soil vapor and treat.
Removal	Excavation	Earthmoving/Excavation	Wheeled, bulk scraper, removes surficial or subsurficial soil into storage compartment.
Ex Situ Treatment	Biological	Aerobic	Microbes cultivated to degrade constituents under aerobic conditions. Includes composting, land farming and slurry reactors.
		Anaerobic	Microbes cultivated to degrade constituents under anaerobic conditions, typically an in-vessel process.
	Physical-Solidification	Pozzolan-portland cement	Pozzolan mixed with soil/sediment using auger type mechanism.
		Pozzolan-lime/flyash	Pozzolan mixed with soil/sediment using auger type mechanism.
	Physical-Solidification (con't)	Micro-encapsulation	High density polyethylene is mixed with soil/sediment to form plastic frit.
	Physical-Separation	Washing (wet separation)	Mix soil/sediment with water and wet-classify soil particles by size and density. Includes dry screening (grizzly, vibratory, trammel), attrition scrub, hydrocyclones, flotation, water treatment/recycle.
		Low temperature thermal desorption	Heat soil in an incinerator-like unit to drive off the volatile organics
		Magnetic classification	Soils subjected to magnetic field to remove ferrous metals.
	Oxidation-thermal	High temperature processes	Includes: electric reactor, fluid bed incinerator, molten salt, multi-hearth incinerator, rotary kiln incinerator, plasma arc incinerator and catalytic incinerator.
	Oxidation-other	Supercritical	Soil mixed with water and excess air under supercritical pressure and temperature.
		Chemical	Oxidizing agent such as hydrogen peroxide or potassium permanganate solution mixed into soil.
		Microwave plasma	Microwave frequency electromagnetic radiation applied to soil.

TABLE 3-5
TECHNOLOGY FOR SOIL/SEDIMENT (SOURCE CONTROL)
(Cont.)

SOIL/ SEDIMENT GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS	DESCRIPTION
Ex Situ Treatment (cont)	Chemical-extraction	Supercritical extraction	Constituents extracted in countercurrent process using carbon dioxide, propane or other highly volatile solvent under supercritical temperature and pressure conditions. Solvent is separated from extracted constituents (flashed or distilled) and recycled.
		Aqueous solvent	Constituents extracted using aqueous solvent such as acid, base, salt or surfactant solutions. Extracted soil is rinsed. Solvent and rinsewater treated and recycled.
	Chemical-extraction (cont)	Amine Extraction	Constituents extracted using secondary or tertiary amines, usually triethyl amine (TEA). TEA is completely soluble in water below 20°C. Seperation of TEA from solids are achieved by gravity and centrifuging. TEA is seperated from water by heating causing the TEA to be insoluble. TEA is recycled by distillation, leaving the extracted organics, usually an oily sludge. The sludge is then incinerated.
Disposal	Solids Handling	Backfill on-site	Reuse of treated soil as backfill in excavated areas.
		Subtitle D landfill	Disposal of soil that has been treated to remove toxicity hazard. Local or regional landfill, that accepts industrial solid waste (off-site or constructed on-site)
		RCRA Landfill	Disposal of soil, treated to remove toxicity hazard, in a RCRA hazardous waste landfill (off-site).

TABLE 3-6
TECHNOLOGY FOR GROUNDWATER REMEDIATION (MIGRATION CONTROL)

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS	DESCRIPTION
No-Action	None	Not applicable	No Action.
Institutional controls	Access Control	Fencing, Security	Access to site restricted by security force at access points. Perimeter patrolled daily.
		Wall and posting	Access to site is restricted by construction of a permanent, low-maintenance wall. Warning signs posted.
		Deed restrictions	Deed for property modified to restrict future sales and land use, or U.S. Government holds deed into perpetuity.
	Monitoring	Groundwater monitoring	Periodic sampling of groundwater to monitor changes in the extent of migration of potentially hazardous constituents.
	Alternative Water Supply	City water line or bottle water	Extend city supply line to area or provide trucked in water.
Containment	Horizontal barriers	Soil cap	Place two to five feet of clean fill on affected areas of the site, grade and seed.
		Clay cap	Add one to two foot clay layer beneath soil cap.
		Asphalt cap	Highway-grade base and asphalt pavement over affected areas of site.
Containment (cont)	Vertical barriers (cont)	Sheet pile	Steel barrier wall driven into soil in sections using a drop-hammer or vibrating hammer.
		Slurry wall	Trench around affected area and fill trench with cement/bentonite or soil/bentonite slurry.
		Grout Curtain	Pressure injection of grout in a regular pattern of drill holes.
		Vibrating beam	Drive steel beam into ground and inject slurry as beam is withdrawn.
Diversion	Vertical Barriers	Slurry wall	Trench around affected area and fill trench with cement/bentonite or soil/bentonite slurry.
		Grout Curtain	Pressure injection of grout in a regular pattern of drill holes.
		Vibrating beam	Drive steel beam into ground and inject slurry as beam is withdrawn.
		Interceptor trench	A trench is dug downgradient of the groundwater plume to divert the groundwater.
Collection		Interceptor trench	A trench is dug downgradient of the groundwater plume to collect the groundwater.
		Collector wells	Several wells are set up to capture the groundwater.

TABLE 3-6
TECHNOLOGY FOR GROUNDWATER REMEDIATION (MIGRATION CONTROL)
(Cont.)

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS	DESCRIPTION
In Situ Treatment	Biological	Aerobic	Cultivate microbes in aquifer to degrade constituents by controlling pH, and supplying oxygen and nutrients.
		Anaerobic	Cultivate microbes in aquifer to degrade constituents by controlling pH, and supplying oxygen and nutrients.
		Air sparging	Treatment combines in situ air stripping with aerobic biodegradation
On Site Treatment	Biological	Aerobic biodegradation (Activated sludge)	Cultivate aerobic microbes to degrade constituents by controlling oxygen, pH, nutrients and temperature.
		Anaerobic biodegradation	Cultivate methanogenic microbes to degrade constituents by controlling oxygen, pH, nutrients and temperature.
		Landfarming/spray irrigation	Promotes aerobic biodegradation by mixing the groundwater with soil, and controlling moisture, nutrients, and pH.
	Physical/chemical	Reverse osmosis	Membrane separation is used to remove organic and inorganic contaminants.
		Ultraviolet Oxidation	Organics are treated with a combination of UV light and an oxidizing agent (ozone or peroxide)
On Site Treatment (cont)	Physical/chemical (cont)	Reduction	Heavy metals are treated by inducing electrochemical reactions
		Neutralization	Metal hydroxide formed form dissolved species and settled-out of solution.
		Hydrolysis	Water and caustic are used to destroy organic contaminants.
		Wet air oxidation	Heat and pressure are used to degrade waste.
		Supercritical water oxidation	Organics are oxidized in a reactor using supercritical water as the oxidizing medium.
		Ion exchange	Aqueous solvent or rinsewater exposed to cationic and/or anionic resin bed where constituents are exchanged (captured on resin surface) with other species. Resin is regenerated.
		Air stripping	Organics are removed by transfer to the air phase.
		Steam stripping	Organics are removed by transfer to steam phase.
		Distillation	Groundwater is heated, and the organics are driven off and collected.

TABLE 3-6
TECHNOLOGY FOR GROUNDWATER REMEDIATION (MIGRATION CONTROL)
(Cont.)

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS	DESCRIPTION
On Site Treatment (cont)	Physical/chemical (cont)	Precipitation/coagulation/ flocculation	Various reagents are used to induce settling of particulates in the groundwater.
		Sedimentation/clarification/ gravity thickening	Separates water from metal hydroxide solids.
		Hardness Removal	Removes calcium and other minerals from groundwater.
		Filtration	Particulates are removed from the groundwater.
		Carbon adsorption - liquid phase	Solution exposed to activated carbon bed for removal of dissolved organic constituents. Carbon thermally regenerated with off-gas treatment.
		Carbon adsorption - vapor phase	Off-gas from air stripping unit is passed through carbon to remove organics from the air stream.
		Mechanical aeration	Aerators are used to transfer oxygen to the groundwater. Aeration also promotes the removal of volatile organics.
Treated water disposal	SPDES Permit	Surface water	Discharge treated wastewater to drainage ditch, with eventual flow to nearby surface water body.
		Groundwater	Reinject treated groundwater at site.
		SEDA POTW	Collect treated wastewater in tank truck, transport to on-site wastewater treatment plant and discharge.
	Reinjection	Groundwater	Treated water is reinjected via a leach field.

3.3.2.2 Capping In-Place

Capping the site can reliably seal the subsurface from the aboveground environment which could in turn reduce underground migration of wastes, and both prevent windburn dispersion of particulates and sediment transport via run-off. Caps can be constructed relatively quickly and if properly installed, will perform for at least 20 years. Unforeseen settling, invasions by burrowing animals and deep-rooted plants contribute to the need for periodic monitoring and maintenance of the cap. However, even with these long-term maintenance requirements, capping may still be considerably more economical than other remedial alternatives. In addition, it may only be necessary of advisable to cap significantly contaminated pads.

The designs of modern caps usually conform to the performance standards in 40 CFR 264.310, which addresses RCRA landfill closure requirements. These standards include minimum liquid migration through the wastes, low cover maintenance requirements, efficient site drainage, high resistance to damage by settling or subsidence, and a permeability lower than or equal or the natural soils.

Capping in-place involves leveling and grading the area of interest on the subject site, placing an impermeable cap over the area and placing a protective soil cap over the impermeable layer. The engineered cap will provide provisions to minimize erosion, control surface water runoff/runon, gas venting if required, and long term groundwater monitoring in accordance with the requirements of 6 NYCRR Part 360.

3.3.2.3 Excavation/Hauling/Landfilling

Excavation of hazardous materials is performed extensively for site remediation. Excavation is usually accompanied by on or offsite treatment or disposal in an on or off-site secured landfill. Excavation employs the use of bulldozers, front end loaders, back hoes, and other earth moving equipment to physically remove soil and buried materials. There are no absolute limitations on the types of waste which can be excavated and removed. However, worker health and safety weighs heavily in the decision to excavate explosive waste material. Other factors which will be considered include the mobility of the wastes, the feasibility of on-site containment, and the cost of disposing the waste or rendering it non-hazardous once it has been excavated. A frequent practice at hazardous waste sites is to excavate and remove contaminant "hot spots" and to use other remedial measures for less contaminated soils.

Excavation and removal can almost totally eliminate the contamination at a site and the need for long-term monitoring. Another advantage is that the time to achieve beneficial results can be short relative to such alternatives as in-situ bioremediation.

The biggest drawbacks with excavation, removal, and off-site disposal are associated with worker safety, cost, and institutional aspects. Where highly hazardous materials are present, excavation can pose a substantial risk to worker safety. Costs associated with off-site disposal are high and frequently result in the elimination of this alternative as a cost-effective alternative. Finally, institutional aspects can add significant delays to program implementation.

The construction of an on-site RCRA type hazardous waste landfill has been successfully used to manage contaminated soils at other CERCLA sites. However, landfilling of hazardous materials is becoming increasingly difficult and more expensive due to steadily growing regulatory control of this technology. Landfilling can usually be regarded as the least attractive alternative for a site cleanup action.

Removal has been retained as a general response action and consists of excavation using a backhoe or an excavator. A bulldozer may be used if necessary, to loosen the shale fill prior to loading into dumper trucks for on-site or off-site hauling. Loading could be done using one or two 5-cy bucket front-end loaders. The production rate is estimated to be 150 cy/hr/loader (225 ton/hr loader).

On-site hauling is estimated to be done at a rate of 100 cy/hr/dumper truck. Off-site hauling to a Subtitle D landfill is estimated to be done at a rate of 40 cy/day/truck (60 ton/day/truck).

3.3.2.4 Low Temperature Thermal Desorption

Thermal desorption, otherwise known as low-temperature thermal stripping, is a process in which the contaminated soil is heated in order to vaporize the organic contaminants. The vapor then passes through a series of air emission control units. The organic contaminants are treated with catalytic or thermal oxidation, or a carbon adsorption system. Unlike incinerators in which the soil is subjected to high temperatures and combustion in the primary chamber, thermal desorbers heat the soil at lower temperatures and combust the vapor in air pollution control equipment prior to discharge. In some instances, activated carbon can be substituted for a thermal oxidizer.

There are two major types of thermal desorbers currently available. One set relies on indirect heating. The soil and the heat transfer medium, generally a synthetic oil or a molten salt do not contact each other. The other type of unit, a direct-heated device, is similar to a rotary kiln incinerator. The soils are heated in the unit by a flame which directly contacts the soil. The flame is only hot enough to promote volatilization and not incineration. Indirectly heated units maintain the soil at a higher temperature, while directly fired units tend to have a higher throughput.

The type of unit required depends on the nature of the contaminants present and the treatment criteria.

The thermal desorber is operated in the range of 300°F to 850°F, depending on the type of unit and the nature of the contaminants. A higher temperature is necessary if PAHs and other petroleum hydrocarbons are present at the site. PAH and petroleum compounds have higher boiling points than volatile organic compounds. If a thermal oxidizer is used for combustion, the operating temperature in this chamber is usually in the range of 1,500°F to 2,200°F. The primary advantage to this system over incineration is that only the vaporized organics and water from the soil enter the combustion chamber, thus minimizing the operating costs.

Thermal desorption has been demonstrated effective for the removal of organics from contaminated soils. Thermal desorption has been used to treat soils contaminated with chlorinated hydrocarbons, petroleum hydrocarbons and PAHs to levels less than 10 mg/kg for total petroleum hydrocarbons and less than 0.1 mg/kg for specific chlorinated hydrocarbons. Thermal desorption is ineffective in removing metals, but the effluent from the thermal desorption unit could be stabilized prior to backfilling to prevent metals migration and to ensure that the treated soils meet the criteria for backfilling, if required.

There are potentially five effluents from this system: the treated soil, scrubber water, baghouse filters residuals, spent carbon canisters, and debris. If an afterburner is used, no spent carbon is generated. The scrubber water may be treated and sent to the local wastewater treatment plant or discharged into a nearby surface water body. The spent carbon can be thermally regenerated and reused. The soil can be either backfilled or sent off-site for disposal. The baghouse filters residual will be sent to an appropriate disposal facility.

Debris can be segregated, sized, and washed. Some debris will also be suitable for thermal desorption. The treated debris would then be disposed of on-site or sent off-site for additional treatment and disposal.

Air emissions controls are an integral part of these units. In addition to the organic controls, baghouses and scrubbers are often used. Scrubbers are used to remove acid gases, and baghouses are used to remove particulate matter. The use of scrubbers would not be required if it is unlikely that HCL emissions will exceed the 4 lbs/hr limit required by federal regulations. Scrubber effluent can be passed through a carbon system and reused. The exact configuration of the emissions controls depends on the design of the thermal desorber and the characteristics of the contaminated soil.

3.3.2.5 Soil Vapor Extraction

Soil Vapor Extraction (SVE) systems withdraw air through soil in order to extract volatile organic compounds. A vacuum apparatus is used to create negative pressure in the soil to accomplish this. Volatile constituents partition to the air in the soil and are subsequently recovered. Typical systems consist of a vacuum extraction well or wells, an air/water separator, a vacuum pump, a carbon adsorption canister (though a catalytic/thermal oxidizer or vapor condenser may also be used), and associated vacuum gauges.

The extraction wells may be either horizontal or vertical. Horizontal wells are generally more effective in situations where the contaminated soil is shallow (less than 10 feet deep).

SVE systems are generally used in unsaturated soils. Most sites at SEDA would require dewatering during certain periods of the year, such as the spring, when the water table rises to near the ground surface. This could be accomplished separately from the SVE system by using either trenches or extraction wells. However, the amount of water to be removed is likely to be small, since the overburden aquifer thickness at SEDA is generally thin and does not readily yield water; also the suction lift is only 10 to 15 feet. Therefore, it may be possible to simultaneously remove air and entrained water from the site using a strong vacuum system. Once the entrained water is separated from the air in an air/water separator, the water collected would be treated and discharged to either the nearby surface streams/drainage ditches or transported to the biological wastewater treatment plant.

3.3.2.6 Solidification/Stabilization

There are several solidification/stabilization technologies that may be feasible for remediation of site impacted by heavy metals; these are pending treatability testing. For the purposes of this report, Portland cement will be used as a typical solidification technology because it is one of the more standard approaches. Solidification/Stabilization is a process in which the waste material is mixed with; water, pozzolanic material such as Portland cement, and proprietary additives. Lime or fly ash are typical stabilization reagents that may be added. The treated waste material is allowed to solidify into a specific block-size having significant unconfined compressive strength, physical stability and rigid, cement-like texture. This process decreases constituent mobility by binding constituents into a leach-resistant, concrete-like matrix while increasing the waste material volume by approximately 50%. Solidification is expected to be completed at 75 ton/hour (tph) or about 50 cy/hr.

Solidification may be performed either on-site or off-site. For the purpose of cost estimating off-site solidification could be completed at a Resource Conservation and Recovery Act (RCRA) treatment, storage, disposal facility (TSDF) either 220 miles east of the site or 180 miles west of the site.

3.3.2.7 Soil/Sediment Washing

Soil washing is a water-based process for mechanically extracting soils to remove organic and inorganic pollutants. Soil washing is a treatment option especially applicable to soils contaminated with semi-volatile organics. In the process, soil is slurried with water and subjected to intense scrubbings. To improve the efficiency of soil washing, the process may include the use of surfactants, detergents, chelating agents or pH adjustment. The wash solution is then treated to remove the pollutants from solution after which it is recycled back to the soil washing process. In the case of in-situ soil flushing, the treated washing solution can be reinjected into the soil via a recirculation system. It has applicability for a wide variety of soil types and conditions, but is more effective for heterogeneous soils that are composed of a large fraction of coarse particles and a smaller fraction of fine particles. Certain site factors can limit the success of soil washing/flushing:

1. Highly variable soil conditions,
2. Low permeability (high silt or clay content) which will reduce percolation and leaching,

3. Chemical reactions with soil cation exchange and pH effects may decrease contaminant mobility and,
4. If performed in-situ, the groundwater flow must be well defined in order to recapture washing solutions.

Certain chemical contaminants of concern, such as semi-volatiles, tend to sorb to the fines or become entrained with the fines of the soil matrix, i.e. particles that are less than 0.25 mm. Since the fines are comprised of a large surface area and contain iron and manganese oxides, which are effective natural sorbents, the pollutants are strongly held during the washing process. Although the process does not effectively remove these pollutants from soil by dissolution, washing can be the first step in an effective treatment train since the washing process reduces the volume of soil that may require further treatment or disposal. Volume reduction by particle size separation is important because pollutants, once separated by washing, can be treated using various treatment schemes including a soil slurry bioreactor, acid extraction or solidification. Washing processes that separate the smaller fraction of fine clay and silt particles from the larger fraction of coarse sand and gravel soil particles can effectively separate and concentrate chemical constituents into a smaller volume of soil that can be further treated or disposed. The clean, larger fraction of coarse material can be returned to the site for continued use. Therefore, by employing a combination of physical separation techniques, the process of soil washing will decontaminate the large diameter fraction of soil and reduce the volume of waste material by causing constituents to be separated from the larger quantity of coarse particles and concentrate these materials into the smaller quantity of fine particles.

A number of unit processes are incorporated in any soil washing treatment train. Many of the processes used in soil washing utilize equipment and techniques that are typically used in the mining industry for material sizing operations. These sizing and washing processes are water intensive and therefore, water availability is an essential requirement. Variations in vendor soil washing schemes, equipment and washing solutions occur depending on the site conditions, and the cleanup goals. Many vendor processes include proprietary aspects that limit detailed descriptions of the process. In general, soil is first excavated and sized to remove oversized objects. The oversized objects are then washed in a separate process that may involve a high pressure spray washer. The remaining soil is slurried with clean make-up water and recycled process treatment water in a mixing trommel where coarse particles are removed. The soil slurry remaining is fed to a floatation unit where hydrophobic constituents are removed as a froth. The underflow can be mixed with washwater and extraction agents, such as detergents/surfactants, to remove contaminants by dissolution or suspension. Using a series of soil classification process equipment such as attrition machines, hydrocyclones, rotary screens and spiral classifiers, the remaining slurry is separated into a washed product and a fine fraction consisting of silts and clays. The silt and clay fraction that may still contain unwashed pollutants can then treated using biological techniques, solidification or be disposed of in an appropriate landfill.

Soil washing consists of many of the technologies listed on Table 3-5 including:

Physical-Separation

- dry screening (grizzly)
- dry screening (vibratory screen)
- wet trommel screens
- wet sieves
- attrition scrubber (wet)
- dense media separator (wet)
- hydrocyclone separators
- flotation separator
- gravity separators
- dewatering

Chemical-Extraction

- washwater treatment/recycle
- residual treatment and disposal
- treated water discharge

Biotrol is a commercially available soil washing process. Reduction of levels of metals ranged from 45-85%. The degree to which metals can be removed depends on the type of metallic compound, oxide, insoluble salt, etc. The data from the Biotrol treatability tests is not sufficient to draw any conclusions on the effectiveness of soil washing as a metal remover. However, removal of organics ranged between 90-99%. Total costs include mobilization and treatment costs. Costs for the disposal of residuals generated during soil washing must also be contended with. Costs are significantly lower for large volumes of soil.

The coarse fraction may typically be backfilled or otherwise reused as daily landfill cover while the fine fraction may be subsequently treated via technologies such as slurry bioreactors, acid extraction or solidification.

The throughput of a soil washing system can vary depending upon the vendor. Common throughput rates are between 15 to 20 tons/hr.

3.3.2.8 In-Situ Detoxification and Solidification

Since the disturbance and excavation of unstable explosive materials in soils is potentially extremely hazardous, some in-situ technologies have inherent advantages, since they do not require removal of the unstable explosive materials. For these technologies to be considered feasible, the majority of the materials to be detoxified must be already consolidated in a local area. For example, should the sampling data at a site indicate that the majority of the constituents of concern are localized, then in-situ processing will be considered. There are three (3) in-situ technologies which may be applied should site conditions be favorable. These are:

- In-situ vitrification
- In-situ radio frequency heating
- In-situ solidification.

In-situ vitrification involves vitrifying soil in place by the application of a high electric current. In-situ vitrification (ISV) uses an electrical network to melt soil or sludge at temperatures of 1,600 to 2,000°C, thus destroying organic pollutants by pyrolysis. Inorganic pollutants are incorporated within the vitrified mass, which has properties of glass. Both the organic and inorganic airborne pyrolysis byproducts are captured in a hood, which draws the contaminants into an off-gas treatment system that removes particulates and other pollutants of concern.

The vitrification process begins by inserting large electrodes into contaminated zones containing sufficient soil to support the formation of a melt. An array (usually square) of four electrodes are placed to the desired treatment depth in the volume to be treated. Because soil typically has low conductivity, flaked graphite and glass frit are placed on the soil surface between the electrodes to provide a starter path for electric current. The electric current passes through the electrodes and begins to melt soil at the surface. As power is applied, the melt continues to grow downward, at a rate of 1 to 2 inches per hour. Individual settings (each single placement of electrodes) may grow to encompass a total melt mass of 1,000 tons and a maximum width of 30 feet are considered possible. Depths of 17 feet have been achieved to date with the existing large scale equipment. Adjacent settings can be positioned to fuse to each other and to completely process the desired volume at a site. Stacked settings to reach deep contamination are also possible.

The large-scale system melts soil at a rate of 4 to 6 tons per hour. Since the void volume present in particulate materials (20-40% for typical soils) is removed during processing, a corresponding volume reduction occurs. Volume is further reduced as some materials present in the soil, such as humus and organic contaminants, are removed as gases and vapors during processing. After cooling, a vitrified monolith results, with a silicate glass and microcrystalline structure. This monolith possesses excellent structural and environmental properties.

For vitrification to be a viable treatment option, the waste must contain enough silica/alumina to provide the "glass structure" this limits in situ vitrification with low levels of organic, heavy metal, and other contaminants. Additionally, this technology is still somewhat experimental and has not been used in widespread applications.

Factors that will affect the applicability of this technology include:

1. The moisture content of soil influences energy cost;
2. The depth of soil to be vitrified;
3. The types and concentrations of the contaminants in the soil;
4. The vitrified soil is denser, therefore ground surface settles and must be filled; and
5. The high levels of organics and metals in some soils and the low oxygen levels above the melt could result in reduction of metal oxides, affecting the leachability of the "glass."

In-site radio frequency heating involves the application of radio frequency waves to soil. This technology has been successfully used to heat soil in place. Soil temperatures up to 350°F have been reached. Since many of the explosives expected to be present are relatively non-volatile, the addition of heat may provide a viable means to stimulate their removal as a vapor. The extracted vapors can be controlled by various control technologies such as catalytic incineration, incineration or carbon adsorption. As with in-situ vitrification, electrodes are installed in an isolated area, and radio frequency waves are applied to the soil. The technology heats soil in a manner similar to the way the microwave oven heats food. As with in-situ vitrification, this technology has not been used extensively.

In-situ solidification involves the formation of an in-place monolithic mass through the mixing of a pozzolantic or a siliceous material with the existing soil. Multi-axis overlapping hollow stem augers are used to inject solidification/stabilization (S/S) agents and blend them with contaminated soils in-situ. The augers are mounted on a crawler-type base machine. A batch mixing plant and raw materials storage tanks are also involved. The machine can treat 90 to 140 cubic yards of soil per 8-hour shift at depths up to 100 feet.

The product of the in-situ S/S technology is a monolithic block down to the treatment depth. since material is added to the soil a volume increase occurs which ranges from 10 to 30 percent, depending on the nature of the soil matrix and the amount of fixation reagents and water required for treatment. Solidification or stabilization is more effective when the material is excavated first, mixed and replaced. In-situ mixing can produce gaps and voids that would not occur if the material were excavated. However, if conditions are correct in-situ mixing can be successful in decreasing leaching of contaminants.

This technology is applicable to soils contaminated with metals and semivolatile organic compounds (pesticides, PCBs, phenols, PAHs, etc.). It should be noted that this technique has been used in mixing soil cement, or chemical grout for more than 18 years on various construction applications, including cutoff walls and soil stabilization and is widely applied.

3.3.2.9 Resource Reclamation

The amount of metals (i.e., copper, brass, lead and aluminum) on-site may warrant a resource reclamation program. This program could be in lieu of or in conjunction with the previously described options. The resource reclamation program would probably consist of the following operations:

- Bulk materials recovery
- Initial materials separation
- Explosive materials detonation
- Secondary materials separation and cleaning
- Smelting operations
- Purification and benefaction operations.

Many other unit operations such as water and wastewater treatment would also be required. Economic and technologic analyses would be used to determine the viability of this option.

3.3.2.10 Implementation of Institutional Controls

Institutional controls is a viable remedial alternative for most sites. An institutional control could be to have the future land use restricted, thereby preventing exposure due to dermal contact, etc. The land use restriction would prevent excavation, building, or construction in the area. The land use would be restricted in a legal document such as the deed for the property, so that if it were sold, it would be under the restrictions of the document. It is also possible to reclassify the on-site groundwater so that it could not be used as a source of potable water.

3.3.2.11 Composting

Composting is a biological process used typically for the treatment of wastes with a high concentration of biodegradable organic solids. The fate of inorganics (metals) is not completely understood. Compounds that have limited aqueous solubility are not readily metabolized by microorganisms. Composting is initiated by mixing biodegradable organic matter with organic carbon sources and bulking agents (to enhance the porosity of the mixture). The organic rich environment leads to intense microbial metabolic action, increasing the temperature. This self heating environment promotes more microbial activity, up to a certain temperature, at which point the microbial population begins to decline.

Materials and facilities required for composting are:

1. Biodegradable organic substrate;
2. Bulking agent;
3. Water;
4. Containment structure;
5. Mixing equipment; and
6. Means to provide oxygen.

There are three general levels of composting that exist. The lowest technological approach requires that the material is shaped into a pile and allowed to heat. Water and nutrients are added. Air exchange is generally poor, although the pile can be turned to increase aeration. Temperature control is also poor. In the second level, aeration is increased by providing perforated pipes under the pile. Attached blowers aid in aeration and cooling of the pile.

The third level is that of the enclosed composting pile with automated materials handling for aeration and cooling. With increased control over the process, cost obviously increases.

Successful composting of explosives and propellant contaminated soil in laboratory and pilot scale tests have been performed by USATHAMA. A field scale demonstration project was conducted at the Louisiana Army Ammunition Plant. (USATHAMA - Task Order 8, Field Demonstration - Composting of Explosives - Contaminated Sediments at LAPP - September 88). The results of this and other research projects of biotransformation and composting of 2,4,6TNT, RDX, HMX, and tetryl having determined the following:

1. TNT is microbially transformed, but not completely mineralized to inorganic products. High organic carbon concentrations, aerobic conditions and the presence of readily biodegradable substrates have enhanced the biotransformation of TNT. No conclusive evidence of aromatic ring cleavage exists. The nitro group reduction is usually catalyzed by microbes leading to biotransformation products that are strongly adsorbed to organic material.

2. Anaerobic conditions have been found to enhance RDX biotransformation. High TOC levels or low redox potential have been found to enhance RDX degradation in the presence of sufficient organic nutrients. When RDX degradation was incomplete, nitrous intermediates were produced.

3. Complete biodegradation of HMX has not been observed in aqueous or soil systems. However up to 53% removal has been observed. Partial HMX degradation is facilitated by anaerobic conditions. High TOC and low redox potential have been found to enhance HMX degradation also. Degradation products include mono and dinitroso products, methanol, and formaldehyde.

4. Tetryl biotransformation has little reported information. 80% to 90% of C^{14} tetryl initially spiked into compost was detected as an unextractable residue after 56 days.

Pathways of transformation for TNT, 2,4-DNT, and RDX are discussed more in Section 3.1.3.6. Parameters effecting composting efficiency include:

1. Temperature;
2. Moisture content;

3. Chemical and biological characteristics concentrations of substrate;
4. Concentrations of inorganic nutrients, nitrogen, phosphorus;
5. Heat production and retention of compost; and
6. Partial pressure of oxygen within the composting material.

Optimization of all of these parameters for each explosive has not been determined.

Composting has several characteristics which relate to its applicability to a particular situation. These include:

1. Material volume to be treated, space required;
2. Time requirement;
3. Level of contamination initially;
4. Level of contamination required; and
5. Transformation products.

Composting requires space and time, if the volumes of soil to be treated is large, this might make composting an unrealistic option. Composting has been used to treat highly contaminated soils with concentrations of explosives in the range of 10,000 mg/kg - 600,000 mg/kg. The final concentrations which were attained could be higher than the initial concentration of the waste at Seneca, making it an unreasonable treatment, or possibly altogether unnecessary.

Another possible application of biological treatment for soils in-situ bioreclamation. In-situ bioreclamation is used to treat contaminated areas that contain biodegradable organic compounds as a primary source of contamination. In-situ bioreclamation is more economical for soils with 10-10,000 ppm of contamination, with higher levels being more suitable for excavation and aboveground treatment, such as composting. In-situ bioreclamation has been more difficult at sites with environmental influences that slow microbial processes. High concentrations of metals and organics that are toxic to microbes being could be a potential problem. Hydrology at the site must allow for rapid and controlled movement of nutrient enriched water through the contaminated region. Success of this technology has been observed mostly in gasoline and other light hydrocarbons. It has not been applied to remediation or explosive material and would have little, if any, affect upon decreasing the concentration of heavy metals in soils.

3.3.2.12 Excavation/Incineration/Disposal

The Rotary Kiln Incinerator process was determined to be a success according to a program commissioned by USATHAMA. The results of the program were as follows:

1. A transportable incineration system could be disassembled, transported and reassembled and operational within 2 weeks;
2. 99.99% destruction efficiency in the kiln ash, 99.999% destruction efficiency in the fabric filters ash, no explosives detected in the stack gas;
3. Stack emissions in compliance with federal, state and local regulations including: SO_2, Hydrocarbons, NO_x, CO, and particulates; and
4. Ash residues were not hazardous from the standpoint of EP toxicity and reactivity.

The soils incinerated were from the Savanna Army Depot Activity (SADA) and the Louisiana Army Ammunition Plant (LAPP). The soils had very different characteristics. SADA soil was drier, sandier, had a higher TNT content, plus little or no HMX or RDX. LAPP soil was more moist, contained higher HMX and RDX concentrations and metals content.

The equipment required for a rotary kiln incineration system include the following:

1. Soil feed system;
2. Primary combustion chamber (rotary kiln);
3. Secondary combustion chamber (after burner);
4. Heat exchanger;
5. Fabric filter collector; and
6. Induced draft fan and stack.

Preliminary testing was done to establish maximum soil feed rates and minimum kiln temperatures to determine whether explosives breakthrough would be detectable in the stack gas or ash.

3.3.2.13 RCRA Subtitle D Landfill

The Subtitle D landfill refers to a solid waste landfill, either constructed on-site at SEDA, or an existing municipal landfill 10 to 40 miles from SEDA. Such a landfill would meet NYSDEC and EPA RCRA Subtitle D landfill construction specifications.

3.3.2.14 Off-site Treatment and Disposal

This technology consists of excavating the contaminated areas, segregating the different materials present (soil, debris, water, etc.), and disposing of each media off-site in an appropriate disposal facility. The contaminated on-site media which are not a RCRA listed waste, may be considered a characteristic hazardous waste. Each media would have to be tested prior to treatment and disposal.

3.3.3 Selected Remedial Technologies for Groundwater (Migration Control and Treatment)

The following technologies can be considered for evaluation as groundwater remedial alternatives:

- slurry wall;
- institutional controls;
- air sparging;
- interceptor trenches;
- hardness removal/precipitation;
- filtration;
- liquid-phase carbon;
- air stripping;
- UV oxidation;
- vapor-phase carbon;
- carbon adsorption;
- ion exchange; and
- Reverse Osmosis.

3.3.3.1 Slurry Wall

A slurry wall is a subsurface barrier used to divert or contain a groundwater plume. A slurry wall is constructed by digging a trench down to an impermeable or semi-impermeable zone, which at SEDA would be the competent shale. The trench is then filled in with bentonite, or some other impermeable material. Slurry walls generally require low maintenance, and are a proven technology in similar applications, providing the bottom of the slurry wall is "keyed" into an impermeable material. Slurry walls can be used to divert incoming clean water from a contaminated area or can be installed completely around the contaminated area, thereby isolating the area. If the area is totally isolated then either a cap must be installed or water must be removed, treated and discharged out of the isolated area. If water is not removed from the isolated area then infiltrating rainfall may cause mounding of groundwater within the slurry wall, leading to breakout at the surface.

3.3.3.2 Implementation of Institutional Controls

There are a number of institutional controls that may be implemented at the site, and may be a part of any long-term solution. Access to the sites at SEDA is limited by a fence that surrounds the entire Depot and by 24-hour security patrols.

Another type of institutional control is a deed restriction. This is more applicable as a source control measure, but could be used to indicate that no drinking water wells should be constructed at the site. Additionally, an alternative water supply could be provided for any future residences at the site that would normally rely on groundwater.

Groundwater monitoring is another institutional control. The monitoring program can be modified to account for the results of the remedial activities.

3.3.3.3 Air Sparging

Air sparging is a technique that uses a large number of wells to inject air and nutrients into the groundwater plume. The treatment uses a combination of air stripping and in-situ biological treatment. The system may be operated aerobically or anaerobically, depending on the nature of the contaminants. In an aerobic system, air or oxygen is injected. In an anaerobic system, methane is typically injected.

3.3.3.4 Interceptor Trenches

An interceptor trench is a 2- to 3-foot wide trench that is dug to a specified depth; at SEAD it would likely be dug to the top of the relatively-impermeable competent shale. The trench is lined with a geotextile that helps minimize the collection of fine soil particles that could clog the drainage system. A perforated PVC pipe is placed in the trench, and sloped to a low point collection sump. A number of sumps may be used depending on the natural slope and the length of the trench. The trench is then filled with gravel or some other highly permeable material. The top 1 to 2 feet of the trench can be backfilled with the removed soil in order to minimize inflow of rainwater. Interceptor trenches can be used to cut off the forward migration of a plume, or can be used in the middle of a plume as a collection device.

3.3.3.5 Hardness Removal/Precipitation

In general, all of the organic treatment processes considered for the groundwater at SEDA are subject to scaling, fouling, or plugging if the groundwater is high in hardness, alkalinity, iron, or other minerals. The groundwater at SEDA is fairly high in hardness and alkalinity, and some pretreatment of the water would be necessary to optimize the performance of an organic treatment unit.

3.3.3.6 Filtration

Filtration is another important unit operation. Filtration will remove silt and precipitated metals prior to the organic treatment unit. This will help the efficiency of the organic treatment unit and provide for a better discharge. A variety of filters have been used in groundwater remediations, including inline pressure filters, sand-bed filters, and multi-media bed filters. The specific filter used will depend upon the specifications of the organic treatment unit, and cost and maintenance considerations.

3.3.3.7 Liquid-Phase Carbon

Activated carbon is another common treatment technique used for groundwater remediation and has been shown to be very effective in treating TCE and 1,2-DCE. The groundwater after pretreatment is passed through carbon beds. The organic contaminants are adsorbed in the carbon and removed from the water. Over time, the adsorptive capacity of the carbon is diminished and the effluent concentrations will start to increase. At this point new carbon beds are installed and the spent carbon is sent offsite for regeneration or disposal.

3.3.3.8 Air Stripping

Air stripping is another common groundwater treatment process which is very effective in treating TCE and 1,2-DCE. The groundwater is passed through the stripping tower, where it is contacted by a countercurrent air stream. Trays or column packing is used to increase the surface area of the air/water contact. The organic constituents are transferred from the water to the air. Next, depending on the air emissions requirements, the air phase may be treated, or directly discharged. Vapor-phase activated carbon may be used to treat the air stream. The air passes through the carbon which, as described above, adsorbs the organic constituents. The spent carbon is then sent off site for regeneration or disposal.

3.3.3.9 UV Oxidation

UV Oxidation is a treatment technique that combines ultraviolet (UV) light with an oxidizing agent (peroxide and/or ozone) to destroy organic constituents. It is especially effective for chlorinated organics, such as TCE and 1,2-DCE. The water is mixed with peroxide, and then enters the UV reaction chamber. Ozone is added to the reaction chamber, and OH radicals are formed. The formation of the OH radicals is catalyzed by the UV light. The OH radicals react rapidly with the chlorinated organics, generating CO_2 and water. Any ozone not reacted is decomposed in an off-gas treatment unit prior to discharge.

3.3.3.10 Vapor-Phase Carbon

Vapor-phase carbon may be used in conjunction with a number of the other migration control technologies. The purpose of vapor-phase carbon is to treat the off-gas to minimize air emissions. Vapor-phase carbon is very efficient in capturing TCE and heavier organics. It is somewhat less efficient at capturing DCE, and lighter organics. Carbon is extremely inefficient in capturing vinyl chloride.

3.3.3.11 Carbon Adsorption

Carbon adsorption can be used to treat groundwater and surface water containing soluble organics and certain metals. Full scale experience indicates removals of aromatics, phenols, and PAH to 1ppb or less.

3.3.3.12 Ion Exchange

Ion exchange is a physical process that can be used to treat water contaminated with heavy metals and is potentially applicable to ionic organic compounds. Ion exchange can theoretically remove all of the selected ionic constituents if adequate resin contact time and proper resin is used.

3.3.3.13 Reverse Osmosis

Reverse osmosis can be used to treat contaminated pumped, groundwaters and surface waters. It has been used to remove metals and organics with a molecular weight greater than 200. Organics tend to cause fouling of membranes however. Also the process serves only to concentrate the contaminants which still then have to be disposed of.

3.4 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

3.4.1 Introduction

The 1986 Superfund Amendments and Reauthorization Act (SARA) adopted and expanded a provision of the 1985 National Contingency Plan (NCP) that remedial actions must at least attain compliance with applicable or relevant and appropriate requirements (ARARs) of other environmental and public health statutes when conducting remedial actions.

Applicable or relevant and appropriate requirements have been defined by the EPA as follows:

> "Applicable requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site." (Final NCP Rule, 55 FR 8814, March 8, 1990).

> "Relevant and appropriate requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site." (Final NCP Rule, 55 FR 8817, March 8, 1990).

ARARs typically fall into the following three classifications:

- Chemical-specific ARARs are health or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values of allowable soil, water, or air contamination. These concentration limits are specific for a hazardous substance, pollutant, or contaminant in the various environmental media. Examples of chemical specific ARARs include maximum contaminant levels (MCLs), federal ambient water quality criteria (AWQC), state water quality standards, and National Ambient Air Quality Standards (NAAQS).

- Location-specific ARARs are restrictions placed on the concentrations of hazardous substances or the conduct of activities solely because they are in specific locations. These requirements are described in environmental laws and regulations which control actions that may be required in performing a remedial action. For example, a section of the Clean Water Act contains prohibitions regarding the unrestricted discharge of dredged or fill material into wetlands. The filling of wetlands can sometimes be necessary if roads are required for mobilization of heavy equipment.

- Action specific ARARs are requirements and/or limitations on managing hazardous waste which may be generated as a result of a remedial action. These requirements and limitations are described in laws and regulations which govern the application of various technologies or activities at CERCLA sites. RCRA statutes, which primarily deal with hazardous waste management, generally contain the most action-specific requirements which are applied to CERCLA actions. New hazardous waste regulations, such as the RCRA corrective action regulations and the Land Ban restrictions, will be reviewed for their applicability to activities performed during a remedial action.

Identification and refinement of ARARs will occur throughout the remedial investigation and feasibility study. A preliminary identification of ARARs has been performed based upon the initial site characterization data compiled by the Army. In addition, several of the location specific ARARs have been evaluated as to their relevance and applicability. As more specific information is developed regarding the chemicals released on site, special site conditions, and potential use of various remedial technologies, additional ARARs will be selected and existing ARARs will be reviewed for their appropriateness.

3.4.2 Preliminary Identification of ARARs and TBCs

3.4.2.1 Potential ARARs

The following federal and state regulatory requirements are potentially applicable or relevant and appropriate to the subject site. Table 3-7, Sources of Chemical Specific ARARs, Table 3-8, Sources of Location Specific ARARs, and Table 3-9, Sources of Action Specific ARARs, are presented as a listing of state and federal regulations which have been considered as potential sources of ARARs.

The applicability of the chemical specific ARARs listed in Table 3-7 have been determined by the existing conditions at SEDA. The groundwater could be used as a drinking water supply since the State of New York has classified the groundwater as GA. Surface water on SEDA is classified by the State of New York.

Several available documents pertaining to SEDA have been reviewed to determine if the location specific ARARs of Table 3-8 have been complied with. The following summarizes the preliminary research.

According to the Fish and Wildlife Management Plan (July 1988) prepared by the U.S. Army Material Command, there are ten areas of SEDA which have been designated as freshwater wetlands by NYSDEC. A more detailed wetlands delineation will be performed as part of the terrestrial survey. It is possible that dredging and fill activities might take place on the site. ARARs pertaining to these activities have been included on Table 3-8.

The Installation Assessment of the Seneca Army Depot (January 1980) did not indicate that any endangered species were present at SEDA, but did indicate that the following endangered species are known to exist in the area: the Indiana Bat (Myots Sodalis) and the American osprey (Pandion halaietus carolinensis). The report also stated that since no large or deep permanent streams exist, protected aquatic species have not been considered and that the state-protected bog turtle (Clemmys muhlenbergi) dwells in marshy areas which are numerous in the area.

TABLE 3-7

SOURCES OF CHEMICAL SPECIFIC ARARS

Federal:

- Resource Conservation and Recovery Act (RCRA), Groundwater Protection Standards and Maximum Concentration Limits (40 CFR 264, Subpart F)
- Clean Water Act, Water Quality Criteria (Section 304) (May 1, 1987 - Gold Book)
- Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) (40 CFR 141.11-.16)

New York State:

- New York State Codes, Rules and Regulations (NYCRR) Title 6, Chapter X
- New York Groundwater Quality Standards (6 NYCRR 703)
- New York Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) (10 NYCRR 5)
- New York Surface Water Quality Standards (6 NYCRR 702)
- New York State Raw Water Quality Standards (10 NYCRR 170.4)
- New York RCRA Groundwater Protection Standards (6 NYCRR 373-2.6 (e))
- New York State Department of Environmental Conservation, Division of Water, Technical and Operational Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values, September 25, 1990
- Surface Water and Groundwater Classifications and Standards (6 NYCRR 700-705)
- Declaration of Policy, Article 1 Environmental Conservation Law (ECL)
- General Functions, Powers, Duties and Jurisdiction, Article 3 Environmental Conservation Law, Department of Environmental Conservation
- ECL, Protection of Water, Article 15, Title 5.
- Use and Protection of Waters, (6 NYCRR, Part 608)

TABLE 3-8

SOURCES OF LOCATION SPECIFIC ARARS

Federal:

- o Executive Orders on Floodplain Management and Wetlands Protection (CERCLA Floodplain and Wetlands Assessments) #11988 and 11990
- o National Historic Preservation Act (16 USC 470) Section 106 et seq. (36 CFR 800) (Requires Federal agencies to identify all affected properties on or eligible for the National Register of Historic Places and consult with the State Historic Preservation Office and Advisory Council on Historic Presentation)
- o RCRA Location Requirements for 100-year Floodplains (40 CFR 264.18(b)).
- o Fish and Wildlife Coordination Act (16 USC 661 et seq.) (Requires actions to protect fish or wildlife when diverting, channeling or modifying a stream)
- o Clean Water Act, Section 404, and Rivers and Harbor Act, Section 10, Requirements for Dredge and Fill Activities (40 CFR 230)
- o U.S. Army Corps of Engineers Regulations for Construction and Discharge of Dredged or Fill Materials in Navigable Waterway (33 CFR 320-330).
- o Wetlands Construction and Management Procedures (40 CFR 6, Appendix A).
- o USDA/SCS - Farmland Protection Policy (7CFR 658)
- o USDA Secretary's memorandum No. 1827, Supplement 1, Statement of Prime Farmland, and Forest Land - June 21, 1976.
- o EPA Statement of Policy to Protect Environmentally Significant Agricultural Lands - September 8, 178.
- o Farmland Protection Policy Act of 1981 (FPPA)(7 USC 4201 et se q).
- o Wild and Scenic Rivers Act (16 USC 1271).
- o Endangered Species Act (16 USC 1531).
- o Wilderness Act (16 USC 1131).

New York State:

- o New York State Freshwater Wetlands Law (ECL Article 24, 71 in Title 23).
- o New York State Freshwater Wetlands Permit Requirements and Classification (6 NYCRR 663 and 664).
- o New York State Floodplain Management Act and Regulations (ECL Article 36 and 6 NYCRR 500).
- o Endangered and Threatened Species of Fish and Wildlife Requirements (6 NYCRR 182).
- o New York State Flood Hazard Area Construction Standards.

TABLE 3-9
SOURCES OF ACTION SPECIFIC ARARS

Federal:

- RCRA Subtitle C Hazardous Waste Treatment Facility Design and Operating Standards for Treatment and Disposal systems, (i.e., landfill, incinerators, tanks, containers, etc.) (40 CFR 264 and 265); Minimum Technology Requirements.
- RCRA, Subtitle C, Closure and Post-Closure Standards (40 CFR 264, Subpart G).
- RCRA Groundwater Monitoring and Protection Standards (40 CFR, Subpart F).
- RCRA Generator Requirements for Manifesting Waste for Offsite Disposal (40 CFR 262).
- RCRA Transporter Requirements for Off-Site Disposal (40 CFR 263).
- RCRA, Subtitle D, Non-Hazardous Waste Management Standards (40 CFR 257).
- Safe Drinking Water Act, Underground Injection Control Requirements (40 CFR 144 and 146).
- RCRA Land Disposal Restrictions (40 CFR 268) (On and off-site disposal of excavated soil).
- Clean Water Act, - NPDES Permitting Requirements for Discharge of Treatment System Effluent (40 CFR 122-125).
- Effluent Guidelines for Organic Chemicals, Plastics and Resins (Discharge Limits) (40 CFR 414).
- Clean Water Act Discharge to Publically - Owned Treatment Works (POTW) (40 CFR 403).
- DOT Rules for Hazardous Materials Transport (49 CFR 107, 171.1-171.500).
- Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities (29 CFR 1904, 1910, 1926).
- SARA (42 USC 9601)
- OSHA (29 CFR 1910.120)
- Clean Air Act (40 CFR 50.61)

New York State:

- New York State Pollution Discharge Elimination System (SPDES) Requirements (Standards for Stormwater Runoff, Surfacewater, and Groundwater discharges (6 NYCRR 750-757).
- New York State RCRA Standards for the Design and Operation of Hazardous Waste Treatment Facilities (i.e., landfills, incinerators, tanks, containers, etc.); Minimum Technology Requirements (6 NYCRR 370-373).
- New York State RCRA Closure and Post-Closure Standards (Clean Closure and Waste-in-Place Closures) (6 NYCRR 372).
- New York State Solid Waste Management Requirements and Siting Restrictions (6 NYCRR 360-361), and revisions/enhancements effective October 9, 1993.
- New York State RCRA Generator and Transporter Requirements for Manifesting Waste for Off-Site Disposal (6 NYCRR 364 and 372).

Recent telephone conversations with state and federal wildlife specialists suggest that the presence of endangered species or critical habitats is unlikely at SEDA. The U.S. Fish and Wildlife Service has indicated in a letter (Appendix D) that there are no critical habitats or endangered or threatened species in the SEDA area, although some transient species may occur and that there are Bald Eagles (Haliaeetus Leucocephalus) nesting at the Montezuma National Wildlife Refuge (personal communication: Paul Nickerson and Mark Clough, U.S. Fish and Wildlife Service). According to the National Heritage Program of NYSDEC, there are no state listed endangered or threatened species in the general area of SEDA (personal communication: Burrel Buffington, Information Officer, National Heritage Program).

Preliminary information has been reviewed concerning the applicability of the Wild and Scenic Rivers Act to SEDA. Those rivers which have been designated as wild and scenic in accordance with the Act are listed in 16 U.S.C. 1271. According to the administering agency, the National Park Services, there are no designated rivers located within the Seneca region (personal communication: Phil Huffman, National Park Service). The State of New York has similar state legislation, the Wild, Scenic and Recreation Rivers Act. According to the Lands and Forests Division of the Department of Environmental Conservation (NYSDEC), the nearest state designated river is the Genesee River, approximately 45 miles to the west.

The appropriate Flood Insurance Rate Map (FIRM) of the Federal Emergency Management Agency (FEMA) will be consulted. Based on information contained on Panel 5, Town of Varikc, New York, Seneca County (Community Panel Number 360758 0005 B). The entire northern half of the Depot is not subject to flooding and is located within "areas determined to be outside the 500-year flood plain" (Zone X).

The U.S. Fish and Wildlife Service administers the Wilderness Act and the National Wildlife Refuge System. Through review of the NY statewide comprehensive plan, it has been determined that there are no areas protected by the Wilderness Act in the State of New York. The nearest National Refuge, Montezuma National Wildlife Refuge, is located approximately 20 miles to the northeast of the Seneca Army Depot.

In order to determine if the National Historic Preservation Act should be considered a location specific ARAR, An Archeological Overview and Management Plan for Seneca Army Depot (September 1986) was obtained and reviewed. According to this document, four prehistoric archeological sites are known to exist at SEDA and 231 potential historic archeological sites were identified based on documentary sources. According to the report, no specific historic sites are recorded at SEDA and, according to an earlier report, Historical Report on Seneca Army Depot, 1972 Heraldic Section, DARCOM there are no sites worthy of inclusion on the National Register.

The nearest known archeological sites the potential historic archeological sites and will be determined for the subjects site.

Action specific ARARs are listed because of the potential for various kinds of treatment. The action specific ARARs used in conjunction with chemical specific ARARs will be considered in evaluating technologies early in the planning process.

3.4.2.2 Potential Sources of Items "To Be Considered" (TBC) as Alternative Sources of ARARs

When ARARs do not exist for a particular chemical or remedial activity or when the existing ARARs are not protective of human health or the environment, other criteria, advisories and guidance may be useful in designing and selecting a remedial alternative. The criteria, advisories and guidance were developed by EPA, other Federal agencies, and state agencies. Table 3-10 lists Potential Sources of Items "To Be Considered" as Alternatives for ARARs.

3.4.2.3 Potential Chemical-Specific ARAR and TBC Levels

A preliminary evaluation of the site conditions indicates the media of potential concern are groundwater, surface water, and soil. The following tables provide numerical listings of potential chemical-specific ARARs and TBCs for the constituents detected at the site during previous investigations. Table 3-11, Preliminary Identification of ARARs for Groundwater, and Table 3-12, Preliminary Identification of ARARs for Surface Water, summarize the potential chemical-specific ARARs for groundwater. As an additional source of ARARs, records of decisions (RODs) from similar sites will be examined to obtain ARARs clean-up levels which may be considered.

3.5 DATA QUALITY OBJECTIVES (DQO)s

Ultimately, the RI/FS process requires decisions regarding future site remedial actions, including whether or not any actions are required. These decisions will be based upon the data collected during the RI. Consequently, the collected data must be of sufficient quantity

TABLE 3-10
POTENTIAL SOURCES OF ITEMS "TO BE CONSIDERED" AS ALTERNATIVES FOR ARARS

Federal:

- Safe Drinking Water Act National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs).
- Proposed Maximum Contaminant Levels (50 Federal Register 46936-47022, November 13, 1985).
- Proposed Maximum Contaminant Levels Goals (50 Federal Register 46936-47022, November 13, 1985).
- Proposed Requirements for Hybrid Closures (combined waste-in-place and clean closures) (52 Federal Register 8711).
- USEPA Drinking Water Health Advisories, long-term only.
- USEPA Health Effect Assessment (HEAs).
- TSCA Health Data.
- Toxicological Profiles, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.
- Policy for the Development of Water-Quality-Based Permit Limitations for Toxic Pollutants (49 Federal Register 9016).
- Cancer Assessment Group (National Academy of Science) Guidance.
- Groundwater Classification Guidelines.
- Groundwater Protection Strategy.
- Waste Load Allocation Procedures.
- Fish and Wildlife Coordination Act Advisories.
- Federal Guidelines for Specification of Disposal Site for Dredged or Fill Material.
- USEPA Interim Guidance for Establishing Soil Lead Clean Up Levels.
- RCRA Clean-Up Criteria for Soils/Groundwater (RFI Guidance), EPA 530-SW-89-031.

New York State:

- New York State Proposed Safe Drinking Water Standards Maximum Contaminant Levels for VOCs (10 NYCRR 5).
- New York State Underground Injection/Recirculation at Groundwater Remediation Sites (Technical Operating Guidance (TOG) Series 7.1.2).

TABLE 3-1
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- o New York State Analytical Detectability for Toxic Pc
- o New York State Toxicity Testing for the SPDES Permit
- o New York State Regional Authorization for Temporary Dis
- o Sediment Criteria - December, 1989 - Used as Guidance
Protection, Division of Fish and Wildlife, New York State
Conservation.
- o New York State, Division Technical and Administrative Guidance M
and Wildlife Impact Analysis for inactive Hazardous Waste Sites; Oc
- o New York State, Division Technical and Administrative Guidance M
Determination of Soil Cleanup Objectives and Cleanup Levels, November
- o New York State, Division Technical and Administrative Guidance Memorandu
of Inactive Hazardous Waste Disposal Site Numbers, February 1987, (HWR-400
- o New York State, Division Technical and Administrative Guidance Memorandum (
Preparation of Annual "Short List" of Prequalified Consultants, January 1993, (HWR-40

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- o New York State, Division Technical and Administrative Guidance Memorandum (TAG
Guidelines for Entries to the Quarterly Status Report of Inactive Hazardous Waste Disposal Sites, May 1987, (HWR-4003).
- o New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Guidelines for Classifying Inactive Hazardous Waste Disposal Sites, June 1987, (HWR-4004).
- o New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Insurance Requirements for Consultant and Construction Contracts and Title 3 Projects, September 1989, (HWR-4005).
- o New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Consultant Contract Overhead Rates and Multipliers, April 1988, (HWR-4006).
- o New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Phase II Investigation Generic Workplan, May 1988, (HWR-4007).
- o New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Phase II Investigation Oversight Guidance, November 1990, (HWR-4008).
- o New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Team Submissions in Responding to Requests for Proposals and Title 3 Projects, June 1992, (HWR-4009).
- o New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Roles and Responsibilities of the NYSDEC Regional Offices, January 1992, (HWR-4010).
- o New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Contractor/Consultant Oversight Guidance - O&D Memo #88-26, July 1988, (HWR-4011).

- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Roles and Responsibilities of the Technology Section - Site-Specific Projects, April 1990, (HWR-4029).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Selection of Remedial Actions at Inactive Hazardous Waste Sites, May 1990, (HWR-4030).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites, October 1989, (HWR-4031).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Disposal of Drill Cuttings, November 1989, (HWR-4032).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Inactive Sites Interface with Sanitary Landfills, December 1989, (HWR-4033).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Guidelines for Eligibility Determination for Work Performed Under the EQBA Title 3 Provisions, January 1900, (HWR-4034).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Project Manager and Contract Manager Responsibilities Under Standby Contract, March 1990, (HWR-4034).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Landfill Regulatory Responsibility, March 1990, (HWR-4036).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Major Milestone Dates for Tracking Remedial Projects, April 1990, (HWR-4037).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Remediation of Inactive Hazardous Waste Disposal Sites, April 1990, (HWR-4038).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Contract Appeals, October 1990, (HWR-4039).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Permitting Jurisdiction Over Inactive Hazardous Waste Site Remediation - O&D Memo #94-04, March 1994, (HWR-4040).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Releasing Sampling Data, Findings and Recommendations, February 1991, (HWR-4041).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Interim Remedial Measures, June 1992, (HWR-4042).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Procedures for Handling RPP-Funded PSAs, February 1992, (HWR-4043).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Accelerated Remedial Actions at Class 2, Non-RCRA Regulated Landfills, March 1992, (HWR-4044).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Enforcement Referrals, July 1992, (HWR-4045).

- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Determination of Soil Cleanup Objectives and Cleanup Levels, January 1994, (HWR-4046).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Priority Ranking System for Class 2 Inactive Hazardous Waste Sites, December 1992, (HWR-4047).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Interim Remedial Measures-Procedures, December 1992, (HWR-4048).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Referral of Sites to the Division of Water, December 1992, (HWR-4049).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Payment Review Process, April 1993, (HWR-4050).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Early Design Strategy, August 1993, (HWR-4051).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Administrative Records and Administrative Record File, August 1993, (HWR-4052).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Obtaining Property Access for Investigation, Design, Remediation and Monitoring/Maintenance, September 1993, (HWR-4053).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Contract Conceptual Approval Process, November 1994, (HWR-4054).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Contract Final Approval Process, November 1994, (HWR-4055).
- New York State, Division Technical and Administrative Guidance Memorandum (TAGM): Remedial Action by PRPs, April 1995, (HWR-4056).

Table 3-11
Preliminary Identification of ARARs for Analytes/Parameters in Groundwater and Surface Water at SEDA

Analytes/Parameters	Federal Safe Drinking Water Act (a)			New York State Standards		Federal AWQC to Protect Human Health (c)		Federal AWQC to Protect Aquatic Life (c)		New York State AWQ Standards - Surface Water Class AA (d)		Laboratory Reporting Limits (z)
	MCLs (a)	MCLGs (a)	Secondary MCLs (a)	DWQS (b)	GWQS (d)	W & AO	AO	Acute	Chronic	Aquatic	Human Health	
Conductivity (umho/cm)	NA	NA	NA	NA								
pH (standard units)	NA	NA	6.5-8.5	NA	6.5-8.5	5-9			6.5-9	6.5-8.5	6.5-8.5	
Alkalinity (mg/L as CaCO3)	NA	NA	NA	NA					20			
Total Dissolved Solids (mg/L)	NA	NA	500	NA	500	250				500	500	
Common Anions (mg/L)		**mg/l**		**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**
Bromide	NA	NA	NA	NA								
Chloride	NA	NA	250	250	250 WS			860	230		250 WS	
Fluoride	4	4	2	2.2	1.5 WS					q	1.5 WS	0.1
Nitrate (as nitrogen)	10	10	NA	10	10 WS	10					10 WS	0.01
Nitrite (as nitrogen)	1	1	NA	1	10 WS							
Sulfate	500	500	250	250	250 WS						250 WS	
Metals (mg/L)		**mg/l**		**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**
Aluminum	NA	NA	0.05-0.2			e	e	e	e	0.1		0.2
Antimony	0.006	0.006	NA			0.014 *	4.3 *	0.088 p	0.03 p			0.06
Arsenic	0.05	0.05	NA	0.05	0.025 WS	1.80E-05 *	1.75E-05	0.36 g	0.19 g	0.19	0.05	0.01
Barium	2	2	NA	2	1 WS	1					1 WS	0.2
Beryllium	0.004	0.004	NA			3.70E-06	6.41E-05	0.13	0.0053	r	1.1	0.005
Cadmium	0.005	0.005	NA	0.05	0.01 WS	0.01		0.0039 h	0.0011 h	h		0.005
Calcium	NA	NA	NA									5
Chromium (VI)	0.1 f	0.1 f	NA	0.1	0.05 WS					0.011		
Chromium (III)	0.1 f	0.1 f	NA	0.1	0.05 WS	33 *	670 *	1.7 h	0.21 h	s	0.05 WS	0.01
Cobalt											0.005	
Copper	1.3 w	1.3	1		0.2 WS			0.018 h	0.012 h	y	0.2 WS	0.025
Cyanide	0.2	0.2	NA		0.1 WS	0.2	220 *	0.022	0.0052	0.0052	0.1 WS	0.01
Iron	NA	NA	0.3	0.3	0.3 WS	0.3			1	0.3	0.3 WS	0.1
Lead	0.015 w	0	NA		0.025 WS	0.05		0.082 h	0.0032 h	u	0.05 WS	0.003
Magnesium	NA	NA	NA								35 WS	5
Manganese	NA	NA	0.05	0.3	0.3 WS	0.05	0.1				0.3 WS	0.015
Mercury	0.002	0.002	NA	0.002	0.002 WS	1.40E-04 *	1.46E-04	0.0024	1.20E-05		0.002 WS	0.0002
Nickel	0.1	0.1	NA			0.0134	0.1	1.4 h	0.16 h	v		0.04
Phosphorus						NA	NA	NA	NA			
Potassium												5
Selenium	0.05	0.05	NA	0.01	0.01 WS	NA	NA	0.02	0.005	0.001	0.01 WS	0.005
Silver	NA	NA	0.1	0.05	0.05 WS	9.2E-04 y	0.05	4.1 h, 9.2E-4 y		0.0001	0.05 WS	0.01
Sodium	NA	NA	NA	No Limit	20 WS							5
Thallium	0.002	0.0005	NA			0.0017 *	0.0063 *	1.4	0.04	0.008		0.01
Vanadium	NA	NA	NA							0.014		0.05
Zinc	NA	NA	5	5	0.3 WS		10	0.12 h	0.11 h	x		0.02

Table 3-11
Preliminary Identification of ARARs for Analytes/Parameters in Groundwater and Surface Water at SEDA

Analytes/Parameters	Federal Safe Drinking Water Act (a)			New York State Standards		Federal AWQC to Protect Human Health (c)		Federal AWQC to Protect Aquatic Life (c)		New York State AWQ Standards - Surface Water Class AA (d)		Laboratory Reporting Limits (z)
	MCLs (a)	MCLGs (a)	Secondary MCLs (a)	DWQS (b)	GWQS (d)	W & AO	AO	Acute	Chronic	Aquatic	Human Health	
Petroleum Hydrocarbons (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.001
Volatile Organics (ug/L)	ug/L			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone				50 o	50 o							10
Benzene	5	0	NA	5 i	0.7 WS	0.66	40	5300	NA	5 i	0.7 WS	5
Bromodichloromethane	100 j	0	NA	100 j		0.27 *	2.2 *	NA	NA			0.5
Bromoform	100 j	0	NA	100 j		4.3 *	360 *	NA	NA			5
Carbon tetrachloride	5	0	NA	5 i	5 WS	0.25 *	4.4 *	35200	NA	5 i		5
Carbon disulfide				50 o	50 o							
Chlorobenzene				5 i	5 i	480	21000 *	250 l	50 l	5	20 WS	5
Chloroform	100 j	0	NA	100 j	7 WS	0.19	15.7	28,900	1,240		7 WS	5
Chloroethane	NA	NA	NA	5 i	5 i					5 i		10
Chloromethane	NA	NA	NA	5 i	5 i					5 i		10
Dibromochloromethane				100 j		0.41	34					5
Dichlorodifluoromethane	NA	NA	NA									0.5
1,1-Dichloroethane	NA	NA	NA	5 i	5 i					5 i		5
1,2-Dichloroethane	5	0	NA	5 i	5 i	0.38 *	99 *	118,000	20000	5 i	0.3 WS	0.5
1,1-Dichloroethene	7	7	NA	5 i	5 i	0.057	3.2	11,600 m		5 i		5
cis-1,2-Dichloroethene	70	70	NA	5 i	5 i	NA	NA	11,600 m		5 i		0.5
trans-1,2-Dichloroethene	100	100	NA	5 i	5 i	700 *	NA	11,600 m		5 i		0.5
1,2-Dichloropropane	5	0	NA	5 i	5 i	0.52	39			5 i		5
cis-1,3-Dichloropropene				5 i	5 i	10 n*	1,700 n*	6,060 n	244 n	5 i		5
trans-1,3-Dichloropropene				5 i	5 i	10 n*	1,700 n*	6,060 n	244 n	5 i		5
Diethylether												
Ethylbenzene	700	700	NA	5 i	5 i	1400	3,280	32,000		5 i		5
Methylene chloride	5	0	NA	5 i	5 i	4.7 *	1,600 *			5 i		5
Methyl ethyl ketone	NA	NA	NA									10
Methyl isobutyl ketone												
1,1,2,2-Tetrachloroethane	NA	NA	NA	5 i	5 i	0.17	10.7		2,400	5 i		5
Tetrachloroethene	5	0	NA	5 i	5 i	0.8	8.85	5,280	840	5 i		5
Toluene	1000	1000	NA	5 i	5 i	6,800 *	200,000 *	17,500		5 i		5
1,1,1-Trichloroethane	200	200	NA	5 i	5 i	18,400	1,030,000			5 i		5
Trichloroethene	5	0	NA	5 i	5 i	2.7	80.7	45,000	21,900	5 i		5
Trichlorofluoromethane												0.5
Vinyl chloride	2	0	NA	2	2 WS	2	525					10
Xylenes (total)	10000	10000	NA	5 i	5 i	NA	NA	NA	NA	5 i		5

Table 3-11
Preliminary Identification of ARARs for Analytes/Parameters in Groundwater and Surface Water at SEDA

Analytes/Parameters	Federal Safe Drinking Water Act (a)			New York State Standards		Federal AWQC to Protect Human Health (c)		Federal AWQC to Protect Aquatic Life (c)		New York State AWQ Standards - Surface Water Class AA (d)		Laboratory Reporting Limits (z)
	MCLs (a)	MCLGs (a)	Secondary MCLs (a)	DWQS (b)	GWQS (d)	W & AO	AO	Acute	Chronic	Aquatic	Human Health	
Semivolatile Organics (ug/L)	ug/L			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Phenol				50 o	1 WS	3,500	4,600,000	10,200	2,560		1 WS	10
2-Methylphenol				5 i	5 i					5 i		10
2-Chloronapthalene				50 o	10 WS	1,700 *	4,300 *					10
2,4-Dimethylphenol				5 i	5 i	540 *	2,300 *	2,120		5 i		10
4,6-Dinitro-2-methylphenol				5 i	5 i					5 i		50
4-Chloroaniline				50 o	50 o							10
4-Methylphenol				5 i	5 i					5 i		10
4-Nitroaniline												50
1,2-Dichlorobenzene	600	600	NA	5 i	4.7 WS	2,700 *	17,000 *		763	5		10
1,3-Dichlorobenzene	600	600	NA	5 i	5 i	400 *	2,600 *	1120	763	5	20 WS	10
1,4-Dichlorobenzene	75	75	NA	5 i	4.7 WS	400 *	2,600 *	1120	763	5	30 WS	10
1,2,4-Trichlorobenzene	70	70	NA	50 o	50 o	488 1*		250 1	50 1	5	10 WS	10
Acenaphthene	NA	NA	NA	50 o	50 o	1,200 *	2,700 *	1,700	520			10
Anthracene	NA	NA	NA	50 o	50 o	1.2E-04 *	5.4E-04 *					10
Benz(a)anthracene	NA	NA	NA	50 o	50 o	2.8E-03	3.11E-02					
Benzo(b)fluoranthene	NA	NA	NA	50 o	50 o			NA	NA			10
Benzo(k)fluoranthene	NA	NA	NA	50 o	50 o	2.8E-03 *	3.11E-02 *	NA	NA			10
Benzo(g,h,i)perylene	NA	NA	NA	50 o	50 o							10
Benzo(a)pyrene	0.2	0	NA	50 o	ND WS	2.8E-03 *	3.11E-02 *	NA	NA			10
Benzoic Acid				5 i	5 i					5 i		50
Butylbenzylphthalate	NA	NA	NA			3,000 *	5,200 *	NA	NA			10
Chrysene	NA	NA	NA	50 o	50 o	2.8E-03 *	3.11E-02 *	NA	NA			10
Dibenz(a,h)anthracene						2.8E-03 *	3.11E-02 *	NA	NA			10
Dibenzofuran				50 o	50 o							10
Diethylphthalate	NA	NA	NA			23,000	120,000	NA	NA			10
Di-ni-octylphthalate												10
Fluoranthene				50 o	50 o	42	54	3980	NA			10
Fluorene	NA	NA	NA	50 o	50 o	2.8E-03 *	3.1E-02 *	NA	NA			10
Hexachlorobenzene	1	0	NA	5 i	0.35 WS	7.2E-04	7.4E-04	6 y	3.68 y	5 i		10
Indeno(1,2,3-c,d)pyrene	NA	NA	NA	50 o	50 o	2.8E-03 *	3.11E-02 *	NA	NA			10
Isophorone				50 o	50 o	8.4 *	600 *					10
2-Methylnaphthalene				50 o	50 o							10
N-Nitrosodiphenylamine						4.9	16 *	NA	NA			10
Naphthalene	NA	NA	NA	50 o	50 o	NA	NA	2300	620		10 WS	10
Phenanthrene	NA	NA	NA	50 o	50 o	NA	NA	30 y	6.3 y			10
Pyrene	NA	NA	NA	50 o	50 o	2.8E-03 *	3.11E-02 *	NA	NA			10
Dibutylphthalate	NA	NA	NA		50 WS	2,700	12,000					10
bis(2-Ethylhexyl)phthalate					50 WS					0.6		10
Pentachlorophenol				1		0.28 *	8.2 *					50

Table 3-11
Preliminary Identification of ARARs for Analytes/Parameters in Groundwater and Surface Water at SEDA

Analytes/Parameters	Federal Safe Drinking Water Act (a)			New York State Standards		Federal AWQC to Protect Human Health (c)		Federal AWQC to Protect Aquatic Life (c)		New York State AWQ Standards - Surface Water Class AA (d)		Laboratory Reporting Limits (z)
	MCLs (a)	MCLGs (a)	Secondary MCLs (a)	DWQS (b)	GWQS (d)	W & AO	AO	Acute	Chronic	Aquatic	Human Health	
PCBs/Pesticides (ug/L)	ug/L			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
PCBs	0.5	0	NA	0.5	0.1 WS	7.90E-05	7.90E-05	2	0.014	0.001	0.01 WS	
Aroclor-1254	0.5	0	NA	0.5	0.1 WS	4.40E-05 *	4.50E-05 *	2	0.014			1
Aroclor-1260	0.5	0	NA	0.5	0.1 WS	4.40E-05 *	4.50E-05 *	2	0.014			1
Aldrin	NA	NA	NA	5 i	0.001 B	7.40E-05	7.90E-05	3		5 i		0.05
alpha-Chlordane	NA	NA	NA	5 i	5 i					5 i		0.5
beta-BHC				5 i	5 i					5 i		0.05
Bromacil	NA	NA	NA		4.4 WS							
Chlordane	2	0		2	0.1 WS	4.6E-04	4.8E-04	2.4	0.0043			0.5
p,p'-DDD					ND	8.3E-04 *	8.4E-04 *	0.6	NA	0.001	0.01 WS	0.1
p,p'-DDE					ND	5.9E-04 *	5.9E-04 *	1050	NA	0.001	0.01 WS	0.1
p,p'-DDT					ND	2.4E-05	2.4E-05	1.1	0.001	0.001	0.01 WS	0.1
Dieldrin	NA	NA	NA		ND WS	7.1E-05	1.4E-04 *	2.5	0.0019		0.001 B	0.1
Endosulfan				NA		74	159	0.22	0.056	0.009		
Endosulfan I				NA		74	159	0.22	0.056	0.009		0.05
Endosulfan II				NA		74	159	0.22	0.056	0.009		0.1
Endosulfan sulfate						0.93 *	2 *	NA	NA			0.1
Endrin	2	2	NA	0.2	ND WS	0.76 *	0.81 *	0.18	0.0023		0.2 WS	0.1
Endrin aldehyde						0.76 *	0.81 *	NA	NA			
gamma-BHC (Lindane)	0.2	0.2	NA	5 i	5 i					5 i		0.05
Heptachlor	0.4	0	NA	0.4	ND	2.1E-04 *	2.1E-04 *	0.52	0.0038	0.001	0.009 WS	0.05
Heptachlor epoxide	0.2	0	NA	0.2	ND	1.0E-04 *	1.1E-04 *	0.52	0.0038	0.001	0.009 WS	0.05
Methoxychlor				40								0.5
Toxaphene				3								1
Chlorinated Herbicides (ug/L)	ug/L			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
2,4-D	70	70	NA	50								0.029
2,4-DB				50 o	50 o							0.029
2,4,5-T	NA	NA	NA	50 o	50 o							0.029
2,4,5-TP (Silvex)	50	50	NA	10								0.029
Dalapon	200	200	NA	50 o	50 WS							0.029
Dicamba	NA	NA	NA	5 i	0.44 WS					5 i		0.029
Dichloroprop				50 o	50 o							0.029
Dinoseb	7	7		5 i	5 i					5 i		0.029
MCPA				50 o	50 o							0.588
MCPP				50 o	50 o							0.588

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Preliminary Identification of ARARs for Analytes/Parameters in Groundwater and Surface Water at SEDA

Analytes/Parameters	Federal Safe Drinking Water Act (a)			New York State Standards		Federal AWQC to Protect Human Health (c)		Federal AWQC to Protect Aquatic Life (c)		New York State AWQ Standards - Surface Water Class AA (d)		Laboratory Reporting Limits (z)
	MCLs (a)	MCLGs (a)	Secondary MCLs (a)	DWQS (b)	GWQS (d)	W & AO	AO	Acute	Chronic	Aquatic	Human Health	
Explosives (ug/L)	**ug/L**			**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
HMX	NA	NA	NA	50 o	50 o							13
RDX	NA	NA	NA	50 o	50 o							0.836
1,3,5-Trinitrobenzene				5 i	5 i					5 i		0.258
1,3-Dinitrobenzene	NA	NA	NA	5 i	5 i					5 i		0.108
Tetryl	NA	NA	NA	5 i	5 i					5 i		4
2,4,6-Trinitrotoluene	NA	NA	NA	5 i	5 i					5 i		0.113
4-amino-2,6-Dinitrotoluene				5 i	5 i					5 i		0.0598
2-amino-4,6-Dinitrotoluene				5 i	5 i					5 i		0.0349
2,6-Dinitrotoluene	NA	NA	NA	5 i	5 i					5 i		0.314
2,4-Dinitrotoluene	NA	NA	NA	5 i	5 i	0.11	9.1	330	230	5 i		0.0205

Note: * = A recalculated value using IRIS, as of 9/90 (see (c) below).
AO = AWQC for the protection of human health from the ingestion of aquatic organisms, only.
AWQC = EPA Ambient Water Quality Criteria.
B = bioaccumulation
DWQS = New York Primary Drinking Water Quality Standard
GWQS = New York Groundwater Quality Standard, Class GA Groundwater assumed.
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
mg/L = milligrams per liter.
ND = Compound not detected.
PCB = polychlorinated biphenyl.
POC = Principle Organic Contaminant
ug/L = micrograms per liter.
umho/cm = micromhos per centimeter.
W & AO = AWQC for the protection of human health from the ingestion of water and aquatic organisms.
WS = water source
Secondary MCLs are not potential ARARs but are To Be Considered (TBCs) and have been included for comparison purposes only
(a) 40 CFR 141, Subpart G, May 1995.
(b) Official Compilation of Codes, Rules & Regulations of the State of New York, Title 10, Chapter 1, Part 5, June 1995.
(c) Table of Water Quality Criteria Summary Concentrations (in ug/L), US EPA, Office of Science & Technology, Health & Ecological Criteria Division, 1994.
(d) 6 NYCRR Parts 701 - 705, June 1995. Class GA groundwater and class AA surface water values used.
(e) pH Dependent Criteria
(f) Value for total chromium.
(g) Value for trivalent arsenic.
(h) The concentration (ug/L) = exp{0.7852[ln(ppm hardness)] - 3.490} = 2.687 ug/L with a hardness of 300 ppm.
(i) Value for listed principle organic contaminants(POCs); total for principle and unspecified organic contaminants (POCs + UOCs) may not exceed 100 ug/L.
(j) 1994 Proposed rule for Disinfectants & Disinfection By-Products : The total for all trihalomethanes (chloroform, bromodichloromethane, dibromochloromethane, and bromoform) cannot exceed the 0.08 level.
(k) The water hardness at SEDA was averaged from surface water samples taken at SEAD-4, -13, -26, and -45 and was determined to be 300 ppm.
(l) Value for total chlorinated benzenes.
(m) Value for total dichloroethenes.
(n) Value for total 1,3-dichloropropenes.
(o) Value for listed unspecified organic contaminants (UOCs); total for principle and unspecified organic contaminants (POCs + UOCs) may not exceed 100 ug/L.
(p) Value for total phthalate esters.
(q) Value (ug/L) = (0.02)exp{0.907 [ln(ppm hardness)] + 7.394} = 5740.5 ug/L with a hardness of 300 ppm.
(r) The value is 11 ug/L when the hardness is <= 75 ppm. The value is 1100 ug/L when the hardness is > 75 ppm.
(s) Value (ug/L) = exp{0.819 [ln(ppm hardness)] + 1.561} = 508.9 ug/L with a hardness of 300 ppm.
(t) Value (ug/L) = exp{0.8545 [ln(ppm hardness)] - 1.465} = 30.2 ug/L with a hardness of 300 ppm.
(u) Value (ug/L) = exp{1.266 [ln(ppm hardness)] - 4.661} = 12.9 ug/L with a hardness of 300 ppm.
(v) Value (ug/L) = exp{0.76 [ln(ppm hardness)] + 1.06} = 220.3 ug/L with a hardness of 300 ppm.
(w) The value of 0.015 mg/L for Lead is an ACTION LEVEL. The value of 1.3 mg/L for Copper is also an ACTION LEVEL.
(x) Value (ug/L) = exp{0.85 [ln(ppm hardness)] + 0.50} = 210.2 ug/L with a hardness of 300 ppm.
(y) Proposed Rule.
(z) For a complete listing of Reporting Limits, refer to Tables C-2 through C-8 in this document.

Table 3-12
Guidance and Standard Criteria Values for Analytes found in Soil and Sediment at SEDA

Analytes/Parameters	Lowest Effect Level (a)	Severe Effect Level (a)	Human Health Bioaccumulation (a) Sediment Criteria ug/kgOC	Benthic Aquatic Life Acute Toxicity (a) Sediment Criteria ug/kgOC	Benthic Aquatic Life Chronic Toxicity (a) Sediment Criteria ug/kgOC	Wildlife Bioaccumulation (a) Sediment Criteria ug/kgOC	Soil TAGM (f)	Background Soil Concentrations (i)	MDL (e)
Conductivity (umho/cm)									
pH (standard units)									
Alkalinity (mg/L as CaCO3)									
Total Organic Carbon									
Common Anions (mg/kg)	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Bromide									
Chloride									
Fluoride									
Nitrate (as nitrogen)									
Nitrite (as nitrogen)									
Sulfate									
Metals (mg/kg)	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum							SB	14,592.84	20
Antimony	2 L	25 L					SB	3.59	6
Arsenic	6 H	33 H					7.5 or SB	6.13	1
Barium							300 or SB	88.01	20
Beryllium							0.16 or SB	0.73	0.5
Cadmium	0.6 H	9 L					1 or SB	0.83	0.5
Calcium							SB	101,903.83	500
Chromium (VI)									
Chromium (III)	26 H	110 H					10 or SB	22.13	1
Cobalt							30 or SB	12.22	5
Copper	16 H	110 H					25 or SB	24.14	2.5
Cyanide							g	0.3	1
Iron	2 % H	4 % H					2000 or SB	26,626.65	10
Lead	31 H	110 L					h	21.86	0.3
Magnesium							SB	12,221.77	500
Manganese	460 H	1100 L					SB	669.38	1.5
Mercury	0.15 L	1.3 L					0.1	0.07	0.02
Nickel	16 H	50 L					13 or SB	33.62	4
Phosphorus									
Potassium							SB	1761.48	500
Selenium							2 or SB	0.53	0.5
Silver	1 L	2.2 L					SB	0.4	1
Sodium							SB	103.74	500
Thallium							SB	0.28	1
Vanadium							150 or SB	23.92	5
Zinc	120 H/L	270 L					20 or SB	82.5	2
Petroleum Hydrocarbons (mg/kg)	NA	NA	NA	NA	NA	NA	NA		3.3

Table 3-12
Guidance and Standard Criteria Values for Analytes found in Soil and Sediment at SEDA

Analytes/Parameters	Lowest Effect Level (a)	Severe Effect Level (a)	Human Health Bioaccumulation (a) Sediment Criteria ug/kgOC	Benthic Aquatic Life Acute Toxicity (a) Sediment Criteria ug/kgOC	Benthic Aquatic Life Chronic Toxicity (a) Sediment Criteria ug/kgOC	Wildlife Bioaccumulation (a) Sediment Criteria ug/kgOC	Soil TAGM (f)	Background Soil Concentrations (i)	MDL (e)
Volatile Organics (ug/kg) (b)	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Acetone							200		10
Benzene			600				60		5
Bromodichloromethane									0.5
Bromoform									5
Carbon tetrachloride			600				600		5
Carbon disulfide							2,700		5
Chlorobenzene				34,600	3,500		1,700		5
Chloroform							300		5
Chloroethane							1,900		0.5
Chloromethane									10
Dibromochloromethane							NA		5
Dichlorodifluoromethane									0.5
1,1-Dichloroethane							200		5
1,2-Dichloroethane			700				100		0.5
1,1-Dichloroethene			20				400		5
cis-1,2-Dichloroethene									5
trans-1,2-Dichloroethene							300		5
1,2-Dichloropropane									0.5
cis-1,3-Dichloropropene									5
trans-1,3-Dichloropropene									5
Diethylether									
Ethylbenzene							5,500		5
Methylene chloride							100		5
Methyl ethyl ketone							300		10
Methyl isobutyl ketone									
4-Methyl-2-Pentanone							1,000		10
1,1,2,2-Tetrachloroethane			300				600		5
Tetrachloroethene			800				1,400		5
Toluene							1,500		5
1,1,1-Trichloroethane							800		5
Trichloroethene			2000				700		5
Trichlorofluoromethane									0.5
Vinyl chloride			70				200		10
Xylenes (total)							1,200		5

Table 3-12
Guidance and Standard Criteria Values for Analytes found in Soil and Sediment at SEDA

Analytes/Parameters	Lowest Effect Level (a)	Severe Effect Level (a)	Human Health Bioaccumulation (a) Sediment Criteria ug/kgOC	Benthic Aquatic Life Acute Toxicity (a) Sediment Criteria ug/kgOC	Benthic Aquatic Life Chronic Toxicity (a) Sediment Criteria ug/kgOC	Wildlife Bioaccumulation (a) Sediment Criteria ug/kgOC	Soil TAGM (f)	Background Soil Concentrations (i)	MDL (e)
Semivolatile Organics (ug/kg) (c)	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
2-Chloronapthalene									330
2-Chlorophenol							800		330
2-Methylphenol							100 or MDL		330
2-Nitroaniline							430		1,600
2-Nitrophenol							330 or MDL		330
2,4-Dichlorophenol							400		330
2,4-Dimethylphenol									330
2,4-Dinitrophenol							200 or MDL		1,600
2,4,5-Trichlorophenol							100		1,600
3-Nitroaniline							500 or MDL		1,660
4,6-Dinitro-2-methylphenol									1,600
4-Chloro-3-Methylphenol							240 or MDL		330
4-Chloroaniline							220 or MDL		330
4-Methylphenol							900 or MDL		330
4-Nitroaniline									1,600
4-Nitrophenol							100 or MDL		1,600
1,2-Dichlorobenzene				120,000	12,000		7,900		330
1,3-Dichlorobenzene				120,000	12,000		1,600		330
1,4-Dichlorobenzene				120,000	12,000		8,500		330
1,2,4-Trichlorobenzene							3,400		330
Acenaphthene			NA	NA	140,000 E		50,000		330
Acenapthylene							41,000		330
Anthracene							50,000		330
Benz(a)anthracene							224 or MDL		
Benzo(b)fluoranthene							1,100		330
Benzo(k)fluoranthene							1,100		330
Benzo(g,h,i)perylene							50,000		330
Benzo(a)pyrene							61 or MDL		330
Benzoic Acid							2,700		1,600
Butylbenzylphthalate							50,000		330
Chrysene							400		330
Dibenz(a,h)anthracene							14 or MDL		330
Dibenzofuran							6,200		330
Diethylphthalate							7,100		330
Dimethylphtlate							2,000		330
Di-n-octylphthalate							50,000		330
Fluoranthene					1,020,000 E		50,000		330
Fluorene							50,000		330

Table 3-12
Guidance and Standard Criteria Values for Analytes found in Soil and Sediment at SEDA

Analytes/Parameters	Lowest Effect Level (a)	Severe Effect Level (a)	Human Health Bioaccumulation (a) Sediment Criteria ug/kgOC	Benthic Aquatic Life Acute Toxicity (a) Sediment Criteria ug/kgOC	Benthic Aquatic Life Chronic Toxicity (a) Sediment Criteria ug/kgOC	Wildlife Bioaccumulation (a) Sediment Criteria ug/kgOC	Soil TAGM (f)	Background Soil Concentrations (i)	MDL (e)
Semivolatile Organics (ug/kg) (c)	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Hexachlorobenzene			150	9,081,000	5,570,000	12,000	410		330
Indeno(1,2,3-c,d)pyrene							3,200		330
2-Methylnaphthalene							36,400		330
Nitrobenzene							200 or MDL		330
N-Nitrosodiphenylamine									330
Naphthalene							1,300		330
Pentacholophenol							1,000 or MDL		1600
Phenanthrene					120,000 E		50,000		330
Phenol							30 or MDL		330
Phenol, total chlorinated					600				
Phenol, total unchlorinated					500				
Pyrene							50,000		330
Dibutylphthalate							8,100		330
bis(2-Ethylhexyl)phthalate					199,500		50,000		330
PCBs/Pesticides (ug/kg) (d)	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
PCBs			8	2,760,800	19,300	1,400	1,000 (sed), 10,000		
Aroclor-1254			8	2,760,800	19,300	1,400	1,000 (sed), 10,000		160
Aroclor-1260			8	2,760,800	19,300	1,400	1,000 (sed), 10,000		160
Aldrin			100			770	41		8
alpha-Chlordane									80
alpha-BHC							110		8
beta-BHC							200		8
delta-BHC							300		8
gamma-BHC (Lindane)							60		8
Bromacil									
Chlordane			1	1,400	30	6	540		
gamma-Chlordane							340		80
p,p'-DDD			10	1,100,000	1,000	1,000	2,900		16
p,p'-DDE			10	1,100,000	1,000	1,000	2,100		16
p,p'-DDT			10	1,100,000	1,000	1,000	2,100		16
Dieldrin			100			770	44		16
Endosulfan				780	30		900		
Endosulfan I				780	30		900		8
Endosulfan II				780	30		900		16
Endosulfan sulfate							1,000		16
Endrin			800		4,000 E	800	100		16
Endrin aldehyde									
Endrin Ketone							NA		16

Table 3-12
Guidance and Standard Criteria Values for Analytes found in Soil and Sediment at SEDA

Analytes/Parameters	Lowest Effect Level (a)	Severe Effect Level (a)	Human Health Bioaccumulation (a) Sediment Criteria ug/kgOC	Benthic Aquatic Life Acute Toxicity (a) Sediment Criteria ug/kgOC	Benthic Aquatic Life Chronic Toxicity (a) Sediment Criteria ug/kgOC	Wildlife Bioaccumulation (a) Sediment Criteria ug/kgOC	Soil TAGM (f)	Background Soil Concentrations (i)	MDL (e)
PCBs/Pesticides (ug/kg) (d)	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Heptachlor			0.8	13,100	100	30	100		8
Heptachlor epoxide			0.8	13,100	100	30	20		8
Methoxychlor							NA		80
Parathion							1,200		
Chlorinated Herbicides (ug/g)	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g
2,4-D							0.5		0.003
2,4-DB									0.003
2,4,5-T							1.9		0.003
2,4,5-TP (Silvex)							0.7		0.003
Dalapon									0.003
Dicamba									0.003
Dichloroprop									0.003
Dinoseb									0.003
MCPA									0.05
MCPP									0.05
Explosives (ug/g)	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g
HMX									2.2
RDX									1
1,3,5-Trinitrobenzene									0.25
1,3-Dinitrobenzene									0.25
Tetryl									0.65
2,4,6-Trinitrotoluene									0.25
4-amino-2,6-Dinitrotoluene									NA
2-amino-4,6-Dinitrotoluene									NA
2,6-Dinitrotoluene							1		0.26
2,4-Dinitrotoluene									0.25

Note:

E = EPA Water Quality criterion.

H = Persaud,D., Jaagumagi, R., and A. Hayton, 1992. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of the Environment, Queen's Printer for Ontario.

L = Long, E.R., and L.G.Morgan, 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National States and Trends Program. NOAA Technical Memorandum No. 5, OMA52, NOAA National Ocean Service, Seattle, WA.

P = Water Quality criteria within the Technical Guidance for Screening Contaminated Sediments (see note (b) : Appendix 1, Newell et al. (1987), and 6NYCRR Parts 702.8 and 702.13).

SB = Site Background

sed = sediment

(a) Technical Guidance for Screening Contaminated Sediments, New York State Department of Environmental Conservation, November 1993.

(b) Per Revised TAGM HWR-94-4046, Total VOCs <= 10 ppm.

(c) Per Revised TAGM HWR-94-4046, Total SVOCs <= 500 ppm and individual SVOCs < 50 ppm.

(d) Per Revised TAGM HWR-94-4046, Total Pesticidces <= 10 ppm.

(e) For a complete listing of Reporting Limits, refer to Tables C-2 through C-8 in this document.

(f) NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046, Revised Janrurary 24, 1994. Soil cleanup objectives are based on a soil organic carbon content of 1% (0.01) and should be adjusted for the actual organic carbon content if it is known. Use the highest of either the MDL, SB, or TAGM value, as appropriate.

(g) Some forms of Cyanide are complex and very stable while other forms are pH dependent and hence are very unstable. Site-specific form(s) of Cyanide should be taken into consideration when establishing soil cleanup objectives.

(h) Background levels for lead vary widely. Average levels in undeveloped, rural areas may range from 4-61 ppm. Average background levels in metropolitan or suburban areas or near highways are much higher and typically range from 200-500 ppm.

(i) Background soil data represent the 95th Upper Confidence Level of the mean for concentrations in background samples from 27 sites (8 Moderately Low Priority AOCs Expanded Site Inspection, April 1995, Table 1.1-3)

DATA USES	ANALYTICAL LEVEL	TYPE OF ANALYSIS	LIMITATIONS	DATA QUALITY
SITE CHARACTERIZATION MONITORING DURING IMPLEMENTATION	LEVEL I	- TOTAL ORGANIC/INORGANIC VAPOR DETECTION USING PORTABLE INSTRUMENTS - FIELD TEST KITS	- INSTRUMENTS RESPOND TO NATURALLY-OCCURING COMPOUNDS	- IF INSTRUMENTS CALIBRATED AND DATA INTERPRETED CORRECTLY, CAN PROVIDE INDICATION OF CONTAMINATION
SITE CHARATERIZATION EVALUATION OF ALTERNATIVES ENGINEERING DESIGN MONITORING DURING IMPLEMENTATION	LEVEL II	- VARIETY OF ORGANICS BY GC; INORGANICS BY AA; XRF - TENTATIVE ID; ANALYTE-SPECIFIC - DETECTION LIMITS VARY FROM LOW ppm TO LOW ppb	- TENTATIVE ID - TECHNIQUES/INSTRUMENTS LIMITED MOSTLY TO VOLATILES, METALS	- DEPENDENT ON QA/QC STEPS EMPLOYED - DATA TYPICALLY REPORTED IN CONCENTRATION RANGES
RISK ASSESSMENT PRP DETERMINATION SITE CHARACTERIZATION EVALUATION OF ALTERNATIVES ENGINEERING DESIGN MONITORING DURING IMPLEMENTATION	LEVEL III	- ORGANICS/INORGANICS USING EPA PROCEDURES OTHER THAN CLP CAN BE ANALYTE-SPECIFIC - RCRA CHARACTERISTIC TESTS	- TENTATIVE ID IN SOME CASES - CAN PROVIDE DATA OF SAME QUALITY AS LEVELS IV, NS	- SIMILAR DETECTION LIMITS TO CLP - LESS RIGOROUS QA/QC
RISK ASSESSMENT PRP DETERMINATION EVALUATION OF ALTERNATIVES ENGINEERING DESIGN	LEVEL IV	- HSL ORGANICS/INORGANICS BY GC/MS; AA; ICP - LOW ppb DETECTION LIMIT	- TENTATIVE IDENTIFICATON OF NON-HSL PARAMETERS - SOME TIME MAY BE REQUIRED FOR VALIDATION OF PACKAGES	- GOAL IS DATA OF KNOWN QUALITY - RIGOROUS QA/QC
RISK ASSESSMENT PRP DETERMINATION	LEVEL V	- NON-CONVENTIAL PARAMETERS - METHOD-SPECIFIC DETECTION LIMITS - MODIFICATION OF EXISTING METHODS - APPENDIX 8 PARAMETERS	- MAY REQUIRE METHOD DEVELOPMENT/MODIFICATION - MECHANISM TO OBTAIN SERVICES REQUIRES SPECIAL LEAD TIME	- METHOD-SPECIFIC

SOURCE: DATA QUALITY OBJECTIVES FOR REMEDIAL RESPONSE ACTIVITIES DEVELOPMENT PROCESS EPA, 1987

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CLIENT/PROJECT TITLE
SENECA ARMY DEPOT ACTIVITY
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 726511-02001

FIGURE 3-9

SUMMARY OF ANALYTICAL LEVELS APPROPRIATE TO DATA USES

SCALE
DATE JUNE 1995

and quality to support this decision-making process. Data Quality Objectives (DQO)s is the portion of the RI/FS which considers issues related to data quality and quantity. As the name implies, DQOs establish objectives and requirements for data collection which, if reasonably met, will assure that the collected data is valid for its intended use. The DQO process is typically performed during the initial phases of the project and is an integral part of the scoping process. Establishing DQOs during the preliminary phases of the project is appropriate since the sampling and analysis program must be designed with the intent of meeting or exceeding all the requirements established by the DQOs.

In response to the need to better define the types of data necessary to support this DQO process, EPA (1987) identified five (5) levels of data quality. These levels range from screening techniques, identified as Level 1, to non-standardized analytical techniques, specified as Level 5. Figure 3-9, Summary of Analytical Levels Appropriate to Data Uses, provides an overview of the various levels of data quality and the appropriate uses of the data.

Level 1 data is classified as field screening data, generally obtained by the use of portable instruments. This information can provide real-time data to assist in the optimization of sampling locations and for health and safety support. Data can be generated regarding the presence or absence of certain contaminants (especially volatile organic compounds, VOCs), at sampling locations. For example, generally during soil boring operations, the soils obtained from the split-spoon sampler is screened for the presence of volatile organics using a hand-held instrument equipped with a Photoionization Detector (PID). The occurrence of high readings, above normal background levels, from a sampling location provides a qualitative indication that volatiles are present and, therefore, samples collected from this location should be subjected to more rigorous analytical techniques.

Level 2 data is also screening data but is characterized as a higher level of screening quality data. Depending upon the level of QA/QC associated with the techniques used to generate this data, it may be used in support of engineering decisions. Another important factor which will relate to the quality of the data collected at this level is the skill of the operator. Usually the operator must be an analytical chemist familiar with good laboratory practices.

Level 2 data would include both field and laboratory analyses which require the use of portable analytical instruments, mobile laboratories stationed at or near the site, and analyses performed in the laboratory without the extensive QA/QC of the higher level of data quality.

Depending upon the types of contaminants, sample matrices, and personnel skills, reliable qualitative and quantitative data can be obtained. In general, when quantitative data is desired, confirmation of field results will be obtained by submitting duplicate samples to the laboratory for analysis. The accuracy of field results will be assessed by comparing the results.

Level 2 data cannot be used for risk assessment calculations, as the QA/QC requirements are not rigorous enough to assure that the quality of the information is sufficient for this use. Although Level 2 data can include method blanks, internal standards, and surrogate spikes, it usually does not include such QA/QC procedures as matrix spikes or multipoint calibration curves which is required for higher level data.

Level 3 data is generated by laboratories which follow strict EPA QA/QC requirements as stated in the written methods. Level 3 analyses provide confirmed identification and quantification of organic and inorganic compounds in water, sediment, and soil samples. Analytical procedures includes spikes, spike duplicates, laboratory duplicates, and multipoint calibration curves.

Level 4 data is generated by analyses performed in the Contract laboratory Program (CLP). Routine Analytical Services (RAS) are performed according to methods established by the USEPA and the CLP Statement of Work (SOW). The New York State Department of Environmental Conservation (NYSDEC) has also established CLP Protocols for routine analyses with requirements that are considered equivalent to the USEPA requirements for Level 4 data. Level 4 analyses are characterized by rigorous QA/QC requirements defined in the SOW. The data package submittal from the laboratory contains all the raw data generated in the analyses, including mass spectral identification charts, mass spectral tuning data, spike recoveries laboratory duplicate results, method blank results, instrument calibration, and holding times documentation.

Level 5 data is generated by the performance of non-routine analyses classified as Special Analytical Services (SAS). These analyses incorporate many of the QA/QC measures used in the CLP routine methods with additional specific QA/QC measures as required by the method. The components of a Level 4 RAS data package submittal can be modified to accommodate these non-routine analyses. The determination of explosives in soil and water at SEDA will be conducted by using a non-routine analytical method and, thus, will be reported as Level 5 data quality.

3.5.1 Intended Use of Data

The requirements of DQOs are dictated by the intended use of the data. Since the intended use of the data is to support several decisions for the RI/FS process, the first step in establishing DQOs is to identify these decisions. Once the decisions, which the collected data will support, have been identified, the levels of data quality can be specified. The sampling program and the analytical techniques to be employed must be consistent with the required levels of data quality. For the SEDA project these decisions have been identified and include the following:

- Determining the nature and extent of current environmental impacts;
- Monitoring for health and safety;
- Assessing the risk to human health and the environment;
- Selecting appropriate remedial alternatives;
- Designing remedial actions, if necessary;
- Determining background levels of constituents of concern; and
- Determining regulatory compliance with ARARs.

3.5.2 Data Quality

Figure 3-5, Summary of Analytical Levels Appropriate to Data Uses, identifies the levels of data quality required for the various intended uses. EPA has indicated that at a minimum, Level 3 quality data should be collected to support many of the decisions to be made at the SEDA site, such as Risk Assessment. However, in order to meet the requirements of New York State, samples for metals in soils/sediments and surface water/groundwater will be collected and analyzed according to NYSDEC CLP protocols and the data reported as Level 4. The analysis for explosives in soil/sediment and surface water/groundwater is a non-routine EPA method and will be analyzed and reported as Level 5. Specifying Level 4 and Level 5 quality data will assure that the data collected in this program is of sufficient quality for the intended use.

Level 1 data will involve headspace scanning of the opened spoon using a hand-held vapor meter equipped with a Photoionization Detector (PID). The presence of elevated readings indicate soils which need special handling precautions as the presence of explosives may be indicated. Precision and accuracy for Level 1 data has not been established by EPA. The intended use of this information is for health and safety monitoring and identification of gross contamination.

Level 2 data may be collected during the soil collection program. This level of data quality would be collected during the soil sampling program. If a large number of samples are to be evaluated, soil screening techniques may be utilized. The soil screening data will constitute both Level 1 and Level 2 data. Soil samples will be screened for the presence of explosives using a Spectronic 20. The procedure for screening explosives in soils involves extracting the explosives in acetone, KOH, and Na_2SO_3, followed by the spectrographic analysis using a Spectronic 20 or equivalent. A review of data from SEDA (i.e., OB Grounds) indicates that 246 TNT is a reasonable indicator compound for a field screening. Based upon both visual and Level 1 headspace readings, special handling precautions may be employed. The intended use of this data is for defining the nature and extent of explosives at the site and for the engineering evaluation of alternatives.

The screening of heavy metals in soil will be performed at the contracted laboratory. The procedure will involve an acid extraction followed by analysis, on-site, using atomic adsorption (AA). A suitable indicator compound for the presence of heavy metals in soil will be developed on a site by site basis.

The reasons that a Level 2 screening may be incorporated into a program include:

- Cost - Comparison of the cost for screening for heavy metals and explosives will decrease the cost by a factor of approximately four (4) compared to the cost of obtaining all Level 4 and 5 data;

- Amount of Samples - The amount of samples to be collected will be substantial enough to warrant screening; and

- Constituents to be Screened - Since there is substantial interest in heavy metals, and explosives screening will be required for each class of chemical. Methodologies have been developed which will provide a reasonable degree of confidence in the data. This may involve two types of screening, i.e., one for metals, and one for explosives. The level of effort involved in performing these screening analyses in substantially less than that required by Level 4 and 5. Furthermore, the screening results can be reported in 24 and 48 hours and will aid in decision-making for field operations. Full Level 4 data packages will take up to 35 days to obtain the results.

Since the objective of the sampling program is to collect valid samples, samples considered valid must be defined. Table 3-13, Goals of Data Quality, identifies the range of accuracy and

TABLE 3-13

GOALS FOR DATA QUALITY

Chemical Class	Precision (% RPD[1])		Accuracy (% Recovery[2])	
	Water	Soil	Water	Soil
Heavy Metals	75-125	50-150	50-150	20-180
Explosives	75-125	50-150	70-130	50-150
Volatiles	75-125	50-150	70-130	50-150

[1] %RPD - Relative Percent Difference of Spike Duplicates

[2] % Recovery - Recovery of Spikes

precision which will be used as a factor in determining if the samples are considered valid. These goals are based upon historical determinations of accuracy and precision from the CLP program. Other considerations, such as holding time, proper shipping methods and chain-of--custody forms, will be considered and evaluated during the data validation process. These considerations will not be described in this section.

The evaluation of data quality will be based upon a formal data validation process, which will evaluate the quality of data from a laboratory perspective. This process considers numerous factors such as laboratory blanks, spike recoveries, holding time consideration, spectral identification matching and instrument calibration. In addition to the evaluation of the data from a laboratory perspective, consideration will be given to the precision of the data from a field perspective. This will involve the collection of sufficient field duplicate samples, usually between 5% to 10%, field blanks and trip blanks.

If sufficient data points have been collected, the variability associated with the occurrence of pollutants in the environment will be quantitated. The error associated with environmental data is generally expressed as a confidence interval of the measurement. Confidence intervals provide a basis for assessing the inherent variability associated with any distribution of environmental data. Several techniques can be used to estimate confidence intervals associated with data points. These techniques begin by determining the type of distribution of data set comprises. The two types of data distribution usually encountered in environmental measurements are normal distributions and lognormal distributions. The distinction between the two can be determined from the evaluation of the histogram. The histogram is a graphical presentation between frequency of occurrence and a data set. Once the frequency of distribution has been established, the confidence interval associated with each measurement is determined through a statistical evaluation of the variance associated with the measurements. The techniques to be employed are beyond the scope of this discussion, other than simply indicating that the confidence interval with each data set will be evaluated and presented with the collected data.

3.5.3 Data Quantity

The issue of determining an appropriate minimum database for an investigation of a hazardous waste site, such as at SEDA, is critical to a proper sampling and analysis plan. EPA (1987), has provided guidance related to the methods which the agency considers appropriate in performing this analysis. One technique that may be used involves the use of geostatistics or the statistical analysis of regionalized variables.

The field of geostatistics, which includes a technique called "Kriging", was developed for estimating reserves for mining operations. These methods are applicable for site assessment and monitoring situations where data are collected on a spatial network of sampling locations. The methods can be employed to determine sample spacing for collection networks and can be used to obtain probability maps of pollutant concentration. The primary advantage of geostatistics, over other spatial estimation techniques, is that the technique has the ability to determine both the precision of the resulting estimates and the range of influence of the sample. Kriging, in environmental assessments is used to obtain the minimum variance which will produce unbiased estimates of the concentration of a pollutant at a point. This information can be used to determine the average concentration in an area or a volume. Kriging is a weighted moving average method used to interpolate values from a sample data set. The Kriging weights are computed from a variogram which measures the degree of correlation among sample values as a function of the distance and direction between samples. Unlike classical statistics, the deviation between data points is not assumed to be random, as factors affecting the deviation at one point also operate at nearby points.

All geostatistical evaluations begin by first constructing a variogram. The variogram is generally a plot of variance verses distance between sample pairs, The plot describes how the variance between samples changes as a function of distance and direction between samples. Calculation of variance begins by first compiling all data pairs which are the same distance between them. Variance is then calculated as one-half the average squared difference between these sample pairs.

The general formula for calculation of variance, (h), is:

$$\Upsilon^{(h)} = \frac{1}{2n} \sum_{i=1}^{n} (X_i - X_i)^2$$

Where:

n = number of pairs of samples a distance h apart
x_i = value of first sample in i-the pair
x_i = value of second sample in i-the pair

The "general model" shown in Figure 3-6, General Variogram Model and Examples of

Individual Variogram Models, shows the main parameters derived from a variogram model, namely:

- The sill, which shows the highest level of variance measured by the variogram. Some variograms do not have a sill.
- The range is the distance at which the variogram plateaus or reaches the sill value and represents a measure of the maximum distance of influence of a drill hole in the direction concerned. Beyond this distance, sample values are independent of one another. Some variograms do not have a range.
- The nugget effect is the value of the variogram at zero distance. It represents the sample variability at a small distance caused by small scale geologic controls. It also gives an important indication of the presence and magnitude of sampling and assaying errors.

A variety of variogram models may be used to develop the variograms of experimental data. Examples of such models are shown in Figure 3-10. The most common single model is the spherical model. Other models which are commonly found include:

- The exponential model, which does not have a range but reaches a sill asymptotically.

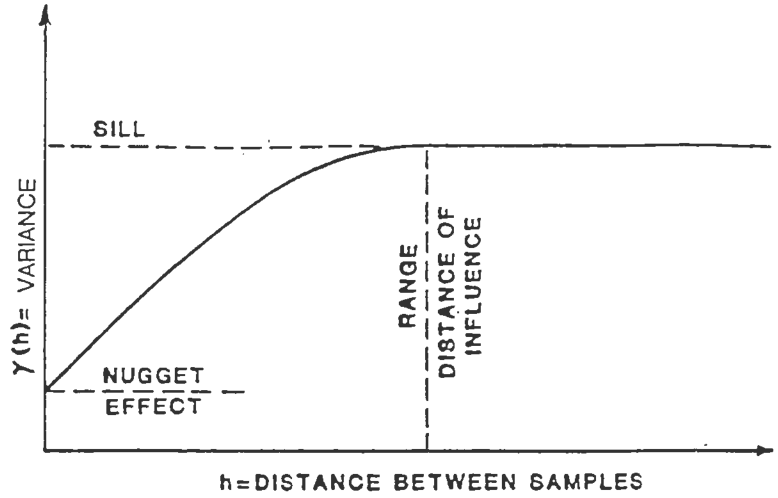
- The parabolic model, which indicates a linear drift or trend and a high level of continuityin the sample values. It will be observed if there is a systematic linear increase or decrease in values.

- The gaussian model, which behaves like the parabolic model for short distances but plateaus at large distances.

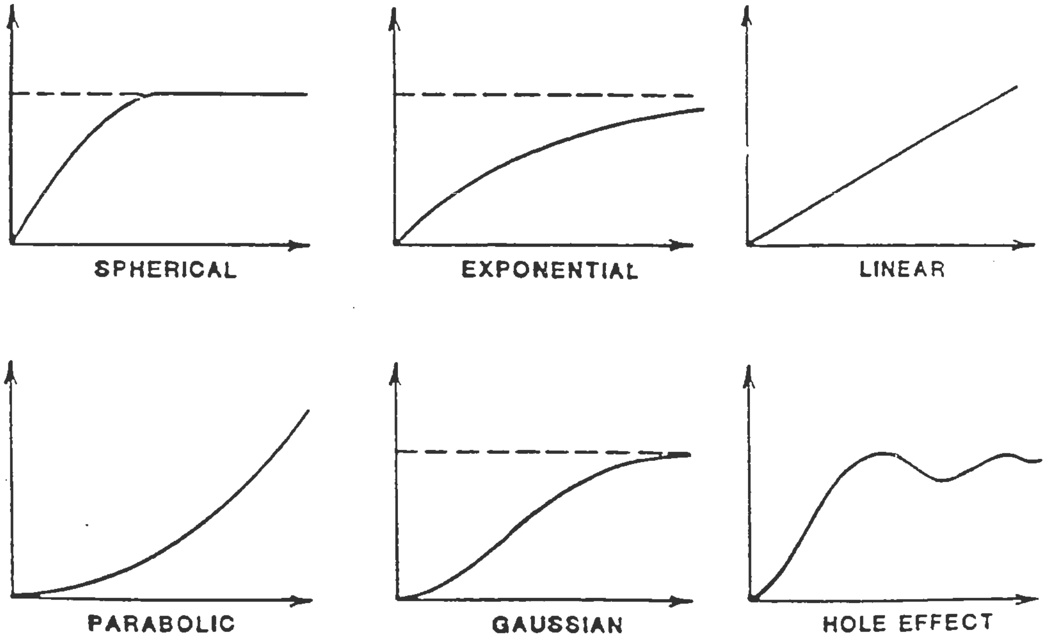
- The linear model, which indicates that the variability is directly proportional to the distance.

- The "hole effect" model, which may be indicative of periodicities in the data, or may only reflect improper sample spacing.

Once a semivariogram has been calculated, it must be interpreted by fitting to it a mathematical formula or "model" which will help to identify the characteristics of the deposit and yield numerical parameters which describe the deposit's continuity.



GENERAL MODEL



SPHERICAL

EXPONENTIAL

LINEAR

PARABOLIC

GAUSSIAN

HOLE EFFECT

INDIVIDUAL MODELS

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SENECA ARMY DEPOT ACTIVITY
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT ENVIRONMENTAL ENGINEERING	DWG NO. 726511-02001

FIGURE 3-10

GENERAL VARIOGRAM MODEL AND EXAMPLES OF INDIVIDUAL VARIOGRAM MODELS

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From a properly modelled variogram one can determine whether the data are correlated, if this correlation is isotropic, the distance at which samples become independent, if there is a nugget effect (variability smaller than scale of observation), and whether any drift is present. Care must be taken in the variogram modeling to characterize the data distribution, as environmental variables are often logarithmically distributed and will require a transformation prior to variogram calculations. One advantage of geostatistics is that variances of the errors associated with making an estimate (extension variance) can be calculated from the variogram. The distribution of the errors can then be used to develop confidence intervals about an estimate. The Kriging system is then developed by minimizing the extension variance using the method of Lagrange multipliers as described by Zirchky, J.H., (1986). Once the Kriging is performed, a procedure known as cross-validation can be used to refine the variogram model. Cross validation compares actual values and Kriging estimates, if the variogram models are correct the average error between values should be near zero.

In summary, geostatistical evaluations (variograms, kriging, and cross validation) of the sampling data will be incorporated into data quality objectives to:

- Allow calculation of minimum variance and unbiased estimates;
- Account for actual spatial variability at a site;
- Determine precision of resulting estimates and range of influence of a sample;
- Account for directional correlations between sample points;
- Estimate average concentrations of blocks to facilitate clean-up criteria design.

3.6 DATA GAPS AND DATA NEEDS

The data gaps and needs are contained in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

4.0 TASK PLAN FOR THE RI

4.1 PRE-FIELD ACTIVITIES

Pre-field activities for the RI at the subject site are contained in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

4.2 FIELD INVESTIGATIONS

Field investigations for the subject site are discussed in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

4.3 DATA REDUCTION, ASSESSMENT AND INTERPRETATION

Upon completion of all field investigations identified in Section 4.2, the data will be reviewed, processed evaluated and interpretated. Conclusions will be described for each of the following subcategories. The need for additional data will be identified through the assessment and interpretation process.

4.3.1 Geophysical Data

The methodology and sampling procedures found in Section 4.2. will produce a variety of subsurface data which will be reduced and analyzed. Objectives of this assessment will include:

- Identification of the location and extent of the distribution of any buried objects and former trenches.

The following figures will be prepared to support the interpretation of the geophysical data:

Electromagnetic Induction Survey (EM)

1) The EM survey grid will be shown on a base map of the site.
2) Contours of the quadrature and in-phase component readings will be prepared and shown on a base map of the site. The individual EM readings will be provided on tables.

Ground Penetrating Radar (GPR) Survey

3) The GPR survey lines will be shown on a base map of the site.
4) The subsurface image radar profiles from the graphic strip recorder, annotated by the geophysicist, will be provided as an appendix.

EM and GPR Surveys

5) Anomalous areas defined by the EM and GPR survey will be shown as shaded areas on a base map of the site.

4.3.2 Soils Data

The data that will be collected in accordance with Section 4.2 will be reviewed and complied within a manner which will allow easier evaluation. The summarized sampling data will be evaluated to meet the following objectives:

- Identify the pollutants found in the soil including the location, the approximate subsurface elevation and the concentration levels;
- Make an adequate determination of the background levels of chemicals in soil by incorporating appropriate soil results into the SEDA - wide background soil database.
- Portray the high levels of impacts (Source Areas) using plan and cross-sectional views;
- Validate the quality of the Level IV and V data (contents of data packages are described in Section 9.3.2 of Appendix C and definitions of the data validation effort are discussed in Sections 3.2 and 9.2.4 of Appendix C);
- Validate the quality of the Level II data (definitions of the data validation effort are discussed in Section 3.2 of Appendix C);
- Estimate the volume and mass of pollutants in each source area; and
- Evaluate the human health and environmental risk.

4.3.3 Surface Water and Sediment Data

Section 4.2 data will be reviewed and analyzed. The objectives of the evaluation of the collected surface water and sediment samples will be the following:

- Describe the surface water body in terms of typical seasonal and historic flow characteristics, as well as point of origin variations in water elevation;

- Validate the Level IV and V data (contents of data packages are described in Section 9.3.2 of Appendix C and definitions of the data validation effort are discussed in Sections 3.2 and 9.2.4 of Appendix C);
- Identify and quantify contaminants found in surface water sample;
- Evaluate and quantify the composition of sediment samples;
- To the extent wetlands are present and contribute to the aquatic system, describe the characteristics of the wetlands and identify and quantify contaminants found in water and sediment samples;
- Estimate the volume and extent of impacted sediments in surface water bodies; and
- Estimate the human health and environmental risk posed by the surface water/sediments.

4.3.4 Groundwater Data

Sampling data that is gathered in accordance with the approach described in Section 4.2.4, Groundwater Investigation, will be analyzed as follows:

- Tabulation of data collected from the monitoring wells, including groundwater elevation, water quality monitoring well construction characteristics;
- Identify and evaluate the groundwater characteristics such as transmissivity, hydraulic conductivity and relative recharge of the monitoring wells;
- Validate the Level IV and V data (contents of data packages are described in Section 9.3.2 of Appendix C and definitions of the data validation effort are discussed in Sections 3.2 and 9.2.4 of Appendix C);
- Vertical and horizontal hydraulic gradients will be estimated and used to identify groundwater flow characteristics;
- Identify the chemical constituents and their concentrations in the groundwater;
- Spatially identify the extent of dispersion of chemical concentrations. The resulting plume will be displayed graphically. This data will be compared with the conceptual site model for consistency;
- Compare data to that which has been evaluated in previous reports in order to track over time the apparent dispersion of any contaminant plume; and
- Evaluate the human health and environmental risk.

4.3.5 Hydrogeologic Data

Hydrogeologic Data will be treated in the following ways:

- Reduce slug testing data and calculate hydraulic conductivity;
- Reduce vertical conn test data and plot data;
- Determine horizontal direction and gradient of groundwater flow; and
- Determine vertical direction and gradient of groundwater flow where applicable.

4.3.6 Geological Data

Geologic Data will be treated in the following ways:

- Establish stratigraphy and develop geologic cross section;
- Develop isopach map; and
- Develop fracture trace and lineament map.

4.3.7 Ecological Data

Based on the approach and sampling program identified by Section 4.2.5, Ecological Investigation, an ecological assessment and interpretation of data will be conducted. The following objectives will be met by this evaluation:

- Describe the presence of important terrestrial and aquatic habitats;
- Identify significant receptor populations and assess relevant routes of exposure;
- Characterize all significant ecological threats; and
- Perform an environmental risk assessment.

4.3.8 Survey Data

The survey data will be evaluated for accuracy and completeness. All future site maps will be prepared from the base map of this survey. The base map will provide ground elevations, well casing elevations, well locations, surface water bodies and any other pertinent features of the subject site.

4.3.9 Evaluation of ARARs

A preliminary identification of ARARs has been made in Section 3.4, Preliminary Identification of Applicable or Relevant and Appropriate Requirements (ARARs). Several ARARs were evaluated to determine their applicability. The list of ARARs found in the

Tables in Section 3.4 are subject to modification as the remedial investigation progresses and new information is collected.

The data and information collected during the field investigation and the data analysis stages will serve as the basis by which a comparison to each listed ARAR may take place. The evaluation of all potential ARARs will be conducted in a manner consistent with the procedures described in the EPA CERCLA Compliance with Other Laws Manual, (Interim Final), (August 1988) CERCLA Compliance with Other Laws Manual: Part II Clean Air Act and Other Environmental Statutes and State Requirements (August 1989), and other pertinent guidance documents. Each requirement will be evaluated with regard to the data to determine if it is applicable. If the requirement is not applicable, a procedure to determine whether it is relevant and appropriate will be implemented. Because of the site specific nature of the investigation, a requirement must both be relevant and appropriate to the site's particular situation if it is to be complied with. In the absence of a chemical, location or action specific ARAR, other available criteria or guidelines (TBCs) will be evaluated and considered. These regulations constitute Federal and State advisories, guidance and proposed standards that are not legally binding. Where applicable, such advisories will be used in the absence of ARARs and be considered during the course of the remedial investigation.

4.4 BASELINE RISK ASSESSMENT

Following data evaluation, a risk assessment will be performed using methods described in the EPA Risk Assessment Guidance for Superfund (1989) Volume I (Human Health Evaluation Manual) and Volume II (Environmental Evaluation Manual and related guidance. The objective of the risk assessment is to characterize the current and potential public health and environmental risks that would exist under the no-action alternative. The risk assessment will be based on evaluation of available demographic, geographic, physical, chemical, and biological factors that describe the impacts of hazardous waste releases form the site. The assessment will evaluate the types and concentrations of hazardous chemicals present at the site, the migration potential of contaminants through various media, their toxicology, and the degree of exposure to human and ecological receptors. The results of the exposure assessment will be coupled with the toxicological evaluation to determine the degree of endangerment posed by exposure.

The assessment of both environmental and human health risk plays a critical role in the CERCLA RI/FS process. The RI/FS process is designed to support risk management decisions for control of hazardous waste sites. In other words, critical decisions regarding the necessity for implementing a remedial action and allowable soil and water concentration are supported by risk analyses. The role that risk information activities plays in the RI/FS process is illustrated in Figure 4-1, Risk Information Activities in the RI/FS Process.

The human health risk assessment process will include, at a minimum, the following basis steps; as shown in Figure 4-2, Human Health Baseline Risk Assessment Process.

1. Data collection and evaluation,
2. Exposure assessment;
3. Toxicity assessment; and
4. Risk characterization.

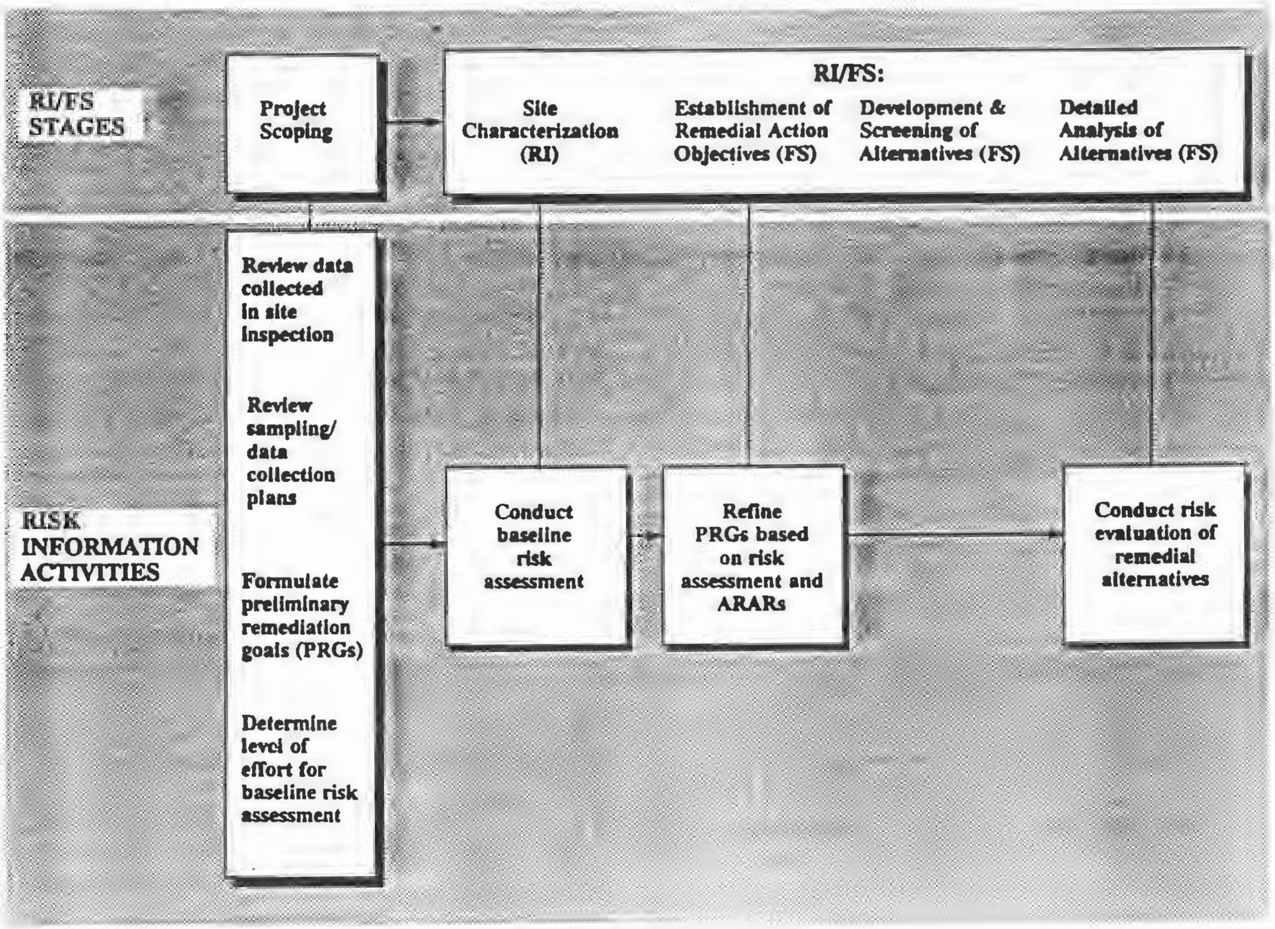
In an attempt to reduce quantitative recalculations, a risk assessment workplan and a pathway analysis (as two separate and consecutive deliverables) will be submitted to the USEPA, Region II for review befor proceding with quantitative aspects of the evaluations. Specific elements addressed include:

1. The rationale for and selection of chemicals of potential concern.
2. An exposure pathway analysis.
3. Modelling approaches for estimating exposure point concentrations.
4. The specific parameters and assumptions to be used in quantifying exposure.
5. The toxicological criteria to be used in quantifying risks.

4.4.1 <u>Identification of Chemicals of Potential Concern</u>

The first step in the public health evaluation is the identification of the chemicals of concern for which a quantitative risk analysis will be performed. Based on the preliminary review of available data, three chemical classes, volatile organics, explosives and metals, are of concern at the site. Indicator chemicals will be selected on the basis of a number of factors in order to represent the entire spectrum of compounds measured on site. These factors include:

- Magnitude of environmental concentrations;
- Frequency detected;
- Distribution among site matrices;
- Toxicity;



Source: USEPA, Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, December 1989.

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

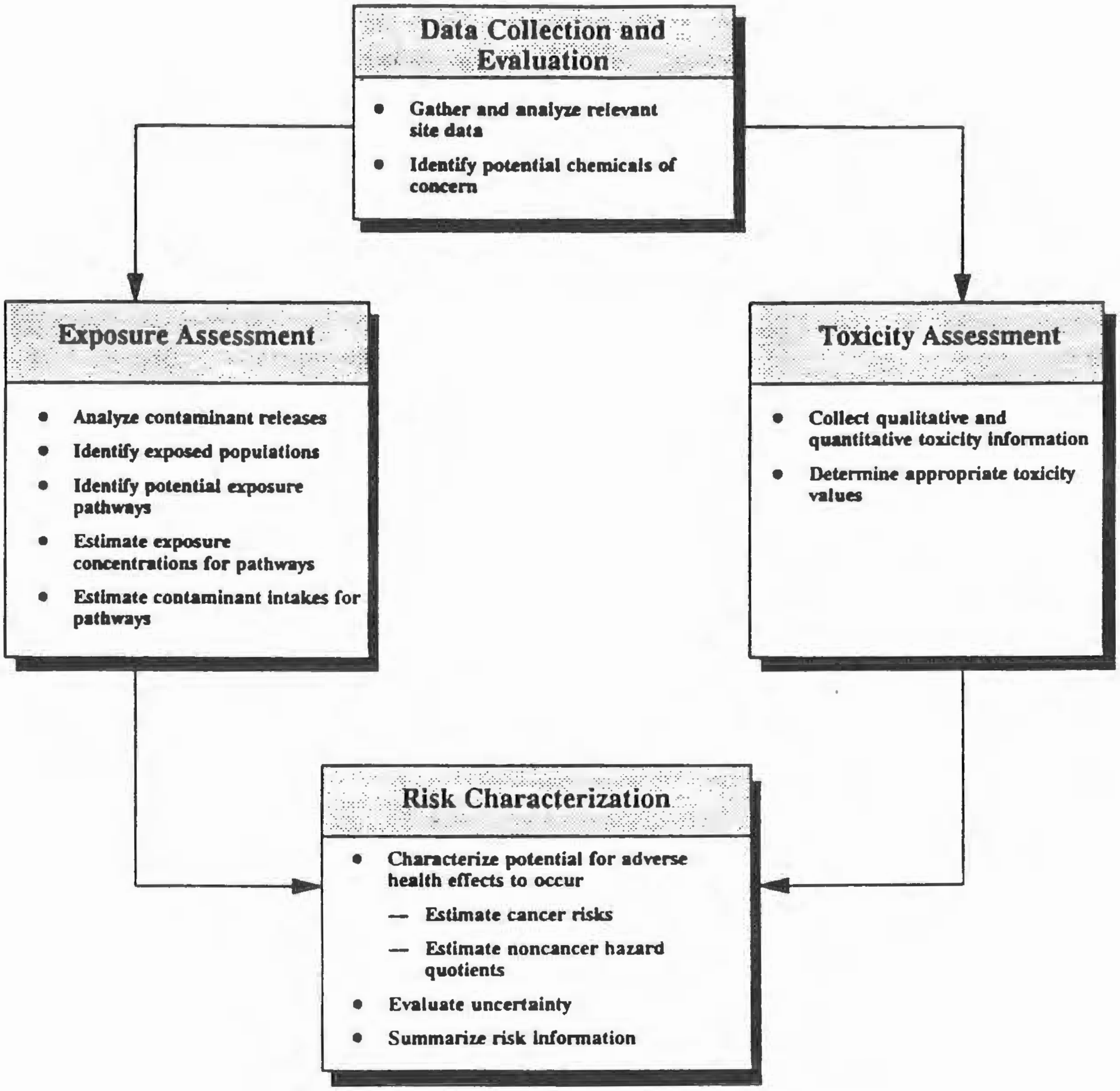
CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 726511-02001

FIGURE 4-1

RISK INFORMATION ACTIVITIES IN THE RI/FS PROCESS

SCALE
DATE JANUARY 1995



Source: USEPA, Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, December 1989.

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DWG NO. 726511-02001

FIGURE 4-2

HUMAN HEALTH BASELINE RISK ASSESSMENT PROCESS

SCALE
DATE JANUARY 1995

- Essential nutrients;
- Environmental fate;
- Presence in area background samples; and
- Evidence in laboratory contamination.

The risk posed by chemicals of concern without available toxicological criteria will be evaluated qualitatively. Chemicals of potential concern for the subject site are discussed in Subsection 3.1.3,Data Summary and Conclusions.

4.4.2 Exposure Assessment

The second step in the public health evaluation is the characterization of potential exposure pathways and receptors. The basic outline of the potential populations at risk, most likely exposure routes, and potential future land uses was presented in Section 3.2, Identification of Potential Receptors and Exposure Scenarios. The details of these outlined sections will be developed on a site to site basis in the individual RI/FS scoping documents.

Potential pathways of human exposure include:

1. Dermal exposure to surface water and sediments due to surface water run-off and soil erosion,
2. Inhalation of fugitive dust emissions and volatile organic emissions from soil and surface water,
3. Incidental ingestion and dermal exposure to onsite soils,
4. Ingestion, dermal contact, and inhalation of volatiles from groundwater,
5. Ingestion of biota from an on-site surface water body,
6. Ingestion of food crops and livestock.exposed to fugitive dusts and contaminated irrigation water.

The identification of potentially exposed populations will consider the surrounding land-use, locations of nearby residences, and sensitive subpopulations. Receptors that will be evaluated in the risk assessment for the current use scenario will include on-site industrial workers, on-site deer hunters and off-site residents, if necessary. Receptors that will be evaluated for future use scenario will be on-site residents, and on-site construction workers.

Ingestion of groundwater and ingestion of food crops and livestock are not significant current pathways since the on-site groundwater is not a likely source of potable water. However, a potable water well survey, a survey of natural springs, and a survey of agricultural and livestock farming will be performed within a one-mile radius of the installation. These surveys will be performed using available maps of the area combined with driveby or observations. All groundwater, agricultural, and livestock related pathways will be considered under future use scenarios.

Dermal exposure to surface water and sediments and inhalation exposure to potential volatile organic compounds released from surface water represent exposure pathways for people wading in off-site portions of any surface water body (i.e., stream or creek). Wading in a creek/stream is possible for people fishing in the off-site portions of a creek/stream and for children playing in the creek/stream. Ingestion of edible fish caught in a surface water body could result in human exposure through bioaccumulation and biomagnification of the contaminants in the surface and sediments.

Surficial soil and dust could become airborne due to vehicular traffic or wind erosion. Persons at or near the site could inhale particulates which have been contaminated with on-site material. As a conservative screening step, representative particulate air concentrations, if available, and the concentration of contaminants in the surficial soils will be used to estimate the concentration of contaminants in the airborne particulates. If the results of the screening analysis warrant, a more sophisticated analysis subsequently may be conducted. This analysis would potentially involve site-specific emissions modeling and/or refined dispersion modeling.

Volatile organic compounds (VOCs) present in the soil may be emitted to the air via diffusion through the soil surface. This emission may be enhanced by site activities which disturb the soil surface (e.g. minor excavations for maintenance or utility repairs).

VOC emissions will be estimated using the approaches described by USEPA in the Air/Superfund National Technical Guidance Study (NTGS) Series documents. The following two documents in the NTGS series will provide specific guidance: Guideline for Predictive Baseline Emissions Estimation Procedures for Superfund Sites ((USEPA 1992) and Models for Estimating Air Emission Rates from Superfund Remedial Actions (USEPA 1993). Equations from these documents will be used to estimate emissions of VOCs from undisturbed areas of contamination (i.e. the no action scenario) as well as other operations including soil excavation, truck transport of soil, and uncovered soil piles, as appropriate.

Once emission rates have been developed for each chemical and unit operation of concern, the emission rates will be used as input to a model which estimates the ambient air concentrations near the work area or at a downwind receptor. A conservative box modeling approach will be used to assess near-field exposures of site workers. The box model treats the contaminated soil as a uniform emission source over the time period of interest. The box, or mixing volume, is defined by the surface area of the emission/exposure area and an assumed mixing height. The volatilized chemicals are assumed to mix uniformly throughout the box, with dilution from surface winds.

If appropriate, and if the results of screening and on-site analyses indicate potential risks off-site, dispersion models will be used to estimate air concentrations at other receptors of concern. Deposition of contaminants to soil or surface water receptors will also be assessed in this step, if warranted. This pathway may be relevant in some cases, if nearby residents consume food crops grown near the site (and therefore subject to deposition exposure and uptake), or if they consume fish taken from local waters. Guidance for dispersion modeling in Procedures for Dispersion Modeling and Air Monitoring for Superfund Air Pathway Analysis (USEPA 1989) will be followed. Available algorithms for estimating deposition from USEPA or California Air Resources Board (CARB) will be used in conjunction with dispersion models to predict deposition rates. (USEPA is expected to release a new version of the ISC model which incorporates up-to-date deposition subroutines.) The appropriate models will be selected based on the characteristics of each particular site area to be assessed as a source (e.g., bare fields, grasssy fields, berms, etc.) and the exposure pathways of concern. The specific air pathway analysis methodology will be further discussed in the RI/FS Project Scoping Plan.

Workers who may visit the site may be required to excavate or come in contact with soil at the site. Therefore, excavation workers represent the only population that currently have the potential for exposure which include both surface and subsurface soils. Exposure could occur due to ingestion of soils retained on the hands and from inhalation of volatile organic emissions and fugitive dusts generated during site activities. Dermal exposure to cadmium, PCBs, and dioxins/furans will be quantified if present in the soils consistent with USEPA Region II guidance. The USEPA Dermal Exposure Assessment: Principles and Applications (Interim Report EPA/600/8-91/011B. January 1992) will be consulted for general reference.

Potential future uses of the sites will also be considered in the exposure assessment. For the future use scenario, on-site residents and construction workers will be the exposed populations. Under assumed baseline (i.e., non-action) conditions, the future use exposure scenarios would be the same as those under current conditions. Exposure frequencies for people at the site would be increased, based on the assumption that future workers would be on the site daily, rather than the occasional on-site visits which characterize current use exposures.

The use of this area is not restricted by local zoning laws and either residential or light industrial 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. There is no pressure to develop land in this area. 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."

In this human health risk assessment, for the purposes of worst case considerations, the future land use of these sites will be considered to be residential. The possibility of this actually occurring is remote since the Army intends to continue using the sites for light industrial use. Although the risk due to future residential land use will be calculated, 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.

Where appropriate based on the available data, the upper 95% confidence limit on the arithmetic mean of the log-transform data will be used to estimate exposure point concentrations.

Exposure point concentrations for the chemicals of concern in the various environmental media will be determined from results of direct measurements (e.g. surface water concentrations are exposure concentrations for the surface water body) or from the application of environmental fate and transport models to the data developed in the Remedial Investigation. For each medium and each receptor, exposure concentrations will be developed and combined with upper tendency (e.g., 90th or 95th percentile) exposure parameters to produce reasonable maximum exposure estimates (RME). The general basis and guidelines used for exposure projections will be in accordance with the Risk Assessment Guidance for Superfund (RAGs) and the Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (U.S. EPA, 1991). The Superfund Exposure Assessment Manual (USEPA, 1988a) and the Exposure Factors Handbook (USEPA, 1990) will only be used for scenarios not included in the Supplemental Guidance.

The exposure concentrations will be used to determine chemical intakes for each of the receptors for individual media and to determine total chemical intakes for receptors exposed to multiple contaminated media. The chemical intakes will be calculated using standard USEPA assumptions for inhalation, ingestion, and dermal contact with contaminated media (USEPA. 1988a). Exposure during childhood will be determined using chemical intake calculations and childhood activity patterns (e.g., wading in offsite portions of a surface water body). These estimates will be incorporated into lifetime average intake estimates. Potential noncarcinogenic effects for both adults and children will be defined separately. Parameters for the calculation of chemical intakes from other pathways (e.g., fish and food crop ingestion) will be taken from the Exposure Factors Handbook (USEPA, 1990).

4.4.3 Toxicity Assessment

The toxicity assessment will summarize the relevant toxicological data for the chemicals of concern. The primary source of toxicological data used in the analysis will be the EPA's Integrated Risk Information System (IRIS). IRIS is the definitive source for Reference Dose (RfD), Reference concentration (RfC), and Carcinogenic Slope Factor (CSF) data published by the EPA. The IRIS database is updated frequently and some data may be superseded during the preparation of the Risk Assessment. The IRIS database will be consulted at the beginning of the draft Toxicity Assessment and the data obtained will be used through the complete draft document. IRIS will be consulted again prior to completion of the Final document to check for significant changes in the database used in the Risk Assessments.

If a chemical of concern is not in the IRIS database, other sources will be consulted in order to develop estimates for RfD, RfC, and CSF values. Estimates for these parameters will be developed using route-to-route extrapolation or structure activity analogies and will not be used without the approval of the USEPA, Region II. The following sources will be used as supplemental sources of information: (1) The USEPA's Health Effects Assessments (HEAs), (2) Toxicological profiles prepared by the Agency for Toxic Substances and Disease Registry (ATSDR), and (3) Air and Water Quality Criteria Documents, (4) NIOSH and OSHA Occupational Health Guidelines, (5) Scientific literature sources of toxicological and chemical data. The USEPA will be consulted if it is felt that there are valid technical reasons for selecting toxicity values other than those found in the references cited above. Summary toxicity profiles which summarize pertinent information regarding the chemicals will be developed for each chemical, using the references cited. The hierarchy for toxicity information will be IRIS > HEAST tables > consultation with USEPA ECAO in Cincinnati, Ohio.

4.4.4 Risk Characterization

The Risk Characterization process integrates the information from the Exposure and Toxicity Assessments to develop estimates of the route-specific and overall risks to the exposed populations. The process characterizes the nature and magnitude of potential risks associated with exposure to soils, groundwater, surface water, sediments and air at the site.

The initial step in Risk Characterization is a comparison of exposure concentrations to ARARs. This step identifies the media specific contamination which exceeds established regulatory criteria for both health-based and non-health-based ARARs.

Risk estimates are calculated for all media and chemicals of concern. This step is performed regardless of ARAR exceedance or conformance because (1) not all ARARs are health based, and (2) even if a health-based ARAR is not exceeded, media and chemical specific risk calculations are required for summarizing risk estimates.

The risk will be calculated for potential carcinogenic and non-carcinogenic risks posed to the human populations from exposure to the chemicals of concern. The risks of individual chemical exposures within a medium will be combined for similar effects. The Risk Assessment Guidance for Superfund (USEPA, 1989) recommends summing of the carcinogenic risks across chemicals without consideration of potential synergistic or antagonistic effects. Non-carcinogenic risks, however, are summed only for chemicals which produce similar toxic effects. For example, the potential risks of developing liver effects from chemical A, as expressed by a hazard index value, would not be added to the potential risks of developing neurological effects from exposure to chemical B. The characterizations will be developed on a media and route specific basis. Where appropriate, the media and route specific risk estimates will be combined to provide and overall assessment of the population risk.

The risk characterization will be performed according to the procedures contained in the Risk Assessment Guidance for Superfund (USEPA, 1989).

4.4.4.1 Uncertainty Analysis

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. These categories of uncertainties will be discussed in the risk assessment.

Due to the conservative nature of the assumption parameters selected in establishing Reasonable Maximum Exposures (RMEs) the various exposure pathways, uncertainty analysis will be performed on all exposure pathways and/or routes exhibiting cancer risks greater than 10^{-4} or noncarcinogenic hazard indices greater than 1. USEPA Region II guidance uses "central tendency analysis" to address issues of overly conservative assumptions. In central tendency analysis, central tendency (50th percentile) exposure parameters are combined with the average (95% UCL) exposure point concentration in a re-analysis of chemical intakes and health risks. This technique will be used in the risk assessments attempting to present a more likely risk while showing how conservatism increases uncertainty.

4.4.5 Environmental Assessment

An environmental assessment will be performed for the site with the objective of ascertaining existing and potential future environmental impacts of the site if no remedial action is taken. The results of this analysis will then be used in the development and evaluation of remedial alternatives.

A primary methodology to be utilized in assessing aquatic environmental impacts is a comparison of site water concentration levels to water quality criteria for the protection of aquatic life. These aquatic life criteria, based primarily on toxicity, are listed within the USEPA, Ambient Water Quality Criteria Document (May 1, 1987, The "Goldbook"). In addition, New York state has established a set of water criteria for fishing and fish propagation. These data will be combined with the ecological evaluation completed for the Remedial Investigation to qualitatively determine the aquatic impact. Available sediment guidelines and criteria will also be considered. The sediment criteria developed by the USEPA, sediment criteria for various organic and inorganic constituents developed by NYSDEC (1994), and "Effects Range" values for several inorganics, pesticides, PCBs, and PAHs developed by NOAA (1991) will be used in the assessment. The ecological investigation will be performed according to RAGs, Part II.

To evaluate terrestrial environmental impacts, published information concerning the toxicity of various chemical constituents to terrestrial organisms will be considered. If warranted, concentrations of contamination in on-site contaminated matrices will be extrapolated to probable contaminant concentrations at or within the organism (i.e., extrapolation allowing for dilution, organism uptake, bioaccumulation).

Contaminants of concern will be selected separately for the environmental assessment and based on the criteria for human health assessment: Magnitude and frequency of detection, distribution, toxicity, environmental fate, and other factors. Toxicity criteria will be based on the potential for bioaccumulation and biomagnification.

The selection of organisms for tissue analysis will depend on the results of the initial habitat assessment. Terrestrial organism analyses will be conducted following the review of soil analytical results. Shellfish are good aquatic indicator species for representing worst case bioaccumulation. Earthworms and mice are very good terrestrial indicators. Quantitative exposure doses for higher level consumers such as the red-tailed hawk (sp. Buteo jamaicensis) or red fox (sp. Vulpes vulpes) will be calculated using the tissue analysis from the habitat assessment. USEPA's Wildlife Exposure Factors Handbook (EPA/600/R-93/187a & 187b), will then be used to extrapolate the potential doses for such receptors. In general, tissue sample data will be used to assess the bioaccumulation of chemicals of concern so that estimates of potential for effecting human and higher level organisms can be assessed.

Data on fish populations will be collected as defined on the "Fish Data Sheet," Figure A-24 in Appendix A.

4.4.6 Identification of ARARs

Chemical-specific ARARs will be determined for the contaminants at the site. The chemical-specific concentration limits established by either federal or state environmental laws will be compiled with for each applicable environmental medium.

Location-specific ARARs are those requirements that establish restrictions on remedial activities or limitations on contaminant levels on the basis of site characteristics or the physical characteristics of the surrounding area. Currently, there are no known location-specific ARARs for the general site area. As part of this project, location-specific ARARs will be further researched to ensure compliance.

Activity-specific ARARs are standards that establish restrictions or controls on particular kinds of remedial activities related to management of hazardous substances or pollutants. Specific remedial activities will be evaluated as opposed to the specific chemicals present at this site. Examples of activity-specific ARARs include closure regulations, incineration standards, and pretreatment standards for discharges to publicly owned treatment works. Because different types of remedial actions will be evaluated, different activity-specific ARARs will apply to the various alternatives.

4.5 DATA REPORTING

The program described in this work plan is intended to provide a data base which will yield an understanding of on-site conditions in accordance with all applicable state and federal law, including numerous guidance documents. However, during the RI process there may be a need to expand a particular task. Consequently, the expeditious completion of the program requires good communication between the AE, SEDA, USACE, NYSDEC and EPA. This section describes the mechanisms which will ensure that communications between all concerned is maintained.

4.5.1 Preliminary Reports

At the completion of the first round of field sampling, a letter report characterizing the site will be furnished by the Army Project Manager. This letter report will at a minimum list the locations and quantities of contaminants at the site. Should a second and even a third round of confirmatory sampling be required, additional letter reports will be prepared at the conclusion of each.

At the conclusion of the field work, a Preliminary Site Characterization Summary in the format of the first four chapters of an RI report will be prepared. This document will form the basis of the discussion at a Project Manager's progress meeting.

A draft RI report will be prepared at completion of the site investigation and the data evaluation. The report will summarize the results of the field investigation and record searches, and present the data and conclusions in a clear, concise record. The RI report will also present the results of the data evaluation. This task is compete upon review, comments and revision of the draft RI report document as governed by the Interagency Agreement (IAG).

4.5.2 Quarterly Reports

The Army shall submit to EPA and NYSDEC quarterly reports, no later than the 10th day of the months of January, April, July, and October, which shall include the following:

1. Minutes of all formal Project Manager, Technical Review Committee (TRC), or other formal meetings held during the preceding period. This shall also include a summary of issues discussed at the Project Manager meetings which may have occurred in the last quarter;

2. Status report on all milestones met during the period, report and explanation for any milestones not met during the preceding period and assessment of milestones scheduled for the next reporting period;

3. Outside inspection reports, audits, or other administrative information developed during the preceding period, including notice of any outside inspections or audits scheduled during the next reporting period;

4. Permit status as applicable;

5. Personnel staffing status or update;

6. Copies of all Quality Assurance Data and sampling and test results and all other laboratory deliverables received by the Army during the reporting period, if any; and

7. Community relations activity update.

4.5.3 Monthly Reports

When field work, associated with response activities, is being conducted at the subject site, the Army shall submit a monthly Field Activity Report to EPA and NYSDEC, not later than the 10th day of the month addressing the following:

1. A summary of work completed in the field, i.e., sampling events or well installation. Upon request, copies of trip reports and/or field logs shall be provided;

2. Anticipated or actual delay of a scheduled field activity, to include basis and any effect on subsequent events or scheduled activities;

3. Discovery or indication of significant additional contamination or any new family of hazardous substances at an AOC other than that previously recognized or expected for the AOC location;

4. Quantum increase in concentration of hazardous substances of any media beyond that previously recognized or expected for that AOC location;

5. Determination of any specific or potential increase of danger to the public, the environment, or to individuals assigned to work at the site. Such a determination shall be reported to the EPA and NYSDEC as soon as discovered; and

6. Copies of all Quality Assurance Data and sampling and test results and all other laboratory deliverables received by the Army during the month, if any.

4.6 TASK PLAN SUMMARY FOR THE RI

The previous five sections of the task plan have described activities which will be conducted as part of performing the RI and the reports to be prepared during this program. This section provides a summary of the activities which will be performed for each media to be sampled. All laboratory analyses will be performed in accordance with the methodology presented in the Chemical Data Acquisition Plan (Appendix C).

A summary of the number and type of samples to be collected at the subject site is contained in the appropriate RI/FS Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

The data will be validated in accordance with the EPA Region II Standard Operating Procedure (SOPs) for Evaluating Organic and Inorganic Data. Factors to be considered include: sample holding times, instrument calibration, blanks, surrogate recoveries, matrix spike duplicates, and other quality control parameters. The Guidance For Data Useability in Risk Assessment (U.S. EPA, 1990) will be used to evaluate data to be used in the risk assessment. Quality Assurance (QA) will be documented by comparison between the contracted laboratory results and the independent government laboratory. The EPA currently does not provide guidelines for Level II data validation. If Level II analyses are applicable to the subject site, the QC program for the Level II analyses will include: instrument calibration, duplicates, and blanks. The Level II data will be validated in consultation with the contracted laboratory.

Data evaluation will be completed upon receipt of the data from the field investigation. Data will be compared to project objectives and summarized into a usable format for data manipulation. Tables will be created to exhibit data, contaminant levels will be plotted on-site maps, and groundwater contour maps and geologic cross sections will be developed. Contaminant receptors will be identified, contaminant migration pathways refined, as part of the risk assessment. The results of this task will be used in the FS and in the evaluation of remedial alternatives.

5.0 TASK PLAN FOR THE FS

In accordance with the current EPA guidance manual, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA Interim Final (October 1988), a feasibility study (FS) for each site will be conducted based on the results of the remedial investigation (RI), and will serve as the mechanism for the development and evaluation of remedial action alternatives.

The FS process will involve the development of alternatives, screening of the alternatives, and a detailed analysis of selected alternatives. The screening process of the alternatives will be conducted to ensure that each alternative protects human health and the environment from each potential pathway of concern at the site. During the detailed analysis, the alternatives will be refined and modified based on additional site characterization or treatability studies conducted during the RI.

5.1 DEVELOPMENT OF ALTERNATIVES

The purpose of this phase of the FS process is to develop an appropriate range of remedial action alternatives that will undergo screening. Alternatives will be developed following the standard EPA method of identifying and screening technologies/processes and assembling them into alternatives. The method will consist of six steps:

1. The development of remedial action objectives that are risk-based, with consideration given to ARARs. The remedial action objectives will also be based on media of interest and chemical constituents of concern, exposure pathways, and the preliminary remediation goals for each site.

2. The development of general response actions for each medium of interest that will satisfy each remedial action objective for the site.

3. The estimation of quantities of media to which general response actions will be applied to meet remedial action objectives.

4. The identification of remedial technologies and process options associated with each general response action. Screening and elimination of technologies and processes will be based on technical implementability.

5. Evaluation of technologies and processes in order to retain processes that are representative of each technology that is retained from the technology screening.

6. The assembling of technologies and processes into a range of alternatives as appropriate.

A flowchart of the approach to the alternative development is shown in Figure 5-1, Feasibility Study -Development and Screening of Remedial Action Alternatives.

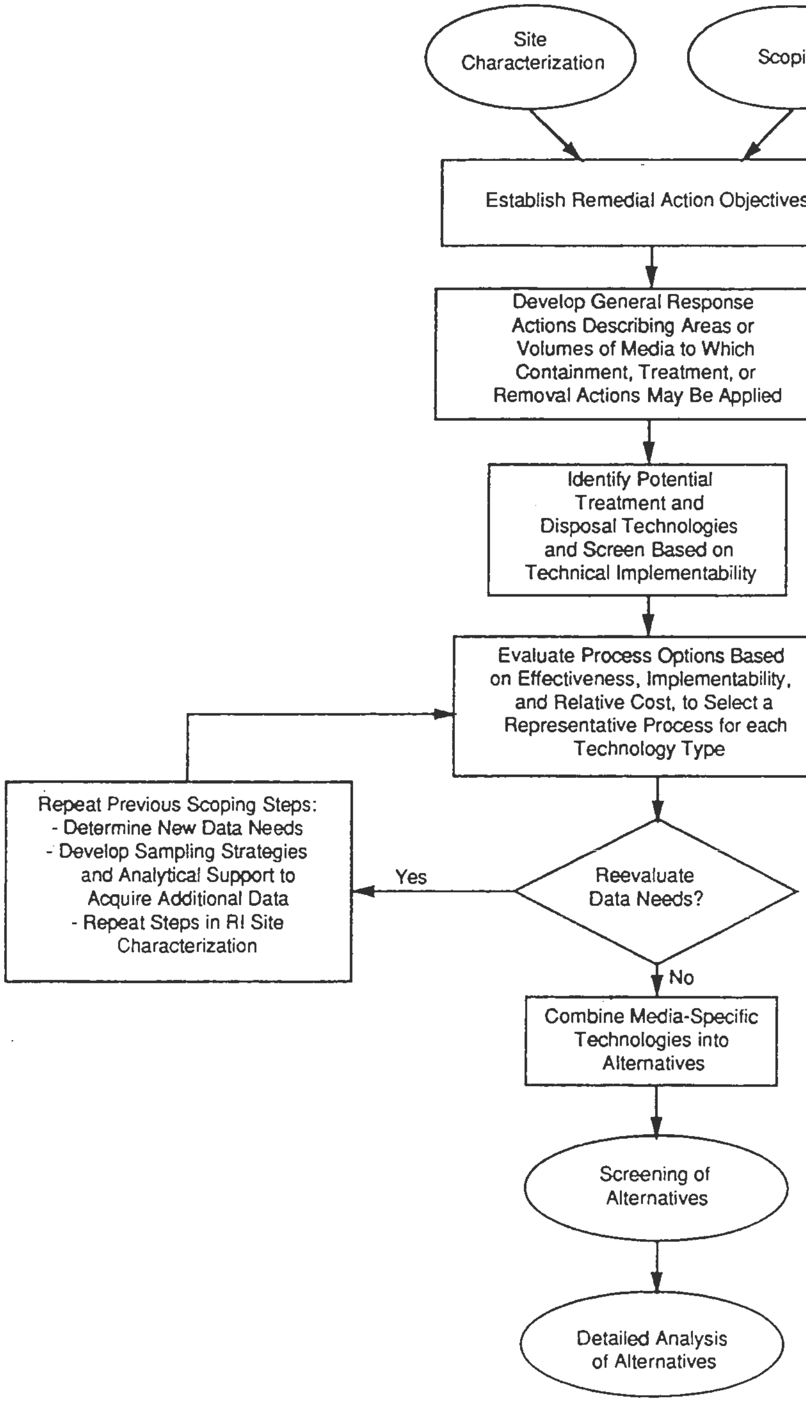
5.1.1 Development of Remedial Action Objectives

Remedial action objectives will be developed based on the data collected in the RI, the contamination migration pathways and the potential receptors defined in the Risk Assessment. The remedial action objectives will consist of medium-specific objectives for the protection of human health and the environment, will be risk based, and will comply with ARARs to the greatest extent possible. Protection of human receptors usually involves reducing exposure and reducing contaminant levels. Protection of environment receptors usually seeks to preserve or restore a resource and therefore needs to define the media of interest and contaminant levels required. A preliminary identification of remedial action objectives were defined during scoping and are presented by media in Table 3-4 of Section 3.

Initially, the objectives will be based on information such as reference doses and risk specific doses. The final objectives will be specific to the site and based on results of the risk assessment and evaluation of expected exposures. Development of response objectives will also include refinement of ARARs specific to the site. Overall, the objectives will seek to define clean-up levels that will minimize risks to human health and the environment.

5.1.2 Development of General Response Actions

Based on the remedial action objectives defined, general response actions will be developed to satisfy those objectives. A preliminary identification of general response actions were defined during scoping and are presented by media in Table 3-4 of Section 3. Depending on the site, general response actions will be developed for source control and migration control.



Source: EPA Guidance Document for Conducting RI/FS Under CERCLA (Interim Final, October 1988)

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CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 726511-02001

FIGURE 5-1
FEASIBILITY STUDY DEVELOPMENT AND SCREENING OF REMEDIAL ACTION ALTERNATIVES

SCALE
DATE JANUARY 1995

Categories of remedial action include:

1. no action/institutional controls
2. containment
3. excavation or collection, treatment, and disposal.

The general response actions defined during scoping will be developed for each site as information about the site increases with the collection of data during the RI. In the development of alternatives, general response actions may be combined due to varied contamination and migration pathways at the site.

5.1.3 Estimation of Quantities to be Remediated

During this stage of the alternative development process, an initial determination will be made of areas or volumes of media to which the general response actions might be applied. Interactions between media must be taken into account, and will be more fully examined when data has been collected from the RI. Defining these areas and volumes of media to which general response actions apply will consider the evaluation of acceptable exposure levels, potential exposure routes and site conditions, and the nature and extent of contamination.

For sites with discrete hot spots or areas of more concentrated contamination, areas and volumes for remediation will be defined on the basis of the site-specific relationship of volume (or area) to contaminant level.

5.1.4 Identification and Screening of Remedial Technologies and Process Options

This step of the process is used to identify applicable technology types. The term technology type is used to describe general categories of technologies, such as physical, chemical, or biological treatment. For each technology type, several process options may be included. The evaluation of remedial technologies will be divided into source and migration control technologies if it is possible that both source and migration control technologies are required for a site. General remedial action technologies and process options have been identified during the scoping for consideration as possible remedial actions at SEDA. Remedial action technologies and process options, arranged according to categories for general response actions for remediation of soil/sediment are presented in Table 3-5 of Section 3.

Groundwater remedial technologies are presented in Table 3-6 of Section 3. Detailed descriptions of the process options for remediation of both soil/sediment (source control) and groundwater (migration control) are provided in Section 3.3.2 of Section 3.

During this screening step, process options and entire technologies will be evaluated and potentially eliminated on the basis of effectiveness, implementability, and cost. One process type for each technology will be selected. The effectiveness evaluation will focus on the potential effectiveness of a process option to deal with the volumes of media required to be processed, in addition to being able to obtain remediation goals; potential impacts to human health and environment; and reliability which the process has shown for the given contaminants. The implementation evaluation will focus on the ability to obtain necessary permits, the availability of treatment, storage, or disposal services, and the availability of equipment and people to implement the technology. The cost evaluation will focus on relative capital and O&M costs which are used to compare process options within the same technology.

5.1.5 Assembling of Selected Technologies Into Alternatives

Alternatives for the each site will be formed from the general response actions and process options for each medium or operable unit. Each remedial alternative will be an overall site remedy. The no action alternative will be considered as a baseline against which all other alternatives can be evaluated. Depending on the site, two categories of alternatives will be assembled. The first category of alternatives will be termed Source Control because these alternatives are those that are effective in controlling the releases from source materials. The second category of alternatives will be designated Migration Control because these alternatives are effective in mitigating the movement of pollutants from the source area.

5.2 SCREENING OF ALTERNATIVES

Alternatives which have been determined to meet the remedial action objectives for each medium of interest will be screened. The purpose of the screening is to select alternatives for detailed analysis. At this stage it may be necessary to identify and verify action specific areas and begin treatability testing. Before screening, it may be necessary to further define some aspects of the selected alternatives, such as interactions among different media and remediation timeframes.

The alternatives will be evaluated against short-term and long-term aspects of three broad criteria: effectiveness, implementability, and cost. Further, analysis of alternatives may include such aspects as time to achieve a desired risk level for a certain media. A key aspect of the screening evaluation is the effectiveness of each alternative in protecting human heath and the environment. The screening criterion includes the evaluation of each alternative as to the protectiveness it provides and the reductions in toxicity, mobility, or volume it achieves. Implementability is a measure of both the technical and administrative feasibility of construction and operating a remedial action alternative. Both capital and operation and maintenance will be considered during the screening of alternatives.

5.3 DETAILED ANALYSIS OF ALTERNATIVES

The nine evaluation criteria which will serve as the basis for the detailed analyses of the alternatives include the following:

1. overall protection of human health and the environment
2. long-term effectiveness and permanence
3. reduction of toxicity, mobility, or volume
4. short-term effectiveness
5. implementability
6. cost
7. state acceptance
8. community acceptance.

The analysis should provide adequate information for the final selection of an alternative and should include:

1. Further definition of each alternative with respect to areas/volumes of media to be addressed,
2. A summary profile of each alternative against the evaluation criteria, and
3. A comparative analysis among the alternatives to assess the relative performance of each alternative with respect to each evaluation criteria.

5.4 TASK PLAN SUMMARY FOR THE FS

The task plan for the FS will consists of the following tasks:

1. *Development of Alternatives including the development of remedial action objectives, general response actions, and remedial technologies and process options.*
2. *Screening of Alternatives.*
3. *Detailed Analysis of Alternatives.*

6.0 PLANS AND MANAGEMENT

6.1 SCHEDULING

Scheduling for the RI/FS is provided the RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

6.2 STAFFING

This section contains a listing of project staff and describes the functional relationships of the organizational structure and responsibilities of the support functions. These personnel will provide overview and guidance to the project team and will assist the project manager in the resolution of technical difficulties.

The USACE project manager will oversee the entire project. He is the contact at the Corps of Engineers to whom the project manager must report.

The project manager is responsible for the effective day-to-day management of the project staff; direct communication and liaison with the USACE and SEDA; technical approach and review of deliverables, management of resources, schedules, and budgets, and communication among the general and technical support functions.

The general support personnel include a health and safety manager and quality assurance manager. The health and safety manager is responsible for preparing the health and safety plan for site activities and training project personnel in safety practices. The quality assurance manager is responsible for monitoring and periodically auditing to assure QC procedures outlined in the Chemical Data Acquisition Plan are followed by the field team and the laboratory.

The support personnel in ecological sciences, engineering, hydrogeology, and regulatory compliance will provide technical support and assist in the resolution of difficulties related to their individual fields.

Outside support, if required, will be retained to assist in the field investigation, to provide laboratory assistance, and to aid in UXO detection and handling.

Information on staffing for the RI/FS is provided in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Workplan.

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APPENDIX A

FIELD SAMPLING AND ANALYSIS PLAN

GENERIC INSTALLATION RI/FS WORK PLAN

SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK

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1.0 INTRODUCTION

Environmental measurements are subject to a wide variety of instrument, spatial, and temporal variables. A representative sample of the material from which it is collected must accurately depict the spatial, temporal, physical, and chemical qualities of the material. Standard operating procedures help to minimize those errors which result in the collection of invalid data or nonrepresentative samples. This is important as field data collection provides the primary basis upon which site investigations, assessments, and remedial actions are based.

There are four basic factors which affect the quality of sampling data. These are: 1) Selection of the sample collection site; 2) Method of sample collection (including sampling equipment decontamination practices); 3) Sample preparation, preservation and storage methods; and 4) Sample analysis (including laboratory practices). Samples must be representative of the media from which they are extracted, and maintain their integrity and/or constituents between the time of sampling and the time of analysis. Field measurement devices and procedures also must follow set procedures to obtain precise and accurate readings at representative locations.

This document presents the Field Sampling and Analysis Plan (FSAP) for the collection of precise, accurate, and representative field data. If a non-standard situation is encountered in the field, the Project Manager or Remedial Services Manager will be contacted immediately and advised of the situation. If it is deemed necessary the appropriate contacts at SEDA and the Army Corps of Engineers-Huntsville will be contacted. Lastly, if approval from NYSDEC or EPA is necessary these agencies will be contacted. If the provided FSAP does not cover a situation encountered in the field, procedures recommended by the EPA or other suitable authority will be followed.

This FSAP describes the field sampling methods and data collection procedures for work conducted at Seneca Army Depot in Romulus, New York.

Performance of the tasks described herein require adherence to health and safety procedures defined in the Site-Specific Safety and Health Plan (SSHP) provided in Appendix B. Addenda to the SSHP will be developed, as necessary, for specific field data collection tasks.

The pre-field activities include the following:

1. A site inspection to familiarize key project personnel with site conditions and finalize direction and scope of field activities,
2. A comprehensive review of the Health & Safety Plan with field team members to insure that the hazards that might occur and preventive and protective measures for those hazards are completely understood,
3. An inspection of all equipment necessary for field activities to insure proper functioning and usage, and
4. A comprehensive review of sampling and work procedures with field team members.

2.0 PRESAMPLING CONSIDERATIONS

2.1 COMMUNICATIONS

Personnel responsible for the design and/or implementation of field sampling activities are encouraged to establish and maintain close communications with personnel responsible for the performance of chemical, physical, or biological characterization activities. Development of open communication between these two parties provides an important conduit by which information relevant to the representativeness, integrity, and quality of the sample can be transferred. For example, laboratory personnel are an important source of information and materials that are essential to ensure that samples are properly preserved at the time of their collection. Laboratory personnel can also assist sampling personnel with the definition of sample volume and number of sample aliquots that are required to complete the analyses of interest. Furthermore, laboratory personnel should also assist program management and field personnel with the definition of analytical procedures used to quantify the pollutants of concern to ensure that suitable procedures with appropriate detection limits are specified. Field personnel should provide laboratory personnel with advance notification of sample shipment to minimize the period of time between sample collection and analysis. On the day that the samples are shipped, the laboratory should be notified of the samples that they are expected to receive using the Sample Shipment List form (Figure A-1). Furthermore, this mechanism can be used to advise laboratory personnel of unusual properties exhibited by samples as they were being collected. Finally, the establishment of open communications between field and laboratory personnel can facilitate implementation of managerial decisions to refocus the emphasis or extent of certain investigations.

Field personnel must also contact the U.S. Army Corps of Engineers Missouri River Division (MRD) Laboratory in Omaha, Nebraska prior to the beginning of a field program if QA samples will be analyzed by MRD. The field personnel should obtain a LIMS number from the MRD sample custodian during this initial contact. MRD's phone number is (402) 697-2623.

Specifically, field personnel are responsible for the following:

1) daily communication with the project manager to advise of the project status;
2) communication with the contracted laboratory and MRD's laboratory prior to and during sampling of sediment, soil, and water; and

SAMPLE SHIPMENT LIST

LABORATORY:

CONTACT:

FAX NUMBER:

DATE SHIPPED:

PROJECT:

EXPECTED ARRIVAL DATE:

FROM: FIELD TRAILER, SENECA ARMY DEPOT

PHONE : FAX:

PLEASE CALL THE ABOVE NUMBER IF THE SAMPLES THAT ARRIVE AT THE LABORATORY DO NOT CORRESPOND TO THE LIST BELOW

SAMPLES SHIPPED:
(include all samples including duplicates, trip blanks, and rinsates)

SAMPLE NAME		MATRIX (circle one)	
1		W	S
2		W	S
3		W	S
4		W	S
5		W	S
6		W	S
7		W	S
8		W	S
9		W	S
10		W	S
11		W	S
12		W	S
13		W	S
14		W	S
15		W	S
16		W	S
17		W	S
18		W	S
19		W	S
20		W	S
21		W	S
22		W	S
23		W	S
24		W	S
25		W	S
26		W	S
27		W	S
28		W	S
29		W	S
30		W	S

COMMENTS:

NOTE:

1) W = WATER, S = SOIL OR SEDIMENT

3) communication with subcontractors, the frequency of which is to be determined by the project manager.

2.2 SAMPLE INTEGRITY ISSUES

The selection and use of suitable sample containers is an important facet of any field sampling and analysis project. Storage of samples in unsuitable containers can lead to sample loss, sample contamination, and/or sample degradation, each of which has direct implications on the representativeness, and therefore the utility of the data that is ultimately reported.

Prior to the initiation of field work, project personnel will familiarize themselves with sample bottle, storage, and packaging requirements and recommendations. Specific issues that will be reviewed include analytical sample size requirements, sample bottle type, sample preservation requirements, and holding times between collection and analysis. Sources of this information include conversations with laboratory personnel and review of analytical methodology descriptions provided in any of numerous reference sources, such as those listed in SW-846.

Once familiar with sample packaging and preservation requirements, project personnel will obtain the necessary sample bottles and transport containers as well as essential preservative chemicals and supplies. Frequently, sample bottles and transport containers can be obtained directly from the laboratory where the subsequent analyses will be completed; although outside vendors of these materials should also be considered. In either case, it is important to insure that all containers are suitably precleaned, dried, capped, and stored prior to their use for holding samples. The sampling glassware and containers will meet the conditions in "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers" published by EPA's Office of Emergency and Remedial Response (April 1990). Whenever the integrity of any sample container is suspect, due to presence of foreign liquids or debris or due to conditions of suspected or known incomplete container closure, the sample container will not be used and recleaned prior to use.

Sample preservation will be completed immediately after the collection of the required sample volume. Frequently, sample preservation includes the performance of some field determination (e.g., pH measurement), the addition of a small quantity of a chemical preservative to the sample, the closure of the sample container and its placement in a container (e.g., ice chest) where a controlled environment (4° C) has been established. Alternatively, some subset of the listed steps may be required. Regardless of the level of sample preservation required, it is imperative that required procedures be implemented immediately at the time of sample collection.

More complete discussions of sample bottle preparation, sample preservation, sample storage, and packaging and shipping are presented in Sections 4 and 5 of this appendix.

2.3 QUALITY CONTROL SAMPLES

Four types of quality control samples will be produced and submitted to the laboratory as a result of each field study: Trip Blanks, Field or Equipment Rinse Blanks, Field Duplicates, and Matrix Spike/Matrix Spike Duplicates. All water used for trip blanks, field equipment rinse blanks and the final rinse in the decontamination procedure will be demonstrated as analyte-free according to the criteria in USEPA Region II CERCLA Quality Assurance Manual. Distilled water from a local water distributor will be chemically analyzed before field work begins to demonstrate it is analyte-free. Then this water will be used throughout the fieldwork. Descriptions of these samples are presented below.

Trip Blank: This sample is used to determine whether contaminants are being introduced to field samples due to improper laboratory procedures, poor container precleaning operations or due to conditions encountered during transport. Trip blanks will be prepared only for volatile organic compound analyses of only groundwater and surface water samples.

A volatile organic analysis trip blank is prepared by filling a precleaned screw cap septum vial with demonstrated analyte-free water, preserving it as described in the Chemical Data Acquisition Plan, sealing the vial, and placing it into the transport chest with other empty bottles. This sample is transported to the field, where it remains stored with the empty sample bottles until those bottles are used. Trip blanks will accompany shipments of aqueous samples for volatile organic analysis. Then the trip blank is stored with the samples until they are analyzed at the analytical laboratory. Typically one trip blank is provided for each day of anticipated field sample collection. Trip blanks are only required when sampling aqueous samples undergoing VOC analysis.

Field (Equipment) Rinse Blank: This sample is used to determine whether field sampling (decontamination and sample collection) procedures or the environment of the job site are possible sources of contaminant introduction. One field blank sample will be prepared each day for each matrix obtained that day and submitted for the same analyses requested that day. Rinse blanks must be collected at a rate of one rinse blank per type of equipment used each day a decontamination event is carried out. {Note: For groundwater samples only a rinsate will be collected every other day a sampling event is carried out. The reason for this is because only 2 to 4 samples will be collected each day with the low flow sampling method and daily rinsates would produce an unreasonable number of rinsates in proportion to the number of field samples.} It is permissible to use the same aliquot of water on all equipment associated to a particular matrix for analysis of semivolatiles, pesticides, PCBs, explosives, and inorganics. This rinse must be performed sequentially on all sampling equipment. In the field, demonstrated, analyte-free water is poured into the sampling device, and then transferred directly to the sample container. Field blanks for SUMMA canisters or VOST equipment are sample collection media that are subjected to the entire sample collection pathway (i.e., lab to field and back to lab), including all sample handling and transfer processes but are both actually exposed during a sampling event. The results are used to assess whether any contamination or background levels of any substances appear as a result of passive exposure at any points during the handling process.

Field Duplicate: Field duplicates (or replicates) are used to provide an estimate of the precision of field sampling and analytical procedures. A field duplicate sample is defined as two samples that are collected simultaneously from one location. Duplicate samples will each have unique sample numbers, and they will be analyzed separately as two unknowns within the laboratory. Information denoting the true identify of each duplicate will be recorded in the field notebook. Replicate samples must be collected at a rate of one per twenty environmental samples or less per matrix. This is a separate replicate from that prepared and analyzed by the laboratory.

Matrix Spike/Matrix Spike Duplicate:

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to evaluate the precision and accuracy of the analytical methods used by the laboratory. MS/MSD samples are collected using the same procedures as a field duplicate. The extra bottles that will be used for MS and MSD analyses will be labeled the same as the sample. A note will be added to the Chain-of-Custody form that this sample will be used for MS and MSD analyses. One set of MS/MSD samples will be obtained for every 20 samples of each matrix obtained. For soil and sediment samples no additional volume of sample is required.

However, for water samples, i.e., groundwater and surface water, additional volumes of sample must be collected. The laboratory should specify the additional sample volume to run the MS and MSD samples. Typically, triple sample volume is required.

Batch Blanks:

Batch blanks are sample collection media (e.g., VOST tubes or SUMMA canisters) that are extracted from the initial supply received from the vendor and forwarded directly to the lab for analysis. The results are used to determine whether any substances are inherently present on the collection of media by virtue of their composition or as a result of the manufacturing, shipment or preparation processes.

2.4 SAMPLE NUMBERING SCHEME

A uniform sample numbering scheme will be used to be certain that each sample has a unique number. The Site Manager will ensure that the sample numbering scheme is followed in the field so that site workers do not duplicate numbers. The general components of the numbering scheme are 1) matrix, 2) SWMU #, 3) location # and 4) sample #.

The general numbering scheme will be as follows:

Matrix - SWMU # - Location #. Sample #;

Where: Matrix is either SB = Soil Boring;
MW = Monitoring Well;
SW = Surface Water;
SD = Sediment;
SS = Surface Soil;
TP = Test Pit; or
BE = Berm Excavation.

SWMU # is identified according to the assigned SEAD number (e.g., SEAD-4);

Location # is identified consecutively beginning with 1 for each matrix type; and

Sample # is identified consecutively beginning with .1 for each location.

For borings, the depth interval for soil samples will be recorded in a field logbook along with the corresponding sample number. All soil samples collected during a boring will be assigned a number sequentially with depth (i.e., xxx.1, xxx.2, xxx.3, etc.) The samples selected for laboratory analyses will retain their original number assignment.

The distance from shore, water depth, sample depth range, and sample number will be recorded for surface water and sediment samples.

3.0 FIELD OPERATIONS

The task list below is a generic list of all potential field operation tasks that may be performed during RI/FS programs at SEDA. The field tasks are:

1. Initial Site Survey;
2. Unexploded Ordnance (UXO) Survey;
3. Geophysical Survey;
4. Surface and Subsurface Soil Sampling;
5. Monitoring Well Installation;
6. Monitoring Well Development and Sampling;
7. Surface Water and Sediment Sampling;
8. Soil Gas Survey;
9. Sampling for Propellants and Other Materials;
10. Photo Lineament and Fracture Trace Study;
11. Aquifer Characterization;
12. Ecological Investigation;
13. Field Surveying;
14. Investigation Derived Waste Management; and
15. Flux Chamber Emissions Measurements.

The following sections describe the objectives and techniques associated with the previously mentioned tasks.

3.1 INITIAL SITE SURVEY

The initial site survey should consist of field reconnaissance. The site reconnaissance should be performed to locate general site features and confirm the presence of significant features (i.e., buildings, utilities, potential source areas, roads, vegetation, surface water bodies, etc.) identified in the workplan. Also, sampling locations should be identified and marked with stakes and flagging during this initial survey. Consideration should also be given to the accessibility of the site with regard to drilling rigs and heavy machinery.

3.2 UNEXPLODED ORDNANCE CLEARANCE

3.2.1 Objectives

An unexploded ordnance (UXO) survey will be conducted in areas suspected of containing UXOs that will be accessed by field personnel during the conduct of this Work Plan. The UXO survey will consist of:

- Hand-held magnetometry surveys of access routes and areas of SWMUs where field personnel and equipment will be performing field work.
- Flagging suspected UXOs and limits of cleared access routes and sampling routes.
- Down-hole magnetometry surveys during drilling in areas suspected to contain UXOs.

3.2.2 UXO Clearance Procedures

An electromagnetic (active all-metals) induction detector and a passive ferrous metals detector will be used to search the access routes and sampling areas. The hand held magnetometers and a description of their operation are listed below:

1. Electromagnetic (Active All-Metals) Induction Detectors

   Active locators, as a class, generate a magnetic field. Their detection ranges are determined by the strength of their magnetic field, the attenuation of the field in the soil, the size and makeup of the items being sought, and the amount of conductive clutter in the search area. These factors tend to limit active detection ranges to three (3) feet or less, depending on the search instrument. A major advantage to this type of detector is its all metals capabilities. These instruments are capable of detecting ordnance constructed of both ferrous and nonferrous metals. Active locators can affect UXO fuses; therefore it is necessary to have some knowledge of the types of ordnance and their fuzing systems that may be encountered within the search area. The U.S. military currently utilizes locators that employ the multiple-coil, balanced bridge, and phase-imbalance types of active locators.

   The active all-metals magnetometer that will be used is the White's Eagle II SL 90. The White's Eagle II SL 90 is able to detect a 75 to 81 mm projectile at a depth of 1.5 to 2 feet. There are many environmental considerations that can affect the depth of detection (magnetic signatures), i.e., soil characteristics (minerals and salts present), type of metal being detected, size of the metal object, orientation of the object (vertical or horizontal to the linear axis of the object), metallic contamination of the site (wide spread fragmentation), and the capabilities of the detector. Activities such as earth removal and tree grubbing can also change the magnetic signatures in the earth. With all factors taken into consideration, there are no iron clad measurements regarding the sizes of UXOs or depths at which they can be detected.

2. Passive Ferrous Metals Detector

Passive ferrous metal detectors detect anomalies in the earth's magnetic field which are produced by ferromagnetic (ferrous metal) targets. Generally passive locators respond to either: 1) the magnitude of the magnetic field strength (Proton-Precession) or 2) the gradient or rate of change of the field (Fluxgate). The detection ranges of passive locators are dependent on the resolution of the device, the magnetic features of the search area, magnetic features of the item being located, and the search technique being used (i.e., continuous sweep or grid mapping). The standard passive magnetometers in use today to detect ordinances are of the Fluxgate and the Proton-Precession types.

The passive ferrous metal magnetometers that will be used are the Mk 26 Mod 0 Ordrnance Locator (Forster Ferex 4.021) and the Schonstedt Model GA-52B.

Extreme care for the personnel and equipment entering the site's sampling areas is required at certain SWMUs where ordinances and UXOs are likely to be present. Some of these items have been exposed to fire or explosions and because of this, any of these items which are still explosively loaded are extremely hazardous. The active all-metals and passive detectors will be used to search the access routes and sampling sites for hazardous items.

Depending upon the object size, physical properties (ferrous or nonferrous) and depth of burial, large non-ordnance metal objects may also be located and marked on the SWMU areas. Excavation to determine the identification of these items will be performed as needed to complete the study of the ten SWMUs (See Section 3.3).

UXOs will not be moved unless absolutely necessary. A qualified SEAD UXO removal team consisting of personnel who have graduated from the U.S. Naval EOD School, Indian Head, Maryland will be required to move and properly dispose of any UXOs.

All UXOs that can be safely moved and must be moved, will be moved remotely. Under no circumstances will any of the following items be moved (remotely or otherwise) by EOD personnel:

1. UXO with a point initiating base detonating-lucky (PIBDL) fuse;
2. UXO with a Mechanical Time fuse;
3. UXO with an All-Ways-Acting fuse;
4. UXO with a Cocked Strike fuse;
5. UXO with a Graze Back Up fuse; and
6. Any UXO with a fuse system that cannot be identified.

3.2.3 Downhole Magnetometry Survey

Specialized techniques such as down hole magnetometry can also be performed. If manual operation of the soil boring equipment is performed, rechecks of the bore hole at two (2) foot intervals until virgin soil is encountered will be performed. If remote drilling procedures are employed, no additional checks of the site are required after the initial active all-metals and passive ferrous metals inspection of the sampling site have been performed.

3.2.4 Flagging Suspected UXOs and Cleared Areas

All UXOs discovered during the survey will be marked with yellow flags. Cleared access routes and work areas will be outlined with orange flags. Field personnel will not go outside the delineated cleared areas.

3.2.5 Data Verification

Data verification for UXO clearance will be an ongoing process during the clearance of the access routes and sampling areas with the main emphasis being the location of hazardous UXOs and components.

3.3 GEOPHYSICAL SURVEYS

3.3.1 Seismic Refraction

3.3.1.1 Objectives

Seismic refraction surveys may be performed at the SWMUs to determine the direction of groundwater flow by measuring the depth to the water table, provided that no existing monitoring wells (at least three) can be used to determine groundwater flow direction. These data, along with land topographic information, will be used to more accurately locate the up and downgradient monitoring wells. Seismic refraction may also be used to characterize the depth to bedrock at the site.

3.3.1.2 Field Procedures

3.3.1.2.1 Survey Line Layout

Seismic refraction transects will be laid out at each site. The shot point locations along each profile will be located using a metal tape and marked with spray paint or flagging. These shot point locations will be used to define each individual seismic spread. The seismic data will be collected using an industry standard 12 or 24 channel signal enhancement seismograph.

The geophone cable will be laid out along each profile using the shot point locations described above. In grassy areas, the geophones will be coupled to the ground using 3 inch metal spikes that are attached to the base of the geophone. When the geophones are to be placed on asphalt or concrete, small metal base plates will replace the metal spike on each geophone. The geophones placed on asphalt or concrete will be weighted down using small 2 to 3 pound sand bags to improve overall coupling with the ground and to help minimize background noise levels. Geophones will be spaced at 5 feet or less throughout the survey, based on site conditions and in-field evaluation of the data.

Once the seismograph setup is complete and data collection is ready to commence, the background noise level at each geophone location will be monitored. The background noise is displayed on the seismograph CRT as a series of moving bars, the amplitude of which is proportional to the background noise level. This review provides information on ambient noise levels, while also highlighting geophones that may be malfunctioning. Geophones that display a high level of noise will be moved or have their placement adjusted.

3.3.1.2.2 Seismic Energy Source

An impact or dropped weight will be used as the seismic energy source. Due to the shallow nature of the water table (i.e., generally less than 10 feet in depth) a low energy source will be sufficient to accurately image the water table surface.

3.3.1.2.3 Data Collection

Three shots will be fired for each geophysical spread located at the spread ends and spread center. A paper copy of each seismic record will be made in the field. Each record will be reviewed for quality to insure that adequate signal to noise levels were present for the shot. Upon initial acceptance, a preliminary velocity analysis will be performed in the field to define the subsurface structure along each spread. This preliminary review will focus on determining if the water table surface has been properly resolved. Upon final acceptance of each shot, the seismic record will be annotated to identify the transect number, the spread number, the shot point number, and the shot point location.

After each record is reviewed, accepted, and annotated, the data collection procedure is repeated for the remainder of the shot points for each spread.

3.3.1.2.4 Surveying

Subsequent to the seismic data collection, a survey will be performed to provide X,Y,Z station information for the seismic shot point locations to ± 1.0 feet horizontally and ± 0.1 feet vertically. These data will be used during seismic data reduction and seismic modeling.

3.3.1.3 Data Reduction

3.3.1.3.1 First Break Analysis

The seismic refraction method relies upon the analysis of the arrival times of the first seismic energy at each geophone location to provide details about the subsurface geology. The time when the seismic energy arrives at each geophone location is referred to as the first break. Each seismic record will be reviewed, both using the seismograph CRT and the paper records, to determine the first breaks at each geophone. This analysis will be preliminarily performed in the field with the data checked after the completion of the field program. These first break data values will be tabulated and used to create time-distance plots as described below.

3.3.1.3.2 Time-Distance Plots

For each seismic spread, a graph will be made of the first break determinations for all of the spread shot points. These graphs will display, in an X-Y plot, the first breaks (time) versus the geophone locations (distance). These time-distance plots form the basis of the geophysical interpretation.

3.3.1.3.3 Velocity Analysis/Layer Assignment

The time-distance plots will be individually analyzed to assign each first break arrival to an assumed layer within the subsurface. It is estimated that up to four distinct seismic layers may exist at the site. These include the unsaturated and saturated surficial deposits, the weathered bedrock, and the competent bedrock. In general, these various layers can be grouped into broad ranges of seismic velocities. As an example, unsaturated deposits will generally have a seismic velocity of less than 2,500 feet per second. By comparison, the saturated deposits should have seismic velocities in the range of 4,500 to 5,500 feet per second.

The time-distance plots will be interpreted to yield the velocity distribution within the subsurface. Each first break arrival will be assigned to one of the above mentioned layers. This velocity analysis and layer assignment will form the basis for the data files to be used during the seismic modeling.

3.3.1.4 Data Interpretation

3.3.1.4.1 Computer Processing

Once the first break analysis and layer assignments are complete, input seismic data files will be created for use in the seismic modeling software. The input files include all of the information pertaining to the spread geometry, shot point locations and depths, first break arrivals, and layer assignments. The elevation data will also be input into the computer files. The computer program, SIPT2 version 2 of the Bureau of Mines original program SIPT (Scott, 1977) will be used to model the seismic data.

The following software programs will be used for seismic data acquisition, processing and interpretation.

SIPIK-Electronic data transfer from seismograph to personal computer and interactive first break picking.

SIPIN-Creation of input files necessary for interpretation program SIPT2.

SIPT2-Two dimensional cross-sectional modeling program for layer velocity interpretation.

All of these programs are produced by Rimrock Geophysics, Inc. of Lakewood, Colorado. SIPT2 is version 2 of the Bureau of Mines original program SIPT.

In summary, the following procedures and software are utilized in the collection, processing, and interpretation of seismic refraction data. After the data is collected with the seismograph it is electronically transferred from the seismograph to a personal computer using the program SIPIK. In addition to data transfer capabilities, this software allows the user to perform computerized first break picks of seismic arrivals. Along with this program Parsons ES utilizes the program SIPIN which allows the user to define all data collection parameters and format the data files for direct input to the program SIPT2. SIPT2, which is version 2 of the program SIPT, allows for the interactive computer interpretation of the seismic refraction data. Throughout this entire process there are no manual data entry steps.

This is discussed further in the following sections.

3.3.1.4.2 Computer Modeling

The computer program SIPT2 will be used to model the seismic refraction data. SIPT2 is an interactive computer program developed for the inverse modeling of seismic refraction data. SIPT2 reads data directly from the multi-channel seismograph and allows it to be processed immediately using many methods. This program uses input seismic refraction data to create two-dimensional cross-sectional models of velocity layering within the subsurface. The program uses the delay time method to produce a first approximation of the subsurface velocity layering. This approximation is then refined through the use of iterative ray tracing and model adjustment to minimize the differences between field measured first arrival times and the forward modeled raypath times. The program also provides various levels of velocity analyses that will be reviewed to provide diagnostic information on the model solutions.

3.3.1.4.3 Interpretation

The results of the computer modeling will be reviewed with the known geology of the site. The subsurface velocity layering will be attributed to known or expected geologic units. A detailed analysis will be made of the velocity distribution of the upper, unsaturated materials to ensure that, near surface low velocity materials are not adversely affecting the data quality and interpretation. The velocity distribution within the bedrock will also be reviewed to provide information on the presence and degree of weathering and to identify any lithologic or fracture related changes within the bedrock.

3.3.1.4.4 Seismic Cross-Sections

Based upon the seismic refraction data and the logs from the various monitoring wells, two seismic cross-sections will be generated for each SWMU. These cross-sections will show the land surface elevation and the elevation of the water table and bedrock surfaces. If the presence of other geologic units is determined from the seismic data, these will also be shown. The locations of bedrock piezometers, along with the stratigraphic information derived from them, will be shown on these cross-sections.

3.3.2 Electromagnetic (EM-31) Survey

3.3.2.1 Objectives

Electromagnetic (EM-31) surveys may be performed at selected SWMUs. The objectives of the EM-31 surveys will be to delineate waste boundaries, identify the location of buried metallic objects, and identify the locations of old disposal pits. The EM-31 method will typically be employed in conjunction with Ground Penetrating Radar (GPR) surveys so as to provide significant redundancy during the geophysical investigations.

3.3.2.2 EM-31 Survey Procedures

The electromagnetic data at each SWMU will be collected using both grid and profile based surveys. In general, the grid based surveys will use either a 10 foot by 10 foot or 20 foot by 20 foot grid spacing. The corners of the geophysical survey grids will be established using a registered NY State land surveyor. The individual EM-31 survey lines and station locations will be established using both hip chains and hand held compasses.

At all of the SWMUs where EM-31 data will be collected, a data logger will be used to record the individual electromagnetic readings. Both the in-phase and quadrature components of the electromagnetic field will be measured and recorded. Readings will be measured both parallel and at 90° to the transect line at every location. These data will in turn be stored on a computer and printed out at the end of each field day. For each SWMU where EM-31 data is to be collected, a calibration area, free of cultural interference, will be established. The EM-31 response will be measured at this area at the start of each day. This check will be made every 2-3 hours throughout the survey to insure that no significant meter drift is occurring during each survey.

3.3.2.3 Data Interpretation

Upon completion of each electromagnetic survey, the data will be presented in both profile and contour form. Both the in-phase and quadrature components will be plotted. This multiple presentation format will aid in the interpretation of the data. All of these presentation aids will be interpreted to identify the locations of buried metallic objects, disposal pits, waste boundaries, and areas of elevated subsurface soil apparent conductivities. These data will be compared to the results of the GPR surveys to provide as complete and accurate interpretation of the subsurface conditions at each SWMU as possible.

3.3.2.4 Data Verification

The EM-31 instrument is calibrated by the manufacturer. This calibration can be rechecked in the field but this requires that access to highly resistive rock outcrops are available. A secondary field calibration is performed on a daily basis to insure repeatability of measurements and to check against daily meter drift. This field calibration is the only performance evaluation that is performed on these instruments. The EM-31 data will be collected at each SWMU to evaluate only relative variations in subsurface conductivities. The absolute terrain conductivity is not required since the individual SWMU objectives are to identify relative variations in subsurface conditions associated with waste boundaries, buried metallic objects, etc. During the individual SWMU surveys, up to five station repeats will be performed on a daily basis so as to qualitatively evaluate the overall data repeatability.

3.3.3 Electromagnetic (EM61) Survey

3.3.3.1 Objectives

Electromagnetic surveys may be conducted with the Geonics EM61 High-Sensitivity Metal Detector at selected SWMUs. The objective of the EM61 surveys is to identify the location and depth of buried metallic objects, including UXO, utility lines, underground storage tanks, and waste disposal pits. The unit is capable of detecting a single drum at a depth of about 10 feet. The EM61 utilizes time-domain electromagnetic principles to provide higher resolution and rejection noise than the frequency-domain EM31. However, the EM61 is not well-suited to map shallow groundwater contamination or changes in surficial geologic materials.

3.3.3.2 EM61 Survey Procedures

The EM61 can be operated by one person. The device consists of a one-meter square transmitter/receiver frame, an electronics backpack, and a hand-held data logger. The frame houses two coaxial coils: one 40 cm above the other. The frame may be equipped with wheels and towed as a cart behind the operator. Alternatively, in rough terrain, the wheels are removed and the transmitter/receiver frame may be carried by the operator.

The corners of each EM61 grid will be established by a registered NY State land surveyor. Additional temporary markers or flags will be placed for control within the grid. Data is typically collected along parallel profile lines spaced 5 feet apart. Discrete measurements are taken every 8 inches along the profile lines. Measurements are automatically triggered by the survey wheel and stored in the data logger. The voltages (mV) induced in both receiver coils are recorded at each station.

In addition to the EM61 operator, a second individual will record the progress of the survey as well as any surface features that might affect the response of the instrument. Detailed recordkeeping will facilitate the discrimination of surface and subsurface objects. This person will also place survey markers to allow the EM61 operator to maintain accurate profile lines.

3.3.3.3 Data Interpretation

Upon completion of each EM61 survey, the data will be presented in both profile and contour form as a check of data quality and completeness. After correcting for bias or offset in each data set, the response from the lower coils will be presented as color contour maps to facilitate interpretation. The difference in the response of the upper and lower coils may be used to estimate the depth of each anomaly. The EM61 data will be compared to the results of other geophysical surveys to provide a comprehensive interpretation of subsurface conditions.

3.3.3.4 Data Verification

The EM61 is calibrated by the manufacturer. There is no means or necessity to calibrate the instrument in the field. The functionality of each instrument is tested daily by passing the EM61 over a known metallic object and noting the response. The background response of the EM61 may vary slightly from day to day or from instrument to instrument. However, post-processing of the data removes this bias. Interpretation of EM61 data requires only the relative response of each receiver coil.

3.3.4 Ground Penetrating Radar (GPR) Survey

3.3.4.1 Objectives

A GPR survey of selected areas within a SWMU will be conducted to locate buried structures (i.e., buried or filled-in pits, trenches, disposal areas) and obtain more information on anomalies detected during the electromagnetic surveys. GPR can also identify the original ground surface beneath berms.

3.3.4.2 GPR Survey Procedures

The GPR instrument will be hand operated on the areas at each SWMU identified in Section 4 of the Work Plan. As the equipment is pulled across the site, the reflected radar pulses are transmitted to the receiver unit where they are converted to analog signals. The analog signal is transmitted to the control unit where the signal is electronically processed and sent to the graphic recorder. The graphic recorder produces a continuous chart display on electro-sensitive paper. This real-time display enables the operator to interpret the data on site.

3.3.4.3 Data Verification

Data from the GPR survey will be verified when subsurface explorations are performed to identify anomalies and penetrate through disposal pits.

3.3.5 Exploration of Subsurface Geophysical Anomalies

3.3.5.1 Objectives

Exploration of subsurface geophysical anomalies will be performed to verify the data obtained during the GPR and electromagnetic surveys.

3.3.5.2 Excavation Procedures

Only those SWMUs that potentially contain UXOs will be investigated by a UXO technician with the aid of UXO Safety Officer and UXO Project Leader. All SMWUs not suspected of containing UXOs will have excavations performed without the aid of UXO personnel.

The excavations will be performed using a backhoe with a smooth-edged bucket operated by a UXO technician (if required). At no time will non-UXO personnel be permitted on the excavation site until they are cleared to enter by the UXO Safety Officer. The excavation will extend to a distance of five feet on either side of the subsurface anomaly. The width, length, and depth will be based on the size of the geophysical anomaly with applicable considerations for prevailing conditions such as flooding or stability of the excavation. Based on consultation with the Project Leader, UXO Project Leader, and UXO Safety Officer, the final depth of excavation will be decided. The boom and bucket of the backhoe will be operated in such a manner as to not exert impact or shock to the soil or its contents. The depth of the excavation increment (not to exceed two feet) will be at the discretion of the UXO Safety Officer. The contents of each bucket of material removed from the excavation will be gently placed on the ground and spread out to expose the contents as much as possible for a visual inspection. If at any time during the excavation, the UXO Safety Officer determines the risks and hazards are too great to proceed with the excavation, the excavation will be halted. The UXO Safety Officer has absolute and final authority in determining the procedures and safety issues associated with the excavation. All SWMUs not suspected of containing UXOs will be investigated without the aid of UXO personnel.

The excavation will be continuously monitored with a PID or OVM. At no time will any personnel be permitted to enter the excavation. If the pit is not closed immediately after any samples have been obtained, the excavation will be barricaded to prevent accidental entry by personnel working on the site. Each excavation will be marked after closure as needed for identification of the site.
A log containing the location of each excavation will be maintained by the UXO team. The log will include the excavation number, location, items observed (such as UXOs or drums), and other significant data. Records pertaining to sampling, geological data and associated requirements will be maintained by the project geologist as described in Section 3.4.3 of this appendix.

Due to the potential hazards associated with the excavations, when necessary, the UXO contractor will obtain samples for the project geologist in accordance with the sample collection procedures described in Section 3.3.3 of this appendix. The excavation equipment will be cleaned between excavation sampling operations in accordance with decontamination procedures outlined in Section 4.4 of this appendix.

3.4 SOIL SAMPLING

3.4.1 Objectives

Surface and subsurface soil samples will be obtained to determine the nature and extent of contamination within and around each SWMU; and establish background levels in similar soils.

3.4.2 Boring Techniques

Hollow stem augers (4.25 or 6.25 inch I.D.) will be used to drill each boring. The borings will be advanced to "refusal" which will represent the depth of the "competent" bedrock. Penetration through the till and upper few feet of the weathered shale can be easily documented by split spoon sampling and the augering rate. However, the determination at auger "refusal" in competent shale will be somewhat subjective as the hollow stem augers can generally penetrate through the shale although at a very slow rate. For the purposes of these studies, auger "refusal" in "competent" shale will be defined as the depth (after penetrating the weathered shale) when augering becomes significantly more difficult and auger advancement is slow.

Remote drilling operations may be required at some of the SWMUs due to the potential presence of unexploded ordnance. Drilling procedures could involve the manual set up of the augers and split spoons, remote auguring, remote driving of the split spoon and manual retrieval of the split spoon sample.

Soil samples will be collected continuously during the boring using a standard three-inch diameter, two-foot long carbon steel split spoon barrel. Soil samples will be screened for volatile organic compounds using a PID or OVM and for radioactivity with a radiation meter. Three of the samples from each boring will be selected for chemical analysis: 1) 0 to 2 inches below grade; 2) immediately above the water table; and 3) midway between samples (1) and (2). The intermediate sample will be collected at a depth where one of the following site specific items occurs: (1) a stratigraphic change such as the base of the fill, (2) evidence of perched water table, (3) elevated photoionization detection (PID) readings, or (4) visibly affected soil (e.g., oil stains). If none of these occur, then the intermediate sample will be collected at the halfway point between the samples collected at the surface and at the water table. If intermediate split spoon samples exhibit elevated PID readings, the one with the highest concentration will be the one intermediate sample to be analyzed. Each of these samples will be submitted for chemical testing for parameters identified in the Chemical Data Acquisition Plan. Samples to be analyzed for volatile organic compounds will be collected first in two 40 ml vials with septum seals; these soil samples will not be homogenized or composited during the sampling process. The remaining soil from the spoon will be mixed (homogenized) in a decontaminated stainless steel bowl with a decontaminated stainless steel utensil and placed in appropriate sample containers.

All borings will be logged using a standardized boring log form (Figure A-2). Soil samples will be classified according to the Unified Soil Classification System (USCS). In addition, a lithologic description will be provided according to the Burmiester system. Each boring log will record:

1. Boring identification and location;
2. Type of and manufacturer's name of drilling equipment;
3. Type and size of sampling and drilling equipment;

4. Starting and ending dates of drilling;
5. Length and depth of each sampled interval;
6. Length of each recovered sample;
7. Depth of all stratigraphic changes;
8. Lithologic description according to the Burmiester system and soil classification using standard USCS nomenclature;
9. Depth at which groundwater is first encountered;
10. Depths and rates of any water losses;
11. Depth to static water level;
12. Depths at which drilling problems occur and how the problems are solved;
13. Total boring depth;
14. Reason for terminating borehole;
15. Surface elevation; and
16. VOC readings of split spoon samples.

Selected soil samples will be collected for grain-size analysis. The data will be used for one or more purposes including selection and design of remediation technologies, estimation of hydraulic conductivity, and if necessary, selection of sand pack material for well construction. Soil samples will be collected above and below the water table. The grain size analysis will be performed using ASTM method D:422-63 or a similar method and will include a determination of the particle size distribution of the silt and clay fraction [No. 200 (75nm) sieve] using a hydrometer or similar method. The results will be plotted on a grain-size distribution curve.

After the boring is completed, it will be filled to the ground surface with lean grout containing at least 3% bentonite powder by volume. The cement/bentonite grout seal will be placed from the bottom of the boring to approximately 3 feet below the land surface by pouring the mixture into the hole. The grout mixture will consist of Portland cement (ASTM C 150-86) and water in the proportion of not more than 7.0 to 8.0 gallons (gal) of clean water per bag of cement [1 cubic foot (ft^3) or 94 pounds (lb)]. Additionally, 3 percent by weight of bentonite powder will be added to help reduce shrinkage of the grout mixture. The grout will be allowed to set a minimum of 48 hours. If the borehole is greater than 15 feet and groundwater is present in the borehole, the grout will be pumped through a tremie pipe to the bottom of the boring. Grout will be pumped in until undiluted grout discharges from the bore hole at the ground surface. A bentonite backfill consisting of bentonite pellets will be placed from the top of the cement/bentonite grout seal to the ground surface and allowed to hydrate.

PAGE 1 OF

OVERBURDEN BORING REPORT

ENGINEERING-SCIENCE, INC. | **CLIENT:** | **BORING NO.:**

PROJECT :

LOCATION :

JOB NO. :
EST. GROUND ELEV.:
START DATE:
FINISH DATE:
CONTRACTOR:
DRILLER:
INSPECTOR:
CHECKED BY:
CHECK DATE:

DRILLING SUMMARY:

DRILLING METHOD	HOLE DIA.	DEPTH INT.	SAMPLER SIZE	SAMPLER TYPE	HAMMER TYPE	HAMMER WT/FALL

DRILLING ACRONYMS:

HSA	HOLLOW-STEM AUGERS	HMR	HAMMER	SS	SPLIT SPOON
DW	DRIVE-AND-WASH	SHR	SAFETY HAMMER	CS	CONTINUOUS SAMPLING
MRSLC	MUD-ROTARY SOIL-CORING	HHR	HYDRAULIC HAMMER	5I	5 FT INTERVAL SAMPLING
CA	CASING ADVANCER	DHR	DOWN-HOLE HAMMER	NS	NO SAMPLING
SPC	SPIN CASING	WL	WIRE-LINE	ST	SHELBY TUBE
				3S	3 INCH SPLIT SPOON

MONITORING EQUPMENT SUMMARY

INSTRUMENT TYPE	DETECTOR TYPE/ENERGY	RANGE	BACKGROUND READING	BACKGROUND TIME	BACKGROUND DATE	CALIBRATION TIME	CALIBRATION DATE	WEATHER

MONITORING ACRONYMS

PID	PHOTO - IONIZATION DETECTOR	BGD	BACKGROUND	DGRT	DRAEGER TUBES
FID	FLAME - IONIZATION DETECTOR	CPM	COUNTS PER MINUTE	PPB	PARTS PER BILLION
GMD	GEIGER MUELLER DETECTOR	PPM	PARTS PER MILLION	MDL	METHOD DETECTION LIMIT
SCT	SCINTILLATION DETECTOR	RAD	RADIATION		

QA/QC:

QA/QC SAMPLES COLLECTED: YES or NO
Duplicate Sample Number:
MRD Sample Number:

QA/QC Rinsate Sample Number:

INVESTIGATION DERIVED WASTE:

AMOUNT OF SOIL DRUMMED:

DRUM NUMBER:

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FIGURE A-2

OVERBURDEN BORING REPORT

ENGINEERING-SCIENCE, INC.	**CLIENT:**	**BORING #:**

MONITORING				COMMENTS:	
INSTRUMENT	INTERVAL	BGD	TIME		DRILLER:
					INSPECTOR:
					DATE:

DEPTH (FT)	SAMPLING			SAMPLE				SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
	BLOWS PER 6 INCHES	PENE-TRATION RANGE (FEET)	RECOV-ERY RANGE (FEET)	DEPTH INT (FEET)	NO.	VOC	RAD SCRN			
5										
10										
15										
20										

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FIGURE A-2 (cont.)

OVERBURDEN BORING REPORT

ENGINEERING-SCIENCE, INC.	**CLIENT:**	**BORING #:**

MONITORING			
INSTRUMENT	INTERVAL	BGD	TIME

COMMENTS:

DRILLER:

INSPECTOR:

DATE:

DEPTH (FT)	SAMPLING			SAMPLE				SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
	BLOWS PER 6 INCHES	PENE-TRATION RANGE (FEET)	RECOV-ERY RANGE (FEET)	DEPTH INT (FEET)	NO.	VOC	RAD SCRN			

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FIGURE A-2 (cont.)

Split spoon barrels will be decontaminated as described in Section 4.4 of this appendix. Drilling augers will be steam cleaned along with other drilling equipment between boring locations.

3.4.3 Test Pitting Techniques

The primary objective of the test pitting is to provide a means for visual evaluation of subsurface soils and collection of soil samples. Test pitting will also be used to investigate anomalies discovered during the geophysical surveys.

Test pit locations will be marked in the field prior to performing the excavation. The excavations will be performed with a backhoe using a smooth edged bucket when possible. The top 6 to 12 inches of soil will be segregated so that it can be used to cover the other backfilled soils when the test pit is closed. The length and width of the excavation will be kept as small as practical to minimize the potential of exposing field personnel to hazardous conditions. If UXOs or explosives are anticipated to be present, UXO personnel will perform the excavation and obtain the soil samples. Procedures to excavate soils that may contain UXOs are described in Section 3.2.4 of this appendix. A staging area, which includes run-off containment features, will be set up for visual inspection of the soils so that soils partially contaminated with hazardous constituents are not spread out over the site. If UXOs or explosives are observed in excavated soils where they were not anticipated, the excavation will be stopped until the UXO personnel can examine the situation and recommend a course of action to the AE Safety Officer.

The excavation will be continuously monitored by the project geologist with a PID. At no time will any personnel be permitted to enter the excavation. Any containers excavated from a pit containing liquid or solid substances will be overpacked and, later, tested for hazardous constituents. The test pit will be closed by backfilling the pit with the soil that was removed from it. As discussed above, the surface soils will be backfilled last. If the pit is not to be closed immediately after the required samples have been obtained, the excavation will be barricaded to prevent accidental entry by personnel working on the site. Each excavation will be marked after closure as needed for identification of the location.

A log for each test pit will be prepared to record the subsurface soil conditions, monitoring data, location of samples obtained, and other information as shown in Figure A-3. Where appropriate, photographs of the test pits will be taken.

Samples will not be collected from every test pit location, as some test pits will be excavated only to investigate the source of geophysical anomalies. The criteria for selecting test pit samples will depend on the scope defined in the RI/FS Project Scoping Plan. However, in general the test pit samples will be collected at a depth where one of the following occurs: 1) a stratigraphic change as at the base of fill, 2) evidence of a perched water table, 3) elevated PID readings, or 4) visibly affected soil (i.e., oil stains).

Test pit samples will be collected using the bucket of the backhoe. The bucket will be scraped along the side of the test pit at the desired depth to allow sediment to fall into the bucket or the bucket will scoop soil from a desired depth in the test pit. Samples for volatile organic analyses will be collected from the bucket and placed in vials. For the remaining samples, the soil will be collected from the backhoe bucket with a stainless steel shovel or scoop, mixed in a stainless steel bowl, then transferred to the appropriate sample containers.

Some composite samples will be collected from test pits. To prepare soil composite samples, equal sized subsamples are placed into a decontaminated stainless steel container (e.g., bowl, pan) and thoroughly mixed. The required volume is then recovered and placed into the sample container, while the excess is discarded. Whenever possible compositing of soils should be limited to situations where dry or loosely bound (non-agglomerated) materials are present, as wet or agglomerated materials are difficult to homogenize without mechanical devices.

The excavation equipment will be cleaned between test pit excavations as described in Section 4.4 of this appendix.

Berm excavations with a back hoe will be performed in the same manner as test pits.

3.4.4 Surface Soils

Grab samples of surface soils will be obtained by removing a representation section of soil from 0 to 2 inches below ground surface. The section will have a similar cross-section over the entire depth range of the sample. Volatile organic samples will be collected as core samples from a depth of 0 to 2 inches below ground surface (less organic matter). Data regarding the soil sample will be recorded on the sampling record form for soils (Figure A-4). Surface soil samples will be collected with a stainless steel trowel or scoop, then placed

TEST PIT REPORT

ENGINEERING-SCIENCE, INC.	CLIENT:	TEST PIT #:

PROJECT:
LOCATION:

JOB NUMBER:
EST. GROUND ELEV.
INSPECTOR:
CONTRACTOR:
START DATE:
COMPLETION DATE:
CHECKED BY:
DATE CHECKED:

TEST PIT DATA

LENGTH	WIDTH	DEPTH	EXCAVATION / SHORING METHOD

MONITORING DATA

INSTRUMENT	DETECTOR	BACKGROUND	TIME/ DATE

QA/QC DUPLICATE SAMPLE: YES or NO
Duplicate Sample Number:
MRD Sample Number:

QA/QC Rinsate Sample Number:

COMMENTS:

SCALE (FT)	VOC./ RAD.	SAMPLE		STRATA SCHEMATIC	DESCRIPTION OF MATERIALS (BURMEISTER METHODOLOGY)	REMARKS
		NUMBER	DEPTH RANGE			
1						
2						
3						
4						
5						

TEST PIT REPORT

ENGINEERING-SCIENCE, INC.	**CLIENT:**	**TEST PIT #:**

MONITORING DATA

INSTRUMENT	DETECTOR	BACKGROUND	TIME/ DATE

DATE START:

DATE FINISH:

INSPECTOR:

CONTRACTOR:

SCALE (FT)	VOC./ RAD.	SAMPLE		STRATA SCHEMATIC	DESCRIPTION OF MATERIALS (BURMEISTER METHODOLOGY)	REMARKS
		NUMBER	DEPTH RANGE			

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FIGURE A-3(cont.)

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SAMPLING RECORD - SOIL/SEDIMENT

ENGINEERING - SCIENCE, INC.

CLIENT:

DATE:

PROJECT:

LOCATION:

INSPECTOR:
LABORATORY:
SAMPLING STAFF:
CHAIN OF CUSTODY #:

WEATHER / FIELD CONDITIONS CHECKLIST (RECORD MAJOR CHANGES)

TIME (24 HR)	TEMP (APPRX)	WEATHER (APPRX)	REL. HUMIDITY (GEN)	WIND VELOCITY (APPRX)	WIND DIRECTION (0 - 360)	GROUND / SITE SURFACE CONDITIONS

MONITORING

INSTRUMENT	DECTECTOR

SAMPLE #	DEPTH RANGE	TIME	TYPE (GRAB / COMP.)	COLOR	GRAIN SIZE	USCS CLASS	FOREIGN MAT. (Y/N)	SAMPLE DEVICE	CLEANING PROCEDURE	CONTAINER SIZE/TYPE	MON. VOC/RAD	QC SPL (Y/N)

QA/QC SAMPLES:

QA/QC DUPLICATE SAMPLES COLLECTED: YES or NO
Duplicate Sample Name:
MRD Sample Name:

QA/QC RINSATE SAMPLE NAME:

COMMENTS:

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FIGURE A-4

in a stainless steel bowl. Any VOC samples will be placed in VOA vials before mixing the soil. The soil will then be mixed and placed in the remaining sample containers.

3.4.5 Health and Safety Procedures

All soil sampling will be performed in accordance with the health and safety procedures described in Appendix B of this Work Plan. At SWMUs where there is a potential for UXOs and explosives, access routes and sampling work areas will be searched by UXO personnel prior to soil sampling operations. The boundaries of the access routes will be marked with orange survey flags. All UXOs located during the search operation will be flagged with yellow survey markers.

Remote drilling and test pitting by UXO personnel will be performed at locations deemed advisable by the Project Manager and UXO personnel.

All samples collected during the soil sampling operations at potentially UXO SWMUs will be inspected by UXO personnel for small UXO components prior to on-site testing or shipment for off-site laboratory testing. In areas heavily contaminated by UXOs or UXO components, samples will be collected by UXO personnel.

3.5 MONITORING WELL INSTALLATION

This section outlines the installation of overburden monitoring wells. In the event that monitoring well pairs or clusters are necessary, this section also discusses installation of shallow and deep bedrock wells. A 4 1/4-inch or 6 1/4-inch hollow-stem auger will be used to drill the borings and install the overburden wells. If necessary, rock coring or air rotary methods will be employed for drilling and installing the monitoring wells in bedrock.

All activities described in this procedure will be overseen by a qualified geologist.

3.5.1 Objectives

The objectives of this task are to install monitoring wells that will provide representative samples of groundwater quality and accurate determinations of piezometric head in the overburden and, if necessary bedrock, aquifers. The overburden wells will have a maximum screen length of ten feet and will be screened across the water table and through the entire till/weathered shale aquifer if possible. Based on depth to water measurements and boring logs from previous reports on the Seneca Army Depot Facility, the water table occurs within the till. If the water table occurs in competent bedrock or there is a potential for impacts to groundwater in bedrock, shallow and/or deep bedrock wells may be installed. If a saturated thickness of greater than 20 feet is encountered multiple monitoring wells will be installed.

3.5.2 Decontamination of Equipment

Every appropriate precaution must be taken during drilling and construction of monitoring wells to avoid introducing contamination into the borehole. All equipment to be placed into the boring will be decontaminated before use at the site and between boreholes using EPA Region II and NYSDEC protocols. Equipment must be steam-cleaned between holes and only non-chlorinated potable water may be used during drilling operations, unless otherwise approved by the NYSDEC. The manufacturers of PVC pipe immediately wrap the pipe in plastic bags after it comes off the extrusion line to protect the pipe from any contamination during storage and transport. Companies who prepare the pipe for use in well construction typically slot the pipe, dust it, wash it with a mild Alconox solution, and also wrap it in plastic to protect if from contamination during storage and transport. The PVC pipe will be steamcleaned prior to installation in the borehole.

3.5.3 Well Installation

This section provides information on installation of overburden and bedrock monitoring wells as well as microwells, which will be used for collecting groundwater for field screening.

Proper design, construction, and installation of the proposed monitoring wells are essential for accurate interpretation of the groundwater data. The program to be implemented is consistent with the USEPA Region II CERCLA QA Manual and the NYSDEC Technical and Administrative Guidance Manuals (TAGMS) regarding design, installation, development and collection of groundwater samples. Further, the program is in compliance with all requirements described in the NYSDEC, 6 NYCRR Part 360, Solid Waste Management Facilities Regulations, Section 360-2.11, which details groundwater monitoring well requirements.

The installation of each monitoring well will begin after the boring has been completed. Only one well will be installed in each boring. Installation will begin within 48 hours for fully cased boreholes. Once installation has begun, no breaks in the installation process will be made until the well has been grouted and the drill casing removed. In some instances installation of well clusters (i.e., overburden and bedrock wells) may be required. The number of wells at a sampling location will depend on the heterogeneity and simplicity of the geology, the physical/chemical properties of the contaminants, and the location of the suspected sources of pollutants.

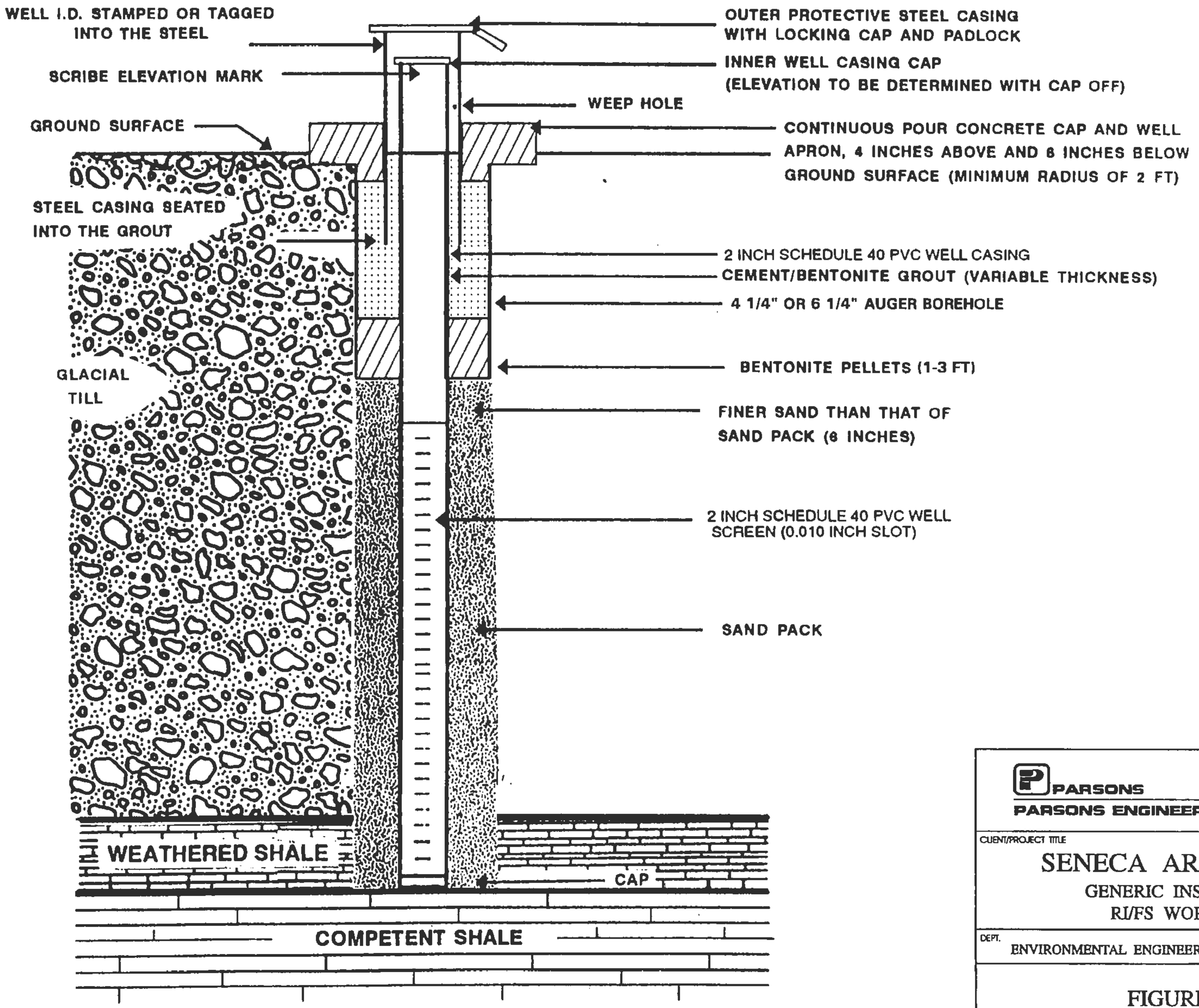
Overburden wells will be installed using hollow-stem augers. These wells will be screened from 3 feet above the water table to the top of competent bedrock. Figures A-5 and A-6a illustrate typical overburden monitoring well details. Water table variations, site stratigraphy, expected contaminant flow will also be considered in determining the screen length and position. Previous well logs and current fieldwork suggest these wells will not be more than 20 feet deep with well screen lengths of 10 feet or less. Soil split spoon samples will be collected continuously as the auger penetrates the formation. Soil samples will be collected as described in the soil boring program. The monitoring wells will be constructed of new 2-inch National Sanitation Foundation (NSF) or ASTM-approved schedule 40 PVC wire wrapped screens as required by NYSDEC with threaded, flush joints that contain a rubber gasket. No solvents or gloves, or other adhesives will be used to connect the PVC casing. A silt sump "point" will be placed at the bottom of each well.

The slot size for the monitoring wells has been determined and approved as part of an earlier RI at the Ash Landfill at SEDA. NYSDEC, USEPA, and the Army have reviewed the grain size curves for till and weathered shale from the OB Grounds as well as the documentation determining the proper screen size based on these curves. Given the types of formation materials (which were confirmed from visual soil classification at the OB Grounds, Ash Landfill, and 25 ESI sites in various locations at SEDA) the nature of their deposition, and their widespread distribution in the area, the till and weathered shale samples are not significantly different from the OB Grounds to preclude the use of these curves from the OB Grounds for slot size selection at the sites involved in this RI/FS program. A 0.010-inch slot size used with a #3Q-ROC filter pack was determined to be appropriate for the monitoring wells on-site.

Several methods for sizing filter materials and well screen openings are available in the literature. The methods are cited in Aller et al., (1989), Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, Environmental Monitoring Systems Laboratory Office of Research and Development, U.S. Environmental

Protection Agency, Las Vegas, Nevada, EPA 600/4-89/034, and Driscoll, F.G. (1988). Groundwater and Wells. Most methods are similar in concept and do not differ appreciably in their results. The first step in designing the filter pack is to obtain sieve analyses on the sample of the formation intended to be monitored. The filter pack material size is selected on the basis of the finest formation materials present.

A sand pack will be placed by pouring sand from the surface into in the annular space between the well screen and the hollow stem auger. If the well is greater than 15 feet deep, a tremie pipe will be used to place the sand pack. The sand pack will not extend more than 2 feet (but at least 6 inches) above the top, or 6 inches below the bottom of the screen. A finer grained sand pack material, 6 inches thick, will be placed at the top of the sand pack,



* 3 PROTECTIVE BOLLARDS WILL BE
PLACED AROUND THE WELL

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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

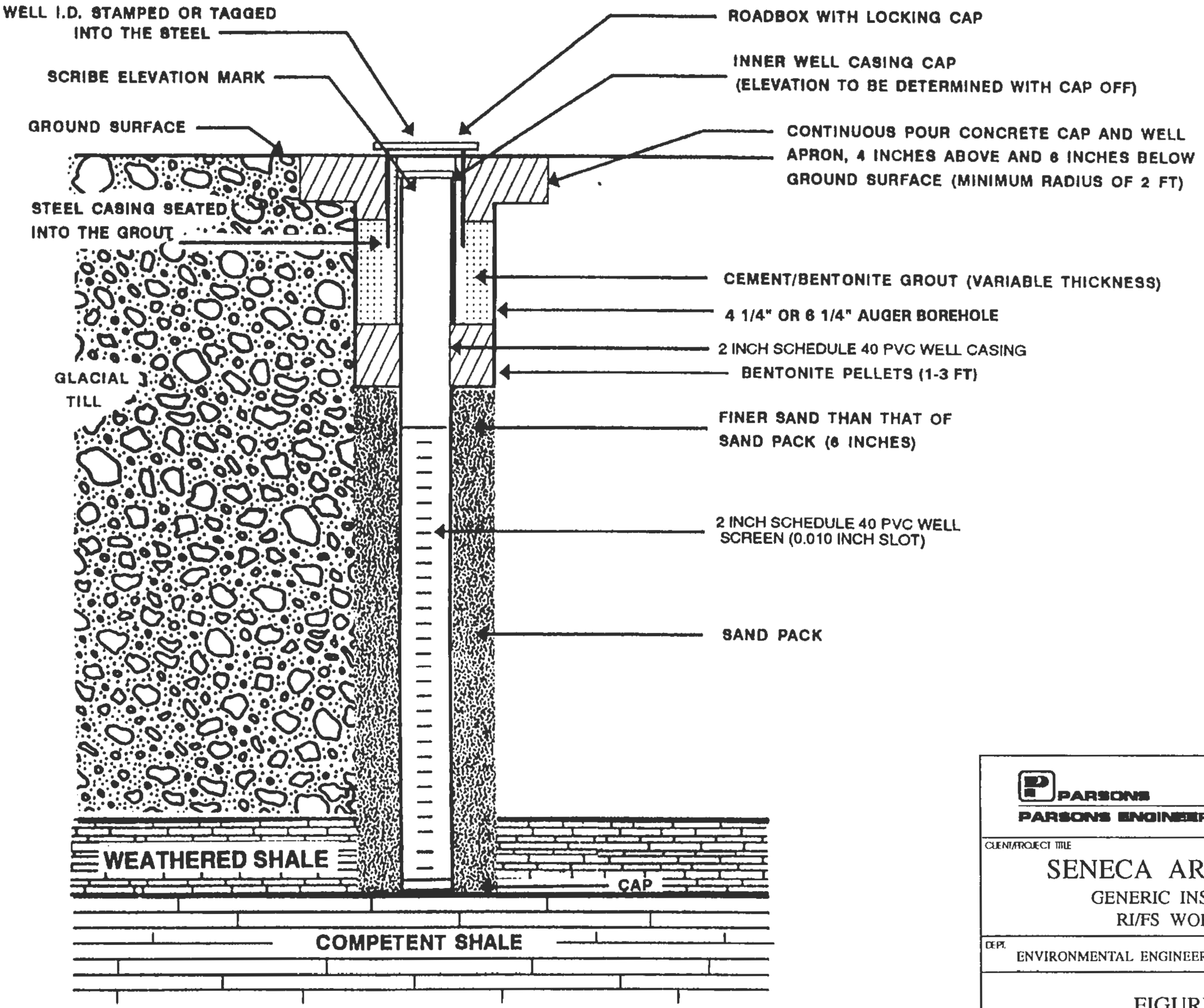
DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 726519-02002

FIGURE A-5

TYPICAL OVERBURDEN MONITORING WELL DETAIL

SCALE
DATE JANUARY 1995

R:\GRAPHICS\SENECA\OVERBURD.CDR(CVM)



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GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 726519-02002

FIGURE A-6 a

TYPICAL FLUSH-MOUNT
MONITORING WELL DETAIL

SCALE
DATE JANUARY 1995

R:\GRAPHICS\SENECA\FLUSHMNT.CDR(CVM)

between the sand pack and the bentonite seal to prevent infiltration of the bentonite into the sand pack around the well screen. A layer of bentonite pellets, between 1 and 2 feet thick, will be used to seal the well and will be poured within the annular space. Potable water will be poured on the pellets in a continuous stream for a period of one hour. Then, the remaining annular space will be completely filled with a lean cement grout containing at least 3% by weight bentonite to cement. The grout mixture will be placed in the annular space by pouring it from the surface.

In all instances, wells will be protected with a steel casing, at least 4 inches in diameter in untrafficed areas. This protective steel casing will extend 3 1/2 feet below the ground surface to prevent heaving by frost. The depth of the protective casing may be reduced to allow for better well construction in shallow bedrock situations. However, in this instance the casing should be shortened so that no more than 2.5 feet stick up above the ground surface. The protective casing will have a locking cap and a brass, weather resistant padlock. Duplicate keys will be obtained. A cement collar will surround the well. A weep hole will be drilled at the base of the protective steel casing above the cement collar to allow drainage of water. A locking expandable cap will also be placed in the top of the well casing. This cap will provide protection from inappropriate filling of the well, should the protective casing lock be broken. To allow the water in the well to equilibrate when the expandable cap is tightened, a small slot shall be cut in the PVC well pipe 1-inch below the base of the expandable well cap. A permanent well identification marker will be attached to the steel protective casing.

Three protective ballards will be placed around each monitoring well that has a steel-protective casing. The bollards will be placed 3 feet from the well. At each bollard location, from 2 to 2.5 feet of the bollard shall be cemented below the ground surface and at least 2.5 feet shall be exposed above the ground surface. Care should be taken to ensure that the ballard is not cemented at depth that corresponds with the screened section of the well.

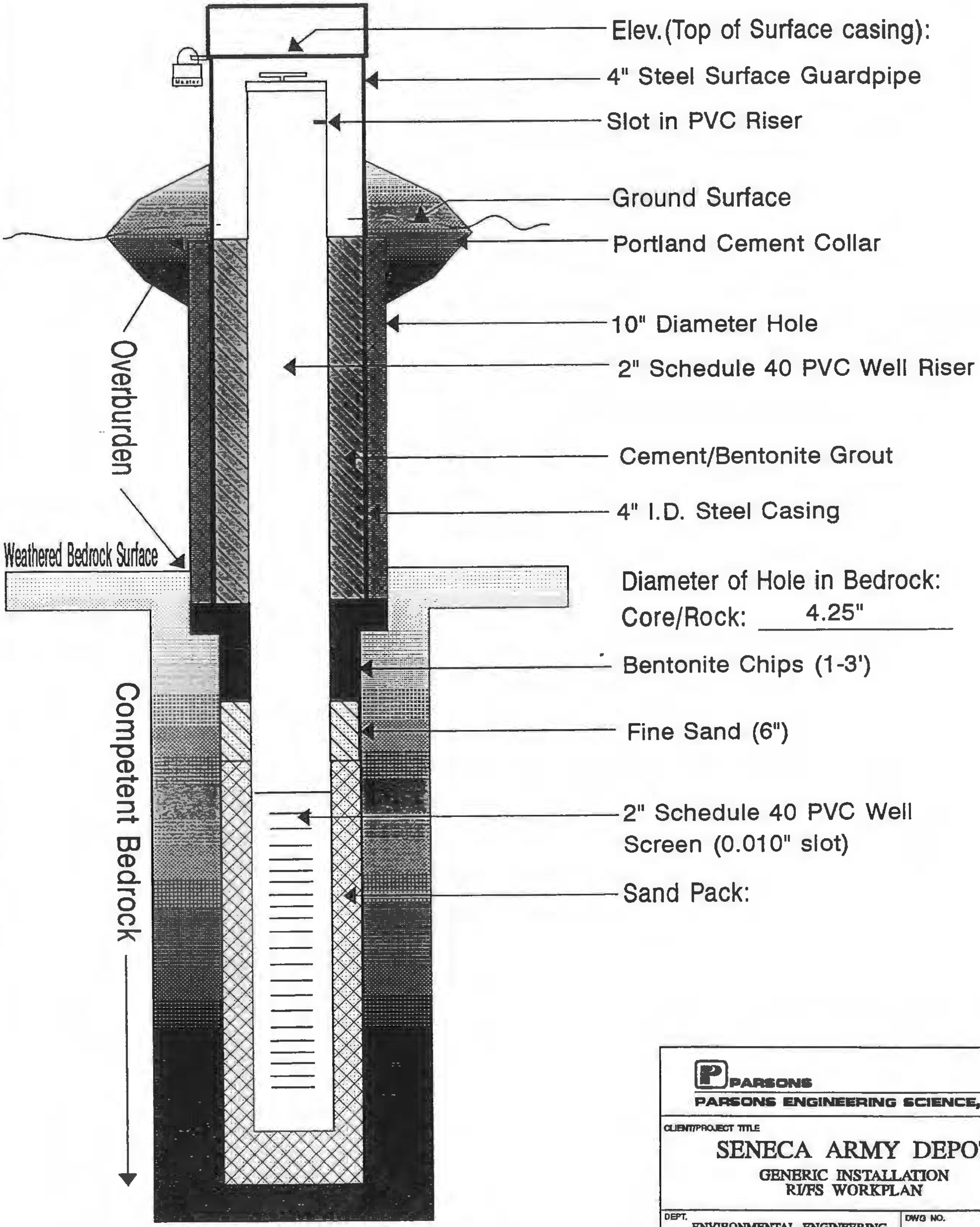
In trafficked areas where the steel casing may be hit, a roadway box will be installed. Where flush-mount wells are required, the surface completed protective casing will be a roadway box. The cement/bentonite grout will fill the annulus of the borehole to a depth equal to at least 6 inches below the ground surface. The roadway box will then be placed in the hole so that the rim of the box is at or no greater than 1 inch above the ground surface. The roadway box steel casing will be seated into the grout. The space between the roadway box and the borehole will be filled with neat cement to the ground surface.

The roadway box will contain a bolt-down top and rubber gasket. A locking cap will be paced on the end of the riser pipe. For roadway boxes, no slot for groundwater equilibration will be cut in the PVC to prevent possible infiltration of surface water into the well in the event the roadway box fills up with surface water. If the box needs to be installed underground due to earth moving operations at the SWMU, a large magnet will be placed in the roadway box so that it can be easily found.

The monitoring well protective casings will be marked with the well number using metal stamps, a metal plate pop riveted to the steel casing, not to the cover, or paint on the pipe, not the cover. The well number will be painted on the roadway box cover and etched on a metal tag on the locking cap inside the roadway box. The details of well installation will be recorded.

If required, shallow bedrock wells will be installed in the following manner. The shallow bedrock wells will be installed using a drilling rig equipped with 4.25 or 6 1/4-inch I.D. hollow stem augers, a 5 7/8-inch roller bit, and HQ size coring equipment. The shallow bedrock wells will be double cased. Figure A-6b illustrates typical shallow bedrock well details. At each location a 4-inch steel casing will be installed approximately 3-4 feet into the competent shale using hollow stem augers and a roller bit. The 4-inch steel casing will be installed with a 2-foot bentonite seal at its base and the annular space between the 4-inch casing and the borehole grouted to the surface and allowed to set for a minimum of 48 hours. Next, an HQ size coring bit and core barrel will be used to advance the hole from 0 to 10 feet into competent shale (Figure A-7). During coring, potable demonstrated analyte-free water will be 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 will be 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 PVC monitoring wells will be installed in the 0 to 20 foot zone of the competent shale using similar techniques to those described previously for the overburden wells. The filter pack and grout materials for bedrock wells will be installed using a tremie system or a pump system.

In the event that deep bedrock wells (i.e., well clusters) are necessary they will be installed in the following manner. The deep bedrock wells will be installed using a drilling rig equipped with 4.25 or 6.25-inch I.D. hollow stem augers, 5-1/2-inch roller bit and HQ size rock coring equipment. The borehole will be advanced through the overburden using a



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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT

GENERIC INSTALLATION
RI/FS WORKPLAN

DEPT. ENVIRONMENTAL ENGINEERING

DWG NO.

FIGURE A-6b

TYPICAL BEDROCK
MONITORING WELL DETAIL

SCALE NOT TO SCALE

DATE JUNE 1995

CORE BORING REPORT

ENGINEERING-SCIENCE, INC.	**CLIENT:**	**BORING #:**

PROJECT: ____________________

JOB NO.: ____________

EST. GROUND ELEV.: ____________

DATE CORING STARTED: ____________

DATE CORING COMPLETED: ____________

CONTRACTOR: ____________

DRILLER: ____________

INSPECTOR: ____________

GEOLOGIST: ____________

CHECKED BY: ____________

DATE CHECKED: ____________

MONITORING

INTRUMENT	INTERVAL	BGD	TIME

COMMENTS:

CORE EQUIPMENT: BARREL LENGTH:

TYPE	SERIES	RANGE	O.D.	I.D.

APPROX. WATER LEVEL:

OVERBURDEN THICKNESS:

TOTAL FOOTAGE CORED:

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)	BEDROCK/ CORE DESCRIPTIONS AND REMARKS (color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

FIGURE A-7

CORE BORING REPORT

ENGINEERING-SCIENCE, INC.	**CLIENT:**	**BORING #:**

MONITORING			
NTRUMENT	INTERVAL	BGD	TIME

COMMENTS:

INSPECTOR:
GEOLOGIST:
DRILLER:
DATE:

DEPTH FEET	RUN # RANGE FEET	RECOVERY FEET	CORE MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)	BEDROCK/ CORE DESCRIPTIONS AND REMARKS (color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

hollow stem auger, and into the bedrock using a 5-1/2-inch roller bit and HQ size rock coring equipment. To reduce the potential short circuiting between shallow and deep bedrock monitoring wells, an unscreened, vertical zone of 20 feet will be left between the wells so that they each monitor discrete zones. The deep wells will be triple cased. At each well location 6-inch inner diameter steel surface casing will be set approximately 3-4 feet into the competent shale using hollow stem auger techniques. The 6-inch steel casing will be installed with a 2-foot bentonite seal at its base and the annular space between the casing and borehole grouted and allowed to set a minimum of 48 hours before drilling is resumed. Next, a 5 1/2-inch roller bit will be used to penetrate the 0-10 foot zone of the competent shale, a zone already screened by the shallow bedrock wells previously described. A 4-inch steel casing will be 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 will be grouted to the ground surface. The grout will be allowed to set for 48 hours before the next drilling phase. The next phase of drilling will involve a combination of rock coring and constant head packer testing in 10 foot intervals of shale. Each 10 foot interval below the 4-inch steel casing will be cored in 5-foot intervals using an HQ size drill bit and core barrel. During coring, the core hole will be lubricated with water as previously described for the shallow bedrock wells. When the 10 foot interval has been cored, the conductivity of the interval will be determined using a constant head packer test. If the test shows the interval meets the minimum acceptable conductivity ($> 1 \times 10^{-6}$ cm/s), a well will be installed at this depth. If the conductivity for the interval is less than 1×10^{-6} cm/s, then another 10 foot interval will be cored and tested. Coring and packer testing will continue in 10-foot intervals until a hydraulic conductivity value greater than 1×10^{-6} cm/s is encountered or until a total depth of 100 feet is attained. If a depth of 100 feet is reached, the 10 foot zone with the highest conductivity will be screened. The proximity (i.e., depth) of the well screen relative to potential sources of contamination will also be considered when placing the well screen. Any open core hole below the proposed well screen interval will be grouted and allowed to set for 48 hours prior to well installation. The filter pack and grout materials for bedrock wells will be installed using a tremie system or a pump system.

All shallow and deep bedrock monitoring wells will be provided with an expandable locking well cap, a locking steel protective casing and concrete pad. Bedrock wells that consist of a protective casing stick up shall also have 3 protective ballards installed around their perimeter as described previously in the overburden wells installation procedure. All water used in the drilling process will be containerized in 55-gallon drums.

The details of the borings will be recorded on the Overburden Boring Report Form shown previously as Figure A-2. Details of the well installation will be recorded on the appropriate form shown as Figures A-8 to A-11.

Microwells Installation will be performed to rapidly establish the extent of groundwater contamination by collecting numerous groundwater samples for field screening purposes. The data from the microwells will influence the location of monitoring wells. Microwell installation is to be used on sites where the depth to groundwater is less than 5 feet from the ground surface; this is commonplace at SEDA.

The microwells will consist of hollow AW drilling rods with a penetrometer point on the end that is advanced to a depth of 5.0 feet. Then the rod will be retracted 1.0 foot to allowing the point to fall out of the coupling, and groundwater to enter the AW rod through hydrostatic equilibration. Once the microwell has been installed it will be allowed to stand until the groundwater level has equilibrated. During equilibration, the microwells will be capped to prevent any precipitation from entering the well. The water level in the well will be measured prior to sampling. Sampling procedures are described in Section 3.6.5 of Appendix A.

3.6 MONITORING WELL DEVELOPMENT AND SAMPLING

3.6.1 Objectives

The purpose of this task is to remove sediment and fines from the well and surrounding soil so that a representative sample of the groundwater can be obtained.

3.6.2 Monitoring Well Development

The development of monitoring wells will be performed 2 to 7 days after well installation and at least 7 days before well sampling and water elevation monitoring activities.

OVERBURDEN MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
PROTECTIVE RISER COMPLETION

ENGINEERING-SCIENCE, INC. **CLIENT:** **WELL #:**

PROJECT: ____________________

LOCATION: ____________________

PROJECT NO: ____________________

INSPECTOR: ____________________

CHECKED BY: ____________________

DRILLING CONTRACTOR: ____________________

DRILLER: ____________________

DRILLING COMPLETED: ____________________

BORING DEPTH: ____________________

DRILLING METHOD(S): ____________________

BORING DIAMETER(S): ____________________

ASSOCIATED SWMU/AOC: ____________________

POW DEPTH: ____________________

INSTALLATION STARTED: ____________________

INSTALLATION COMPLETED: ____________________

SURFACE COMPLETION DATE: ____________________

COMPLETION CONTRACTOR/CREW: ____________________

BEDROCK CONFIRMED (Y/N?) ____________________

ESTIMATED GROUND ELEVATION: ____________________

PROTECTIVE SURFACE CASING:

DIAMETER: __________ LENGTH: __________

RISER:

TR: __________ TYPE: __________ DIAMETER: __________ LENGTH: __________

SCREEN:

TSC: __________ TYPE: __________ DIAMETER: __________ LENGTH: __________ SLOT SIZE: __________

POINT OF WELL: (SILT SUMP)

TYPE: __________ BSC: __________ POW: __________

GROUT:

TG: __________ TYPE: __________ LENGTH: __________

SEAL: TBS: __________ TYPE: __________ LENGTH: __________

SAND PACK: TSP: __________ TYPE: __________ LENGTH: __________

SURFACE COLLAR:

TYPE: __________ RADIUS: __________ THICKNESS CENTER: __________ THICKNESS EDGE: __________

CENTRALIZER DEPTHS

DEPTH 1: __________ DEPTH 2: __________ DEPTH 3: __________ DEPTH 4: __________

COMMENTS:

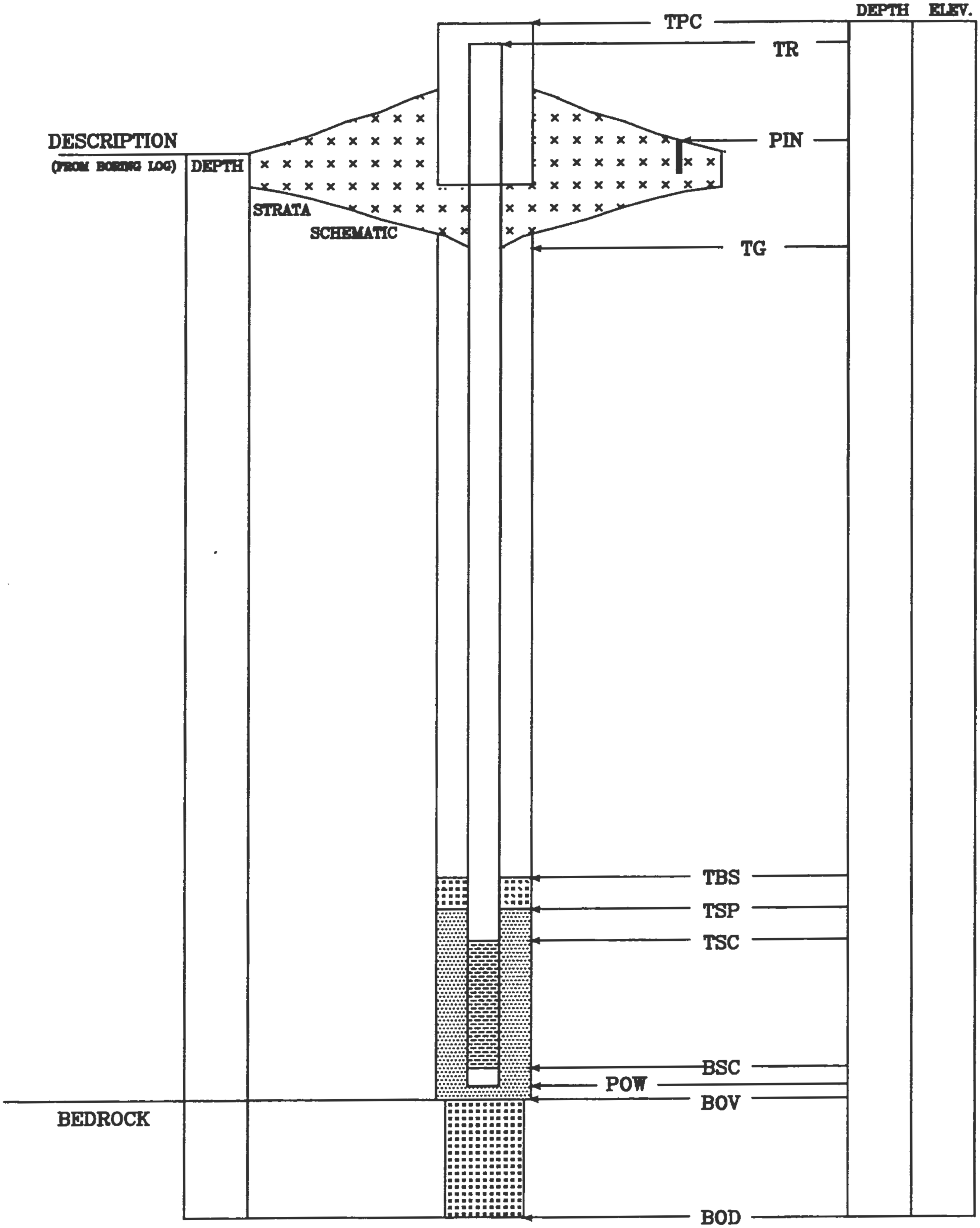
* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

SEE PAGE 2 FOR SCHEMATIC

OVERBURDEN MONITORING WELL
PROTECTIVE RISER INSTALLATION DETAIL

ENGINEERING-SCIENCE, INC.	CLIENT:	WELL #:

DATE: ______________



* NOT TO SCALE

OVERBURDEN MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
ROADWAY BOX - SURFACE COMPLETION

ENGINEERING-SCIENCE, INC.	**CLIENT:**	**WELL #:**

PROJECT: ____________________
LOCATION: ____________________

PROJECT NO: ____________________
INSPECTOR: ____________________
CHECKED BY: ____________________

DRILLING CONTRACTOR: ____________________
DRILLER: ____________________
DRILLING COMPLETED: ____________________
BORING DEPTH: ____________________
DRILLING METHOD(S): ____________________
BORING DIAMETER(S): ____________________
ASSOCIATED SWMU/AOC: ____________________

POW DEPTH: ____________________
INSTALLATION STARTED: ____________________
INSTALLATION COMPLETED: ____________________
SURFACE COMPLETION DATE: ____________________
COMPLETION CONTRACTOR/CREW: ____________________
BEDROCK CONFIRMED (Y/N?) ____________________
ESTIMATED GROUND ELEVATION: ____________________

PROTECTIVE SURFACE CASING:
DIAMETER: __________ LENGTH: __________

RISER:
TR: __________ TYPE: __________ DIAMETER: __________ LENGTH: __________

SCREEN:
TSC: __________ TYPE: __________ DIAMETER: __________ LENGTH: __________ SLOT SIZE: __________

POINT OF WELL: (SILT SUMP)
TYPE: __________ BSC: __________ POW: __________

GROUT:
TG: __________ TYPE: __________ LENGTH: __________

SEAL: TBS: __________ TYPE: __________ LENGTH: __________

SAND PACK: TSP: __________ TYPE: __________ LENGTH: __________

SURFACE COLLAR:
TYPE: __________ RADIUS: __________ THICKNESS CENTER: __________ THICKNESS EDGE: __________

CENTRALIZER DEPTHS
DEPTH 1: __________ DEPTH 2: __________ DEPTH 3: __________ DEPTH 4: __________

COMMENTS:

* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

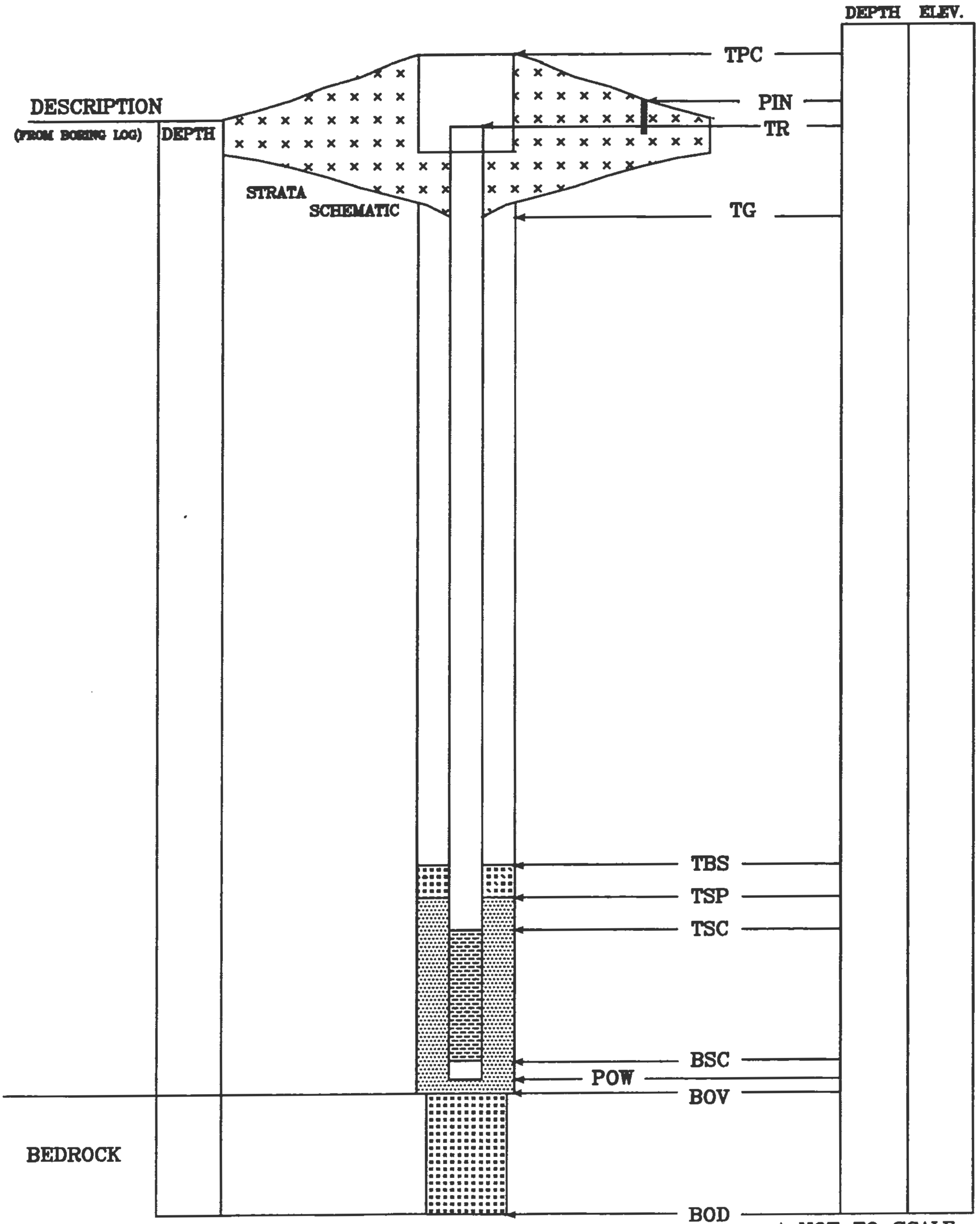
SEE PAGE 2 FOR SCHEMATIC

FIGURE A-9

OVERBURDEN MONITORING WELL
ROADWAY BOX INSTALLATION DETAIL

ENGINEERING-SCIENCE, INC.	CLIENT:	WELL #:

DATE: ____________________



* NOT TO SCALE

PAGE: 1 OF 2

BEDROCK MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
PROTECTIVE RISER COMPLETION

ENGINEERING-SCIENCE, INC. | **CLIENT:** | **WELL #:**

PROJECT: ____________________
LOCATION: ____________________

PROJECT NO: ____________________
INSPECTOR: ____________________
CHECKED BY: ____________________

DRILLING CONTRACTOR: ____________________
DRILLER: ____________________
DRILLING COMPLETED: ____________________
DEPTH TO BEDROCK: ____________________
BORING DEPTH: ____________________
DRILLING METHOD(S): ____________________
BORING DIAMETER(S): ____________________
ASSOCIATED SWMU/AOC: ____________________

POW DEPTH: ____________________
OUTER CASING INSTALLATION: ____________________
INNER CASING INSTALLATION: ____________________
SURFACE COMPLETION DATE: ____________________
COMPLETION CONTRACTOR/CREW: ____________________
CORE TYPE/SIZE: ____________________
FOOTAGE CORED: ____________________
ESTIMATED GROUND ELEVATION: ____________________

PROTECTIVE CASING:
DIAMETER: __________ LENGTH: __________

OUTER CASING:
TC: ______ TYPE: __________ DIAMETER: ______ LENGTH: __________ POC: ______

RISER:
TR: __________ TYPE: __________ DIAMETER: ______ LENGTH: __________

SCREEN:
TSC: __________ TYPE: __________ DIAMETER: ______ LENGTH: __________ SLOT SIZE: ______

POINT OF WELL: (SILT SUMP)
TYPE: __________ BSC: __________ POW: ______

GROUT:
OUTER TG: __________ TYPE: __________ LENGTH: __________
INNER TG: __________ TYPE: __________ LENGTH: __________

SEAL: TBS: __________ TYPE: __________ LENGTH: __________

SAND PACK: TSP: __________ TYPE: __________ LENGTH: __________

SURFACE COLLAR:
TYPE: __________ RADIUS: __________ THICKNESS CENTER: __________ THICKNESS EDGE: __________

CENTRALIZER DEPTHS
DEPTH 1: __________ DEPTH 2: __________ DEPTH 3: __________ DEPTH 4: __________

COMMENTS:

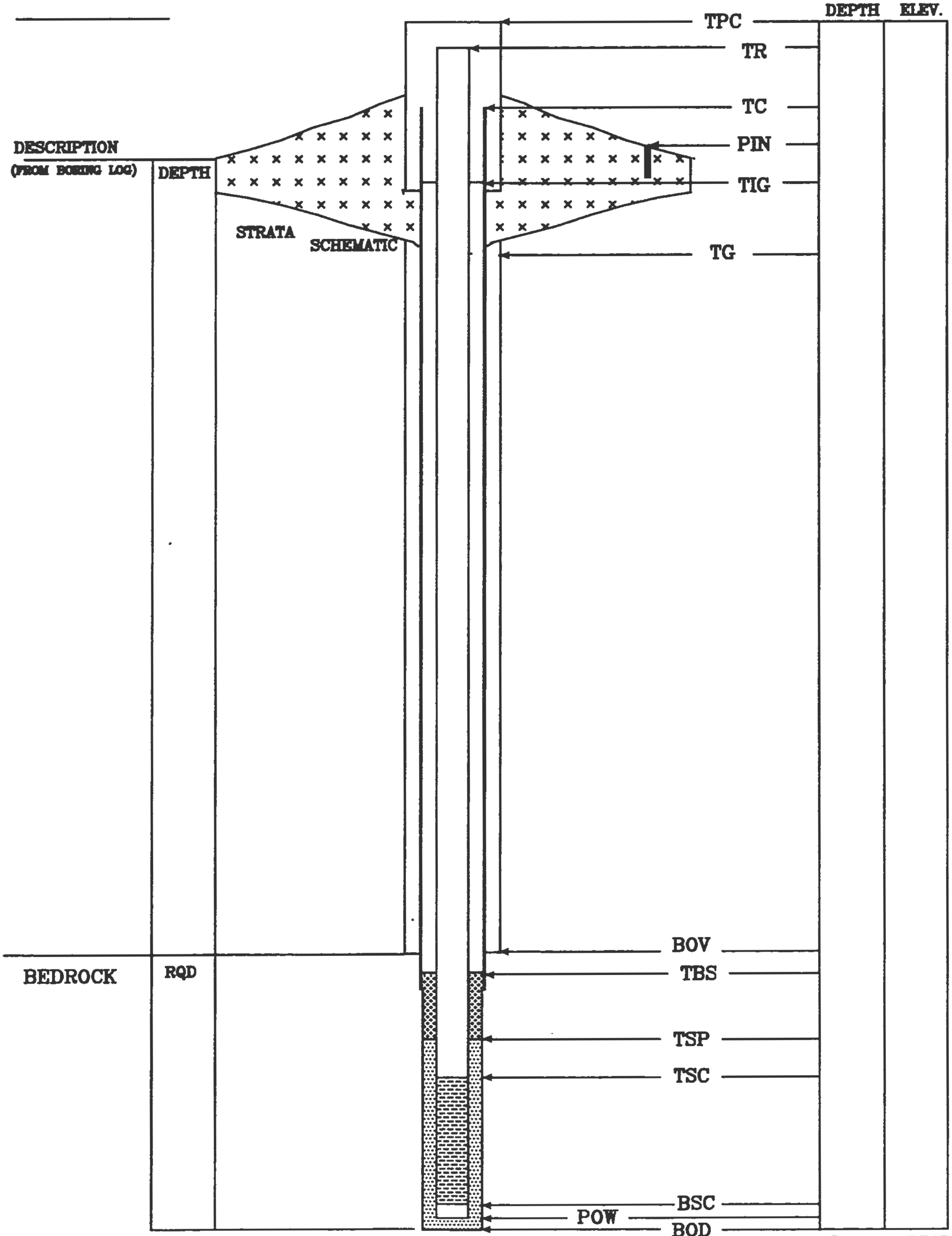
* ALL MEASUREMENTS REFERENCED TO GROUND SURFACE

SEE PAGE 2 FOR SCHEMATIC

BEDROCK MONITORING WELL
PROTECTIVE RISER – INSTALLATION DETAIL

ENGINEERING–SCIENCE, INC.	CLIENT:	WELL #:

DATE: ______________



* NOT TO SCALE

BEDROCK MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
ROADWAY BOX - SURFACE COMPLETION

ENGINEERING-SCIENCE, INC. | **CLIENT:** | **WELL #:**

PROJECT: ______________________
LOCATION: ______________________

PROJECT NO: ______________
INSPECTOR: ______________
CHECKED BY: ______________

DRILLING CONTRACTOR: ______________
DRILLER: ______________
DRILLING COMPLETED: ______________
DEPTH TO BEDROCK: ______________
BORING DEPTH: ______________
DRILLING METHOD(S): ______________
BORING DIAMETER(S): ______________
ASSOCIATED SWMU/AOC: ______________

POW DEPTH: ______________
OUTER CASING INSTALLATION: ______________
INNER CASING INSTALLATION: ______________
SURFACE COMPLETION DATE: ______________
COMPLETION CONTRACTOR/CREW: ______________
CORE TYPE/SIZE: ______________
FOOTAGE CORED: ______________
ESTIMATED GROUND ELEVATION: ______________

PROTECTIVE CASING:
DIAMETER: __________ LENGTH: __________

OUTER CASING:
TC: ______ TYPE: __________ DIAMETER: ________ LENGTH: __________ POC: ________

RISER:
TR: __________ TYPE: __________ DIAMETER: ________ LENGTH: __________

SCREEN:
TSC: __________ TYPE: __________ DIAMETER: ________ LENGTH: __________ SLOT SIZE: ________

POINT OF WELL: (SILT SUMP)
TYPE: __________ BSC: __________ POW: ________

GROUT:
OUTER TG: __________ TYPE: __________ LENGTH: __________
INNER TG: __________ TYPE: __________ LENGTH: __________

SEAL: TBS: __________ TYPE: __________ LENGTH: __________

SAND PACK: TSP: __________ TYPE: __________ LENGTH: __________

SURFACE COLLAR:
TYPE: __________ RADIUS: __________ THICKNESS CENTER: ________ THICKNESS EDGE: ________

CENTRALIZER DEPTHS
DEPTH 1: __________ DEPTH 2: __________ DEPTH 3: __________ DEPTH 4: __________

COMMENTS:

SEE PAGE 2 FOR SCHEMATIC

* ALL MEASUREMENTS REFERENCED TO GROUND SURFACE

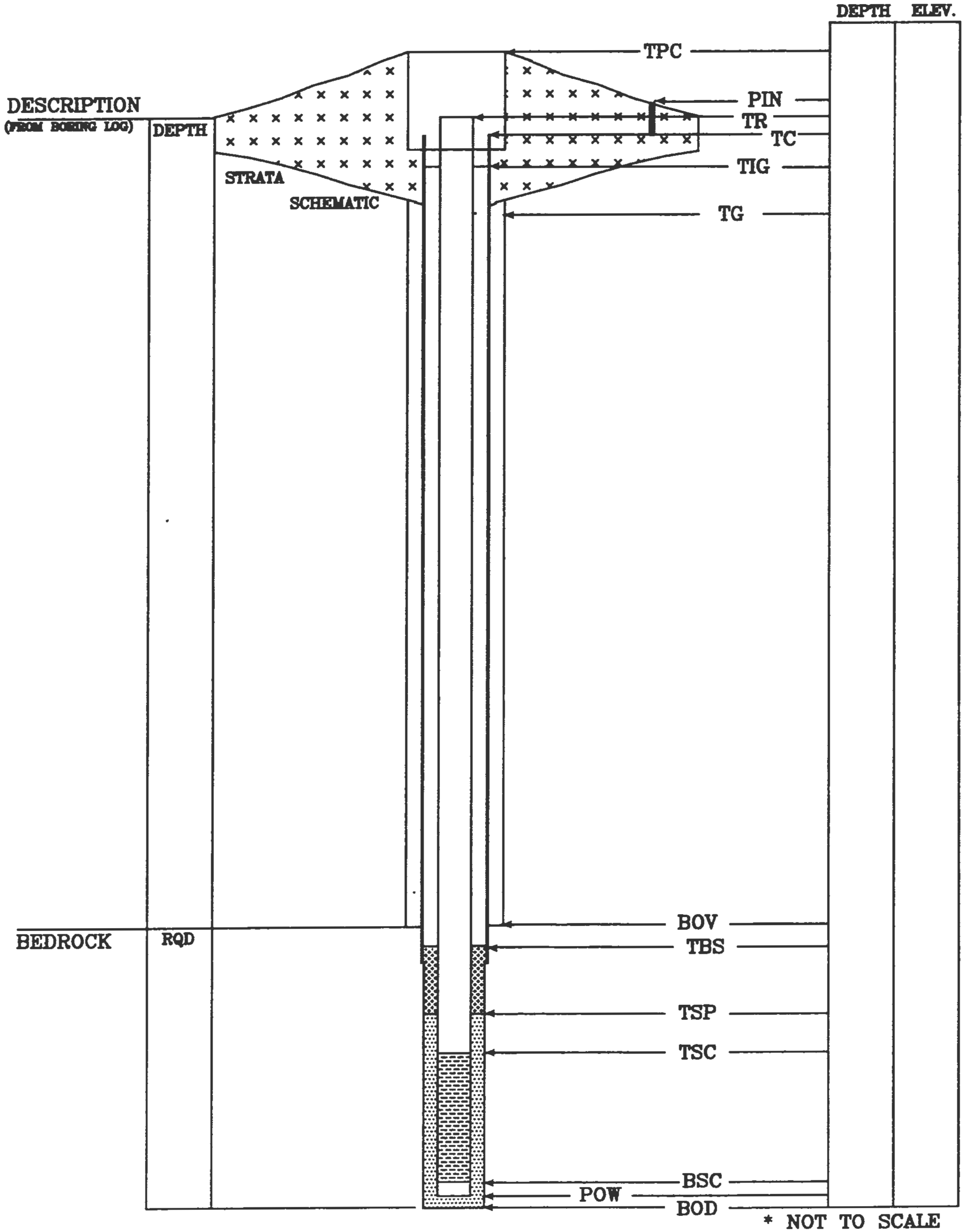
H:\ENG\SENECA\GENERIC\APPEND.A\BRKRBDT.WK3

FIGURE A-11

BEDROCK MONITORING WELL
ROADWAY BOX COMPLETION DETAIL

ENGINEERING–SCIENCE, INC.	CLIENT:	WELL #:

DATE: ____________



* NOT TO SCALE

If necessary, access routes and sampling work areas where UXOs are potentially present will be searched by UXO personnel prior to monitoring well development and sampling operations (boundaries of the access routes will have been previously marked with orange survey flags). All UXOs located during the search operation will be flagged with yellow survey markers. In areas heavily contaminated by UXOs or UXO components, well development and groundwater sampling could be performed by UXO personnel.

Development of wells will be accomplished by light surging and removal of water with a bailer followed by pumping with peristaltic pump. Water will not be added to the well to aid in development. All development equipment will be decontaminated prior to use in each well. The decontamination procedures for downhole development equipment and the bailer are provided in Section 4.4 of this appendix.

As the wells may be slow to recharge due to the low permeability of the formation, surging and overpumping may need to be performed numerous times on each well, with complete recharge between each episode. Every attempt will be made to remove excessive turbidity from the wells because high turbidity can result in elevated metal concentrations detected in the groundwater. A well development report will be completed, as shown on Figure A-12, Well Development Report.

3.6.3 Development Criteria

Each monitoring well will be developed to assist in ensuring the collection of representative groundwater samples. The criteria for determining if the well has been properly developed is based upon the guidance provided by the NYSDEC, TAGM #HWR-88-4015. This guidance document specifies an upper level of allowable levels of turbidity in groundwater from monitoring wells which is considered acceptable for determining the water quality of metals in the aquifer. This policy does not apply to surface waters.

The development procedure consists of light surging with a surge block for 2 to 5 minutes, with periodic removal of water using a bailer. The diameter of the surge block will be slightly smaller than the well diameter. The light surging is performed to remove any silt and clay "skin" that may have formed on the borehole wall during drilling. After surging, the water in the well is to be removed using a peristaltic pump (or similar pump) at a rate of between 1.5 and 3 liters per minute. At the end of the development process, the water will be removed at a minimum rate of 0.1 liter per minute. The low flow rate of water removal from the well is to allow for development of the well and the 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.

WELL DEVELOPMENT REPORT

ENGINEERING-SCIENCE, INC.	**CLIENT:**	**WELL #:**

PROJECT : ____________________
LOCATION: ____________________

DATE: ____________
PROJECT NO. : ____________

DRILLING METHOD (s): ____________________
PUMP METHOD (s): ____________________
SURGE METHOD (s): ____________________
INSTALLATION DATE: ____________________

INSPECTOR: ____________________
CONTRACTOR: ____________________
CREW: ____________________
START DEVELOPMENT DATE: ____________________
END DEVELOPMENT DATE: ____________________

WATER DEPTH (TOC): ____________ ft
WELL DIA. (ID CASING): ____________ ft
BORING DIAMETER: ____________ ft

INSTALLED POW DEPTH(TOC): ____________ ft
MEASURED POW DEPTH(TOC): ____________ ft
SILT THICKNESS: ____________ ft
POW AFTER DEVELOPMENT: ____________ ft

DIAMETER FACTORS (GAL/FT):

DIAMETER (IN):	2	3	4	5	6	7	8	9	10	11	12
GALLONS/ FT:	0.163	0.367	0.654	1.02	1.47	2.00	2.61	3.30	4.08	4.93	5.87

STANDING VOLUME INSIDE WELL = WATER COLUMN X WELL DIAMETER FACTOR = ________ GAL. = A

STANDING WATER IN ANNULAR SPACE =
WATER COL. BELOW SEAL(ft) X (BORING DIAM. FACTOR - WELL DIAM. FACTOR) X 0.3 = ________ GAL. = B

SINGLE STANDING WATER VOLUME = A + B = ... ________ GAL. = C

MINIMUM VOLUME TO BE REMOVED = 5 X C .... ________ GALS.

ACTIVITY	START TIME	END TIME	ELAPSED TIME	GALLONS REMOVED	pH	CONDUCTIVITY	TEMP	COLOR	OTHER
TOTALS/FINAL									

COMMENTS:

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FIGURE A-12

Prior to the beginning of well development, any water lost during the drilling process will be removed. Development operations shall be performed until the following primary conditions are met:

1. Water samples will have the lowest possible NTUs (preferably < 50 NTUs); and
2. The temperature, specific conductivity and pH of the well water vary by no more than 10 percent over 2 consecutive readings. Readings will be conducted for each well volume.

In addition to meeting the above primary conditions, removal of at least three well volumes of water from the well is a secondary condition that should be met if the well will allow. If not, remove as much water as necessary to meet the primary conditions, but at least one well volume.

Temperature, specific conductivity and pH will be measured in the field. A nephelometer will be used to measure turbidity. The instruction manuals for these instruments will be kept with the instruments in the field.

3.6.4 Well Survey

The locations and elevations of all existing and newly installed monitoring wells must be surveyed to obtain their location which is then plotted on a map in the hydrogeologic report. The location of each well will be tied to the New York State coordinate system. The ground surface elevation, the top of the monitoring well riser pipe and the top rim of the protective steel casing (with the top open) must be accurately measured to the nearest one-hundredth of a foot. The elevation of the riser pipe will be made at a notch cut into the lip of the pipe. The plug or cap covering the well will be removed for this measurement. Well survey procedures are described in Section 4.16 of the Work Plan.

3.6.5 Groundwater Sampling Procedures and Analyses

This section describes the groundwater sampling procedures for monitoring wells and microwells, according to the Draft SOP titled Groundwater Sampling Procedure, Low Flow Pump Purging and Sampling (EPA, May 15, 1995). The entire text of the draft SOP is included as Attachment A-3.

Prior to groundwater sample collection from monitoring wells, water levels in all wells will be measured to the nearest one-hundredth of a foot as described in Section 6.1 of this appendix. Down hole equipment will be decontaminated according to the procedures outlined in Section 4.4, of this appendix.

A polyethylene ground cloth and 5-gallon bucket will be placed beneath all sampling equipment during well purging and sampling to prevent the spread of contaminated groundwater. Well purging will continue until the pH, temperature, and specific conductivity are observed to vary less than 10% over 3 consecutive readings and the water sample is less than 50 NTUs as described in Section 3.6.3 of this appendix.

Because past high turbidities in the purge and sampling water in monitoring wells at SEDA are likely due to the turbulent, silt-producing surge of a Teflon bailer, a low flow purging method has been developed. The wells shall be purged prior to sampling using a low flow pump with a dedicated Teflon tube.

<u>Sampling Procedure</u>

Pumps, which will be used to purge and sample monitoring wells which have a 2.0 inch I.D. or greater well casing, will be low flow centrifugal or bladder pumps constructed of stainless steel or teflon. The pumps will not be dedicated or permanently installed in the wells. Peristaltic pumps may be used only for inorganic sample collection specified in Section II of this SOP.

1. Pump, safety cable, tubing and electrical lines will be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well. The pump intake must be kept at least two feet above the bottom of the well to prevent mobilization of any sediment or NAPL present in the bottom of the well.

   Importantly, if a gas-powered generator is used to drive the pump motor or controller, the generator must be placed, at a minimum of 25 feet downwind of the well to limit the incidence of cross-contamination during sampling.

2. Measure the water level again with the pump in well before starting the pump. Start pumping the well at 200 to 500 milliliters per minute. All flow rates will be measured using a graduated cylinder and a wrist watch or stop watch. Ideally, the pump rate should cause little or no water level drawdown in the well (less than 0.3 ft. and the

water level should stabilize). The water level should be monitored every three to five minutes (or as appropriate) during pumping. Care should be taken not to cause pump suction to be broken, or entrainment of air in the sample. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the sell dry and/or to ensure stabilization of indicator parameters. If the recharge rate of the well is very low purging should be interrupted so as not to cause the drawdown within the well to advance below the pump. However, a steady flow rate should be maintained to the extent practicable. Sampling should commence as soon as the volume in the well has recovered sufficiently to permit collection of samples. In some very low-yielding formations it may not be possible to sample with minimal drawdown even using low pumping rates. In the past, these wells have been pumped to dryness and sampled as soon as they recovered sufficiently. However, this approach has several problems including the potential for significant loss of volatiles due to cascading through the dewatered sand pack. Recent recommendations from the Dallas Ground-water Sampling Workshop suggest that other methods such as lysimeters may be more appropriate for sampling low permeability formations.

3. During purging of the well, monitor the field indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every three to five minutes (or as appropriate). The well is considered stabilized and ready for sample collection once all the field indicator parameter values remain within 10% for three consecutive readings, however, the following criteria shall be used for pH, conductivity, DO, Eh and turbidity. Three successive readings must be within ±3% for conductivity, and ±10% for dissolved oxygen and Eh, and 5 NTUs for turbidity. The variability within each water quality indicator parameter is the current recommendation out of the EPS Office of Research and Development and has been adopted by Region II. If the parameters have stabilized, but the turbidity is not in the range of the 50 NTU goal, the pump flow rate should be decreased to no more than 100 ml/min. Measurement of the indicator parameters for DO and Eh must be obtained using a flow through cell in a manner in which the sample is not exposed to air prior to the measurment. Other parameters may be taken in a clean container, such as a glass beaker. The order of equilibration for each water quality indicator parameter should be pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. However, it should be noted that temperature and pH, while often used as equilibration indicators are actually quite insensitive in terms of distinguishing between formation water and stagnant casing water.

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4. The actual sampling flow rate for volatiles must be accomplished with a gradual reduction in the flow rate down to 100 milliliters per minute and sustained hydraulic head pressure within the sampling tube. A gradual reduction in association with sustained hydraulic head pressure will minimize aeration, bubble formation, turbulent filling of sample bottles, and loss of volatiles due to extended residence time in the tubing. Hence, this coincides with the USEPA Region II Quality Assurance Manual (October 1989) and the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (OSWER Directive #9950.1, September 1986), which states that when collecting samples where volatile constituents are of concern using a bladder pump, pumping rates should not exceed 100 milliliters per minute (mls/min). If problems are encountered trying to maintain a uniform 100 mls/min flow rate during sampling, the inside diameter (I.D.) of the sampling tube will be reduced as it reaches the well head to ensure hydraulic head pressure is maintained. A reducer coupling (0.5 inch to 0.25 inch) will be installed approximately six feet from the actual sample port. Proper fitting installation, including the use of teflon tape, will eliminate connection problems.

   The sample discharge for all other analytical parameters can be a continuous flow of up to 500 milliliters per minute. To decrease the sampling collection time for other parameters a 0.5-inch coupling and tubing should replace the reducer coupling and 0.25-inch tubing. Therefore, a stoppage in flow could occur after the collection of volatile organic samples in order to change the coupling/tubing.

   During sampling, drawdown of the static water column level will be minimal.

5. After purging the well, the sampling team will change to new outer gloves for sample collection. Groundwater samples collected for volatile analyses will be collected first, before any of the other parameters of interest and will be obtained in a manner that will minimize the loss of volatile compounds. VOCs samples will be collected first and directly into prepreserved sample containers. All sample containers should be filled by allowing the pump discharge to flow gently down to the inside of the container with minimal turbulence.

   Samples requiring pH adjustment will have their pH checked to assure that the proper pH has been obtained. For VOC samples, this will require that a test sample be collected to determine the amount of preservative that needs to be added to the sample containers prior to sampling.

The groundwater sampling order is as follows: 1) volatile organic compounds, 2) total metals 3) semivolatile organic compounds, 4) total metals (prepreserved), 5) herbicides, 6) pesticides and PCBs, 7) explosives, 8) phenols, 9) cyanide, 10) sulfate and chloride, 11) nitrate and ammonia, and 12) radionuclides. Groundwater samples will be collected with the required quality assurance/quality control (QA/QC) samples, then transmitted to the laboratory for chemical analysis in accordance with the Chemical Data Acquisition Plan (CDAP).

5. Collection of filtered samples is not recommended. The results of filtered samples are useful only for the evaluation of filtering techniques as a treatment component. If filtered metal samples are to be collected, the use of an in-line filter is preferred. A high pressure, in-line 0.45 um particulate filter will be pre-rinsed with approximately 400 ml of deionized water and attached to the discharge end of the pump's tubing. After the sample is filtered, it must be preserved immediately.

6. As each sample is collected, the sample will be labeled. All samples requiring cooling will be placed into an ice cooler maintained at 4°C for delivery to the laboratory.

   After collection of the samples, the pump's tubing shall be properly discarded or dedicated to the well for re-sampling (by hanging the tubing inside the well), decontaminated or properly discarded.

7. Measure and record well depth.

8. Secure the well.

Samples will be preserved and packed in ice for shipment to the laboratory as described in Sections 4.3.4.4 and 5.0 of this appendix. Data regarding groundwater sample collection will be recorded on the Sampling Record form for groundwater (Figure A-13). Chain-of-Custody records will be maintained as described in Section 5.3.2 of this appendix.

Decontamination

Sampling equipment will be decontaminated prior to used and following sampling of each well. Pumps will not be removed between purging and sampling operations. The pump (including support cable and electrical wires which are in contact with the sample) will be decontaminated by one of the procedures listed below.

SAMPLING RECORD - GROUNDWATER

PARSONS ENGINEERING - SCIENCE, INC.	**CLIENT: ACOE**	**WELL #:**

PROJECT: RI/FS FIELD INVESTIGATION PROGRAM
LOCATION: SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

DATE:
INSPECTORS:
PUMP #:
BLADDER #:
GROUND / SITE

WEATHER / FIELD CONDITIONS CHECKLIST (RECORD MAJOR CHANGES)

Date	TIME (24 HR)	TEMP (APPRX)	WEATHER (APPRX)	REL. HUMIDITY (GEN)	WIND DIRECTION (0 - 360)	SURFACE CONDITIONS

MONITORING

INSTRUMENT	SERIAL NO.

WELL DIAMETER FACTORS

DIAMETER (INCHES):	1	1.5	2	3	4	5	6	7	8	9	10
GALLONS / FOOT:	0.041	0.092	0.163	0.367	0.654	1.02	1.47	2.00	2.61	3.30	5.87

STANDING WATER VOLUME = WELL DIAMETER FACTOR * WATER COLUMN

HISTORIC DATA	DEPTH POW (TOC)	DEPTH TOP OF SCREEN	WELL DEV. TURBIDITY	WELL DEV. pH	WELL DEV. SPEC. COND
DATA COLLECTED AT WELL SITE	PID READING (OPENING WELL)	STATIC WATER LEVEL	CALCULATED STANDING WATER VOL. (GAL)	DEPTH TO PUMP INTAKE (DEPTH TOS + 2 ft)	PUMPING START TIME
RADIATION SCREENING DATA	PUMP PRIOR TO SAMPLING (cps)		PUMP AFTER SAMPLING (cps)		

MONITORING DATA COLLECTED DURING PURGING OPERATIONS

DATE	TIME (min)	PUMPING RATE (L/min)	CUMULATIVE VOL (GALLONS)	TEMPERATURE (C)	SPEC. COND (umhos)	pH	Eh	DISSOLVED OXYGEN	TURBIDITY (NTU)

Figure A-13

SAMPLING RECORD - GROUNDWATER

PARSONS ENGINEERING - SCIENCE, INC. | **CLIENT:** ACOE | **WELL #:**

SAMPLING ORDER		TAL/	PRESERV.	BOTTLES		SAMPLE NO.	TIME	CHECKED BY/ DATE
				COUNT/ VOLUME	TYPE			
1	VOA			2/ 40 ml	G. vial			
1A	524.2			2 X 2/ 40 ml	G. vial			
2	SVOC			2/ 1 L	G. Amber			
3	HERB			2/ 1 L	G. Amber			
4	PEST/ PCB			2/ 1 L	G. Amber			
5	METALS + Sn			1/ 1 L	P			
6	CN			1/ 1 L	P			
7	TPH			2/ 1 L	G			
8	Hardness							
9	TDS							
10	COD							
11	SULFIDE			1/ 500 ml	G			
12	CATIONS K, Mn, Mg, Fe, Na			1/ 1 L	G. Amber			
13	ANIONS			1/ 1 L	P			
14	AMMONIA			1/ 1 L	P or G			
15	GROSS ALPHA/BETA			1/ 1 Gallon	P			

QA/QC BOTTLE COUNTS ARE TRIPLED IF MS/ MSD SAMPLES ARE COLLECTED

QA/QC DUPLICATE SAMPLE COLLECTED?

Duplicate Sample Name:

MRD Sample Name:

QA/QC rinsate sample name:

MATRIX SPIKE sample collected?

INVESTIGATION DERIVED WASTE (IDW):

DATE:				
VOLUME:				
DRUM NO.				

Figure A-13

PROCEDURE 1

Steam clean the outside of the submersible pump.

Pump hot water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump five gallons of non-phosphate detergent solution through the inside of the pump.

Pump tap water through the inside of th epump to remove all of the detergent solution.

Pump distilled/deionized water through the pump.

*Please note that when decontaminating centrifugal pumps manufactured by GRUNDFOS, the motor collant chamber contains water and potential contaminants from prior usage. Therefore, to avoid cross contamination, the coolant fluid must be removed and replaced. See manufacturers installation and operating instructions for further details.

PROCEDURE 2

The decontaminating solutions can be either be pumped from buckets through th epump or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropyl alcohol used in the decontamination process be used sparingly and water flushing steps be extended to ensure that any sediment trapped in the pump is flushed out. The outside of the pump and the electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution (five gallons).

Flush with tap water to remove all of the detergent solution.

Flush with distilled/deionized water.

Flush with isopropyl alcohol.

Flush with distilled/deionized water.

*Please note that when decontaminating centrifugal pumps manufactured by GRUNDFOS, the motor collant chamber contains water and potential contaminants from prior usage. Therefore, to avoid cross contamination, the coolant fluid must be removed and replaced. See manufacturers installation and operating instructions for further details.

Sampling of microwells will be performed to collect groundwater samples for field screening analysis. Microwells will be allowed to equilibrate prior to sampling. The water level in the well will be monitored during equilibration. The well will be sampled within three hours of installation. Once equilibrated, the well will be sampled by lowering a Teflon tube into the well (i.e., through the center of the AW drilling rod) and into the water. Then, the top of the tube will be plugged to that when the tube is raised water is retained in the tube. The water will then be transferred to a 40 ml amber glass vial for headspace analysis for volatile organic compounds.

The headspace analyses will require 1 VOA vial with **no** HCL. These vials will only be filled 1/2 full at the time of sampling. Therefore, before leaving for the field the half-way mark on the vials should be established - this can be done by pouring 20 mls of water into a vials and noting the level in the vial and then using this as a guide to mark the remaining sample vials with tape or a scribed mark (don't use the test vial for a sample). At the time of sample collection, each of the vials should be filled to exactly the half-way mark.

Trip blanks for the headspace analyses are to consists of a VOA vial filled exactly 1/2 full with demonstrated analyte-free water. This trip blank, as with the others, is filled at the beginning of the day and follows the samples around during sampling, storage and shipping. The headspace trip blank is not preserved with HCL.

The headspace samples will be chilled overnight in a cooler with a temperature blank VOA vial. At this time the headspace samples should have their own chain of custody documentation in place until they are analyzed. The next morning the samples will be placed in a warm/hot water bath (use the water from the water cooler) until they warm up to the temperature of the room (65-70 degrees F). Use the temperature blank VOA to check the temperature of the samples. Add additional hot water as necessary to heat up the samples. Note: do not immerse the tops of the sample vials in the water bath!!!!!. When the samples have warmed to room temperature they should be removed from the bath and shaken for 1 minute; remove the temperature blank from the bath and place it next to the samples. After shaking, the samples should be placed on the lab bench and allowed to stand for at least 1 minute prior to analysis - record the temperature of the temperature blank prior to analysis of the samples (see below). The samples should be analyzed within the first few hours of the morning. The temperature of the water samples will affect the amount of VOCs in the gas phase above the water.

The operator of the GC is responsible for completing the chain of custody documentation for the headspace samples. Syringes and bulbs will be blanked as a routine. On the first day only, a five-point calibration curve for the volatile compounds of interest will be established using the standard. At the beginning of each day (or analysis session), with the exception of the first day when a full calibration is performed, a two-point calibration will be run and the response factors will be checked.

Sample analysis is to be performed by extracting gas from the headspace above the water sample using a gas-tight syringe. Then exactly 1 ml of gas will be injected into the GC. After the run is over, this will be repeated, two more times for the same sample. This will provide a triplicate analysis for each sample. If dilution of the sample is required, reruns will also be analyzed three times for confirmation of the results. Between each sample, one standard (2 or 5 ppm) will be run to establish retention times for the compounds.

3.7 SURFACE WATER AND SEDIMENT SAMPLING

3.7.1 Objectives

The objective of this task is to obtain representative samples of surface water and sediment. Generally, surface water and sediment samples will be obtained at the same location and time.

For intermittent streams, surface water and sediment sampling will be scheduled and occur during high flow conditions in order to assure that water is present for collection, as well as to characterize stormwater runoff.

3.7.2 Surface Water Sampling Procedures

If necessary, access routes and sampling work areas where UXOs are potentially present will be searched by UXO personnel prior to sampling surface water and sediment. Boundaries of cleared access routes will be marked with orange survey flags. All UXOs located during the search operation will be flagged with yellow survey markers.

In areas heavily contaminated by UXOs or UXO components, surface water and sediment samples could be collected by UXO personnel.

Surface water sampling equipment will be decontaminated prior to use in accordance with the procedures outlined in Section 4.4 of this appendix. Surface water samples will be obtained from the designated locations shown in Section 4 of the Work Plan. The sampling will be accomplished by using the following procedure:

1. Establish the exact location of each sampling station in the field. The sample site will be noted on a site plan and marked in the field with flagging and a 4-foot wooden stake. The stake will be labeled with the sample site number.

   At least one background surface water sample will be collected from each site. Background steam surface water locations will be chosen so as to assure that the location is not influenced by the site. Background sample locations will be in areas beyond the influence of any drainage swales originating on the site and beyond the influence of the effects of overland flow from the site, with a consideration for the effects of local topography. The selection of background sample locations in drainage swales with intermittent flow will be similar to that described above for streams. However, in some instances the swales may originate on the site and collection of background surface water samples from selected swales may not be feasible.

2. Measure the volatile organic vapors in the atmosphere above the water body with a PID or OVM. If the concentration at breathing level is steadily elevated above background levels, use appropriate health and safety equipment as described in the Health and Safety Plan (Appendix B).

3. Collect the sample from the surface water body by immersing a clean beaker or the sample bottle without preservatives. The sampling beaker should be completely submerged in an inverted position and then turned in an upstream direction and allowed to fill without collecting any surface debris. If bottles are used for sample collection, a 45-degree angle should be used. Sampling will proceed from downstream locations to minimize impacts associated with disturbance of sediments. If the sample is collected by sampling personnel wading into the body of water, the sampler should approach the sampling location from downstream and all parts of the sampler's body should remain downstream of the sample container during sample collection (wading will be avoided if possible). Water samples will be analyzed as described in Section 4 of the Work Plan and the Chemical Data Acquisition Plan (Appendix C).

4. Fill all appropriate sample containers (listed in Appendix C, Chemical Data Acquisition Plan) directly or from the intermediate sample collection container, if necessary. Collect any QA/QC samples that are required for this location.

5. Measure the following parameters by direct immersion of instrument probes into the water body, if possible:

1. Temperature,
2. pH, and
3. Specific conductance

If direct measurement is not possible, measure these parameters from water obtained from a field sample container, separate from the analytical sample container. The instruction manuals for these instruments will be kept with the instrument in the field.

6. Record all the field data on the Sampling Record form for surface water (Figure A-14). Chain-of-Custody records will be maintained as described in Section 5.3.2 of this appendix. Samples will be preserved and packed for shipment to the laboratory as described in Sections 4.3, 4.4, and 5.0 of this appendix. Pertinent information includes distance from shore and water depth.

3.7.3 Sediment Sampling Procedures

Obtaining sediment samples is normally not a difficult task unless sampling is being conducted at great depth, in which case a boat and appropriate sampling device would be necessary. There are no set procedures for the collection of representative samples of stream sediments where the stream materials may be quite variable, i.e., coarse gravels to fine clays. Therefore, care must be taken to obtain samples that will be representative of the sediment materials present. Sampling will start at downstream locations and go upstream to minimize disturbance of sediments. The sampler will approach the sample location from downstream.

At least one background sediment sample will be collected from each site. Background sediment locations will be chosen so as to assure that the location is not influenced by the site. Background sample locations will be in areas beyond the influence of any drainage swales originating on the site and beyond the influence of the effects of overland flow from the site, with a consideration of the effects of local topography. The selection of background sample locations in drainage swales with intermittent surface water flow will be similar to that described above for streams. However, in some instances the swales may originate on the site and collection of background sediment samples from selected swales may not be feasible.

PAGE OF

SAMPLING RECORD - SURFACE WATER

ENGINEERING - SCIENCE, INC.	**CLIENT:**	**DATE:**

PROJECT: ____________________

LOCATION: ____________________

INSPECTOR: ____________________

LABORATORY: ____________________

LAB. STAFF: ____________________

CHAIN OF CUSTODY #: ____________________

WEATHER / FIELD CONDITIONS CHECKLIST (RECORD MAJOR CHANGES)

TIME (24 HR)	TEMP (APPRX)	WEATHER (APPRX)	REL. HUMIDITY (GEN)	WIND (FROM) VELOCITY (APPRX)	WIND (FROM) DIRECTION (0 - 360)	GROUND / SITE SURFACE CONDITIONS

MONITORING

INSTRUMENT	DECTECTOR

SAMPLE #	DEPTH	TIME	TEMP	MON. (VOC)	COLOR	TURBIDITY (NTU)	pH	SPEC. COND.	D.O.	SAMPLING DEVICE	CLEANING PROCEDURE	CONTAINER TYPE / SIZE	QC SPL (Y/N)

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FIGURE A-14

Usually, very simple techniques are used to collect sediment samples. Most samples are grab samples, which can be kept as individual samples or combined to form composite samples. Sediment samples will be collected after the collection of surface water samples and will be obtained from the top 6-inches of sediment. The following are some suggested techniques for sediment sampling:

1. In small, low flowing streams or near the shore of a pond or lake, a Ponar sampler or beaker can be used to grab sediments;

2. To obtain sediments from larger streams or further from the shore of a pond or lake, a beaker made from the appropriate material can be clamped to a telescoping aluminum pole. A Ponar sampler could also be used; and

3. To obtain sediments from rivers or in deeper lakes and ponds, a spring loaded sediment dredge or benthic sampler can be used.

When sampling from large rivers, ponds, or lakes, it may be necessary to lay out a visual or surveyed grid, if possible, then collect individual or composite samples from locations within the grid.

All sediment samples collected, except those destined for volatile organic analysis, will be homogenized prior to being placed into sample containers. Volatile organics samples will not be composited.

All sediment samples will be described according to the "Standard Practice for Description and Identification of Soils (Visual-Manual Method), a copy of which is included in Attachment A-2 of this appendix.

All the field data will be recorded on the Sampling Record form for soil/sediment (Figure A-4). Pertinent data includes distance from shore, water depth, and depth range over which the sample was collected. Chain-of-Custody records will be maintained as described in Section 5.3.2 of this appendix. Samples will be preserved and packed for shipment to the laboratory as described in Sections 4.3, 4.4, and 5.0 of this appendix.

3.8 SOIL GAS SURVEY

3.8.1 Objectives

Soil gas surveys are performed to evaluate the potential volatile organic compounds in the soil or in the groundwater. The soil gas survey will allow a delineation of the source areas, which may be contributing to groundwater contamination.

3.8.2 Explanation Of Method

The method involves extracting a small representative sample of soil gas through a hollow steel probe driven a few feet into the ground and analyzing the gas for the presence of volatile contaminants. 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.

Soil gas analysis is used as a screening tool for rapidly identifying contaminant sources in soils and, in some cases, delineating groundwater contamination plumes. In soils above groundwater contamination plumes, the expected soil gas concentrations will be much less than those concentrations which would be expected for source soils. The soil gas program described in this workplan will identify areas where volatile organics range in concentration between 0.5 to 100 ppm. These concentrations will indicate the presence of source materials (i.e., soils saturated with solvents). These soils constitute a continual sink for groundwater impacts.

The soil gas evaluation program involves three essential elements. These are:

1. Soil Gas Sampling
2. Analytical Support
3. Data Interpretation

3.8.3 Soil Gas Sampling

1. A 1.75-inch, outer diameter, steam-cleaned, hollow hardened carbon steel drilling rod (AW) is driven approximately 5 feet below the ground surface using a drilling rig equipped with standard drilling equipment. The steel drilling rod is fitted with a penetrometer point on the tip (Figure A-15).

2. Once the desired depth of penetration is reached, the drilling rod is withdrawn approximately 6 inches which allows the penetrometer point to dislodge from the rod and creates a void space through which soil gas can be extracted. A metal rod is inserted into the hollow drilling rod to ensure that the penetrometer point has been dislodged. If necessary, the point is knocked out with the metal rod.

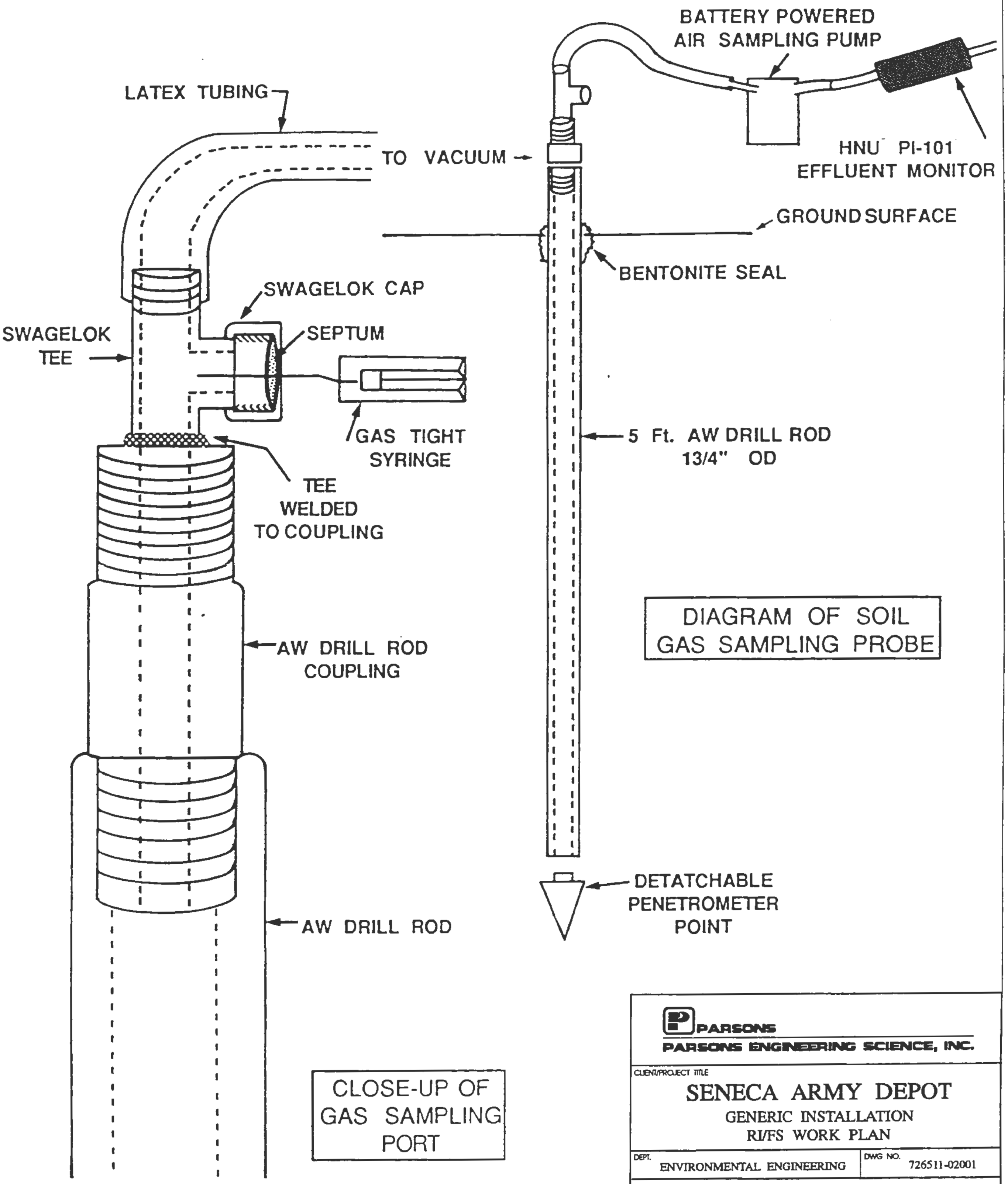
3. Bentonite is packed at the ground surface around the probe to prevent influx of atmospheric air into the sample probe.

4. The hollow drilling rod exposed above the land surface is fitted with a coupling containing both evacuation and sampling ports. Teflon tape will be used on the threads connecting the coupling to the hollow drilling rod to prevent infiltration of surface gases into the sampling port.

5. The probe is purged by creating a slight negative pressure with an air sampling pump through a latex evacuation line to ensure that the gases flowing through the hollow drilling rod are representative of soil gases. Samples of soil gas are collected prior to contact with any tubing or pumps.

6. The effluent gas from the air sampling pump will be monitored with a hand held vapor monitor, such as the HNU PI101. The gas sample will be collected immediately if the effluent monitoring indicates an increase in the concentration of volatiles. Gas samples will be collected to coincide, as much as possible, with the highest concentration of gas found to be present. If no increase in the concentration of soil gas is determined by the effluent monitoring then purging will be performed. The volume of the sampling train will be calculated to determine the length of time required for purging. The flow rate of the pump will be between 1 and 3 L/min. After purging, a soil gas sample is collected through a septum port using a gas-tight gas sampling syringe.

7. The sample is then injected into the portable gas chromatograph for analysis.



CLOSE-UP OF GAS SAMPLING PORT

DIAGRAM OF SOIL GAS SAMPLING PROBE

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 726511-02001

FIGURE A-15
SOIL GAS SAMPLING PROBE

SCALE
DATE JANUARY 1995

8. The drilling rod is removed from the ground using the drill rig and the probe hole is backfilled with bentonite to prevent infiltration of surface water. Drilling rods will be steam cleaned after each use. Other sampling equipment (e.g., drill couplings, sampling syringes, tubing, etc.). will be decontaminated after each use according to the decontamination procedures outlined in Section 4.5 of this appendix. All syringes will be decontaminated prior to field use and checked for cleanliness by running blanks.

9. The sampling locations will be marked in the field so that a land surveyor can produce coordinates and elevations for them. Soil gas sampling data is to be recorded on Figure A-16, Soil Gas Sample Location Data.

3.8.4 Analytical Support

Soil gas samples are analyzed in the field using a portable gas chromatograph to facilitate real time data acquisition. 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 an electric current. The magnitude of this current can be used, when compared to standards, to determine concentrations of compounds present in the sample.

The analytical system to be utilized for this program is 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 Photoionization Detector (PID). The PID is ideal for detecting volatile organic compounds which contain aromatic rings and unsaturated double bonds.

SOIL GAS SAMPLE LOCATION DATA

ENGINEERING-SCIENCE

CLIENT:

DATE:

PROJECT :

LOCATION:

INSPECTOR:

CONTRACTOR:

TYPE OF RIG:

WEATHER/FIELD CONDITIONS (record major changes)				MONITORING	
TIME	TEMP	PRECIP.	GROUND SURFACE CONDITIONS	INSTRUMENT	DETECTOR

SAMPLE LOCATION:

BLOWS PER 6 INCHES:

DEPTH OF PENETROMETER POINT (ft):

DEPTH TO BOTTOM OF ROD (FT):

TIME START EVACUATION PUMP:

TIME STOP EVACUATION PUMP:

OVM MAXIMUM:

TIME OF OVM MAXIMUM:

TIME OF SOIL GAS SAMPLE:

FLOW RATE (ml/min):

VOLUME OF GAS REMOVED AT SAMPLE TIME (ml):

SYRINGE NUMBER:

COMMENTS:

IS GROUNDWATER PRESENT IN THE SAMPLING PIPE?: YES NO

SAMPLE LOCATION:

BLOWS PER 6 INCHES:

DEPTH OF PENETROMETER POINT (ft):

DEPTH TO BOTTOM OF ROD (FT):

TIME START EVACUATION PUMP:

TIME STOP EVACUATION PUMP:

OVM MAXIMUM:

TIME OF OVM MAXIMUM:

TIME OF SOIL GAS SAMPLE:

FLOW RATE (ml/min):

VOLUME OF GAS REMOVED AT SAMPLE TIME (ml):

SYRINGE NUMBER:

COMMENTS:

IS GROUNDWATER PRESENT IN THE SAMPLING PIPE?: YES NO

SAMPLE LOCATION:

BLOWS PER 6 INCHES:

DEPTH OF PENETROMETER POINT (ft):

DEPTH TO BOTTOM OF ROD (FT):

TIME START EVACUATION PUMP:

TIME STOP EVACUATION PUMP:

OVM MAXIMUM:

TIME OF OVM MAXIMUM:

TIME OF SOIL GAS SAMPLE:

FLOW RATE (ml/min):

VOLUME OF GAS REMOVED AT SAMPLE TIME (ml):

SYRINGE NUMBER:

COMMENTS:

IS GROUNDWATER PRESENT IN THE SAMPLING PIPE?: YES NO

FIGURE A-16

Page of

SOIL GAS SAMPLE LOCATION DATA

SAMPLE LOCATION: BLOWS PER 6 INCHES:	OVM MAXIMUM:
	TIME OF OVM MAXIMUM:
DEPTH OF PENETROMETER POINT (ft):	TIME OF SOIL GAS SAMPLE:
DEPTH TO BOTTOM OF ROD (FT):	FLOW RATE (ml/min):
TIME START EVACUATION PUMP:	VOLUME OF GAS REMOVED AT SAMPLE TIME (ml):
TIME STOP EVACUATION PUMP:	SYRINGE NUMBER:
COMMENTS: IS GROUNDWATER PRESENT IN THE SAMPLING PIPE?: YES NO	
SAMPLE LOCATION: BLOWS PER 6 INCHES:	OVM MAXIMUM:
	TIME OF OVM MAXIMUM:
DEPTH OF PENETROMETER POINT (ft):	TIME OF SOIL GAS SAMPLE:
DEPTH TO BOTTOM OF ROD (FT):	FLOW RATE (ml/min):
TIME START EVACUATION PUMP:	VOLUME OF GAS REMOVED AT SAMPLE TIME (ml):
TIME STOP EVACUATION PUMP:	SYRINGE NUMBER:
COMMENTS: IS GROUNDWATER PRESENT IN THE SAMPLING PIPE?: YES NO	
SAMPLE LOCATION: BLOWS PER 6 INCHES:	OVM MAXIMUM:
	TIME OF OVM MAXIMUM:
DEPTH OF PENETROMETER POINT (ft):	TIME OF SOIL GAS SAMPLE:
DEPTH TO BOTTOM OF ROD (FT):	FLOW RATE (ml/min):
TIME START EVACUATION PUMP:	VOLUME OF GAS REMOVED AT SAMPLE TIME (ml):
TIME STOP EVACUATION PUMP:	SYRINGE NUMBER:
COMMENTS: IS GROUNDWATER PRESENT IN THE SAMPLING PIPE?: YES NO	
SAMPLE LOCATION: BLOWS PER 6 INCHES:	OVM MAXIMUM:
	TIME OF OVM MAXIMUM:
DEPTH OF PENETROMETER POINT (ft):	TIME OF SOIL GAS SAMPLE:
DEPTH TO BOTTOM OF ROD (FT):	FLOW RATE (ml/min):
TIME START EVACUATION PUMP:	VOLUME OF GAS REMOVED AT SAMPLE TIME (ml):
TIME STOP EVACUATION PUMP:	SYRINGE NUMBER:
COMMENTS: IS GROUNDWATER PRESENT IN THE SAMPLING PIPE?: YES NO	

FIGURE A-16

Quantitative analysis of soil gas requires quantitative gas standards. Gas standards will be prepared by a gas standard vendor such as Scott Specialty Gas or Canaan Scientific Products, Inc. The gas standard mixture will include trichloroethane, 1,2-dichloroethene, benzene, toluene, and xylene, each at concentrations of approximately 100 ppmv. This standard mixture will be certified by the standard manufacturer and a certificate of analysis will accompany the gas standard. All field calibration standards will be prepared from this certified gas standard. Dilutions will be made from this standard by injecting a known volume of calibration gas into a clean glass sampling bulb of known volume.

Since the intent of the soil gas program is to indicate the presence of elevated concentrations of volatile organic compounds, soil gas results will be expressed as total volatile organic compounds as trichloroethane. If retention time matches between the soil gas sample and the calibrated gas standard are within ± 1 sec. then individual compounds detected in the soil gas will be reported. However, since the soil gas program is a screening program determination of individual organic compounds is not critical to the detection and delineation of likely source areas.

A detailed description of the analytical procedures is as follows:

Calibration Procedures and Frequency

The analytical instrument will be calibrated each day prior to the analysis of a sample.

Gas Standards

Gas standards will be prepared from certified pre-calibrated compressed gas cylinders. Compressed gas standards offer advantages in time savings and ease of use. However, they are limited to only those compounds within the cylinder. The VOC concentrations will be traceable to National Bureau of Standards (NBS) standards.

The calibration procedure is as follows:

1. A two stage pressure regulator is attached to the cylinder for gas removal.
2. A clean, labeled, glass gas sampling bulb (approx. 125 ml), with a teflon connection is placed over the second stage effluent port. The teflon stopcocks at both ends are opened.

3. The diaphragm of the regulator is turned counterclockwise until the pressure in the diaphragm is unnoticeable by the hand.

4. The cylinder valve is opened. The first stage pressure will indicate the current cylinder pressure.

5. The second stage pressure is increased to 2 psig by turning the regulator valve clockwise.

6. Gas should be heard passing through the bulb as the second stage pressure is increased. The bulb is allowed to purge for approximately 10 seconds. The teflon stopcock furthest from the regulator is closed, then, the stopcock closest to the regulator is closed. The gas is now captured within the glass bulb at the delivery pressure of the regulator.

7. Using a gas-tight, designated syringe, an appropriate volume of captured gas will be removed from the bulb through the silicone septum and injected into the clean sampling bulb.

8. The Response Factor (RF) for each analyte is obtained as the ratio of the gas concentration injected and the area under the peak produced by that injection. This integration is performed electronically by the on-board electronic integrator.

9. Response factors will be obtained for each analyte listed in the gas standard.

10. For constant volume injections, the RF represents the concentration of analyte per unit area of instrument response. It is obtained by injecting a known concentration of analyte into the instrument and dividing the concentration by the area of the peak observed on the chromatogram. The analyte concentration in an unknown soil gas sample is determined by injecting an equal volume of gas into the gas chromatograph. The peak area obtained from the unknown sample is multiplied by the RF to determine the actual concentration of the analyte injected.

    The RF allows conversion of peak areas into concentrations for the contaminants of interest. The RF used is changed if the standard response varies 50%. If the standard injections vary by more than 50% the standard injections are repeated. If the mean of the two standard injections represents greater then 50% difference than a third standard is injected and a new RF is calculated from the three standard injections. A new data sheet is started with the new RFs and calibration data.

$$\%\ Difference = \frac{A\ area - B\ area}{A\ area}$$

Where: A = mean peak area of standard injection from first calibration
B = peak area of subsequent standard injection

The low peak standards will be made fresh daily.

A two point calibration curve will be performed daily, one point will be approximately 0.5 ppmv and the second point will be at approximately 5 ppmv. Dilutions of the calibrated gas standard will be performed using gas-tight syringes and injecting appropriate volumes into clean gas-tight gas sampling bulbs of known volume.

11. Syringe blanks will be performed for each syringe to be used prior to analysis. Syringes will be cleaned with Alconox or equivalent detergent and brush daily. They will be baked out in an oven at a minimum temperature of 60°C. for a minimum of 1 hour prior to use.

12. System blanks are ambient air drawn through a probe not installed in the ground and through the complete sampling apparatus. This air is analyzed by the same procedure as a soil gas sample. One system blank will be run at the start of each day from the batch of probes to be used.

13. A duplicate field sample will be taken after every 20 sample locations or at a minimum of one per day.

14. Field notebooks will be kept detailing the sample identification and amount of sample injected.

The following system parameters will also be noted:

a) Gas flows for the ultra pure air
b) Tank pressures for the ultra pure air
c) Integrator parameters
    1) Gain and baseline offset
d) Column
    1) type
    2) length and diameter
    3) packing material
    4) temperature
e) Operator
f) Date and time

If any system parameters change, the chromatograms are labelled with the changes noted.

15. Sample Documentation - The field notebooks will allow for full traceability of results. The response factors used and how they were calculated will be noted. The sample number, time, amount injected and the peak are noted.

The actual chromatogram can be traced from this information. The sample concentration is calculated using the RF, amount injected and peak area for the component of interest.

3.8.5 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.

When examining chromatographs and comparing peak heights, several factors must be considered. Retention times (used to identify compounds) will vary with operating temperature and carrier gas flow rate. The detector responds to mass, not necessarily the concentration of the gas. Consequently, the sample volume injected into the chromatograph is important when interpreting output. "Gain", the degree of electronic amplification of the signal from the detector, must also be considered. If concentrations and volumes of two samples are equal, peak height will be higher in the one analyzed using a higher gain. Typically, large sample volumes and, if necessary, high gains are used to detect very low concentrations.

Typically, the soil gas survey is used to provide screening data, identifying areas where compounds are present and the total volatile organic concentration. This is primarily accomplished by expressing the concentrations of compounds as the trichloroethane equivalents. Various volumes and concentrations of trichloroethane gas reference standards are injected under similar operating conditions as those for the unknown samples. Quantification of VOCs in the samples is accomplished by comparing the area of the compound peaks on the sample chromatogram with the area of the trichloroethane reference standard peak. This is most often accomplished by the instrument integrator, however, it can be accomplished manually.

The soil gas data will be tabulated by relating each location to a specific concentration of total volatile organic compound, expressed as trichloroethane equivalents. Additionally, individual volatile organic peaks will be quantified, such as trichloroethane, providing a reasonable retention time match can be obtained, ± 1 sec. This data will also be presented on a site map with each sampling location assigned a specific soil gas concentration. Soil gas isocontours will then be interpreted from the obtained data, thereby identifying approximate boundaries for likely source areas.

3.9 SAMPLING PROCEDURES FOR PROPELLANTS AND OTHER MATERIALS

3.9.1 Propellants

At certain SWMUs propellants may be present in pipes associated with former manufacturing or treatment processes. To determine whether the propellants can be safely sampled and analyzed, residue in the pipes will be sampled and tested by UXO personnel. If the material is determined to be safe to handle, it will be sampled and analyzed.

Propellants will be sampled using a decontaminated stainless steel implement that will scrape residue from the inner wall of the pipe. The propellants will be transferred to a decontaminated stainless steel bowl, then placed into the appropriate sample bottles. If field conditions require changing this sampling procedure, then the changes will be documented along with other sampling data on the Sampling Record form for soils (Figure A-14).

3.9.2 Asbestos

3.9.2.1 Introduction

Asbestos, once commonly referred to as the miracle mineral, has been used as a reinforcement fiber for more than 3,000 years. Because of the abundant availability of the fiber, its acoustic and tensile qualities, and its resistance to fire and chemicals, asbestos has been used extensively in building materials since before the turn of the century. Asbestos-containing building materials (ACBM) has become a major item of concern with building renovations and demolition.

Inhalation of asbestos fibers has recently been found to be a health hazard to humans. For this reason the United States Environmental Protection Agency (USEPA), under the authority granted by the Clean Air Act (National Emission Standards for Hazardous Air Pollutants), requires removal of all regulated asbestos-containing materials likely to be disturbed during work activities. Notifications are required to be submitted to USEPA, or its designated local agency, outlining asbestos-containing materials likely to be disturbed during renovation/demolition activities and proposed abatement methods for protection of public health. The burden of identifying what materials are asbestos-containing is placed on the building owner. In addition to notification requirements, a number of state and local agencies require submittal of an asbestos inspection report presenting results of an asbestos inspection conducted by a certified asbestos inspector.

3.9.2.2 Assessment Procedures

A complete survey and assessment of asbestos-containing building materials (ACBM) in a building or facility typically consists of the following steps:

- Review of as-built drawings, other construction drawings, and building specifications;
- Interviews with mechanical personnel, HVAC personnel, boiler room personnel, and/or other appropriate facility personnel;
- Visual inspection of each room and completion of standard building inspection forms for each room or area. Information collected during the survey includes a description of the floor, ceiling, and walls; an estimate of the amount, type, and condition of suspected

ACBM; identification of the structures coated with suspected ACBM; and a description of any physical or operational constraints that may affect asbestos removal. A detailed description of the asbestos inspection is provided in 3.9.2.3;

- Collection of bulk samples of suspected ACBM, such as: insulation on pipes and pipe fittings; boilers, ducts, and other equipment; resilient floor coverings; acoustical insulation; wall and ceiling plaster; and fireproof insulation. A detailed description of asbestos sampling procedures is given in Section 3.9.2.4; and
- Laboratory analysis of asbestos samples by an accredited laboratory (including Polarized Light Microscopy (PLM) with dispersion staining (EPA Method 600/M4-82.020) and Transmission Electron Microscopy Analysis (NYSDOH Method 198.4) for nonfriable organically bound (NOB) materials).

The inspection and sample collection will be conducted by a New York State Certified Asbestos Inspector. The asbestos assessment report will be in accordance with 12 NYCRR 56 pre-demolition inspection requirements.

3.9.2.3 Asbestos Inspection

An asbestos inspection, sampling, and sample analysis will be conducted in order to identify and quantify accessible suspected asbestos-containing building materials (ACBM). The inspection will consist of a review of existing building plans, if available, to familiarize the certified inspector with the building layout, as well as to identify pipe chases and dead spaces; and a room by room walk-through of the building to determine the location, condition, quantity, and type (friable of non-friable) of suspect ACBM present. Access to all areas will be required to ensure inspection of all accessible suspect ACBM. Suspect ACBM includes surface materials (sprayed-on troweled-on wall and ceiling plasters, acoustical insulation, and fireproofing), thermal insulation (e.g., insulation on pipes, pipe fittings, tanks, boilers, and ducts), and miscellaneous materials (e.g., vinyl floor tile, roofing, baseboard molding, and vibration joint cloth). Suspect ACMB will be located on building floor plans (either provided by the building owner or field drawn) to assist in development of the asbestos sampling plan and for inclusion in the final report.

An attempt will be made to identify ACMB in areas not readily accessible (e.g., pipe chases and permanent drop ceilings) and in areas deemed unsafe. A "hand pressure test" will be performed where feasible to determine material friability. Friable is defined by the USEPA as the ability to crush, pulverize or otherwise reduce to a powder state by hand pressure. The inspector will note the proximity of the suspect ACBM to assist in developing potential areas of concern. Sample areas (homogeneous areas of ACBM) will be identified to determine appropriate sample locations and quantities. Building Inspection Forms (Figure A-17) will be completed for documentation of inspection observations. Information to be included on this form includes a description of all surfaces, ceiling height, estimation of type, quantity and condition of suspect ACBM, and a description of any physical or operational constraints that may effect abatement costs.

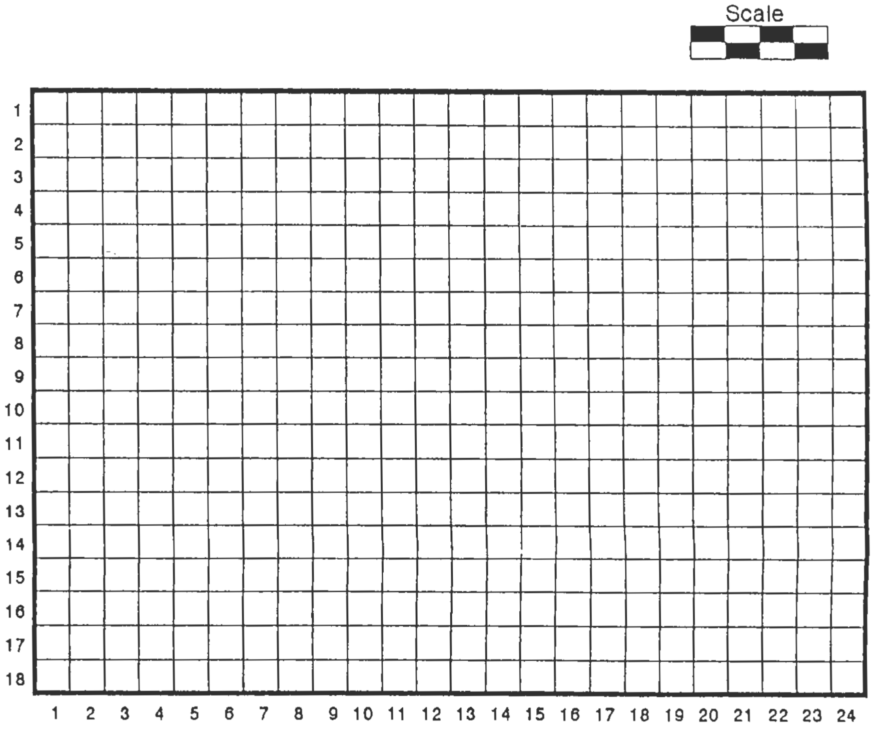
3.9.2.4 Sample Collection

Asbestos sampling of friable suspect ACBM will be performed in an Asbestos Hazard Emergency Response Act (AHERA) format modified to address site-specific conditions, including access restrictions. Where appropriate, a random sampling scheme (as described in USEPA guidance Document 560/5-85-030a "Asbestos in Buildings: Simplified Sampling Scheme for Friable Surfacing Materials, October 1985) will be used for the confirmation of the presence or absence of asbestos. Although based on past experience certain conditions are invariably encountered where random selection is not possible (i.e., excessive height of pipe runs and materials penetrating permanent barriers), an attempt will be made to select sample locations so they best represent the defined sample area. A minimum of three samples of each suspected friable ACBM will be collected in accordance with AHERA protocol, because ACBM is typically non-homogeneous and, consequently, unreliable conclusions can be drawn from the results of a single sample. At least three negative samples are generally necessary for friable suspect ACBM to be considered non-asbestos material. In order to minimize analytical costs and if appropriate, the laboratory will be instructed to analyze sample triplets using the "first positive" strategy (i.e., if the first or second sample results indicate the presence of asbestos, then the remaining samples from the triplet will not be analyzed).

Sampling of non-friable suspect ACBM (i.e., floor tile, roofing material, vinyl sheeting, mastics, etc.) will be handled on a case by case basis because limited regulatory guidance is available for collection of non-friable materials. In general, one to three samples will be collected from non-friable suspect ACBM, depending on aerial coverage of material, access, and equipment or building occupant tolerance for destructive sampling. Unless requested otherwise, destructive sampling will be kept to a minimum since past inspections have often been conducted a year or more prior to anticipated renovation/demolition work. For materials such as roofing, where compromising of structural integrity is a concern, sampling will be avoided or limited to a preliminary screening type effort with recommendations for follow-up confirmation sampling prior to renovation/demolition.

BUILDING INSPECTION FORM

PROJECT ______________________________
BUILDING ______________________________
ROOM ______________________________
INSPECTOR ______________________________
SAMPLE NOS. ______________________________
ROOM DIM. (LxWxH) ______________________________



CEILING	DESCRIPTION	QUANTITY
Suspended Tile		
Glued Tile		
Plaster		
Sheetrock		
Concrete		
Metal Deck		
Above Ceiling		
Other		

Height ______________________________
Shape ______________________________

FLOOR		
Concrete		
Wood		
Tile		
Carpet		
Other		

WALLS	DESCRIPTION	QUANTITY
Concrete		
Plaster		
Sheetrock		
Wall Paper		
Other		

MECHANICAL INSULATION		
Pipe		
Pipe		
Packing		
Packing		
Gasket		
Other		
Other		

HVAC ______________________________

COMMENTS ______________________________

FIGURE A-17

One quality control sample (i.e., split sample) will be collected for every 20 samples collected. The qualify control sample will be labeled and handled in the same manner as ordinary samples, the laboratory will not know which samples are for quality control.

Samples and sample locations will be identified by a unique sample identification number which will be recorded on the sample container, the sampling area floor plan, sample data sheet, and the chain of custody form. Sample area will be "patched" using caulk, duct tape, and/or paint to encapsulate any loose asbestos fibers and to provide marking for future reference.

3.9.3 Oil

Oil or other light non-aqueous phase layers may be present on the surface of water. It is proposed that this oil or light non-aqueous phase layer (LNAPL) be sampled at certain SWMUs. A decontaminated stainless steel or glass container will be lowered into the oil and water so that the mouth of the container is upright, but tipped at approximately at 45 degree angle. The container will be lowered into the liquid just enough so that mostly oil will enter the container. The oil will be poured into the appropriate sample bottles for liquid samples while minimizing the amount of water added to the bottles.

3.9.4 Dust

Dust and dirt on the floor of some of the buildings will be sampled for various parameters. This material will be sampled using the same procedures as for surface soils (Section 3.3.4 of this appendix) except that the dust and dirt may have to be collected over a broad area of the floor rather than digging into the soil. The size of the area will be recorded on the Sampling Record form.

3.10 PHOTO LINEAMENT AND FRACTURE TRACE STUDY

The photo-lineament and fracture trace analysis is designed 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 is to determine the direction and presence of bedrock fractures as they pertain to controlling groundwater flow direction. Specifically, the study will locate an area or areas on or near a site where groundwater flow in the bedrock (shale) may be influenced or preferentially controlled by one or more well defined (possibly intersecting) fractures. Preferential flow along fractures is significant when trying to assess contaminant transport in the bedrock aquifer. If such an area exists on a site it will be considered as a possible location for the installation of a well (or well cluster). This reconnaissance technique is a precursor to bedrock well installation and can provide the basis for locating well clusters that address potential impacts to bedrock, i.e., competent shale. The photo-lineament analysis provides 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 provides 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 will be 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 is based upon scale imagery, times of the year of photos, and angle of illumination. Stereo pairs of air-photos will be analyzed and the photo-lineaments characterized by length and suspected strength of expression. On each platform linear features will be characterized as strong, moderate, or subtle in expression. Upon completion of the photo interpretation the lineament data will be digitized and overlain on the site base map. The lineament data will be analyzed and plotted in several forms including histograms and frequency diagrams. The data will be filtered on the basis of lineament orientations and length. The lineament data from the different platforms will also be 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 will be compared with documented regional structures, faults, and strike and dip data.

To study bedrock fractures, outcrops will be identified within the study area using air photographs, topographic maps, existing bedrock geologic quadrangle maps and field investigations. The outcrop stations will be selected based on their proximity to the site, quality of exposure, and geographic coverage. During the field investigation fracture orientations (strike and dip) will be recorded at each outcrop location. In addition to orientation, the morphology, spacing, and length of each joint, fault or bedding plane should be recorded. In order to delineate the most important fracture sets, the data will be filtered on the basis of joint orientation, dip angle, size, roughness, and planarity. Filtered data will also be 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 will be 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 provides for a rapid evaluation of the lineament azimuth data with actual fracture trends measured in the field. These data will also be compared with regional strike and dip data to identify potential preferential flow pathways for groundwater within the bedrock.

3.11 AQUIFER CHARACTERIZATION AND SURFACE WATER DATA COLLECTION

3.11.1 Groundwater Level Measurements

Three rounds of water level measurements will be completed for the monitoring wells on the site. Each round of water level measurements will be conducted within a 10-hour period so that the represent a "snap-shot" of groundwater conditions at the site. The water levels shall be measured to the nearest one hundredth of a foot using a battery-operated water level indicator. At wells where LNAPLs may be present, an oil-water interface probe will be used to measure the LNAPL thickness and water level. If necessary, a bottom filling bailer specially designed to obtain samples of petroleum products floating on water will be used. This bailer is especially useful when thin layers (less than 0.05 feet) of LNAPLs are present. The indicator or probe will be calibrated against a tape measure to provide an accurate depth measurement. The calibration will occur at the beginning of each field program and once per month thereafter.

All groundwater depth measurements will be referenced to the notch on the top of the well casing, not the top of the protective casing.

Groundwater elevation information will be recorded in the field on the appropriate form, either a Sampling Record form for groundwater (Figure A-13), a Groundwater Elevation Report (Figure A-18) or in a notebook.

Water level measurement equipment including the water level indicator and bailer will be decontaminated before use at the site and between monitoring wells, according to the procedures outlined in Section 4.4 of this appendix.

PAGE OF

GROUNDWATER ELEVATION REPORT

ENGINEERING-SCIENCE, INC.	**CLIENT:**	**DATE:**

PROJECT: ____________________ PROJECT NO: ____________________

LOCATION: ____________________ INSPECTOR: ____________________

MONITORING EQUIPMENT:

INSTRUMENT	DECTECTOR	BGD	TIME	REMARKS

WATER LEVEL INDICATOR:

INSTRUMENT	CORRECTION FACTOR

COMMENTS:

		DEPTH TO		CORRECTED	MEASURED	INSTALLED	PRODUCT	WELL STATUS / COMMENTS
WELL	TIME	WATER	PRODUCT	WATER LEVEL	POW	POW	SPEC. GRAV.	(Lock?, Well #?, Surface Disturbance?, Riser marked?, Condition of: riser, concrete, protective casing, etc.)

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FIGURE A-18

Personnel conducting water level measurements should not any wells that do not appear to be under equilibrium (i.e., pressurized or under vacuum conditions) when the measurements are made. If a well is not in equilibrium, it should be allowed to stand until such conditions are reached prior to taking the water level measurement.

An accurate representation of the equilibrated, unconfined aquifer water table conditions may be compromised if water level measurements on the same site are made before, during and after a heavy rainstorm. Freeze and Cherry (1974) state that anomalously large rises in the water levels in observation wells in shallow unconfined aquifers have been observed during heavy rainstorms. The heavy rainstorm creates an inverted zone of saturation of the ground surface and the advancing water front traps air between itself and the water table. Air pressures in this zone build up to values much greater than atmospheric causing a rise in the water level in the well. The anomalous rise usually dissipates within a few hours, or at most a few days (freeze and cherry 1979). While this phenomenon is not like to be common to every precipitation event, site conditions at SEDA would favor this occurrence under the right circumstances.

3.11.2 Hydraulic Conductivity Testing Using Constant Head Packer Testing

The in-situ hydraulic conductivity of the deep competent shale coreholes will be determined using constant head packer testing (Earth Manual: USBR 7310-89). The testing will be 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 competent shale wells at SEDA (at the Ash Landfill) ranged between 1.9×10^{-7} cm/sec and 4.7×10^{-5} cm/sec. For the purposes of this work plan 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, the 20-foot section interval of shale that has been cored will be cleaned. The cleaning procedure involves 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 is performed until water discharging from the top of the well head is clear. This procedure is usually performed for at least 20 to 30 minutes depending on the amount of rock flour and chips in the corehole.

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

A 500-gallon tank of potable, demonstrated analyte-free water should be 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 provides the ability to regulate and monitor the water being injected into the interval during the test. The water head above the test interval is determined using both the transducer and an electronic water level meter. This water head, in addition to other considerations, is used to determine the minimum inflation pressure applied to the packers for the test. Next the packers are inflated to determine the water head for the test interval. The packers are then deflated and water was flushed through the system to remove any entrapped air. When the system is flushed, the packer is inflated to the pre-determined inflation pressure. Next the pressure within the enclosed system is monitored to verify that the seal between the packer and the corehole wall is adequate; if it remains steady, this indicates a sealed system.

The test is 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 is to be performed at each interval consisting of three increasing steps to the maximum pressure and then two decreasing steps to the starting pressure. This 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 is pumped into the test interval at the required pressure until the flow rate becomes stable; it should stabilize within about 5 minutes. Flow rates will be maintained during three 5-minute intervals during which 30-second readings of flow will be recorded. During the test small adjustments should be made to the flow rate (i.e., injection pressure) to hold the downhole pressure in the test interval constant. The test is completed after the 5-cycles are performed. An appropriate low flow meter (with a flow range between approximately 0.010 and 0.25 gals/min) shall be used to regulate and monitor the flow of water into the test zone. The field data for the packer testing will be on recorded Figure A-19.

The hydraulic conductivity will be calculated using the method described in "Procedure for Constant Road Hydraulic Conductivity Tests in Single Drill Holes" (Earth Manual: USBR 7310-89) and based on information contained in Houlsby (1976).

3.11.3 Hydraulic Conductivity Testing in Monitoring Wells

3.11.3.1 Overburden Monitoring Wells

The in-situ hydraulic conductivity in monitoring wells can be determined using rising head slug tests. 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 to be used is described below. Prior to the beginning the test, the water level in the well will be 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) will be lowered into the well to an appropriate depth so that when the slug is lowered into the well it would not come in contact with the transducer. At least one foot should be allowed between the bottom of the well and the transducer. Next, either a 3-foot or 5-foot long stainless steel slug with a 1.66-inch diameter will be lowered into the well using clean nylon rope so that the top of the slug is just below the static water level previously measured in the well. The hollow stainless steel slug should contain machined ends onto which stainless screw caps with o-ring gaskets fit. The slug should be filled with potable water for the test. In some instances a thinner, solid 2-foot long slug should be used for the slug test if the 5-foot slug becomes repeatedly snagged on the transducer cable at the start of the test, thereby disrupting the test results. After the slug is lowered into the well, the water level in the well will be allowed to equilibrate. Water levels are measured until they stabilized to within 0.01 feet for 5 minutes by monitoring the transducer via the data logger. The stabilized water level at the end of the test should be nearly equal to the original static water level.

After stabilization of the water level, the slug will be quickly removed and data logger started simultaneously thereby beginning the slug test. A 2-channel Hermit model 1000C data logger shall be used to record the slug test data. The data logger should be configured for logarithmic data collection so that early changes in the water level are recorded. After 10 minutes of data collection the water level will be monitored with the data logger to

CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE	CLIENT:	DATE:

PROJECT : LOCATION: CORE HOLE/WELL:	INSPECTOR: CONTRACTOR: TEST INTERVAL (ft):

WEATHER/FIELD CONDITIONS (record major changes)				MONITORING	
TIME	TEMP	PRECIP.	GROUND SURFACE CONDITIONS	INSTRUMENT	DETECTOR

CORE HOLE/WELL SPECS:	INSTRUMENT SPECS:
ELEVATION GROUND SURFACE (ft):	TYPE OF DATA LOGGER:
DIAMETER CORE HOLE/WELL (in):	TRANSDUCER TYPE(S):
LENGTH OF TEST INTERVAL (ft):	TYPE OF PACKER(S):
DEPTH OF TEST INTERVAL (ft):	MAXIMUM INFLATABLE PACKER PRESSURE (psi):
TEMPERATURE OF GROUNDWATER (deg. C):	PUMP CAPACITY (gal./min.):
CORE HOLE STABILITY: GOOD FAIR POOR	DIAMETER OF FEED PIPE (in.):

DEPTH TO GROUNDWATER MEASUREMENTS IN CORE HOLE/WELL PRIOR TO TESTING:

DATE								
TIME								
DEPTH								

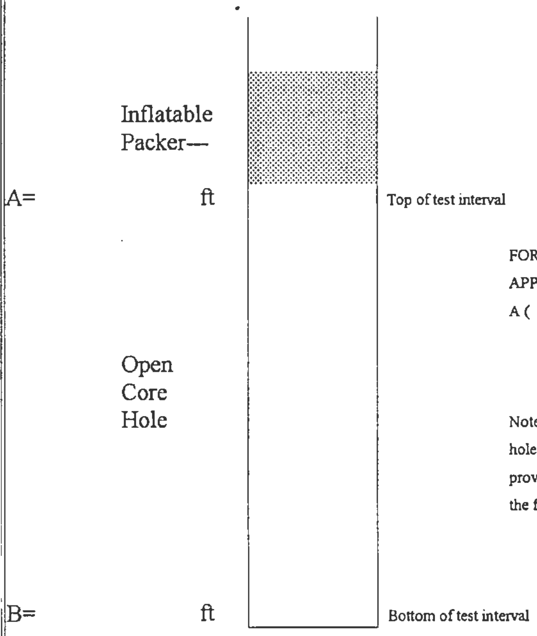
CORE HOLE/WELL CLEANING PROCEDURE:

METHOD OF CLEANING (i.e. water jet, etc.):

VOLUME OF GROUNDWATER BAILED FROM THE INTERVAL BELOW PACKER (gallons):

TOTAL PRESSURE TO BE APPLIED TO TEST INTERVAL:

_____________ lbf/sq. in. (psi)



FOR THE INTERVAL A (ft) TO B (ft) THE TOTAL PRESSURE APPLIED TO THE DRILL HOLE TEST INTERVAL SHOULD NOT EXCEED

A (ft) X 1 lbf/sq. in. (psi) = lbf/sq. in. (psi)

Note: As a gernal rule, total pressure (static head plus guage pressure) applied in the drill hole should not exceed 1 lbf/sq. in. (psi) per foot of overburden at the top of the test interval, provided the interval is greater than 10 feet. High pressures may artificially fracture the formation materials.

CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE	CLIENT:	DATE:
PROJECT : LOCATION: CORE HOLE/WELL:		INSPECTOR: CONTRACTOR: TEST INTERVAL (ft):

DETERMINATION OF WATER HEAD ABOVE THE TEST INTERVAL:

METHOD 1 - DEPTH TO WATER TABLE (ft):
(use electronic water level meter)

METHOD 2 - PRESSURE ON PNEUMATIC PRESSURE GUAGE (lbf/sq. in. or psi):
(To convert lbf/sq. in. (psi) to feet or head of water multiply by 2.31)

DETERMINATION OF MINIMUM INFLATION PRESSURE TO BE APPLIED TO PACKER(S):

Equation:

$$SH + PP + PE = \text{MINIUM INFLATION PRESSURE} \quad (1)$$

WHERE:
SH = STATIC PRESSURE AT THE MIDPOINT ELEVATION OF THE TEST INTERVAL, lbf/sq. in. or kPa
PP = GUAGE PRESSURE TO BE MAINTAINED DURING THE TEST, lbf/sq. in. or kPa
PE = PRESSURE NEEDED TO EXPAND PACKER TO HOLE DIAMETER AS DETERMINED BEFORE INSERTION IN THE DRILL HOLE BY EXPANDING THE PACKER IN A LENGTH OF PIPE HAVING A DIAMETER SIMILAR TO THE HOLE DIAMETER, lbf/sq. in. or kPa

CALCULATIONS:

SH =
PP =
PE =

DETERMINATION OF WATER HEAD FOR THE TEST INTERVAL:

PRESSURE ON PNEUMATIC PRESSURE GUAGE (lbf/sq. in. or psi):
(To convert lbf/sq. in. (psi) to feet or head of water multiply by 2.31)

PIEZOMETER PRESSURE AFTER FINAL PACKER INFLATION PRIOR TO TEST (lbf/sq. in. or psi):

FIGURE A-19

Page of

CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE
CLIENT:
DATE:

PROJECT :
LOCATION:
CORE HOLE/WELL:

INSPECTOR:
CONTRACTOR:
TEST INTERVAL (ft):

TEST 1: Press. A (STARTING)
REQUIRED PRESSURE FOR TEST INTERVAL (lbf./sq. in. or psi):

STABILIZED FLOW (gal./min.):
TOTAL VOLUME OF WATER USED FOR TEST 1 (gal.):

BACK FLOW: YES NO
BACK PRESSURE (lbf/sq. in. or psi):
DECAY OF HOLDING PRESSURE: YES NO

INTERVAL 1

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
0						
0:30						
1:00						
1:30						
2:00						
2:30						
3:00						
3:30						
4:00						
4:30						
5:00						

Water Injected into Hole in Testing Period:
(Total quantity read from water meter)
Starting reading:
Ending reading:

INTERVAL 2

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
5:30						
6:00						
6:30						
7:00						
7:30						
8:00						
8:30						
9:00						
9:30						
10:00						

Water Injected into Hole in Testing Period:
(Total quantity read from water meter)
Starting reading:
Ending reading:

INTERVAL 3

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
10:30						
11:00						
11:30						
12:00						
12:30						
13:00						
13:30						
14:00						
14:30						
15:00						

Water Injected into Hole in Testing Period:
(Total quantity read from water meter)
Starting reading:
Ending reading:

FIGURE A-19

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CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE	CLIENT:	DATE:

PROJECT :
LOCATION:
CORE HOLE/WELL:

INSPECTOR:
CONTRACTOR:
TEST INTERVAL (ft):

TEST 2: Press. B
(INCREASING)

REQUIRED PRESSURE FOR TEST INTERVAL (lbf./sq. in. or psi):

STABILIZED FLOW (gal./min.):
TOTAL VOLUME OF WATER USED FOR TEST 2 (gal.):

BACK FLOW: YES NO
BACK PRESSURE (lbf/sq. in. or psi):
DECAY OF HOLDING PRESSURE: YES NO

INTERVAL 1

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
0						
0:30						
1:00						
1:30						
2:00						
2:30						
3:00						
3:30						
4:00						
4:30						
5:00						

Water Injected into Hole in Testing Period:
(Total quantity read from water meter)

Starting reading:
Ending reading:

INTERVAL 2

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
5:30						
6:00						
6:30						
7:00						
7:30						
8:00						
8:30						
9:00						
9:30						
10:00						

Water Injected into Hole in Testing Period:
(Total quantity read from water meter)

Starting reading:
Ending reading:

INTERVAL 3

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
10:30						
11:00						
11:30						
12:00						
12:30						
13:00						
13:30						
14:00						
14:30						
15:00						

Water Injected into Hole in Testing Period:
(Total quantity read from water meter)

Starting reading:
Ending reading:

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FIGURE A-19

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CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE	CLIENT:	DATE:

PROJECT :
LOCATION:
CORE HOLE/WELL:

INSPECTOR:
CONTRACTOR:
TEST INTERVAL (ft):

TEST 3: Press. C (MAXIMUM)

REQUIRED PRESSURE FOR TEST INTERVAL (lbf./sq. in. or psi):

STABILIZED FLOW (gal./min.):
TOTAL VOLUME OF WATER USED FOR TEST 3 (gal.):

BACK FLOW: YES NO
BACK PRESSURE (lbf/sq. in. or psi):
DECAY OF HOLDING PRESSURE: YES NO

INTERVAL 1

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
0						
0:30						
1:00						
1:30						
2:00						
2:30						
3:00						
3:30						
4:00						
4:30						
5:00						

Water Injected into Hole in Testing Period: Starting reading:
(Total quantity read from water meter) Ending reading:

INTERVAL 2

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
5:30						
6:00						
6:30						
7:00						
7:30						
8:00						
8:30						
9:00						
9:30						
10:00						

Water Injected into Hole in Testing Period: Starting reading:
(Total quantity read from water meter) Ending reading:

INTERVAL 3

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
10:30						
11:00						
11:30						
12:00						
12:30						
13:00						
13:30						
14:00						
14:30						
15:00						

Water Injected into Hole in Testing Period: Starting reading:
(Total quantity read from water meter) Ending reading:

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CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE
CLIENT:
DATE:

PROJECT :
LOCATION:
CORE HOLE/WELL:

INSPECTOR:
CONTRACTOR:
TEST INTERVAL (ft):

TEST 4: Press. B (DECREASING)

REQUIRED PRESSURE FOR TEST INTERVAL (lbf./sq. in. or psi):

STABILIZED FLOW (gal./min.):
TOTAL VOLUME OF WATER USED FOR TEST 4 (gal.):

BACK FLOW: YES NO
BACK PRESSURE (lbf/sq. in. or psi):
DECAY OF HOLDING PRESSURE: YES NO

INTERVAL 1

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
0						
0:30						
1:00						
1:30						
2:00						
2:30						
3:00						
3:30						
4:00						
4:30						
5:00						

Water Injected into Hole in Testing Period:
(Total quantity read from water meter)

Starting reading:
Ending reading:

INTERVAL 2

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
5:30						
6:00						
6:30						
7:00						
7:30						
8:00						
8:30						
9:00						
9:30						
10:00						

Water Injected into Hole in Testing Period:
(Total quantity read from water meter)

Starting reading:
Ending reading:

INTERVAL 3

TIME	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE
(min)	Required	Actual		Feet of Water	Guage	(gal./min.)
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
10:30						
11:00						
11:30						
12:00						
12:30						
13:00						
13:30						
14:00						
14:30						
15:00						

Water Injected into Hole in Testing Period:
(Total quantity read from water meter)

Starting reading:
Ending reading:

Page of

CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE	CLIENT:	DATE:
PROJECT : LOCATION: CORE HOLE/WELL:		INSPECTOR: CONTRACTOR: TEST INTERVAL (ft):

TEST 5: Press. A (STARTING)	REQUIRED PRESSURE FOR TEST INTERVAL (lbf./sq. in. or psi):

STABILIZED FLOW (gal./min.):

TOTAL VOLUME OF WATER USED FOR TEST 5 (gal.):

BACK FLOW: YES NO

BACK PRESSURE (lbf/sq. in. or psi):

DECAY OF HOLDING PRESSURE: YES NO

INTERVAL 1

TIME (min)	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE (gal./min.)
	Required	Actual		Feet of Water	Guage	
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
0						
0:30						
1:00						
1:30						
2:00						
2:30						
3:00						
3:30						
4:00						
4:30						
5:00						

Water Injected into Hole in Testing Period: Starting reading:

(Total quantity read from water meter) Ending reading:

INTERVAL 2

TIME (min)	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE (gal./min.)
	Required	Actual		Feet of Water	Guage	
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
5:30						
6:00						
6:30						
7:00						
7:30						
8:00						
8:30						
9:00						
9:30						
10:00						

Water Injected into Hole in Testing Period: Starting reading:

(Total quantity read from water meter) Ending reading:

INTERVAL 3

TIME (min)	PRESSSURE IN TEST INTERVAL			PRESSURE ABOVE TEST INTERVAL		FLOW RATE (gal./min.)
	Required	Actual		Feet of Water	Guage	
	lbf/sq.in. or psi	Transducer (psi)	Guage (psi)	(ft)	(lbf/sq. in. or psi)	
10:30						
11:00						
11:30						
12:00						
12:30						
13:00						
13:30						
14:00						
14:30						
15:00						

Water Injected into Hole in Testing Period: Starting reading:

(Total quantity read from water meter) Ending reading:

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CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE	CLIENT:	DATE:

PROJECT :
LOCATION:
CORE HOLE/WELL:

INSPECTOR:
CONTRACTOR:
TEST INTERVAL (ft):

CALCULATION OF LUGEON VALUES

Test Interval	Testing Times *		Guage Pressure		Water Injected into Test Interval in Testing Period	Lugeon Value	
(meters)	Required (min)	Actual (min)	Required (bars)	Actual (bars)	(liters)	For Each Test	Repres. Value (choose one)
	15		10				
	15		15				
	15		20				
	15		15				
	15		10				

Note: * = testing time consists of three 5 minute intervals

Equation:

Lugeon Value = water taken in test (liters/meter/min.) X 10 (bars) / test pressure(bars) (2)

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CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE

CLIENT:

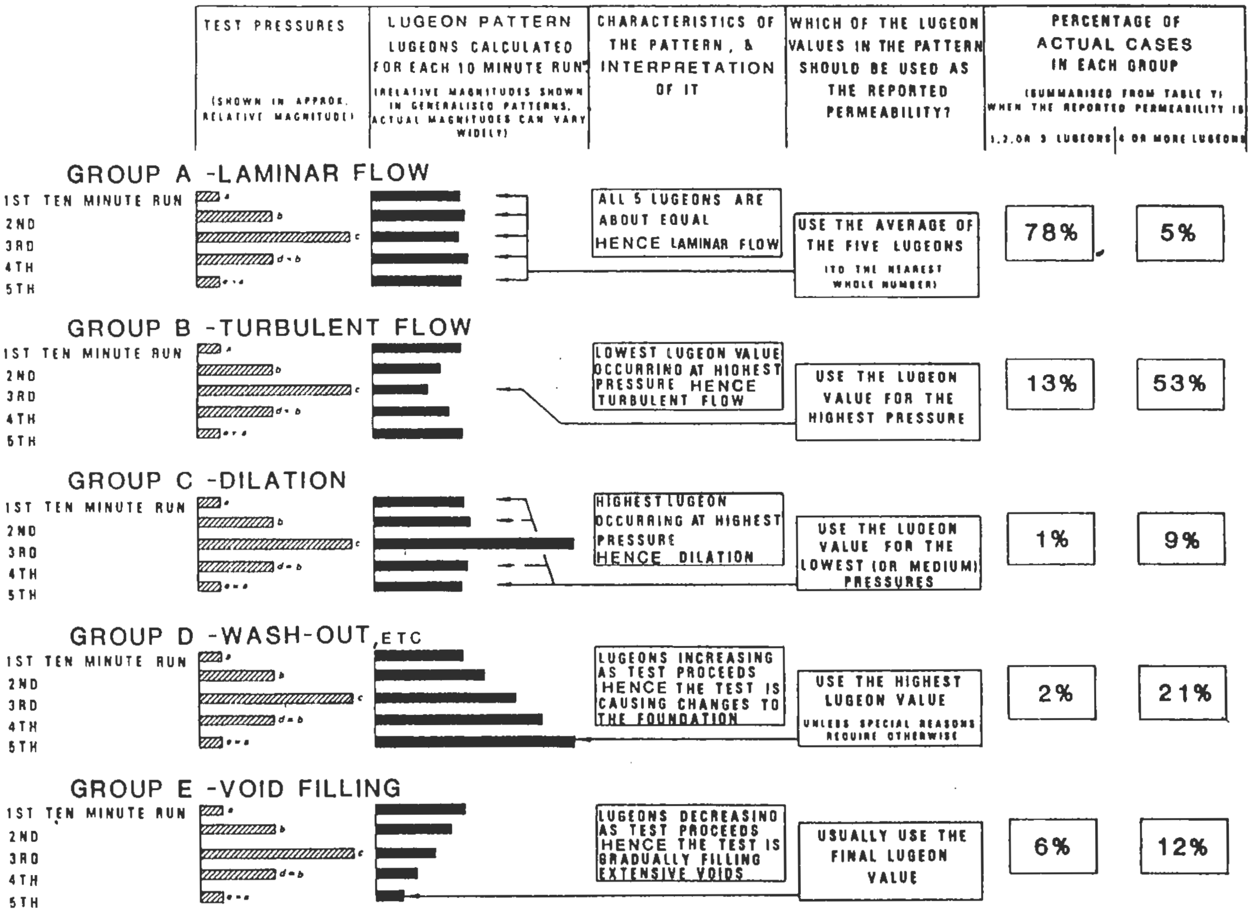
PROJECT:
LOCATION:
CORE HOLE/WELL:

Page of

DATE:

INSPECTOR:
CONTRACTOR:
TEST INTERVAL (ft):

TABLE 1: *Lugeon patterns for various occurrences during testing: Their interpretation and percentage occurrences*



	TEST PRESSURES (SHOWN IN APPROX. RELATIVE MAGNITUDE)	LUGEON PATTERN LUGEONS CALCULATED FOR EACH 10 MINUTE RUN* (RELATIVE MAGNITUDES SHOWN IN GENERALISED PATTERNS, ACTUAL MAGNITUDES CAN VARY WIDELY)	CHARACTERISTICS OF THE PATTERN, & INTERPRETATION OF IT	WHICH OF THE LUGEON VALUES IN THE PATTERN SHOULD BE USED AS THE REPORTED PERMEABILITY?	PERCENTAGE OF ACTUAL CASES IN EACH GROUP (SUMMARISED FROM TABLE V) WHEN THE REPORTED PERMEABILITY IS 1,2,OR 3 LUGEONS	4 OR MORE LUGEONS
GROUP A -LAMINAR FLOW 1ST TEN MINUTE RUN 2ND 3RD 4TH 5TH	a b c d=b e=a		ALL 5 LUGEONS ARE ABOUT EQUAL HENCE LAMINAR FLOW	USE THE AVERAGE OF THE FIVE LUGEONS (TO THE NEAREST WHOLE NUMBER)	78%	5%
GROUP B -TURBULENT FLOW 1ST TEN MINUTE RUN 2ND 3RD 4TH 5TH	a b c d=b e=a		LOWEST LUGEON VALUE OCCURRING AT HIGHEST PRESSURE HENCE TURBULENT FLOW	USE THE LUGEON VALUE FOR THE HIGHEST PRESSURE	13%	53%
GROUP C -DILATION 1ST TEN MINUTE RUN 2ND 3RD 4TH 5TH	a b c d=b e=a		HIGHEST LUGEON OCCURRING AT HIGHEST PRESSURE HENCE DILATION	USE THE LUGEON VALUE FOR THE LOWEST (OR MEDIUM) PRESSURES	1%	9%
GROUP D -WASH-OUT, ETC 1ST TEN MINUTE RUN 2ND 3RD 4TH 5TH	a b c d=b e=a		LUGEONS INCREASING AS TEST PROCEEDS HENCE THE TEST IS CAUSING CHANGES TO THE FOUNDATION	USE THE HIGHEST LUGEON VALUE UNLESS SPECIAL REASONS REQUIRE OTHERWISE	2%	21%
GROUP E -VOID FILLING 1ST TEN MINUTE RUN 2ND 3RD 4TH 5TH	a b c d=b e=a		LUGEONS DECREASING AS TEST PROCEEDS HENCE THE TEST IS GRADUALLY FILLING EXTENSIVE VOIDS	USUALLY USE THE FINAL LUGEON VALUE	6%	12%

*CALCULATED USING DIRECT PROPORTION TO RELATE TO LUGEON'S 'DEFINITION' PRESSURE OF 10 BARS (150 P.S.I.)

THIS TABLE GIVES GENERAL PATTERNS ONLY. DISCRETION IS NECESSARY IN ADAPTING THESE TO THE INEVITABLE VARIATIONS MET IN PRACTICE

FIGURE A-19

CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE
CLIENT:
DATE:
PROJECT :
LOCATION:
CORE HOLE/WELL:
INSPECTOR:
CONTRACTOR:
TEST INTERVAL (ft):

CALCULATION OF HYDRAULIC CONDUCTIVITY:

CALCULATE THE HYDRAULIC CONDUCTIVITY OF THE SOIL OR ROCK BY THE FOLLOWING EQUATION:

(see page 1255 of the Earth Manual paper for an example calculation)

$$k = \frac{q}{2\pi LH} \ln \frac{L}{r}\text{, where } L \geqq 10r \qquad (2)$$

or

$$k = \frac{q}{2\pi LH} \sinh^{-1} \frac{L}{2r}\text{, where } 10r \geqq L \geqq r \qquad (3)$$

where:

k = hydraulic conductivity, ft/yr or cm/s
q = constant rate of flow into the test interval, ft^3/yr or cm^3/s
L = length of the test interval, ft or cm
H = differential head of water at test interval, ft or cm
r = radius of the borehole, ft or cm
ln = natural logarithm, $\log_e$
$\sinh^{-1}$ = inverse hyperbolic sine, $\sinh^{-1} x \ln (x + \sqrt{x^2 + 1})$
pi = 3.1415

TEST RESULTS:

PRESS.	TEST	q	L	H	r	HYDRAULIC CONDUCTIVTY
A	1					
B	2					
C	3					
B	4					
A	5					

Page of

CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE	CLIENT:	DATE:
PROJECT : LOCATION: CORE HOLE/WELL:		INSPECTOR: CONTRACTOR: TEST INTERVAL (ft):
CALCULATIONS (continued):		

Page of

CONSTANT HEAD HYDRAULIC CONDUCTIVITY PACKER TEST

ENGINEERING-SCIENCE	CLIENT:	DATE:

PROJECT : LOCATION: CORE HOLE/WELL:	INSPECTOR: CONTRACTOR: TEST INTERVAL (ft):

COMMENTS:

determine if it has stabilized. When the water level reaches 80 percent of the original static water level and stabilizes to 0.02 feet over a 5-minute time period, the test will be stopped. The slug test field data will be recorded on Figure A-20. The test data will be downloaded to a portable computer in the field and reviewed to evaluate whether the data is acceptable.

The slug test information for each monitoring well will be reduced using the procedure described by Bouwer and Rice (1976) and 1989). Normalized recovery rates will be plotted against time on a semi-logarithmic plot and the hydraulic conductivity is determined by the computer program AQTESOLV Version 1.1 Release 4. Prior to running the program the time and water level data will be imported into an AQTESOLV data file. Next, input data required for analyzing the slug test will be entered. The input data consist 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. Once the data are plotted, the hydraulic conductivity will be determined using the automatic iterative 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 and 1989).

Recent refinements in the interpretation of slug test data in unconfined formations using the Bouwer and Rice (1976 and 1989) Method (i.e., Zlotnik, V., 1994, Groundwater, V.32, No. 5, and more recently, Hyder, Z. and Butler, J.J. Jr., 1995, Groundwater V. 33 No. 1). In response to this, the method for interpreting slug test data using the Bouwer and Rice (1976 and 1989) technique will be modified to include, where appropriate, the recommendations of Zlotnik (1994). In instances where there is no significant vertical flow affecting the test according to the geometric criteria stated by Zlotnik (i.e., $L/D \approx 1$) this method will not be used. Because all of the overburden wells to be installed in the till are proposed to be screened across most of the aquifer saturated thickness, the criteria for test geometry ($L/D \approx 1$) is expected to hold true in most instances.

In another recent article, Hyder and Butler (1995) state that "the Bouwer and Rice (1976) method does appear to provide reasonable estimates of field values [of hydraulic conductivity] in a large number of situations." However, they also present information that can be used to assess the error in the Bouwer and Rice determination of hydraulic conductivity thereby allowing the field practitioner to assess if the parameter estimate is acceptable for a particular application. The recommended techniques of Hyder and Butler

SLUG TEST REPORT FORM

ENGINEERING-SCIENCE, INC. **CLIENT:** **WELL #:**

PROJECT: ______ INSPECTOR: ______
LOCATION: ______ TEST DATE: ______

WELL AND AQUIFER INFORMATION

WELL POINT (installed): ______
WELL CASING INNER DIAMETER: ______
BOREHOLE DIAMETER: ______
STATIC DEPTH TO WATER: ______
SCREENED INTERVAL - FROM: ______
TO: ______

WELL SCREEN SLOT SIZE: ______
AQUIFER THICKNESS: ______
PRODUCT PRESENT (Y/N?) ______

(all depths measured from TOC, or taken from installation detail)

TEST EQUIPMENT SPECIFICATIONS

DATA LOGGER BRAND: ______
INSTRUMENT MODEL: ______
TRANSDUCER BRAND: ______

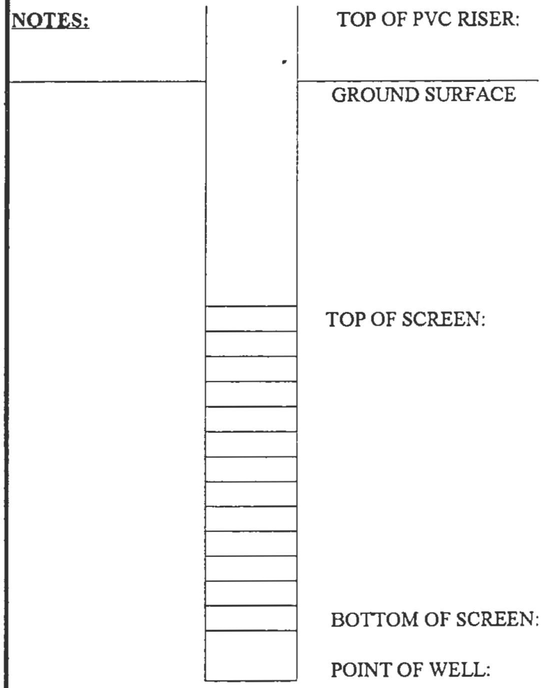
TRANSDUCER RATING (PSI): ______
SLUG/BAILER DIMENSIONS: ______
SLUG/BAILER VOLUME: ______

TEST INFORMATION

REFERENCE VALUE: ______
TRANSDUCER MODE: SURFACE LEVEL or TOC
STATIC WATER (START): ______
START TIME: ______
END TIME: ______
STATIC WATER (END): ______
ELAPSED TIME: ______

DATA LOGGER TEST NUMBER: ______
TRANSDUCER DEPTH: ______
TRANSDUCER - LINEARITY: ______
- SCALE: ______
- OFFSET: ______
- DELAY: ______
SATURATED SCREEEN LENGTH: ______

NOTES:



TOP OF PVC RISER: 0.00 ft
GROUND SURFACE
TOP OF SCREEN:
BOTTOM OF SCREEN:
POINT OF WELL:

(ALL DEPTHS RELATIVE TO THE TOP OF PVC CASING)

COMMENTS:

CONVERSION: 2.30667 FEET OF WATER/PSI

YOU MUST RESET THE REFERENCE VALUE PRIOR TO BEGINNING EACH TEST!!!!!

(1995) for evaluating the strict applicability of the Bouwer and Rice (1976) method will also be employed, where appropriate.

The geologist or hydrogeologist responsible for slug test data reduction will continue to assess peer-reviewed literature on interpreting slug test data in unconfined overburden aquifers and will make the necessary modifications to the interpretation method based on applicable recommendations in the literature.

3.11.3.2 Bedrock Monitoring Wells

Hydraulic conductivity in the fractured shale bedrock will initially be determined using slug testing and the Bouwer and Rice (1976 and 1989) data reduction method(s) described above. This will serve as an initial assessment of conductivity under contention that the mm- to cm-scale fractures in the shale may behave as equivalent porous media (EPM). However, for this Generic RI/FS workplan other methods for determining hydraulic conductivity in the shale bedrock will also be evaluated and employed, where applicable, to provide additional comparative conductivity data. The methods outlined in the following four articles will be among those evaluated:

1. Morris L. Maslia and Robert B. Randolph, U.S.G.S. Water Supply Paper 2308, pp. 1-16.

2. Kent S. Novakowski, Analysis of Aquifer Tests Conducted in Fractured Rock: A review of the Physical Background and the Design of a Computer Program for Generating Type Curves, Ground Water, January-February 1990, v. 28, no. 1, pp 99-107.

3. D.N. Jenkins and John K. Prentice, Theory for Aquifer Test Analysis in Fractured Rocks Under Linear (Nonradial) Conditions, Ground Water, January-February 1982, v. 28, no. 2, pp 1-21.

4. D.N. Jenkins and John K. Prentice, Corrections to Theory for Aquifer Test Analysis in Fractured Rocks Under Linear (Nonradial) Conditions, Ground Water, March-April 1982, v. 20, no. 2, pp 321-2.

3.11.4 Vertical Connection Testing

If necessary, to assess the degree of vertical connection between the shallow till/weathered shale aquifer and the deep competent shale aquifer, vertical connection tests will be performed at well pair and cluster locations. The tests are 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 subject site. Such an impermeable boundary would be an important influence on the possible spread of contaminants.

At well pairs, one vertical connection test will be performed by pumping 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 will be lowered into the shallow well to monitor the water level changes. At well clusters, two vertical connection tests will be performed. One will be performed by pumping water from the shallow competent shale well and measuring the change in the water level in the till/weathered shale well. The second test will be performed by pumping 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 can also be assessed. For the latter test, a transducer will be lowered into each of the two shallower wells and connected to a Hermit 1000c 2- channel data logger. The duration of pumping will be for 60 minutes. The wells will be allowed to recover for approximately 60 minutes.

The method for preparing the data logger and transducer is similar to that used for the slug tests except a linear scale should be programmed into the data logger, as a logarithmic scale is not necessary for this test. The transducer and cable will be decontaminated between each test. All water bailed from the wells during these tests will be containerized. Vertical connection test data will be recorded on Figure A-21.

3.11.5 Surface Water Elevation Measurements

When required, staff gauges will be installed in surface water bodies (streams or ponds) at locations where surface water is anticipated to be present year round. The gauge will be driven into the sediment so that the scale can be seen from shore and the gauge will not move. The elevation and location of each gauge will be measured by a land surveyor.

VERTICAL CONNECTION TEST REPORT

ENGINEERING-SCIENCE, INC.	CLIENT:	**WELL #:**

PROJECT:		INSPECTOR:	
LOCATION:		TEST DATE:	

WELL AND AQUIFER INFORMATION

TILL/WEATHERED SHALE WELL:		**COMP. SHALE BEDROCK WELL:**	
WELL POINT (installed):		WELL POINT (installed):	
STATIC DEPTH TO WATER:		STATIC DEPTH TO WATER:	
SCREENED INTERVAL - FROM:		SCREENED INTERVAL - FROM:	
TO:		TO:	

(all depths measured from TOC, or taken from installation detail)

TEST EQUIPMENT SPECIFICATIONS

DATA LOGGER BRAND:		TRANSDUCER RATING (PSI):	
INSTRUMENT MODEL:		TRANSDUCER BRAND:	

TEST INFORMATION FOR TILL/WEATHERED SHALE WELL

REFERENCE VALUE:		DATA LOGGER TEST NUMBER:	
TRANSDUCER MODE:	SURFACE LEVEL or TOC	TRANSDUCER DEPTH:	
STATIC WATER (START):		TRANSDUCER - LINEARITY:	
START TIME:		- SCALE:	
END TIME:		- OFFSET:	
STATIC WATER (END):		- DELAY:	
ELAPSED TIME:			

TEST INFORMATION FOR SHALLOW COMPETENT SHALE WELL

REFERENCE VALUE:		DATA LOGGER TEST NUMBER:	
TRANSDUCER MODE:	SURFACE LEVEL or TOC	TRANSDUCER DEPTH:	
STATIC WATER (START):		TRANSDUCER - LINEARITY:	
START TIME:		- SCALE:	
END TIME:		- OFFSET:	
STATIC WATER (END):		- DELAY:	
ELAPSED TIME:			

TEST INFORMATION FOR DEEP / SHALLOW COMPETENT SHALE WELL (cirle one)

STATIC WATER (START):		NEAR DRYNESS ?:	YES NO
PRUGE METHOD	PERISTALTIC PUMP or BAILER	WATER DEPTH AFTER PURGE (END):	
TIME START PURGE:		ELAPSED TIME:	
TIME END PURGE:			

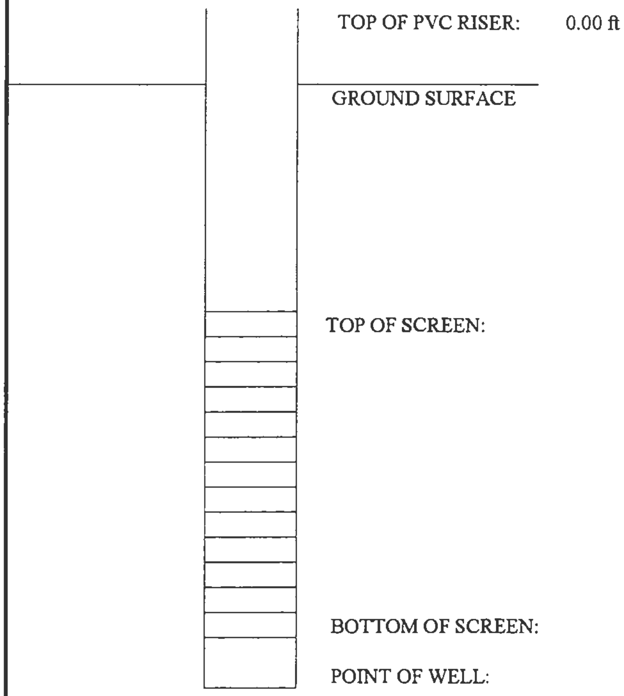
COMMENTS:
CONVERSION: 2.3O667 FEET OF WATER/PSI
YOU MUST RESET THE REFERENCE VALUE PRIOR TO BEGINNING EACH TEST!!!!!

FIGURE A-21

NOTES/DIAGRAMS:

TILL/WEATHERED SHALE WELL

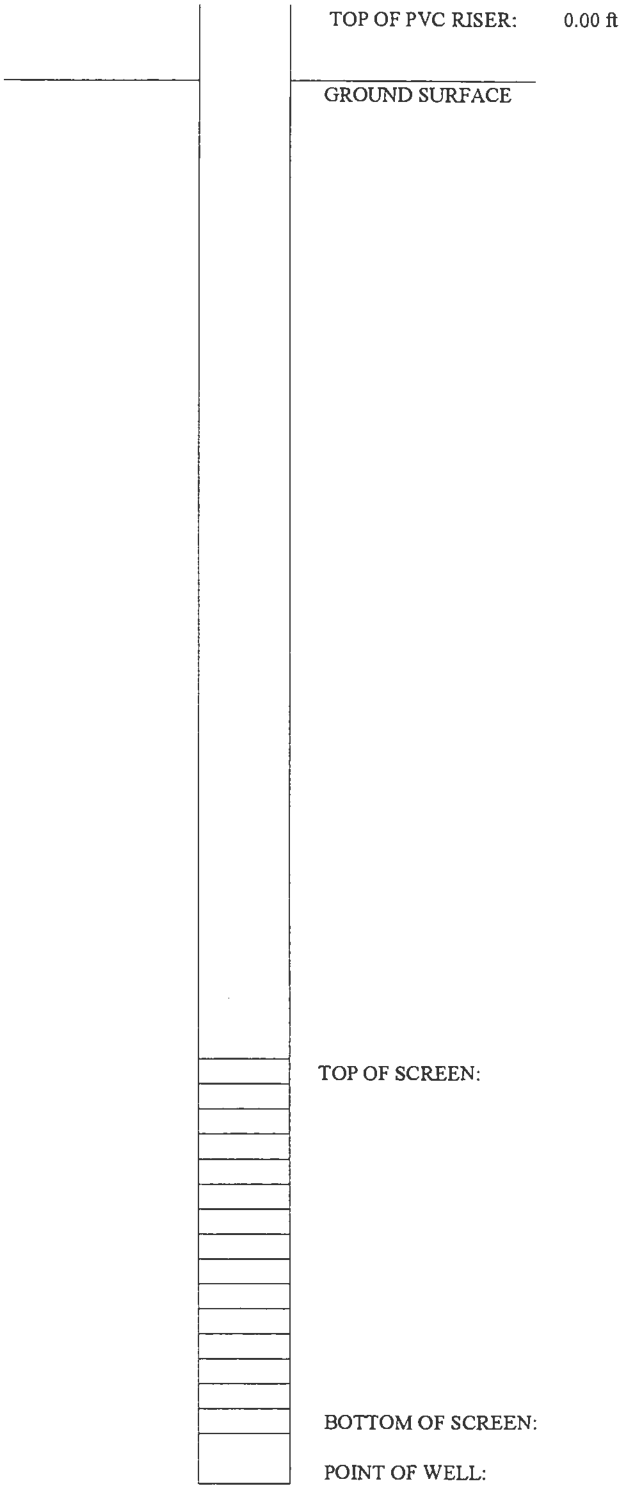
.WELL #:________



(ALL DEPTHS RELATIVE TO THE TOP OF PVC CASING)

COMPETENT SHALE WELL

WELL #:________



(ALL DEPTHS RELATIVE TO THE TOP OF PVC CASING)

3.11.6 Surface Water Flow Measurements

Stream flow rates will be measured according to the velocity-area method as described by Corbet (1945), Stream Gauging Procedure, USGS Water Supply Paper 888. A site will be selected for the stream transect near the surface water staff gauge and the surface water elevation will be recorded. In the absence of a surface water staff gauge, a temporary gauge will be established. Surface elevations and times will be recorded before and after flow measurements to determine if the stream level changed during the course of flow gaging.

A tape measure will be stretched perpendicular to the stream channel and the ends will be secured. The stream width will than be divided into ten to thirty segments. (The USGS recommends that no more than 10%, and preferably no more than 5%, of the flow be represented in any one segment).

For each segment, the midpoint depth will be recorded (d_i). The average velocity, V_i, for each segment will be measured depending on the water depth at that midpoint. If the water is less than 2.5 feet deep, velocity measurements will be taken at 0.6 times the total depth below the water's surface. if the water is deeper than 2.5 feet, velocity measurements will be taken at 0.2 and 0.8 times the total depth below the water's surface. In this instance, the resulting velocity for the sequent is a simple average of the 0.2 and 0.8 velocity measurements.

Using the Teledyne-Gurley flowmeter, the velocity is measured by counting the revolutions of the bucket-wheel over a know time (40-70 seconds), using the stopwatch. These time and revolution numbers are recorded in the notebook and converted to velocities using the rating tables supplied with the flowmeter.

The Marsh-McBirney flowmeter measures velocity directly. While this instrument proves easier to use there is some question as to its accuracy. It should tehrefore be used only as a back-up rather than the primary method for flow measurements.

The discharge for each segment (q_i) will be calculated as the product of the segment velocity (v_i), depth (d_i) and width (w_i):

$$q_i = v_i d_i W_i$$

The total estimated discharge for that stream profile will be equal to the sum of each segment's calculated discharge.

3.12 ECOLOGICAL INVESTIGATION

The potential mechanisms for the movement of pollutants from the subject site to off-site areas include physical and biological means, acting independently or in combination with each other. The purpose of this investigation is to assess any possible environmental impacts. This information is required to fully evaluate the risk from this site. Environmental risk includes risk to aquatic and terrestrial biota which may be impacted due to the inadvertent intake of constituents found at the site or which have migrated off the site. Ecological assessment, as per EPA's 1989 Environmental Evaluation Manual, is defined as "a qualitative and/or quantitative appraisal of the actual or potential effects of a hazardous waste site on plants and animals other than people and domesticated species". At SEDA, the ecological assessment will focus upon the terrestrial biota residing on the subject site and the aquatic species in on-site surface water bodies.

The ecological assessment will consist of an initial site reconnaissance and biological sampling. This will include a habitat characterization to obtain information on what species are likely to utilize the site, as well as an assessment of soil, sediment, and aquatic chemistry. The initial assessment will investigate the biotic populations which would most likely be exposed. These biological populations include fish and shellfish which may inhabit the surface water bodies and any wetlands which may exist on and adjacent to the subject site as well as terrestrial habitats.

The ecological assessment objectives are:

1. To document and evaluate the terrestrial and aquatic habitats and organisms on and adjacent to the site;
2. To identify any wetland habitats;
3. To provide a database for the assessment of environmental risks; and
4. If necessary, to determine the concentrations of pollutants in aquatic and terrestrial organisms based on a qualitative analysis of aquatic and terrestrial communities data and an evaluation of the viability of the aquatic and terrestrial ecosystems as described in Section 3.12.1.

3.12.1 Approach to the Ecological Assessment

In order to fully understand the interrelationship of the subject site and its association with the environment, it is necessary to document existing, surrounding, vegetative cover types. Cover typing is done by traversing the site on foot and noting major cover types in relation to the location of the subject site. The terrestrial ecology team will characterize and map the upland and wetland vegetation cover types within the general study area.

For the vegetative cover type mapping forested areas will be characterized based on dominant tree species after Stout (1958) and U.S. Fish and Wildlife Service (USFWS)(1979) (e.g., northern hardwood, birch/pine forest).

Following an analysis of initial wetland mapping and cover typing, the assessment will include sampling of terrestrial and aquatic biota. The sampling program for aquatic and terrestial biota are discussed in Section 3.12.3.

Ecologists will collect aquatic and terrestrial community data which will generally describe the respective ecosystems. Specifically, all fish and shellfish collected at each station will be identified and enumerated, not just those species subject to tissue sampling. Terrestrial and aquatic macroinvertebrates will be collected by scraping hard surfaces or substrate sampling. All taxa will be grossly identified (order to genus, as practicable) and listed. Small mammals (mice, and moles) will be captured, identified, and released. These data will provide an overview of the aquatic and terrestrial communities from which the specimens were collected for chemical pollutant analysis of tissues. This information will be considered when describing the occurrence of any environmental risks associated with the ecological community.

From the sediment certain pollutants can move through the food chain. These pollutants may be taken up by organisms in the lower trophic levels (e.g., zooplankton and macrobenthos) which are ultimately consumed by fish. Bioaccumulation occurs within each trophic level and may lead to biomagnification at higher trophic levels. The tissue of macroinvertebrates, fish, and shellfish collected at select stations may be analyzed. Actual tissue analyses will be dependent upon what species are collected and in what size and abundance. The approach to the initial ecological assessment will consist of documenting the biological conditions at the subject site, including nearby areas upgradient of the site with possible subsequent collection of select aquatic and terrestrial organism tissue samples for bioaccumulation analysis following the analysis and evaluation of all soil, sediment and water samples.

One potential pathway for pollutant migration is associated with the introduction of impacted sediment-ladden water to the aquatic ecosystems. If this pathway of transport is being utilized, then contaminants should be present in the tissue of shellfish. Shellfish are filter feeders and strain water to remove the microorganics that are used for food. Because they are not selective in this straining process, suspended particulate matter is often ingested with the food. This is especially true during periods of naturally high suspended particles, such as after heavy rains or when bottom sediments are disturbed. Once ingested, pollutants can bioaccumulate. The initial evaluation will document the presence and overall quality of the shellfish present. If deemed appropriate, the analysis of shellfish tissue provides a sensitive measurement for potential biological pathways of pollutant transport. If shellfish are not present or plentiful in surface water bodies on the site, another macroinvertebrate will be sought, such as crayfish.

Fish may also provide a means of off-site pollutant movement. The extent that this is likely, depends on the species of fish and range of movement experienced by the fish. Fish are not as effective biomarkers as macroinvertebrates, because it is not known for certain where the fish have been prior to collection, and therefore, in many cases the presence of pollutants in the tissues of fish cannot be readily associated with a particular source. Should it become necessary to sample fish at the upgradient locations, these data will likely represent background levels of pollutants in fish and will serve as a baseline for comparing fish concentrations collected at other locations. Fish collected at locations on and adjacent to the site may be subject to the greatest potential concentrations of pollutants. Fish collected at locations further downstream and downgradient may provide an indication of the extent of off-site biological transport.

Several terrestrial examples of potential pathways for pollution migration are earthworms, mice, and plants. Earthworms (Eisena sp.) are good invertebrate indicator species because their soft muscular body wall covered with a thin cuticle is exposed to sediment on a continuous basis and therefore can readily absorb toxic chemicals. They are detritus feeders and represent the base of the food chain for many other species, ie., avifauna. Their range is small relative to mobile species. Laboratory assay and sampling methods for toxicity testing of earthworms is well established and extensive data exists in the literature. Small burrowing mammals such as mice and moles represent an additional indicator species for terrestrial bioassessment because of their proximity to soil. They are a common prey item for higher trophic levels and can represent a quantifiable unit for potential contamination to receptor organisms. Field and laboratory studies are well established and data in the literature is extensive. Sampling techniques are readily employed.

Vegetative species composition of the habitat is important in determining habitat quality. Species diversity and composition can readily indicate pollution tolerance or intolerance. In addition, plants are critical to nutrient cycling in both aquatic and terrestrial ecosystems. Because they are stationary, plants are subject to the effect of contamination within a local area. Readily visible examples of potential toxic contamination can be seen in vegetation. Vegetative physical features such as leaf chlorosis and root elongation can provide quantitative endpoints for initial bioassessment. The nature and pattern of visible injury may indicate pathways characteristic of specific pollutants. As primary producers, plants are essential to higher trophic levels. Plant species diversity is often important in determining habitat quality for an area because most wildlife species require numerous food and species types, and high species diversity often indicates a stable community. Laboratory and in situ toxicity testing on vegetation can be readily employed.

Toxicity testing will depend upon the results of the initial assessment. For example, if pollutants are reaching the surface water body on-site and do not seem to effect terrestrial organisms in route, then toxicity testing for the surface water body organisms only would be conducted. In general, the toxicity testing would probably involve one or more of the following: earthworms--to study effects on terrestrial invertebrates; bobwhite, woodcock or mallards--to study effects on wildlife; Daphnia or fathead minnows--to study effects on aquatic life; and root elongation tests to study effects on plants.

The toxicity tests will utilize site soils or water. In that way any synergistic effects of more than one chemical will be included in the testing protocol. The focus of the toxicity tests will be to determine LC_{50} or EC_{50}, the concentration causing acute effects (LC_{50}) or a specific, predetermined effect (EC_{50}). Consideration will be given to when exposures are chronic or episodic (e.g., constant leaching or precipitation-caused leaching) in terms of deriving a correct testing protocol.

To the extent possible, the data collected in this program will be compared to other data collected by the NYSDEC or reported in the literature in order to put results into perspective regarding biota concentrations.

Wildlife directly observed or for which signs (e.g., tracks, droppings, nests) are observed will be noted during the terrestrial survey. Species likely to use the given habitats but not observed during the field survey will also be noted. The plants and animals reported herein may serve as biological pathways for movement of pollutants from the immediate area or to higher trophic levels. Knowledge of the site terrestrial environs will play a role in formulating an evaluation of the environmental risk.

3.12.2 Wetlands Delineation

Wetlands will be delineated at the subject site as part of the ecological investigation. On a national level the Army Corps of Engineers (COE) is currently enforcing the criteria of the 1987 Corps of Engineers Wetlands Delineation Manual (1987 Manual). By act of Congress, this 1987 document has temporarily replaced the 1989 Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989 Manual). At the time of this study, the methodology for defining jurisdictional wetlands is undergoing review and revisions by the various responsible agencies. In light of this information, it was decided for this project that the 1987 Manual would be used to delineate wetlands.

Wetlands on the site will be delineated using the 1987 Manual. Wetland cover types will be evaluated using aerial photographs, existing wetland maps (NYSDEC Wetland Regulatory Maps and United States Fish and Wildlife Service (USFWS) National Wetland Inventory Maps) and field reconnaissance. Wetland boundaries that extend a significant distance off of the subject site will not be surveyed as part of this delineation. Wetlands outside the subject site will be evaluated using aerial photographs, existing wetland maps (NYSDEC Wetland Regulatory Maps and USFWS National Wildlife Inventory Maps) and field reconnaissance to confirm wetland delineations, where necessary. The biotic survey of habitats and communities is intended to be an initial assessment. If necessary, Wetland Evaluation Technique (WET) or a comparable method will be used to conduct a functional wetland assessment. Biological conditions and contaminant levels from the various media will be evaluated and compared to available criteria and background levels. Following an analysis of these results, a determination regarding the necessity and scope of tissue sampling will be made. If results show concentrations of pollutants above background levels, or stressed biological communities, tissue sampling to investigate both bioaccumulation and potential pathways to man may be warranted.

Wetland cover types will be based on the classification of Cowardin et al. (1979), which is currently used by the USFWS for their National Wetland Inventory mapping. As noted previously, wetlands are potential sinks or transport receptors for pollutant migration in the environment. Therefore, ecologists will map the larger wetlands in the study area. Dominant plant species in the overstory, understory, and ground cover will be identified. All soil types and hydrological patterns including groundwater discharge points and surface drainage patterns will be identified and placed on topographical maps. The data form to be used to document the observations in shown Figure A-22. The study area includes: (1) areas that are unlikely to be exposed to surface runoff from the subject site (which can be considered controls); and (2) areas that are potentially affected by pollutants due to the known topography and hydraulic gradient of the off-site area and (3); all surface water pathways and the cummulative effects that potential contaminants associated with each site may have on the watershed area. This characterization will be qualitative in nature.

A wetlands assessment and restoration plan will be necessary for any wetlands impacted or disturbed by contamination or remedial activities.

3.12.3 Sampling Program

The initial, sampling program will focus upon habitat and community descriptions, benthic surveys, biological sampling, toxicity testing and possibly whole body tissue analysis.

The presence of significant terrestrial biotic resources within the 2-mile study area will be 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 will be reviewed for the location of these significant wetland resources in the study area. The location of all significant resources occurring in the study area will be mapped at a scale of 1 inch = 2000 feet. Information on the hunting,

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): __________ Date: __________
Project/Site: __________ State: __________ County: __________
Applicant/Owner: __________ Plant Community #/Name: __________
Note: If a more detailed site description is necessary, use the back of data form or a field notebook.

Do normal environmental conditions exist at the plant community?
Yes _____ No _____ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes _____ No _____ (If yes, explain on back)

VEGETATION

Dominant Plant Species	Indicator Status	Stratum	Dominant Plant Species	Indicator Status	Stratum
1.			11.		
2.			12.		
3.			13.		
4.			14.		
5.			15.		
6.			16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC __________
Is the hydrophytic vegetation criterion met? Yes _____ No _____
Rationale: __________

SOILS

Series/phase: __________ Subgroup:[2] __________
Is the soil on the hydric soils list? Yes _____ No _____ Undetermined __________
Is the soil a Histosol? Yes _____ No _____ Histic epipedon present? Yes _____ No _____
Is the soil: Mottled? Yes _____ No _____ Gleyed? Yes _____ No _____
Matrix Color: __________ Mottle Colors: __________
Other hydric soil indicators: __________
Is the hydric soil criterion met? Yes _____ No _____
Rationale: __________

HYDROLOGY

Is the ground surface inundated? Yes _____ No _____ Surface water depth: __________
Is the soil saturated? Yes _____ No _____
Depth to free-standing water in pit/soil probe hole: __________
List other field evidence of surface inundation or soil saturation.
____
Is the wetland hydrology criterion met? Yes _____ No _____
Rationale: __________

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes _____ No _____
Rationale for jurisdictional decision: __________

---

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.

[2] Classification according to "Soil Taxonomy."

Figure A-22

agricultural and forestry use of the terrestrial resources in the study area will be obtained from the SEDA, local residents, field reconnaissances and review of current (1991) aerial photography (scale 1 inch to 500 feet).

The terrestrial biotic assessment will involve two general study areas, a broad and a small study area. Within the broadest study area, which will include each 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, will be identified.

Within the smaller study area, which which include the site and an area 0.5 mile from the site perimeter, the major vegetative communities, wildlife species associated with each cover type, and the value of the habitats to the associated wildlife will be identified. Observations for signs of overt symptomology will be conducted in the 0.5 mile study area.

The aerial photography will be reviewed to delineate the major upland and wetland vegetative cover types in the 0.5 mile study area. These major cover types will be mapped at a scale of 1 inch = 1000 feet. Existing wetland maps will be reviewed for freshwater wetland locations. Field surveys will be performed to confirm or revise the cover type identification and boundaries and determine plant species composition, relative abundance, and density. Existing information will be reviewed to confirm species presence (Cowardin, 1965, SEDA, 1992). Freshwater wetlands on the sites will be identified and delineated using the 1987 Corps of Engineers Wetland Delineation Manual. These wetlands will be surveyed and mapped at a scale of 1 inch = 200 feet.

Wildlife species, including amphibians, reptiles, birds and mammals, expected to inhabit the study areas' identified cover types, will be determined primarily from existing information obtained from the SEDA and the nearby Montezuma National Wildlife Refuge (U.S. Fish and Wildlife Service, 1990, 1991, U.S. Fish and Wildlife Service and NYS Department Environmental Conservation, 1991). In addition, all wildlife observed during the course of the ecological and surface water/sediment field programs will be recorded to species, when possible. The habitat value of the cover types to wildlife will be assessed during these field surveys. Any signs of wildlife and vegetation stress or alterations observed during the above surveys will also be noted.

The terrestrial biotic assessment will focus on determining the species composition, relative abundance and species richness of the terrestrial floral and faunal communities inhabiting the sites and adjacent areas. The qualitative description will include examples where there are any overt symptomology, such as plant leaf chlorosis (yellowing) or reduced plant growth, and obvious tumors on small mammals will be qualitatively assessed. The qualitative assessment will characterize and evaluate the existing terrestrial biotic community and identify potential terrestrial biotic receptors and interactions with terrestrial communities adjacent to the sites.

Terrestrial invertebrate samples will be collected utilizing a one foot square quadrat. The upper three inches of ground surface soil and vegetation will be removed with a trowel. Samples collected will be stored on ice until initial screening and preservation is performed. All samples will be individually placed into a five-gallon bucket and enough water was added to create a slurry with the clay particles. The sample will then be poured into a 0.5 mm mesh brass sieve and rinsed down with a hand held water sprayer. All sample portions remaining in the sieve will be placed into appropriately labelled one-liter jars and preserved with 70 percent isopropyl alcohol. Samples will be sorted in the laboratory under 10X magnification and identified to the lowest practical taxon.

Benthic sample collection surveys within the appropriate drainage ditches will be conducted to determine the presence and characteristics of the macroinvertebrate community that may be present. Paired samples will be taken at three stations established in the ditch. If the ditch is dry, conventional aquatic macroninvertebrate sampling techniques are not appropriate. Samples should then be taken by establishing a one square foot quadrat across the channel of the swale (the typical width of a channel is one foot or less). All sediment and plants within the one square foot quadrat to a depth of three inches will be removed with a trowel and placed in a clean container. The aboveground portion of each plant will manually searched for invertebrates, any specimen found will be placed in a sample container, and all sediment rinsed from the root systems of the plants. The plants will then be discarded. All sediment will be screened through a No. 35 testing sieve with 0.5 mm openings to remove all fine material from the sample. The remaining material will be placed in a sample container, labeled and preserved in isopropyl alcohol. Sorting and identification of macroninvertebrates will occur at a later time.

A qualitative evaluation of the aquatic macroinvertebrate community will be made by hand scraping of hard substrates (rocks, tree limbs). Detailed taxonomic study is not proposed (organisms will be identified to genus, family, or order) as the objective of such sampling is to generally characterize the invertebrate community for which little or no data exists. In addition, an inventory of sediment-dwelling (benthic) macroinvertebrates will be made by using a petite Ponar grab sampler, which samples a 6-inch by 6-inch portion of the bottom (provided the gear can be utilized where the substrate is suitable for sampling with such gear, e.g., organic material, silt, sand, or smaller sized gravel). Sediment will be washed through a 0.5 mm screen and any remaining invertebrates preserved for later identification. Invertebrate collections will be combined such that a taxa list can be developed for each station.

The results of the macroinvertebrate community survey and tissue analyses will be used to provide an indication of the extent of pollutant migration to the on-site surface water body and estimate the uptake by the invertebrate community. This data will comprise the database for determining the occurrence of any environmental risks.

Any toxicity testing that may be deemed necessary will be done according to procedures outlined in EPA's manual entitled Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference. Toxicity tests will focus upon the organisms potentially exposed (e.g., fish, burrowing mammals, plants, etc.). At this time it is anticipated that <u>in situ</u> studies or onsite studies would be most appropriate given the multitechnical nature of the contamination.

If toxicity is documented, this data will be used in planning the remedial action. If no toxicity is observed, then it might reasonably be assumed that any stress noted to biota on or adjacent to the subject site is due to habitat disruption, external sources of toxic chemicals, natural variability, etc.

Toxicity testing would be conducted by a DEC-approved testing firm. A protocol for toxicity testing will be developed focusing upon: species to be tested; media to be tested; acute or chronic testing procedure; and reporting of results. Interpretation of results will be jointly derived by ecologists familiar with the site and the toxicologists performing the analysis. Results will be presented in a short report detailing the approach, rationale, methods, results and interpretation. The Project Manager will use these results as part of the remedial action assessment procedure.

If an established stream or creek is determined to be a potential pathway at the site, fish will be collected at appropriate stations using a variety of sampling methods including 25-foot beach seine, a backpack electroshocker, minnow traps, and angling. The sampling will follow the Standard Operating Procedures for fish sampling located in Appendix A, "Field Sampling and Analysis Plan." Relative abundance of fish species by gear type will be provided to the extent that the gear employed allow such quantification. All fish collected will be weighed, measured and length-weight frequencies will be utilized to determine approximate age distribution by fish species.

Precision in whole-body analyses will be determined from replicate samples submitted to the laboratory should such analyses become necessary. A replicate sample will consider those individual organisms that have been matched or stratified to reduce extraneous variance in body burdens. The small size of the species expected to be encountered may not likely allow for enough sample to be split. Results from the homogenized samples collected from the same trophic levels will serve as an indicator of variability between individuals.

The hierarchy of fish collection for tissue analyses are:

1. Forage species (i.e., darter or shinner).
2. Non-migratory fish (i.e., bass, pickerel or catfish);
3. Migratory fish, (i.e., trout or salmon); and

As previously mentioned, shellfish provide a useful measure of potential uptake of chemicals in the biota because they are relatively nonmobile and filter feeders. Therefore, the presence of organics, heavy metals and explosives in shellfish samples represent a sensitive indicator of the presence or absence of these chemicals in specific aquatic habitats. The homogenized soft tissues of up to three specimens of the same species collected from each station, provided enough specimens are collected for meaningful analysis, will be analyzed for the appropriate parameters. Ecologists will attempt to collect shellfish samples at designated stations at the site. An ecologist will initially canvass the faster flowing waters where sediment buildup is minimal. Depending upon availability of organisms, these station locations may change. Final station locations from which shellfish are collected will be noted and indicated on the map presented in the project report. All shells will be kept to confirm species identification. These shells will be labeled to correspond with tissue labels. In the event that annual hydrologic conditions or sedimentation inhibit establishment of unionid populations, an attempt will be made to collect another invertebrate species (e.g., crayfish).

In summary, the ecological investigation will involve the following tasks:

1. Review of existing data including FEMA maps, wildlife management plans, and other information which has been compiled from the NYSDEC and EPA.
2. Identify and assess the terrestrial and aquatic habitats during a field reconnaissance program. This program will include:

    - Identification of ground cover, wildlife, and terrestrial habitats; and
    - Wetlands delineation in the ecological study area;
    - Identification of the aquatic habitat of surface water bodies in the areas defined in the ecological study area;
    - Collection of invertebrate samples at the identified sediment sampling locations;
    - Conduct toxicity testing;
    - Sample both fish and shellfish for pollutant concentration in aquatic tissue, if necessary; and
    - Sample earthworms and mice for pollutant concentration in terrestrial tissue, if necessary.

The pollutant concentrations testing in aquatic organisms, the collection of benthic invertebrate samples, and toxicity testing will be based on surface water, sediment and surface soil sampling results along with an initial, qualitative analysis of the viability of the sites terrestrial and aquatic ecosystems. The viability of the ecosystems will be assessed during the initial site ecological assessment, which will consist of investigating and documenting the biological conditions at the subject site.

3.12.4 Biotic Sampling

3.12.4.1 Objectives

The objective of this task is to obtain biota samples of the organisms which are present in the terrestrial and aquatic ecosystems. This data, in addition to the sediment and surface water quality, will be used in evaluating both the human health and the environmental risk.

3.12.4.2 Biotic Sampling Procedures

Aquatic macroinvertebrate samples will be obtained by using a Ponar sampler. A Ponar sampler is a clamshell type grab sampler which penetrates and collects soft sediments and the organisms residing therein. Ponar grab samples will be taken to determine the community of organisms living on or within the soft substrates of the water body. The rationale behind this type of sampling is that the sample is taken from a fixed surface area of sediment and the data collected from such samples are assumed to be representative of the sampling area. If a ponar sampler is not appropriate for the subject site, an equally effective sampling method will be used.

In general the fauna is non-motile and therefore is not subject to disturbance by the gear. Since some aquatic organisms live closely associated with the sediment, a device such as a grab sampler will sample not only the surface of the substrate but also several inches into the sediments thereby collecting burrowing organisms too. In general, this gear is used in conjunction with other aquatic macroinvertebrate sampling devices to give a comprehensive picture of that community.

The following collection equipment is necessary for aquatic macroinvertebrate sampling:

- Petite ponar grab samples with attached line or cable;
- Benthic sample wash screen (0.5-mm screen size);
- Tubs for receiving samples;
- Funnel;
- Sample jars;
- Seventy percent ethanol;
- Internal labels for bottles;
- Pencils;
- Benthos data sheets; and
- Hand brush or tooth brush for cleaning any rock in samples.

Upon arrival at the station:

- Measure bottom water temperature and dissolved oxygen. Record on data sheet along with water depth;

- Drop the Ponar Grab to the bottom: let line or cable slacken; pull sharply upward on the line to trip closing mechanism; retrieve sample and deposit into tub for subsequent sieving through screen;
- Insert thermometer into sediment;
- Repeat for replicate grabs (3 replicates per station);
- Record sediment temperature, other appropriate remarks (water body condition and a subjective description of the substrate), and note time;
- Wash each sample through a 0.5 mm sieve screen (or an appropriate subsample if sample is very large) to remove excess fine sediments. Large stones may also be removed by hand after careful washing or brushing to remove clinging organisms. In cases of high numbers subsampling will be accomplished utilizing a sample splitter; and
- Place sample via funnel into appropriately labeled container, preserve in 70 percent ethanol.

Before leaving station, check data sheets to be sure all necessary information is legibly recorded. Initial data sheets.

Check all samples to be sure all are preserved and labeled. Read over all data sheets to check for legibility and completion; make conversions from metric to English where necessary.

Each sample should have an interior and exterior label containing the following information:

1. Study location;
2. Station number;
3. Grab Number (replicate);
4. Date;
5. Gear; and
6. Sample serial number.

The following criteria have been established to determine whether a sample is valid in terms of the amount of sediment collected. If all the criteria are not met, the sample should be discarded and a new one taken:

- All three grabs must be of approximately equal volume. If not, discard the sample most unlike the other two and recollect, and

- If upon retrieval of the grab, material is lodged between its jaws (thereby allowing for the loss of part of the sample), that grab should be repeated.

Shellfish captured in ponar grab samples may be used for tissue analysis for select chemical analyses as needed and temporarily stored alive in de-ionized water. Specimens of the same species would be combined for composite samples. Maximum holding before initial stages of analysis would not exceed 2 hours.

The Benthos Data Sheet (Figure A-23), will be filled out both in the field and in the laboratory, as appropriate.

3.12.4.3 Collection of Shellfish For Tissue Chemical Analyses

The purpose of this section is to describe field procedures for collecting shellfish (bivalves). Shellfish are considered to be good biomarkers for xenobiotic substances because they are relatively immobile and filter significant quantities of water as part of their normal feeding behavior. In contrast to community characterization surveys, the objective of collecting shellfish for tissue analysis is to collect an appropriate volume of soft tissue within the general confines of the collection station. However, if an inventory survey of the benthic community is also to be implemented, shellfish specimens can be obtained from those collections, as long as there is proper documentation of the source of the specimens.

In freshwater systems, shellfish usually occur in relatively shallow water (less than three feet deep) although they can occur in much deeper habitats. Substrates preferred by those species of shellfish that do not attach to rigid structures by byssal threads include gravel, sand, and in some cases, silt. Sampling techniques used to collect shellfish should allow on-site flexibility to select the method most applicable to the specific site conditions encountered at each collection station.

If site-specific conditions are known in advance, it may be appropriate to forego the use of certain types of equipment. Perhaps the most efficient collection technique is to simply gather shellfish by hand if it is known that shellfish beds exist in shallow water. Therefore, additional collection equipment is listed as optional.

BENTHOS DATA SHEET

SERIAL NO. | | | | | B | A | (1 – 6)

NO. OF REPLICATES | | (8)

CLIENT | | | | | | | | (12 – 18)

COLLECTORS:

WEATHER:

WATER BODY:

SITE | | | | | | | | | (20 – 27)

REMARKS:

STATION | | | | | (29 – 32)

GEAR | | | | | (34 – 37)

RECORDED BY:

DATE: DAY (39) MONTH (41) YEAR (44) : HOUR (47) : MIN. (50)

WATER QUALITY DATA

SERIAL NO. (1 – 6)	DEPTH ( ) (8 – 11)	TEMP. ( ) (13 – 17)	D.O. (19 – 22)	COND (μMHO) (24 – 27)	pH (29 – 32)	
☐☐☐☐ B B	START	.	.	.	.	.
☐☐☐☐ B C	END	.	.	.	.	.
☐☐☐☐ B D	INST. NO.					

SERIAL NO. | | | | | B | E | (1 – 6)

	START	END
SECCHI ( )	☐☐.☐ (8 – 11)	☐☐.☐ (13 – 16)
RIVER STAGE ( )	☐☐.☐ (18 – 21)	☐☐.☐ (23 – 26)
WATER DEPTH ( )	☐☐.☐ (28 – 31)	☐☐.☐ (33 – 36)

SEDIMENT TYPE ☐ (38) C=1 SL=2 S=3 H=4 O=5

SEDIMENT TEMP.( ) ☐☐☐.☐ (40 – 44)

RECORDED BY:

ARTIFICIAL SUBSTRATE DATA

SERIAL NO. | | | | | B | F | (1 – 6)

DATE SET: DAY (8) MONTH (10) YEAR (13)

DATE RETRIEVED (16, 18, 21)

RECORDED BY:

TOTAL DAYS ☐☐☐ (24 – 26)

NO. OF REPLICATES ☐ (28)

QUALITY CONTROL BY: DATE:

FIGURE A-23

BENTHOS DATA SHEET

SORTED BY: ____________________

SHEET ________ OF ________

IDENTIFIED BY: ____________________

SERIAL NO. ☐ ☐ ☐ ☐ B G
1 6

OBS. NO. 8 10	ORGANISM NAME	ORGANISM NUMBER 12 27	LIFE STAGE 29	SERIAL NO. ☐☐☐☐ A DENSITY OR REL. ABUND. 31 ( ) 35	SERIAL NO. ☐☐☐☐ B DENSITY OR REL. ABUND. 37 ( ) 41	SERIAL NO. ☐☐☐☐ C DENSITY OR REL. ABUND. 43 ( ) 47	COMMENTS

QUALITY CONTROL BY: ____________________

DATE: ____________________

FIGURE A-23 (cont.)

The following gear should be taken to accomplish the collection tasks:

- Balance scale;
- Knife/dissection tools;
- Soap solution;
- Disposable latex or vinyl gloves;
- Cooler(s);
- Dry ice or cube ice with salt;
- Chain-of-custody sheet;
- Deionized or distilled water;
- Spray bottles;
- Paper towels;
- Stainless steel bowls;
- Fish data sheets;
- Sample labels;
- Plastic (polyethylene) sealable freezer bags;
- Aluminum foil;
- Pencils and markers;
- Boat (optional);
- Petite ponar sampler (optional);
- Shovel and/or rake (optional);
- Five gallon bucket (optional); and
- Strapping tape.

Prior to collecting shellfish, it is important to coordinate with the analytical laboratory regarding their specific needs for the analyses being conducted. The minimum amount of shellfish tissue required for analysis should be established by the laboratory. Sample handling procedures, will follow procedures established by this SOP. All equipment should be checked ahead of time to ensure that it is in working order.

Shellfish specimens should be collected from throughout the station to avoid collecting atypical specimens that do not reflect the overall conditions at the station. If possible, the specimens collected should be the same taxa and represent the range of sizes available at the time of collection from both experimental and control stations. It is preferable to collect many (i.e., three) individuals for tissue analysis, rather than one large individual. If enough individuals cannot be collected by hand, it may be necessary to use additional shore-based or boat-based collection techniques, including petite ponar grab samplers and/or a shovel or a rake to sift through bottom material for shellfish. Bottom material can be shoveled into a bucket and sorted on shore for shellfish. All shellfish collected should be sorted by taxa on site. To achieve an adequate size, the most common taxa would be selected for analysis. In the event that the habitat at the station is unsuited to shellfish, the specific conditions should be documented. It may be appropriate to attempt to collect specimens near but outside the originally established sampling station boundary if the sampling objective can still be achieved by doing so.

Shellfish selected for tissue analysis should be:

- Carefully opened with a knife and all soft tissue scraped from the shell;
- Soft tissue should be blotted dry with an absorbent paper towel and placed on the balance scale for weighing;
- Minimum sample size is 10 grams (more tissue is preferred);
- Retain all shells from each station for identification, measurement and count;
- The tissue is wrapped in three layers of aluminum foil and placed in a labeled sealable plastic bag and immediately stored in a cooler with dry ice;
- Seal the cooler with the samples using strapping tape;
- Complete a chain of custody form for the samples and transport the cooler to the laboratory as soon as possible; and
- Check ice again within 24 hours if cooler is not delivered to the laboratory within one day of being sealed and replenish ice as needed.

Confirm the identity of all specimens by shell characteristics included in each shellfish sample using, as needed, appropriate keys and reference materials. Measure the maximum shell width of each specimen to the nearest millimeter. Confirm the count of individual specimens. Record this information on the appropriate data sheet.

If the sampling project reveals that shellfish (bivalves) are scarce and will not provide sufficient sample biomass for analysis, then crayfish (e.g., Orconectes spp.) will be substituted as the target organism if their abundance provides sufficient sample biomass within reasonable collection efforts. Achieving sufficient biomass will require whole-body compositing of several specimens for each sample.

Crayfish are also members of the marcoinvertebrate community, and exhibit the following characteristics which make them reasonable alternative if shellfish are unavailable:

- Aquatic detrital consumer;
- Direct substrate contact;
- Limited mobility; and
- Important in aquatic and terrestrial food chains.

Crayfish (e.g., Orconectes spp.) will be collected using a modified minnow trap, dip net, seine, or baited throwline. Reasonable efforts will be made to collect sample specimens within a 50-yard radius of the first specimen captured at the sample station. Low abundance of specimens may require the collecting activities to cover a larger area than anticipated. The actual collecting boundaries will be designated on the station location map. Crayfish collected for a single sample will:

- Be temporarily stored alive in a stainless steel bowl (1-quart capacity) containing about 2 inches of deionized or distilled water while the collection is being made;
- Only specimens of the same species will be combined for a composite sample;
- If more than one taxa is collected, and tissue from several specimens are needed to meet minimum sample weight requirements then all specimens will be combined into one composite sample;
- All sample handling equipment will be thoroughly cleaned before collecting the next sample; and
- All of the appropriate aforementioned SOP sections for shellfish will be followed.

NOTE: If neither shellfish nor crayfish are available for tissue sampling, it may be possible that amphipods can be collected. This possibility will be attempted prior to discontinuing the macroinvertebrate tissue analysis portion of the program.

3.12.4.4 Fish Seining

The seining program is designed to capture fish that frequent shoreline and shallow water areas, over bottoms that are relatively flat and free of snags. Seining is done at shoreline locations at either specified "representative" sampling locations or at "randomly" chosen locations depending upon project objectives. The seining program will be closely coordinated with the other fisheries efforts, as appropriate. The program will provide information on the near shore fish community as well as spawning and/or nursery areas of fish.

The following gear should be taken to accomplish each seining effort:

- Beach seine (straight or bag net) in good working order (with no holes), and poles or bridles;
- Fish data sheets;
- Pencils, labels and a water proof covered notebook;
- Fish-measuring board, if necessary;
- Balance and spring scale, if necessary;
- Taxonomic key for local fish species;
- Holding containers for fish;
- Plastic jars for preserved specimens, if necessary;
- Formalin;
- Chest waders or hip boots;
- Scientific collection permit;
- Beach seine patching kit; and
- Water temperature and dissolved oxygen instrumentation.

The area should be checked for objects in the water which could cause injury if stepped on.All the gear on the equipment list should be gathered and noted. Data sheets should be put in a plastic notebook. Check to make sure the seine is properly rigged with poles and has no holes in the bag and/or wings. Make necessary repairs with nylon twine and spare mesh. The substrate should be firm, thereby allowing for secure footing. Water depths should not be greater than the height of the seine to be used.

The sampling procedures are:

- The area to be seined is clear of obstructions that would snag the seine;
- Hold the lead line close to or on the water body substrate;
- Deploy the seine quickly and quietly either parallel or perpendicular to the shore (depending on the seine design and water depth);
- Retrieve the seine with a steady, even pull keeping the lead line on the substrate such that fishes are quickly encircled;

- Collect all juvenile and adult fishes and identify the species, and count the number collected; and
- Collect water quality data and preserve and label selected specimens to be returned to the laboratory for confirmation of field identification and further examination if required.

Following sample collection, put equipment back in its proper place. Store the seine in a dry area away from direct sunlight after it has been cleaned of debris. Make necessary conversions on data sheets and check the data sheet for errors or omissions.
A seine haul is considered void (non-quantitative) under any of the following conditions:

- If a haul cannot be completed or is hampered because of snags, accidents, or poor technique;
- If a hole is found in the bag and/or wings that would allow fish to escape. A hole in the bag or wings should be reported on data sheets; and
- If the seine is found to be tangled so the lead and float lines are not clear of each other.

Voiding a sample takes judgement on the part of the crew leader. Every effort should be made to do each seine haul efficiently and with proper technique. Fish captured in voided and/or valid seine hauls may be used for tissue analyses as needed, so long as the fish are properly labeled as to the date, station, etc. The sample area must not be disturbed before or during the seine. If the seine has to be redone, from 15 to 30 minutes is allowed to elapse to let the area settle before re-sampling a station. Alternatively, the repeated seine can be conducted adjacent to the previous seine.

All field data will be entered onto the Fish Data Sheet shown on Figure A-24.

3.12.4.5 Backpack Electroshocking

Backpack electroshocking is an efficient method for collecting near shore or small stream fishes particularly in habitats with snags and obstructions which limit seining operations. It is effective in most freshwaters of normal conductivity (100-500 micromhos/cm). The principal of electroshocking is to produce, by the electroshocker, a voltage gradient between the natural electrical balance of the fish and the surrounding water thereby stunning it and allowing capture by nets.

FISH

SERIAL NO. ☐ ☐ ☐ ☐ F A
1 6

NO. OF REPLICATES ☐
8

CLIENT ☐ ☐ ☐ ☐ ☐ ☐ ☐
12 18

SITE ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
20 27

STATION ☐ ☐ ☐ ☐
29 32

GEAR ☐ ☐ ☐ ☐
34 37

COLLECTORS: ________________

WEATHER: ________________

WATER BODY: ________________

REMARKS: ________________

____

____

RECORDED BY: ________________

TIME OF COLLECTION

DAY MONTH YEAR HOUR MIN.

START ☐ ☐ ☐ ☐ ☐ ☐ ☐ : ☐ ☐ : ☐ ☐
39 41 44 47 50

END ☐ ☐ ☐ ☐ ☐ ☐ ☐ : ☐ ☐ : ☐ ☐
53 55 58 61 64

TOTAL ☐ ☐ : ☐ ☐
67 70

SERIAL NO. ☐ ☐ ☐ ☐ F B
1 6

DEPTH

WATER BODY ( ) SAMPLE ( ) RIVER STAGE ( )

START ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ . ☐
8 10 12 14 16 19

END ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ . ☐
21 23 25 27 29 32

WATER QUALITY DATA

SERIAL NO. ☐ ☐ ☐ ☐ F C
1 6

TEMP. ( ) D.O. COND. (μMHO) pH

START ☐ ☐ ☐ ☐ . ☐ ☐ ☐ ☐ . ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ . ☐
8 12 14 17 19 22 24 27

END ☐ ☐ ☐ ☐ . ☐ ☐ ☐ ☐ . ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ . ☐
29 33 35 38 40 43 45 48

INSTRUMENT NO. ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
50 54 56 59 61 64 66 69

SECCHI ( )

START ☐ ☐ ☐ . ☐
71 74

END ☐ ☐ ☐ . ☐
76 79

RECORDED BY: ________________

QUALITY CONTROL BY: ________________ DATE: ____________

FORM ESG-3 3/81

FIGURE A-24

FISH

SORTED BY: ____________________

IDENTIFIED BY: ____________________

SHEET ________ OF ________

SERIAL NO. ☐ ☐ ☐ ☐ F D
1 6

OBS. NO.	ORGANISM NAME	ORGANISM NUMBER	LIFE STAGE	COUNT	TL (MM)	WEIGHT (GM)	SEX			REPROD. COND.	DIS. / PAR.	GRP. DATA	COMMENTS
							M	F	U				
8 10		12 27	29	31 35	37 40	42 46	48	50	52	54	56	58	

QUALITY CONTROL BY: ____________________ SCALE OR BALANCE CALIBRATION DATE: ____________________ DATE: ____________

FORM ESG-3 3/81

FIGURE A-24 (cont.)

The procedure is to isolate a section of stream or shoreline of known length while utilizing barrier net at the upstream and downstream locations which define a 100 foot reach. Electroshocking begins from downstream and proceeds upstream. Amperage level output from the shocker is maintained at a constant setting by adjusting voltage as water depth changes. As fish are stunned they are collected by net and placed in a bucket containing ambient water.

Snags, rocks, brush piles and the like can be sampled effectively by electrofishing. Since the electric field will penetrate such obstructions.

The collection equipment include:

- Coffelt BP-2 backpack electroshocker;
- Fish data sheets;
- Pencils, labels and a waterproof covered notebook;
- Fish-measuring board, if necessary;
- Balance and spring scale, if necessary;
  Taxonomic key for local fish species;
- Holding containers for fish;
- Plastic jars for preserved specimens, if necessary;
- Formalin;
- Polarized sunglasses;
- Rubber gloves;
- Chest waders or hip boots;
- Scientific collecting permit; and
- Water temperature and dissolved oxygen instrumentation.

All gear on the equipment list should be gathered and noted. Data sheets should be put in a plastic notebook. Check to make sure that the shocker battery is fully charged. The unit is usually plugged into a wall socket for 8-12 hours of charging prior to use with the toggle switch turned to the charging position. Check that the electrode nets have no extraneous holes that would allow fish to escape capture.

Sampling is as follows:

- Begin at the downstream end of the sampling station (rubber gloves should be worn at all times);
- Place both electrodes in the water at about equal depth. Turn on the shocker and depress the switches;
- Note amperage and adjust to 0.5 or greater amperes by changing voltage setting;
- Make sure that the deadman's switch on each electrode pole is working properly;
- Proceed slowly upstream sweeping the entire breadth of the stream with the electrodes (one crew member should occasionally release the deadman's switch to interrupt the current field; this procedure reduces the tendency for fish to sense the field at a distance and flee);
- Stunned fish should be netted and placed in a bucket of ambient water for processing when the station sampling is completed;
- When finished, turn off the shocker and process the fish, recording the relevant data on the fish data sheet;
- All juveniles and adult fishes collected are identified to species and counted;
- When possible an estimate of the numbers including species and size that escaped collection is made in an attempt to evaluate collection efficiency; and
- Collect water quality data and preserve and label selected specimens to be returned to the laboratory for confirmation of field identification and further examination, if required.

Following collection be sure the shocker is turned off. Store in a dry area in an upright position. Check over all data sheets to assure that all entries have been made. Check preserved samples to insure integrity and no leakage.

Electroshocking is considered void (non-quantitative) under any of the following conditions:

- The electroshocker cannot be adjusted to a minimum output of 0.5 amps;
- A tear or hole is discovered in a collecting net; and
- Water turbidity or darkness precludes seeing all stunned fish.

Fish Processing of samples is as follows:

- Once the individuals selected for analysis have been chosen, they should be weighed (nearest gram), measured (nearest mm) and whole body tissue samples extracted. Rough age determination will be accomplished from a weight-length frequency distribution and, where practical, from fish scale samples. The entire fish is submitted for analysis if the sample is a forage fish and/or a young-of-year specimen;
- Whole-body samples should be blotted dry with an absorbent paper towel and placed on the balance scale for weighing (minimum sample size is 10 grams);
- All dissection tools are to be rinsed, washed with soap solution, rinsed, rinsed twice with distilled or deionized water and dried between each sample dissection;
- All whole-body tissue samples will be wrapped in three layers of aluminum foil and sealed in separately labeled plastic bags;
- Samples are to be stored in a cooler with dry ice;
- All chain-of-custody documentation and handling/packing procedures will be followed;
- The field sampling team will identify in the field notebook all pertinent information regarding the fish samples collected; and
- Remove scales from fish. Do not remove the skin.

Following sampling, check all data sheets including chain of custody forms for legibility and completeness. Return all equipment to the proper places after cleaning and performing any needed maintenance. All samples will go directly to the lab for Level IV.

3.13 SURVEYING

Any surveying performed at SEDA will provide accurate site base maps which will be used for the following purposes:

1. Map the direction and compute the velocity of groundwater movement,
2. Locate all the environmental sampling points,
3. Serve as the basis for volume estimates of impacted soils and sediments which may require a remedial action, and
4. Map the extent of any impacted groundwater above established ARAR limits.

Additional surveying will conform to the specifications cited below. The survey will involve photogrametric mapping, followed by a field survey. By having an aerial

- Plastic (polyethylene) sealable freezer bags;
- Aluminum foil;
- Pencils and markers;
- Boat;
- Beach seine (one or more sizes);
- Backpack electroshocker;
- Conventional fishing rod(s);
- Gill nets;
- Measuring board;
- Strapping tape;
- SOP's for collection gear; and
- Scientific collecting permit.

Prior to collecting fish, it is important to coordinate with the analytical laboratory regarding their specific needs for the analyses being conducted. The minimum amount of fish tissue required to complete defensible analytical results should be established by the laboratory. Sample preservation procedures, contamination avoidance measures, in-field preparation procedures, packaging requirements and chain-of-custody procedures will follow procedures established by this SOP and the SOP for Sample Packaging, Shipping and Chain-of-Custody Procedures. All equipment should be checked ahead of time to ensure that it is in working order.

Fish selected at each station for tissue analysis should, if possible, be of the same species. It is preferred that the species to be collected have an existing historical database. Typical sampling programs require the collection of fish to occur in areas considered free of pollutants (reference area). These areas are normally described in the sampling work plan. Although areas are described in the work plan, the final sampling location is a field decision.

The aquatic reference (control) area should have faunal and floral characteristics similar to the exposure study (experimental) site and should be located hydrologically upgradient of the exposure study sites. The reference area should share a high number of biological and physical characteristics with the experimental/exposure locations. Sampling should continue with reasonable efforts until enough individuals are collected for meaningful analyses.

Fish Processing of samples is as follows:

- Once the individuals selected for analysis have been chosen, they should be weighed (nearest gram), measured (nearest mm) and whole body tissue samples extracted. Rough age determination will be accomplished from a weight-length frequency distribution. The entire fish is submitted for analysis if the sample is a forage fish and/or a young-of-year specimen;
- Whole-body samples should be blotted dry with an absorbent paper towel and placed on the balance scale for weighing (minimum sample size is 10 grams);
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- All whole-body tissue samples will be wrapped in three layers of aluminum foil and sealed in separately labeled plastic bags;
- Samples are to be stored in a cooler with dry ice;
- All chain-of-custody documentation and handling/packing procedures will be followed;
- The field sampling team will identify in the field notebook all pertinent information regarding the fish samples collected; and
- Remove scales from fish. Do not remove the skin.

Following sampling, check all data sheets including chain of custody forms for legibility and completeness. Return all equipment to the proper places after cleaning and performing any needed maintenance. All samples will go directly to the lab for Level IV.

3.13 SURVEYING

Any surveying performed at SEDA will provide accurate site base maps which will be used for the following purposes:

1. Map the direction and compute the velocity of groundwater movement,
2. Locate all the environmental sampling points,
3. Serve as the basis for volume estimates of impacted soils and sediments which may require a remedial action, and
4. Map the extent of any impacted groundwater above established ARAR limits.

Additional surveying will conform to the specifications cited below. The survey will involve photogrametric mapping, followed by a field survey. By having an aerial photographic survey performed for the site, the site topographic data can be electronically inputted to the software on AutoCad System. This approach will produce more accurate site maps and since the software stores the data as a 3-dimensional file, it will facilitate a great deal more flexibility in its future use. Typical examples of what this software can produce automatically are stormwater run-off calculations, cut and fill calculations, and graphical cross-section through any part of the site. The field control will establish horizontal and vertical control and will serve as the basis for relating the photogrametric information to actual land elevations and the New York State Plane Coordinate System.

3.13.1 Field Surveying

During the field survey, plastic or wooden hubs shall be used for all basic control points. A minimum of two (2) concrete monuments with 3.25-inch domed brass or aluminum alloy survey markers (caps) and witness posts will be established at the site. The concrete monuments will be located within the project limits and will be set 50 feet from the edge of any existing roads in the interior of the project limits and will be a minimum of 500 feet apart. The placement of all monuments, hubs, etc., shall be coordinated with SEDA. Witness posts, etc., shall be durable and brightly colored to preclude damage due to normal landscaping activities. Concrete monuments shall be constructed so as to preclude damage due to frost action. Horizontal control (1:10,000) and vertical control (1:5,000) of third-order or better shall be established for the network required for all the monuments. The caps for new monuments shall be stamped in a consecutively numbered sequence (e.g., SEAD-#-year, USAED-Huntsville).

The dies for stamping the numbers and letters into these caps shall be of 1/8 inch in size. All coordinates will be to the closest 0.01 foot and will be referenced to the State Plane Coordinate System and all elevations are to be referenced to the 1929 North American Vertical Datum. Elevations to the closest 0.10 foot shall be provided for the ground surface at each soil boring. Elevations to the closest 0.01 foot shall also be established for the survey marker and the top of casing (measuring point) at each monitoring well.

The location, identification, coordinates and elevations of all the control points recovered and/or established at the site and all of the geophysical survey areas, soil borings, monitoring wells (new and existing) and all surface water sampling points will be plotted on a topographic map (at a scale of 1 inch = 50 feet) to show their location with respect to surface features within the project area. A tabulated list of the monuments, the soil borings and the surface water sample points including their coordinates and elevations, a "Description Card" for each monument established or used for this project, the 1 inch = 50 feet map and all field books and computations will be prepared. The tabulation shall consist of the designated number of each boring, monument or surface water sampling point, the X- and Y- coordinates and all the required elevations. The Description Card shall show a sketch of each monument; its location relative to reference marks, buildings, roads, towers, etc.; written description telling how to locate the monument from a known point; the monument name or number and the adjusted coordinates and elevations.

During the field survey, level circuits will close on a benchmark whose elevation is known (other than the starting benchmark is possible). The following criteria will be met in conducting the survey:

- Instruments will be pegged regularly;
- Rod levels will be used;
- Foresight and backsight distances will be reasonably balanced; and,
- Elevation readings will be recorded to 0.01 foot.

Temporary monuments will be set and referenced for future recovery. All monuments will be described in the field notes. Sufficient description will be provided to facilitate their recovery.

Traverses will be closed and adjusted in the following manner:

- Bearing closures will be computed and adjusted, if within limits;
- Coordinate closures will be computed using adjusted bearings and unadjusted field distances;
- Coordinate positions will be adjusted if the traverse closes within the specified limits. The method of adjusting shall be determined by the surveyor;
- Final adjusted coordinates will be labeled as "adjusted coordinates." Field coordinates will be specifically identified as such; and
- The direction and length of the unadjusted error of closure, the ratio of error over traverse length, and the method of adjustment will be printed with the final adjusted coordinates.

Level circuits will be closed and adjusted in the following manner:

- For a single circuit, elevations will be adjusted proportionately, provided the raw closure is within the prescribed limits for that circuit; and
- In a level net where the elevation of a point is established by more than one circuit, the method of adjustment will consider the length of each circuit, the closure of each circuit, and the combined effect of all the separate circuit closures on the total net adjustment.

For this project, all surveys shall be third-order plane surveys as defined by the following standards and specifications:

Traverse

Standard error of the mean for length measurements	1 in 10,000
Position closure per loop in feet after azimuth adjustment	1:5,000 checkpoint or 3.34 M** (whichever is smaller)

Leveling

Levels error of closure per loop in feet	0.05 M**

M** is the square root of distance in miles.

Third-order plane surveys and horizontal angular measurements will be made with a 20-second or better transit. Angles will be doubled, with the mean of the doubled angle within 10 seconds of the first angle. Distance measurements will be made with a calibrated tape corrected for temperature and tension or with a calibrated electronic distance meter instrument (EDMI). When using EDMI, the manufacturer's parts per million (ppm) error is applied, as well as corrections for curvature and refraction.

Site surveys will be performed in accordance with good land surveying practices and will conform to all pertinent state laws and regulations governing land surveying. The surveyor shall be licensed and registered in New York. Upon completion of the project, all original field notebooks, computations, and pertinent reference materials will be available at the surveyor's office. Photostatic copies of these materials will be kept in the project files.

All field note reduction will be checked and marked in such a way that a visual inspection of the field notes will confirm that checks have been made. All office entries in field notebooks will be made in colored pencil. The office worker who reduces or checks field notes will initial each page worked on in the color used on that page.

Monitoring well locations will be surveyed only after the installation of the tamperproof locking cap guard pipe or road box, which will be set in concrete. The following elevations will be measured:

- Top of the outer protective casing at the point opposite the lock or bolt on the guard pipe or road box;.
- Top of the inner PVC riser pipe (on the lip, not the cap); and
- Finished concrete pad adjacent to the outer well casing.

3.13.2 Aerial Photographic Survey

SEDA was photographed from the air on December 12, 1991 and December 14, 1993 for the purpose of constructing photogrammetric site plans with 2 foot contour intervals. This photogrammetric map is the basis for the site base map. The photographs should also be used for the ecological survey to identify significant vegetative types. Site survey information should be from the photographs which were taken at a scale of 1" - 500". Ground control was performed during the months of November and December of 1991, and January and February of 1992; additional ground control was performed in November 1993 through February 1994.

Any additional aerial photographic surveys will be performed with an aerial camera equal to or better than a Ziess RMKA 15/23 with a focal length of 6 inches. The scale of the photography will be suitable for determination of 2 foot ground contours, but will not be greater than 1" = 600. Black and white aerial photographs will be sufficient. The photographs to be taken will be sufficient enough to cover the entire area to be investigated, including the sections of Reeder Creek which will be sampled. Since the site is within the confines of the Seneca Army Depot, an active military installation, written permission will be necessary to conduct the aerial flyover. The deliverables for the surveyor will include:

1. A list indicating the location, identification, coordinates and elevations of each monument, soil boring, monitoring well and surface water sample point;
2. Two sets of black and white contacts;
3. An Intergraph IDGS file, on tape, of the topographic map;
4. Photostatic copies of the surveyor's field notes.

3.14 INVESTIGATION-GENERATED WASTE MANAGEMENT

All soil and water generated during drilling and well development and purging will be collected on-site. All drill cuttings, well development water, purge water generated during sampling, and decontamination liquids will be contained in approved 55-gallon drums. All drums will be labeled as to contents and origins using commercially available, all-weather labels. Investigation derived waste information for each SWMU will be recorded on Figure A-25. At the end of each phase of drilling, documentation lists of the required chemical analyses, evaluation of site conditions and knowledge of regulatory requirements) will be provided which will recommend the disposition for each drum. For each drum considered to contain contaminated material, a specific optimum method of disposal will be recommended, along with a price for disposal. The material will be disposed under manifest, using the SEDA RCRA disposal permit. SEDA is the generator and ultimate signatory of transport and disposal manifests.

In the case of soil excavated from test pits, the Army has been granted a written exemption from USEPA allowing test pit soil to be backfilled in lieu of testing and possible management as a waste. Please refer to the exemption letter from EPA to the U.S. Army, dated September 16, 1991, attached at the end of this appendix.

3.15 EMISSION ISOLATION FLUX CHAMBER MEASUREMENTS

3.15.1 Introduction

The sampling and analysis procedure for Emission Isolation Flux Chambers outlined in this document is from, Measurement of Gaseous Emission Rates from Land Surfaces Using An Emission Isolation Flux Chamber User's Guide, EPA Report No. EPA/600/8-86/008, February, 1986. It is to be used in conjunction with the accepted procedures and guidelines of the document. The guidelines and procedures contained herein may be modified if during field activities it is found that modifications to the sampling and analysis plan would result in greater precision, accuracy and efficiency of sampling activities.

3.15.1.1 Sampling Theory and Methodology Overview

The flux chamber technique uses an enclosed device (flux chamber) to sample gaseous emissions from a defined surface area. Clean dry sweep air is added to the chamber at a fixed, controlled rate. The volumetric flow rate of sweep air through the chamber is recorded and the concentration of the species of interest is measured at the exit of the chamber.

INVESTIGATION DERIVED WASTE: DRUM INVENTORY
SENECA ARMY DEPOT, ROMULUS, NY

SEAD-__________

DRUM NUMBER	LOCATION	CONTENTS	START DATE (OF ACCUMULATION)

NOTES:

1) Drum numbers should indicate the SEAD from which they come. For example, the first drum from SEAD-4 should be numbered 4-1.
2) Add an "S" for soil/sediment, and a "W" for water, i.e., 4-1W.
3) Be specific on the contents about origin (boring #'s, well #'s, decon water, PPE, etc.).

The emission rate is calculated as:

$$E_i = Y_iQ/A$$

where: E_i = emission rate of component i, mass per area-time

Y_i = concentration of component i in the air flowing from the chamber, mass per volume

Q = flow rate of air into the chamber, volume per time

A = surface area enclosed by the chamber, area

All parameters are measured directly. Most of the emission rate assessments are of area sources much larger than the enclosed surface area of the flux chamber. In these cases, an overall emission rate for the area source is calculated from multiple measurements based on random sampling and statistical analysis.

The gaseous emissions are collected from an isolated surface area with the emission flux chamber. The gaseous emissions are swept thorough an exit port where they are sampled. The concentration is sampled discretely. The emission rate is calculated based upon the surface area isolated, the sweep air flow rate and the gaseous concentration measured. An estimated average emission rate for the area source is calculated based upon selective sampling of a defined total area.

3.15.2 Overview

Each emission isolation flux chamber and all associated peripheral equipment will be certified and calibrated prior to field use. The flux chambers will be checked for background contamination and recovery efficiency. The following procedures compiled from EPA/600/8-86/008, Measurement of Gaseous Emission Rates From Land Surfaces Using An Emission Isolation Flux Chamber User's Guide, will be used to characterize the flux chambers. All applicable data obtained during calibration and operation will be recorded on copies of the forms contained herein.

3.15.2.1 Background Interference Check

The background interference check procedure is as follows:

1. Place the flux chamber to be characterized over a Teflon, Mylar, or stainless steel surface;

2. Using a certified flow meter introduce the flow of ultra high purity (UHP) air (< 0.01 ppm THC) at a rate of 5 Liters/minute (lpm) to the flux chamber via the inlet port. Figure A-26 illustrates the layout of a typical emission isolation flux chamber;

3. Record and adjust if necessary the flow rate at time intervals defined by residence times (t). For example, if the flux chamber volume is 30 liters and the sweep air flow is 5 lpm, t has a value of 6 minutes under normal operating conditions. The flow rate should be monitored for a minimum of 4 residential times. Data to be recorded on Flux Chamber Calibration Form, Figure A-27;

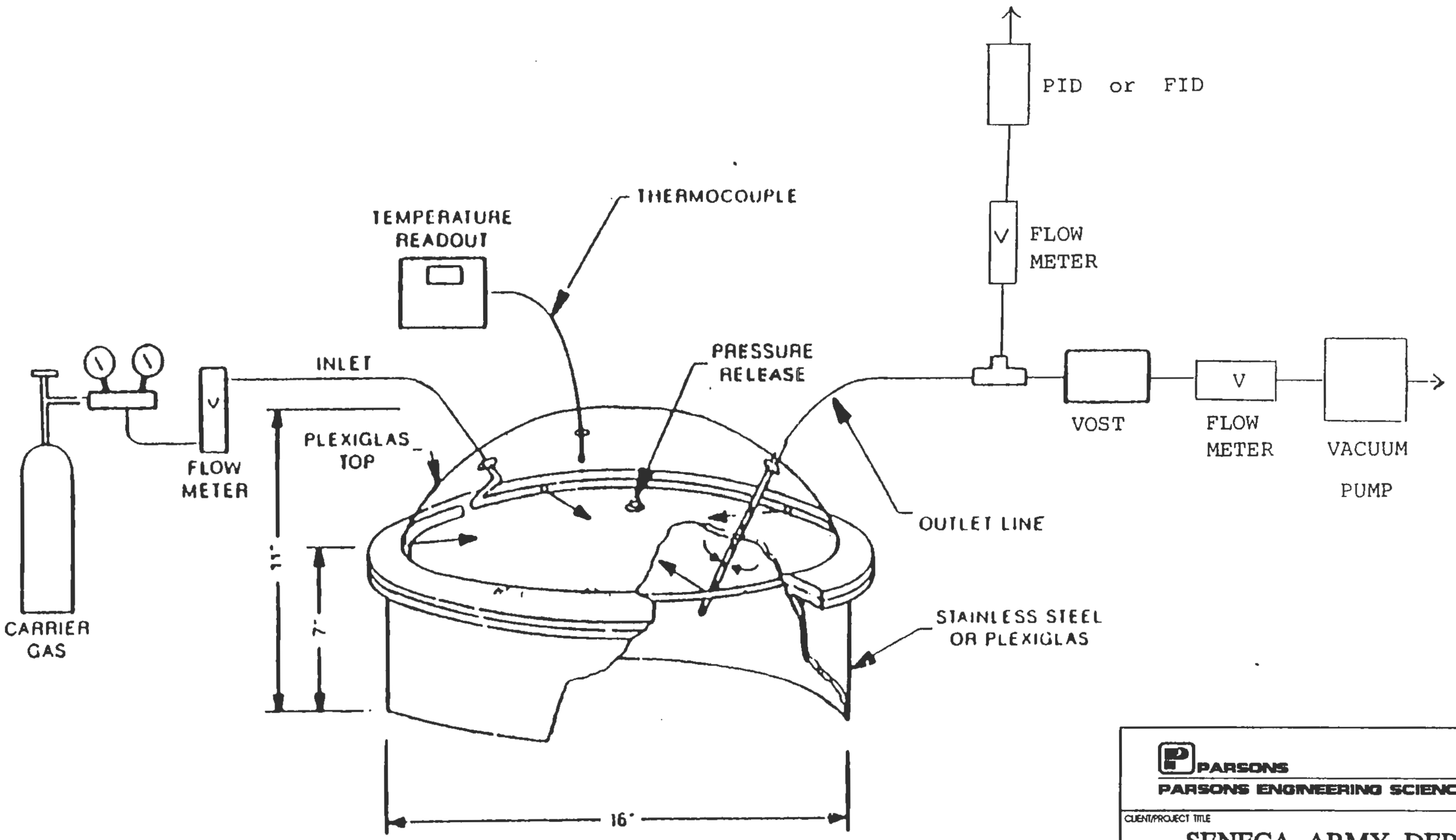
4. Once the flow has stabilized, attach a sample medium, such as volatile organic sampling train (VOST) or passivated SUMMA canister typical of the type to be used for field measurements to the outlet port and adjust the outlet flow rate specified for the sample mediá. For VOST samples, outlet flow will be induced and controlled by a calibrated rotameter and vacuum pump connected in series. To ensure no ambient air is being drawn through the sample, a flow indicating device, i.e., rotameter or bubbler, will be placed in-line upstream of the sample medium;

5. Allow approximately 5 minutes for the outlet flow to stabilize;

6. When the outlet flow rate has stabilized, attach a new VOST or SUMMA canister to the outlet port and continue for 30 minutes. During this period check, record, and adjust if needed the flow rate every ten minutes;

7. After 30 minutes have expired, remove the sample medium and submit for laboratory analysis. Parameters to be analyzed for should be the same that will be targeted during actual field investigations; and

8. Obtain results from the analyzing laboratory and check for background contamination. Background levels should be less than 10 percent of measured field concentrations or 10 ppm total, whichever is smaller. If higher levels are present, disassemble the flux chamber, clean all internal parts with distilled water, replace those suspected to be



CUT AWAY TO SHOW
SWEEP AIR INLET LINE
AND THE OUTLET LINE

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT. ENVIRONMENTAL ENGINEERING	DWG NO. 726511-02001

FIGURE A-26

DIAGRAM OF STANDARD EMISSION ISOLATION FLUX CHAMBER

SCALE	DATE JANUARY 1995

FLUX CHAMBER CALIBRATION FORM

PROJECT ID : ____________ SAMPLER ID / SN : ________ / ________

DATE : ____________ OPERATOR : ____________

FLUX CHAMBER VOLUME (V) : ____________ liters.

ULTRA HIGH PURITY GAS CONCENTRATION / CYLINDER NO. : ________ / ________

CALIBRANT GAS CONCENTRATION / CYLINDER NO. : ________ / ________

FLOW METERS SN's : INLET - ________ OUTLET - ________

BACKGROUND INTERFERENCE CHECK

Time	Sweep Air Rate, Q (lpm)	Residence No. (Q/V)	Air Temperature Chamber (C)	Ambient (C)	Comments
		1			
		2			
		3			
		4			
		5			
		6			
		7			
		8			
		9			
		10			

VOST SAMPLE IDENTIFICATION : ____________

BACKGROUND LEVELS : ____________

RECOVERY EFFICIENCY DETERMINATION

Time	Sweep Air Rate, Q (lpm)	Residence No. (Q/V)	Air Temperature Chamber (C)	Ambient (C)	Comments
		1			
		2			
		3			
		4			
		5			
		6			
		7			
		8			
		9			
		10			

VOST SAMPLE IDENTIFICATION NUMBER : ____________ .

PERCENT RECOVERY : ____________ .

FIGURE A-27

contaminated, reassemble, and retest. If results are satisfactory, proceed to characterize the flux chamber for recovery efficiency.

3.15.2.2 Recovery Efficiency Determination

The recovery efficiency determination procedure is as follows:

1. Set a flux chamber as outlined in steps 1 through 3 above;

2. Introduce a calibration gas consisting of hexane in air with a predetermined certified concentration into the flux chamber through a gas inlet fitting. The inlet rate should be set to 0.5 lpm using a calibrated flow meter for measurement;

3. Attach a calibrated portable PID or FID to the chamber's outlet port;

NOTE: THE PORTABLE PID OR FID SHOULD BE CALIBRATED AS PER MANUFACTURER'S SPECIFICATIONS.

4. Allow 4 residence times for gaseous mixture to equilibrate or until readings on the portable monitoring instrument have stabilized, whichever is sooner. Check, record, and adjust if necessary the flow rate at time intervals defined by residence time. Data is to be recorded on the Flux Chamber Calibration Form, Figure A-27;

5. Once the flow has stabilized, attach a volatile organic sampling train (VOST) or passivated SUMMA canister typical of the type to be used for field measurements to the outlet port and adjust the outlet flow rate specified for the collection media. For VOST samples, outlet flow will be induced and controlled by a calibrated rotameter and vacuum pump connected in series downstream of the VOST. To ensure that no ambient air is being drawn through the sample medium, a flow indicating device, i.e., rotameter or bubbler, will be placed in-line upstream of the sample medium;

6. Allow approximately 5 minutes for the outlet flow to stabilize;

7. When the outlet flow rate has stabilized, attach a new VOST or SUMMA canister to the outlet port and continue for 30 minutes. During this period check, record, and adjust if needed the flow rate every ten minutes;

8. After 30 minutes have expired, remove the VOST and submit for hexane analysis.

NOTE: THE HANDLING OF THE VOST SAMPLE CARTRIDGES WILL BE IN ACCORDANCE WITH THE PROCEDURES OUTLINED IN THE STANDARD OPERATING PROCEDURE FOR ANALYSIS OF VOLATILE ORGANIC SAMPLING TRAIN CARTRIDGES.

9. Compare the measured concentration determined by laboratory analysis to the true concentration corrected for dilution. Results should be within 10 percent. Calculate percent recovery using following equations.

Percent Recovery = $(C_{IM}/C_{IT}) \times 100$

where: C_{IM} = the measured concentration of species I (ppmv) corrected for dilution as follows:

$$C_{IM} = (1/DF) \times C$$

where C is the sample concentration (ppmv) and DF is the dilution factor calculated as follows:

$$S_1/(S_2+S_1)$$

where S1 is the flow rate of the trace gas and S2 is the sweep air flow rate

C_{IT} = the true concentration of species I, gas cylinder value (ppmv); and

10. If percent recovery is less than 90 percent, the flux chamber should be examined for leaks or flow rate problems.

Upon successful completion of background contamination and percent recovery checks, the emission isolation flux chamber can be implemented for field sampling. Pre-established QA/QC procedures regarding sample blanks, duplicates and batch blanks should be followed as outlined in Appendix C, the CDAP to ensure sample collection integrity.

3.15.3 Field Sampling with Emission Isolation Flux Chamber

The field sampling procedure is as follows:

1. Upon arrival to the SWMU designated for flux chamber sampling, field personnel will begin entering information on the Flux Chamber Emission Measurements Field Data Sheet, Figure A-28. Information to be recorded will include:

    a. Date;
    b. Sampling personnel;
    c. Sampling location (SWMU) and cell number in the SWMU;
    d. Surface description;
    e. Concurrent activity at site and in environs;
    f. Ambient conditions including dry and wet bulb temperature measured by calibrated psychrometer; and
    g. Soil moisture content measured by a tensiometer.

    NOTE: THE AVERAGE SOIL MOISTURE READING IN THE AOC MUST BE GREATER THAN THIRTY CENTIBARS BEFORE FLUX CHAMBER SAMPLING CAN BE STARTED, UNLESS SPECIFICALLY AUTHORIZED BY THE PROJECT MANAGER. THE AVERAGE SOIL MOISTURE IN THE AOC IS DEFINED AS THE ARITHMETIC MEAN OF TENSIOMETER READINGS IN THE AOC WITH ONE READING TAKEN IN EACH OF THE CELLS TO BE SAMPLED.

2. Using a flux chamber which has met the acceptance criteria for background contamination and percent recovery, position it over the area to be sampled and work it into the ground surface to a depth of 2 to 3 cm. Inspect the perimeter of the flux chamber contacting the ground to ensure that a good chamber-to-ground seal has been achieved;

3. Attach a portable PID or FID to the outlet, start the flow of UHP air and adjust to 5 lpm as measured using a certified flow rate meter;

4. Record the time, sweep air rate, chamber inside temperature and ambient temperature on the "FLUX CHAMBER EMISSION MEASURES FIELD DATA SHEET". Check, record and, if necessary, adjust the flow rate approximately every 6 minutes. Also record the portable PID or FID;

FLUX CHAMBER EMISSION MEASUREMENTS FIELD DATA SHEET

PROJECT ID : ______________ SAMPLER ID / SN : __________ / __________

DATE : ______________ OPERATOR : ______________

SAMPLING LOCATION (AOC) No. / SAMPLE ID : __________ / __________

SURFACE DESCRIPTION : ______________

CONCURRENT ACTIVITY : ______________

SOIL MOISTURE CONTENT (CENTIBARS) : ______________

FLUX CHAMBER VOLUME (V) : ______________ liters

ULTRA HIGH PURITY GAS CONCENTRATION / CYLINDER NO. : __________ / __________

FLOW METERS SN's : INLET ______________ OUTLET ______________

Time	Sweep Air Rate, Q (lpm)	Residence No. (Q/V)	Air Temperature Chamber (C)	Ambient (C)	Comments
		1			
		2			
		3			
		4			
		5			
		6			
		7			
		8			
		9			
		10			

COMMENTS: ______________

FIGURE A-28

5. After 24 minutes, note the reading on the portable PID or FID. Attach a VOST or SUMMA canister typical of the type being used;

6. Adjust the flow rate as specified for the sample medium. When the flow rate has stabilized, attach a new sample media and collect the sample for 30 minutes as timed by a stop watch. Check, record and, if necessary, adjust the flow rate approximately every 10 minutes;

7. Remove and cap the sample and return it to its container;

8. Record the time, sweep air rate, air temperature inside and outside, sample number, location and type; and

9. Initiate a chain of custody.

QC checks for the data collection and sampling aspects of the air sampling program will include, but not be limited to, the following:

1. Proper flow rates and times noted;

2. Submission of field biased blanks. Field-biased blanks of collection media (VOST or SUMMA canister) will be placed in appropriately cleaned and sized sample containers in the field and treated in the same manner as actual field samples, to provide a QC check on sample handling. The purpose of analyzing "batch blank" and "field blank" samples is to determine the extent, if any, to which sampled substances are present on the collection media without having actually been exposed in a sampling event; and

3. Field calibration checks. Calibration checks will be performed before, during and after the scheduled sampling event. Copies of the calibration sheets will be submitted to the Field Team Leader to take on site for reference and to the project file. Calibration will be performed as specified in the method.

A complete explanation of the QC requirements is contained in the Appendix C, Chemical Data Aquition Plan.

4.0 POST SAMPLE COLLECTION PROCEDURES

Once a solid or liquid sample has been collected, it needs to be handled in an appropriate manner so that it will continue to have concentrations of contaminants that are representative of those in the sample at the time of collection. Sampling equipment used for sample collection or field determinations must also be decontaminated prior to reuse to prevent cross-contamination.

4.1 COMPOSITING

Occasionally, samples, except samples for volatile organic analysis, will be composited prior to chemical or physical characterization. Equivalent sized (weight, volume) aliquots will be collected from each selected location and combined in a receptacle. The material will be mixed, then distributed into the appropriate sample containers (Section 4.3). Necessary preservatives will be added (Section 4.2), then samples will be packed appropriately (Section 5.0). Samples collected for volatile organic analysis will not be composited by the laboratory.

When composites are to be prepared in the field, collect sufficient sample volume to fill all required containers. If discrete subsamples are to be combined to produce one final sample, collect equivalent sized (weight, volume) aliquots from each selected locations and combined these in a common receptacle. Perform all necessary sample preparative operations (e.g., sample filtration, sleeve screening) on the combined sample and fully homogenize the remaining material. When liquid samples requiring chemical stabilization are collected, add necessary preservatives at the required level and mix. Remove necessary sample aliquots and place into clean sample bottles and package for shipment. The laboratory will be notified as to how many samples were composited so that the correct detection limit will be used. Whenever compositing is contemplated, consideration most be given to issues of sample loss, contamination and degradations.

4.2 SAMPLE PRESERVATION

Sample preservation will be performed in the field, immediately after sample collection and field preparative steps are completed. Soils and other forms of solid materials are preserved by completely filling the sample container with sample, tightly securing the container top, followed by placement of the sample on ice or in a freezer and out of sunlight. Preservatives are added to some of the aqueous samples depending on the analysis to be performed. Table 4.1 of the Chemical Data Acquisition Plan (Appendix C) outlines the required preservatives and holding times for soil and water samples. In many cases where pH control or additions of reagents are required, separate bottles and chemical preservatives may be supplied by the laboratory. In other cases the reagents or preservatives may be placed in the sample bottle prior to delivery to the site.

Many concentrated acids, bases, and many other chemicals required for sample preservation can not be shipped by air. This limitation should be anticipated and these materials will be shipped to the job site before sampling begins.

4.3 SAMPLE STORAGE

Samples should be stored in a nonreactive and noncontaminating containers. Appropriate containers include those made of polyethylene, glass, or teflon. In general, samples collected for metals and general water quality parameters are stored in polyethylene bottles. Samples collected for organic analysis are routinely placed in glass, preferably amber glass bottles. Soil samples are generally placed in glass jars with teflon lids or cap liners.

In most cases, bottles will be supplied by the laboratory conducting the analyses. It is the responsibility of the project staff to inform the laboratory of the exact analyses that will be conducted so the lab can supply the appropriate bottles. Table 4.1 of the Chemical Data Acquisition Plan (Appendix C) presents the types of containers that will be used for various analyses.

4.4 EQUIPMENT AND MATERIAL DECONTAMINATION

All equipment used during the collection, preparation, preservation, and storage of environmental samples must be cleaned prior to their use and after each subsequent use. Frequently, sampling equipment must be cleaned between successive uses in the field to prevent cross contamination. When field cleaning is needed, it is essential that it be conducted diligently, to ensure that all parts of the field equipment that come in contact with the sample are properly decontaminated.

Supplies needed for cleaning or decontamination is dependent upon the materials and equipment to be cleaned. When small items require cleaning in the field, several small buckets and small containers of reagents or wash liquids are adequate. However, when major items, such as large pumps, require decontamination, it may be necessary to transport large wash basins and larger volumes of washing solutions. The following is a general equipment list for field decontamination operations.

1. Detergent, such as Alconox;
2. Potable water;
3. Demonstrated analyte free water;
4. Methanol;
5. Hexane and/or other suitable solvents to remove petroleum products;
6. Storage vessels to transport large volumes of water to the site;
7. Buckets for washing and rinsing equipment;
8. Paper towels, clean rags or chemwipes to remove excessive soil or petroleum products before the equipment is decontaminated;
9. Ultrapure HNO_3; and
10. Plastic squeeze bottles for rinsing equipment;

The following procedure will be used to decontaminate the sampling equipment (e.g., split spoons, syringes, bowls, scoops, bailers, soil gas sampling rods and points):

1. Wipe with rag, towel or chemwipes, or steam clean to remove excess soils or debris;
2. Wash and scrub with low phosphate detergent;
3. Tap water rinse;
4. Rinse with 10% HNO_3, ultrapure, on stainless steel equipment;
5. Tap water rinse;
6. Rinse with high-purity methanol followed by hexane rinse;
7. Rinse well with demonstrated analyte free water;
8. Air dry; and
9. Use equipment immediately or wrap in clean aluminum foil or teflon film for temporary storage.

When it is necessary to use split spoon sampling devices which are composed of carbon steel instead of stainless steel, the nitric acid rinse may be lowered to a concentraiton of 1% instead of 10% so as to reduce the possibility of leaching metals from the spoon itself.

Rinse water level tapes and slugs (slug testing) with tap water, followed by demonstrated analyte-free water. Place in a polyethylene bag to prevent contamination during storage or transit.

Clean submersible pumps used for purging the deep wells prior to use and between wells by pumping copious amounts of tap water through the pumps and associated hoses, followed by rinsing with demonstrated analyte-free water. Clean the exterior of the submersible pumps and hoses that contact formation water by washing with detergent/water solution, followed by a tap water rinse, and a final rinse with demonstrated analyte-free water. Dedicate all tubing to individual wells or dispose of it, i.e., do not reuse tubing. To prevent degradation of or damage to submersible pump seals, impellers, and electric motors, do not rinse with solvents and/or acids.

Drilling equipment, such as augers, mud tubs, downhole hammers and drill rods, and backhoe buckets will be steam cleaned before use at each location and at the end of the job before going off-site.

5.0 SAMPLE PACKAGING, SHIPPING, AND CHAIN-OF-CUSTODY PROCEDURES

Once the samples have been collected, prepared, preserved, and appropriately stored, they must be packaged and shipped. In addition, from the time of sample collection until analyses have been completed, chain-of-custody procedures must be implemented and manufactured to document control and handling of the samples. This section outlines procedures for the packing and shipping environmental samples and general chain-of-custody procedures.

5.1 PACKAGING AND SHIPPING PROCEDURES FOR ENVIRONMENTAL SAMPLES

All sample containers must be placed in a sturdy, insulated shipping container for transport to the laboratory. A metal or plastic picnic cooler is recommended. The following is an outline of the procedures to be followed.

1. Using fiberglass tape, secure the drain plug at the bottom of the cooler to ensure that liquid from sample container breakage or melting ice does not leak from the cooler.

2. Line the bottom of the cooler with a layer of absorbent material such as vermiculite between 2 and 6 inches thick.

3. Use pieces of carved-out plastic foam or individually wrapped glass containers to help prevent breakage.

4. Pack sample bottles in the cooler. Hand tighten all screw caps and mark sample volume level on the outside of large containers.

5. Pack small containers, such as 40 milliliter vials, in small plastic sandwich bags. When shipping these with larger containers, cushion smaller vials to minimize breakage.

6. Pack additional cushioning material, such as vermiculite or bubble pack, between the sample containers.

7. Pack ice, sealed in plastic bags, on top of the samples in the cooler when samples must be kept cold.

8. Seal the chain-of-custody form in a plastic bag and attach it to the inside or top of the cooler lid.

9. Close the lid of the cooler; be sure it is tightly fastened.

10. Seal the container with strong tape (fiberglass reinforced). Wrap the tape vertically around the cooler: two wraps each on the long and short dimensions.

11. Attach a shipping label with a return address to the outside of the cooler, along with, arrows indicating "This End Up" on all four sides, and "This End Up" label on the top of the lid.

12. Apply additional labels such as "Fragile" or "Liquid In Glass" as necessary.

13. If the cooler is not equipped with a padlock, apply a signed custody seal between the lid and body of the cooler.

Samples packaged in this way can be shipped by commercial carrier. Staff should be prepared to open and reseal the cooler for inspection when offering them for shipment. Be aware that some commercial carriers have limits for the number of pounds per item that can be shipped. Notify the laboratory of the name of the carrier, the containers' Bill of Lading numbers, and it's expected delivery date.

5.2 PACKING AND SHIPPING HAZARDOUS SAMPLES EXCLUDING THOSE FROM CLOSED CONTAINERS

1. Place one, decontaminated, labeled sample container in a 2-mil-thick self-sealing plastic bag. Care should be taken to position the sample label so that it may be read through the bag.

2. Place some vermiculite in the bottom of a half-gallon or gallon metal paint can to absorb shock and leaking material in the event of sample breakage. The sealed sample bag is then placed in the can. Additional vermiculite is added to fill the remaining space in the can. Close the can lid and seal in place with clips.

3. Attach address and return mailing labels to each can. Attach additional Department of Transportation Labels as are required by provisions of 49 CFR 171, 172, 173, or 178. Such labels may include "Flammable Liquid", "Flammable Solid", "Corrosive", etc.

4. Place the can in a cooler that has been partially filled with vermiculite. Additional vermiculite should then be placed where needed to secure the metal can. If more than one can is being shipped, this should be specified in the carrier's bill of lading. Seal a copy of the chain-of-custody record in a plastic bag, place it in the cooler, and shut and fasten the cooler lid.

5. Mark the top of the cooler with a "This End Up" label. The outside must display the same labels as are present on the metal can inside; In addition, arrows pointing to the top must appear on all four sides. Attach a label marked "Laboratory Samples" to the lid.

6. Secure the drain plug and lid of the cooler with fiberglass tape and custody seals as described in Section 5.1.

7. Check to be sure that the carrier's bill of lading is completed and signed. The sampler's certification for restricted articles must also be completed and signed. Personnel should be prepared to open and reseal the cooler if requested by the carrier. If transported by air, samples should be shipped by cargo aircraft only.

5.3 RECORD KEEPING AND CHAIN-OF-CUSTODY PROCEDURES

5.3.1 Record Keeping

Most of the sampling data and well installation information will be written on the forms presented in this appendix. Log books will be used to record the daily activities of each sampling team but they should also be used to record any data not entered into the standard forms.

5.3.1.1 Daily Inspector Report

Daily Inspector Report should be completed for each field team (Figure A-29). The information on the form should provide an indication of the tasks activities performed by

DAILY INSPECTOR REPORT

ENGINEERING - SCIENCE, INC. **CLIENT:** **DATE:**

PROJECT : ______________________

LOCATION: ______________________

PROJECT NO. : __________

INSPECTOR : __________

CONTRACTOR : __________

CREW : __________

RIG # : __________

WEATHER: AM __________

PM __________

START TIME: __________

END TIME: __________

TOTAL HOURS: __________

LOCATION	H & S LEVEL	METHOD/ ITEM	PROJECTED DEPTH	START DEPTH	END DEPTH	TOTAL FOOTAGE	SAMPLE INTERVAL	# ITEMS/ SAMPLES

NON-PRODUCTIVE TIME

LOCATION	REASON	ACTION TAKEN	TIME DOWN

WASTE MANAGEMENT INFORMATION

LOCATION	SPOIL TYPE ON SITE	DRUMS / CONTAINERS FILLED	DRUMS / CONTAINERS USED	COMMENTS

COMMENTS: (visitors, general remarks, etc.)

INSPECTOR: __________

FIGURE A-29

the field team during the course of the day. Information regarding non-productive time and waste management should also be included on this form. These forms shall be kept in the on-site files.

5.3.1.2 Daily Field Summary

A Daily Field Summary form should be completed by the site manager at the end of each day (Figure A-30). This form should provide an overall indication of the tasks/activities performed on a particular day. These forms shall be kept in the on-site files.

5.3.1.3 Sample Log Book

A sample log book will be maintained. The log book will consist of a 3-ring binder containing pages found in Figure A-31. The log book will record all samples collected in the field including QA/QC samples the samples shall be entered into this book on the day the samples are collected.

5.3.1.4 Sample Delivery Group (SDG) Tracking

Tracking of sample delivery groups (SDGs) of various media will be performed using the SDG Tracking Form (Figure A-32). The SDG tracking form will be used as a guide in order meet the sampling programs QA/QC requirements.

5.3.1.5 Photographs

Photographs of all sampling locations and operations are desirable, although they frequently will not be allowed. If photographs are taken, the photographer should record time, date, site location, and brief description of the subject on the back of the photo, (polaroid) or in a log book and then sign it. Photographic documentation that may be used as evidence should be handled in a way to ensure that chain-of-custody can be established.

5.3.2 Custody Procedures

Chain-of-custody documentation must be implemented and followed whenever samples are collected, transferred, stored, analyzed, or destroyed. The primary objective of these procedures is to create an accurate written record that traces the possession and handling of the sample from the moment of its collection through analysis, to disposal.

DAILY FIELD SUMMARY

ENGINEERING-SCIENCE, INC. | **CLIENT:** | **DATE:**

CLIENT/PROJECT : ______________________
LOCATION: ______________________
PROJECT NO. : ______________________
CHECKED BY: ______________________

DRILLING SUMMARY

RIG	LOCATION	INSPECTOR	ACTIVITY METHOD	TOTAL FOOTAGE	NUMBER OF SAMPLES	EOD DEPTH	COMMENTS

OTHER ACTIVITIES

MAN/CREW	LOCATION	INSPECTOR	ACTIVITY	COMMENTS

COMMENTS: (general)

FIGURE A-30

SAMPLE LOG BOOK **PROJECT:**

				(CHECK APPROPRIATE COLUMNS)						
DATE SAMPLED	SAMPLE NAME	MATRIX	COMMENTS (e.g., whole or partial sample	LAB SAMPLE	LAB DUPLICATE	LAB RINSATE	TRIP BLANK	MRD SAMPLE	MRD RINSATE	MATRIX SPIKE

FIGURE A-31

SAMPLE DELIVERY GROUP

TRACKING FORM

SDG TYPES:

SOIL	SEDIMENT	SURFACE WATER	GROUNDWATER
SOIL BORINGS SURFACE SOILS TEST PITS BERM EXCAVATIONS			

SEAD NUMBER:

SDG TYPE: ______________

OPENING DATE ______________

CLOSING DATE ______________

	SAMPLE	CHECK IF QA/QC TAKEN
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

NOTES:

1) SDG OPEN FOR 14 DAYS OR 20 SAMPLES, WHICHEVER COMES FIRST

2) QA/QC SAMPLES TO BE TAKEN AT THE FREQUENCY OF 1 QA/QC SET FOR EVERY 20 SAMPLES

COMMENTS:

FIGURE A-32

A sample is defined as being in someone's "custody" if:

1. It is in one's actual possession, or
2. It is in one's view, after being in one's physical possession, or
3. It is in one's physical possession and then locked up so that no one can tamper with it, or
4. It is kept in a secured area, restricted to authorized personnel only.

The number of persons involved in collecting and handling samples should be kept to a minimum.

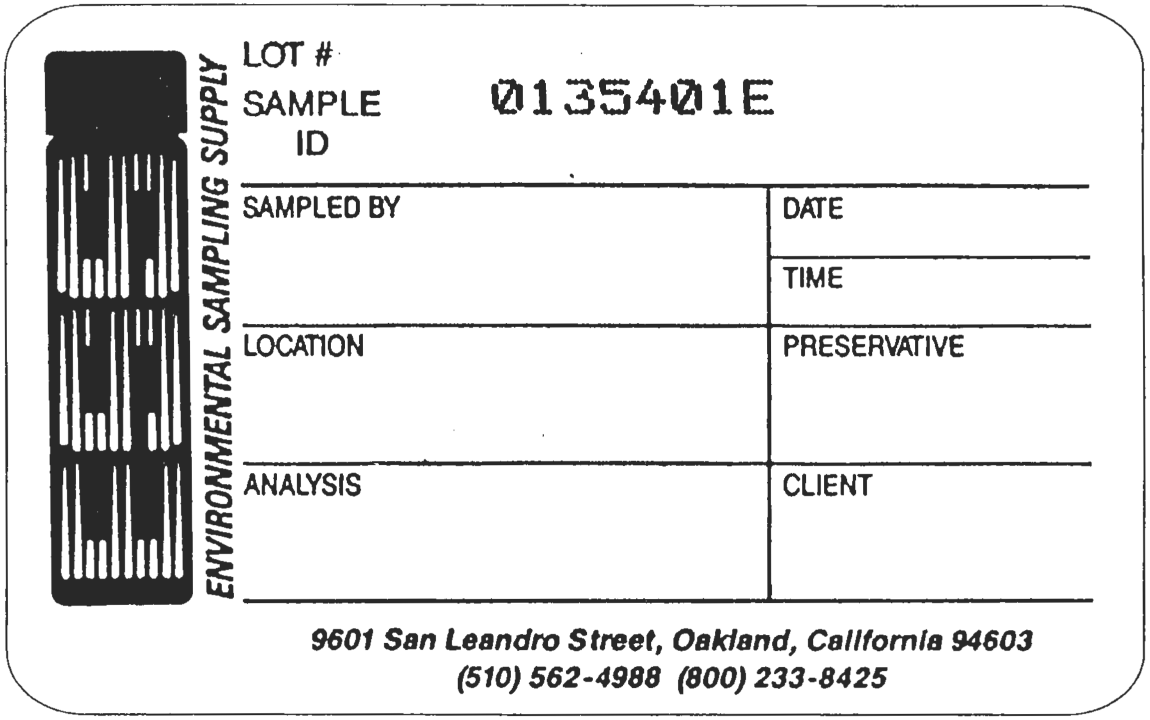
Labels or tags must be firmly affixed to the sample containers. Be sure that the container is dry enough for a gummed label to be securely attached. Each sample must be labeled using waterproof ink and sealed immediately after it is collected. Labels should be filled out before collection to minimize handling of sample container. Clear tape will be placed over the label. Tags attached by string are acceptable when gummed labels are not applicable. Figure A-33 is an example of a sample label.

A Chain-of-Custody form (Figure A-34) will be filled out for and accompany the samples placed in each cooler for shipment to the laboratory. This form records the type of sample, sample number, sampling time, analyses to be performed, and the bottles and preservatives used.

One member of the sampling team will be designated Field Sample Custodian. The samples and forms are transferred to the Field Sample Custodian by the team members who collect the samples at the end of each day. The Field Sample Custodian is responsible for packaging and dispatching samples to the appropriate laboratory. This responsibility includes filling out, dating, and signing the appropriate portion of the chain-custody record.

When transferring the samples, the receiver and sender must sign and record the date and time of transfer on the chain-of-custody record. Custody transfers made to the Field Sample Custodian should account for each sample, although samples may be transferred as a group. Every person who takes custody must fill in the appropriate section of the chain-of-custody record.

All packages sent to the laboratory will be accompanied by the chain-of-custody form and other pertinent forms. A copy of these forms will be retained by the Field Sample Custodian and stored in the central file for the project in the office. Mailed packages can be registered with return receipt requested. For packages sent by common carrier, receipts should be retained as part of the permanent chain-of-custody documentation. The laboratory custodian should sign field chain-of-custody forms to acknowledge receipt of the samples in the labs and either initiate separate laboratory custody procedures or maintain the field chain-of-custody until the sample is disposed. All chain-of-custody documentation will be returned to the central file.



ENVIRONMENTAL SAMPLING SUPPLY

LOT #
SAMPLE ID 0135401E

SAMPLED BY	DATE
	TIME
LOCATION	PRESERVATIVE
ANALYSIS	CLIENT

9601 San Leandro Street, Oakland, California 94603
(510) 562-4988 (800) 233-8425

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 726511-02001

FIGURE 33
EXAMPLE OF SAMPLE LABEL

SCALE
DATE JANUARY 1995

PARSONS
ENGINEERING-SCIENCE, INC.

Prudential Center
Boston, MA 02199

Phone: 617-859-2000
Fax: 617-859-2043

CHAIN-OF-CUSTODY RECORD

PAGE OF

JOB NO. ______
PROJECT ______
CONTACT ______

LABORATORY ______
ADDRESS ______
CONTACT ______

		SAMPLING				ANALYSES											
SAMPLE NO.	LABORATORY SAMPLE NO.	DATE	TIME	SAMPLE DEPTH	SAMPLE MATRIX	VOA	SVOC	METALS	PEST/PCB	CN	HERB	TPH				NO. OF CONTAINERS	COMMENTS (Special Instructions, cautions, etc.)

VOA Vial										
Glass Bottle										
Plastic Bottle										
Preservative										
Container Volume										

Sampled and Relinquished by Sign Print Firm Date Time	Received by Sign Print Firm Date Time
Relinquished by Sign Print Firm Date Time	Received by Sign Print Firm Date Time

Evidence Samples tampered with? ☐ No ☐ Yes
If Yes, explain in remarks.

PRESERVATION KEY:
A - Ice
B - Filtered
C - Acidified with HCl
D - Acidified with HNO_3
E - Acidified with H_2SO_4
F - NaOH + Ascorbic
G - Other

REMARKS: (Sample storage, nonstandard sample bottles)

Cooler #:

ESB - Form COC1 White - return with data Yellow - lab copy Pink - Sampler copy

FIGURE A-34

Attachment A-1

Exemption Letter From EPA Dated September 16, 1991

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
JACOB K. JAVITS FEDERAL BULDING
NEW YORK, NEW YORK 10278

SEP 20 1991

Mr. Gary Kittell
Director of Engineering and Housing
Department of the Army
Seneca Army Depot
Romulus, New York 14541-5001

Re: Seneca Army Depot Superfund Site

Dear Mr. Kittell:

I am writing you this long overdue letter to confirm that I agreed at the meeting we had this past February that, in general, soils excavated from test pits dug during remedial investigation could be redeposited without regulatory restriction. This of course would not apply if obviously contaminated materials were unearthed (e.g., drums, visibly contaminated soil etc.). Subsequent evaluation might also require remediation of the redeposited soil. In such cases the material/soil would require proper disposal.

If you have any questions on this please call me at (212) 264-8670.

Sincerely yours,

Robert J. Wing

Robert J. Wing, Chief
Federal Facilities Section

cc: K. Gupta, NYSDEC
R. Battaglia, SEAD
K. Healy, USACE

Attachment A-2

Standard Practice for Description and Identification of Soils (Visual - Manual Method)

Designation: D 2488 – 84

Standard Practice for
Description and Identification of Soils (Visual-Manual Procedure)[1]

1. Scope

1.1 This practice covers procedures for the description of soils for engineering purposes.

1.2 This practice also describes a procedure for identifying soils, at the option of the user, based on the classification system described in Test Method D 2487. The identification is based on visual examination and manual tests. It must be clearly stated in reporting an identification that it is based on visual-manual procedures.

1.2.1 When precise classification of soils for engineering purposes is required, the procedures prescribed in Test Method D 2487 shall be used.

1.2.2 In this practice, the identification portion assigning a group symbol and name is limited to soil particles smaller than 3 in. (75 mm).

1.2.3 The identification portion of this practice is limited to naturally occurring soils.

NOTE 1—This practice may be used as a descriptive system applied to such materials as shale, claystone, shells, crushed rock, etc. (See Appendix X2).

1.3 The descriptive information in this practice may be used with other soil classification systems or for materials other than naturally occurring soils.

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific precautionary statements see Section 8.

1.5 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terms and Symbols Relating to Soil and Rock[2]

D 1452 Practice for Soil Investigation and Sampling by Auger Borings[2]

D 1586 Method for Penetration Test and Split-Barrel Sampling of Soils[2]

D 1587 Practice for Thin-Walled Tube Sampling of Soils[2]

D 2113 Practice for Diamond Core Drilling for Site Investigation[2]

D 2487 Test Method for Classification of Soils for Engineering Purposes[2]

3. Definitions

3.1 Except as listed below, all definitions are in accordance with Terms and Symbols D 653.

NOTE 2—For particles retained on a 3-in. (75-mm) US standard sieve, the following definitions are suggested:

Cobbles—particles of rock that will pass a 12-in. (300-mm) square opening and be retained on a 3-in. (75-mm) sieve, and

Boulders—particles of rock that will not pass a 12-in. (300-mm) square opening.

3.1.1 *clay*—soil passing a No. 200 (75-µm) sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when air-dry. For classification, a clay is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index equal to or greater than 4, and the plot of plasticity index versus liquid limit falls on or above the "A" line (see Fig. 3 of Test Method D 2487).

3.1.2 *gravel*—particles of rock that will pass a 3-in. (75-mm) sieve and be retained on a No. 4 (4.75-mm) sieve with the following subdivisions:

coarse—passes a 3-in. (75-mm) sieve and is retained on a ¾-in. (19-mm) sieve.

fine—passes a ¾-in. (19-mm) sieve and is retained on a No. 4 (4.75-mm) sieve.

3.1.3 *organic clay*—a clay with sufficient organic content to influence the soil properties. For classification, an organic clay is a soil that would be classified as a clay, except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.4 *organic silt*—a silt with sufficient organic content to influence the soil properties. For classification, an organic silt is a soil that would be classified as a silt except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.5 *peat*—a soil composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

3.1.6 *sand*—particles of rock that will pass a No. 4 (4.75-mm) sieve and be retained on a No. 200 (75-µm) sieve with the following subdivisions:

coarse—passes a No. 4 (4.75-mm) sieve and is retained on a No. 10 (2.00-mm) sieve.

medium—passes a No. 10 (2.00-mm) sieve and is retained on a No. 40 (425-µm) sieve.

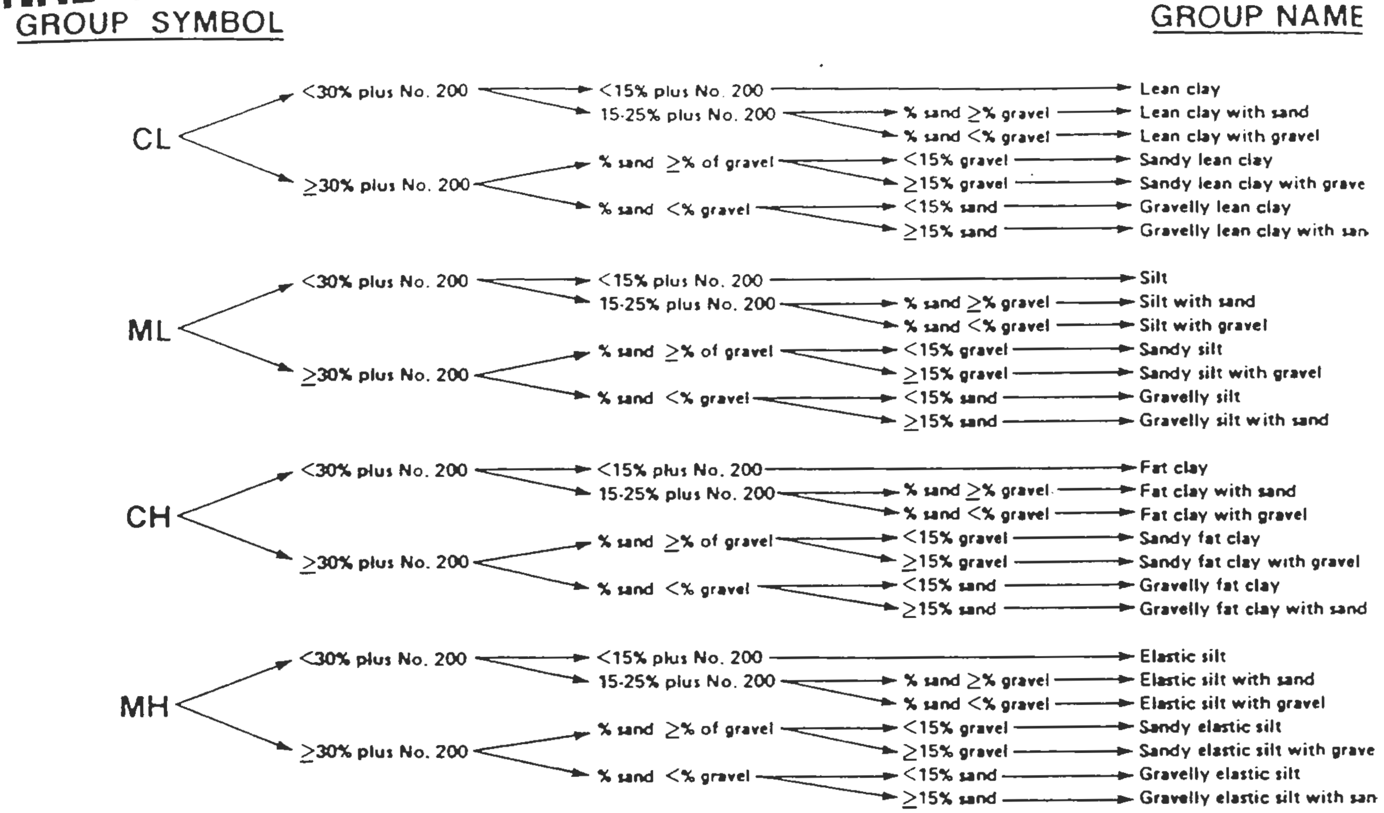
---

[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

Current edition approved Oct. 3, 1984. Published December 1984. Originally published as D 2488 – 66 T. Last previous edition D 2488 – 69 (1975).

[2] *Annual Book of ASTM Standards*, Vol 04.08.

FINAL DRAFT



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1a Flow Chart for Identifying Inorganic Fine-Grained Soil (50 % or more fines)

fine—passes a No. 40 (425-µm) sieve and is retained on a No. 200 (75-µm) sieve.

3.1.7 *silt*—soil passing a No. 200 (75-µm) sieve that is nonplastic or very slightly plastic and that exhibits little or no strength when air dry. For classification, a silt is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index less than 4, or the plot of plasticity index versus liquid limit falls below the "A" line (see Fig. 3 of Test Method D 2487).

4. Summary of Practice

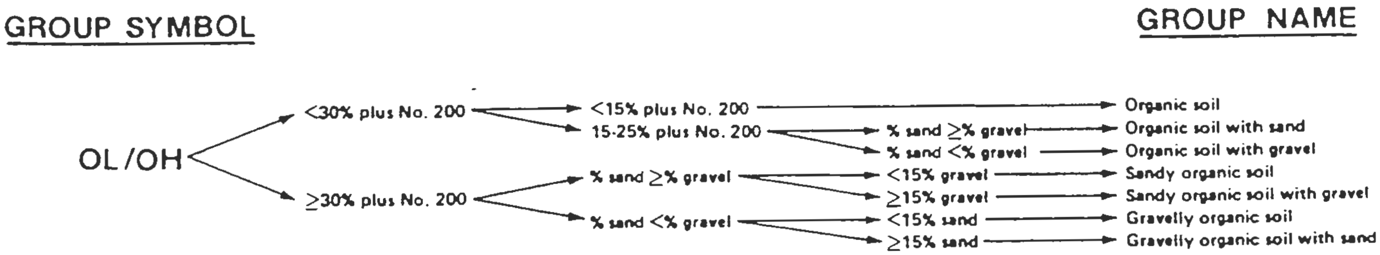
4.1 Using visual examination and simple manual tests, this practice gives standardized criteria and procedures for describing and identifying soils.

4.2 The soil can be given an identification by assigning a group symbol(s) and name. The flow charts, Figs. 1a and 1b for fine-grained soils, and Fig. 2, for coarse-grained soils, can be used to assign the appropriate group symbol(s) and name If the soil has properties which do not distinctly place it into a specific group, borderline symbols may be used, see Appendix X3.

NOTE 3—It is suggested that a distinction be made between *dual symbols* and *borderline symbols.*

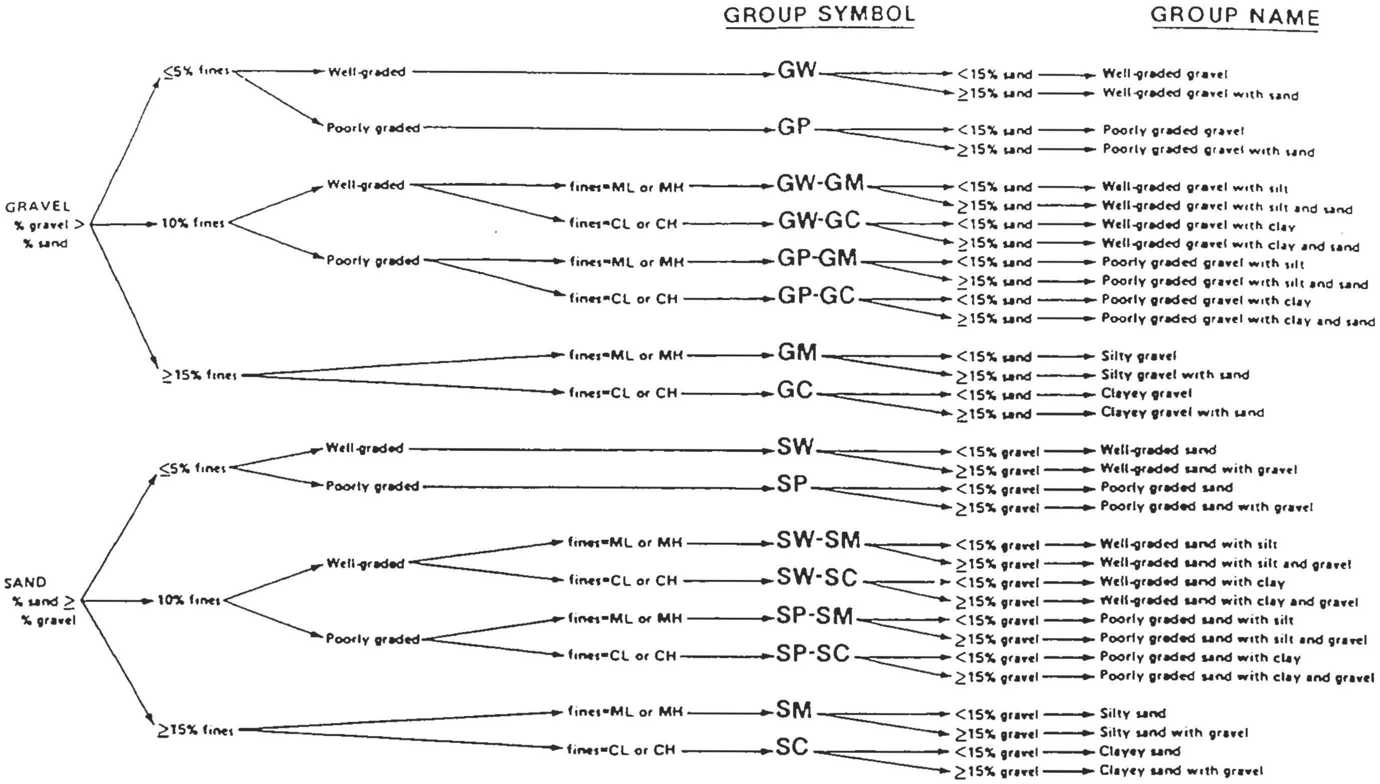
Dual Symbol—A dual symbol is two symbols separated by a hyphen. for example, GP-GM, SW-SC, CL-ML used to indicate that the soil has been identified as having the properties of a classification in accordance with Test Method D 2487 where two symbols are required. Two symbols are required when the soil has between 5 and 12 % fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

Borderline Symbol—A borderline symbol is two symbols separated by a slash, for example, CL/CH, GM/SM, CL/ML. A borderline symbol should be used to indicate that the soil has been identified as having properties that do not distinctly place the soil into a specific group (see Appendix X3).



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1b Flow Chart for Identifying Organic Fine-Grained Soil (50 % or more fines)



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 2 Flow Chart for Identifying Coarse-Grained Soils (less than 50 % fines)

5. Significance and Use

5.1 The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.

5.2 The descriptive information required in this practice should be used to supplement the classification of a soil as determined by Test Method D 2487.

5.3 This practice may be used in identifying soils using the classification group symbols and names as prescribed in Test Method D 2487. Since the names and symbols used in this practice to identify the soils are the same as those used in Test Method D 2487, it shall be clearly stated in reports and all other appropriate documents, that the classification symbol and name are based on visual-manual procedures.

5.4 This practice is to be used not only for identification of soils in the field, but also in the office, laboratory, or wherever soil samples are inspected and described.

5.5 This practice has particular value in grouping similar soil samples so that only a minimum number of laboratory tests need be run for positive soil classification.

NOTE 4—The ability to describe and identify soils correctly is learned more readily under the guidance of experienced personnel, but it may also be acquired systematically by comparing numerical laboratory test results for typical soils of each type with their visual and manual characteristics.

5.6 When describing and identifying soil samples from a given boring, test pit, or group of borings or pits, it is not necessary to follow all of the procedures in this practice for every sample. Soils which appear to be similar can be grouped together; one sample completely described and identified with the others referred to as similar based on performing only a few of the descriptive and identification procedures described in this practice.

6. Apparatus

6.1 *Required Apparatus:*

6.1.1 *Pocket Knife or Small Spatula.*

6.2 *Useful Auxiliary Apparatus:*

6.2.1 *Small Test Tube and Stopper* (or jar with a lid).

6.2.2 *Small Hand Lens.*

7. Reagents

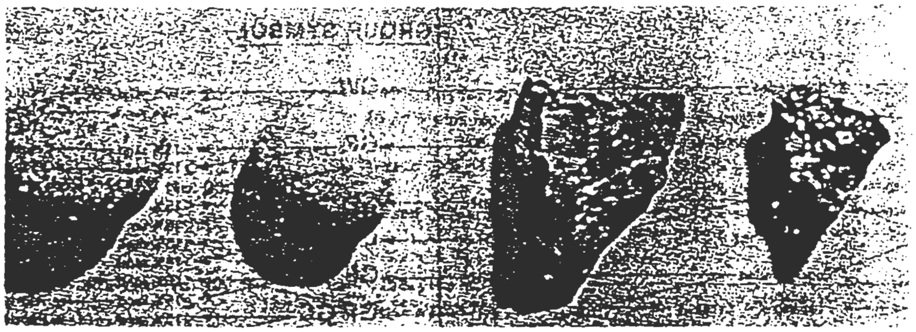
7.1 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean water from a city water supply or natural source, including non-potable water.

7.2 *Hydrochloric Acid*—A small bottle of dilute hydrochloric acid, HCl, one part HCl (10 *N*) to three parts water (This reagent is optional for use with this practice). See Section 8.

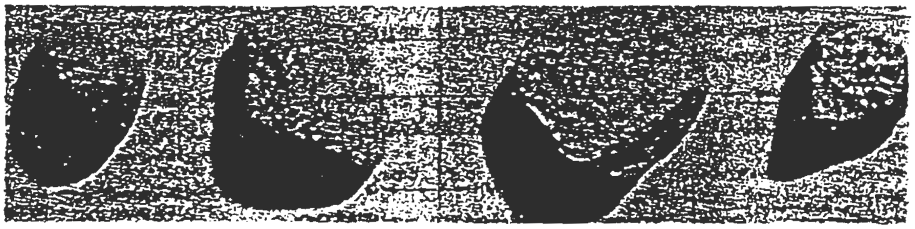
8. Safety Precautions

8.1 When preparing the dilute HCl solution of one part concentrated hydrochloric acid (10 *N*) to three parts of distilled water, slowly add acid into water following necessary safety precautions. Handle with caution and store safely. If solution comes into contact with the skin, rinse thoroughly with water.

8.2 **Caution**—Do not add water to acid.



(a) Rounded (b) Angular



(c) Subrounded (d) Subangular

FIG. 3 Typical Angularity of Bulky Grains

9. Sampling

9.1 The sample shall be considered to be representative of the stratum from which it was obtained by an appropriate, accepted, or standard procedure.

NOTE 5—Preferably, the sampling procedure should be identified as having been conducted in accordance with Practices D 1452, D 1587, or D 2113, or Method D 1586.

.2 The sample shall be carefully identified as to origin.

NOTE 6—Remarks as to the origin may take the form of a boring number and sample number in conjunction with a job number, a geologic stratum, a pedologic horizon or a location description with respect to a permanent monument, a grid system or a station number and offset with respect to a stated centerline and a depth or elevation.

9.3 For accurate description and identification, the minimum amount of the specimen to be examined shall be in accordance with the following schedule:

Maximum Particle Size, Sieve Opening	Minimum Specimen Size, Dry Weight
4.75 mm (No. 4)	100 g (0.25 lb)
9.5 mm (3/8 in.)	200 g (0.5 lb)
19.0 mm (3/4 in.)	1.0 kg (2.2 lb)
38.1 mm (1½ in.)	8.0 kg (18 lb)
75.0 mm (3 in.)	60.0 kg (132 lb)

NOTE 7—If random isolated particles are encountered that are significantly larger than the particles in the soil matrix, the soil matrix can be accurately described and identified in accordance with the preceeding schedule.

TABLE 1 Criteria for Describing Angularity of Coarse-Grained Particles (see Fig. 3)

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

9.4 If the field sample or specimen being examined is smaller than the minimum recommended amount, the report shall include an appropriate remark.

10. Descriptive Information for Soils

10.1 *Angularity*—Describe the angularity of the sand (coarse sizes only), gravel, cobbles, and boulders, as angular, subangular, subrounded, or rounded in accordance with the criteria in Table 1 and Fig. 3. A range of angularity may be stated, such as: subrounded to rounded.

10.2 *Shape*—Describe the shape of the gravel, cobbles, and boulders as flat, elongated, or flat and elongated if they meet the criteria in Table 2 and Fig. 4. Otherwise, do not mention the shape. Indicate the fraction of the particles that have the shape, such as: one-third of the gravel particles are flat.

10.3 *Color*—Describe the color. Color is an important property in identifying organic soils, and within a given locality it may also be useful in identifying materials of similar geologic origin. If the sample contains layers or patches of varying colors, this shall be noted and all representative colors shall be described. The color shall be described for moist samples. If the color represents a dry condition, this shall be stated in the report.

10.4 *Odor*—Describe the odor if organic or unusual. Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. This is especially apparent in fresh samples, but if the samples are dried, the odor may often be revived by heating a moistened

TABLE 2 Criteria for Describing Particle Shape (see Fig. 4)

The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and elongated	Particles meet criteria for both flat and elongated

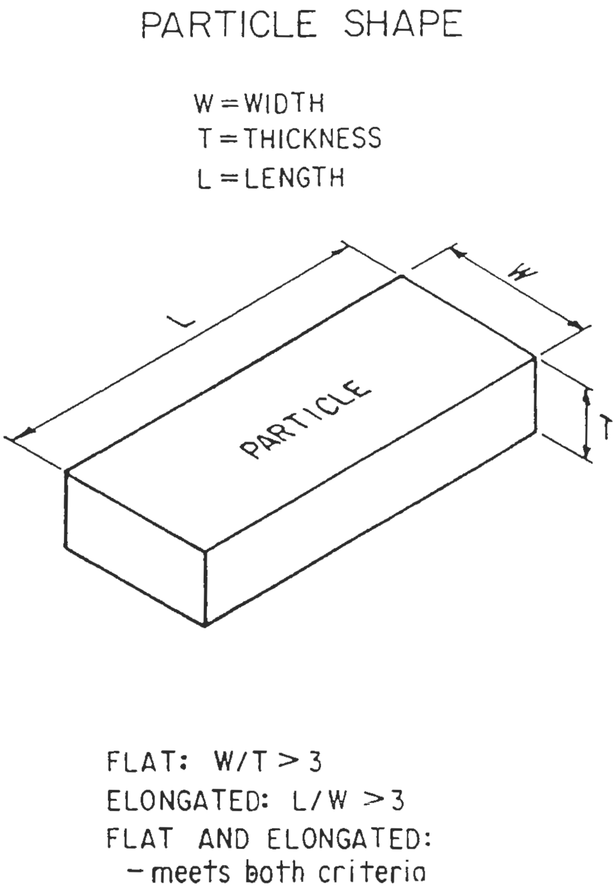


FIG. 4 Criteria for Particle Shape

TABLE 3 Criteria for Describing Moisture Condition

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

sample. If the odor is unusual (petroleum product, chemical, and the like), it shall be described.

10.5 *Moisture Condition*—Describe the moisture condition as dry, moist, or wet, in accordance with the criteria in Table 3.

10.6 *HCl Reaction*—Describe the reaction with HCl as none, weak, or strong, in accordance with the critera in Table 4. Since calcium carbonate is a common cementing agent, a report of its presence on the basis of the reaction with dilute hydrochloric acid is important.

10.7 *Consistency*—For intact fine-grained soil, describe the consistency as very soft, soft, firm, hard, or very hard, in accordance with the criteria in Table 5. This observation is inappropriate for soils with significant amounts of gravel.

TABLE 4 Criteria for Describing the Reaction With HCl

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

TABLE 5 Criteria for Describing Consistency

Description	Criteria
Very soft	Thumb will penetrate soil more than 1 in. (25 mm)
Soft	Thumb will penetrate soil about 1 in. (25 mm)
Firm	Thumb will indent soil about ¼ in. (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very hard	Thumbnail will not indent soil

10.8 *Cementation*—Describe the cementation of intact coarse-grained soils as weak, moderate, or strong, in accordance with the criteria in Table 6.

10.9 *Structure*—Describe the structure of intact soils in accordance with the criteria in Table 7.

10.10 *Range of Particle Sizes*—For gravel and sand components, describe the range of particle sizes within each component as defined in 3.1.2 and 3.1.6. For example, about 20 % fine to coarse gravel, about 40 % fine to coarse sand.

10.11 *Maximum Particle Size*—Describe the maximum particle size found in the sample in accordance with the following information:

10.11.1 *Sand Size*—If the maximum particle size is a sand size, describe as fine, medium, or coarse as defined in 3.1.7. For example: maximum particle size, medium sand.

10.11.2 *Gravel Size*—If the maximum particle size is a gravel size, describe the maximum particle size as the smallest sieve opening that the particle will pass. For example, maximum particle size, 1½ in. (will pass a 1½-in. square opening but not a ¾-in. square opening).

10.11.3 *Cobble or Boulder Size*—If the maximum particle size is a cobble or boulder size, describe the maximum dimension of the largest particle. For example: maximum dimension, 18 in. (450 mm).

10.12 *Hardness*—Describe the hardness of coarse sand and larger particles as hard, or state what happens when the particles are hit by a hammer, for example, gravel-size particles fracture with considerable hammer blow, some gravel-size particles crumble with hammer blow. "Hard" means particles do not crack, fracture, or crumble under a hammer blow.

10.13 Additional comments shall be noted, such as the presence of roots or root holes, difficulty in drilling or augering hole, caving of trench or hole, or the presence of mica.

10.14 A local or commercial name or a geologic interpretation of the soil, or both, may be added if identified as such.

10.15 A classification or identification of the soil in accordance with other classification systems may be added if identified as such.

11. Identification of Peat

11.1 A sample composed primarily of vegetable tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor, shall be designated as a highly organic soil and shall be identified as peat, PT, and not subjected to the

TABLE 6 Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

TABLE 7 Criteria for Describing Structure

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note thickness
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

identification procedures described hereafter.

12. Preparation for Identification

12.1 The soil identification portion of this practice is based on the portion of the soil sample that will pass a 3-in. (75-mm) sieve. The larger than 3-in. (75-mm) particles must be removed, manually, for a loose sample, or mentally, for an intact sample before classifying the soil.

12.2 Estimate and note the percentage of cobbles and the percentage of boulders. Performed visually, these estimates will be on the basis of volume percentage.

NOTE 8—Since the percentages of the particle-size distribution in Test Method D 2487 are by dry weight, and the estimates of percentages for gravel, sand, and fines in this practice are by dry weight, it is recommended that the report state that the percentages of cobbles and boulders are by volume.

12.3 Of the fraction of the soil smaller than 3 in. (75 mm), estimate and note the percentage, by dry weight, of the gravel, sand, and fines (see Appendix X4 for suggested procedures).

NOTE 9—Since the particle-size components appear visually on the basis of volume, considerable experience is required to estimate the percentages on the basis of dry weight. Frequent comparisons with laboratory particle-size analyses should be made.

12.3.1 The percentages shall be estimated to the closest 5 %. The percentages of gravel, sand, and fines must add up to 100 %.

12.3.2 If one of the components is present but not in sufficient quantity to be considered 5 % of the smaller than 3-in. (75-mm) portion, indicate its presence by the term *trace*, for example, trace of fines. A trace is not to be considered in the total of 100 % for the components.

TABLE 8 Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very high	The dry specimen cannot be broken between the thumb and a hard surface

13. Preliminary Identification

13.1 The soil is *fine grained* if it contains 50 % or mor fines. Follow the procedures for identifying fine-grained soil of Section 14.

13.2 The soil is *coarse grained* if it contains less than 50 % fines. Follow the procedures for identifying coarse-graine soils of Section 15.

14. Procedure for Identifying Fine-Grained Soils

14.1 Select a representative sample of the material fo examination. Remove particles larger than the No. 40 siev (medium sand and larger) until a specimen equivalent t about a handful of material is available. Use this specimen for performing the dry strength, dilatancy, and toughnes tests.

14.2 *Dry Strength:*

14.2.1 From the specimen, select enough material to mold into a ball about 1 in. (25 mm) in diameter. Mold the material until it has the consistency of putty, adding water if necessary.

14.2.2 From the molded material, make at least three test specimens. A test specimen shall be a ball of material about ½ in. (12 mm) in diameter. Allow the test specimens to dry in air, or sun, or by artificial means, as long as the temperature does not exceed 60°C.

14.2.3 If the test specimen contains natural dry lumps, those that are about ½ in. (12 mm) in diameter may be used in place of the molded balls.

NOTE 10—The process of molding and drying usually produces higher strengths than are found in natural dry lumps of soil.

14.2.4 Test the strength of the dry balls or lumps by crushing between the fingers. Note the strength as none, low, medium, high, or very high in accorance with the criteria in Table 8. If natural dry lumps are used, do not use the results of any of the lumps that are found to contain particles of coarse sand.

14.2.5 The presence of high-strength water-soluble cementing materials, such as calcium carbonate, may cause exceptionally high dry strengths. The presence of calcium carbonate can usually be detected from the intensity of the reaction with dilute hydrochloric acid (see 10.6).

14.3 *Dilatancy:*

14.3.1 From the specimen, select enough material to mold into a ball about ½ in. (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

14.3.2 Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the

TABLE 9 Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

TABLE 10 Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

reaction as none, slow, or rapid in accordance with the criteria in Table 9. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

14.4 *Toughness:*

14.4.1 Following the completion of the dilatancy test, the test specimen is shaped into an elongated pat and rolled by hand on a smooth surface or between the palms into a thread about ⅛ in. (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about ⅛ in. The thread will crumble at a diameter of ⅛ in. when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, the pieces should be lumped together and kneaded until the lump crumbles. Note the toughness of the material during kneading.

14.4.2 Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 10.

14.5 *Plasticity*—On the basis of observations made during the toughness test, describe the plasticity of the material in accordance with the criteria given in Table 11.

14.6 Decide whether the soil is an *inorganic* or an *organic* fine-grained soil (see 14.8). If inorganic, follow the steps given in 14.7.

14.7 *Identification of Inorganic Fine-Grained Soils:*

14.7.1 Identify the soil as a *lean clay*, CL, if the soil has medium to high dry strength, no or slow dilatancy, and medium toughness and plasticity (see Table 12).

14.7.2 Identify the soil as a *fat clay*, CH, if the soil has high to very high dry strength, no dilatancy, and high toughness and plasticity (see Table 12).

14.7.3 Identify the soil as a *silt*, ML, if the soil has no to low dry strength, slow to rapid dilatancy, and low toughness and plasticity, or is nonplastic (see Table 12).

14.7.4 Identify the soil as an *elastic silt*, MH, if the soil has low to medium dry strength, no to slow dilatancy, and low to medium toughness and plasticity (see Table 12).

TABLE 11 Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A ⅛-in. (3-mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

NOTE 11—These properties are similar to those for a lean clay. However, the silt will dry quickly on the hand and have a smooth, silky feel when dry. Some soils that would classify as MH in accordance with the criteria in Test Method D 2487 are visually difficult to distinguish from lean clays, CL. It may be necessary to perform laboratory testing for proper identification.

14.8 *Identification of Organic Fine-Grained Soils:*

14.8.1 Identify the soil as an *organic soil*, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soils usually have a dark brown to black color and may have an organic odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

NOTE 12—In some cases, through practice and experience, it may be possible to further identify the organic soils as organic silts or organic clays, OL or OH. Correlations between the dilatancy, dry strength, toughness tests, and laboratory tests can be made to identify organic soils in certain deposits of similar materials of known geologic origin.

14.9 If the soil is estimated to have 15 to 25 % sand or gravel, or both, the words "with sand" or "with gravel" (whichever is more predominant) shall be added to the group name. For example: "lean clay with sand, CL" or "silt with gravel, ML" (see Figs. 1a and 1b). If the percentage of sand is equal to the percentage of gravel, use "with sand."

14.10 If the soil is estimated to have 30 % or more sand or gravel, or both, the words "sandy" or "gravelly" shall be added to the group name. Add the word "sandy" if there appears to be more sand than gravel. Add the word "gravelly" if there appears to be more gravel than sand. For example: "sandy lean clay, CL", "gravelly fat clay, CH", or "sandy silt, ML" (see Figs. 1a and 1b). If the percentage of sand is equal to the percent of gravel, use "sandy."

15. Procedure for Identifying Coarse-Grained Soils (Contains less than 50 % fines)

15.1 The soil is a *gravel* if the percentage of gravel is estimated to be more than the percentage of sand.

15.2 The soil is a *sand* if the percentage of gravel is estimated to be equal to or less than the percentage of sand.

15.3 The soil is a *clean gravel* or *clean sand* if the percentage of fines is estimated to be 5 % or less.

15.3.1 Identify the soil as a *well-graded gravel*, GW, or as a *well-graded sand*, SW, if it has a wide range of particle sizes and substantial amounts of the intermediate particle sizes.

15.3.2 Identify the soil as a *poorly graded gravel*, GP, or as a *poorly graded sand*, SP, if it consists predominantly of one size (uniformly graded), or it has a wide range of sizes with

TABLE 12 Identification of Inorranic Fine-Grained Soils from Manual Tests

Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

some intermediate sizes obviously missing (gap or skip graded).

15.4 The soil is either a *gravel with fines* or a *sand with nes* if the percentage of fines is estimated to be 15 % or more.

15.4.1 Identify the soil as a *clayey gravel*, GC, or a *clayey sand*, SC, if the fines are clayey as determined by the procedures in Section 14.

15.4.2 Identify the soil as a *silty gravel*, GM, or a *silty sand*, SM, if the fines are silty as determined by the procedures in Section 14.

15.5 If the soil is estimated to contain 10 % fines, give the soil a dual identification using two group symbols.

15.5.1 The first group symbol shall correspond to a clean gravel or sand (GW, GP, SW, SP) and the second symbol shall correspond to a gravel or sand with fines (GC, GM, SC, SM).

15.5.2 The group name shall correspond to the first group symbol plus the words "with clay" or "with silt" to indicate the plasticity characteristics of the fines. For example: "well-graded gravel with clay, GW-GC" or "poorly graded sand with silt, SP-SM" (see Fig. 2).

15.6 If the specimen is predominantly sand or gravel but contains an estimated 15 % or more of the other coarse-grained constituent, the words "with gravel" or "with sand" shall be added to the group name. For example: "poorly graded gravel with sand, GP" or "clayey sand with gravel, SC" (see Fig. 2).

15.7 If the field sample contains any cobbles or boulders, or both, the words "with cobbles" or "with cobbles and boulders" shall be added to the group name. For example: ilty gravel with cobbles, GM."

16. Report

16.1 The report shall include the information as to origin, and the items indicated in Table 13.

NOTE 13—*Example: Clayey Gravel with Sand and Cobbles, GC*—About 50 % fine to coarse, subrounded to subangular gravel; about 30 % fine to coarse, subrounded sand; about 20 % fines with medium plasticity, high dry strength, no dilatancy, medium toughness; weak reaction with HCl; original field sample had about 5 % (by volume) subrounded cobbles, maximum dimension, 150 mm.

In-Place Conditions—Firm, homogeneous, dry, brown

Geologic Interpretation—Alluvial fan

NOTE 14—Other examples of soil descriptions and identification are given in Appendixes X1 and X2.

NOTE 15—If desired, the percentages of gravel, sand, and fines may be stated in terms indicating a range of percentages, as follows:

Trace—Particles are present but estimated to be less than 5 %
Few—5 to 10 %
Little—15 to 25 %
Some—30 to 45 %
Mostly—50 to 100 %

16.2 If, in the soil description, the soil is identified using a classification group symbol and name as described in Test Method D 2487, it must be distinctly and clearly stated in log forms, summary tables, reports, and the like, that the symbol and name are based on visual-manual procedures.

17. Precision and Bias

17.1 This practice provides qualitative information only, therefore, a precision and bias statement is not applicable.

TABLE 13 Checklist for Description of Soils

1. Group name
2. Group symbol
3. Percent of cobbles or boulders, or both (by volume)
4. Percent of gravel, sand, or fines, or all three (by dry weight)
5. Particle-size range:
   Gravel—fine, coarse
   Sand—fine, medium, coarse
6. Particle angularity: angular, subangular, subrounded, rounded
7. Particle shape: (if appropriate) flat, elongated, flat and elongated
8. Maximum particle size or dimension
9. Hardness of coarse sand and larger particles
10. Plasticity of fines: nonplastic, low, medium, high
11. Dry strength: none, low, medium, high, very high
12. Dilatancy: none, slow, rapid
13. Toughness: low, medium, high
14. Color (in moist condition)
15. Odor (mention only if organic or unusual)
16. Moisture: dry, moist, wet
17. Reaction with HCl: none, weak, strong

For intact samples:

18. Consistency (fine-grained soils only): very soft, soft, firm, hard, very hard
19. Structure: stratified, laminated, fissured, slickensided, lensed, homogeneous
20. Cementation: weak, moderate, strong
21. Local name
22. Geologic interpretation
23. Additional comments: presence of roots or root holes, presence of mica, gypsum, etc., surface coatings on coarse-grained particles, caving or sloughing of auger hole or trench sides, difficulty in augering or excavating, etc.

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLES OF VISUAL SOIL DESCRIPTIONS

X1.1 The following examples show how the information required in 16.1 can be reported. The information that is included in descriptions should be based on individual circumstances and need.

X1.1.1 *Well-Graded Gravel with Sand (GW)*—About 5 % fine to coarse, hard, subangular gravel; about 25 % fine coarse, hard, subangular sand; trace of fines; maximum size, 75 mm, brown, dry; no reaction with HCl.

X1.1.2 *Silty Sand with Gravel (SM)*—About 60 % predominantly fine sand; about 25 % silty fines with low plasticity, low dry strength, rapid dilatancy, and low toughness; about 15 % fine, hard, subrounded gravel, a few gravel-size particles fractured with hammer blow; maximum size, 25 mm; no reaction with HCl (Note—Field sample size smaller than recommended).

In-Place Conditions—Firm, stratified and contains lenses of silt 1 to 2 in. (25 to 50 mm) thick, moist, brown to gray; in-place density 106 lb/ft^3; in-place moisture 9 %.

X1.1.3 *Organic Soil (OL/OH)*—About 100 % fines with low plasticity, slow dilatancy, low dry strength, and low toughness; wet, dark brown, organic odor; weak reaction with HCl.

X1.1.4 *Silty Sand with Organic Fines (SM)*—About 75 % fine to coarse, hard, subangular reddish sand; about 25 % organic and silty dark brown nonplastic fines with no dry strength and slow dilatancy; wet; maximum size, coarse sand; weak reaction with HCl.

X1.1.5 *Poorly Graded Gravel with Silt, Sand, Cobbles and Boulders (GP-GM)*—About 75 % fine to coarse, hard, subrounded to subangular gravel; about 15 % fine, hard, subrounded to subangular sand; about 10 % silty nonplastic fines; moist, brown; no reaction with HCl; original field sample had about 5 % (by volume) hard, subrounded cobbles and a trace of hard, subrounded boulders, with a maximum dimension of 18 in. (450 mm).

X2. USING THE IDENTIFICATION PROCEDURE AS A DESCRIPTIVE SYSTEM FOR SHALE, CLAYSTONE, SHELLS, SLAG, CRUSHED ROCK, AND THE LIKE

X2.1 The identification procedure may be used as a descriptive system applied to materials that exist in-situ as shale, claystone, sandstone, siltstone, mudstone, etc., but convert to soils after field or laboratory processing (crushing, slaking, and the like).

X2.2 Materials such as shells, crushed rock, slag, and the like, should be identified as such. However, the procedures used in this practice for describing the particle size and plasticity characteristics may be used in the description of the material. If desired, an identification using a group name and symbol according to this practice may be assigned to aid in describing the material.

X2.3 The group symbol(s) and group names should be placed in quotation marks or noted with some type of distinguishing symbol. See examples.

X2.4 Examples of how group names and symbols can be incororated into a descriptive system for materials that are not naturally occurring soils are as follows:

X2.4.1 *Shale Chunks*—Retrieved as 2 to 4-in. (50 to 100-mm) pieces of shale from power auger hole, dry, brown, no reaction with HCl. After slaking in water for 24 h, material identified as "Sandy Lean Clay (CL)"; about 60 % fines with medium plasticity, high dry strength, no dilatancy, and medium toughness; about 35 % fine to medium, hard sand; about 5 % gravel-size pieces of shale.

X2.4.2 *Crushed Sandstone*—Product of commercial crushing operation; "Poorly Graded Sand with Silt (SP-SM)"; about 90 % fine to medium sand; about 10 % nonplastic fines; dry, reddish-brown, strong reaction with HCl.

X2.4.3 *Broken Shells*—About 60 % gravel-size broken shells; about 30 % sand and sand-size shell pieces; about 10 % fines; "Poorly Graded Gravel with Sand (GP)."

X2.4.4 *Crushed Rock*—Processed from gravel and cobbles in Pit No. 7; "Poorly Graded Gravel (GP)"; about 90 % fine, hard, angular gravel-size particles; about 10 % coarse, hard, angular sand-size particles; dry, tan; no reaction with HCl.

X3. SUGGESTED PROCEDURE FOR USING A BORDERLINE SYMBOL FOR SOILS WITH TWO POSSIBLE IDENTIFICATIONS.

X3.1 Since this practice is based on estimates of particle size distribution and plasticity characteristics, it may be difficult to clearly identify the soil as belonging to one category. To indicate that the soil may fall into one of two possible basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example: SC/CL or CL/CH.

X3.1.1 A borderline symbol may be used when the percentage of fines is estimated to be between 45 and 55 %. One symbol should be for a coarse-grained soil with fines and the other for a fine-grained soil. For example: GM/ML or CL/SC.

X3.1.2 A borderline symbol may be used when the percentage of sand and the percentage of gravel are estimated to be about the same. For example: GP/SP, SC/GC, GM/SM. It is practically impossible to have a soil that would have a borderline symbol of GW/SW.

X3.1.3 A borderline symbol may be used when the soil could be either well graded or poorly graded. For example: GW/GP, SW/SP.

X3.1.4 A borderline symbol may be used when the soil could either be a silt or a clay. For example: CL/ML, CH/MH, SC/SM.

X3.1.5 A borderline symbol may be used when a fine-grained soil has properties that indicate that it is at the boundary between a soil of low compressibility and a soil of high compressibility. For example: CL/CH, MH/ML.

X3.2 The order of the borderline symbols should reflect similarity to surrounding or adjacent soils. For example: soils in a borrow area have been identified as CH. One sample is considered to have a borderline symbol of CL and CH. To show similarity, the borderline symbol should be CH/CL.

X3.3 The group name for a soil with a borderline symbol should be the group name for the first symbol, except for:

CL/CH lean to fat clay
ML/CL clayey silt
CL/ML silty clay

X3.4 The use of a borderline symbol should not be used indiscriminately. Every effort shall be made to first place the soil into a single group.

X4. SUGGESTED PROCEDURES FOR ESTIMATING THE PERCENTAGES OF GRAVEL, SAND, AND FINES IN A SOIL SAMPLE

X4.1 *Jar Method*—The relative percentage of coarse- and fine-grained material may be estimated by thoroughly shaking a mixture of soil and water in a test tube or jar, and then allowing the mixture to settle. The coarse particles will fall to the bottom and successively finer particles will be deposited with increasing time; the sand sizes will fall out of suspension in 20 to 30 s. The relative proportions can be estimated from the relative volume of each size separate. This method should be correlated to particle-size laboratory determinations.

X4.2 *Visual Method*—Mentally visualize the gravel size particles placed in a sack (or other container) or sacks. Then, do the same with the sand size particles and the fines. Then, mentally compare the number of sacks to estimate the percentage of plus No. 4 sieve size and minus No. 4 sieve size present. The percentages of sand and fines in the minus sieve size No. 4 material can then be estimated from the wash test (X4.3).

X4.3 *Wash Test (for relative percentages of sand and fines)*—Select and moisten enough minus No. 4 sieve size material to form a 1-in (25-mm) cube of soil. Cut the cube in half, set one-half to the side, and place the other half in a small dish. Wash and decant the fines out of the material in the dish until the wash water is clear and then compare the two samples and estimate the percentage of sand and fines. Remember that the percentage is based on weight, not volume. However, the volume comparison will provide a reasonable indication of grain size percentages.

X4.3.1 While washing, it may be necessary to break down lumps of fines with the finger to get the correct percentages.

Attachment A-3
Groundwater Sampling Procedure, Low Flow Pump Purging and Sampling
(Draft, EPA, Region II, May 15, 1995)

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUND WATER SAMPLING PROCEDURE
LOW FLOW PUMP PURGING AND SAMPLING

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I.SCOPE & APPLICATION

This standard operating procedure (SOP) provides for collection of groundwater samples from monitoring wells. The procedure will, in most situations, provide for the collection of ground water samples with minimum turbidity. This procedure is designed to be used in conjunction with the analyses for the most common types of ground water contaminants (volatile and semi-volatile organic compounds, pesticides, PCBs, metals and inorganic compounds).

II.EQUIPMENT

Adjustable rate, pumps (e.g., low flow centrifugal or bladder pumps constructed of stainless steel or Teflon). Peristaltic pumps may be used only for inorganic sample collection.

Tubing: Tubing used in purging and sampling each well must be dedicated to that well. Once properly located, moving the pump in the well should be avoided. Consequently the same tubing should be used for purging and sampling. Teflon or Teflon lined polyethylene tubing must be used to collect samples for organic analysis. For samples collected for inorganic analysis, Teflon or Teflon lined polyethylene, PVC, Tygon or polyethylene tubing may be used.

Water level measuring device, 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

Flow measurement supplies (e.g., graduated cylinder and stop watch).

Interface probe, if needed.

Power source (generator, nitrogen tank, etc.).

Purge criteria parameter monitoring instruments - pH, turbidity, specific conductance, temperature, eH and dissolved oxygen.

Decontamination supplies.

Sample Bottles.

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Sample preservation supplies (as required by the analytical methods).

Sample tags or labels, chain of custody.

Well construction data, location map, field data from last sampling event.

Approved Field Sampling Plan / QA Program Plan. Logbook(s).

III.PRELIMINARY SITE ACTIVITIES

Check well for damage or evidence of tampering, record pertinent observations.

Lay out sheet of polyethylene for monitoring and sampling equipment.

Measure VOCs (volatile organic compounds) at the rim of the unopened well with a PID or FID instrument and record the reading in the field logbook.

Remove well cap.

Measure VOCs (volatile organic compounds) at the rim of the well with a PID or FID instrument and record the reading in the field logbook.

If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one.

Measure and record the depth to water (to 0.01 ft) in all wells to be sampled before any purging begins. Care should be taken to minimize disturbance to the water column and to any particulate attached to the sides or at the bottom of the well.

Measure and record the depth of any DNAPL's or LNAPL's with an interface probe. Care should be given to minimize disturbance of any sediment which has accumulated at the bottom of the well.

IV.SAMPLING PROCEDURE

Pumps specified in Section II of this SOP will be used to purge and sample monitoring wells which have a 2.0 inch I.D. or greater well casing.

1. Pump, safety cable, tubing and electrical lines will be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well. The pump intake must be kept at least two feet above the bottom of the well to prevent mobilization of any sediment or NAPL present in the bottom of the well.

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2.Measure the water level again with the pump in well before starting the pump. Start pumping the well at 200 to 500 milliliters per minute. Ideally, the pump rate should cause little or no water level drawdown in the well (less than 0.3 ft. and the water level should stabilize). The water level should be monitored every three to five minutes (or as appropriate) during pumping. Care should be taken not to cause pump suction to be broken, or entrainment of air in the sample. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the recharge rate of the well is very low purging should be interrupted so as not to cause the drawdown within the well to advance below the pump. However, a steady flow rate should be maintained to the extent practicable. Sampling should commence as soon as the volume in the well has recovered sufficiently to permit collection of samples. In some very low-yielding formations it may not be possible to sample with minimal drawdown even using low pumping rates. In the past, these wells have been pumped to dryness and sampled as soon as they recovered sufficiently. However, this approach has several problems including the potential for significant loss of volatiles due to cascading through the dewatered sand pack. Recent recommendations from the Dallas Ground-water Sampling Workshop suggest that other methods such as lysimeters may be more appropriate for sampling low permeability formations.

3.During purging of the well, monitor the field indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every three to five minutes (or as appropriate). The well is considered stabilized and ready for sample collection once all the field indicator parameter values remain within 10% for three consecutive readings. If the parameters have stabilized, but the turbidity is not in the range of the 5 NTU goal the pump flow rate should be decreased to no more than 100 ml/min. Measurement of the indicator parameters should continue every three to five minutes. Measurements for DO and Eh must be obtained using a flow through cell in manner in which the sample is not exposed to air prior to the measurement. Other parameters may be taken in a clean container, such as a glass beaker.

4.VOCs samples will be collected first and directly into prepreserved sample containers. All sample containers should be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

Samples requiring Ph adjustment will have their Ph checked to assure that the proper Ph has been obtained. For VOC samples, this will require that a test sample be collected to determine the amount of preservative that needs to be added to the sample containers prior to sampling.

5.As discussed in Section XI of the QAM, collection of filtered samples is not recommended. The results of filtered samples are useful only for the evaluation of filtering techniques as a

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treatment component. If filtered metal samples are to be collected, the use of an in-line filter is preferred. A high pressure, in-line 0.45 um particulate filter will be pre-rinsed with approximately 400 ml of deionized water and attached to the discharge end of the pump's tubing. After the sample is filtered, it must be preserved immediately.

6.As each sample is collected, the sample will be labeled. All samples requiring cooling will be placed into an ice cooler maintained at 4oC for delivery to the laboratory.

After collection of the samples, the pump's tubing shall be properly discarded or dedicated to the well for re-sampling (by hanging the tubing inside the well), decontaminated or properly discarded.

7.Measure and record well depth.

8.Secure the well.

V.DECONTAMINATION

Sampling equipment will be decontaminated prior to use and following sampling of each well. Pumps will not be removed between purging and sampling operations. The pump (including support cable and electrical wires which are in contact with the sample) will be decontaminated by one of the procedures listed below.

Procedure 1

Steam clean the outside of the submersible pump.

Pump hot water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump five gallons of non-phosphate detergent solution through the inside of the pump.

Pump tap water through the inside of the pump to remove all of the detergent solution.

Pump distilled/deionized water through the pump.

Procedure 2

The decontaminating solutions can be either be pumped from buckets through the pump or the pump can be disassembled and

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flushed with the decontaminating solutions. It is recommended that detergent and isopropyl alcohol used in the decontamination process be used sparingly and water flushing steps be extended to ensure that any sediment trapped in the pump is flushed out. The outside of the pump and the electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution (five gallons).

Flush with tap water to remove all of the detergent solution.

Flush with distilled/deionized water.

Flush with isopropyl alcohol.

Flush with distilled/deionized water.

VI.FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the ground water samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each batch of samples (a batch may not exceed 20 samples). Trip blanks are required for the VOC samples at frequency of one per sample cooler.

Field duplicate.

Equipment blank (not necessary if equipment is dedicated to the well).

Trip blank (VOCs)

Groundwater samples should be collected from the areas of the lowest level of contamination at the beginning of daily sampling to areas of the highest at the conclusion of daily sampling. The equipment blanks collected from the pump should be collected after sampling from the most contaminated wells.

VII.FIELD LOGBOOK

A field log must be kept each time ground water monitoring activities are conducted in the field. The field logbook should document the following:

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Well identification.

Well depth, and measurement technique.

Static water level depth, date, time, and measurement technique.

Presence and thickness of immiscible liquid layers and detection method.

Collection method for immiscible liquid layers.

Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.

Well sampling sequence and time of sample collection.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analysis.

Field observations of sampling event.

Name of sample collector(s).

Weather conditions.

QA/QC data for field instruments.

APPENDIX B
SITE-SPECIFIC SAFETY AND HEALTH PLAN

SENECA ARMY DEPOT ACTIVITY
GENERIC INSTALLATION RI/FS WORK PLAN
ROMULUS, NEW YORK

PREPARED BY: ____________________
Health and Safety Officer

APPROVED BY: ____________________
Project Manager

JUNE, 1995

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this Site-Specific Safety and Health Plan (SSHP) is to establish personnel protection standards and mandatory safety practices and procedures for field investigation efforts. This plan assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may arise during RI/FS field investigations at solid waste management units (SWMUs) at Seneca Army Depot, Romulus, New York.

This plan may be modified by Addenda to accommodate changes in specific work plans and task specific and location specific hazards for the various SWMU investigation activities. Addenda to this plan will incorporate data obtained during subsequent sampling.

The provisions of the plan are mandatory for all of the AE's personnel engaged in on-site hazardous waste operations. Subcontractors working for the AE must conform to this Health and Safety Plan unless they prepare and administer a plan with equivalent requirements. All AE and AE contract personnel who engage in project activities must be familiar with this plan and comply with its requirements; these personnel must sign-off on the Plan Acceptance Form (to be attached), which will be submitted to the AE Project Manager for retention in the project file. All personnel performing work under this plan must be trained and have a current medical examination in accordance with 29 CFR 1910.120. This SSHP follows the requirements of ER385-1-92, Safety and Health Elements for HTRW Documents (Attachment B-7).

1.2 PERSONNEL

All AE site personnel and AE subcontractors performing duties or working in areas where there is the potential for exposure to hazardous material will meet the training requirements of OSHA 29 CFR 1910.120 before working on-site. Site personnel and their duties are outlined below:

1. AE's Site Manager, responsible for all AE personnel and AE's subcontractors on-site and designates duties to the on-site personnel. The name of the Site Manager or, if the Site Manager is absent, the name of the acting Site Manager, shall be posted in the command post.

2. The Site Safety Officer is responsible for carrying out the provisions of this HASP with regard to site work, and will ensure that all personnel entering the site understand and adhere to the provisions of this plan and that personnel meet the training and medical monitoring requirements of 29 CFR 1910.120. Any changes in the provisions of this HASP shall be made in writing by the Site Safety Officer and shall be approved by the Project Safety Officer or Corporate Health and Safety Officer. Any personal protective equipment upgrades or downgrades shall be documented in writing by the Site Safety Officer. The Site Safety Officer shall have the authority to stop an operation or site work if, in the opinion of the Site Safety Officer, the site conditions or the manner in which the work is being conducted, presents a hazard to site personnel, surrounding populations, or the environment. The name of the Site Safety Officer or, if the Site Safety Officer is absent, the name of the Acting Site Safety Officer, shall be posted in the Command Post.

3. UXO personnel will be responsible for locating and identifying unexploded ordnance on the site and for clearing access pathways to sampling and work locations. UXO personnel shall not move or dispose of any UXO found. Disposal and demolition of UXOs will be performed by SEDA EOD personnel.

4. SEDA EOD personnel will be responsible for disposal and demolition of any UXOs found at the site.

5. The Site Safety Monitors are responsible for all air monitoring. Air monitoring requirements for the Seneca Site are set forth in Section 6.0 of SSHP.

6. Field personnel will be involved in sampling, inspections, field monitoring, and decontamination, as specified in this SSHP the Work Plan, and the Field Sampling and Analysis Plan (Appendix A to the Work Plan). These activities will be carried out in accordance with the QA/QC protocols in the Chemical Data Acquisition Plan (CDAP). Site personnel will only perform tasks for which they have received appropriate training.

Site visitors who are not affiliated with the AE, the AE's subcontractors, USEPA, NYSDEC, or Seneca Army Depot will not be allowed into active work areas without making arrangements with Seneca and the AE well in advance of the planned visit. Site visitors must present evidence of appropriate training and participation in a medical surveillance program in accordance with 29 CFR 1910.120, and evidence of ability to use a respirator in accordance with 29 CFR 1910.134.

Seneca Army Depot, USEPA and NYSDEC personnel will be permitted into active work areas after presenting a letter addressed to the AE's Site Safety Officer certifying they have passed a physical examination and are certified to wear the appropriate respiratory protective equipment. However, if the representatives from these agencies are non-UXO qualified personnel, they will not be permitted to be inside the exclusion zone during UXO operations. Also, UXO operations will cease if non-UXO qualified personnel enter any area in which UXO operations are in progress.

All visitors will follow the advice and instructions of the AE's Site Manager and Site Safety Officer. Failure to follow these instructions may endanger the health and safety of visitors and other on-site personnel.

2.0 SITE CHARACTERIZATION

2.1 SITE HISTORY AND DESCRIPTION

The Seneca Army Depot, a 10,587 acre facility in Seneca County, Romulus, New York, has been owned by the United States Government and operated by the Department of the Army since 1941 (Figure B-1). Since its inception in 1941, SEDA's primary mission has been the receipt, storage, maintenance, and supply of military items. This function includes disposal of military ammunition and explosives by burning and detonation.

2.2 PLANNED SITE ACTIVITIES

The field activities at the AOCs include the following tasks: UXO detection and clearance geophysical surveying; sampling-related geophysical surveys (e.g., EM-31, GPR); test pit excavations; soil sampling; monitoring well installation, development, and sampling; surface water sampling and sediment sampling. The UXO detection and clearance are ordnance "avoidance activities" that will initially be performed at sites where UXOs are a concern. The subsequent geophysical surveys (e.g.,GPR, EM-31) will be performed to investigate subsurface anomalies that may include buried drums or other material (including UXOs). These anomalies may be intrusively investigated with consideration of the procedures described in Section 9.0 of this SSHP.

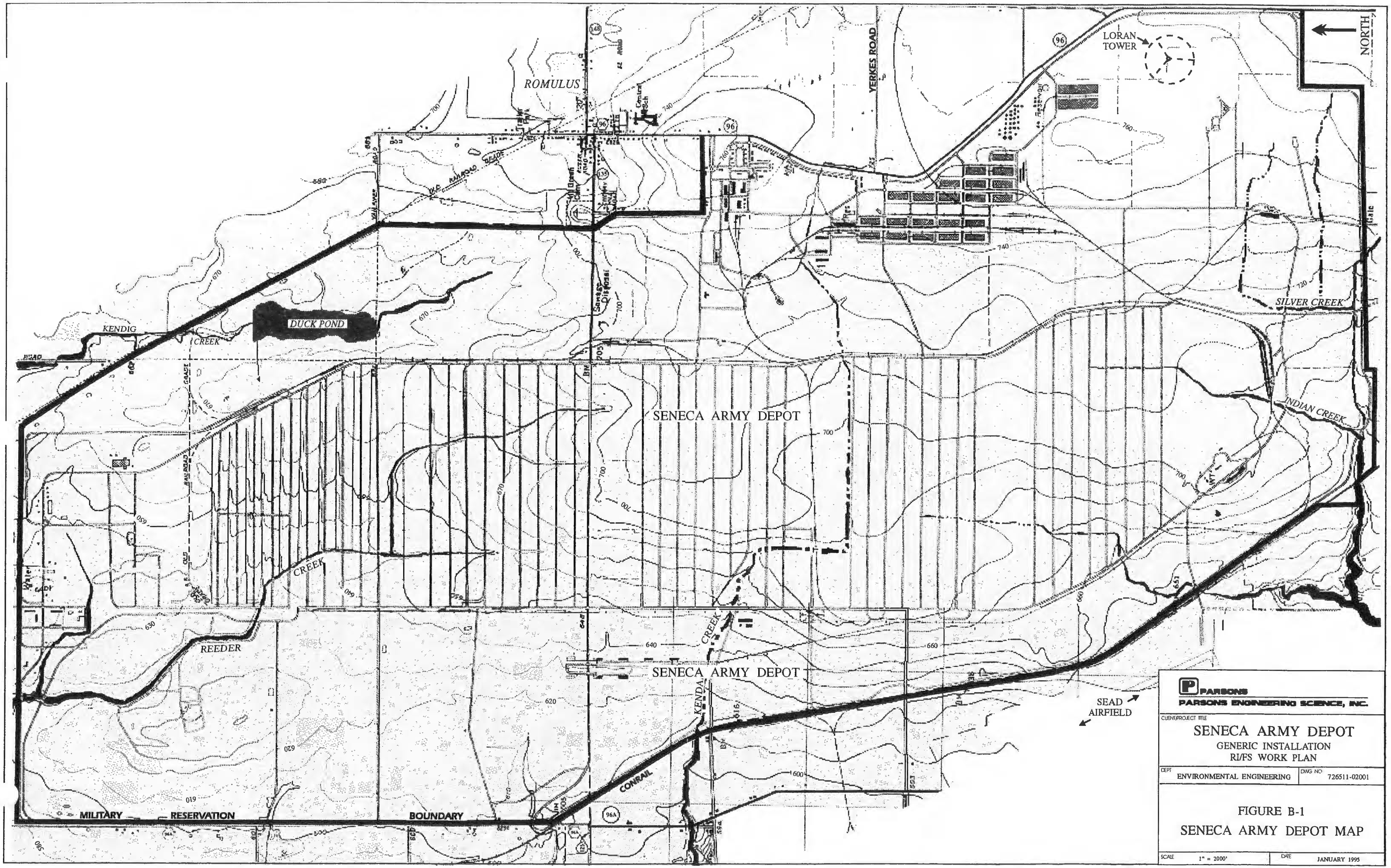
2.3 HAZARD EVALUATION

The chemical and physical hazards which may be encountered at the AOCs are described below.

2.3.1 Exposure Potential

The primary sources of exposure at the subject sites (SWMUs) will be the surface and subsurface soils and groundwater. These media may be contaminated with heavy metals, explosive compounds or low level radioactive waste. The exposure potential for each of the planned site activities is described below.

Geophysical Monitoring and UXO Detection and Removal - The geophysical monitoring is non-intrusive and generally has a low exposure potential. There is some potential for exposure to metal and explosive contaminated surface soils. Several types of geophysical techniques will be used to detect the presence of UXOs and buried trenches which may contain UXOs. Once detected, these areas will be flagged and the high anomalies will be removed by qualified UXO



PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT ENVIRONMENTAL ENGINEERING
DWG NO 726511-02001

FIGURE B-1
SENECA ARMY DEPOT MAP

SCALE 1" = 2000'
DATE JANUARY 1995

trained demolition experts. There are high risks associated with these operation due to premature detonation. UXO handling procedures are described in Section 9.

Soil Sampling - The primary route of exposure during the soil sampling will be through contact with metal and explosive contaminated soil. There is also potential inhalation exposure of radioactive alpha particulates during drilling. There is a potential for explosion due to unexploded ordnance. This risk will be minimized by a prior clearing of boring locations and by implementing a remote drilling program. The overall exposure potential for soil sampling is moderate due to remote drilling procedures. There is a high potential for direct contact with contaminated soils.

Monitoring Well Installation, Development, and Sampling - The exposure potential for the monitoring well development and sampling is similar to that of soil sampling. There will be additional monitoring wells installed so remote drilling and UXO hazards are possible. There is potential contact exposure to contaminated groundwater, particularly during well development.

Test Pit Excavations - Test pits will be dug in some areas to assess potential contaminant sources and to collect soil samples. There is a medium potential for UXO detonation during the excavation. The area to be excavated will be cleared by UXO personnel prior to and during the excavation and prior to the collection of the samples. During the sampling there is a moderate potential for contact exposure to metals and explosive compound contaminated soils.

Surface Water Sampling - The exposure potential for the surface water sampling to be conducted at the SWMUs is low. The waters to be sampled are not expected to contain high levels of contaminants. Surface water at some sites include drainage swales and pooled water that may contain higher levels. There is some potential for contact exposure to dissolved metals and explosives in surface water.

Sediment Sampling - The primary route of potential exposure during sediment sampling is through contact with contaminated sediments and surface waters. There is some potential for exposure to volatile contaminants which may be contained in the sediments. The exposure potential for fugitive dusts is low, since the handled sediments will be wet and will not produce dusts.

2.3.2 Chemical Hazards

A large number of compounds have been detected in previous soil and groundwater investigations at the Seneca site. Most of these compounds are heavy metals and explosives.

The following is a summary of the toxic effects of these compounds. Exposure limits and physical properties are given in Table B-1 and in the Chemical Hazard Evaluation Sheets contained in Attachment B-1.

Arsenic - Arsenic becomes a skin irritant with prolonged exposure: moist areas of the skin; respiratory mucosa; angles of eyes, ears, nose, and mouth; and the wrists being common sites of irritation. Acute exposure symptoms include abdominal pain, vomiting, and watery diarrhea followed by shock due to fluid loss. Acute inhalation exposure can cause chest pain, coughing, giddiness, and general weakness which precede gastrointestinal symptoms. Symptoms of chronic inhalation exposure proceed in three phases. Initial symptoms are weakness, loss of appetite, occasional nausea and vomiting, and some diarrhea. The second phase consists primarily of irritant effects of the eyes, nose, and respiratory passages, with perforation of the nasal septum common, and allergic reactions of the skin. The third phase consists of peripheral neural effects, usually numbness. Arsenic has been causally associated with skin cancer and implicated in increases in the incidence of lung cancer.

Barium - Barium and its compounds are highly toxic. Acute symptoms are excessive salivation; vomiting; colic; diarrhea; convulsive tremors; slow, hard pulse; and elevated blood pressure. Bleeding in the stomach, intestines, and kidneys may occur. Chronic exposure results in enlargement of the liver and spleen, and increases in white blood cell counts. Barium has been found to produce lung cancer in rats.

Benzene - Benzene will cause local irritation to the skin, eyes and respiratory tract and may cause redness, dryness and scaling of the skin due to defatting. Acute systemic effects include headache, dizziness, convulsions, coma and death may occur due to effects on the heart. Chronic exposures effects the blood-forming tissues primarily, resulting initially in increases in blood cell counts followed by aplastic anemia with an overactive or under active bone marrow. Epidemiological studies have linked benzene with leukemias and it is classified as a suspected human carcinogen.

TABLE B-1
PERMISSIBLE EXPOSURE LIMITS FOR SELECTED COMPOUNDS AT SEDA

		Permissible Exposure Limits(1) (mg/m3)	Short-Term Exposure Limits (mg/m3)(2)	Ceiling Limits (mg/m3)(3)	Other Exposure Limits (mg/m3)(4)	Carcinogenic Rating(5)
Metals	Arsenic	0.01	–	–	0.002(6)	A
	Barium	0.5	–	–	–	–
	Cadmium dust	0.2	–	0.6	–	B1
	Chromium (VI)	0.05	–	0.1	0.001(7)	A
	Copper, Dust and Mist	1.0	–	–	–	D
	Mercury	0.01	0.03	0.1	–	D
	Nickel	0.1	–	–	0.015(7)	A
	Selenium	0.2	–	–	–	(8)
	Zinc Total Dust	10.0	–	–	–	–
Volatiles		(PPM)	(PPM)			
	Benzene	1.0	5	–	0.33(0.1)(7)	A
	Toluene	100	150	–	–	D
	Xylene	100	150	–	–	D
	Petroleum Products					
Semi-volatiles	PCB's	0.5 (skin)	–	–	0.001(7)	B2
	DDT	1.0 (skin)	–	–	0.5(7)	B2
	Nicotine	0.5	–	–	–	–
Explosives						
	HMX	–	–	–	1.5(9)	–
	RDX	–	–	–	1.5(9)	C
	2,4,6-TNT	0.5 (skin)	–	–	–	(8)
	2,6-DNT	1.5 (skin)	–	–	–	B2
	2,4-DNT	1.5 (skin)	–	–	–	B2
	Tetryl	1.5 (skin)	–	–	0.5 (skin)(10)	–
Ionizing Radiation	Beta/Gamma	–	–	–	2 mRem/hr	(6)
	Alpha	–	–	–	2 mRem/hr	(6)

Notes:

(1) OSHA 8-hour time-weighted average Permissible Exposure Limits (PEL). For metals, PEL shown is lowest of compounds likely to be encountered on-site.
(2) OSHA Short-Term Exposure Limit. 15 minute time-weighted average concentration
(3) OSHA Ceiling Limit. Concentration not to be exceeded during any part of the work day.
(4) Occupational Exposure Limits from other sources.
(5) EPA weight of evidence ratings for each compounds.
  A Confirmed human carcinogen
  B1 Probable confirmed human carcinogen. Limited human evidence.
  B2 Probable confirmed human carcinogen. Sufficient animal evidence.
  C Possible Human Carcinogen, Limited Animal Evidence
  D Not classifiable
  – No data or carcinogenic rating not determined.
(6) NIOSH REL Ceiling
(7) NIOSH REL TWA
(8) Substance identified as suspected or confirmed human carcinogen by agency other than USEPA.
(9) Sitting, 1991.
(10) PEL derived by analogy to 2,4,6-TNT and dinitrobenzene

Cadmium - Cadmium compounds induce vomiting at low oral doses and systemic oral poisoning is rare. Acute exposure can occur by inhalation, producing irritation in the respiratory tract followed hours later by coughing, chest pain, sweating and chills and, later, general weakness, severe respiratory irritation, and fluid build up in the lungs. These symptoms can lead to emphysema or death. Chronic exposure can lead to emphysema, kidney damage, and possible heart and blood pressure effects. Animal studies have shown cadmium to produce cancer, birth defects, testicular atrophy, and liver and nerve damage. Some studies in man have shown an association of cadmium exposure with cancers of the prostate and kidney.

Chromium - Chromium compounds can act as allergens, resulting in local irritation of the skin and respiratory tract. Systemic effects are generally a result of the irritating properties of chromium compounds on the eyes, nose, and respiratory tracts. Chromium compounds has been shown to be carcinogenic in rats and has been associated with increases in lung cancer in humans. The irritant and carcinogenic effects differ widely for various compounds of chromium.

Copper - Copper is a soft, heavy metal which occurs naturally as a variety of salts, as well as in the pure metallic form. Copper is an essential trace element in humans and animals. Copper salts are irritating to the skin and cause itching, erythema, and dermatitis. They may cause conjunctivitis, ulceration and clouding of the cornea. Metallic copper can cause keratinization of the hands and soles of the feet. Inhalation of copper fumes can cause congestion of the nasal mucous membranes and perforation of the septum. Ingestion causes irritation of the gastrointestinal tract, producing nausea, vomiting, gastritis, and diarrhea. If vomiting fails to occur, gradual absorption from the bowel may cause systemic poisoning. The systemic effects of copper include capillary damage, kidney and liver damage, and excitation followed by depression. Jaundice and hemolytic anemia can also occur following acute poisoning.

Mercury - Mercury is a local irritant of skin and mucous membranes any may be a skin sensitizer in some people. Acute poisoning symptoms are generally irritant: acute inhalation exposure results in inflammation of the lung and bronchioles. Chronic exposure symptoms are non-specific: weight loss, appetite loss, memory loss, insomnia, indigestion, weakness, metallic taste in mouth, tremors in eyelids, fingers, lips, or tongue, and loosening of teeth. Symptoms may vary among individuals. Long-term or high dose exposures can produce irritability, delirium, anxiety, or manic depressive psychosis.

Nickel - Dermal exposure to nickel and nickel compounds results in contact dermatitis and chronic eczema. Nickel and its compounds are also irritants to the conjunctiva of the eye and mucous membranes of the upper respiratory tract. Chronic exposure to elemental nickel and its salts may result in lung and nasal passage cancer. Effects are also seen on the heart, muscles, brain, and kidney.

Selenium - Selenium and various selenium compounds can effect the body if inhaled, if they come into contact with the eyes or skin, or if swallowed. Selenium compounds if inhaled in large quantities can cause severe breathing difficulties. Skin contact can cause burns or rashes. Long-term exposure can cause paleness, stomach disorders, coated tongue, and nervousness. Fluid in the abdominal cavity, damage to the liver and spleen have been reported in animals.

Petroleum Products -

Fuel Oils -- Fuel oils are mixtures of straight-chain, branched, double-bonded, cyclic, and aromatic hydrocarbons containing 10 to 16 carbons. Fuel oils come in six grades, numbered 1 to 6, with the lower numbered fuel oils being composed of lighter mixtures of hydrocarbons. The toxicity of these fuel oils varies widely, though all produce skin irritation with prolonged contact. Inhalation exposure is generally not a problem due to the low volatility of these mixtures, though cases of inhalation intoxication from Fuel oil No. 1 (jet fuel) have been reported to cause dizziness, headache, nausea, palpitations, and pressure in the chest. Lighter fuel oils are rapidly absorbed from the stomach and cause gastrointestinal irritation,vomiting, diarrhea, and may cause drowsiness and central nervous depression. Ingestion may lead to aspiration into the lungs which may cause pulmonary edema, hemorrhage, irritation, and cardiac and kidney effects. Pulmonary exposure may also occur through exposure to mists. Chronic exposure may lead to kidney damage. Fuel oils are not classified as carcinogens and teratogenic data are negative.

Gasoline - Gasoline is a mixture of five-carbon to eleven-carbon straight-chain, branched, double-bonded, cyclic,and aromatic hydrocarbons. Acute inhalation exposure effects are primarily on the central nervous system, including staggered gait, slurred speech and confusion. High levels may cause coma or death from respiratory failure. Contact exposure results in irritation, defatting, and some individuals may develop an allergic reaction to gasoline. Chronic exposures may result is kidney damage and in lead toxicity with leaded gasolines. Gasoline is not classified as a carcinogen. Teratogenic and mutagenic data are negative.

Polychlorinated Biphenyls (PCBs) - Polychlorinated biphenyls primarily effect the skin and the liver. Skin areas exposed to PCBs develop chloracne, which consists of small pimples and dark pigmentation. Later, comedones and pustules develop. Some PCBs are suspected carcinogens, producing liver tumors. Acute and chronic exposures can result in edema, jaundice, vomiting, anorexia, nausea, abdominal pains, and fatigue.

Toluene - Toluene will cause local irritation to the skin, eyes, and respiratory tract. and may cause defatting, drying and scaling of the skin. Acute systemic effects include headache, dizziness,nausea, loss of appetite, lassitude and eventual coma if exposure is prolonged. Toluene does not display the effects on the blood forming tissues seen with benzene and is not classified as a carcinogen in humans or animals. Chronic exposures can result in effects on the liver, kidneys and central nervous system.

Xylenes -- Acute effects are of xylene exposure include skin and mucous membrane irritation, central nervous system effects, and respiratory irritation leading to pulmonary congestion, edema, and hemorrhage. Inhalation exposure can also lead to liver and cardiac damage. Chronic exposure can result in effects on the liver, kidneys and central nervous system and may have an effect on the blood forming tissues, No carcinogenic effects have been documented; possible teratogenic effects have been observed.

HMX - The chemical name of HMX is octahydro-1,3,5,7 -tetranitro -1,3,5,7 -tetrayocine. Considered a poison by ingestion or intravenous injection, HMX remains an explosive of concern to many industries who handle this compound. At high temperatures, HMX decomposes violently and emits toxic fumes of NOX.

RDX - The chemical name of RDX is hexahydro-1,3,5 -trimethyl -1,3,5-triazine. The solubility of RDX in water at 18° was found to be 44.7 ppm and hydrolysis is slow. RDX is a corrosive irritant to the skin, eyes and mucous membranes. Experimental reproductive abnormalities and epileptiform convulsions from exposure have been reported. It is one of the most powerful high explosives in use today. RDX has more shattering power than TNT and is often mixed with TNT as a bursting charge for aerial bombs, mines and torpedoes. When heated to decomposition it emits toxic fumes of NO_x.

2,4,6-TNT - The chemical name of 2,4,6-TNT is 2,4,6-trinitrotoluene. It is not been known to undergo hydrolysis in the environment. Symptoms of exposure to TNT are sneezing, coughing, sore throat, and muscle pain. TNT effects the blood, liver kidneys, skin, central nervous system, and cardiovascular system. Human systemic effects when ingested include: hallucinations, cyanosis, and gastrointestinal changes. Experimental reproductive abnormalities and mutagenic data have been reported. This chemical has been classified as a skin irritant and has been implicated in aplastic anemia. TNT can cause headaches, weakness, anemia, liver injury and may be absorbed through the skin. TNT is flammable or explosive when exposed to heat or flame. Moderate explosion hazard; will detonate under strong shock. It is a comparatively insensitive explosive, however, sudden heating of any quantity will cause detonation.

2,6-DNT - The chemical name of 2,6-DNT is 2,6-dinitrotoluene. It is not expected to hydrolyze under normal environmental conditions. NIOSH recommends to reduce exposure to DNT to the lowest levels possible. Experimental testing of 2,6-DNT has shown it to be more active as a liver carcinogen than 2,4-DNT isomer. The major target organs are the blood, liver, and central nervous system. Symptoms of exposure include anoxia, cyanos, anemia, and jaundice.

2,4-DNT - The chemical name of 2,4-DNT is 2,4-dinitrotoluene. It is not expected to hydrolyze under normal environmental conditions. 2,4-DNT is poisonous if swallowed or injected subcutaneously. It has been shown to be carcinogenic, teratogenic, and mutagenic in experimental tests. 2,4-DNT can cause anemia, methemoglobinemia, cyanosis, and liver damage. The chemical will combust when exposed to heat or flame; can react with oxidizing materials. There have been cases of explosion during manufacture and storage and mixture with nitric acid is a high explosive. Other mixtures such as alkalies can cause a significant increase in pressure. When heated to decomposition it emits toxic fumes of NO_x.

2.3.3 Physical Hazards

Due to the operations at some of the SWMUs, there is very likely to be unexploded ordnance or explosives dispersed in the SWMUs. Large portions of the SWMUs have not been surveyed for UXOs and no catalog of locations of UXOs is available. The presence of UXOs on the site presents a **EXTREMELY HAZARDOUS CONDITION.**

UXB personnel trained in the discovery and handling of UXOs shall perform all UXO clearance at the SWMUs to be investigated. Cleared pathways and work areas shall be outlined with red "DANGER" tape. Employees shall not cross the tape into uncleared areas.

When working in cleared areas, the work crews and equipment shall be positioned such that the chance for accidental movement into uncleared areas is minimized. Equipment shall be placed so as not to impede emergency escape and evacuation along the cleared pathways.

Cleared roads and pathways shall be marked. **ON-SITE WORKERS SHALL NOT STRAY FROM THE CLEARED PATHWAYS AND ROAD!** UXOs found on the site may have been subjected to stresses which render them very unstable and the UXOs may detonate with even very slight disturbance. **ON-SITE WORKERS SHALL NOT TOUCH, KICK, OR OTHERWISE DISTURB ANY MATERIALS ON-SITE WHICH MAY BE UXOs**.

Other than the presence of UXOs, the principle physical hazards at the Seneca site involve working around heavy equipment, site terrain, and site debris.

Terrain hazards include marshy areas, areas of rough terrain, and areas of protruding debris. In areas where access is difficult or hazardous, access paths shall be cleared and maintained, and movement through these areas shall be along the access paths.

Activities on-site will include:

1. Site visits;
2. Geophysical surveys;
3. Unexploded ordnance detection and clearance;
4. Soil boring and sampling;
5. Surface water and sediment sampling;
6. Test pit excavation; and
7. Monitoring well installation, development and sampling.

Hazards associated with these activities are varied and include vehicle/pedestrian collisions; fire; contact or crushing injuries resulting from materials handling and equipment operations; unexploded ordnance contact; abrasions, contusions, lacerations, etc. resulting from use of power tools; and elevated noise levels. The potential for such hazards necessitates that all on-site personnel wear appropriate protective clothing, including coveralls, gloves, eye and face protection, safety boots, ear plugs and hard hats.

2.3.4 Motor Vehicles and Motorized Equipment

All motor vehicles will be maintained in a safe operating condition and in accordance with local and state safety requirements. All vehicles and moving equipment will be operated on-site and en route to and from sites in accordance with state and local motor vehicle regulations for speed, lights and warnings, passenger carrying, and operation. If any equipment is left unattended at night adjacent to a highway in use, it will be provided with suitable barricading, lighting, reflectors, or other suitable visual warnings to identify its location.

Any mobile equipment, including drilling rigs, earth-moving machinery (i.e. test pits), or other similar types of equipment, will be operated in strict compliance with the manufacturer's instructions, specifications, and limitations, as well as any applicable regulations. The operator is responsible for inspecting the equipment daily to assure that it is functioning properly and safely. This inspection will include all parts subject to faster than normal wear and all lubrication points.

Hand and audible (horn) signals to equipment operators will be the commonly accepted industry standard signals for the type of equipment being used. All signals will be reviewed by the operator and signaller before work begins. Only one person will signal the equipment operator at any give time.

When equipment with moving booms, arms, or masts is operated near overhead hazards, the operator, with assistance from the designated signaling person, will assure that the moving parts of the equipment maintain safe vertical and horizontal clearances to the hazards. Moving booms, arms, or masts will be lowered and secured prior to being moved from one location to another, even on the same site, Equipment will be kept at least 10 feet (ft) away from energized electrical lines rated up to 50 kilo volts (kV) and 16 ft away from lines rated over 50 and up to 750 kV.

Drill rigs and other equipment not specifically designed to move with the boom, mast or arm in an elevated position will be returned to traveling position and condition before being moved. Movement through the depot facility will be along established roads. All site equipment will be inspected before each use to ensure that it is in proper working order. Any equipment found to be unsafe shall be repaired or taken out of service.

2.3.5 Heat Stress

Site work at the SWMUs may be conducted during the summer and early fall months and heat stress is a serious concern. Heat stress monitoring for employees wearing protective clothing will be conducted whenever the temperature is above 60°F. For employees not wearing protective clothing, heat stress monitoring will be conducted when the temperature is above 80°F. Pulse rate and oral temperature measured at the end of each work period will be used to monitor heat stress in on-site employees. Heat stress monitoring procedures are described in Attachment B-2 of this HASP, Standard Operating Procedures for Emergencies Due to Heat and Heat Stress Monitoring.

2.3.6 Cold Stress

Site work at the SWMUs may be conducted during cold weather. Cold stress monitoring for employees working outdoors will be conducted. Two factors influence the development of a cold injury: ambient temperature and wind velocity. Cold stress monitoring will be conducted when temperatures are below 4°C (40°F). Cold stress monitoring procedures are described in Attachment B-2 of this SSHP, Standard Operating Procedures for Emergencies Due to Cold and Cold Stress Monitoring.

2.3.7 Biological Hazards

Biological hazards can result from encounters with mammals, insects, snakes, spiders, ticks, plants, parasites, and pathogens. Mammals can bite or scratch when cornered or surprised. The bite or scratch can result in local infection or infection with systemic pathogens or parasites. Insect and spider bites can result in severe allergic reactions in sensitive individuals. Exposure to poison ivy, poison oak or poison sumac results in skin rash. Ticks are a vector for a number of serious diseases. Dead animals, organic wastes, and contaminated soil and water can harbor parasites and pathogens.

2.3.7.1 Poison Ivy

Poison ivy is common throughout SEDA. Know how to recognize the poison ivy plant and avoid walking through areas of heavy growth. If you must walk through areas of poison ivy, keep extremities covered and avoid contact of bare skin with poison ivy leaves and stems. When digging in areas of poison ivy growth, avoid contact with the roots; these too can produce a reaction.

Wash skin areas exposed to the poison ivy as soon as possible. Oils from the poison ivy plant can adhere to clothes. Wash clothes exposed to poison ivy before wearing again.

2.3.7.2 Ticks and Lyme Disease

Ticks may be common during the spring and summer at SEDA. Two types of ticks may be encountered.

The dog tick is the larger, more common tick. After biting, the dog tick will remain attached to the victim until engorged with blood. Usually, dog ticks can be found by careful inspection of the body at the end of the work day. If the tick is already imbedded in the skin, remove it with tweezers or fingers by grasping the tick as close to the skin as possible and pulling downward. Check to make sure all tick parts have been removed from the skin. Wash the area of the bite with soap and water. Seek medical attention if any tick parts remain in the skin. Dog ticks may transmit rocky mountain spotted fever and other diseases.

The deer tick is much smaller, ranging from poppy seed to grape seed size, and does not remain attached to the skin for very long after biting. You may be bitten by a deer tick and never see the tick. Deer ticks can transmit Lyme disease, which can have serious, long-term health effects if left untreated. If you discover a small tick imbedded in the skin, remove it as above. Check the area of the bite periodically. If you develop a rash or develop flu-like symptoms, seek medical attention. Lyme disease is characterized by a bulls-eye type rash; light in the center with an outer red area. Flu-like symptoms may also occur. These signs may occur at different times and the rash may not appear.

If you discover any bites on the skin, wash the affected area and seek medical attention if a rash or flu-like symptoms appear.

Take the following steps to limit the likelihood of getting tick bites:

- Tuck pants legs into socks;
- Wear long sleeves, hat and closed shoes;
- Use tick repellant, such as DEET, on clothes;
- Check body for ticks daily; and
- Shower immediately after work and wash work clothes daily.

2.3.7.3 Snakes

Poison snakes are not common to the area of SEDA, though central New York is within the range of rattlesnakes and copperheads. To minimize the chance of snake bites:

- Do not put hands and feet where you have not looked;
- Avoid stepping into clumps of weeds and brush;
- Step heavily. Snakes can feel footfalls through the ground and will avoid you if they can; and
- Wear heavy leather boots and loose fitting pants.

Caution should be used if any snake is encountered.

2.3.8 Radiation Hazards

Radioactive materials were stored at Seneca Army Depot in the form of pitch blend, a tarry, uranium oxide ore derived from coal. The pitch blend has been removed from the depot, however, the possibility exists that small amounts of this radioactive material were disposed on-site. Monitoring for radioactivity will be conducted at selected SWMUs to further minimize the small chance of exposure.

The hazards associated with radioactive materials result from the particles emitted from the material. Potential chemical toxicity of radioactive elements are usually of secondary importance relative to the potential for health effects from the radioactivity. Three types of radioactive particles are of concern with regard to environmental radioactivity: alpha particles, beta particles, and gamma or x- rays. The hazards associated with each of these types of radiation are discussed below.

Alpha Radiation

Alpha particles are large radioactive particles consisting of two neutrons and two protons. Alpha particles can only travel a few inches in air and can be shielded by a piece of paper or clothing. The outer layers of the skin are also an effective shield to alpha particles and thus, alpha particles do not represent an external radiation hazard. However, if alpha particles are ingested or inhaled they can represent a significant internal radiation hazard. Ingestion or inhalation of alpha emitting radionuclides, such as radium, radon, and thorium have been associated with cancers of the lungs and leukemia.

Beta Radiation

Beta particles are fast moving particles which are equal in mass to electrons. Beta particles are moderately penetrating and can be shield by thin layers of plastic or plexiglass. Beta particles from strong sources have a maximum range in air of about 30 feet. Beta particle from other sources have a range in air of 1 to 20 feet. Beta particles can penetrate the outer layers of skin and are an external radiation hazard to the skin and the eyes, as well as an internal radiation hazard. The dose received from an ingested beta emitting radionuclide is less than the dose that would be received from an equivalent amount of an alpha emitting material. Internal exposure to beta emitters has been associated with cancer in various organs.

Gamma radiation

Gamma radiation or x-rays are highly penetrating photons and have ranges measured in kilometers. Gamma radiation is considered primarily an external exposure hazard because of the long range and highly penetrating nature of the radiation. Dense materials, such as lead and concrete are effective as shielding for gamma radiation. Exposure to gamma rays has been associated with increased incidence of cancers in various organs.

3.0 HEALTH AND SAFETY TRAINING

All site workers involved in hazardous work have met the training requirements set forth in 29 CFR 1910.120(e). All employees engaged in hazardous waste site work have received 40 hours of training in hazardous waste site operations and safety procedures. Written certification of this training will be provided as an attachment to the SSHP. This training has been followed by 3 days of supervised on-site experience. Employees performing hazardous waste work prior to March 1987, who received initial training that was standard at that time, are assumed to satisfy 29 CFR 1910.120 as a result of training and experience.

Supervisors and site managers have received an additional 8 hours of specialized training on the safe management of site operations. All employees have received annual updated training. Additional training has been provided to those employees designated to respond to site emergencies. Additional training will be provided to those employees who may be exposed to unique or special hazards at the site.

On-site safety training will consist of a detailed safety meeting and training session prior to the beginning of any field work. This meeting will cover all site activities and will also review the site emergency response plan. All site workers and managers are required to attend this meeting. Other topics to be discussed will include donning and doffing of personnel protective equipment as well as a brief toxicological review of site-specific known and suspected contaminants.

Daily safety meetings will also be conducted prior to each day's activities. These meetings will cover the safety measures to be employed during that day's activities and the emergency response and evacuation procedures for each work site and work crew.

On-site training will be documented using the form contained in Attachment B-3, On-Site Documentation Forms.

3.1 INITIAL SITE TRAINING

Initial site training shall consist of a review of this site specific SSHP and shall cover the following topics:

- Site Personnel and Duties;
- Site Description;
- Site Characterization;
- Chemical and Physical Hazard Evaluation;
- Toxicological Information;
- Heat Stress and Cold Stress;
- Site Layout, Site Control Measures, and Work Zones;
- Personnel Protective Equipment;
- Air Monitoring;
- Safe Work Practices and Engineering Controls;
- Spill Containment Program;
- Decontamination Procedures;
- Emergency Response Plan;
- On-site Emergency Plan;
- Off-site Emergency Plan;
- Evacuation Procedures;
- Safe Distances and Places of Refuge;
- Emergency Decontamination;
- Emergency and Personnel Protective Equipment;
- Emergency Telephone Numbers;
- Directions to Hospital;
- Medical Surveillance Requirements; and
- Health and Safety Training

The UXO subcontractor will provide site specific basic UXO Recognition and Avoidance Training. The following areas will be included:

1. Basic UXO and UXO component recognition training;
2. UXO avoidance and reporting procedures;
3. Specific hazards related to UXOs;
4. UXO emergency procedures; and
5. Emergency medical care related to UXOs.

3.2 SAFETY BRIEFINGS

Safety briefings shall be conducted at least weekly and at the beginning of new operations, changes in site conditions, and changes in operating procedures due to weather, new equipment, or additional site information.

The topics covered in the safety briefings will include, as appropriate:

- Evacuation routes and emergency procedures;
- Use of additional protective equipment;
- Terrain hazards;
- Weather hazards;
- New chemical or toxicological information;
- Periodic review of portions of the site specific SSHP; and
- Review of site incidents, follow-up, and corrective measures.

4.0 MEDICAL SURVEILLANCE

All personnel conducting work in the exclusion and contamination reduction zones will be participating in a medical surveillance program which meets the criteria set forth in OSHA 29 CFR Part 1910.120. This rule requires that employees engaged in hazardous waste site work receive a medical examination at least annually, and they be certified by the examining physician to wear a respirator without restrictions. All subcontractors involved in hazardous work must certify to the AE that all site workers meet the above criteria. Written certification of completion of medical exams for designated project employees will be provided as a separate attachment of this HASP.

Employees of Seneca Army Depot (SEDA) who will be performing activities in active work areas at the fifteen SWMUs will be required to participate in SEDA's medical surveillance program for respirator use.

4.1 PHYSICAL EXAMINATIONS

Employees receive physical exams annually and at the time of termination from the AE's or reassignment from the hazardous work assignments.

Personnel who are significantly exposed to hazardous materials may require special exams. The need for these tests will be determined by the attending physician after consulting with supervisors and health and safety personnel. Provisions will be made to repeat tests when necessary.

Physical exams will be conducted by or under the direct supervision of a licensed physician or a medical consultant who is Board Certified or Board Eligible in Occupation or Aerospace Medicine by the American Board of Preventive Medicine, Inc. with at least three years of experience in occupational medicine.

The examining physician will furnish the AE's Health and Safety Officer with an oral report and indicate any adverse effects. A written report will follow. The physician is instructed, however, to reveal any specific findings or diagnoses unrelated to occupational exposure to the employee or the employee's designee only.

Medical records for the AE's personnel are kept on file by the AE for at least 30 years plus the length of employment. Medical monitoring for the AE's employees is the responsibility of the AE, and the AE will bear the entire cost.

5.0 SITE LAYOUT AND CONTROL MEASURES

5.1 UNEXPLODED ORDNANCE CLEARANCE

Certain SWMUs are known to contain various types of unexploded ordnance (UXO) or explosives. Only trained UXO technicians will be in the area when the initial clearing is in progress. All movement on these sites shall be along cleared roads and pathways and UXO-trained personnel will be on hand at all times to ensure that untrained personnel follow all procedures relative to UXO. Cleared roads and pathways shall be marked. **ON-SITE WORKERS SHALL NOT STRAY FROM THE CLEARED PATHWAYS AND ROAD!** UXOs found on the site may have been subjected to stresses which render them very unstable and the UXOs may detonate with even very slight disturbance. **ON-SITE WORKERS SHALL NOT TOUCH, KICK, OR OTHERWISE DISTURB ANY MATERIALS ON-SITE WHICH MAY BE UXOs.**

The contracted UXO personnel trained in the discovery and handling of UXOs shall perform all UXO clearance for the SWMUs. Cleared pathways and work areas shall be marked with red "DANGER" tape.

When working in cleared areas, the work crews and equipment shall be positioned such that the chance for accidental movement into uncleared areas is minimized. Equipment shall be placed so as not to impede emergency escape and evacuation along the cleared pathways.

Drilling may be performed by remote operations at the SWMUs where unexploded ordnance are suspected.

5.2 WORK ZONES

The support zone and command post for the field work at the SWMU areas will consist of an office trailer and storage areas at one central location for all SWMUs. The location of the support zone will be determined prior to the commencement of the field work.

The main decontamination facilities for equipment and personnel will be located adjacent to the support zone. These facilities will be used for vehicle and heavy equipment decontamination and for personnel decontamination and personal hygiene facilities. Temporary decontamination facilities will be set up at the individual SWMUs as necessary.

Two types of exclusion zones will be established onsite. UXO exclusion zones will include all on-site areas beyond the areas flagged by contracted UXO personnel as cleared of UXOs. Chemical contaminant exclusion zones will be set up for conducting drilling and other fixed location tasks. These exclusion zones will be set up at individual work locations when necessary.

The chemical contaminant exclusion zone will consist of a 50-foot buffer around all sides of the drill rig, marked by barrier tape or fencing. If surface contamination is not suspected in the area and none is created as a result of the operations, the exclusion zone barriers will be removed when the work at each location is completed.

If surface contamination is created or suspected as a result of the operations, an exclusion zone will be defined around the suspected surface contamination until the problem has been mitigated.

Mobile operations, such as sediment sampling and geophysical surveying, will not have defined exclusion zones.

5.3 UTILITIES CLEARANCE

Facility maps will be obtained and consulted prior to commencing any intrusive work. Borehole sites will be positioned accordingly, marked with wooden stakes, and then cleared with SEDA. Drilling is to be done at the marked, cleared locations only.

5.4 SITE CONTROL

SEDA is responsible for overall site security. All AE personnel and subcontractors and all equipment to be used in the field investigation shall be logged in each day at the command post prior to proceeding to other areas of the site. All persons other than work crews wishing to enter the active work areas shall first sign in at the command post.

5.5 SITE COMMUNICATIONS

Routine site communications will be maintained between all work crews and the support zone with two-way radios. On-site emergency communications will be maintained by the use of air horns. Details of the emergency communications are contained in the Emergency Response Plan in Section 11.0 of this SSHP.

6.0 MONITORING

6.1 GENERAL

Standard Operating Procedures for the calibration and operation of all monitoring instruments and copies of the operating manuals for these instruments will be kept in the command post. Instruments will be field calibrated daily (each day the instrument is used). Instruments will be calibration checked a minimum of twice daily, before and after use or as recommended by the manufacturer. Calibration log sheets will be kept for each instrument and will become part of the permanent file. A copy of a calibration log sheet is contained in Attachment B-3, On-Site Documentation Forms.

Instruments will be kept on charge whenever not in use. All monitoring and instrument calibration will be done by persons who have been trained in the use of the equipment.

6.2 ON-SITE MONITORING

6.2.1 Monitoring Overview

All site work which breaks the ground surface will be monitored, at a minimum, with an organic vapor meter (Thermoelectron Organic Vapor Meter (OVM-580B/580S) equipped with a 10.6e V lamp), and a particulate meter (MIE Miniram PDM-3). Radiation monitoring shall be conducted during all intrusive work performed in areas of potential radioactive contamination with a thin window Geiger-Mueller pancake-type detector with a count rate instrument for gamma and beta radiation (e.g., Victoreen Model-190 Survey and count rate meter with Model 489-* Probe for alpha particulate and Model 489-11C Probe for Beta & Gamma detection).

Instrument settings on all direct reading air monitoring instruments will be set on the most sensitive scale unless a reading is detected. The action levels for changes in personnel protective equipment and personnel actions are given in Table B-2, Action Levels for Changes in Respiratory Protection. The action levels specified for the organic vapors may be increased or decreased if air sample analysis (GC or GC/MS) results indicate a greater or lesser degree of hazard for the given organic vapors readings. Any changes in the action levels will be

TABLE B-2
ACTION LEVELS FOR CHANGES IN RESPIRATORY PROTECTION AND SITE EVACUATION

	LEVEL OF PROTECTION/ACTION TAKEN				
INSTRUMENT	LEVEL D	LEVEL C	LEVEL B	PROCEED WITH CAUTION	EVACUATE SITE
HNU (ppm)	BKGD	<5	5-500		>500
OVA (ppm)	BKGD	<5	5-500		>500
OXYGEN (%)	19.5-23	19.5-23	19.5-23		>23
LOWER EXPLOSIVE LIMIT (%)	<10	<10	<10	10<LEL<25	>25
RADIATION METER (mR/HR)	<0.5	<0.5	<0.5	0.5<mR<5	>5
AEROSOL MONITOR (mg/m3)	<1.0	1.0-10	10-50		>50

documented in writing by the Site Safety Officer and approved by the Project Safety Officer or the Corporate Health and Safety Officer.

6.2.2 Volatile Organics Monitoring

Monitoring of volatile organics will be conducted with an organic vapor meter (OVM 580B or 580S) during excavation of test pits, soil borings and in areas where the ground surface is disturbed. Two OVMs will be used, one at the work site and one downwind of the work site.

6.2.3 Dust/Particulates Monitoring

Monitoring of airborne particulates will be conducted with the MIE Miniram (PDM-3) during excavation of test pits, soil boring and in areas where surface contamination and fugitive dust is expected to be high. Measurements will be data logged and a TWA for the work period will be calculated. Two Minirams will be used, one at the worksite, and one downwind of the work area.

6.2.4 Radiation Monitoring

Radiation monitoring will be conducted using a Geiger-Mueller pancake-type detector. Monitoring for gross beta and gamma radiation will be conducted in the work zone and on all samples. Monitoring for gross alpha radiation will be conducted on all sampled obtained from the borings.

Background for gross beta and gamma shall be established at each work zone prior to beginning of work each day. The background reading shall be the level recorded about three feet above the ground surface in the vicinity of the work area. If gross beta and gamma readings in work zone consistently exceed three times background, stop work, back off from the work area, and consult with Project Health & Safety Officer and notify Project Manager.

Background for gross alpha readings shall be established at each work zone prior to beginning of work each day. The background readins shall be the level recorded at the ground surface in the vicinity of the work area, but away from areas of potential contamination. If gross alpha readings from the samples exceed three times background, cover the sample with the split spoon, back off from the work area, and consult Health and Safety Officer and notify the Project Manager.

If work zone readings or soil sample survey readings exceed 3 times background at any time during drilling any person directly involved with the drilling or handling soils or soiled drilling equipment shall perform a self-frisk prior to leaving the work area and prior to eating, smoking or drinking, using the following procedure:

a. Verify frisker is on the x1 scale;
b. Survey hands before picking up probe;
c. Hold probe approximately 1/2 inch from the surfae being surveyed and move the probe slowly over the surface (2 inches per second maximum). Take care not to touch the surface being monitored with the probe;
d. Monitor face (pause at mouth and nose);
e. Monitor neck and shoulders;
f. Monitor arms (pause at each elbow);
g. Monitor chest and abdomen;
h. Monitor back, hips and seat of pants;
i. Monitor legs (pause at each knee); and
j. Monitor shoe tops and bottoms (pause at soles and heels).

The absence of gamma readings above background should not be interpreted as the complete absence of radioacitivity. Radioactive materials emitting low-energy gamma, alpha, or beta radiation may be present, but for a number of reasons may not cause a response on the instrument. Unless airborne, these radioactive materials should present minimal hazard. More thorough surveys should be conducted as site operations continue, to document the absence of radioactive materials.

Radiation survey meters must only be used by persons who have been trained in the proper interpretation of their readings. The meters require frequent calibration and checking to ensure that the readings are accurate.

6.2.5 Draeger Tubes

At work locations where there is the potential for chemicals to exceed Permissible Exposure

Limit (PELs) action levels in the breathing zone, chemical specific indicator tubes (Draeger or equivalent) will be used to monitor the work area. The Draeger Tubes allow the site worker to identify a chemical of concern (COC) which may be present in a PID reading. Using this technique, potential chemicals of concern can be discounted or validated as present. Action levels are generally one half of the PEL.

6.2.6 O_2/LEL/H_2S Monitoring

The use of a 3-range monitor (O_2/LEL/H_2S) will allow the site worker to evaluate the oxygen level, explosivity, as well as detect the presence of hydrogen sulfice (H_2S) gas in any Solid Waste Management Unit (SWMU) where these levels are of concern (such as in a confined space).

6.2.7 TLD Badges

Personnel working within the exclusion and decontaminations areas of sites potentially contaminated with radiation may be required to wear a thermoluminescent dosimeter (TLD) personal radiation monitoring device. The TLD shall be worn on the front area of the chest at all times while working within the exclusion and decontamination zones. These badges will be used to determine each individual's exposure to radiation as a result of their involvement in field investigations at Seneca Army Depot.

6.3 ACTION LEVELS AND RESPIRATORY PROTECTION

Action levels for all instruments are given in Table B-2, Action Levels for Changes in Respiratory Protection. When an action level is equalled or exceeded, immediately shut down the operation and evacuate the work area. Allow the levels to stabilize and reenter the work area to make a measurement. Restart work if levels are below the action levels. If the action level remains exceeded, re-assess the situation. Upgrade personnel protective equipment (PPE) prior to reentry of the area.

Periodic measurements will be made for total VOCs at the work face (e.g., top of well, drill cuttings, excavation spoils). If the total VOC levels at the work face are higher than action level but ambient levels are below action levels, proceed carefully and monitor more frequently.

If total VOCs at the work face exceed 10 times the ambient air action level, upgrade personnel protective equipment.

6.4 WIND DIRECTION INDICATOR

A wind direction indicator (such as survey flagging tied to a stake) will be erected at every active work site. This will enable the site safety monitor and on-site personnel to determine upwind locations necessary for proper health and safety procedure implementation and, if necessary, evacuation procedures.

6.5 COMMUNITY AIR MONITORING PLAN

Real-time air monitoring, for volatile compounds and particulate levels at the perimeter of the work area is necessary if either of the following conditions are met:

a. At SWMUs where residences or occupied buildings are greater than 1/4 mile away, and concentrations of organic vapors at the work zone exceeds 500 ppm, providing that monitoring for worker Health and Safety is conducted at least every two hours.

b. At SWMUs where residences or occupied buildings are less than 1/4 mile away.

The plan includes the following:

- Volatile organic compounds must be monitored at the downwind perimeter of the work area daily at 2 hour intervals. If total organic vapor levels exceed 5 ppm above background, work activities must be halted and monitoring continued under the provisions of a Vapor Emission Response Plan. All readings must be recorded and be available for State (DEC & DOH) personnel to review.

- Particulates should be continuously monitored upwind, downwind and within the work area at temporary particulate monitoring stations. If the downwind particulate level is 150 ug/m^3 greater than the upwind particulate level, then dust suppression techniques must be employed. All readings must be recorded and be available for State (DEC & DOH) personnel to review.

6.5.1 Vapor Emission Response Plan

If the ambient air concentration of organic vapors exceeds 5 ppm above background at the perimeter of the work area, activities will be halted and monitoring continued. If the organic vapor level decreases below 5 ppm above background, work activities can resume but more frequent intervals of monitoring, as directed by the Safety Officer, must be conducted. If the organic vapor levels are greater than 5 ppm over background but less than 25 ppm over background at the perimeter of the work area, activities can resume provided:

- The organic vapor level 200 ft. downwind of the work area or half the distance to the nearest residential or commercial structure, whichever is less, is below 5 ppm over background, and

- More frequent intervals of monitoring, as directed by the Safety Officer, are conducted.

If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown. When work shutdown occurs, downwind air monitoring as directed by the Safety Officer will be implemented to ensure that vapor emission does not impact the nearest residential or commercial structure at levels exceeding those specified in the Major Vapor Emission section.

6.5.2 Major Vapor Emission

If any organic levels greater than 5 ppm over background are identified 200 feet downwind from the work area or half the distance to the nearest residential or commerical property, whichever is less, all work activities must be halted.

If, following the cessation of the work activities, or as the result of an emergency, organic levels persist above 5 ppm above background 200 feet downwind or half the distance to the nearest residential or commercial property from the work area, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (200 Foot Zone).

If efforts to abate the emission source are unsuccessful and if any of the following levels persist for more than 30 minutes in the 20 Foot Zone, then the Major Vapor Emission Response Plan shall automatically be placed into effect if organic vapor levels are approaching 5 ppm above background.

However, the Major Vapor Emission Response Plan shall be immediately placed into effect if organic vapor levels are greater than 10 ppm above background.

6.5.3 Major Vapor Emission Response Plan

Upon activation, the following activities will be undertaken:

1. All Emergency Response Contacts as listed in the Health and Safety Plan of the Work Plan will go into effect;

2. The local police authorities will immediately be contacted by the Safety Officer and advised of the situation; and

3. Frequent air monitoring will be conducted at 30 minutes intervals within the 20 Foot Zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the Safety Officer.

7.0 PERSONAL PROTECTIVE EQUIPMENT

The selection and use of personnel protective equipment at the subject site will be in accordance with the AE's Personal Protective Equipment Program, contained in Attachment B-4. The unknown nature of hazardous waste site work and the possibility of changing conditions during the conduct of the work may require changes in the personal protective equipment. When changes in personal protective equipment become necessary, these changes shall be made in accordance with the action levels and criteria set forth in this plan and according to the established procedures contained in The AE's Personal Protective Equipment Program.

Routine site work at the Seneca site will be performed in Level D protection, augmented with overboots, inner surgical gloves, and chemical-resistant outer gloves. Level C respiratory protection with organic vapor/acid gas cartridges will be carried by all work crews to be donned when air monitoring indicates the need for respiratory protection. Required equipment for Levels B, C, and D are detailed in Table B-3, Description of Personal Protective Equipment and Levels of Protection.

The organic vapor monitor will be the primary instrument for determining contaminant concentrations which may trigger a change in respiratory protection. Level C protection will be worn in situations where inhalation of fugitive dust containing metals or explosives is determined to be present in high levels. Action levels for changes in personnel protection equipment are shown in Table B-2.

In the event that personal protective equipment (PPE) is ripped or torn, work shall stop and PPE shall be removed and replaced as soon as possible. The minimum levels of protection to be worn and the equipment which shall be available for general site tasks are shown in Table B-4, Minimum Levels of Protection and Available Upgrade Protection for Site Tasks.

TABLE B-3
DESCRIPTION OF PERSONAL PROTECTIVE EQUIPMENT AND LEVELS OF PROTECTION

LEVEL D

HARD HAT
EYE PROTECTION - SAFETY GOGGLES, GLASSES, OR FACE SHIELD
SAFETY SHOES - STEEL TOE, LEATHER
(or)
SAFETY BOOTS - STEEL TOE, NEOPRENE
OVERBOOTS, INNER SURGICAL GLOVES, AND CHEMICAL-RESISTANT OUTER GLOVES
PROTECTIVE OVERALLS, EAR PLUGS

LEVEL C

LEVEL D PROTECTIVE EQUIPMENT PLUS:
RESPIRATORY PROTECTION - FULL FACEPIECE AIR PURIFYING RESPIRATOR (APR), CARTRIDGE OR CANISTER

SKIN PROTECTION - POLY-COATED TYVEK OR SARANEX COVERALL*
INNER LATEX GLOVES*
OUTER NITRILE GLOVES*
NEOPRENE BOOT COVERS*

LEVEL B

LEVEL C PROTECTIVE EQUIPMENT EXCEPT FOR:
RESPIRATORY PROTECTION - FULL FACEPIECE SELF-CONTAINED BREATHING APPARATUS (SCBA) INSTEAD OF APR

---

*OTHER MATERIALS MAY BE SPECIFIED TO PROVIDE BETTER PROTECTION WHEN WORKING WITH CERTAIN TYPES OF CHEMICALS.

TABLE B-4

MINIMUM LEVELS OF PROTECTION AND AVAILABLE UPGRADE PROTECTION FOR SITE TASKS

Activity	PPE Worn	PPE With Crew	Emergency PPE at Command Post
Geophysical Survey	D	C	
Soil Boring and Sampling	D	C	B
Monitoring Well Development and Sampling	D	C	B
Surface Water and Sediment Sampling	D	C	B
Decontamination	C	-	B
Test Pits	C	B	
Soil Gas Survey	D	C	B

8.0 SAFE WORK PRACTICES AND ENGINEERING CONTROLS

Safe work practices and engineering controls shall be implemented to comply with OSHA 29 CFR 1910.120 to limit employee exposure to hazardous substances or conditions. The use of personnel protective equipment has limitations and presents hazards of its own, such as physical stress and interference with peripheral vision, calling for the consideration and implementation of work practices and engineering controls prior to beginning site tasks and before the use of personnel protective equipment is instituted.

The safe work practices and engineering controls discussed below apply to general site procedures.

8.1 SAFE WORK PRACTICES

The following work practices are intended for use when site activities involve potential exposure to hazardous substances or conditions.

1. Certain SWMUs are known to contain various types of unexploded ordnance (UXO) or explosives.
   All movement on the site shall be along cleared roads and pathways.
   ON-SITE WORKERS SHALL NOT STRAY FROM THE CLEARED PATHWAYS AND ROAD!
   ON-SITE WORKERS SHALL NOT TOUCH, KICK, OR OTHERWISE DISTURB ANY MATERIALS ON-SITE WHICH MAY BE UXOs.
2. The buddy system will be utilized at all times within the exclusion zone.
3. Entry into and exit from zones within the site must be made via the established access control points.
4. Prescribed personnel protective equipment must be worn as directed by the Site Health and Safety Office and Project Manager.
5. Assumptions will not be made concerning the nature of materials found on the site. Should any unusual situations occur (not covered by the Site Standard Operating Procedures), operations will cease and the Site Health and Safety Officer and the Project Manager will be contacted for further guidance.
6. Communication hand signals must be understood and reviewed daily.
7. Consultation with the Project Manager shall be made to avoid any uncertainties.

8. Ground fault circuit interrupters shall be used on all field electrical equipment. Improperly grounded/guarded tools shall be tagged out-of- service and the Project Manager shall be notified immediately.
9. If a piece of equipment fails or is found to be in need of repair, it will be immediately tagged out-of-service and the Project Manager shall be notified. This equipment will not be returned to service until repairs have been completed and the equipment tested by a competent individual.
10. Unsafe conditions shall be reported immediately.
11. Unusual odors, emissions, or signs of chemical reaction shall be reported immediately.
12. Workers will minimize contact with hazardous materials by:
    a. Avoiding areas of obvious contamination
    b. Using poly sheeting to help contain contaminants
    c. Avoiding contact with toxic materials
13. Only essential personnel will be permitted in the work zones.
14. Whenever possible, personnel will be located upwind during material handling.
15. At the first sign of odors detected inside the facepiece of a respirator, or if the employee begins experiencing any signs or symptoms of exposure to site toxic material (this information will be discussed during the daily meeting and can be found on the appropriate Chemical Hazard Evaluation Sheets, Attachment B-1), the employee will leave the area immediately and report the incident to the Health and Safety Officer and Project Manager.
16. Smoking will be allowed only in designated areas of the support zone.

8.2 PERSONAL HYGIENE PRACTICES

The following personal hygiene practices will apply to field work conducted at the SEDA SWMU areas:

1. No smoking or chewing of tobacco or gum shall be allowed within the exclusion or decontamination zones.
2. No eating or drinking shall be allowed in the exclusion or decontamination zones.
3. On-site personnel shall remove protective clothing and wash face and hands prior to leaving the decontamination zones.
4. Disposable outerwear will be placed in drums located in the personnel decontamination area. Drums will be staged on-site at a central location for later disposal.

8.3 UXO CONTAMINATED SAMPLING OPERATIONS

For safety purposes in areas where UXOs are suspected, soil and well boreholes are checked with a Forster Ferex/4.021 (Mk 26 Mod) Ordnance Locator. It is a USACE requirement that all boreholes in areas possibly contaminated with UXOs must be rechecked at 2 foot to 4 foot intervals during drilling operations. This can be eliminated if remote drilling equipment is used.

In areas of heavy UXO equipment contamination, the UXO contractor EOD technicians can collect samples with hand augers or similar equipment. The physical hazards and measures used to deal with those are outlined in Section 2.3, Hazard Evaluation.

8.3.1 Inspection of Laboratory Samples Prior to Off Site Shipment

Many of the UXO components intended for disposal at the site are quite small and could easily be included in laboratory samples for off site testing. These items, although quite small, will produce small fragments moving at a high velocity if initiated during laboratory testing. These fragments could cause severe injuries to laboratory personnel processing these samples. All samples should be inspected by qualified UXO contractor EOD personnel to ensure that they do not contain any small UXO components.

8.4 FIRE CONTROL

Fire extinguishers, suitable for Class A, B, and C fires (rated at least 1A, 10BC), will be available at sampling sites for use on small fires. All samples must be treated as flammable or explosive. The site safety officer will have available the telephone number of the nearest fire station and local law enforcement agencies in case of a major fire emergency.

8.5 SPILL CONTROL

In the event of a spill, the site safety officer will be notified immediately. The important factors are that no personnel are overexposed to vapors, gases, or mists and that the liquid does not ignite. Waste spillage must not be allowed to contaminate any local water source. Small dikes will be erected to contain spills, if necessary, until proper disposal can be completed. Subsequent to cleanup activities, the site safety officer will survey the area to ensure that no toxic or explosive vapors remain.

8.6 EXPLOSIVE FIRES

Under no circumstances will an attempt be made to fight an explosive fire. If a fire involving explosive materials should occur on the site, all personnel will immediately evacuate the site. Fire department personnel responding to the incident must be informed of the fact that the fire involves explosive materials.

8.7 CONFINED SPACE ENTRY

No confined space entry is planned for the investigations of the SWMUs. If confined space entry becomes necessary during the implementation of the work, a confined space entry procedure will be appended to the site safety plan and will be instituted prior to allowing any confined space entry.

8.8 SITE INSPECTIONS

Site inspections will be conducted daily by the site safety officer to ensure that site work is accomplished in accordance with the approved safety plan, contract requirements and federal regulations. Daily inspections will be documented.

8.9 ACCIDENT REPORTING AND RECORDKEEPING

Accidents and near miss incidents will be recorded on the accident report form contained in Attachment B-3 - Site Documentation Forms. Accidents reports are to be completed by involved parties if possible. Accidents and near misses will be investigated by the site safety officer and the site manager. The investigation team shall make recommendations for preventing a recurrence of the accident or incident and submit the accident report to the project health and safety officer and the office health and safety representative. The accident report shall be retained on file at the site, in the project files and in office health and safety files. All accidents or incidents which are recordable will be entered on the OSHA 200 log maintained in the AE's home office. In addition, Corps of Engineers contractors' will submit an accident report on form ENG3394.

The office health and safety officer and the project health and safety officer shall review the accident report and approve or make additional recommendations for prevention of the future occurence of the incident. The project health and safety officer shall ensure that remedial recommendations are carried out by the filed staff.

9.0 UNEXPLODED ORDNANCE

Some SEDA SWMU areas may be contaminated with UXO components and UXOs. Basic considerations for unexploded explosive ordnance operations are provided in Attachments B-5 and B-6. All UXO contractor EOD operations will be performed in accordance with the following procedures:

1. **UXO Contractor Explosive Ordnance Disposal Services** - The specific services to be performed in support of this project are listed below. It should be noted that the services are orientated to site safety during evaluation of the applicable SWMUs.

    a. **Unexploded Ordnance Safety Training** - In accordance with 29 CFR Part 1910.120 paragraph (e), the UXO contractor will develop an Unexploded Ordnance (UXO) Safety Training class that will be provided to the prime contractor for the training of all personnel who will be working on the site. This class will include an instructional guide and handouts for workers on the site.

    b. **UXO Inspection of the Sampling Sites** - The UXO contractor will provide the personnel and equipment required to inspect the access routes and sampling sites for UXOs. The magnetometry equipment utilized by the UXO contractor will be capable of detecting both ferrous and nonferrous objects however, heavy metallic contamination will greatly hinder operations on the site.

        (1) **Marking Access Routes and Sampling Site Boundaries** - Dependant upon the equipment size and quantity being brought into a sampling site, a 10' to 20' wide access route will be searched for UXOs. The boundaries of the access route will be marked at 25' intervals with orange survey flags. As with the equipment considerations for the access route, the size of the sampling area may range from an area 50' x 50' in size.

        (2) **Marking and Handling of UXOs** - In addition to the ordnance items disposed at some SWMUs, it can be expected that "ordnance kick-outs" from demolition can be expected to be found on site. All explosive loaded UXOs will be marked with yellow survey flags.

c. **UXO Contractor EOD Site Procedures** - The following practices are standard UXO contractor EOD procedures used on DOD installations throughout the United States. The UXO contractor EOD search team [consisting of two EOD technicians of which one will be a UXO Supervisor as described in the Work Standards for Unexploded Ordnance (UXO) Personnel (Attachment B-6) will conduct a visual surface and electronic subsurface UXO search of the access route and sampling site. In conjunction with the UXO search, the UXO contractor EOD will perform the following steps:

(1) Identify and mark the boundaries of the access route and sampling site areas that will require UXO search operations.

NOTE: **Hand excavation is the preferred method of excavation for buried UXOs; however, if a UXO is buried at a depth estimated to be greater than 12 inches, a backhoe will be used if necessary. Earth moving machinery will not be used to excavate within 12 inches of an UXO. When an excavation is within 12 inches of an UXO hand excavation shall be used to uncover the UXO. All excavations performed by the UXO contractor will be in compliance with 29 CFR Part 1926 and EM 385-1-1.**

(2) Using visual surface locations techniques, electronic subsurface techniques and excavation as required, locate and identify UXOs within the boundaries of the access route and sampling site.

(3) When an explosive, chemical, propellant, or pyrotechnic loaded UXO is located the following steps will be followed:

(a) Mark the UXOs location with a yellow marker flag;

(b) Determine the type of UXO, i.e. projectile, rocket, bomb, etc.;

(c) Determine the condition of the UXO (Armed or Unarmed); and

(d) Determine which of the following explosive/hazard categories is applicable:

1 High Explosive (HE);
2 High Explosive Anti-Tank (HEAT);
3 Armor Piercing High Explosive (APHE);
4 Improved Conventional Munition (ICM);

5 Anti-Personnel Ejection Round Special (APERS);
6 White/Red Phosphorous; and
7 Other.

(e) Determine which of the following fuzing categories is applicable:

1 Point Detonating (PD);
2 Base Detonating (BD);
3 Point Initiating Base Detonating - Lucky (PIBD-Lucky);
4 Mechanical Time (MT);
5 Electronic Time (ET);
6 Proximity (VT);
7 Powder Train Time Fuze (PTTF); and
8 All-Ways Acting (as in the 40 mm grenade system).

NOTE: If the site contains numerous UXOs, report the initial UXO located and continue search operations. Perform all of the steps outlined in paragraphs 1.c(3). through 1.c(3)(e)8. and then report the total number located at the end of the day.

(f) Report the UXO to the Contractor Representative and Government Representative with project oversight responsibility.

(4) In the event that the Contractor or Government Representative requests movement of the UXO(s), the following is applicable for UXO contractor operations on SEDA (The Government representative may request that the UXOs be moved only if he/she is a CEHND Safety Specialist or the Government representative involves a CEHND Safety Specialists in the request):

(a) If the Contractor Representative requests that the UXO(s) be moved, refer this individual to the Government Representative having oversight of the project. The Contractor Representative does not have authority to direct the movement of UXOs on the project site.

(b) Upon request of the Government Representative (who is either a CEHND Safety Specialist or directly involves a CEHND Specialist), the UXO contractor EOD Team Leader will reevaluate the UXO(s) to determine which if any can be moved.

NOTE: **Very careful evaluation of the UXO will be required. As a rule, ordnance items with attached fuzing systems which have been exposed to fire or a detonation are not to be moved and must be destroyed in place. The UXO contractor EOD Team Leader is the only person with the authority to make the decision of whether or not the UXO contractor EOD personnel will move an UXO.**

(c) Unarmed/Unfired UXOs - Any UXO which has not been fired/launched or experienced any other actions (exposed to fire or detonations) required to put the UXO in an armed condition.

1 If the UXO in the unarmed/unfired condition includes any positive safety devices (safety pin/clip, electrical shunts, etc.), and these items are missing, the UXO shall be considered to be armed.

2 If the unarmed/unfired UXO has been damaged by fire or has other physical damage, it shall be considered to be armed.

(d) Armed UXO - Any UXO which has experienced the required actions to place it in an armed condition.

NOTE: **Only unarmed and armed UXOs that are determined to be safe to move will be moved. Under no circumstances will any of the following UXOs be moved:**

- **HEAT with a PIBD -Lucky fuzing system;**
- **Any munition with a Mechanical Time (MT) Fuze;**
- **Any munition with a fuze containing an Impact back-up (graze feature);**
- **Any munition containing an All-Ways Acting fuze (asin the 40 mm grenade system); and**
- **Any munition that you can not determine the type of fuze or if it is safe to move.**

(e) Based on the field evaluation of the UXO(s) by the UXO contractor EOD Team Leader a final decision will be made if the UXO is safe to move. If the UXO contractor EOD Team leader determines that the UXO(s) can safely be moved, the following procedures will be followed:

1 Establish an UXO explosive holding area. This area must be separate from the nonexplosive loaded ordnance component holding area;
2 This holding area will be a minimum of 100 meters from any structures, power lines, and equipment;
3 The holding area will be clearly marked with yellow flags on its four (4) corners;
4 The location of the UXO holding area will be identified to both the contractor and Government site representatives;
5 The UXO(s) will be moved one (1) at a time and in the proper attitude;

<u>6</u> Except as indicated below, the UXO(s) should be moved to the holding area by hand. If required, both EOD technicians will carry the UXO(s) to the holding area;

<u>7</u> Large UXOs (155 mm and above) may be transported by vehicle (backhoe, front end loader, etc.) to the holding area; and

<u>8</u> A record of all UXOs placed in the explosive holding area will be maintained by the UXO contractor EOD Team Leader.

(5) Nonexplosive loaded ordnance components will be collected and stored in a designated location for pick up by SEDA Range Operations personnel at their convenience. Items in this category would include but not be limited to the following types of ordnance/residue:

<u>NOTE:</u> **<u>The location of items too large to be moved by hand will be reported to the SEDA Range Operations Personnel for collection at a later date</u>.**

(a) Armor Piercing (AP) projectiles;
(b) Empty ejection munitions;
(c) Spent rocket motors (when found separated from warheads); and
(d) Nonexplosive loaded training munitions.

(6) A record of all UXOs will be maintained in a log book.

(7) Upon completion of UXO search operations, a UXO Density Report will be provided to the Contractor and Government Representatives.

2. **Sampling Operations** - During sampling operations, the UXO contractor will provide EOD services as needed. Some of the required additional EOD services normally provided on projects of this nature are listed below:

a. **Borehole Magnetometry** - For safety purposes, soil and well boreholes are normally checked with the UXO contractor's Förster Ferex® 4.021 (Mk 26 Mod

0) Ordnance Locator. This is a USACOE requirement that all boreholes in areas that are possibly contaminated with UXOs must be rechecked at 2' or 4' intervals during drilling operations.

NOTE: **The requirement for rechecking the boreholes at 2' and 4' foot intervals can be eliminated if remote drilling equipment is used**.

b. **Collection of Samples** - In areas of heavy UXO contamination, the UXO contractor EOD technicians can collect samples with hand augers or similar equipment. This eliminates the requirement to expose other contractor personnel in high hazard areas.

c. **Excavation Services** - In some cases excavation of trenches for a cross section study of the soil or to obtain samples may be required. Normally the trenching is accomplished with a backhoe. Because of the high level of hazards from the UXOs in the area, the UXO contractor will provide EOD operators for the backhoe. The UXO contractor's technicians are experienced in this area and are familiar with all aspects from sample collection to equipment decontamination between sampling sites.

10.0 DECONTAMINATION

Decontamination is the physical removal of contaminants from clothing and equipment or the chemical change of such contaminants to innocuous substances. Decontamination procedures will take place in the contamination reduction zone. Disposal is an available option in lieu of decontamination when decontamination is impractical.

The following decontamination procedures are intended to meet the requirements of 29 CFR 1910.120(k). No personnel or equipment shall enter the contaminated zone of the site until workers have acknowledged the decontamination procedures and operating procedures intended to minimize contamination. These procedures shall be monitored by the Site Health and Safety Officer to determine their effectiveness. Ineffective procedures will be corrected.

10.1 DECONTAMINATION FACILITIES

The main decontamination facilities at the SEDA SWMU areas will be located adjacent to the support zone. These decontamination facilities will be used for vehicle and heavy equipment decontamination and for personnel decontamination. Personnel decontamination must take place prior to leaving the decontamination area and prior to entering any personnel hygiene facilities or before eating, drinking, or smoking.

10.2 PERSONNEL DECONTAMINATION

Personnel decontamination will consist primarily of a segregated equipment drop, removal and disposal of any non-reusable protective equipment, and washing of hands and face. No heavy contamination of clothing is expected and disposable protective clothing will be disposed of as non-hazardous waste. However, if contamination is detected (i.e., elevated PID readings, visual evidence, or known contact with potentially contaminated liquids) personal protective equipment and cartridges from respirators will be bagged separately from daily garbage. Facilities for personnel and sampling equipment decontamination will be set up between the equipment decontamination pad and the site trailer. Personnel will not enter the office trailer without first going through decontamination, and hands and face must be thoroughly washed before eating, drinking, etc.

Level C Decontamination - The activities to be carried out at each station are described on Table B-5, Measures for Level C Decontamination.

TABLE B-5
MEASURES FOR LEVEL C DECONTAMINATION

Station 1:	Equipment Drop	Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down station may be set up within this area.
Station 2:	Outer Garment, Boots and Gloves Wash and Rinse	Scrub outer boots, outer gloves and splash suit with decon solution or detergent water. Rinse off using copious amounts of water.
Station 3:	Outer Boots and Glove Removal	Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Canister or Mask	If worker leaves exclusive zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty.
Station 5:	Outer Garment Removal	Remove outer garment. Place on plastic for further cleaning or in barrel for disposal.
Station 6:	Face Piece Removal	Facepiece is removed. Avoid touching face with fingers, Facepiece deposited on plastic sheets.
Station 7:	Inner Boot and Glove Removal	Boots and inner gloves removed an deposited in separate containers lined with plastic.
Station 8:	Field Wash	Hands and face are thoroughly washed. Shower as soon as possible.

Level B Decontamination - The activities to be carried out at each station are described on Table B-6, Measures for Level B Decontamination.

10.3 EQUIPMENT DECONTAMINATION

Equipment and vehicle decontamination will consist of pressure washing followed by steam cleaning. Solvent and soap and water washes will be performed when required for sampling or for heavy contamination. Gross contamination, such as caked mud and dirt on augers and split spoons, will be removed at the work site and placed back in the borehole or drummed with other drilling spoils if contaminant indicators (e.g., PID readings) warrant drumming of the soils.

Refer to Section 3.8 of Appendix A in the Field Sampling and Analysis Plan for details or the management of investigation generated wastes.

10.4 PREVENTION OF CONTAMINATION

In an effort to minimize contact with waste and decrease the potential for contamination, the points outlined below will be adhered to during all phases of field investigation and sampling.

1. Personnel will make every effort not to walk through puddles, mud, any discolored surface, and/or any area of obvious contamination.
2. Personnel will not kneel or sit on the ground in the exclusion zone and/or in the Contamination Reduction Zone (CRZ).
3. Personnel will not place equipment on drums, containers, vehicles, or on the unprotected ground.
4. Where appropriate, personnel will wear disposable outer garments and use disposable equipment.

TABLE B-6
MEASURES FOR LEVEL B DECONTAMINATION

Station 1:	Equipment Drop	Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down station may be set up within this area.
Station 2:	Outer Garment, Boots	Scrub outer boots, outer gloves and splash suit and Gloves Wash and Rinse decon solution or detergent water. Rinse off using copious amounts of water.
Station 3:	Outer Boots and Glove Removal	Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Tank Change	If worker leaves exclusive zone to change air tank, this is the last step in the decontamination procedure. Worker's canister air tank is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty.
Station 5:	SCBA Removal	SCBA backpack and facepiece is removed. Avoid touching face with finger. SCBA deposited on plastic sheets.
Station 6:	Outer Garment Removal	Remove outer garments. Place on plastic for further cleaning or in barrel for disposal.
Station 7:	Inner Boot and Glove Removal	Boots and inner gloves removed and deposited in separate containers lined with plastic.
Station 8:	Field Wash	Hands and face are thoroughly washed. Shower as soon as possible.

11.0 EMERGENCY RESPONSE PLAN

This Emergency Response Plan applies to site work at the fifteen SWMU areas listed in Section 1.0 and shown on Figure B-2. Copies of this plan are to be kept at the site command post and support areas. The list of emergency telephone numbers and directions to the nearest exit gate and nearest hospital will be prominently posted in the command post. Copies of the directions to the nearest hospital will be kept in all site vehicles.

This emergency response plan shall be coordinated with SEDA emergency response procedures prior to the beginning of site work.

11.1 ON-SITE EMERGENCIES

On site emergencies can range from minor cuts and scrapes to explosions, fires, and the release of toxic gases. Apparently minor incidents at hazardous waste sites can have serious consequences or may indicate the presence of a previously unknown health and safety hazard. Explosions, fires, and the release of toxic gases will not only involve site workers, but may affect the neighboring populations and the environment.

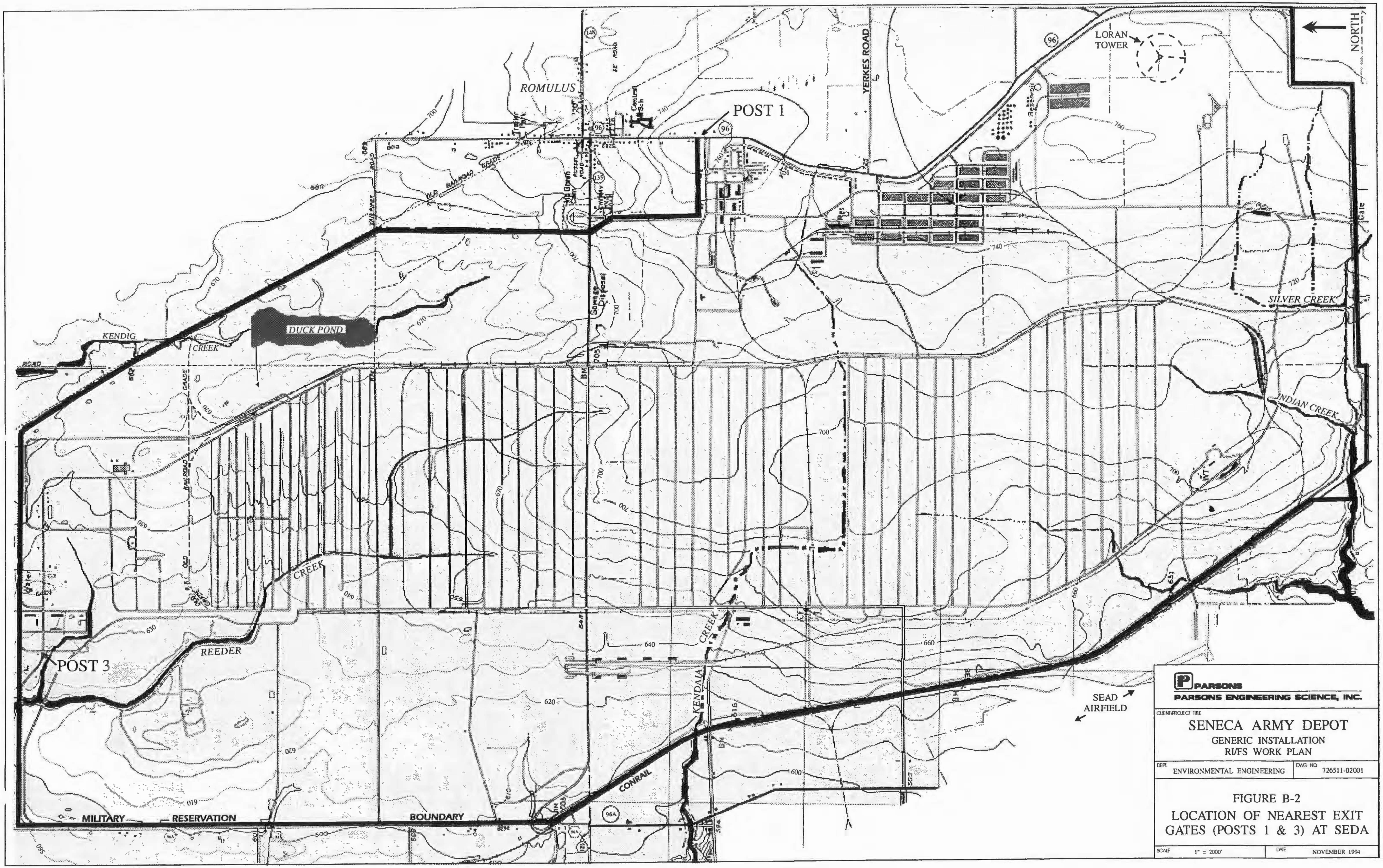
All incidents will be reported as soon as possible to the Site Manager and the Site Safety Officer who will determine the appropriate steps to be taken.

When the incident is minor, the work may continue. When an incident is considered serious, work will be discontinued until the emergency situation has been brought under control, the incident has been evaluated, and any conditions which may have contributed to the emergency have been mitigated.

All site incidents, including near misses, will be investigated and documented, using the Incident Report Form and Incident Follow-Up Report Form in Attachment B-3, On-Site Documentation Forms.

11.2 OFF-SITE EMERGENCIES

In the unlikely event of a vapor release off-site, the contamination source will be secured, if possible.



PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
GENERIC INSTALLATION
RI/FS WORK PLAN

DEPT.	DWG NO.
ENVIRONMENTAL ENGINEERING	726511-02001

FIGURE B-2
LOCATION OF NEAREST EXIT GATES (POSTS 1 & 3) AT SEDA

SCALE		DATE	
SCALE	1" = 2000'	DATE	NOVEMBER 1994

Emergency response contacts will be notified in the following order:

1. SEDA Security and Environmental Office
2. Safety Officer
3. Project Manager

The phone numbers of these contacts are provided in Section 11.9 and will be posted in the site trailer.

SEDA Emergency Response personnel will be utilized in all emergencies which may involve exposure to people away from the work sites. The SEDA Emergency Response Plan for the depot will be implemented when SEDA Emergency Response personnel determine it is necessary.

11.3 SITE PERSONNEL AND LINES OF AUTHORITY

A clear chain-of-command in emergency situations ensures clear and consistent communication between site personnel and, therefore, results in more effective response to the emergency situation. The duties of site personnel in emergency situations are outlined below:

The **Site Manager** will direct all emergency response operations, designate duties to other site personnel, and serve as liaison with government officials and emergency response teams.

The **Site Safety Officer** will make initial contact with off-site emergency response teams (first aid, fire, police, etc.), make recommendations on work stoppage, and provide for on-site first aid and rescue.

The **Command Post Supervisor** will be designated when no one is performing this function during normal site work. This person will maintain contact with off-site response teams and notify additional agencies or offices that need to be contacted.

Decontamination personnel will stand by to perform emergency decontamination. Decontamination personnel will also assist the safety officer in rescue operations when necessary.

Field personnel will assist in rescue operations or take over for decontamination personnel when they are required for other duties.

11.4 EMERGENCY SITE COMMUNICATIONS

Emergency communications will be maintained by use of air horns kept in the support areas and with each work crew. The emergency communications codes are given in Table B-7, On-Site Emergency Communications.

11.5 EVACUATION PROCEDURES

Some areas to be investigated may contain various types of unexploded ordnance (UXO). All movement on the site, **EVEN UNDER EMERGENCY CONDITIONS**, shall be along cleared roads and pathways. Cleared roads and pathways shall be marked. **ON-SITE WORKERS SHALL NOT STRAY FROM THE CLEARED PATHWAYS AND ROAD!**

Evacuation from work sites shall be along the access paths cleared to the various worksites. Equipment shall be placed so as not to impede emergency escape and evacuation along the cleared pathways. Evacuation routes from work areas shall be discussed daily for each work crew as a part of the daily safety meeting.

11.6 EMERGENCY DECONTAMINATION AND FIRST AID

Decontamination procedures used in emergency situations will vary greatly with the severity and particulars of the situation. The AE Site Safety Officer is first aid/CPR certified and will provide advice on the medical and decontamination procedures to be used in each emergency situation. General guidelines for first aid and decontamination procedures are given below.

11.6.1 Inhalation Exposure

Remove the victim from the exposure area to an area with fresh air. Attempt rescue only if proper protective gear (Level B or C) is available for the rescue team. Remove protective clothing and respiratory protective gear as soon as possible to determine if the administration of CPR is necessary. If so, complete decontamination while CPR is being administered. Continue CPR until emergency medical unit arrives. If CPR is not required, complete decontamination and transport to hospital; administer other first-aid as indicated.

TABLE B-7
ON-SITE EMERGENCY COMMUNICATIONS

AIR HORN SIGNAL	ACTION
THREE SHORT BLASTS	SHUT DOWN EQUIPMENT, STAND BY RADIO
ONE LONG BLAST	RETURN TO NEAREST SUPPORT ZONE
CONTINUOUS LONG BLASTS	EVACUATE SITE BY BEST, FASTEST ROUTE

HAND SIGNALS	MEANING
HAND GRIPPING THROAT	OUT OF AIR, CAN'T BREATHE
GRIP PARTNER'S WRIST	LEAVE AREA IMMEDIATELY; NO DEBATE
HANDS ON TOP OF HEAD	NEED ASSISTANCE
THUMBS UP	OK; I'M ALL RIGHT; I UNDERSTAND
THUMBS DOWN	NO; NEGATIVE

11.6.2 Contact Exposure

Remove victim from area and flush affected area with water only. Be careful not to spread the contamination to other parts of the body. Remove protective clothing and flush area with water only. Consult references to determine if soap and water wash is indicated. Do not remove respirator until removal of contaminant from body is reasonably assured and the victim is well into a clean zone.

11.6.3 Physical Injury

If a physical injury occurs or worker collapses in a clean zone. First aid will be administered as indicated.

If a physical injury occurs in a contaminated zone, care must be taken to prevent contact of any contaminant with open wounds. The wound can provide easy access to the body for toxic chemicals which are not normally a skin absorption problem. Protective clothing will be removed carefully to avoid additional injury and avoid any exposure of the wound to contaminants on the clothing.

If a worker collapses or loses consciousness in a contaminated zone, remove protective clothing and respiratory protective gear as soon as possible to determine if the administration of CPR is necessary. If so, complete decontamination while CPR is being administered. Continue CPR until emergency medical units arrive. If CPR is not required, complete decontamination and transport to hospital; administer other first-aid as indicated. The field site will have at least two persons certified in CPR and first-aid per shift.

11.7 EMERGENCY MEDICAL TREATMENT AND FIRST AID

A first aid kit large enough to accommodate anticipated emergencies will be kept in the support zone. In addition, each work crew will carry a smaller first aid kit for minor injuries. If any injury should require advanced medical assistance, the victim will be transported to the hospital.

Each work site will have a vehicle for transportation to the hospital. Keys will be left in or near the ignition.

11.8 EMERGENCY AND PERSONAL PROTECTIVE EQUIPMENT

The support zone will have the following emergency equipment:

Self-Contained Breathing Apparatus (SCBA);
First Aid Kit;
Fire Extinguisher (A, B, C Type);
15-Minute Emergency Eyewash Station; and
Air Horn.

Each work crew will have at the work site the following emergency equipment:

First Aid Kit;
Fire Extinguisher (A, B, C Type);
Hand-Held Eyewash; and
Air Horn.

11.9 EMERGENCY TELEPHONE NUMBERS

Emergency telephone numbers for medical and chemical emergencies are given in Table B-8, Emergency Telephone Numbers. These numbers will be displayed prominently near each site phone.

11.10 DIRECTIONS TO HOSPITAL

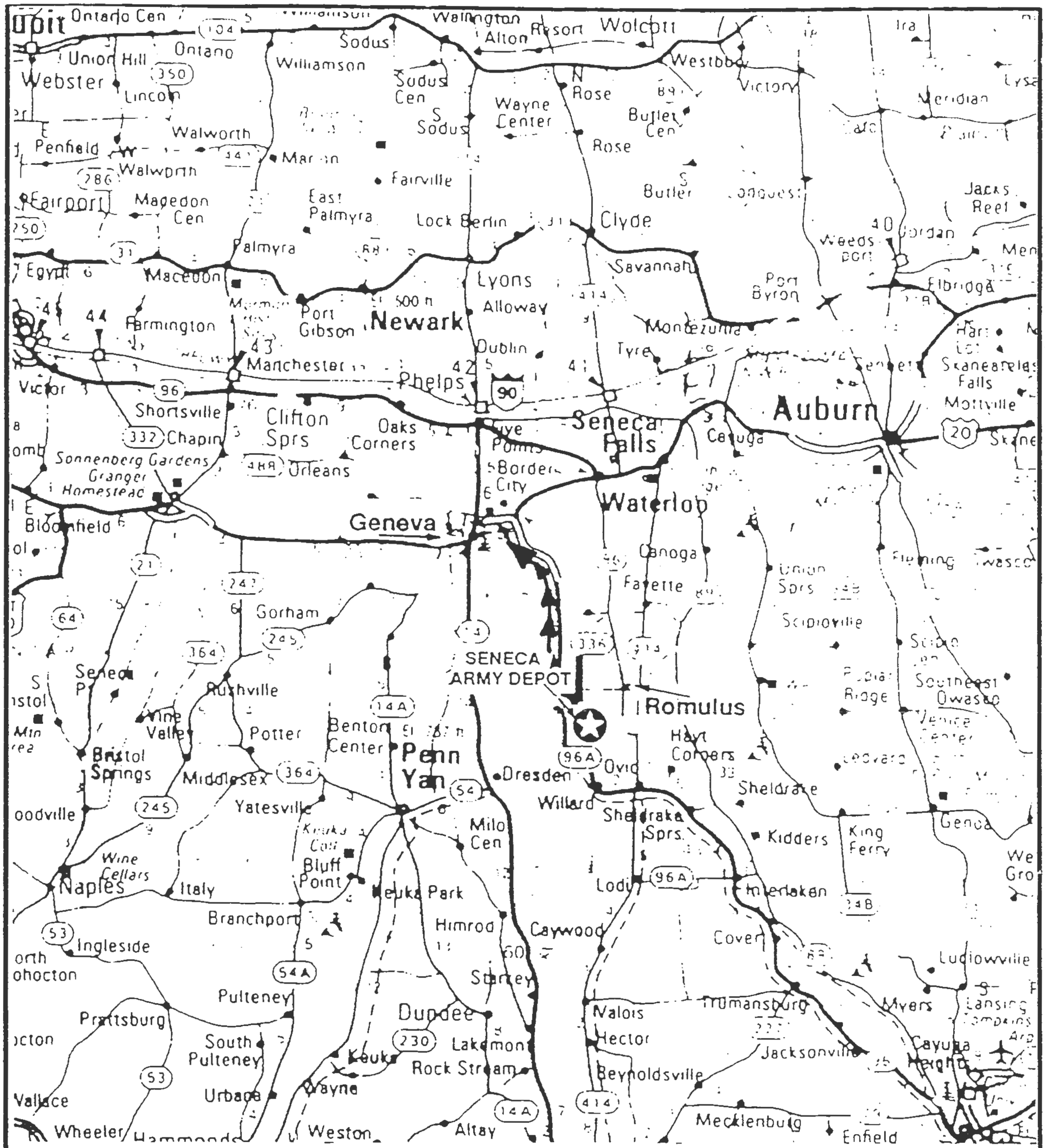
Directions to the nearest hospital are shown and described in Figure B-3, Route to Geneva General Hospital. The map will be displayed in the command post and kept in every site vehicle.

TABLE B-8

EMERGENCY TELEPHONE NUMBERS

SENECA ARMY DEPOT
ROMULUS, NEW YORK

Ambulance SEDA	(607) 869-1436
Fire SEDA	(607) 869-1316
Police SEDA	(607) 869-0448
Geneva General Hospital 186-198 North Street Geneva, New York	(315) 798-4222
SEDA Staff Duty Officer	(607) 869-0251
Seneca Army Depot Security	(607) 869-1243
On Post Calls	3-0-xxx or 4-1-xxx
Chemtrec	(800) 424-9300
National Response Center - Environmental Emergencies	(800) 424-8802
Randy Battaglia - Seneca Army Depot Environmental Contact	(607) 869-1450
- HFA Senior EOD Field Supervisor:	See Appropriate Scoping Document
- Project Manager:	See Appropriate Scoping Document



From Post #3, take right on route 96A.
Follow north to route 20.
Take route 20 heading west into downtown Geneva and follow signs for Geneva General Hospital.

From Post #1, take left on route 96.
Follow north to route 20 intersection.
Take left on route 20 heading west into downtown Geneva and follow signs for Geneva General Hospital.

SENECA ARMY DEPOT

ROUTE TO GENEVA GENERAL HOSPITAL

FIGURE B-3

ATTACHMENT B-1

CHEMICAL HAZARD EVALUATION SHEETS

Chemical Hazard Evaluation Sheets for the subject site are provided in the appropriate Draft RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan

ATTACHMENT B-2

STANDARD OPERATING PROCEDURES FOR EMERGENCIES DUE TO COLD AND COLD STRESS MONITORING

STANDARD OPERATING PROCEDURE FOR EMERGENCIES DUE TO HEAT AND HEAT STRESS MONITORING

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COLD STRESS

Field operations during winter months can create a variety of hazards for the employee. Frostbite, frostnip, and hypothermia can be experienced and, if not remedied, cause severe health effects and even death. Therefore, it is important that all employees are able to recognize the symptoms of these conditions and correct the problem as quickly as possible.

A. THE EFFECTS OF COLD

Persons working outdoors in temperatures at or below freezing may experience frostbite. Extreme cold for a short time may cause severe injury to the body surface or result in profound generalized cooling, causing death. Extremities such as fingers, toes, and ears are most susceptible.

Prolonged exposure to extreme cold produces the following symptoms: shivering, numbness, low body temperature, drowsiness, and marked muscular weakness.

Two factors influence the development of a cold injury: ambient temperature and wind velocity. Windchill is used to describe the chilling effect of moving air in combination with low temperatures. Table 1 shows a windchill chart. As a general rule, the greatest incremental gain in windchill occurs when a wind velocity increases from 5 mph to 10 mph. Additionally, water conducts heat 240 times faster than air. Therefore, the body cools dramatically when personal protective equipment is removed and clothing underneath is perspiration-soaked.

There are three categories of cold-injury: frostnip, frostbite, and hypothermia.

1. Frostnip

Frostnip is the initial symptom of frostbite and is characterized by a whitened area of the skin accompanied by a burning or painful feeling.

Emergency Care

Warm the affected area either by body heat or warm (not hot) water.

2. Frostbite

Frostbite is local tissue damage caused by exposure to low temperatures. Ice crystals form, either superficially or deeply, in the fluids and underlying soft tissue of the skin. The nose, cheeks, ears, fingers, and toes are most commonly affected.

Frostbite Symptoms

- Skin is cold, hard, white, and numb.

- Skin may be blistering.

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- Victim may not be in pain.
- In advanced cases victim experiences mental confusion.
- Judgment impairment.
- Victim will stagger.
- Eyesight failure.
- Unconsciousness.
- Shock symptoms, followed by death.

Frostbite Emergency Care

Cover the frozen area and warm the victim with extra clothing and blankets. Bring the victim indoors (if possible) and allow victim to drink warm liquids.

Rewarm the frozen area quickly by immersion in warm (not hot) water. The best temperature is between 102 and 105°F. This procedure may take up to thirty minutes. The victim will experience greater and greater pain as tissues thaw.

If warm water is not available or not practical to use, wrap the affected area in a sheet and warm blankets.

Severe swelling will develop rapidly after thawing. Discontinue warming the victim as soon as the affected area becomes flush.

When the affected area has been warmed, have the victim exercise it. If the fingers or toes are involved, place dry, sterile gauze between the digits to separate them.

If travel is necessary, cover the affected parts with sterile or clean clothes and keep the injured areas elevated. Obtain medical assistance as soon as possible.

It is important during treatment that you do not:

- Rub the affected area as rubbing may cause gangrene (tissue death).
- Allow the victim to put the affected part near a hot stove or fire.
- Break blisters.
- Allow the victim to walk if the affected area is the feet. (However, walking on a frozen foot is better than staying in the cold.)
- Apply other dressings unless the victim is to be transported for medical aid.
- Allow the victim to smoke or drink alcohol.

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It is important to protect the frozen area from further injury, to warm the affected area rapidly, and to maintain respiration. Never allow the affected area to refreeze. This may lead to further damage and result in eventual amputation.

It is also important to remember that areas that have had frostbite are more susceptible to recurrent frostbite.

3. Hypothermia

Hypothermia results from prolonged exposure to the cold thereby lowering the body's core temperature. Cold does not necessarily mean temperatures below freezing, as hypothermia can be caused by temperatures above 32°F when the person is hungry, wet, tired, and over-exerted. The target organ of hypothermia is the brain.

Hypothermia Symptoms

- Severe shivering.
- Abnormal behavior characterized by decreased efficiency, decreased level of communication, forgetfulness, repetitive behavior, poor motor skills, poor judgment, and general apathy.
- Listlessness and sleepiness.
- Weakness, inability to walk, and repeated falling.
- Later stages include collapse, stupor, unconsciousness, and eventual death.

During hypothermia, the body's thermoregulatory mechanisms may shut down. Shivering is the body's way of warming itself. At 95°F, the body will produce maximum shivering. At 87.8°F, the body loses its capacity to shiver. Table 2 lists the signs of hypothermia. The worker's exposure to cold should be immediately terminated when severe shivering becomes evident.

It is important to note that if a victim is found in a remote area, despite the death-like appearance, the person may be saved. All attempts should be made to revive the victim.

Hypothermia Emergency Care

All stages of hypothermia are treated by either passive or active rewarming. Passive rewarming is accomplished by better conservation of the patient's body heat. However, the victim's thermoregulatory mechanisms must be intact.

Active rewarming means heat is applied to the victim by an external source, either surficially and/or through the core. Treatment includes:

- Preventing further heat loss. Remove the victim to warm, dry place (out of the wind, cold, and rain/snow).

- Remove wet clothing piece-by-piece and dry the underlying skin.
- Dress in several layers of warm, dry clothing, giving preference to the central body core rather than the extremities.
- Cover the victim's head, then wrap victim in blankets.
- If the victim is conscious, allow him/her to drink hot fluids.
- Monitor oral body temperature every 15 minutes. If body temperature falls below 96.8°F, the team member should not be allowed outside until body temperature returns to normal.

In more severe cases of hypothermia, implement the above treatment but also institute some type of active rewarming, including:

- Electric pads or blankets
- Hot-air blowers or heaters
- Heated blankets or clothes
- Use of human body heat

It is important to watch for signs of return of the normal thermoregulatory mechanisms (shivering, teeth chattering, "goose flesh"), and to monitor mental status.

Victim should be transferred to a medical facility after the emergency care steps have been initiated and should not be allowed to return to work for at least 48 hours.

If there has been severe hypothermia, the victim should not be considered dead despite his/her appearance. Treat the victim as stated above and prepare for transfer to a medical facility. If the victim is pulseless and not breathing, perform CPR.

Table 3 lists Threshold Limit Values for working in the cold.

Work-Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below -7°C (20°F) heated warming shelters (tents, cabins, rest rooms, etc.) shall be made available nearby and the workers encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria, are indications for immediate return to the shelter. When entering the heated shelter the outer layer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood

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flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of diuretic and circulatory effect.

For work practices at or below -12°F (10°F) ECT, the following shall apply:

1. The worker shall be under constant protective observation (buddy system or supervision).
2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods must be taken in heated shelters and opportunity for changing into dry clothing shall be provided.
3. New employee shall not be required to work full-time in cold in the first days until they become accustomed to the working conditions and required protective clothing.
4. The weight and bulkiness of clothing shall be included in estimating the required work performance and weights to be lifted by the worker.
5. The work shall be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats shall not be used. The worker should be protected from drafts to the greatest extent possible.
6. The workers shall be instructed in safety and health procedures. The training program shall include as a minimum instruction in:
   a. Proper rewarming procedures and appropriate first aid treatment.
   b. Proper clothing practices.
   c. Proper eating and drinking habits.
   d. Recognition of impending frostbite.
   e. Recognition signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
   f. Safe work practices.

Special caution shall be exercised when working with toxic substances. Cold exposure may require reduced exposure limits.

Eye protection for workers employed out-of-doors in a snow and/or ice-covered terrain shall be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals are required where there is an expanse of snow coverage causing a potential eye exposure hazard.

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Workplace monitoring is required as follows:

a. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60°F) to enable overall compliance with the requirements of the TLV to be maintained.

b. Whenever the air temperature at a workplace falls below -1°C (30°F), the dry bulb temperature should be measured and recorded at least every four hours.

c. In indoor workplaces, the wind speed should also be recorded at least every four hours whenever the rate of air movement exceeds 2 meters per second (5 mph).

d. In outdoor work situations, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below -1°C (30°F).

e. The equivalent chill temperature shall be obtained from Table 1 in all cases where air movement measurements are required, and shall be recorded with the other data whenever the equivalent chill temperature is below -7°C (20°F).

Employees shall be excluded from work in cold at -1°C (30°F) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below -24°C (-10°F) with wind speeds less than 5 mph, or air temperatures below -18°C (0°F) with wind speeds above 5 mph should be medically certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention, because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues, in addition to providing for first aid treatment.

TABLE 1

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS AN EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

*Developed by U. S. Army Research Institute of Environmental Medicine, Natick, MA.

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TABLE 2

SIGNS OF HYPOTHERMIA

Core Temperature °C	°F	Clinical Signs
37.6	99.6	"Normal" rectal temperature.
37	98.6	"Normal" oral temperature.
36	96.8	Metabolic rate increases in an attempt to compensate for heat loss.
35	95.0	Maximum shivering.
34	91.4	Severe hypothermia below this temperature.
32 31	89.4 87.8	Consciousness clouded, blood pressure becomes difficult to obtain but react to light; shivering ceases.
30 29	86.0 84.2	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases.
28	82.4	Ventricular fibrillation possible with myocardial irritability.
27	80.6	Voluntary motion ceases; pupils nonreactive to light; deep tendon and superficial reflexes absent.
26	78.8	Victim seldom conscious.
25	77.0	Ventricular fibrillation may occur spontaneously.
24	75.2	Pulmonary edema.
22 21	71.6 69.8	Maximum risk of ventricular fibrillation.
20	68.0	Cardiac standstill.
18	64.4	Lowest accidental hypothermia victim to recover.
17	62.6	Isoelectric electroencephalogram.
9	48.2	Lowest artificially cooled hypothermia patient to recover.

THRESHOLD LIMIT VALUES WORK / WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT*

AIR TEMPERATURE -- SUNNY SKY		NO NOTICEABLE WIND		5 MPH WIND		10 MPH WIND		15 MPH WIND		20 MPH WIND	
°C (APPROX)	°F	MAXIMUM WORK PERIOD	NUMBER OF BREAKS	MAXIMUM WORK PERIOD	NUMBER OF BREAKS	MAXIMUM WORK PERIOD	NUMBER OF BREAKS	MAXIMUM WORK PERIOD	NUMBER OF BREAKS	MAXIMUM WORK PERIOD	NUMBER OF BREAKS
1. -26° TO -28°	-15° TO -19°	(NORMAL BREAKS)	1	(NORMAL BREAKS)	1	75 MINUTES	2	55 MINUTES	3	40 MINUTES	4
2. -29° TO -31°	-20° TO -24°	(NORMAL BREAKS)	1	75 MINUTES	2	55 MINUTES	3	40 MINUTES	4	30 MINUTES	5
3. -32° TO -34°	-25° to -29°	75 MINUTES	2	55 MINUTES	3	40 MINUTES	4	30 MINUTES	5	NON-EMERGENCY WORK SHOULD CEASE	
4. -35° TO -37°	-30° TO -34°	55 MINUTES	3	40 MINUTES	4	30 MINUTES	5	NON-EMERGENCY WORK SHOULD CEASE			
5. -38° TO -39°	-35° to -39°	40 MINUTES	4	30 MINUTES	5	NON-EMERGENCY WORK SHOULD CEASE					
6. -40° TO -42°	-40° TO -44°	30 MINUTES	5	NON-EMERGENCY WORK SHOULD CEASE							
7. -43° & BELOW	-45° & BELOW	NON-EMERGENCY WORK SHOULD CEASE									

Notes: (a) Schedule applies to moderate to heavy work activity with warm-up beaks of ten (10) minutes in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -30°F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with four breaks in a 4-hour period (Step 5).

(b) The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.

(c) If only the windchill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: (1) special warm-up breaks should be initiated at a windchill of about 1750 W/m^2; (20 all non-emergency work should have cased at or below a windchill of 2250 W/m^2. In general the warm-up schedule provided above slightly under compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.

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*Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labour.

Field operations during the summer months can create a variety of hazards to the employee. Heat cramps, heat exhaustion, and heat stroke can be experienced; and if not remedied, can threaten life or health. Therefore, it is important that all employees be able to recognize symptoms of these conditions and be capable of arresting the problem as quickly as possible.

A. THE EFFECTS OF HEAT

As the result of normal oxidation processes within the body, a predictable amount of heat is generated. If the heat is liberated as it is formed, there is no change in body temperature. If the heat is liberated more rapidly, the body cools to a point at which the production of heat is accelerated and the excess is available to bring the body temperature back to normal.

Interference with the elimination of heat leads to its accumulation and thus to the elevation of body temperature. As a result, the person is said to have a fever. When such a condition exists, it produces a vicious cycle in which certain body processes speed up and generate additional heat. Then the body must eliminate not only the normal but also the additional quantities of heat.

Heat produced within the body is brought to the surface largely by the bloodstream and escapes to the cooler surroundings by conduction and radiation. If air movement or a breeze strikes the body, additional heat is lost be convection. However, when the temperature of the surrounding air becomes equal to or rises above that of the body, all of the heat must be lost by vaporization of the moisture or sweat from the skin surface. As the air becomes more humid (contains more moisture), vaporization from the skin slows down. Thus, on a day when the temperature is 95 to 100°F, with high humidity and little or no breeze,, conditions are ideal for the retention of heat within the body. It is on such a day, or more commonly a succession of such days (a heat wave), that medical emergencies due to heat are likely to occur. Such emergencies are classified in three categories: heat cramps, heat exhaustion, and heat stroke.

1. HEAT CRAMPS

Heat cramps usually affect people who work in hot environments and perspire a great deal. Loss of salt from the body causes very painful cramps of the leg and abdominal muscles. Heat cramps also may result from drinking iced water or other drinks either too quickly or in too large a quantity.

Heat Cramp Symptoms. The symptoms of heat cramp are:

- Muscle cramps in legs and abdomen,
- Pain accompanying the cramps,
- Faintness, and
- Profuse perspiration.

Heat Cramp Emergency Care. Remove the patient to a cool place. Give him sips of liquids such as "Gatorade" or its equivalent. Apply manual pressure to the cramped muscle. Remove the patient to a hospital if there is any indication of a more serious problem.

2. HEAT EXHAUSTION DRAFT

Heat exhaustion occurs in individuals working in hot environments, and may be associated with heat cramps. Heat exhaustion is caused by the pooling of blood in the vessels of the skin. The heat is transported from the interior of the body to the surface by the blood. The blood vessels in the skin become dilated and a large amount of blood is pooled in the skin. This condition, plus the blood pooled in the lower extremities when an individual is in an upright position, may lead to an inadequate return of blood to the heart and eventually to physical collapse.

Heat Exhaustion Symptoms. The symptoms of heat exhaustion are:

- Weak pulse;
- Rapid and usually shallow breathing;
- Generalized weakness;
- Pale, clammy skin;
- Profuse perspiration;
- Dizziness;
- Unconsciousness; and
- Appearance of having fainted (the patient responds to the same treatment administered in cases of fainting).

Heat Exhaustion Emergency Care. Remove the patient to a cool place and remove as much clothing as possible. Administer cool water, "Gatorade," or its equivalent. If possible, fan the patient continually to remove heat by convection, but do not allow chilling or overcooling. Treat the patient for shock, and remove him to a medical facility if there is any indication of a more serious problem.

3. HEAT STROKE

Heat stroke is a profound disturbance of the heat-regulating mechanism, associated with high fever and collapse. Sometimes this condition results in convulsions, unconsciousness, and even death. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age (over 40) bear directly on the tendency to heat stroke. It is a serious threat to life and carries a 20 percent mortality rate. Alcoholics are extremely susceptible.

Heat Stroke Symptoms. The symptoms of heat stroke are:

- Sudden onset;
- Dry, hot, and flushed skin;
- Dilated pupils;
- Early loss of consciousness;
- Full and fast pulse;
- Breathing deep at first, later shallow and almost absent;
- Muscle twitching, growing into convulsions; and
- Body temperature reaching 105 to 106°F or higher.

Heat Stroke Emergency Care. Remember that this is a true emergency. Transportation to a medical facility should not be delayed. Remove the patient to a cool environment if possible, and remove as much clothing as possible. Assure an open airway. Reduce body temperature promptly, preferably by wrapping in a wet sheet or else by dousing the body with water.

If cold packs are available, place them under the arms, around the neck, at the ankles, or at any place where blood vessels that lie close to the skin can be cooled. Protect the patient from injury during convulsions, especially from tongue biting.

B. AVOIDANCE OF HEAT-RELATED EMERGENCIES

Please note that in the case of heat cramps or heat exhaustion, "Gatorade" or its equivalent is suggested as part of the treatment regime. The reason for this type of liquid refreshment is that such beverages will return much-needed electrolytes to the system. Without these electrolytes, body systems cannot function properly, thereby increasing the represented health hazard. Therefore, when personnel are working in situations where the ambient temperatures and humidity are high, and especially in situations where protection Levels A, B, and C are require, the site safety officer must:

- Assure that all employees drink plenty of fluids ("Gatorade" or its equivalent);
- Assure that frequent breaks are scheduled so overheating does not occur; and
- Revise work schedules, when necessary, to take advantage of the cooler parts of the day (e.g., 5:00 a.m. to 1:00 p.m. and 6:00 p.m. to nightfall).
- Assure that workers are acclimated before allowing them to work for extended periods. Heat induces a series of physiological and psychological stresses that the individual worker must adjust to during the first week of heat exposure. Workers should slowly work into their peak work performance over a two-week period. Workers absent from the site several days must be allowed to become reacclimated.

If protective clothing must be worn, especially Levels A and B, the suggested guidelines for ambient temperature and maximum wearing time per excursion are given in the following Table:

Suggested guidelines for continuous use of Level A or Level B protection:

Ambient Temperature (°F)	Maximum Wearing Time per Excusion (minutes)
Above 90	15
85 to 90	30
80 to 85	60
70 to 80	90
60 to 70	120
50 to 60	180

C. REST-RECOVERY REGIME **DRAFT**

One method of measuring the effectiveness of employees' rest-recovery regime is by monitoring the heart rate. The "Brouha Guideline" is one such method:

- During a three-minute period, count the pulse rate for the last 30 seconds of the first minute, the last 30 seconds of the second minute, and the last 30 seconds of the third minute.
- Double the count.

If the recovery pulse rate during the last 30 seconds of the first minute is at 110 beats/minute or less, and the deceleration between the first, second, and third minutes is at least 10 beats/minute, the work-recovery regime is acceptable. If the employee's rate is above that specified, a longer rest period is required, accompanied by an increase intake of fluids .

HEAT STRESS MONITORING

DRAFT

NAME: ______________________ DATE/TIME: ________________

SITE: ________________

COMPANY: ______________________ LOCATION: ________________

Pulse Rate Monitoring (30 second rest prior to first measurement):

Starting Time: __________ Pulse Rate: ________ beats/minute;

rest 30 sec.; ___________; rest 30; ___________ b/m;

rest 30 sec.; ___________; rest 60; ___________ b/m;

rest 60 sec.; ___________; rest 60: ___________ b/m;

Starting Time: __________ Pulse Rate: ________ beats/minute;

rest 30 sec.; ___________; rest 30; ___________ b/m;

rest 30 sec.; ___________; rest 60; ___________ b/m;

rest 60 sec.; ___________; rest 60: ___________ b/m;

Starting Time: __________ Pulse Rate: ________ beats/minute;

rest 30 sec.; ___________; rest 30; ___________ b/m;

rest 30 sec.; ___________; rest 60; ___________ b/m;

rest 60 sec.; ___________; rest 60: ___________ b/m;

Starting Time: __________ Pulse Rate: ________ beats/minute;

rest 30 sec.; ___________; rest 30; ___________ b/m;

rest 30 sec.; ___________; rest 60; ___________ b/m;

rest 60 sec.; ___________; rest 60: ___________ b/m;

Method of Measurement:

Carotid Artery: __________; Instrument (specify type): ______________

Self-Determined & Reported: ________

Site Safety Officer: __________(Contractor); ________(Contract Monitor)

____

Site Safety Officer

ATTACHMENT B-3

ON-SITE DOCUMENTATION FORMS

PLAN ACCEPTANCE FORM

PROJECT HEALTH AND SAFETY PLAN

I have read and agree to abide by the contents of the Health and Safety Plan for the following project:

____

____
Signed

____
Date

Return to Office Health and Safety Representative before starting to work on subject project work site.

DRAFT

INCIDENT REPORT
Page 1 of 6

Inc. rpt. no.:________-___

DATE OF REPORT ______________

SITE: ____

SITE LOCATON: ____

REPORT PREPARED BY: ____
NAME PRINTED TITLE

INCIDENT CATEGORY
(check all that apply)

___ Injury
___ Near Miss
___ Motor Vehicle
___ Mechanical
___ Illness
___ Fire
___ On site equipment
___ Other
___ Property Damage
___ Chemical Exposure
___ Electrical

DATE AND TIME OF INCIDENT ____________________________________

Narrative Report of Incident:
(Provide sufficient detail so that the reader may fully understand the actions leading to or contributing to the incident, the incident occurrence, and actions following the incident. Append additional sheets of paper if necessary.)

____
____
____
____
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DRAFT

INCIDENT REPORT
Page 2 of 6

Inc. rpt. no.:_______-____

WITNESSES TO INCIDENT

1. NAME ______________________ COMPANY ______________
ADDRESS ______________________________
TELEPHONE NO. ______________________________

2. NAME ______________________ COMPANY ______________
ADDRESS ______________________________
TELEPHONE NO. ______________________________

INJURIES

FIRST INJURED PERSON

Name and Address of Injured: ______________________________

____

SSN: ______________ Age: ______ Sex: ______

Years of Service: __________ Time on Present Job: ______

Title/Classification: ______________________________

Severity of Injury or Illness: _____ Non-disabling
_____ Disabling _____ Medical Treatment
_____ Fatality

Estimated Number of Days Away From Job: ______________

Nature of Injury or Illness: ______________________________

____

Classification of Injury:

____ Fractures	____ Heat Burns	____ Cold Exposure
____ Dislocations	____ Chemical Burns	____ Frostbite

DRAFT

____ Sprains
____ Abrasions
____ Lacerations
____ Punctures
____ Faint/Dizziness
____ Respiratory Allergy
____ Dermal Allergy

____ Radiation Burns
____ Bruises
____ Blisters
____ Toxic Respiratory Exposure

____ Heat Stroke
____ Heat Exhaustion
____ Concussion
____ Bites
____ Toxic Ingestion

Part of Body Affected: ______________________________
Degree of Disability: ______________________________

Date Medical Care was Received: ______________________
Where Medical Care was Received: ______________________
Address (if off-site):

____

If Hospitalized
Name, Address and Telephone No. of Hospital:

____

Name, Address and Telephone No. of Physician

____

SECOND INJURED PERSON

Name and Address of Injured: ______________________

____

SSN: ______________ Age:______ Sex:______

Years of Service: _________ Time on Present Job: ______

Title/Classification: ______________________________

Severity of Injury or Illness: ____ Non-disabling
____ Disabling ____ Medical Treatment
____ Fatality

Estimated Number of Days Away From Job: ______________

Nature of Injury or Illness: ______________________

____

DRAFT

Inc. rpt. no.:_______-____

Classification of Injury:

- ____ Fractures
- ____ Dislocations
- ____ Sprains
- ____ Abrasions
- ____ Lacerations
- ____ Punctures
- ____ Faint/Dizziness
- ____ Respiratory Allergy
- ____ Dermal Allergy

- ____ Heat Burns
- ____ Chemical Burns
- ____ Radiation Burns
- ____ Bruises
- ____ Blisters
- ____ Toxic Respiratory Exposure

- ____ Cold Exposure
- ____ Frostbite
- ____ Heat Stroke
- ____ Heat Exhaustion
- ____ Concussion
- ____ Bites
- ____ Toxic Ingestion

Part of Body Affected: ____________________

Degree of Disability: ____________________

Date Medical Care was Received: ____________________

Where Medical Care was Received: ____________________

Address (if off-site):

____

If Hospitalized
Name, Address and Telephone No. of Hospital:

____

Name, Address and Telephone No. of Physician

____

(If more than two injuries, provide information on separate sheet).

PROPERTY DAMAGE

Brief Description of Property Damaged

____

____

____

Estimate of damage: $____________________

DRAFT

Inc. rpt. no.:________-____

INCIDENT LOCATION

____

____

____

INCIDENT ANALYSIS

Causative agent most directly related to accident (Object, substance, material, machinery, equipment, conditions):

____

____

Was weather a factor?: ______________________

Unsafe mechanical/physical/environmental condition at time of incident (Be specific):

____

____

Unsafe act by injured and/or others contributing to the incident (Be specific, must be answered):

____

____

Personal factors (Improper attitude, lack of knowledge or skill, slow reaction, fatigue):

____

____

On Site Incidents

Level of personal protection equipment required in Site Safety Plan:__________ . __________

____

____

Modifications:______________________________

____

____

Was injured using required equipment?:______________

____

____

DRAFT

Inc. rpt. no.:________-____

If not, how did actual equipment use differ from plan:

____

____

____

ACTION TAKEN TO PREVENT RECURRENCE

(Be very specific. What has or will be done? When will it be done? Who is the responsible party to insure that the correction is made?)

____

____

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INCIDENT REPORT COMPLETED BY

RSO Name Printed	RSO Signature

OTHERS PARTICIPATING IN INVESTIGATION

Name Printed	Signature	Title
Name Printed	Signature	Title
Name Printed	Signature	Title

INCIDENT FOLLOW-UP REPORT

DRAFT

Incident No.: Date of Incident:

Site Name: Project No.:

Follow-up Prepared By: Date:

Outcome of Incident:

Physicians Recommendations:
First Injured Person:

Second Injured Person:

Other Injured Persons:

Date Returned to Work:
First Injuried Person:

Second Injured Person:

Other Injured Persons:

Have corrective actions recommended by investigation been implemented ? If not, explain why not. What alternative actions have been taken?

Investigation Team:

Name Printed	Signature	Title

ATTACH ANY ADDITIONAL INFORMATION

DRAFT

SCBA

RESPIRATORY LOG

SITE: ______________________________

LOCATION: ______________________________

DATES OF INVESTIGATION: ______________________________

User	Date of Use	SCBA#	Satisfactory Check-Out (Yes/No - Initials)	Date Cleaned

SCBA Performance Comments:

____

Site Health and Safety Officer   Date

or ES Project Manager

Return to Office Health and Safety Representative at the completion of field activities.

DRAFT

AIR PURIFYING

RESPIRATOR LOG

SITE: ______________________________

LOCATION: ______________________________

DATES OF INVESTIGATION: ____________________

User	Date of Use	Cleaned and Inspected Prior To Use (Initials)	Cartridges Changed Prior to Use (Yes, NO, N/A)	Total Hours on Cartridge

____

Site Health and Safety Officer or ES Project Manager   Date

Return to Office Health and Safety Representative at the completion of field activities.

DRAFT

Site Entry Log:

SITE: ______________________________

LOCATION: ______________________________

DATES OF INVESTIGATION: ______________________________

Date	Name	Company	Activity	Time in / Time out

FIELD AIR MONITORING LOG

DRAFT

DATE ____________

SITE: ______________________________ PAGE ____ OF ____

SITE SAFETY OFFICER: ______________ SAFETY MONITORS: ______________

____

WEATHER CONDITIONS: ______________________________

INSTRUMENTATION CONDITIONS: ______________________________

ACTIVITY/REASON FOR MONITORING	LOCATION	TIME	READING	INITIALS

DRAFT

AIR MONITORING INSTRUMENT

page ___ of ___

CALIBRATION LOG

Project Name : ______________________ Project Location: ______________________

Job Number: ______________________

Instrument Type: ______________________ Instrument Number: ______________________

Date	Cal Gas Conc.	Instrument Reading	Adjusted (Y/N)	New Setting	New Reading	Maintenance Notes	Initials

ATTACHMENT B-4

PERSONAL PROTECTIVE EQUIPMENT PROGRAM

RESPIRATORY PROTECTION PROGRAM

Prepared for

THE ENGINEERING-SCIENCE NORTHEAST OPERATIONS OFFICE

June 1990

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1.0 OBJECTIVE

The objective of the Respiratory Protection Program is to provide Engineering-Science, Inc. (ES) Northeast Operations field personnel with sufficient information and guidance to adequately protect themselves from potential inhalation hazards during hazardous waste or industrial field operations. The use of respirators to protect personnel from inhalation hazards is permitted by OSHA under 29 CFR Part 1910.134 when other more positive methods of protection, such as engineering controls (e.g., ventilation) or work practices (e.g., substitution) are not feasible.

2.0 NEED FOR RESPIRATORY PROTECTION

OSHA has established safe exposure levels for various airborne contaminants that may be encountered at sites during field operations. If worker exposure to these substances exceeds the OSHA permissible exposure limits, OSHA requires that feasible engineering controls and administrative measures be instituted to reduce worker exposure to within acceptable levels. If controls are not feasible, employers are required to provide the appropriate, approved respirators for employee protection. Because of the nature of site work in general, traditional industrial hygiene engineering controls are not usually feasible. Hence, respirators must be relied upon as a means for protecting workers at hazardous waste sites. All respiratory protection practices for ES Denver personnel, including selection and use, shall be in accordance with this program.

3.0 MINIMUM REQUIREMENTS OF AN ACCEPTABLE RESPIRATOR PROGRAM

OSHA has established the requirements for a minimally acceptable program under 29 CFR Part 1910.134. A copy of this standard is included as Appendix A in this manual. Elements that must be incorporated into an OSHA-acceptable program include the following:

- Approved respiratory devices must be properly selected.
- A determination must be made regarding the need for respiratory protective devices.
- An employee training program must be established in which the employee becomes familiar with the respiratory protective devices and is trained in the proper selection and use of respirators and their limitations.
- There must be provisions for:
  The proper maintenance, storage, inspection and repair of respirators.
  Testing for the proper fit of the respiratory protective equipment.
  Medical screening of employees to determine if they are physically able to perform their assigned work while using of respiratory protective equipment.
- Written standard operating procedures for the selection and use of respiratory protective equipment.

4.0 ESTABLISHMENT OF THE RESPIRATOR PROGRAM

Personnel with specific responsibilities for the implementation of the program include the following:

4.1 OFFICE HEALTH AND SAFETY REPRESENTATIVE (PHILLIP HUNT, C.I.H.)

The Office Health and Safety Representative is responsible for:

- Administering the respiratory protection program.
- Setting up and conducting training program.
- Selecting and working with a medical contractor.
- Ensuring the office has the necessary respiratory protective equipment.
- Scheduling and conducting fit testing.
- Development of written standard operating procedures guiding the selection respiratory equipment.
- Maintaining fit test and medical records.

4.2 HEALTH AND SAFETY EQUIPMENT MANAGER

The health and safety equipment manager reports to the Office Health and Safety Representative and is responsible for the following:

- The inspection, maintenance and cleaning of respirators.
- The proper storage of respirators.
- Maintenance of records for the repair of respirators.
- Maintaining an adequate stock of cartridges for air purifying respirators. This person must ensure self-contained breathing apparatuses are filled with Grade D or better breathing air.
- Distributing respirators to field team members.

4.3 PROJECT HEALTH AND SAFETY OFFICER (PHSO)

All hazardous waste and industrial field investigations shall have a Project Health and Safety Officer. This individual reports to the Office Health and Safety Representative and is responsible for the following:

- Ensuring that any team member conducting a field investigation has received training in the selection and use of respirators and has the equipment necessary to conduct the investigation safely.
- Determining the degree of respiratory protection required for each field task or operation.
- Ensuring site-specific training is performed prior to onsite activities.
- Maintaining records of respirator use.

4.4 PROJECT STAFF

All project team members must read and conform to the Project Health and Safety Plan. Employees must present a copy of their fit test log to the equipment manager in order to receive a respirator. Employees are to perform daily inspections and cleaning of their assigned respirator. In the field respirators shall be stored in a convenient, clean and sanitary location when not in use. Workers must report any perceived problems or difficulties with respiratory protecive equipment to their Project Health and Safety Officer. These malfunctions may include, but are not limited to, the following:

- Perception of odor while wearing a respirator.
- Resistance in breathing during respirator use.
- Fatigue due to respirator use.

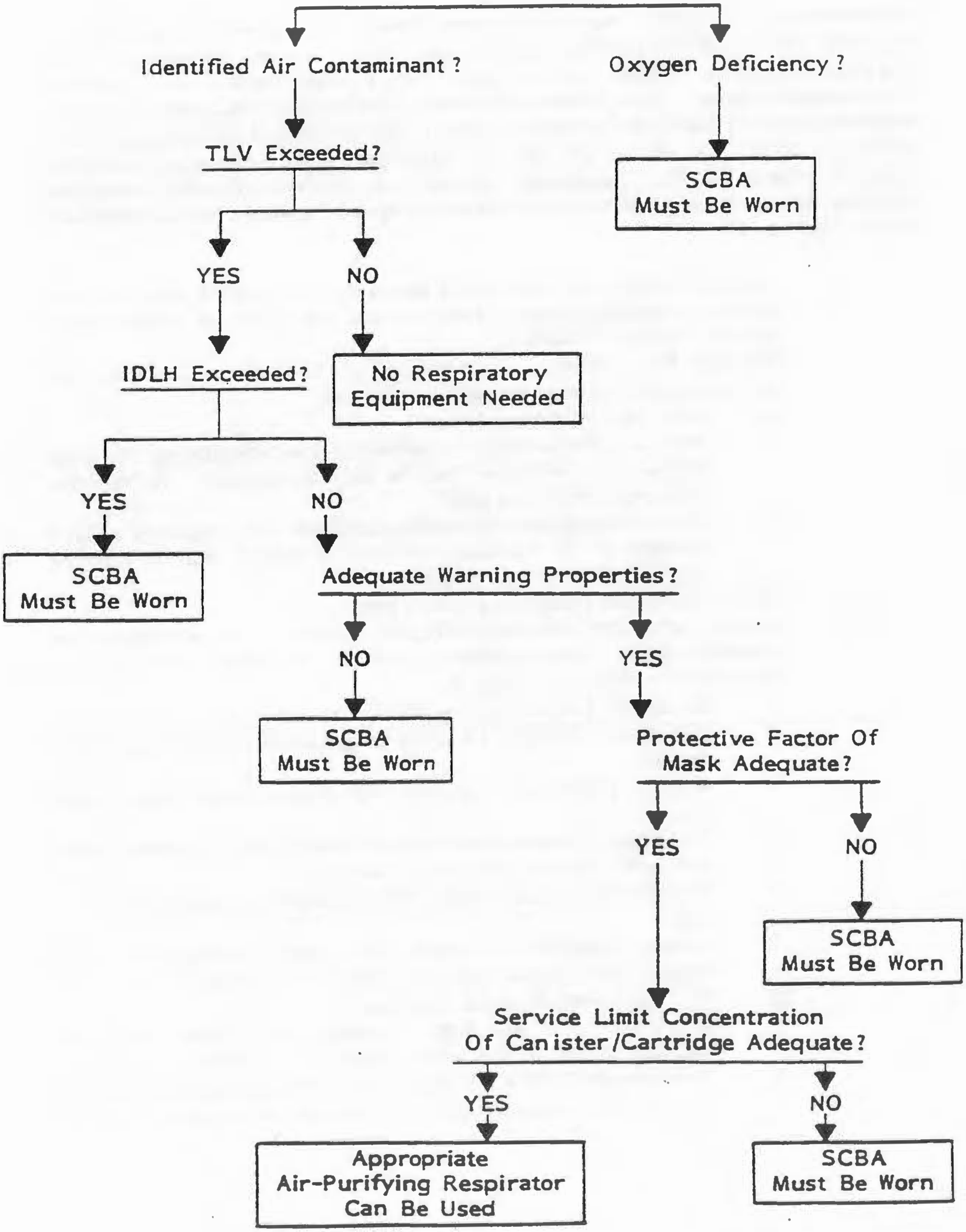
5.0 RESPIRATOR SELECTION

The investigation of hazardous waste sites presents workers with a number of environmental conditions, some of which are better defined than others. It is not the purpose of this document to provide precise decision logic criteria encompassing every potential environmental situation. Each situation is unique. This document recognizes that many decisions concerning respiratory protection selection involve aspects of risk assessment. This procedure ensures that all relevant data are considered in the process of conducting respiratory proectection risk assessments, resulting in the selection of specific respiratory protective equipment items appropriate for protection against hazardous chemical exposure. Steps to take include:

1. Assimilate all available information pertaining to the hazard including: past activities, suspected materials, historical information, land use, analytical data, nature of current activities, etc.
2. Evaluate the relevance and timeliness of the data to determine the appropriate protective level needed for the task.
   a) Is the analytical data relevant?
   b) Was the past sampling or monitoring conducted during the same season as is anticipated for the activities planned? If not, what implication might this hold?
   c) Was past sampling or monitoring conducted from a medium which is pertinent to the evaluation of hazards associated with the activities specified in the task work plan?
3. Identify substances present at the work area.
4. Utilizing the subject areas listed below, evaluate all of the known or suspected chemicals on site. Topics requiring elaboration are detailed in the decision logic criteria section (see Figure 1).
   a) Permissible Exposure Limits (PEL), Threshold Limit Values (TLV).
   b) Eye irritation potential for substance (see below, decision logic criteria section).
   c) Warning properties of substance (see below, decision logic criteria section).
   d) Immediately Dangerous to Life and Health (IDLH) cocnentrations (see below, decision logic criteria section).
   e) Any possibility of poor sorbent efficiency at IDLH concentrations and below.
   f) Is there a possibility of severe skin irritation resulting from skin contact with corrosive gases (see below, decision logic criteria).
   g) The vapor pressure of the substance.
   h) Any possibility of high heat of reaction with sorbent material in cartridge or canister (see below, decision logic criteria).
   i) Is there a possibility of shock sensitivity of chemical being sorbed onto the cartridge or canister (see below, decision logic criteria).

FIGURE 1

DECISION LOGIC FLOW CHART ON CHOOSING APPROPRIATE RESPIRATOR



5. Determine the physical state(s) of the substance as it is likely to be encountered at the hazardous waste site. It will be either:
    a) a gas or vapor;
    b) particulate (dust, fume, or mist), or
    c) a combination of (a) and (b).
6. Oxygen deficient atmospheres (ANSI Z88.2-1980) — air-purifying respirators shall not be worn in environments deficient in oxygen ($<$ 19.5% by volume or partial pressure less than 100 mm of mercury).

5.1 DECISION LOGIC CRITERIA

5.1.1 Skin Adsorption and Irritation

A supplied-air suit may provide skin protection from extremely toxic substances which may be absorbed through the skin or cause severe skin irritation. Most information concerning skin irritation is not quantitative but rather is presented in commonly used descriptive terms, such as "a strong skin irritant, highly irritating to the skin" and "corrosive to the skin." Decisions made concerning skin irritation are judgmental and are often based on this non-quantitative information. As a guideline for the use of the supplied-air suit for substances that are sorbed through the skin, a single skin penetration LD50 of 2 g/kg for any animal species is used.

5.1.2 Poor Warning Properties

Air-purifying devices cannot be used to protect against organic vapors with poor warning properties. Warning properties include odor, eye irritation, taste imparting characteristics, and respiratory irritation. Warning properties provide an indication to the wearer of possible cartridge exhaustion or of poor face piece fit. Adequate warning properties can be assumed when the substances odor, taste, or irritation effects are detectable and persistent at concentrations at or below the permissible exposure limit.

If the odor or irritation threshold of a substance is more than two times greater than the PEL, this substance should be considered to have poor warning properties. Some substances have extremely low thresholds of odor and irritation in relation to the permissible exposure limit. These substances can be detected by a worker within the face piece of the respirator even when the respirator is functioning properly. These substances are considered to have poor warning properties (see Table 1).

Although 30 CFR Part 11*[1] does not specifically eliminate the use of air-purifying respirators for pesticides with poor warning properties, prudent practices dictate that a respirator should not be used to protect against any substance with poor warning properties.

---

* The primary technical criteria for what constitutes a permissible respirator is determined by the technical requirements of 30 CFR Part 11 (Department of Interior, Bureau of Mines, Respiratory Protective Devices and Test for Permissibility).

5.1.3 Sorbents

There are certain limitations to the use of sorbent cartridge/canister respirators. When the following conditions exist, a sorbent cartridge is not recommended:

- A cartridge/canister air-purifying respirator can never be used when evidence exists of immediate (less than 3 minutes) breakthrough time at or below the IDLH concentration.
- An air-purifying canister/cartridge respirator shall not be used when there is reason to suspect that the sorbent does not provide adequate efficiency against the removal of a specific contaminant(s) that may be encountered at the site.
- Where there is reason to suspect that a sorbent has a high heat of reaction with a substance, use of that sorbent is not allowed.
- Where there is reason to suspect that a substance sorbed onto the surface of a cartridge or canister is shock sensitive, use of air-purifying respirators is prohibited.
- For concentrations of organic vapors which exceed 1,000 ppm (10 times the PEL for quarter masks or 50 times the PEL for full facepiece masks). Note: this respirator will not be selected if the contaminant or its concentration are unknown.

5.1.4 Eye Irritation

The decision of whether to use a full-face respirator or a half or quarter-face respirator is often made by considering the chemical's potential for producing eye irritation or damage. The following guidelines deal with eye protection.

Any eye irritation is considered unacceptable for routine work activities. Therefore, only full-face respirators are permissible in contaminant concentrations that produce eye irritation. For escape, some eye irritation is permissible if it is determined that such irritation would not inhibit escape and such irritation is reversible.

In instances where quantitative eye irritation data cannot be found in literature references, and theoretical considerations indicate that the substance should not be an eye irritant, half-face piece respirators are allowed.

In cases where a review of the literature indicates a substance causes eye irritation but no eye irritation threshold is specified, the full-face piece respirators can be used.
Immediately dangerous to life or health (IDLH)

The definition of IDLH provided in 30 CFR 11.3(t) is as follows:

> "Immediately dangerous to life or health" means conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants, such as radioactive materials, which are likely to have adverse cumulative or delayed effects on health."

The purpose of establishing an IDLH exposure concentration is to insure that the worker can escape without injury or irreversible health effects in the event of failure of the respiratory protective equipment. The IDLH is considered the maximum concentration above which only

Table 1

Comparison of Selected Odor Thresholds and TlVs for Chemical Compounds

Compounds	Odor Threshold (ppm)	TLV (ppm)
Group 1 - Odor Threshold and TLV Approximately the Same		
Cyclohexane	300	300
Cyclohexanol	100	50
Epichlorhydrin	10	5
Ethylene diamine	11	10
Hydrogen chloride	10	5
Methyl acetate	200	200
Methylamine	10	10
Methyl chloroform	500	350
Nitrogen dioxide	5	3
Propyl alcohol	200	200
Turpentine	200	100
Group 2 - Odor Threshold from 2 to 10 Times the TLV		
Acrolein	0.2	0.1
Acrylonitrile	21.0	2.0
Allyl alcohol	7.0	2.0
Arsine	0.21	0.05
1,2-Dichloroethylene	500.0	200.0
Dichloroethyl ether	35.0	5.0
Dimethyl acetamide	46.0	10.0
Ethyl benzene	200.0	100.0
Hydrogen selenide	0.3	0.05
Isopropyl glycidylether (IGE)	300.0	50.0
Group 3 - Odor Threshold Equal to or Greater than 10 Times TLV		
Bromoform	530.0	0.5
Camphor (synthetic)	1.6-200	2.0
Carbon tetrachloride	75.0	5.0
Chloroacetophenone	1.0	0.05
Chloroform	200.0	10.0
Chloropicrin	1.0	0.1
Diglycidylether (DGE)	5.0	0.1
Dimethylformamide	100.0	10.0
Ethylene oxide	500.0	1.0
Methyl formate	2000.0	100.0
Methanol	2000.0	200.0
Methyl cyclohexanol	500.0	50.0
Phosgene	1.0	0.1
Toluene 2,4-diisocyanate (TDI)	2.0	0.005

a highly reliable positive-pressure self contained breathing apparatus is permitted. Since IDLH values are conservatively set, any approved respirator may be used up to its maximum use concentration below the IDLH.
In establishing the IDLH concentration the following factors are considered:

1. Escape without loss of life or irreversible health effects. Thirty minutes is considered the maximum permissible exposure time for escape.
2. Severe eye or respiratory irritation or other reactions which would prevent escape without injury.

IDLH should be determined from the following sources:

1. Specific IDLH concentration provided in the literature such as the AIHA

Hygienic Guides and the NIOSH Pocket Guide to Chemical Hazards

2. Human exposure data
3. Acute animal exposure data
4. Acute toxicological data from analogous substances.

The following guidelines should be used to interpret toxicological data reported in the literature for animal species:

1. Where acute inhalation exposure data (30 minutes to 4 hours) are available for various animal species the lowest exposure concentration causing death or irreversible health effects in any species is determined to be the IDLH concentration.
2. Chronic exposure data may have little relevance to the acute effects and should not be used in determining the IDLH.

5.1.6 Protection Factors

The protection factors of respiratory protection devices are a useful numerical tool to aid in the selection of appropriate respiratory protection. Protection factors measure the overall effectiveness of a respirator.

The protection factor of a given respirator for a specific user multiplied by the PEL for a given substance is the maximum allowable concentration of that substance for which the respirator may be used. For example, if the protection factor for a full-face mask respirator is 50 and substance X has a PEL (or TLV) of 10 ppm, the full-face mask respirator will provide protection up to 500 ppm (see Table 2).

5.1.2 Respirator Types

5.1.2.1 Air-Purifying Respirators

As mentioned earlier, an air-purifying respirator can be used only if the atmosphere contains greater than 19.5 percent oxygen and the contaminant is present at a concentration below the IDLH level. Another important consideration is that the contaminant in question has properties which will alert the user that the filter or sorbent is about to be exhausted. The various types of air-purifying respirators utilized by Atlanta are listed below.

5.1.2.2 Half-Mask Respirators

A half-mask respirator fits from under the chin to above the nose. One or two cartridges are used to filter the air and discarded once the use limits are reached. Whereas the quarter-mask is approved for only dusts, the half-mask has approved cartridges for pesticides, organic vapors, dusts, mists, fumes, acid gases, ammonia, and several combinations.

5.1.2.3 Full Face Mask Respirators

The whole face, including the eyes, is protected by the full face mask. It gives 5 times the protection of a half-mask (full face mask PF = 50, half-mask PF = 10). Full Face masks are more expensive, but the added protection is certainly advantageous, no matter how small the risk in a given situation.

5.1.2.4 Atmosphere Supplying Respirators

Atmosphere supplying respirators provide from 5 minutes to several hours of breathing air. The amount of protection provided is based upon the type of face piece and its mode of operation. The full face mask provides the best protection.

Of the three modes of operation, continuous, demand, and pressure-demand, the pressure-demand mode provides the best protection.

There are two types of atmosphere supplying respirators that the Atlanta office uses: airline and self-contained breathing apparatus (SCBA). A description of each is presented below.

5.2.4.1 Airline Respirator

This respirator uses an airline to transport clean compressed air to the wearer. The mode of operation may be either continuous, demand, or pressure-demand. This respirator may be worn in an IDLH environment if: (1) it is pressure-demand type, and (2) it incorporates an escape SCBA into the system, however, no more than 300 feet of airline is allowed.

5.2.4.2 Self-Contained Breathing Apparatus

The self-contained breathing apparatus (SCBA) allows the wearer to carry a cylinder of compressed air or oxygen without the confinement of a hose or airline.
The North 801 and MSA Ultralite are the two types of SCBAs used by Engineering-Science. Both are open-circuit SCBAs. The North respirator is approved for demand and pressure demand modes. Greater protection is afforded, however, when these respirators are operated in the pressure demand mode.

5.2.4.3 Escape

Engineering-Science will provide and ensure that all employees will carry an escape respirator where exposure to extremely toxic substances may occur. (An extremely toxic substance is defined as a gas or vapor having an LC50 equal to or less than 10 ppm). An

Table 2

Selected Respirator Protection Factors

Type of Respirator	Protection Factor (Qualitative Test)
Air-purifying	
quarter-mask	10
half-mask	10
Air-line	
quarter-mask	10
half-mask	10
Hose mask	
full facepiece	10
SCBA, demand	
quarter-mask	10
half-mask	10
Air-purifying	
full facepiece	50
Air-line, demand	
full facepiece	50
SCBA, demand	
full facepiece	50
Air-line, pressure-demand, with escape provision	
full facepiece (no test required)	10,000+
SCBA, pressure-demand or positive pressure	
full facepiece (no test required)	10,000+

For additional information consult ANSI Z88.2 - 1980.

escape SCBA must have at least 5 minutes of breathing air stored in a small cylinder or coiled stainless-steel tube. Escape devices should never be used for entry into hazardous atmospheres.

4.3 SELECTION OF RESPIRATORS USING ACTIVITY MEASUREMENTS

Identification and evaluation of the contaminants that exist at a particular time provide the basis for selection of a respirator. However, real-time monitoring of activities at sites will be conducted using direct reading air monitoring instruments as the index of hazard. Therefore, respirators must be selected prior to initiating an activity, based on characterizations of groundwater and soils, knowledge of the area and associated waste, and previous measurements of worker exposure levels for the same or very similar tasks under similar conditions. Once a level of protection has been chosen, it can be modified based on real-time activity measurements, supplemented with background information and professional judgment.

Below are the allowed modifications. Please note carefully the qualifiers.

- Level B to Level D

This modification may be made in the sustained absence of volatiles or particulates as measured on real-time equipment and at the direction of the PHSO.

- Level C to Level D
  Same as Level B to Level D
- Level D to Level B

May be made at the direction of the PHSO based on the magnitude of the measurements and on professional judgment.

- Level C to Level B

Permissible at the direction of the PHSO in cases where total volatiles or particulate measurements exceed the preset action level based on characterization on the expected contaminants.

- Level D to Level C

Permissible at the direction of the PHSO when total volatiles or particulates exceed the preset action level based on characterization of the expected contaminants and when PEL-TWA measurements are being taken concurrently.

- Level B to Level C

May be made at the direction of the PHSO only when the contaminants and their concentrations are known. This modification should not be used without substantial knowledge of all the chemicals involved and their expected behavior in relation to change in concentration and effect on absorbent cartridges.

6.0 TRAINING AND FITTING

6.1 TRAINING

Selecting the respirator appropriate for a given hazard is important, but equally important is using the selected device properly. Proper use can be ensured by careful training of users and by maintenance of respiratory protective devices.

Engineering-Science requires respirator training as part of the initial training course conducted for workers who are to perform hazardous waste or industrial field operations. Additionally, the ES Denver office requires respirator training to be incorporated into the annual refresher training provided to employees performing hazardous waste activities. Both trainings will address the subjects in Table 3. Project-specific respirator training should be offered by the Project Health and Safety Officer as part of the initial site-specific training.

6.2 RESPIRATOR FITTING

The proper fitting of respiratory protective devices requires the use of a fit test. The fit test is needed to determine a proper match between the facepiece of the respirator and the face of the user.

The test subject shall be given the opportunity to choose the most comfortable respirator from various sizes and manufacturers. The test subject shall hold each facepiece up to the face and eliminate those which do not provide a comfortable fit.

The most comfortable mask is donned and worn for at least 5 minutes to assess comfort. The test subject should evaluate the following points:

- The position of the mask on the nose.
- The room available for eye protection or prescription inserts.
- The room available to talk.
- The position of the mask on the face and cheeks.

After the subject has determined the respirator of greatest comfort, that person shall conduct a negative and positive pressure fit check. Another facepiece shall be selected and retested if the test subject fails the fit checks. After the successful completion of the fit checks, the respirator fit shall be evaluated using a test atmosphere.

6.2.1 Test Atmospheres

The users of respirators are required to test the facepiece-to-face seal of the respirator and to wear the respirator in a test atmosphere. The test atmosphere is simulated in an enclosure that permits the user to enter with the equipment on while an atmosphere of a low-toxicity compound is generated. The isoamyl acetate and irritant smoke test described in the text that follows will be performed by the Office Health and Safety Representative every 6 months for personnel engaged in hazardous waste and industrial field operations. The Office Health and Safety Representative will follow the OSHA protocols for fit testing (29 CFR Part 1910.1028). A summary of this protocol is presented below. After

Table 3

Respirator Training

Lecture and Discussion

- Discussion of classification of respirators (e.g., air purifying and atmosphere-supplying respirators)
- Discussion of respirator capabilities and limitations.
- Instruction on setting "action levels".
- Instruction on OSHA Standard for respiratory protection.
- Proper fitting.
- Classroom and field training in recognizing and copy with emergencies.

Workshop and Field Exercise

- Field exercise in Levels A, B, and C protective ensembles.
- Disassembly and reassembly of respirators emphasizing components, their function, and their relation to the overall function of the respirator.
- Inspection of respirators.
- Proper donning and field fit testing.
- Fit testing with a test atmosphere.
- Cleaning, maintenance, and storage.

the fit test has been successfully completed, a fit test log (see Table 4) will be issued to the test subject.

6.2.1.1 Isoamyl Acetate Test

Isoamyl acetate, a low-toxicity substance with a banana-like odor, is used widely in testing the facepiece fit of organic vapor cartridge/canister respirators. The substance is applied to the cotton wad inside the enclosure. The user should put on the respiratory protective device in an area away from the test enclosure so there is no prior contamination of the cartridge or "pre-exposure" to the isoamyl acetate. The user should perform the following:

- Normal breathing.
- Deep breathing, as during heavy exertion.
- Side-to-side and up-and-down head movements. These movements should not be exaggerated, but should approximate those that take place on the job.
- Talking. This is most easily accomplished by reading a prepared text (e.g., Rainbow Passage) loudly enough to be understood by someone standing nearby.
- Other exercises may be added depending upon the need.

The major drawback of isoamyl acetate test is that odor thresholds vary widely among individuals. Also, the sense of smell is easily dulled and may deteriorate during the test so the user can detect only high vapor concentrations.

Another disadvantage is isoamyl acetate smells pleasant, even in high concentrations. Therefore, unless the worker is highly motivated toward wearing respirators, the results of this test are sometimes suspect.

6.2.1.2 Irritant Smoke Test

The irritant smoke test, similar to the isoamyl acetate test, is used widely in testing the facepiece fit of particulate and particulate/organic vapor filter respirators. This test can be used for both air-purifying and supplied-air respirators. The challenge agent is an irritant (stannic oxychloride) that is available commercially in sealed glass tubes. When the tube ends are broken and air passed through them, a dense, irritating smoke is emitted. In this test, the user steps into the test enclosure and the irritant smoke is sprayed into the enclosure. If the user detects any of the irritant smoke, a defective fit is indicated and adjustment or replacement of the respirator is required. <u>The irritant smoke test must be performed with caution because the aerosol is highly irritating to the eyes, skin, and mucous membranes</u>. As a qualitative means of determining respirator fit, this test has a distinct advantage in that the wearer usually reacts involuntarily to leakage by coughing or sneezing. The likelihood of giving a false indication of proper fit is reduced.

6.2.2 Daily Qualitative Fit Check at the Site

In the field each employee is responsible for performing daily qualitative fit checks of their assigned respirator prior to entry into a hazardous atmosphere. The daily determination of fit will consist of a negative and positive pressure fit checked as described below.

TABLE 4
ENGINEERING SCIENCE, INC.
BOSTON OFFICE
FIT–TEST RECORD LOG

NAME OF EMPLOYEE: ______________________

LOCATION: ES BOSTON OFFICE (101 HUNTINGTON AVE., BOSTON, MA.)

SIGNATURE: ______________________ DATE: __________

NAME OF FIT–TESTER: ______________________

SIGNATURE: ______________________ DATE: __________

TYPE OF RESPIRATOR:	FULL FACE
MANUFACTURER:	NORTH
MODEL:	7600–8A
CORRECTIVE LENSES:	YES

TYPE OF TEST	PASS/FAIL
ISOAMYL ACETATE	P F
IRRITANT SMOKE	P F

6.2.2.1 The Negative Pressure Test

In this test, the user closes off the inlet of the canister, cartridge(s), or filter(s) by covering it with the palm of their hand; inhales gently so that the facepiece collapses slightly; and holds their breath for about 10 seconds. If the facepiece remains slightly collapsed and no inward leakage is detected, the respirator is probably functioning correctly.

6.2.2.2 The Positive Pressure Test

This test is conducted by closing off the exhalation valve and exhaling gently into the facepiece. The fit is considered satisfactory if slight positive pressure can be built up inside the facepiece without any evidence of outward leakage.

7.0 RESPIRATOR INSPECTION, CLEANING, MAINTENANCE, AND STORAGE

7.1 INSPECTION

Respirator inspection to verify operating conditions and maintenance must be made an integral part of the overall respirator program. Wearing a poorly maintained or malfunctioning respirator is, in one sense, more dangerous than not wearing a respirator at all. The employee wearing a defective device thinks they are protected when, in reality, they are not. Emergency escape devices are particularly vulnerable to poor maintenance, since they generally are used infrequently, and then in the most hazardous and demanding circumstances.

7.1.1 Air Purifying Respirators (MSA UltraTwin)

Each individual must inspect their air purifying respirator. The warehouse health and safety equipment manager is responsible for inspecting respirators prior to assignment and upon receipt from the field. Table 5 lists the elements to be observed during the inspection process.

7.1.2 Self-contained Breathing Apparatus (MSA Ultralite and North 801)

Self-contained breathing apparatuses (SCBAs) must be inspected by the warehouse manager on a monthly basis and by the Project Health and Safety Officer prior to beginning work. Each worker must inspect their individual facepiece assembly according to the rubber facepiece and head harness inspection procedures in Table 6. An inspection checklist for SCBAs is presented in Table 7.

7.1.3 Emergency Escape Packs

These 5-minute escape packs will be thoroughly inspected monthly and placed back into service by the health and safety equipment manager. Inspections must include the following:

- Air supply.
- Hood integrity.
- Overall cleanliness.

- Air delivery hose.
- Harness integrity.

7.2 CLEANING AND STORAGE

The health and safety equipment manager is responsible for inspecting and cleaning (if necessary) all respirators returning from the field. Cleaning is accomplished either by using the manufacturers cleaner-sanitizer or by hand washing with a mild soap solution followed by a thorough rinse and air drying. After cleaning, sanitizing and inspecting the respirator, the equipment manager will repackage and store the respirator in an area protected against dust, sunlight, heat, extreme cold, excessive moisture or damaging chemicals. The respirators must be packed and stored so the exhalation valve will rest in a normal position. When respirators are used routinely in the field, they must be cleaned daily by the assigned person.

7.3 MAINTENANCE

Continued usage of respirators will require periodic repair or replacement of component parts of the equipment. Replacement of parts and repair of air purifying respirators, in most cases, present few problems. The manufacturer will provide replacement parts. Replacement parts for respiratory protective devices <u>must</u> be those of the manufacturer of the equipment. <u>Substitution of parts from a different brand or type of respirator will invalidate the approval of the respirator</u>. Maintenance of SCBA equipment is more difficult, primarily because of the valve and regulator assembly. Because of this, regulations <u>require</u> that SCBA equipment be returned to the manufacturer for adjustment or repair.

All maintenance required on a respirator must be recorded in the respirator's log book.

8.0 <u>MEDICAL ASPECTS OF RESPIRATOR USE</u>

Engineering-Science policy provides that no personnel will be permitted to wear a respirator without clearance from a physician to do so. The diagnostic protocol for a fit-to-work classification includes as assessment of the worker's ability to use air purifying respirators and SCBAs. The examining physician will have clinical data, including spirometry, x-ray, and cardiac-function data as well as physical observations on which to base a conclusion. Some individuals, especially those with marginal respiratory and cardiac functions, may experience a sense of choking (angina) when using respirators. If this is distinct and persistent, the worker should not be allowed to wear respiratory protective equipment. A specific conclusion addressing this requirement must accompany the worker's fit-to-work statement from the examining physician.

9.0 <u>EVALUATION OF THE RESPIRATOR PROGRAM</u>

The respirator program will be periodically evaluated by the Office Health and Safety Representative and modified as appropriate.

The auditing of respirator practices will determine whether the appropriate respirators are being selected and worn properly. Examination of respirators in use and in storage will indicate how well the equipment is being maintained. The results of periodic audits of

Table 5

Daily Inspection of Air Purifying Respirators

- Rubber facepiece - check for:
  - Excessive dirt (clean all dirt from facepiece).
  - Cracks, tears, or holes (obtain new facepiece).
  - Distortion (allow facepiece to "sit"free from any constraints and see if distortion disappears; if not, obtain new facepiece).
  - Cracked, scratched, or loose-fitting lenses.

- **Head harness** - check for:
  - Breaks or tears (replace head straps)
  - Loss of elasticity (replace head straps)
  - Broken or malfunctioning buckles or retaining clips (obtain new buckles).

- **Inhalation valve, exhalation valve** - check for:
  - Detergent residue, dust particles, or dirt on valve or valve seat (clean residue with soap and water).
  - Cracks, tears, or distortion in the valve material or valve seat (contact warehouse manager).
  - Missing or defective valve cover (obtain valve cover from equipment manager).

- **Cartridges and canisters** - check for:
  - Proper filter for the hazard (verify with Project Health and Safety Officer).
  - Missing or worn gaskets (contact warehouse manager for replacement).
  - Worn filter and facepiece threads (replace filter or facepiece).
  - Cracks or dents in filter housing (replace filter).

Table 6

Facepiece Inspection Sheet

Device:

ID#:

Date inspected:

Inspected by:

Checklist

Rubber facepiece:

Rubber head harness:

Rubber hose:

Exhalation valve:

Inhalation valves (APR):

Speaking diaphram:

Remarks:

O-rings (APR)

Cartridge (APR)

Type:

Exp. date:

Washing
Sanitization:

Antifogging Agent Application
on lenses:

Table 7

Self-Contained Breathing Apparatus Monthly Inspection Sheet

Device:

Serial #: _

Date inspected:

Inspected by:

Checklist

Rubber facepiece:

Rubber head harness:

Rubber hose:

O-rings

Exhalation valve:

Facepiece Lens:

Harness:

Backpack:

Washing/Sanitizing:

Operating Instructions:

Hydrostatic test date:

No visible damage:

Remarks:

Antifogging Agent Application on lenses:

Air Cylinder Pressure:

Bypass Valve (MSA):

Mainline Valve (MSA):

Alarm:

Regulatory Diaphragm (MSA):

Regulatory Function:

Demand Valve O.K. (North):

Pressure Demand:

Storage Box:

respirator storage and use, consultations with wearers, measurements of hazard levels in work areas, and medical surveillance of wearers will be reviewed and analyzed to determine the effectiveness of the respirator program. Evidence of excessive exposure to hazards will be followed up to determine why inadequate protection was provided, and action will be taken to prevent a repeat of this problem.

APPENDIX A

OSHA RESPIRATORY PROTECTION STANDARD

(29 CFR Part 1910.134)

OCCUPATIONAL SAFETY AND HEALTH STANDARDS
SUBPART I — PERSONAL PROTECTIVE EQUIPMENT

(Code of Federal Regulations, Title 29, Chapter XVII, Part 1910, Subpart I; 36 FR 10466, May 29, 1971; amended at 36 FR 15105, August 13, 1971; 37 FR 22231, October 18, 1972; republished at 39 FR 23502, June 27, 1974; standard provision revoked at 43 FR 49726, October 24, 1978; amended at 49 FR 5322, February 10, 1984)

Subpart I—Personal Protective Equipment

§ 1910.132 General requirements.

(a) *Application.* Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

(b) *Employee-owned equipment.* Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.

(c) *Design.* All personal protective equipment shall be of safe design and construction for the work to be performed.

§ 1910.133 Eye and face protection.

(a) *General.* (1) Protective eye and face equipment shall be required where there is a reasonable probability of injury that can be prevented by such equipment. In such cases, employers shall make conveniently available a type of protector suitable for the work to be performed, and employees shall use such protectors. No unprotected person shall knowingly be subjected to a hazardous environmental condition. Suitable eye protectors shall be provided where machines or operations present the hazard of flying objects, glare, liquids, injurious radiation, or a combination of these hazards.

(2) Protectors shall meet the following minimum requirements:

(i) They shall provide adequate protection against the particular hazards for which they are designed.

(ii) They shall be reasonably comfortable when worn under the designated conditions.

(iii) They shall fit snugly and shall not unduly interfere with the movements of the wearer.

(iv) They shall be durable.

(v) They shall be capable of being disinfected.

(vi) They shall be easily cleanable.

(vii) Protectors should be kept clean and in good repair.

(3) Persons whose vision requires the use of corrective lenses in spectacles, and who are required by this standard to wear eye protection, shall wear goggles or spectacles of one of the following types:

(i) Spectacles whose protective lenses provide optical correction.

(ii) Goggles that can be worn over corrective spectacles without disturbing the adjustment of the spectacles.

(iii) Goggles that incorporate corrective lenses mounted behind the protective lenses.

(4) Every protector shall be distinctly marked to facilitate identification only of the manufacturer.

(5) When limitations or precautions are indicated by the manufacturer, they shall be transmitted to the user and care taken to see that such limitations and precautions are strictly observed.

(6) Design, construction, testing, and use of devices for eye and face protection shall be in accordance with American National Standard for Occupational and Educational Eye and Face Protection, Z87.1-1968.

§ 1910.134 Respiratory protection.

(a) *Permissible practice.* (1) In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to the following requirements.

(2) Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protective program which shall include the requirements outlined in paragraph (b) of this section.

(3) The employee shall use the provided respiratory protection in accordance with instructions and training received.

(b) *Requirements for a minimal acceptable program.* (1) Written standard operating procedures governing the selection and use of respirators shall be established.

(2) Respirators shall be selected on the basis of hazards to which the worker is exposed.

(3) The user shall be instructed and trained in the proper use of respirators and their limitations.

(4) [Removed]

[1910.134(b)(4) deleted by 49 FR 5322, February 10, 1984]

(5) Respirators shall be regularly cleaned and disinfected. Those used by more than

one worker shall be thoroughly cleaned and disinfected after each use.
[1910.134(b)(5)] amended by 49 FR 5322, February 10, 1984]

(6) Respirators shall be stored in a convenient, clean, and sanitary location.

(7) Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency use such as self-contained devices shall be thoroughly inspected at least once a month and after each use.

(8) Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained.

(9) There shall be regular inspection and evaluation to determine the continued effectiveness of the program.

(10) Persons should not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The local physician shall determine what health and physical conditions are pertinent. The respirator user's medical status should be reviewed periodically (for instance, annually).

(11) Approved or accepted respirators shall be used when they are available. The respirator furnished shall provide adequate respiratory protection against the particular hazard for which it is designed in accordance with standards established by competent authorities. The U.S. Department of Interior, Bureau of Mines, and the U.S. Department of Agriculture are recognized as such authorities. Although respirators listed by the U.S. Department of Agriculture continue to be acceptable for protection against specified pesticides, the U.S. Department of the Interior, Bureau of Mines, is the agency now responsible for testing and approving pesticide respirators.

(c) *Selection of respirators.* Proper selection of respirators shall be made according to the guidance of American National Standard Practices for Respiratory Protection Z88.2–1969.

(d) *Air quality.* (1) Compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration shall be of high purity. Oxygen shall meet the requirements of the United States Pharmacopoeia for medical or breathing oxygen. Breathing air shall meet at least the requirements of the specification for Grade D breathing air as described in Compressed Gas Association Commodity Specification G–7.1–1966. Compressed oxygen shall not be used in supplied-air respirators or in open circuit self-contained breathing apparatus that have previously used compressed air. Oxygen must never be used with air line respirators.

(2) Breathing air may be supplied to respirators from cylinders or air compressors.

(i) Cylinders shall be tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR Part 178).

(ii) The compressor for supplying air shall be equipped with necessary safety and standby devices. A breathing air-type compressor shall be used. Compressors shall be constructed and situated so as to avoid entry of contaminated air into the system and suitable in-line air purifying sorbent beds and filters installed to further assure breathing air quality. A receiver of sufficient capacity to enable the respirator wearer to escape from a contaminated atmosphere in event of compressor failure, and alarms to indicate compressor failure and overheating shall be installed in the system. If an oil-lubricated compressor is used, it shall have a high-temperature or carbon monoxide alarm, or both. If only a high-temperature alarm is used, the air from the compressor shall be frequently tested for carbon monoxide to insure that it meets the specifications in subparagraph (1) of this paragraph.

(3) Air line couplings shall be incompatible with outlets for other gas systems to prevent inadvertent servicing of air line respirators with nonrespirable gases or oxygen.

(4) Breathing gas containers shall be marked in accordance with American National Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained, Z48.1–1954; Federal Specification BB–A–1034a, June 21, 1968, Air, Compressed for Breathing Purposes; or Interim Federal Specification GG–B–00675b, April 27, 1965, Breathing Apparatus, Self-Contained.

(e) *Use of respirators.* (1) Standard procedures shall be developed for respirator use. These should include all information and guidance necessary for their proper selection, use, and care. Possible emergency and routine uses of respirators should be anticipated and planned for.

(2) The correct respirator shall be specified for each job. The respirator type is usually specified in the work procedures by a qualified individual supervising the respiratory protective program. The individual issuing them shall be adequately instructed to insure that the correct respirator is issued.
[1910.134(e)(2)] amended by 49 FR 5322, February 10, 1984]

(3) Written procedures shall be prepared covering safe use of respirators in dangerous atmospheres that might be encountered in normal operations or in emergencies. Personnel shall be familiar with these procedures and the available respirators.

(i) In areas where the wearer, with failure of the respirator, could be overcome by a toxic or oxygen-deficient atmosphere, at least one additional man shall be present. Communications (visual, voice, or signal line) shall be maintained between both or all individuals present. Planning shall be such that one individual will be unaffected by any likely incident and have the proper rescue equipment to be able to assist the other(s) in case of emergency.

(ii) When self-contained breathing apparatus or hose masks with blowers are used in atmospheres immediately dangerous to life or health, standby men must be present with suitable rescue equipment.

(iii) Persons using air line respirators in atmospheres immediately hazardous to life or health shall be equipped with safety harnesses and safety lines for lifting or removing persons from hazardous atmospheres or other and equivalent provisions for the rescue of persons from hazardous atmospheres shall be used. A standby man or men with suitable self-contained breathing apparatus shall be at the nearest fresh air base for emergency rescue.

(4) Respiratory protection is no better than the respirator in use, even though it is worn conscientiously. Frequent random inspections shall be conducted by a qualified individual to assure that respirators are properly selected, used, cleaned, and maintained.

(5) For safe use of any respirator, it is essential that the user be properly instructed in its selection, use, and maintenance. Both supervisors and workers shall be so instructed by competent persons. Training shall provide the men an opportunity to handle the respirator, have it fitted properly, test its face-piece-to-face seal, wear it in normal air for a long familiarity period, and, finally, to wear it in a test atmosphere.

(i) Every respirator wearer shall receive fitting instructions including demonstrations and practice in how the respirator should be worn, how to adjust it, and how to determine if it fits properly. Respirators shall not be worn when conditions prevent a good face seal. Such conditions may be a growth of beard, sideburns, a skull cap that projects under the facepiece, or temple pieces on glasses. Also, the absence of one or both dentures can seriously affect the fit of a facepiece. The worker's diligence in observing these factors shall be evaluated by periodic check. To assure proper protection, the facepiece fit shall be checked by the wearer each time he puts on the respirator. This may be done by following the manufacturer's facepiece fitting instructions.

(ii) Providing respiratory protection for individuals wearing corrective glasses is a serious problem. A proper seal cannot be established if the temple bars of eye glasses extend through the sealing edge of the full facepiece. As a temporary measure, glasses with short temple bars or without temple bars may be taped to the wearer's head. Wearing of contact lenses in contaminated atmospheres with a respirator shall not be allowed. Systems have been developed for mounting corrective lenses inside full facepieces. When a workman must wear corrective lenses as part of the facepiece, the facepiece and lenses shall be fitted by qualified individuals to provide good vision, comfort, and a gas-tight seal.

(iii) If corrective spectacles or goggles are required, they shall be worn so as not to affect the fit of the facepiece. Proper selection of equipment will minimize or avoid this problem.

(f) *Maintenance and care of respirators.* (1) A program for maintenance and care of respirators shall be adjusted to the type of plant, working conditions, and hazards involved, and shall include the following basic services:

(i) Inspection for defects (including a leak check),

(ii) Cleaning and disinfecting,

(iii) Repair,

(iv) Storage

Equipment shall be properly maintained to retain its original effectiveness.

(2) (i) All respirators shall be inspected routinely before and after each use. A respirator that is not routinely used but is kept ready for emergency use shall be inspected after each use and at least monthly to assure that it is in satisfactory working condition.

(ii) Self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be fully charged according to the manufacturer's instructions. It shall be determined that the regulator and warning devices function properly.

(iii) Respirator inspection shall include a check of the tightness of connections and the condition of the facepiece, headbands, valves, connecting tube, and canisters. Rubber or elastomer parts shall be inspected for pliability and signs of deterioration. Stretching and manipulating rubber or elastomer parts with a massaging action will keep them pliable and flexible and prevent them from taking a set during storage.

(iv) A record shall be kept of inspection dates and findings for respirators maintained for emergency use.

(3) Routinely used respirators shall be collected, cleaned, and disinfected as frequently as necessary to insure that proper protection is provided for the wearer. Respirators maintained for emergency use shall be cleaned and disinfected after each use.

[1910.134(f)(3) amended by 49 FR 5322, February 10, 1984]

(4) Replacement or repairs shall be done only by experienced persons with parts designed for the respirator. No attempt shall be made to replace components or to make adjustment or repairs beyond the manufacturer's recommendations. Reducing or admission valves or regulators shall be returned to the manufacturer or to a trained technician for adjustment or repair.

(5) (i) After inspection, cleaning, and necessary repair, respirators shall be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Respirators placed at stations and work areas for emergency use should be quickly accessible at all times and should be stored in compartments built for the purpose. The compartments should be clearly marked. Routinely used respirators, such as dust respirators, may be placed in plastic bags. Respirators should not be stored in such places as lockers or tool boxes unless they are in carrying cases or cartons.

(ii) Respirators should be packed or stored so that the facepiece and exhalation valve will rest in a normal position and function will not be impaired by the elastomer setting in an abnormal position.

(iii) Instructions for proper storage of emergency respirators, such as gas masks and self-contained breathing apparatus, are found in "use and care" instructions usually mounted inside the carrying case lid.

(g) *Identification of gas mask canisters.* (1) The primary means of identifying a gas mask canister shall be by means of properly worded labels. The secondary means of identifying a gas mask canister shall be by a color code.

(2) All who issue or use gas masks falling within the scope of this section shall see that all gas mask canisters purchased or used by them are properly labeled and colored in accordance with these requirements before they are placed in service and that the labels and colors are properly maintained at all times thereafter until the canisters have completely served their purpose.

(3) On each canister shall appear in bold letters the following:

(i) —

Canister for ------------------------------------
(Name for atmospheric contaminant)
or

Type N Gas Mask Canister

(ii) In addition, essentially the following wording shall appear beneath the appropriate phrase on the canister label: "For respiratory protection in atmospheres containing not more than ------ percent by volume of ------------ -------------------------------------."
(Name of atmospheric contaminant)

(iii) [Revoked]

(4) Canisters having a special high-efficiency filter for protection against radionuclides and other highly toxic particulates shall be labeled with a statement of the type and degree of protection afforded by the filter. The label shall be affixed to the neck end of, or to the gray stripe which is around and near the top of, the canister. The degree of protection shall be marked as the percent of penetration of the canister by a 0.3-micron-diameter dioctyl phthalate (DOP) smoke at a flow rate of 85 liters per minute.

(5) Each canister shall have a label warning that gas masks should be used only in atmospheres containing sufficient oxygen to support life (at least 16 percent by volume), since gas mask canisters are only designed to neutralize or remove contaminants from the air.

(6) Each gas mask canister shall be painted a distinctive color or combination of colors indicated in Table I-1. All colors used shall be such that they are clearly identifiable by the user and clearly distinguishable from one another. The color coating used shall offer a high degree of resistance to chipping, scaling, peeling, blistering, fading, and the effects of the ordinary atmospheres to which they may be exposed under normal conditions of storage and use. Appropriately colored pressure sensitive tape may be used for the stripes.

[Section 1910.134(g)(3)(iii) revoked at 43 FR 49726 October 24, 1978, 1978 effective November 24, 1978]

TABLE I-1

Atmospheric contaminants to be protected against	*Colors assigned**
Acid gases	White.
Hydrocyanic acid gas	White with ½-inch green stripe completely around the canister near the bottom.
Chlorine gas	White with ½-inch yellow stripe completely around the canister near the bottom.
Organic vapors	Black.
Ammonia gas	Green.
Acid gases and ammonia gas	Green with ½-inch white stripe completely around the canister near the bottom.
Carbon monoxide	Blue.
Acid gases and organic vapors	Yellow.
Hydrocyanic acid gas and chloropicrin vapor	Yellow with ½-inch blue stripe completely around the canister near the bottom.
Acid gases, organic vapors, and ammonia gases.	Brown.
Radioactive materials, excepting tritium and noble gases.	Purple (Magenta).
Particulates (dusts, fumes, mists, fogs, or smokes) in combination with any of the above gases or vapors.	Canister color for contaminant, as designated above, with ½-inch gray stripe completely around the canister near the top.
All of the above atmospheric contaminants	Red with ½-inch gray stripe completely around the canister near the top.

*Gray shall not be assigned as the main color for a canister designed to remove acids or vapors.

NOTE: Orange shall be used as a complete body, or stripe color to represent gases not included in this table. The user will need to refer to the canister label to determine the degree of protection the canister will afford.

§ 1910.135 Occupational head protection.

Helmets for the protection of heads of occupational workers from impact and penetration from falling and flying objects and from limited electric shock and burn shall meet the requirements and specifications established in American National Standard Safety Requirements for Industrial Head Protection, Z89.1-1969.

§ 1910.136 Occupational foot protection.

Safety-toe footwear for employees shall meet the requirements and specifications in American National Standard for Men's Safety-Toe Footwear, Z41.1-1967.

§ 1910.137 Electrical protective devices.

Rubber protective equipment for electrical workers shall conform to the requirements established in the American National Standards Institute Standards as specified in the following list:

Item	*Standard*
Rubber insulating gloves.	J6.6-1967.
Rubber matting for use around electric apparatus	J6.7-1935 (R1962).
Rubber insulating blankets.	J6.4-1970.
Rubber insulating hoods.	J6.2-1950 (R1962).
Rubber insulating line hose	J6.1-1950 (R1962)
Rubber insulating sleeves	J6.5-1962.

§ 1910.138 Effective dates.

(a) The provisions of this Subpart I shall become effective on August 27, 1971, except that:

(1) Any provision in any other section of this subpart which contains in itself a specific effective date or time limitation shall become effective on such date or shall apply in accordance with such limitation; and

(2) If any standard in 41 CFR Part 50-204, other than a national consensus standard incorporated by reference in § 50-204.2(a)(1), is or becomes applicable at any time to any employment and place of employment, by virtue of the Walsh-Healey Public Contracts Act, or the Service Contract Act of 1965, or the National Foundation on Arts and Humanities Act of 1965, any corresponding established Federal standard in this Subpart I which is derived from 41 CFR Part 50-204 shall also become effective, and shall be applicable to such employment and place of employment, on the same date

§ 1910.139 Sources of standards.

Sec.	*Source*
1910.132	41 CFR 50-204.7.
1910.133(a)	ANSI Z87.1-1968, Eye and Face Protection.
1910.134	ANSI Z88.2-1969, Standard Practice for Respiratory Protection
1910.134 Table I-I.	ANSI K13.1-1967, Indentification of Gas Mask Canister.
1910.135	ASNI Z89.1-1969, Safety Requirements for Industrial Head Protection.
1910.136	ANSI Z41.1-1967, Men's Safety-Toe Footwear.
1910.137	ANSI Z9.4—1968, Ventilation and Safe Practices of Abrasive Blasting Operations.

§ 1910.140 Standards organizations.

Specific standards of the following organization have been referenced in this part. Copies of the referenced materials may be obtained from the issuing organization.

American National Standards Institute, 1430 Broadway, New York, NY 10018

ATTACHMENT B-5

SAFETY CONCEPTS AND BASIC CONSIDERATION FOR UXO OPERATIONS

Encl

Rev 16 Dec 92

U.S. ARMY CORPS OF ENGINEERS, HUNTSVILLE DIVISION
SAFETY CONCEPTS AND BASIC CONSIDERATIONS FOR UNEXPLODED EXPLOSIVE ORDNANCE (UXO) OPERATIONS

INTRODUCTION

There is no "safe" procedure for dealing with UXO, merely procedures which are considered least dangerous. However, maximum safety in any UXO operation can be achieved through adherence to applicable safety precautions, a planned approach and intensive supervision. Only those personnel absolutely essential to the operation shall be allowed in the restricted area/exclusion zone during UXO activities(DoD 6055.9-STD). Safety must become a firmly established habit when working with UXO. Safety is the leading edge of quality.

1.GENERAL SAFETY CONCERNS.

a. Care must be observed in searching for, probing for, excavating, moving, and handling UXO. Operations on the UXO should be conducted only after the establishment of a complete plan for the operation involved and careful preparation to insure its implementation. Plans shall be based upon the minimum number of essential personnel, for a minimum amount of time, to the minimum amount of UXO consistent with efficient operations and maximum safety.

b. Only UXO qualified personnel shall be involved in UXO procedures. UXO procedures consist of gaining access (manual excavation) to subsurface UXO, identification, transportation, storage, and disposal of UXO. All personnel engaged in UXO operations shall be thoroughly trained in explosive safety and be capable of recognizing hazardous explosive exposures. Only personnel who have graduated from the US Naval EOD School, Indian Head MD are authorized to handle UXO and perform UXO procedures. Hazardous Devices Technicians who have graduated from the Hazardous Devices School, Redstone Arsenal AL are not trained nor qualified to handle military UXO and will not be involved in UXO operations on a CE project.

c. The use of electroexplosive devices (EED) susceptible to EMR devices in the radio frequency (RF) range, that is, radio, radar, and television transmitters, has become almost universal. Radio frequency electromagnetic radiation consists of waves of electrical energy at radio transmission frequencies. These waves are radiated in a line-of-sight from the antennas of electronic devices that transmit radio, radar, television, or other communication or navigation radio frequency signals. The energy is usually equally radiated in all directions; however, certain types of antennas focus the energy, transmitting it in a single direction or sector only. EMR (RF) can also be reflected from large metallic surfaces or objects into areas not directly reached by the line-of-sight-radiated electric energy.

(1) Under highly undesirable conditions, enough of the energy may be picked up by portions of the EED, associated circuitry, or related objects acting as receiving antennas, to initiate the EED.

(2) Since the strength of the radiation decreases as the distance from the transmitter increases, the further away the ordnance item is, the less hazardous the situation. The energy can pass directly through materials that do not conduct electricity, such as wood or plastic. Therefore, using these materials as a barrier is of little value. The factors to be considered when evaluating the degree of hazard that the EMR (RF) energy represents are: 1) the strength of the field, that is, its power; 2) the nature of the frequencies transmitted; 3) the distance from the transmitter antenna to the ordnance, and; 4) the amount or type of protection available.

d. Some ordnance is particularly susceptible to EMR (RF) emission. This susceptibility is usually caused by the design of the ordnance item or the type of EED that is used. HERO categories have been established under which ordnance is classified as safe, susceptible, and unsafe. A knowledge of ordnance that is normally unsafe in the presence of EMR (RF) is important so that preventive steps can be taken if the ordnance is encountered in a suspected EMR (RF) field.

(1) In general, all ordnance items, even those normally safe when intact, are hazardous when extensively damaged. The damage may expose components, trailing wires, or breaks in shielding integrity that permit the entrance of EMR (RF) energy into the ordnance item and then into the EED.

(2) The presence of antennas, communication and radar devices should be a point of interest on initial site visits and preliminary assessments.

(3) The site shall be surveyed for electromagnetic radiation (EMR) radio frequency (RF) transmitters and appropriate action taken. Minimim safe distances between mobile RF transmitters, TV, and FM broadcasting transmitters and electric UXO demolition procedures are listed in Tables 2-3 and 2-4, TM 9-1375-213-12.

(4) Do not wear outer or undergarments made of wool, silk, or synthetic textiles such as rayon and nylon while working on UXO. These materials can generate sufficient static charge to ignite fuels or initiate explosives. Any person coming in contact with an UXO, shall ground himself prior to touching EEDs. This must be done to discharge any electrostatic charge accumulation from the body.

2. SITE CHARACTERIZATION

a. Make every effort to identify the UXO. Carefully examine the item for markings and other identifying features such as shape, size, and external fittings. However, do not move the item to inspect it. If an unknown UXO is encountered, photographs shall be taken and express-mailed to CEHND-ED-SY, which has access to the TM 60-Series publications.

b. Foreign UXO were returned to the United States for exploitation and disposal. Records search should indicate the possibility of foreign UXO being on the site.

c. If the records search indicates UXO containing military toxic chemical agents may be on the site, a decontamination plan shall be approved prior to entry onto the site. Any time a suspected chemical UXO is encountered, the 2-man concept is immediately implemented and notification shall be made through proper channels. The UXO shall be secured until the military arrives and assumes ownership.

d. UXO which penetrates the earth to a depth where the force of the explosion is not enough to rupture the earth's surface forms an underground cavity called a camouflet. Camouflets will be filled with the end product of the explosion, carbon monoxide gas. Camouflet detection and precautions must be considered if records search indicates the site was used as an impact area.

e. Avoid inhalation of, and skin contact with smoke, fumes, and vapors of explosives and related hazardous materials.

f. Consider UXO which has been exposed to fire and detonation as extremely hazardous. Chemical and physical changes may have occurred to the contents which render it much more sensitive that it was in its original state.

g. Do not rely on the color coding of UXO for positive identification of contents. Munitions having none, incomplete, or improper color coding have been encountered.

h. Avoid the area forward of the nose of a munition until it can be determined that the item is not a shaped charge and High Explosive Anti-tank (HEAT) UXO. The explosive jet can be fatal to great distances forward of the longitudinal axis of the item. Assume any shaped charge munition to contain a piezoelectric (PZ) fuzing system until the fuzing is otherwise identified. A PZ fuze is extremely sensitive, can fire at the slightest physical change, and may remain hazardous for an indefinite period of time.

i. Examine a projectile for the presence or absence of an unfired tracer.

j. Approach an unfired rocket motor from the side. Ignition will create a missile hazard and hot exhaust.

(1) Do not expose electrically fired rocket motors within 25-feet of any exposed electronic transmitting equipment or exposed antenna leads.

(2) If an unfired rocket motor must be transported, it shall be positioned in the direction which offers the least exposure to personnel in the event of the accidental ignition.

k. Consider an emplaced landmine armed until proven otherwise. It may not be possible to tell, or it may be intentionally rigged to deceive.

(1) Many training mines contain firing indicator charges capable of inflicting serious injury.

(2) Exercise care with wooden mines that have been buried for a long time. Because of soil conditions, the wood deteriorates and the slightest inadvertent pressure on top may initiate the fuze.

l. Assume a practice UXO contains a live charge until it can be determined otherwise. Expended pyrotechnic/practice devices may contain red/white phosphorus residue. Due to incomplete combustion, phosphorus may be present and reignite spontaneously if subjected to friction or if the crust is broken.

m. Do not approach a smoking white phosphorus (WP) UXO. Burning WP may detonate the burster or dispersal explosive charge at any time.

n. The detection and identification of suspect explosive materials shall be accomplished IAW Chapter 13, TM 9-1300-214, "Military Explosives".

3. ORDNANCE RELATED HTRW ACTIVITIES.

a. 29 CFR 1926.100(a) requires personnel to wear protective helmets in areas where there is a possible danger of head injury from impact, or from falling or flying objects, or from electrical shock or burns. During field activities on ordnance projects, hardhats need not be worn unless a head injury threat is present.

b. Soil samples, test pit excavation, and/or monitoring well installation are sometimes conducted in areas where subsurface UXO may be found. These intrusive activities must be preceded by a magnetometer survey to assure the safety of the sampling crews.

c. Prior to the drilling rig coming on site, a magnetometer and a hand-held auger shall be utilized to assure the drilling spot is clear of subsurface UXO.

(1) After finding an area the magnetometer indicates is clear of detectable UXO, the hand-held auger should be used to start the drill hole. At not more than 2-foot depth, the hand-held auger shall be withdrawn and the magnetometer probe shall be lowered into the auger hole. This procedure will ensure small UXO items(20mm projectiles and grenades), undetectable from the surface, are now detectable. This procedure shall be repeated until the maximum depth of the hand-held auger.

(2) Borehole monitoring shall continue at 2-foot intervals until virgin soil is encountered.

4. RESTRICTED AREA/EXCLUSION OPERATIONS.

a. Do not allow unauthorized or unnecessary personnel to be present in the vicinity of UXO. During the timeframe that UXO procedures are being accomplished, only necessary UXO personnel shall be within the restricted area/exclusion zone. When non-UXO personnel enter the restricted area/exclusion zone, all UXO procedures will cease. Limit personnel exposure time. UXO operations will always be based upon minimum exposure consistent with efficient operations.

(1) Plan for, provide, and know the measures to be taken in the event of an accident.

(2) Provide a designated emergency vehicle in the area in case of an accident or other emergency.

(3) Coordination with the appropriate airspace representative shall be conducted and the appropriate notification procedures arranged.

b. Before any movement of an UXO, the fuze condition must be ascertained. If the condition is questionable, consider the fuze armed. The fuze is considered the most hazardous component of an UXO, regardless of type or condition.

(1) In general, the condition of a BD fuze in an unexploded projectile cannot be determined through examination of its external features. When there is evidence that the projectile has been fired, the BD fuze is considered to be in the armed condition.

(2) Arming wires and popout pins on unarmed fuzes should be secured by taping in place prior to movement.

(3) Perform any initial movement of an armed fuze remotely and avoid any unnecessary movement of an armed fuze.

c. Personnel working with explosives and explosive ordnance shall comply with the following:

(1) Do not carry fire or spark-producing devices on-site.

(2) Do not smoke, except in authorized areas.

(3) Do not have fires for heating or cooking, except in authorized areas.

(4) Do not conduct operations without approved Standing Operating Procedures (SOP) and proper supervision.

(5) Do not become careless by reason of familiarity with ammunition.

(6) Do not conduct explosive operations during electrical, sand, dust or snow storms.

(7) Do not conduct explosive operations between sunset and dawn.

d. When multiple search teams are operating on a site, the teams shall not work immediately adjacent to each other. A safe separation distance shall be established between each search team. This distance shall be based on the type of UXO expected to be encountered, but the distance shall never be less than 50m.

e. Perform initial movement of an embedded projectile remotely. First movement of an embedded projectile may cause fuze functioning. During this remote operation, precautions shall be taken for a high-order detonation.

(1) DO NOT dismantle, strip, or subject any UXO to unnecessary movement, except in response to a valid requirement.

(2) Do not depress plungers, turn vanes, or rotate spindles, levers, setting rings, or other external fittings on the UXO. Such action may arm, actuate, or function the UXO.

(3) Do not subject a mechanical time fuze to any unnecessary movement.

(4) Do not unscrew a fuze from a fuze well that does not contain a fuze cavity liner. High explosives may be on the threads.

f. Expended pyrotechnic/practice devices may contain red/white phosphorus residue. Due to incomplete combustion, red and white phosphorus may be present and reignite spontaneously if subjected to friction or if the crust is broken.

g. Do not undertake the handling or disposal of liquid propellant fuels or oxidizers if not familiar with the characteristics of the material.

h. Civil War projectiles shall be treated as any other UXO, especially projectiles with uncut Bormann time fuses and projectiles with percussion fuses, brass in particular. These have generally provided a watertight seal, even if they have been in the ground over one-hundred years. No projectile should be exposed to excess heat, the ignition point of black powder, used as a bursting charge in all Civil War projectiles is 457 degrees F. Under no circumstances should an attempt be made to drill a hole in a projectile, either through the fuse or the body of the projectile.

i. Extra care shall be taken when uncovering a buried UXO, if records search indicated WP munitions were fired or destroyed in the area. A buried WP munition may be damaged and when exposed to air, may start burning and detonate. An ample supply of water and mud shall be immediately available if excavation reveals a WP UXO. Appropriate protective equipment (leather gloves, face shield, and flame-retardant clothing) and first aid shall also be immediately available.

5. STORAGE.

a. UXOs, UXO-components, packing materials or empty boxes will not be stored in magazines containing explosives.

b. A fire plan for the storage of explosives shall be prepared and coordination with the nearby fire department shall be conducted.

6. EXCAVATION OPERATIONS.

a. The usual method for uncovering buried UXO is to excavate by hand. Hand excavation is the most reliable method for uncovering UXO, but unless the UXO is very near the surface, hand excavation exposes more people to the hazard of detonation for a longer period of time than any other method. Hand excavation will be accomplished only by UXO personnel.

b. Earth moving machinery (EMM) may be used to excavate for buried UXO, if the UXO is estimated to be deeper than 12 inches. EMM shall not be used to excavate within 12 inches of an UXO. When excavation gets within 12 inches of an UXO, hand excavation shall be used to uncover the UXO. EMM may be operated by non-UXO personnel, under the direct supervision of UXO personnel.

(1) If more than one EMM will be used on the same site, they will be separated by at least 100m during excavation,

(2) During excavation operations, only those personnel absolutely necessary for the operation shall be within the restructed area/exclusion zone.

(3) Excavation and trenching shall comply with the provisions of 29 CFR 1926 subpart P.

7. DISPOSAL OPERATIONS.

a. As a general rule, UXO will be detonated in place when the situation allows. All detonation-in-place should be conducted by electrical means to assure maximum control of the site, except is extreme sandy soil which creates a static electricity hazard. Non-electrical means can be used when the situation dictates.

(1) Do not allow one person to work alone in disposal operations. At least one person shall be available near the disposal site to give warning and assist in rescue activities in the event of an accident. Only UXO qualified personnel shall be involved in on-site disposal operations.

(2) Initiating explosives include lead azide, mercury fulminate, lead styphnate, and tetracene. They manifest extreme sensitivity to friction, heat, and impact. When involved in a fire, they can be expected to detonate without burning. In storage, initiating explosives shall be kept wet with water or water/alcohol mixture. Every effort shall be made to prevent the liquid from freezing; frozen explosives material will not be handled. Lead azide shall not be allowed contact with copper, zinc, or alloys containing any concentration of such metals because of the likely formation of other azides that are more sensitive than the original lead azide. Likewise, mercury fulminate shall not be allowed contact with aluminum, magnesium, zinc, brass or bronze.

(3) If loose, bulk explosives are to be disposed of by detonation, detonate only one kind of explosive in any one given shot.

(4) Exercise extreme care in handling and preparing high explosives for detonation. They are sensitive to detonation by heat, shock, and friction.

(5) Keep initiating explosives in a water-wet condition at all times until ready for final preparation for detonation. The sensitivity of these explosives is greatly increased when dry.

(6) Do not pack a bomb fuze well with explosives unless it can be positively confirmed that the fuze well does not contain any fuze components.

(7) Photoflash bombs must be handled with the same care as black powder, and with even greater care than explosive-loaded bombs.

(8) Some practice bombs do not contain any positive safety features. Positively identify and review all safety precautions prior to handling practice bombs.

(9) WP UXO shall not be detonated into the ground. The UXO shall be counter-charged on the bottom-center-line.

(10) Photoflash powder will react with moisture and generate hydrogen gas, and this reaction may generate sufficient heat or pressure to detonate the UXO. Do not look directly at photoflash UXO during detonation.

b. When disposing of high explosives by detonation, do not approach the disposal site for at least 30 minutes in the event of a misfire.

(1) Carry blasting caps in approved containers and keep them out of the direct rays of the sun.

(2) Do not handle, use, or remain near explosives during the approach or progress of an electrical storm. All persons should retire to place of safety.

(3) Do not use explosives or accessory equipment that are obviously deteriorated or damaged. They may detonate prematurely or fail completely.

(4) Always point the explosive end of blasting caps, detonators, and explosive devices away from the body during handling. This will minimize injury should the item explode.

(5) Use only standard blasting caps of at least the equivalent of a commerical No. 8 blasting cap.

(6) Use electric blasting caps of the same manufacture, whenever possible, for each demolition shot involving more than one cap.

(7) Keep blasting caps in approved containers, located at least 25 feet from other explosives, until they are needed for priming.

(8) Do not bury blasting caps. Use detonating cord to position blasting caps above the ground. Buried blasting caps are subject to unobserved pressures and movement which could lead to premature firing or misfires.

(9) Test electric blasting caps for continuity at least 25 feet downwind from any explosives prior to connecting them to the firing circuit. Upon completion of testing, the lead wires will be short-circuited by twisting the bare ends of the wires together. The wires will remain shunted until ready to connect to the firing circuit.

c. A post-search of the detonation site shall be conducted to assure a complete disposal was accomplished.

d. If the situation dictates, protective measures to reduce shock, blast, and fragmentation damage shall be taken. Army Technical Manual (TM) 5-855-1, <u>Fundamentals of Protective Design for Conventional Weapons</u> and associated software program "CONWEP" contains data on blast effects, groundshock, cratering, ejecta, and fragmentation.

(1) For non-fragmenting explosive materials, evacuation distance should be a minimum of 1250 feet.

(2) For fragmenting explosive materials, evacuation distance should be a minimum of 2500 feet. For bombs and projectiles with caliber 5-inch or greater, use a minimum evacuation distance of 4000 feet.

(3) Items with lugs and/or strongbacks and nose and/or tail plate sections should be oriented away from personnel locations.

e. Consideration shall be given to tamping the UXO to control fragments, if the situation warrants. Fragments shall be minimized not only to protect personnel but property such as buildings, trees, etc.

f. Open burning of explosives and smokeless powder or chemical decomposition of explosives shall not be accomplished without prior approval of the contracting officer.

(1) Do not inhale the smoke or fumes of burning pyrotechnic or incendiary materials. The fumes and dust from many of these materials are irritating and/or toxic if inhaled.

(2) Do not use water on incendiary fires. Water may induce a violent reaction or be completely ineffective, depending on the mixture.

(3) Bury incendiary-loaded munitions in sand when transporting them. This will smother any fire which should start until other corrective action can be taken.

(4) Anticipate a high-order detonation when burning pyrotechnics or incendiary-loaded UXO. Safety measures for personnel and property must be based on this possibility.

g. Inert UXO will not be disposed of or sold for scrap until the internal fillers have been exposed and unconfined. Heat generated during a reclamation operation can cause the inert filler, moisture and air to expand and burst sealed casings. Venting or exposure may be accomplished in any way necessary to preclude rupture due to confined pressure.

8. TRANSPORTATION.

a. If UXO must be transported off-site for disposal, the provisions of 49 CFR 100-199, TM 9-1300-206, and state and local laws shall be followed.

b. When transporting a possible armed fuze, position the fuze in the most neutral orientation possible.

c. Do not transport a WP munition, unless it is immersed in water, mud or wet sand.

d. If loose pyrotechnic, tracer, flare, and similiar mixtures are to be transported, they shall be placed in #10 mineral oil or equivalent to minimize fire and explosion hazard.

e. If an unfired rocket motor must be transported, it shall be positioned in the direction which offers the least exposure to personnel in the event of an accident ignition.

f. If base-ejection type projectiles must be transported to a disposal area or collection point, the base shall be oriented to the rear of the vehicle and the projectile secured, in the event the ejection charge functions in route.

g. If an OEW, with exposed hazardous filler (HE, etc), has to be moved to a disposal area, the item shall be placed in a heavy duty plastic bag to prevent migration of the hazardous filler. Padding should also be added to protect the exposed filler from heat, shock, and friction.

Encl

ORDNANCE AND EXPLOSIVE WASTE CONSIDERATIONS DURING GEOTECHNICAL OPERATIONS

1. OBJECTIVE: To assure all personnel are aware of the policies and procedures relating to Ordnance and Explosive Waste when performing geotechnical field functions.

2. BACKGROUND. Until the mid-1970's land burial of OEW was an authorized method of disposal. Ammunition items that were unserviceable, for whatever reason, were buried in trenches. It was much cheaper to dig a trench and bury ammunition than it was to destroy it by burning or detonation. Generally, disposal trenches were not annotated on installation maps. It was much easier to discard unneeded ammunition into a pond or lake than fill out the required paperwork and return it to the ammunition supply point. Firing ranges were used for other purposes years later. Generally speaking, subsurface clearances were not conducted on past range clearances.

3. REFERENCES:

a. ER 1110-3-109, *Corps-Wide Centers of Expertise Assigned to Major Subordinate Commands and Districts*, dated 15 July 1992.

b. CEHND 1104-3-9, *Management Plan for Ordnance and Explosive Waste (OEW) Mandatory Center of Expertise (MCX) and Design Center*, dated 10 August 1992.

c. U.S. Army Corps of Engineers, Huntsville Division, *Safety Concepts and Basic Considerations for Unexploded Explosive Ordnance (UXO) Operations*, dated 16 December 1992.

d. EM 385-1-1, *Safety and Health Requirements Manual*, dated 1 October 1992.

4. DEFINITIONS:

a. Mandatory Center of Expertise (MCX) is defined as a major subordinate command (MSC) or district command which currently possesses a demonstrated, credible technical capability in a specialized subject area applicable to military construction and beneficial to other USACE commands. All using commands will coordinate with and use the expertise and services of the MCX to satisfactory accomplish their mission. The Huntsville Division is the Corps of Engineers MCX for Ordnance and Explosive Waste (OEW).

b. Ordnance and Explosive Waste (OEW) is an umbrella term to include anything related to munitions designed to cause damage to personnel or material through explosive force, incendiary action, or toxic effects, such as bombs, guided and ballistic missiles; artillery, mortar, and rocket ammunition; small arms ammunition; antipersonnel and antitank landmines, demolition charges; pyrotechnics; grenades, torpedoes and depth charges; containerized and uncontainerized high explosives and propellants; depleted uranium projectiles; toxic military chemical agents; and all similar or related items or components in nature or otherwise designed to cause damage to personnel or material. Soils with explosive constituents will be considered OEW if the concentration is sufficient to present an imminent safety hazard.

(1) Unexploded ordnance (UXO) is an item of OEW which has been primed, fuzed, armed, or otherwise prepared for action, and which has been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to friendly operations, installations, personnel or material and remains unexploded either through malfunction or design or for any other cause.

(2) Chemical Warfare Material (CWM) are those items of explosive ordnance that contain toxic military warfare agents, such as incendiary agents, such as thermite and magnesium; smokes such as white phosphorus and the colored signal smokes; riot control agents such as tear gas and vomiting agents; blood and choking agents; nerve, mustard, and lewisite agents.

(3) Chemical Surety Material (CSM) are those items of explosive ordnance that contain nerve, mustard, and lewisite agents. Only members of the U.S. Army's Technical Escort Unit are authorized to handle, package, and ship CSM items.

c. Explosive ordnance disposal (EOD): The detection, identification, field evaluation, rendering-safe, recovery, and final disposal of OEW.

d. EOD Specialist: An active duty military EOD person who has attended the US Naval EOD School, Indian Head MD.

e. UXO Specialist: A former EOD Specialist; a civilian contractor.

5. POLICY.

a. It is Department of Defense policy to provide the maximum possible protection to personnel and property from the damaging effects of potential accidents involving ammunition and explosives.

b. No person shall be required or instructed to work in surroundings or under conditions which are unsafe or dangerous to his health.

c. Any USACE command involved with a project that includes, or is associated with Army Ranges and Training Land, and Hazardous, Toxic, and Radioactive Waste (HTRW) activities to include surveying, intrusive investigative activities such as soil sampling, trenching, monitoring well installation and construction will coordinate with and use the services of the OEW MCX.

d. No intrusive activities, of any type, will be conducted on a site which is listed in the FUDS inventory as OEWCSM.

e. Only trained explosive ordnance disposal personnel will handle OEW/UXO.

6. PROCEDURES.

a. OEW has to be considered and planned for on all formerly used defense sites (FUDS) and active installations.

b. The surface danger zone of a range (active or inactive), the target area, impact area, ricochet area and the secondary danger zones will be contaminated with UXO. UXO is that ammunition which has failed to function as designed, i.e., a dud. UXO will be found on the surface and subsurface. The varying types of ammunition, angle of fire, and soil types preclude the accurate estimation of the depth of subsurface UXO.

c. Any type of survey activities, foot or vehicular movement, or intrusive work within the surface danger zone, forward of the firing line, should be preceded by a surface and subsurface clearance of UXO.

(1) Footpath and/or vehicular lanes should be cleared, if ordnance cannot be avoided, and conspicuously marked. No personnel should be allowed outside these cleared areas. This limited clearance should entail both surface and subsurface. Subsurface is necessary to find that UXO that is laying just below the surface that may be encountered after rain and vehicular traffic. Depending on the type of ammunition involved, it is possible a vehicle running over an UXO, will cause the item to detonate. Depending on the size of the UXO, personal injury and property damage can be expected.

(2) Subsurface clearance, when necessary, is particularly important when intrusive activities will be used to take soil samples, install monitoring wells, dig test trenches, dig cable trenches, excavate berms and relocate targets. A limited subsurface clearance of the intrusive work area is necessary to preclude equipment operators from being needlessly exposed to UXO. It is possible that an UXO struck by a drill bit, hand auger, cable trencher, backhoe, bulldozer, etc., will detonate. Depending on the size of the UXO, personal injury and property damage can be expected.

(3) Surface and subsurface clearance of UXO will be done only by EOD or UXO Specialists. Generally, UXO Specialists are contracted to provide UXO Support, which includes magnetometry.

d. UXO Support will be site specific. One, two, or more UXO persons may be required, depending on the tasks to be performed.

(1) Generally, a two person UXO Team is required to provide UXO sweeps, magnetometry support, and site safety.

(2) During investigative activities, the UXO Team is generally not tasked to perform disposal activities. If UXO is encountered that cannot be avoided and/or requires disposal, the USACE representative shall request military EOD support. Military EOD will not respond to requests for EOD support from contractor personnel.

(3) Magnetometer sweeps of the intrusive activity sites is required. If the magnetometer indicates a subsurface magnetic anomaly, an alternative site should be selected. This could be just a few feet in any direction. During investigative activities, there is no justification to needlessly expose personnel to excavating magnetic anomalies to determine their identification, when an adjacent area, which is free of magnetic anomalies can be used.

(4) After finding an area the magnetometer indicates is free of magnetic anomalies, the UXO Team will use a hand-held auger to start a drill hole. At not more than 2-foot depth, the hand-held auger should be withdrawn and the magnetometer probe lowered into the auger hole. This procedure will ensure small UXO items (20mm projectiles and grenades, etc.), undetectable from the surface, are now detectable. This procedure should be repeated until the maximum depth of the hand-held auger.

(a) While the UXO Team is hand-augering and checking the area for UXO, no other personnel should be allowed in the area.

(b) If a magnetic anomaly is not detected during this process, the drill rig and/or other equipment and personnel can be allowed on site.

(5) If an UXO is uncovered during a test trench excavation, all operations will cease. The UXO Team will determine the condition of the UXO. If disposal action is required, the USACE representative will request EOD support. Once UXO has been encountered in a test trench, no further excavation of that trench is allowed. The trench will be filled and the applicable report shall indicate UXO was encountered and the trenching activity was abandoned.

(6) During UXO related activities, the UXO Team shall not wear safety shoes or other footwear which would cause the magnetometer to present a false indication.

(7) During UXO related activities, the UXO Team will not be required to wear protective helmets (hard hats) unless, based on a hazard analysis, a head threat injury is present.

(8) Magnetometry will not detect subsurface bulk explosives. If subsurface bulk explosives is anticipated based on the site history, the UXO Team may be required to explosively perforate all projected intrusive investigation sites.

e. The UXO Team shall prepare a work and safety plan to supplement the prime contractor's or the USACE site plan. The UXO plan should indicate the specific magnetometer the UXO personnel are going to use and the procedures the UXO Team shall follow during the accomplishment of the job. This plan does not need to be comprehensive as it is a supplement to the site plan.

f. The following are the minimum, non-waiverable qualifications for UXO personnel:

(1) UXO Team Leader (UXO Supervisor) is a graduate of the U.S. Naval EOD School, Indian Head MD with at least ten years active duty military EOD experience.

(2) UXO Team member(s) (UXO Specialist) is a graduate of the U.S. Naval EOD School, Indian Head MD with at least three years of active duty military EOD experience.

g. All specifications/scopes of work requiring UXO Support should be forwarded to the OEW MCX for review. All work and safety plans involving HTRW investigations, when UXO Support is a requirement, should be forwarded to the OEW MCX for review.

OEW Generic Statement of Work
(For UXO Avoidance)

1. GENERAL: The contractor shall provide a two person Unexploded Ordnance (UXO) team to provide on-site UXO support during all sampling activities. This includes soil sampling and the drilling of monitoring wells. The UXO team will not destroy any UXO encountered. The UXO team will report all UXO to (*Range Control Officer, local COE representative, or other appropriate office* -- **the point of contact to report UXO or CWM is dependent on the site specific conditions and arrangements. Work on an active installation will normally require reporting UXO to the Range Control Officer, Facility Engineer or Post Headquarters. Work on Formerly Used Defense Sites will require prior coordination to determine the point of contact. It could be the local or state law enforcement agency, or the local emergency management agency**), and the contracting officer who will in turn notify the Huntsville Division, Corps of Engineers. The Government will contact the local EOD Unit for disposition of the OEW or UXO.

2. DEFINITIONS:

a. ORDNANCE AND EXPLOSIVE WASTE (OEW): Bombs and warheads, guided and ballistic missiles, artillery, rocket and mortar ammunition, small arms ammunition, anti-personnel and anti-tank mines, demolition charges, pyrotechnics, grenades, containerized and uncontainerized explosives and propellants, military chemical agents and all similar and related items or components, explosive in nature or otherwise designed to cause damage to personnel or material. Soils with explosive constituents are considered to be OEW if the concentration is sufficient to be reactive and present an imminent safety hazard.

b. UNEXPLODED ORDNANCE (UXO): An item of explosive ordnance that has failed to function as designed or has been abandoned, discarded or improperly disposed of and is still capable of functioning and causing damage to personnel or material.

c. INERT ORDNANCE: An item that has functioned as designed, leaving an inert carrier. An item manufactured to serve a specific training purpose. Fragments from UXO.

d. EXPLOSIVE ORDNANCE DISPOSAL (EOD) PERSONNEL: Active duty military EOD personnel.

e. UXO PERSONNEL: Former EOD personnel.

f. CHEMICAL WARFARE MATERIAL (CWM): Any CWM in a munition(s) or container(s). Any dirt or scrap that has been potentially contaminated with a chemical compound designed for military operations to kill, seriously injure or incapacitate persons through its chemical properties.

g. CHEMICAL EVENT: Discovery of an actual or suspected chemical agent or container that may require emergency transportation or disposal.

3. UXO TEAM COMPOSITION AND QUALIFICATIONS: UXO Teams shall consist of two members with the following qualifications;

a. UXO Team Leader: This is the individual who has the direct responsibility and is the technical lead for all UXO operations on the site. This individual shall have documented experience in supervising range clearance operations and supervising personnel. This individual shall be a graduate of the U.S. Naval Explosive Ordnance School at Indian Head, Maryland and have at least 10 years of active duty EOD experience.

b. UXO Team Member: Be a graduate of the U.S. Naval Explosive Ordnance School at Indian Head, Maryland. Have at least 3 years of active duty EOD experience.

4. RESPONSIBILITIES AND AUTHORITY: The UXO Team will provide the explosive ordnance recognition, location and safety function for the prime contractor. The UXO team leader has the final authority for on site personnel regarding all matters concerning UXO.

5. WORK AND SAFETY PLANS: The UXO team will assist in the development of the contractor's site safety and health plan and the work plan. The UXO team leader will conduct UXO safety briefings for all site personnel and visitors.

6. ACCESS ROUTES TO SAMPLING LOCATIONS:

a. Prior to sampling or well drilling crews going on site, the UXO team shall conduct a reconnaissance of the sampling area. The reconnaissance shall include locating a clear path for the sampling crews, vehicles and equipment to approach the site. The approach path, at a minimum will be twice the width of the widest vehicle. The contractor will clearly mark all boundaries of the cleared approach path prevent personnel from straying into uncleared areas. No personnel shall be allowed outside the cleared paths.

b. If UXO is encountered on the surface, divert the approach path around the UXO, clearly mark the area and report the UXO.

c. A magnetometer shall be used to insure there is no subsurface UXO within the approach path. If a magnetic anomaly is encountered and identified as UXO, divert the path around the UXO. Only minor excavation will be done to identify or confirm UXO. If the anomaly is more than one foot deep, assume it to be UXO and divert the approach path. Only UXO personnel shall handle UXO and operate the magnetometer.

7. SOIL SAMPLING AND WELL DRILLING SITES:

a. The UXO team shall locate magnetic anomaly free areas for soil samples and well drilling. If a pre-selected area indicates magnetic anomalies, a new sampling/drilling site will be chosen.

b. The contractor will clearly mark the boundaries of the cleared soil sampling or well site. Personnel will not go outside the cleared area. As a minimum, the cleared area will be a square, with a side dimension equal to twice the length of the largest vehicle or piece of equipment to be brought on site.

c. Prior to drilling equipment being moved to the proposed well location, the UXO team shall locate a magnetic anomaly free site. This shall be accomplished using a magnetometer with downhole monitoring capabilities. The UXO team shall start the borehole with a hand auger. At not more than a two foot depth, the hand auger will be withdrawn and the magnetometer will be lowered into the borehole. This procedure will be used to insure that smaller items of UXO, undetectable from the surface can be detected. If no magnetic anomalies are found, the procedure will be repeated at two foot intervals to the maximum depth of the hand auger, no less than 6 feet. If the proposed well site is still free of magnetic anomalies, the drilling equipment may be brought on site and utilized. Borehole monitoring with the magnetometer shall continue at two foot intervals, until virgin soil is reached. This determination shall be made by the on site geologist.

8. CHEMICAL WARFARE MATERIALS:

a. If suspected CWM is located at any time, all work will cease immediately. Site workers will withdraw along cleared paths from the area containing the CWM. The contractor will clearly mark the area containing the CWM, and report the chemical event to the designated point of contact (POC) as determined in Paragraph 1, and the contracting officer. The report of discovery of suspected CWM will be made within one hour of the discovery. The *POC* will make the final determination as to the actual presence of CWM.

b. If the *POC* confirms the presence of CWM, the government person in charge will report the chemical event to the appropriate agencies.

c. When contacting the *POC* about suspect CWM, the contractor will provide the following information listed in Figure 1. Contact with the *POC* will not be delayed due to lack of information. The suspected CWM report will follow the format in Figure 1.

(1) Date and local time of event.
(2) Location
(3) Quantity and type of munitions(s) or container(s) and chemical agents involved.
(4) Description of what has happened.
(5) Description of property damage.
(6) Personnel casualties and/or injuries.
(7) Whether medical services or facilities were required.
(8) Assistance required.
(9) Any other pertinent information.
(10) UXO team leader's assessment of the situation.

Figure 1, Sample Suspected CWM Data Report

ATTACHMENT B-6

WORK STANDARDS FOR UNEXPLODED ORDNANCE (UXO) PERSONNEL

SUBJECT: Ordnance and Explosive Waste (OEW) Mandatory Center of Expertise (MCX) Work Standards for Unexploded Ordnance (UXO) Personnel

1. The enclosed work standards are established to provide the safety limits under which UXO personnel will be expected to work on projects involving ordnance investigations and clearance actions.

2. Standards for contractor personnel defined in the enclosure are for the most part currently used in existing contracts. New standards will be incorporated into contract documents as new contracts are developed.

3. This guidance should be distributed to all personnel involved in OEW contracting, management, design and execution.

FOR THE DIRECTOR OF PROGRAMS
AND PROJECT MANAGEMENT:

Encl

C. DAVID DOUTHAT, P.E., CSP
Chief, Safety Division

DISTRIBUTION:
PM-OT(all)
PM-SO(all)
ED-CS(Geo/EPUS/Site Dev.)
ED-SY(Torres)
ED-ES(Estimating)
CT
OC(Simmons)
PA

WORK STANDARDS FOR CEHND SAFETY SPECIALISTS

1. SAFETY SPECIALIST QUALIFICATIONS. Any individual involved in the execution, supervision, or oversight of ordnance related activities shall be a graduate of the U.S. Naval Explosive Ordnance Disposal (EOD) School, Indianhead, MD and have been awarded the Master EOD Skill Badge. In addition the individual must have experience in planning, executing, and supervising multiple-team operations. Since most of our clearance actions occur on land, the individual must also have experience managing range clearance operations. This experience is characteristic of an individual with approximately 15 years of active duty military EOD experience.

2. SAFETY SPECIALIST ON-SITE RESPONSIBILITIES. A Safety Specialist shall be on site at the start of all OEW projects to observe contractor operations during all UXO intrusive or demolition activities.

a. The specialist is on hand to ensure that the contractor establishes the appropriate daily safety routines from the outset of the project, to verify employee UXO qualifications, to advise the contractor on questionable procedures, and to contact the appropriate offices when EOD response is needed. These are the minimum safety responsibilities, and do not include potential responsibilities of Quality Assurance oversight, Contracting Officer's Representative, coordination with the Life Cycle Project Manager and CEHND project manager, and other non-safety related responsibilities.

b. The on-site presence requirement can be relaxed once the project is in routine operation, with the written approval of CEHND-PM-SO. Such approval shall reflect that the on-site Safety Specialist is satisfied that the contractor is comfortable with and proficient in executing the UXO related tasks. The Contracting Officer must also be consulted to determine if on-site presence is needed for administrative reasons.

c. Safety Specialists stationed at CEHND should be rotated back to the home office after two weeks at a site, and should spend at least one week in the home office before cycling back to the field. When replacing a Safety Specialist at an on-going removal action, new Safety Specialists shall have at least two days of overlap with the veteran Specialist in order to receive proper orientation.

3. CONTRACTOR UXO QUALIFICATIONS. All Contractor UXO personnel shall be graduates of the U.S. Naval Explosive Ordnance Disposal (EOD) School, Indianhead, MD. USNAVEOD also requires that EOD personnel be U.S. citizens due to the need for access to the TM-60 series publications which are marked NOFORN (NO FOReign Nationals). No UXO personnel shall have been removed from an EOD position due to problems over reliability. Federal military or civilian employees cannot be employed by Contractors for contract work. Credit for EOD experience in National Guard or Reserve units will be based on the documented actual time spent on active duty, not on the total time of service.

a. Senior UXO Supervisor. This individual has direct responsibility for all UXO operations on the site and should therefore be able to demonstrate experience in dealing with the types of ordnance expected to be encountered. The individual shall have experience supervising multiple-team operations and, since most of our clearance actions occur on land, shall have supervised range clearance operations. The individual shall have at least 15 years active duty military EOD experience. Three years of civilian contractor UXO experience may be substituted for 3 years of active duty military EOD experience, but 12 years active duty military EOD experience is not waiverable.

b. UXO Supervisor. This individual supervises a UXO sweep team. This individual shall have experience in range clearance operations. At least ten years combined active military EOD and contractor UXO experience is required for this position. Three years active duty military EOD experience is an absolute requirement.

c. UXO Specialist. This individual shall have more than three years active duty military EOD experience. The UXO specialist may also be a UXO Assistant with at least 5 years combined military EOD and contractor UXO experience.

d. UXO Assistant. This individual has less than three years active duty military EOD experience or may be a graduate of the EOD Assistant Course at Redstone Arsenal, AL or Eglin AFB, FL. An EOD Assistant shall not perform a UXO task without the direct supervision of a UXO supervisor.

e. Quality Control (QC) Specialist. This individual has the responsibility of enforcing the contractor's QC Plan, and shall have the same minimum prerequisites as the UXO supervisor.

f. Site Safety and Health Officer (SSHO). This individual has the responsibility of enforcing the contractor's Site Safety and Health Plan (SSHP), and therefore must be in the field whenever possible observing operations. This individual shall have the same minimum prerequisites as the UXO supervisor. In addition, the SSHO shall have the specific training, knowledge and experience necessary to implement the SSHP and verify compliance with applicable safety and health requirements.

g. Magnetometer or Heavy Equipment Operator. This individual need not be a UXO person, but shall have the necessary training and experience to properly operate the assigned equipment.

4. WORK WEEK.

a. Contractor employees involved in performing unexploded ordnance related tasks shall be limited to a 10-hour day and a 40-hour work week. This limitation is deemed necessary to ensure that UXO personnel receive ample opportunity for rest so that they can remain alert during UXO operations. Exceptions to this 10-hour day/40-hour week shall be granted by CEHND-PM-SO only when public safety is at imminent risk and if the added risk to the UXO personnel has been evaluated and judged to be acceptable. Two consecutive work weeks shall be separated by 48 hours of rest.

b. CEHND-PM-SO Safety Specialists will work basically the same schedule as the contractor. The specialist is subject to the same restrictions as the contractor regarding UXO related tasks.

(1) Overtime. The Safety Specialist is expected to keep current with project paperwork during the Contractor's scheduled work week, and overtime should not be requested for such purposes. If other work is assigned which cannot be accomplished during the scheduled work week, the Safety Specialist shall submit an overtime request. This request shall identify and justify the additional work. Overtime work must be accomplished at the worksite.

(2) Overtime Pay During Travel Status. Contract schedules are under the Government's administrative control, and therefor overtime cannot be paid to a Government employee for traveling on holidays or weekends in support of a contract.

(3) Hazardous Duty Pay. Mere presence on a site containing ordnance or explosive waste does not qualify as hazardous duty. An individual can claim hazardous duty pay if

accomplishing or observing the accomplishment of UXO related tasks within the work exclusion zone. In order to justify HDP, the first Safety Specialist assigned to a site must complete an Explosive Ordnance Site-Specific Hazard Determination form (Appendix A).

5. **UXO TEAM COMPOSITION AND ROLES.** Depending upon the mission, the number of teams, size, and makeup of UXO teams will vary.

a. UXO Investigations or Clearance Actions. Where the mission calls for ordnance discovery or removal, team composition should use the following guidelines.

(1) Each team should consist of one UXO Supervisor and six or less team members. The team should have at least two UXO-qualified personnel.

(2) Teams should not be less than three personnel, including the UXO Supervisor and a UXO Specialist or UXO Assistant.

(3) The UXO Supervisor may supervise tasks and teams other than UXO teams, such as brush-clearing or surveying crews. On the other hand, task limitations imposed upon magnetometer operators and laborers may drive the contractor to assign these tasks to UXO personnel.

(4) The Senior UXO Supervisor should not supervise more than ten UXO Supervisors.

(5) A separate SSHO should be used when six or more UXO teams are working a site. The SSHO should report to the Senior UXO Supervisor. When less than six teams are operating, a UXO Supervisor may act as the SSHO. However, the Site Safety and Health Officer position demands that the SSHO spend at least 50 percent of his time in the field observing UXO operations. If the UXO Supervisor cannot meet the 50 percent field observation criteria, a separate SSHO shall be appointed.

(6) A Quality Control Specialist is not required during investigations, but should be used during removal actions, when the Government must determine that a clearance has been effective. The QC Specialist's responsibilities may not constitute a full-time on-site position, depending on size and complexity of the project, number of teams, and amount of UXO encountered. The QC Specialist must maintain high quality in the removal action without compromising safety. Therefore, QC should not be dual-hatted as a SSHO, nor should he be involved in OEW removal tasks.

(7) The UXO Assistant is authorized to operate the magnetometer, investigate anomalies and assist in disposal operations, all under supervision of a UXO-qualified individual. The UXO Assistant shall not determine if a UXO item is safe to move.

(8) The position of magnetometer operator has been created to take some of the burden from UXO Specialists who in the past were required to operate magnetometers, mark anomalies, and excavate the anomalies. Non-UXO qualified magnetometer operators shall not excavate to identify magnetic anomalies nor handle UXO. They can only operate the equipment and flag the anomalies. With this restriction it is not always wise to specify the magnetometer operator for a project, unless it can be determined that work efficiency will be gained in the process.

b. UXO Avoidance. When an HTRW or a construction project is anticipated in areas with potential OEW problems, UXO support shall be present for the purpose of avoiding ordnance. The UXO team will normally consist of two personnel; a UXO Supervisor and a UXO Specialist or UXO Assistant. The team will usually operate without on-site Safety Specialist oversight.

6. ADVERSE WEATHER CONDITIONS. Since most of the Government contracts for OEW projects are cost-reimbursable, the Government should absorb the cost of work delays caused by adverse weather. The OEW contractor is willing to work in all kinds of weather in order to keep his employees steadily occupied, and is reluctant to stop work during inclement weather. The CEHND Safety Specialist should be aware of the physical and psychological effects of adverse weather. If he determines that weather conditions create an unacceptable level of risk, the CEHND Safety Specialist shall suspend all UXO related tasks and coordinate with the Contracting Officer and the project manager regarding schedule impacts. The following factors should be considered (in addition to the requirements of EM 385-1-1) in determining whether the level of risk is acceptable.

a. Range clearance operations should not be conducted at UXO sites when the ground is covered with snow, unless a surface clearance has already been conducted. Snow cover severely limits visibility of surface UXO.

b. Performance of UXO related tasks may be unsafe in cold weather. Some procedures may require UXO personnel to remove their gloves, exposing their hands to cold injury. The additional layers of clothing required may affect other UXO operations which require manual dexterity, and thus may affect their ability to safely perform the tasks.

c. Some UXO related tasks must be performed in personal protective equipment that is heavy, cumbersome, or restricted in airflow. During hot weather such PPE will have a detrimental physical and psychological effect on the individual, and he should be closely observed for signs of heat stress.

7. ACCIDENT REPORTS. When a contractor lost-time injury or accident occurs, accident reports shall be processed as follows:

a. When the geographic District has no on-site presence, the Safety Specialist shall review and coordinate on all ENG Form 3394 "Accident Reports".

b. When the geographic District has an on-site presence, the Safety Specialist shall review and coordinate on all ENG Form 3394s for accidents within the work exclusion zone. Outside the exclusion zone the geographic District is responsible for the review and coordination.

c. The geographic District will be responsible for the administrative aspects of processing and recording all accident reports for the project on the Corps of Engineers Safety Information Management System.

8. SITE CONTROL. The Safety Specialist will be responsible for safety oversight within the work exclusion zone established for an OEW site. He must limit the exposure of a minimum number of persons, for a minimum time, to the minimum amount of OEW consistent with safe and efficient operations. The following procedures shall be followed when visitors require access to the site:

a. If the visitor is EOD qualified, a safety briefing is required, after which the visitor should be escorted to the points of interest. UXO-related operations need not be interrupted during the visit.

b. If the visitor is not EOD qualified, a safety briefing is required, after which the visitor must be escorted to the points of interest. UXO-related operations must be discontinued until the visitor exits the exclusion zone.

c. If the visitor is a foreign representative, the visit must have been coordinated through CEHND-SL (Sue Baber) prior to admittance into the exclusion zone.

STATEMENT OF WORK GUIDANCE
FOR CONTRACTS NEEDING
AN OEW AVOIDANCE SUPPORT CLAUSE

1. The following Statement of Work (SOW) is a typical addendum that can be added to a larger SOW for a Hazardous, Toxic or Radiological Waste (HTRW), Preliminary Assessment, Site Investigation, or Remedial Investigation /Feasibility Study. This SOW should be used when there is a possibility of contact with Ordnance and Explosive Waste (OEW) during the before mentioned field operations. The goal of this SOW is OEW AVOIDANCE ONLY! If there is known OEW on the site, contact the Huntsville Division Corps of Engineers, and do not use this SOW.

2. If time and resources permit, the Ordnance and Technical Programs Division of the Huntsville Division, Corps of Engineers, will assist in the drafting of SOW verbiage for your specific site and conditions.

3. This SOW does not contain provisions for a record search by the AE firm to determine what types and where ordnance might be encountered. Districts should consider completing a record search to determine the potential for contact with ordnance and the potential types and quantities before using this SOW.

4. Background:

a. OEW sites are manned by either single or multiple UXO teams depending on the action being undertaken. Multiple UXO teams are commonly used on sites involving large removal actions or for major UXO sampling during in depth investigations. During multiple UXO team operations, a Senior UXO Supervisor (who has a minimum of 15 years of EOD/UXO experience) directs all UXO teams (including the team leaders). This SOW does not cover multiple team operations.

b. Single UXO teams are normally used for simple site investigations, UXO avoidance actions (such as soil sampling and monitoring well installation) or small removal actions. For single team operations, experience levels are adjusted to insure the team has adequate experience for the job. Typically, the UXO team leader on a single team site will be more experienced than a team leader (UXO Supervisor) on a multiple team site.

c. An UXO Team will normally consist of one UXO team leader (UXO Supervisor) and one to six team members (UXO specialists or assistants). The maximum UXO team size is limited to six members (one leader to six members) for safety reasons. This OEW Avoidance SOW assumes one UXO team consisting of a team leader and one or two team members.

5. Statements of Work, resultant Work Plans (WP), and Site-specific Safety and Health Plans (SSHP) containing Unexploded Ordnance (UXO) provisions will be reviewed and approved by the Huntsville Division, Corps of Engineers (IAW CEHND 1105-3-9, Management Plan for Ordnance and Explosive Waste (OEW) Mandatory Center of Expertise (MCX) and Design Center, 10 Aug 92) Please allow a minimum of two weeks from receipt for review unless prior coordination

has been made. Items for review can be mailed to:

U.S. Army Corps of Engineers, Huntsville
P.O. Box 1600
ATTN: CEHND-PM-OT
Huntsville, Alabama 35807-4301

The street address for express mail is:

U.S. Army Corps of Engineers, Huntsville
4820 University Sq.
Huntsville, Alabama 35816-1822

6. Items in the bold print in the SOW require coordination for a specific point of contact for notification of unexploded ordnance or the location of suspected chemical warfare materials.

7. The Ordnance and Explosive Wastes Mandatory Center of Expertise at Huntsville Division stands ready to assist you with OEW issues. If you have any questions, give us a call. Programmatic, Regulatory and general information questions should be directed to the Mandatory Center of Expertise at (205) 895-1507. Safety related and technical UXO questions should be directed to the OEW Safety Office at (205) 895-1580.

8. See the attached enclosure for a sample of an OEW generic statement of work for UXO Avoidance.

OEW GENERIC STATEMENT OF WORK
(FOR UXO AVOIDANCE)

1. **GENERAL:** The contractor shall provide a two person Unexploded Ordnance (UXO) team to provide on-site UXO avoidance support during all sampling activities. This includes soil sampling and the drilling of monitoring wells. The UXO team will not destroy any UXO encountered. The UXO team will report all UXO to (*Range Control Officer, local COE representative, or other appropriate office* -- **the point of contact to report UXO or Chemical Warfare Materials (CWM) is dependent on the site specific conditions and arrangements. Work on an active installation will normally require reporting UXO to the Range Control Officer, Facility Engineer or Post Headquarters. Work on Formerly Used Defense Sites will require prior coordination to determine the point of contact. It could be the local or state law enforcement agency, or the local emergency management agency**), and the contracting officer, who will in turn notify the Huntsville Division, Corps of Engineers. The Government will contact the local EOD Unit for disposition of the OEW or UXO.

2. **DEFINITIONS:**

a. ORDNANCE AND EXPLOSIVE WASTE (OEW): Bombs and warheads, guided and ballistic missiles, artillery, rocket and mortar ammunition, small arms ammunition, anti-personnel and anti-tank mines, demolition charges, pyrotechnics, grenades, containerized and uncontainerized explosives and propellants, military chemical agents and all similar and related items or components, explosive in nature or otherwise designed to cause damage to personnel or material. Soils with explosive constituents are considered to be OEW if the concentration is sufficient to be reactive and present an imminent safety hazard.

b. UNEXPLODED ORDNANCE (UXO): An item of explosive ordnance that has failed to function as designed or has been abandoned, discarded or improperly disposed of and is still capable of functioning and causing damage to personnel or material.

c. INERT ORDNANCE: An item that has functioned as designed, leaving an inert carrier. An item manufactured to serve a specific training purpose. Fragments from UXO.

d. EXPLOSIVE ORDNANCE DISPOSAL (EOD) PERSONNEL: Active duty military EOD personnel.

e. UXO PERSONNEL: Former EOD personnel.

f. CHEMICAL WARFARE MATERIAL (CWM): Any CWM in a munition(s) or container(s). Any dirt or scrap that has been potentially contaminated with a chemical compound designed for military operations to kill, seriously injure or incapacitate persons through its chemical properties.

g. CHEMICAL EVENT: Discovery of an actual or suspected chemical agent or container that may require emergency transportation or disposal.

3. **UXO TEAM COMPOSITION AND QUALIFICATIONS:** UXO Team members shall have

the following qualifications;

a. UXO Team Leader: This is the individual who has the direct responsibility and is the technical lead for all UXO operations on the site. This individual shall have documented experience in supervising range clearance operations and supervising personnel. This individual shall be a graduate of the U.S. Naval Explosive Ordnance School at Indian Head, Maryland and have at least 10 years of active duty EOD experience.

b. UXO Team Member: Be a graduate of the U.S. Naval Explosive Ordnance School at Indian Head, Maryland. Have at least 3 years of active duty EOD experience.

4. **RESPONSIBILITIES AND AUTHORITY:** The UXO Team shall provide the explosive ordnance recognition, location and safety function for the prime contractor. The UXO team leader has the final authority for on site personnel regarding all matters concerning UXO.

5. **WORK AND SAFETY PLANS:** The UXO team shall assist in the development of the contractor's site-specific safety and health plan (SSHP) and the work plan (WP). The UXO team leader shall conduct UXO safety briefings for all site personnel and visitors.

6. **ACCESS ROUTES TO SAMPLING LOCATIONS:**

a. Prior to sampling, site investigation or well drilling crews going on site, the UXO team shall conduct a reconnaissance of the areas to be sampled or investigated. The reconnaissance shall include locating a clear path for the investigating, sampling crews, vehicles and equipment to approach the site. The approach path, at a minimum will be twice the width of the widest vehicle. The contractor shall clearly mark all boundaries of the cleared approach path to prevent personnel from straying into uncleared areas. No personnel shall be allowed outside the cleared paths.

b. If UXO is encountered on the surface, the UXO contractor shall divert the approach path around the UXO, clearly mark the area and report the UXO.

c. The UXO contractor shall use a magnetometer with the capabilities that can insure there is no subsurface UXO within the approach path. If a magnetic anomaly is encountered and identified as UXO, divert the path around the UXO. Only minor excavation shall be done to identify or confirm UXO. If the anomaly is more than one foot deep, assume it to be UXO and divert the approach path. Only qualified UXO personnel shall approach UXO items and operate the magnetometer.

7. **SOIL SAMPLING AND WELL DRILLING SITES:**

a. The UXO team shall locate magnetic anomaly free areas for soil samples and well drilling. If a pre-selected area indicates magnetic anomalies, a new sampling/drilling site shall be chosen.

b. The UXO contractor shall clearly mark the boundaries of the cleared soil sampling or well sites. Personnel shall not go outside the cleared area. As a minimum, the cleared area will be a square, with a side dimension equal to twice the length of the largest vehicle or piece of equipment to be brought on site.

c. Prior to drilling equipment being moved to the proposed well location, the UXO team shall locate a magnetic anomaly free site. This shall be accomplished using a magnetometer with downhole monitoring capabilities. The UXO team shall start the borehole with a hand auger. At not more than a two foot depth, the hand auger will be withdrawn and the magnetometer will be lowered into the borehole and the borehole checked for magnetic anomalies. This procedure will be used to insure that smaller items of UXO, undetectable from the surface can be detected. If no magnetic anomalies are found, the procedure will be repeated at two foot intervals to the maximum depth of the hand auger, no less than 6 feet. If the proposed well site is still free of magnetic anomalies, the drilling equipment may be brought on site and utilized. Borehole monitoring with the magnetometer shall continue at two foot intervals, until virgin soil is reached. This determination shall be made by the on site geologist.

8. CHEMICAL WARFARE MATERIALS (CWM):

a. If suspected CWM is located at any time, all work will cease immediately. Site workers will withdraw along cleared paths from the area containing the CWM. The UXO contractor shall clearly mark the area containing the CWM, and report the chemical event to the designated point of contact (POC) as determined in Paragraph 1, and the contracting officer. The report of discovery of suspected CWM will be made within one hour of the discovery. The POC will make the final determination as to the actual presence of CWM.

b. If the POC confirms the presence of CWM, the government person in charge will report the chemical event to the appropriate agencies.

c. When contacting the POC about suspect CWM, the contractor will provide the following information listed. Contact with the POC will not be delayed due to lack of information. The suspected CWM report will follow the following format.

Sample Suspected CWM Data Report

(1) Date and local time of event.
(2) Location
(3) Quantity and type of munitions(s) or container(s) and chemical agents involved.
(4) Description of what has happened.
(5) Description of property damage.
(6) Personnel casualties and/or injuries.
(7) Whether medical services or facilities were required.
(8) Assistance required.
(9) Any other pertinent information.
(10) UXO team leader's assessment of the situation.

ATTACHMENT B-7

SAFETY AND HEALTH ELEMENTS FOR HTRW DOCUMENTS
ER 385-1-92

APPENDIX B

Safety and Health Elements For HTRW Documents

1. Site Description and Contamination Characterization.

a. Describe the site location, topography, approximate size of the site, the onsite jobs/tasks to be performed, and the duration of planned site activities.

b. Compile a complete list of the contaminants found or known to be present in site areas to be impacted by work performed. Compilation of this listing shall be based on results of previous studies; or, if not available, select the likely contaminants based on site history and prior site uses/activities. Include chemical names, concentration ranges, media in which found, locations on-site, and estimated quantities/volumes to be impacted by site work.

2. Hazard/Risk Analysis.

a. Identify the chemical, physical (including radiological), biological, and safety hazards of concern for each site task and/or operation to be performed. Selection of chemicals as indicators of hazards shall be based upon media concentrations (i.e., air, water, soil), toxicity, volatility or risk potential for air entrainment at hazardous levels, and frequency of detection.

b. Describe chemical and physical properties of selected contaminants, sources and pathways of employee exposures, anticipated on- and off-site exposure level potentials, and regulatory (including Federal, State, and Local governments) or recommended protective exposure standards.

c. Specify and justify "action levels" based upon airborne exposure hazards and direct skin contact potentials for upgrades/downgrades in levels of personnel protection; for implementation of engineering and/or work practice controls; for emergency evacuation of on-site personnel; and for the prevention and/or minimization of public exposures to hazards created by site activities. Exposure monitoring/air sampling shall be performed in accordance with paragraph 8 below, resulting data compared with established "action levels," and appropriate corrective actions initiated as necessary.

3. Accident Prevention.

a. Any additional Accident Prevention Plan topics required by EM 385-1-1, but not specifically covered elsewhere in these elements, shall be addressed.

b. Daily safety and health inspections shall be conducted to determine if operations are being performed in accordance with the SSHP, USACE and OSHA regulations, and contract requirements.

c. In the event of an accident/incident, the CO (or approving authority for in-house USACE activities) shall be notified according to EM 385-1-1, Section 2. Within two (2) working days of any reportable accident, the contractor (or responsible USACE supervisor for in-house USACE activities) shall complete and submit an Accident Report on ENG Form 3394 in accordance with AR 385-40 and USACE Supplements to that regulation.

4. Staff Organization, Qualifications, and Responsibilities.

a. Discuss the organizational structure, including lines of authority (chain of command), and overall responsibilities of the contractor and all subcontractors for site activities, including supervisor/employee relationships.

b. Summarize the operational and health and safety responsibilities, and qualifications of each key person identified.

(1) Specifically, a Certified Industrial Hygienist (CIH) with experience in the hazardous waste site operations shall be responsible for the development, implementation, and oversight of the contractor's Safety and Health Program (SHP) and Site Safety and Health Plan (SSHP). The SSHP shall be signed and dated by the CIH prior to submittal. (For in-house USACE activities, this responsibility shall be undertaken by qualified USACE industrial hygiene personnel at the geographic Major Subordinate Command/District Command performing the work.)

(2) A fully trained and experienced Site Safety and Health Officer (SSHO), responsible to the contractor and the CIH (or the USACE approving authority), may be delegated to implement and continually enforce the safety and health program and site-specific plan elements on-site.

(3) At least one person currently certified in Standard First Aid/CPR by the American Red Cross or equivalent agency, according to EM 385-1-1, Section 4, shall be present on-site at all times during site operations.

per Bob Stout - 10/2 --

5. Training.

a. All personnel performing on-site work activities wherein they may be exposed to safety or health hazards resulting from hazardous waste operations shall have completed applicable training in compliance with 29 CFR 1910.120(e).

b. Prior to conducting on-site HTRW activities, all USACE and contractor personnel shall successfully complete a 40 hour HTRW health and safety training course to be followed by an 8-hour annual refresher and/or an 8-hour supervisors course as mandated in OSHA (29 CFR 1910.120) and this regulation.

c. In addition, site-specific training covering site hazards, procedures, and all contents of the approved SSHP shall be conducted by the SSHO for on-site employees and visitors prior to commencement of work or entering the site.

d. The type (including initial, supervisory, refresher, and site-specific), duration, and dates of all employee training performed shall be listed by employee name and certified in the SSHP.

6. Personal Protective Equipment (PPE).

a. A written Personal Protective Equipment (PPE) program in accordance with 29 CFR 1910.120(g)(5) and the respiratory protection requirements of 29 CFR 1910.134 is required.

b. Provide a detailed description of the minimum PPE (including respirators) and specific materials from which the PPE components are constructed for each site-specific task/operation to be performed, based upon the hazard/risk analysis performed above. Component levels of protection (A,B,C,D and modifications) must be relevant to site-specific conditions, including potential heat stress and associated PPE safety hazards.

c. Provide site-specific procedures to determine PPE program effectiveness and for on-site fit-testing of respirators, proper cleaning, maintenance, inspection, and storage of all PPE.

7. Medical Surveillance.

a. All personnel performing on-site work activities wherein they may be exposed to safety or health hazards resulting from hazardous waste operations shall be participants in an ongoing medical surveillance program, meeting the requirements of 29 CFR 1910.120(f) and ANSI Z-88.2.

b. All medical surveillance protocols and examination results shall be reviewed by a licensed physician who is certified in Occupational Medicine or who, by necessary training and experience, is considered Board-eligible by the American Board of Preventive Medicine Incorporated.

c. In consultation with such an occupational physician, and based upon probable site conditions, potential occupational exposures and required protective equipment, specify minimum content and frequencies of necessary medical tests/examinations/consultations.

d. Certification of participation in the medical surveillance program, the date of last examination, and name of reviewing occupational physician shall also be included for each affected employee in the SSHP.

e. The written medical opinion from the attending physician required by 29 CFR 1910.120(f)(7) shall be made available upon request to the CO or approving authority for any site employee.

8. <u>Exposure Monitoring/Air Sampling Program</u>.

a. Where it has been determined that there may be potential employee exposures to and/or off-site migration of hazardous concentrations of airborne substances, appropriate direct-reading (real-time) air monitoring and time-integrated (time-weighted average (TWA)) air sampling shall be conducted in accordance with applicable regulations (OSHA, EPA, State). Air monitoring and air sampling must accurately represent concentrations of airborne contaminants encountered on, and leaving, the site.

b. Sampling and analytical methods following NIOSH criteria (for on-site personnel) and EPA criteria (for site perimeter or off-site locations) shall be appropriately utilized.

c. Personnel samples shall be analyzed only by laboratories successfully participating, in and meeting the requirements of the American Industrial Hygiene Association's (AIHA) Proficiency Analytical Testing (PAT) or Laboratory Accreditation programs.

d. Meteorological monitoring shall be performed on-site and used as an adjunct in determining perimeter and any off-site monitoring locations. Where perimeter monitoring/sampling is not deemed necessary, a suitable justification for its exclusion should be provided.

e. Noise monitoring and radiation monitoring (alpha, beta, gamma) shall be conducted as needed, depending on the site hazard assessment.

f. All monitoring/sampling results shall be compared to "action levels" established pursuant to paragraph 2. above to determine acceptability and need for corrective action.

9. Heat/Cold Stress Monitoring.

a. Heat and/or cold stress monitoring protocols shall be specified and implemented, as appropriate.

b. Work/rest schedules shall be developed by measurement of ambient temperature, humidity, wind speed (wind chill), solar radiation intensity, duration and intensity of work, and level of protective equipment.

c. Minimum required physiological monitoring protocols which will affect work schedules shall be developed.

d. In cases where impervious clothing is worn (i.e., full-body protective clothing), the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" protocol for prevention of heat stress shall be followed, and heat stress monitoring shall commence at temperatures of 70 degrees Fahrenheit and above. Where impervious clothing is not worn, the most current published ACGIH heat stress standard (TLV) shall be used. For cold stress monitoring to help prevent frostbite and hypothermia, the most current published ACGIH cold stress standard shall be referenced and followed, as a minimum.

10. Standard Operating Safety Procedures, Engineering Controls and Work Practices. Address, as appropriate:

a. Site rules/prohibitions (buddy system, eat/drink/ smoking restrictions, etc.).

b. Material handling procedures (soils, liquids, radioactive materials).

c. Drum/container handling procedures and precautions (opening, sampling, overpacking).

d. Confined space entry procedures.

e. Hot-work, sources of ignition, fire protection/prevention, and electrical safety (ground-fault protection, overhead power line avoidance, etc.).

f. Excavation safety.

g. Guarding of machinery and equipment.

h. Fall protection.

i. Hazard Communication.

j. Illumination.

k. Sanitation.

l. Engineering controls.

11. Site Control Measures.

a. Include a site map.

b. Delineate work zones and their access points. Work zone delineation (Exclusion Zone, Contamination Reduction Zone, Support Zone) shall be based upon the contamination characterization data and the hazard/risk analysis to be performed under paragraphs 1 and 2 above.

c. Describe on-site and off-site communications.

d. Describe site security (physical and procedural).

e. Describe general site access.

12. Personal Hygiene and Decontamination.

a. Specify necessary facilities and their locations.

b. Provide detailed standard operating procedures, for frequencies, supplies and materials to accomplish decontamination of site personel.

13. Equipment Decontamination.

a. Specify necessary facilities, equipment, and their locations.

b. Provide detailed procedures, frequencies, supplies and materials, and methods to determine adequacy for the decontamination of equipment used on-site.

14. Emergency Equipment and First Aid Requirements. The following items, as a minimum and as appropriate, shall be immediately available for on-site use:

a. First aid equipment and supplies approved by the consulting physician.

b. Emergency eyewashes/showers (per ANSI Z-358.1).

c. Emergency-use respirators, i.e., escape: 5 - 15 minute emergency escape mask with air bottle; rescue: positive pressure self-contained breathing apparatus (SCBA).

d. Spill control materials and equipment.

e. Fire extinguishers (specify type, size, locations).

15. Emergency Response and Contingency Procedures (On-Site and Off-Site).

a. Local fire/police/rescue authorities having jurisdiction and nearby medical facilities that would be utilized for emergency treatment of injured personnel shall be contacted in order to notify them of upcoming site activities and potential emergency situations, to ascertain their response capabilities, and to obtain a response commitment.

b. An Emergency Response Plan, which complies with 29 CFR 1910.120(l), and which, as a minimum, addresses the following elements, shall be developed and implemented:

(1) Pre-emergency planning and procedures for reporting incidents to appropriate government agencies for potential chemical exposures, personal injuries, fires/explosions, environmental spills and releases, discovery of radioactive materials.

(2) Personnel roles, lines of authority, communications.

(3) Posted instructions and list of emergency contacts: physician/nearby medical facility, fire and police departments, ambulance service, state/local/federal environmental agencies, CIH, Contracting Officer, (approving authority for in-house activities.

(4) Emergency recognition and prevention.

(5) Site topography, layout, and prevailing weather conditions.

(6) Criteria and procedures for site evacuation (emergency alerting procedures/employee alarm system, emergency PPE and equipment, safe distances, places of refuge, evacuation routes, site security and control).

(7) Specific procedures for decontamination and medical treatment of injured personnel.

(8) Route maps to nearest pre-notified medical facility.

(9) Criteria for initiating community alert program, contacts and responsibilities.

(10) Critique of emergency responses and follow-up.

16. Logs, Reports, and Recordkeeping.

a. The following logs, reports, and records shall be developed, retained, and submitted to the CO (or approving authority for in-house activities):

(1) Training logs (site-specific and visitor).

(2) Daily safety inspection logs (may be part of the Daily QC Reports).

(3) Equipment maintenance logs.

(4) Employee/visitor register.

(5) Environmental and personal exposure monitoring/sampling results.

b. All personnel exposure and medical monitoring records are to be maintained in accordance with applicable OSHA standards, 29 CFR 1910 and 1926.

APPENDIX C

CHEMICAL DATA ACQUISITION PLAN

GENERIC INSTALLATION RI/FS WORK PLAN

SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK

JUNE 1995

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2.0 PROJECT DESCRIPTION

This generic Chemical Data Acquisition Plan (CDAP) has been prepared for CERCLA RI/FS programs at the Seneca Army Depot (SEDA) and will serve as the Quality Assurance Project Plan (QAPP) for the work conducted under CERCLA. This CDAP presents the policies, organization, objectives, quality assurance (QA), and quality control (QC) activities to be implemented in CERCLA RI/FS programs. This document has been prepared in accordance with the U.S. Army Corps of Engineers Regulation "Chemical Data Quality Management for Hazardous Waste Remedial Activities" (ER 1110-1-263; March 1990) and NYS Department of Environmental Conservation Division of Hazardous Substances Regulation "RCRA Quality Assurance Project Plan Guidance" (July 1989), and the EPA Region II "CERCLA Quality Assurance Manual" (October 1989). All activities required under Article 24 of the Federal Facility Agreement between SEDA, EPA and NYSDEC shall be performed in conjunction with tasks described in this Chemical Data Acquisition Plan.

Matrices to be sampled and analyzed during the RI/FS programs include soil, groundwater, surface water, and sediment. In performing these analyses, the contracted laboratory will follow all procedures specified in the latest NYSDEC Contract Laboratory Program (CLP) Statement of Work (SOW) for CLP analyses. Non-CLP analyses will be performed in accordance with the methods specified in Section 7 of this CDAP.

This Work Plan (WP), including the Field Sampling and Analysis Plan (FSAP) and the Health and Safety Plan (HASP), contain complete discussions of specific task objectives, their relationships to previous investigations, detailed project design, sampling protocols, and Quality Assurance/Quality Control requirements for sampling. The number and type of samples collected and submitted to the laboratory for analysis are outlined in these plans.

Site specific information is contained in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

3.0 CHEMICAL DATA QUALITY OBJECTIVES

3.1 PROJECT OBJECTIVES AND SCOPE

Specific project objectives include:

- Determine if there has been a release of hazardous constituents from each of the fifteen SMWUs, and
- Determine background levels of constituents of concern

The investigation of the SMWUs under the RI/FS programs will involve sampling of soil, sediment, surface water and groundwater. The basic approach of the Work Plan is to investigate areas likely to have been impacted by a release of hazardous materials. In general, the majority of the sample locations will be located in areas which have the highest potential for being impacted. Some sampling locations on each SWMU will be located in upgradient positions to establish background conditions.

The general parameters of concern are volatile and semi-volatile organic compounds, explosive compounds, pesticides and PCBs, herbicides and heavy metals although not all parameters will be tested for at each SWMU. Asbestos may also be a parameter of concern at selected sites.

If results are obtained during the course of the CERCLA RI/FS programs indicating that an air monitoring program would aid in the investigation of the site, then air samples will be proposed for the contaminants of concern. Air sampling for asbestos may be performed at some SWMUs that contain asbestos in buildings. There are no other air monitoring programs planned other than that required for health and safety monitoring due to field work.

3.2 QUALITY ASSURANCE OBJECTIVES FOR CHEMICAL MEASUREMENTS

The data quality objectives discussed below ensure that all data generated or developed will be in accordance with procedures appropriate for its intended use, and that the data will be of known and documented quality and be able to withstand scientific and legal scrutiny. The quality of the measurement data can be defined in terms of completeness, representativeness, accuracy, precision, comparability, and traceability. Each of these terms is defined as follows:

- Completeness is defined as the percentage of measurements that are judged to be valid measurements. Factors that negatively affect completeness include the following: missing scheduled sampling events, submitting improper quantity of sample, sample leakage or breakage in transit or during handling, missing prescribed holding times, losing sample during laboratory analysis through accident or improper handling, improper documentation such that traceability is compromised, or rejection of sample results due to failure to conform to QC criteria specifications. A completeness objective of at least 90% of the data specified by the statement of work is the goal established for this project.

- Representativeness expresses the degree to which the sample data accurately and precisely represent the population from which the sample was collected. Representativeness is a qualitative parameter that will be controlled by the proper design and management of the sampling program. The QA goal will be to have all samples and measurements be representative of the media sampled and aliquots taken for analysis should be representative of the sample received.

- Accuracy is the measure of agreement between an analytical result and its "true" or accepted value. Large deviations from a known value represent a change in the measurement system. Potential sources of deviation include (but are not limited to) the sampling process, sample preservation, sample handling, matrix effects, sample analysis, and data reduction. Sampling accuracy is typically assessed by collecting and analyzing field and trip blanks for the parameters of interest. Analytical laboratory accuracy is determined by comparing results from the analysis of matrix spikes, surrogates, or check standards to their known values. Accuracy results are generally expressed as Percent Recovery (%R). Accuracy goals for the parameters to be analyzed are presented in Section 7 of this document.

- Precision is the determination of the reproducibility of measurements under a given set of conditions, or a quantitative measure of the variability of a group of measurements compared to their average value. Precision is typically measured by analyzing field duplicates and laboratory duplicates (sample duplicate, matrix spike duplicate, check standard duplicate, and/or laboratory blank duplicate). Precision is most frequently expressed as standard deviation (SD), percent relative standard deviation (%RSD), coefficient of variation (CV), or relative percent difference (%RPD). Precision goals for the parameters to be analyzed are presented in Section 7 of this document.

- Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared with another. Sample data should be comparable with other measurement data for similar samples collected under similar sampling conditions. The utilization of standard sampling techniques, analytical methodologies, and reporting units will aid in ensuring the comparability of data. All results will be reported in a standard format using appropriate, defined units of measure. All laboratory data will be reported according to New York State Department of Environmental Conservation Contract Laboratory Protocols for Level IV and Level III data deliverables.

- Traceability is the extent to which reported analytical results can be substantiated by supporting documentation. Traceability documentation exists in two essential forms; those which link the quantitation process to authoritative standards, and those which explicitly describe the history of each sample from collection to analysis and disposal. The traceability goal for this project is 100%.

The fundamental mechanisms that will be employed to achieve these quality goals are: (1) prevention of defects in quality through planning and design, documented instructions and procedures, and careful selection and training of skilled, qualified personnel, (2) quality assessment through a program of regular audits and inspections, and (3) corrective action in response to audit findings. This CDAP has been prepared in response to these goals and describes the Quality Assurance Program to be implemented and the QC procedures to be followed by the AE and the AE's subcontractors during the course of the RI/FS programs at the Seneca Army Depot.

- Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared with another. Sample data should be comparable with other measurement data for similar samples collected under similar sampling conditions. The utilization of standard sampling techniques, analytical methodologies, and reporting units will aid in ensuring the comparability of data. All results will be reported in a standard format using appropriate, defined units of measure. All laboratory data will be reported according to New York State Department of Environmental Conservation Contract Laboratory Protocols for Level IV data, the NYSDEC Analytical Services Protocol (ASP) Category A deliverables will be issued and for Level III data the NYSDEC ASP Category B deliverables will be issued.

- Traceability is the extent to which reported analytical results can be substantiated by supporting documentation. Traceability documentation exists in two essential forms; those which link the quantitation process to authoritative standards, and those which explicitly describe the history of each sample from collection to analysis and disposal. The traceability goal for this project is 100%.

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4.0 AE CONTRACTOR PROJECT ORGANIZATION AND FUNCTIONAL AREA RESPONSIBILITIES

4.1 PROJECT ORGANIZATION

This section describes the organizational structure, lines of authority, and responsibilities of individuals who will be responsible for the successful execution of the CDAP. Subcontractor personnel providing services in support of this project will perform work in strict compliance with the appropriate contract specifications for this activity.

Details of the project organization for the subject site are included in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan. The project organization identifies the firms that will be performing tasks for the RI/FS programs, the Project Manager, the Technical Advisor, Lead Scientists and the Project Quality Assurance Officer (PQAO).

4.2 FIELD SAMPLING RESPONSIBILITIES

All field sampling activities will be coordinated through the Project Manager. He is responsible for the development, review, and implementation of sampling work plans for the RI/FS programs. The implementation of these work plans includes performance and system audits of the sampling activities by the PQAO with reports submitted to the Project Manager for initiation of corrective action.

The customer service representative at the contracted laboratory is responsible for communicating information to the Project Manager concerning sample handling, applicability of EPA methodologies, and interpreting analysis results and for communicating requests and information from the Project Manager to laboratory personnel.

Sampling personnel will be experienced in U.S. EPA and NYSDEC procedures for surface and subsurface soil and water sampling. In addition, all on-site personnel will have completed the 40-hour health and safety training course in accordance with Occupational Safety and Health Administration (OSHA) requirements. The project Health and Safety Plan, will be made available for all personnel on-site. Sign-off sheets verifying that personnel have read the plan will be maintained in the project file at the site.

Sampling personnel have the responsibility for field calibration of measurement and test equipment on their respective project tasks. All equipment used in the field, such as pH meter, thermometer, and specific conductance meter will have a calibration check on a daily basis. They will maintain field notebooks documenting project activities and will complete other documentation including boring and sampling logs. They will also be responsible for proper labeling, handling, storage, shipping, and chain-of-custody procedures for samples collected during their project tasks.

4.3 CONTRACT LABORATORY RESPONSIBILITIES

Samples will be analyzed in the contracted laboratory under the direction of the Laboratory Director, the Quality Assurance Officer, the Inorganic Laboratory Supervisor; and the Organic Laboratory Supervisor. Analysts and technicians in each laboratory section are responsible for analyzing the samples and performing QC analyses and specified procedures to ensure reliability of the data. They are responsible for proper documentation of all analyses and QC procedures, including the primary data review of results.

A discussion of the contracted laboratory including location, personnel, facilities, instrumentation, and capabilities is contained in the contracted laboratory's Quality Assurance Program Plan (QAPP) attached as Appendix A to this appendix. The contracted laboratory is identified in Section 6.0 of the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

5.0 FIELD ACTIVITIES

A detailed description of field procedures are included in the Field Sampling and Analysis Plan (FSAP) which is included as Appendix A of the Work Plan. The FSAP will address the following topics:

- UXO clearance procedures
- Geophysical survey procedures
- Sample collection procedures for each matrix.
- Description of sampling devices and equipment
- Decontamination procedures
- Waste handling procedures

5.1 LIST OF EQUIPMENT, CONTAINERS, AND SUPPLIES TO BE TAKEN TO THE FIELD

The field equipment needed to perform the field activities at each SWMU are described in the FSAP. In general, this equipment consists of sampling equipment, bottles to store samples, preservatives, sample storage and shipping supplies, decontamination supplies, personal protection equipment, instruments for field screening and health and safety, and forms and notebooks to record data.

5.2 SAMPLING LOCATIONS

Data from the sampling locations will be used to obtain information on the extent of contaminants of concern, locate releases, and measure background concentrations.

The sampling locations for each SWMU are described in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

5.3 GENERAL INFORMATION AND DEFINITIONS

a. Contractor Laboratory. The laboratory performing analysis of the field samples. This may be an AE laboratory, a Remedial Action contractor laboratory or a laboratory subcontracted by either.

The contracted laboratory is identified in the appropriate RI/FS Project Scoping Plan that serves a supplement to this Generic Installation RI/FS Work Plan.

b. QA and QC Samples. Samples analyzed for the purpose of assessing the quality of the sampling effort and of the analytical data. QA and QC samples include splits or replicates of field samples, rinsate blanks, trip blanks, and matrix spike/matrix spike duplicates.

QC Samples. Quality Control samples are collected by the sampling team in duplicate for use by the contractor's laboratory. The identity of these samples is held blind to the analysts and laboratory personnel until data are in deliverable form. The purpose of the sample is to provide site specific, field-originated checks that the data generated by the contractor's analytical lab are of suitable quality. QC samples represent approximately 5% of the field samples.

QA Samples. Split samples sent to a USACE QA laboratory by overnight delivery and analyzed to evaluate the AE and the contractor laboratory performance. QA samples represent approximately 5% of the field samples. The contractor shall coordinate with the designated QA laboratory not less than 48 hours before sampling to assure that the QA laboratory is alerted to receive the QA samples and process then within the time limits specified by applicable EPA regulations and guidelines.

c. Split Samples. Samples that are collected as a single sample, homogenized, divided into two or more equal parts, and placed into separate containers. The sample shall be split in the field prior to delivery to a laboratory. Ordinarily, split samples are analyzed by two different laboratories.

d. Replicate (duplicate, triplicate, etc) Samples. Multiple grab samples, collected separately, that equally represent a medium at a given time and location. This is the required type of collocated sample for volatile organic analyses and most groundwater and surface water samples. Replicate samples must be collected at a rate of one per twenty environmental samples or less per matrix. This is a separate replicate from that prepared and analyzed by the laboratory.

e. Rinsate Blank (Field Equipment Blank). Samples consisting of demonstrated analyte free water collected from a final rinse of sampling equipment after the decontamination procedure has been performed. The purpose of rinsate blanks is to determine whether the

sampling equipment is causing cross contamination of samples. Rinse blanks must be collected at a rate of one rinse blank per type of equipment used each day a decontamination event is carried out. [Note: For groundwater samples only a rinsate will be collected every other day a sampling event is carried out. The reason for this is because only 2 to 4 samples will be collected each day with the low flow sampling method and daily rinsates would produce an unreasonable of rinsates in proportion to the number of field samples.] It is permissible to use the same aliquot of water on all equipment associated to a particular matrix for analysis of VOCs, semivolatiles, pesticides, PCBs, explosives, and inorganics. This rinse must be performed sequentially on all sampling equipment.

f. Trip Blank. Containers of demonstrated analyte-free water that are kept with the field sample containers from the time they leave the laboratory until the time they are returned to the laboratory. The purpose of trip blanks is to determine whether samples are being contaminated during transit or sample collection. Trip blanks pertain only to volatile organic analyses; therefore, the containers must contain no headspace. Only one trip blank is needed for one day's sampling and shall satisfy trip blank requirements for all matrices for that day if the volatile samples are shipped in the same cooler. Trip blanks are only required when sampling aqueous samples undergoing VOC analysis.

5.4 SAMPLING AND PRESERVATION PROCEDURES

5.4.1 Sample Containers and Preservation

It is essential to the validity of analytical results that samples be collected and stored in properly prepared containers to minimize sources of contamination. New sampling glassware and containers will be used whenever possible. Containers from a another supplier that meets the conditions in "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers" published by EPA's Office of Emergency and Remedial Response in April 1990 will be used for the RI/FSs. The type and size of sample containers required are indicated in Table C-1.

Proper sample preservation techniques are important to maintain the integrity of the sample and validity of the analytical results. Methods of preservation are intended to (1) retard biological activity, (2) retard hydrolysis of chemical compounds and complexes, (3) reduce volatility of constituents, and (4) reduce absorption effects. Preservation methods are generally limited to pH control, chemical additives, and refrigeration. The USACE Sample Handling Protocols (Appendix E to ER 1110-1-263) for the contaminants of concern at SEDA are listed in Table C-1.

Field personnel will add preservatives to the bottles that will be used that day (or pre-preserved bottles will be used) and carry equipment (ice and coolers) to keep the sample below 4°C during the day. The only type of preservation used for soil samples is storage at or below 4°C, so field personnel will ensure that the necessary supplies such as ice and ice chests, are readily available at the collection site. Sample preservation will be initiated by field personnel immediately upon sample collection. Samples in prepreserved bottles are tested for pH using litmus paper before they are closed. With the exception of volatile organics samples, the pH will be tested by pouring a small amount of the sample over the litmus paper; litmus paper should not be dipped into the sample. For VOA water samples an extra prepreserved bottle will be used to test the pH. If the

pH in the test bottle is greater than 2 more acid will be added. Once the volume of extra acid needed is determined, a like amount of acid will be added to the other sample bottles prior to sampling. Prepreserved bottles may also be used, however, the pH should be tested after sample collection (as described above) and appropriate volumes of acid or base added, if necessary. If preservation pellets are used (i.e, NaOH), make sure they have dissolved before measuring the pH of the sample.

The procedure listed below, adapted from the drinking water methods, will be used for acidification of volatile organic samples with 1:1 HCl to a pH less than 2. Use 12N HCl to prepare the 1:1 preservative solution.

> Adjust the pH of the sample to <2 by carefully adding 1:1 HCl drop by drop to the required 2 (40 ml) VOA sample vials. The number of drops of 1:1 HCl required should be determined on a third portion of sample water of equal volume.

If acidification of the sample causes effervescence, the sample should be submitted without preservation except for cooling to 4 degrees C. This sample property will be approximately noted when present. When adding sodium thiosulfate to samples containing residual chlorine, the thiosulfate should be added to the vial prior to addition of the sample followed by addition of HCl. The 1:1 HCl solution should be made up with concentrated HCl (12N) and demonstrated analyte-free deionized water.

5.4.2 Holding Times

Maximum holding times for all analytes of interest are presented in Table C-1. These holding times satisfy the requirements of the EPA's SW-846 Protocols and the USACE Sample Handling Protocols (Appendix E to ER 1110-1-263).

5.4.3 Review of Sampling Procedures

The Work Plan and FSAP discuss the details of sampling with respect to equipment, location, and frequency. This document will discuss those elements of field sampling and preservation that directly impact the quality assurance aspects of the RI/FS Programs.

An integral part of any field sampling program is the implementation of a Quality Control program. The QC program for the RI/FS programs includes the collection of field replicate, equipment blank, and matrix spike/matrix spike duplicate samples for all matrices. Each type of QC sample will be collected at a minimum frequency of one per twenty samples (5%). One VOA

TABLE C-1

REQUIRED CONTAINERS, PRESERVATION AND HOLDING TIMES

		Containers[1]	Preservation	Maximum Holding Time from VTSR (see Note A)
I.	Groundwater and Surface Water			
1.	Mercury	P[2]	HNO_3 TO $pH<2$	26 days
2.	Metals, except Mercury	P[2]	HNO_3 to $pH<2$	180 days
3.	Explosives	G[3]	Cool, 4°C	5/40 days[4]
4.	Volatiles	G[7]	HCL to $pH<2$,4°C	7 days
5.	Semi-Volatiles	G[3]	Cool, 4°C	5/40 days[4]
6.	Pesticides/PCBs	G[3]	Cool, 4°C	5/40 days[4]
7.	Nitrate	P,G	Cool, 4°C	2 days
8.	Total Petroleum Hydrocarbons	G[6]	HCL to $pH<2$,4°C	28 days
9.	Radioactivity	P[8]	HNO_3 to $pH<2$	6 months
10.	Total Cyanide	P[8]	Asorbic acid and NaOH, 4°C $pH>12$	14 days
II.	Soil, Asbestos, Other Solids, Oil, and Other Liquids			
1.	Mercury	G[5]	Cool, 4°C	26 days
2.	Metals, except Mercury	G[5]	Cool, 4°C	180 days
3.	Explosives	G[6]	Cool, 4°C	5/40 days[4]
4.	Volatiles	G[7]	Cool, 4°C	10 days
5.	Semi-Volatiles	G[3]	Cool, 4°C	5/40 days[4]
6.	Pesticides/PCBs	G[3]	Cool, 4°C	5/40 days[4]
7.	Nitrate	P,G	Cool, 4°C	2 days
8.	Asbestos	G[6]	None Required	None
9.	Radioactivity	P[8]	None Required	6 months
10.	Total Cyanide	G	None Required	14 days
III.	Fish Tissue			
1.	Mercury	G[9]	Freeze	26 days
2.	Metals, except Mercury	G[9]	Freeze	180 days
3.	Explosives	G[9]	Freeze	5/40 days[4]
4.	TCL Volatiles	G[9]	Freeze	7 days
5.	TCL Semivolatiles	G[9]	Freeze	5/40 days[9]
6.	TCL Pesticides/PCBs	G[9]	Freeze	5/40 days[9]
7.	Cyanide, Total	G[9]	Freeze	12 days

Notes:

A	VTSR = Verified Time of Sample Receipt
1	Polyethylene (P) or Glass (G)
2	500 ml plastic containers with appropriate preservation
3	2.1 liter amber glass containers with Teflon-lined cap
4	5 days from VTSR/40 days from extraction to analysis
5	500 ml glass container with polyethylene liner
6	250 ml amber glass container with Teflon-lined cap
7	3 40 ml amber glass vial with Teflon-lined cap
8	8 oz. high density polyethylene bottle for solid samples, 2L HDPE bottle for liquid samples.
9	Sufficient size for fish. 5 days from sample receipt to extraction/40 days from extraction to analysis

trip blank will be incorporated for each day of sampling. In addition, each type of QC samples will be handled, preserved, and documented in exactly the same manner as required for the matrix and analyte of interest. Field duplicate samples will be submitted to the laboratory blind.

The QA laboratory will be the Missouri River Division laboratory in Omaha, NE. The QA program for the RI/FS programs includes the collection of duplicates, a background soil sample, rinsates for water samples, and trip blanks. QA samples to be collected include duplicates at a minimum frequency of one per twenty samples (5%), a background soil sample split from a background location, rinsates at the rate of one per day for water samples, and trip blanks at a rate of one per shipping cooler containing water samples to be analyzed for volatiles.

5.4.3.1 General Procedure for Sampling Soil, Sediment and Other Solid Materials

Detailed sampling procedures for soil, sediment and other solid materials are provided in Appendix A, Field Sampling and Analysis Plan.

Generally, the procedures are as follows. Using stainless steel sampling equipment, enough solid material is removed from a specified depth to fill the required containers and placed in a decontaminated stainless steel bowl. Samples for VOA will be placed in vials, then the remaining material will be mixed thoroughly with stainless steel implements (spoons, spades, etc.), placed into the appropriate sample containers, and properly preserved. QC and/or QA sample containers shall be filled from the same mixture as one of the samples.

Insulation material for asbestos analysis will be picked up by hand and placed into the appropriate sample container.

5.4.3.2 General Procedure for Sampling Surface Water, Groundwater, and Other Liquid

Detailed sampling procedures for surface water, groundwater and other liquid materials are discussed in Appendix A, Field Sampling and Analysis Plan.

Groundwater samples will be obtained after the monitoring well is purged of water standing in the well. Purging will continue until the pH, temperature, and specific conductivity are observed to

vary less than 10% and the turbidity is less than 50 NTUs. The number of submerged well volumes that will be removed from low recharge wells will vary depending on the recharge rate.

Surface water will be collected as grab samples by submerging containers in the water.

Oil on surface water will be collected by partially submerging a container in the water so that primarily oil entered the container.

5.4.3.3 Other Matrices

Detailed sampling procedures for other matrices are discussed in Appendix A, Field Sampling and Analysis Plan.

Sampling methods and equipment used for other matrices shall meet the requirements of EPA or NIOSH methods. Sampling for fish will require the following equipment: trap nets, electrofishing gear either backmounted or larger boat mounted electroshocker equipment. Sufficient amounts of fish tissue from selected species must be collected for analytical analysis. For larger fish, individual will be analyzed. For smaller fish, a composite sample may be required to obtain the necessary mass of tissue for analysis. Field sampling personnel will record the condition of the fish when captured and their weight and length. Scales from larger game fish, such as smallmouth bass or walleye, will be collected if available. Fish tissue samples will be analyzed with "skin on" instead of the normal fillet to correlate data with New York State's database. In addition to the contaminants of concern, lipid content will be measured.

5.4.3.4 Replicate Samples

One replicate sample will be collected for each batch of 20 or fewer samples per matrix sampled. This is a separate replicate from that prepared and analyzed by the laboratory. This requirement applies to all matrices. Replicate water quality samples will be collected by alternately filling the appropriate containers until the required volume has been obtained. Replicate soil samples will be mixed until a representative homogeneous sample can be obtained. Homogenization will be accomplished by filling a properly decontaminated intermediate bowl (stainless steel) and mixing. The extent of mixing required will depend on the nature of the material and will be considered complete when a consistent physical appearance is achieved. In every situation possible QC duplicates for the COE/MRD approved analytical laboratory and QA replicates for MRD will be collected at the same site.

5.4.3.5 Rinsate Blanks (Field Equipment Blanks)

A rinsate field equipment blank will be collected to detect possible sources of contamination introduced from field sampling equipment that may influence analytical results. The field equipment blank will consist of one set of sample containers for all analytes of interest. Demonstrated analyte-free water will be poured over or through the sampling equipment after the decontamination process. (The results of the analysis of the demonstrated analyte-free water are available upon request.) The rinsate sample should be collected at the beginning of the day. After collection of the rinsate, the sampling equipment will be tagged appropriately (i.e., marked with flagging tape) and will be used to collect a sample (i.e., the QC sample) in the field. In this way, the results of the rinsate analysis can be related to the results of the field sample. In the event that dedicated sampling equipment is used, field equipment blanks will not be collected. Rinse blanks must be collected at a rate of one rinse blank per type of equipment used each day a decontamination event is carried out. [Note: For groundwater samples only a rinsate will be collected every other day a deontamination event is carried out. The reason for this is because only 2 to 4 samples are collected each day with the low flow sampling method and a daily rinsate would produce an unreasonable number of rinsates in proportion to the number of field samples.] The field equipment blanks will be handled, transported, and analyzed in the same manner as all other samples collected during the sampling event.

5.4.3.6 Trip Blanks

A trip blank will be collected for each day of sampling (but only when volatile organics are being sampled) to detect possible sources of volatile organic contamination during sample collection or in transit. Also, trip blanks are only required when sampling aqueous samples undergoing VOC analysis. Trip blanks will be prepared in the laboratory, using demonstrated analyte-free reagent water, and shipped to the site with the sampling containers. They may also be prepared at the field office storage trailers if the bottles are shipped to the field for storage prior to sampling by a bottle supply company; in addition the demonstrated analyte-free water may originate at the site and not at the laboratory. If the demonstrated analyte-free water is stored on-site, it will be kept away from organic solvents in order to avoid extraneous contamination. The trip blank will accompany the sampling containers during field sampling activities without being opened. The trip blank is then packed for shipment along with the volatile organic samples for the day. The trip blank will be logged in and analyzed for TCL or EPA 524.2 volatile organics. The data will be reported with the sample data.

5.4.3.7 Matrix Spike Samples

The use of matrix spikes gives insight into the analytical proficiency and efficiency of the analytical methods. During the field sampling activities, sufficient sample volume must be collected (triple the normal sample volume) so that a Matrix Spike/Matrix Spike Duplicate pair and a Method Blank (MS/MSD/MSB) for TCL constituents, VOCs by Method 524.2, herbicides, explosives, and petroleum hydrocarbons and a matrix spike/replicate pair for TAL constituents, nitrate, and fluoride can be prepared. Samples for matrix spikes will be collected for each batch

5.4.3.5 Rinsate Blanks (Field Equipment Blanks)

A rinsate field equipment blank will be collected to detect possible sources of contamination introduced from field sampling equipment that may influence analytical results. The field equipment blank will consist of one set of sample containers for all analytes of interest. Demonstrated analyte-free water will be poured over or through the sampling equipment after the decontamination process. The rinsate sample should be collected at the beginning of the day. After collection of the rinsate, the sampling equipment will be tagged appropriately (i.e., marked with flagging tape) and will be used to collect a sample (i.e., the QC sample) in the field. In this way, the results of the rinsate analysis can be related to the results of the field sample. In the event that dedicated sampling equipment is used, field equipment blanks will not be collected. One field equipment blank will be collected at a frequency of one in twenty (5%) samples for each matrix sampled. The field equipment blanks will be handled, transported, and analyzed in the same manner as all other samples collected during the sampling event.

5.4.3.6 Trip Blanks

A trip blank will be collected for each day of sampling (but only when volatile organics are being sampled) to detect possible sources of volatile organic contamination during sample collection or in transit. Trip blanks will be prepared in the laboratory, using demonstrated analyte-free reagent water, and shipped to the site with the sampling containers. They may also be prepared at the field office storage trailers if the bottles are shipped to the field for storage prior to sampling by a bottle supply company; in addition the demonstrated analyte-free water may originate at the site and not at the laboratory. The trip blank will accompany the sampling containers during field sampling activities without being opened. The trip blank is then packed for shipment along with the volatile organic samples for the day. The trip blank will be logged in and analyzed for TCL or EPA 524.2 volatile organics. The data will be reported with the sample data.

5.4.3.7 Matrix Spike Samples

The use of matrix spikes gives insight into the analytical proficiency and efficiency of the analytical methods. During the field sampling activities, sufficient sample volume must be collected (triple the normal sample volume) so that a Matrix Spike/Matrix Spike Duplicate pair and a Method Blank (MS/MSD/MSB) for TCL constituents, VOCs by Method 524.2, herbicides, explosives, and petroleum hydrocarbons and a matrix spike/replicate pair for TAL constituents, nitrate, and fluoride can be prepared. Samples for matrix spikes will be collected for each batch of 20 or fewer field samples of the same matrix. A description of the laboratory procedures are outlined in section 7.0 of this document. Detailed sampling procedures are included in the FSAP, Appendix A.

5.5 FIELD DOCUMENTATION

The purpose of documenting site activities is to provide a complete record of all sampling procedures, site conditions, and sample chain of custody. A strict field documentation program consistent with the following documents will be implemented.

- RCRA Ground Water Monitoring Technical Enforcement Guidance Document. U.S. EPA (OSWER-9950.1) September 1986.
- Protocoi for Ground Water Evaluations. U.S. EPA (OSWER Dir. 9080.0-1) September 1986.

5.5.1 Field Logbook

Field logbooks will be used to record all site activities during field operations. Logbooks will be provided to each field sampling team and dedicated to the RI/FS program. Durable hard cover bound logbooks with water proof pages such as those manufactured by TeleDyne will be used. All pages will be numbered consecutively and will not be removed under any circumstances. Entries will be recorded using black indelible ink. Each entry will be dated, legibly written, and contain an accurate and complete description of site activities. Each page will be signed by all personnel making an entry on that particular page. Any changes or corrections will be initialed by the person making the alterations. At the completion of each field sampling event, the field logbook entries will be photocopied and placed on file.

Logbook entries will include the following types of information (this is not intended to be an exhaustive list):

- project name, job number, and location;
- date and time of arrival and departure from the site;
- purpose of site visit such as quarterly sampling, surveying, surface water sampling, etc;
- name of person keeping the log;
- name and affiliation of all persons on-site;

- weather and field conditions at time of sampling and any changes occurring throughout the sampling event;
- photographic information including description of what was photographed, date and time, and number of the negative on the roll;
- significant site observations, such as condition of monitoring wells, color of leachate seeps, etc; and
- summary of the day's activities.

5.5.2 Field Task Forms

Single-page forms will be used for recording the field information that will be obtained during collection of samples, drilling borings, installing monitoring wells and aquifer testing. The forms will be reviewed by the site manager for completeness and will be kept in the field office files when they have been completed. These forms will be used to record the following types of information:

- reference to FSAP, if applicable;
- sample identification number;
- location of sampling point including sample collection depth for surface water and sediment samples;
- description of sampling method including procedures followed, equipment used, well volume removed, calibration of field equipment, sampling sequence, etc;
- sample description (i.e., groundwater, sediment, surface water), appearance, condition, and volume of the samples collected;
- results of field measurements such as pH, conductivity, temperature, etc;
- type of preservation used for each sample;
- description of sample containers; type, quantity, volume, lot numbers and analysis required;
- date and time of sample collection;
- name of collector(s); and
- Chain-of-custody information such as analysis requested and bottles and preservatives used.

6.0 SAMPLE CHAIN OF CUSTODY AND TRANSPORTATION

6.1 SAMPLE LABELS

Sample labels will be affixed to all sample containers during collection. Sample labels will be filled out in indelible ink and include:

- Date and time of collection;
- Sample location;
- Matrix;
- Sample number;
- Analysis to be performed;
- Sampler's name and affiliation; and
- Preservative added.

After the labels have been completed and affixed to the sample container, they will be covered with clean Mylar tape to guard against obliteration of the sample label.

6.2 CHAIN OF CUSTODY PROCEDURES

The goal of implementing chain of custody procedures is to ensure that the sample is traceable from the time of collection through analysis, reporting, and disposal. The chain of custody procedures, sample seals and forms, are initiated in the field at the time of sample collection. Each sample container is sealed with chain of custody tape after sampling is complete. Chain of custody forms including the signatures of the relinquishers and the receiver, the date and time, and any pertinent remarks are filled out and sent along with the samples to the laboratory. The samples and their chain of custody form are placed in coolers and the coolers additionally sealed with chain of custody tape. The coolers are then transported to the contracted laboratory for analysis. Upon arrival at the laboratory, the chain of custody form will be signed and a copy retained with the field data sheets for that round of sampling.

Once the samples are logged into the laboratory system, an internal chain of custody record is maintained. An analyst requesting a sample must sign this chain of custody form before the sample is released to their possession. When the analysis is complete, samples are returned to Sample Management and the chain of custody form updated.

For a complete discussion of laboratory chain of custody procedures, and copies of chain of custody forms, refer to the contracted laboratory's QAPP attached as Appendix A of this document and information detailed in the appropriate RI/FS Project Scoping Plan that serves as an attachment to this Generic Installation RI/FS Work Plan.

6.3 SAMPLE PACKING AND SHIPPING PROCEDURES

In order to minimize the possibility of sample leakage, breakage, or spillage and to comply with USACE Sample Handling Protocol (Appendix E of ER 1110-1-263) and U.S. Department of Transportation shipping regulations, samples will be packaged and shipped according to the procedures summarized below:

- Package all samples so they do not spill, leak or vaporize;
- Uniquely identify and properly label each sample;
- Enter all sample information on a chain of custody form;
- Individually wrap all containers and carefully pack them, upright, in an appropriate cooler. Use cooling packs and packing material to fill the excess space in the cooler;
- Enter the custody tape number on the chain of custody form, sign and date the "Relinquished By" space, seal the chain of custody form in plastic, and attach it to the inside lid of the container;
- Seal the cooler with (signed and dated) custody tape such that the cooler cannot be opened without breaking the tape. Secure the cooler with strapping (fiber) tape;
- Put "This Side Up" labels on all four sides and "Fragile" labels on at least two sides;
- Record the packaging and shipping details (sample numbers, custody form numbers, custody seal numbers, airbill number, etc.) in the Field Activities Notebooks; and
- Ship the cooler for overnight delivery to the analytical laboratory. To ensure that the coolers are shipped to the correct destination, the shipping labels will be checked prior to releasing the coolers to the overnight delivery shipping company.

7.0 LABORATORY ANALYTICAL PROCEDURES

All analytical testing, documentation, and reporting will be performed by the contracted laboratory's personnel. Specific laboratory operations are governed by the contracted laboratory's QAPP which discusses laboratory activities from the arrival of samples to the reporting of validated analytical data. Supplemental QC criteria are provided in the individual methods and in the contracted laboratory's Standard Operating Procedures, as appropriate.

This section of the CDAP outlines the particular provisions of the laboratory QAPP applicable to the testing of samples collected during the RI/FS programs located at SEDA.

7.1 GENERAL LABORATORY PROCEDURES

The contracted laboratory's QAPP, attached as Attachment A to this document, contains detailed discussions of the laboratory facilities, storage areas, analytical instrumentation, equipment and system performance checks, preventative maintenance, glassware cleaning, sample preservation and storage, chemical inventory, and personnel training program.

The general laboratory procedures are discussed in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

7.2 ANALYTICAL METHODS

Environmental samples from the RI/FS programs at SEDA will be analyzed by qualified laboratory personnel according to the methods listed in Table C-2 to C-8 from the following references:

1. NYSDEC CLP Analytical Services Protocol, December 1991 with updates, Statement of Work for Organics and Inorganics Analyses;
2. SW-846, "Test Methods for Evaluating Solid Waste:" Method 8330 for Nitroaromatics and Nitroamines; Method 8150 for Herbicides; Method 8015 for Total Petroleum Hydrocarbons; Method 8080 for PCBs in oil using the latest revision; and Method 9310 for Gross Alpha and Gross Beta, Method 9060 for Total Organic Carbon (TOC);
3. "Methods for Analysis of Water and Wastes, EPA-600\4\79-020, Method 353.2 for Nitrate and Method 340.2 for Fluoride; Method 405.1 for biological oxygen demand (BOD); Method 310.2 for alkalinity; Method 325.3 for chloride; Method 375.4 for sulfate; Method 130.2 for total hardness; Method 410.2 for chemical oxygen demand

7.0 LABORATORY ANALYTICAL PROCEDURES

All analytical testing, documentation, and reporting will be performed by the contracted laboratory's personnel. Specific laboratory operations are governed by the contracted laboratory's QAPP which discusses laboratory activities from the arrival of samples to the reporting of validated analytical data. Supplemental QC criteria are provided in the individual methods and in the contracted laboratory's Standard Operating Procedures, as appropriate.

This section of the CDAP outlines the particular provisions of the laboratory QAPP applicable to the testing of samples collected during the RI/FS programs located at SEDA.

7.1 GENERAL LABORATORY PROCEDURES

The contracted laboratory's QAPP, attached as Attachment A to this document, contains detailed discussions of the laboratory facilities, storage areas, analytical instrumentation, equipment and system performance checks, preventative maintenance, glassware cleaning, sample preservation and storage, chemical inventory, and personnel training program.

The general laboratory procedures are discussed in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

7.2 ANALYTICAL METHODS

Environmental samples from the RI/FS programs at SEDA will be analyzed by qualified laboratory personnel according to the methods listed in Table C-2 to C-8 from the following references [the most recent (at the time of the analysis) revisions of the analytical methods will be employed]:

1. NYSDEC CLP Analytical Services Protocol, December 1991 with updates, Statement of Work for Organics and Inorganics Analyses;
2. SW-846, "Test Methods for Evaluating Solid Waste:" Method 8330 for Nitroaromatics and Nitroamines; Method 8150 for Herbicides; Method 8015 for Total Petroleum Hydrocarbons; Method 8080 for PCBs in oil using the latest revision; and Method 9310 for Gross Alpha and Gross Beta, Method 9060 for Total Organic Carbon (TOC); [Note: When using any method from SW-846, all requirements specified in the method as "recommended" are required (for example but not limited to analysis/reporting of VOC and Semi-VOC TICs, and other QA/QC requirements). Other specifications contained

in Chapter One of SW-846 are also required to be performed. The data should be reported in a format equivalent to the NYSDEC ASP Category B package. This includes but is not limited to all raw data, quantitation reports, sample and standard spectra and QA/QC information.]

3. "Methods for Analysis of Water and Wastes, EPA-600\4\79-020: Method 353.2 for Nitrate and Method 340.2 for Fluoride; Method 405.1 for biological oxygen demand (BOD); Method 310.2 for alkalinity; Method 325.3 for chloride; Method 375.4 for sulfate; Method 130.2 for total hardness; Method 410.2 for chemical oxygen demand

TABLE C-2
PARAMETER LIST FOR INORGANIC AND ORGANIC ANALYSES

I. Soil and Sediment Analyses	Preparation Method	Analytical Method	Reporting Limits (ug/Kg)
A. Inorganics (TAL)			
i. Aluminum	NYSDEC CLP	NYSDEC CLP	20,000
ii. Antimony	NYSDEC CLP	NYSDEC CLP	6,000
iii. Arsenic	NYSDEC CLP	NYSDEC CLP	1,000
iv. Barium	NYSDEC CLP	NYSDEC CLP	20,000
v. Beryllium	NYSDEC CLP	NYSDEC CLP	500
vi. Cadmium	NYSDEC CLP	NYSDEC CLP	500
vii. Calcium	NYSDEC CLP	NYSDEC CLP	500,000
viii. Chromium (and chromium screen)*	NYSDEC CLP	NYSDEC CLP	1,000
ix. Cobalt	NYSDEC CLP	NYSDEC CLP	5,000
x. Copper	NYSDEC CLP	NYSDEC CLP	2,500
xi. Iron	NYSDEC CLP	NYSDEC CLP	10,000
xii. Lead	NYSDEC CLP	NYSDEC CLP	300
xiii. Magnesium	NYSDEC CLP	NYSDEC CLP	500,000
xiv. Manganese	NYSDEC CLP	NYSDEC CLP	1,500
xv. Mercury	NYSDEC CLP	NYSDEC CLP	20
xvi. Nickel	NYSDEC CLP	NYSDEC CLP	4,000
xvii. Potassium	NYSDEC CLP	NYSDEC CLP	500,000
xviii. Selenium	NYSDEC CLP	NYSDEC CLP	500
xix. Silver	NYSDEC CLP	NYSDEC CLP	1,000
xx. Sodium	NYSDEC CLP	NYSDEC CLP	500,000
xxi. Thallium	NYSDEC CLP	NYSDEC CLP	1,000
xxii. Vanadium	NYSDEC CLP	NYSDEC CLP	5,000
xxiii. Zinc	NYSDEC CLP	NYSDEC CLP	2,000
xxiv. Cyanide, total	NYSDEC CLP	NYSDEC CLP	1,000
B. Organics			
i. TCL Volatile Organics	NYSDEC CLP	NYSDEC CLP	Table C-3
ii. TCL Semivolatile Organics	NYSDEC CLP	NYSDEC CLP	Table C-4
iii. TCL Pesticide/PCBs	NYSDEC CLP	NYSDEC CLP	Table C-5
iv. Explosives	8330 CLP	8330	Table C-6
v. Herbicides	8150	8150	Table C-7
vi. Volatile Organics	-	-	-
C. Other Analytes			
i. Fluoride	Extract[1]	340.2	5 mg/kg
ii. Nitrate	Extract [1]	353.2	1 mg/kg
iii. Total Petroleum Hydrocarbons	8015	8015	3.3 mg/kg
iv. Total Organic Carbon (TOC)	9060 (Lloyd Kahn)	9060 (Lloyd Kahn)	
v. Cation Exchange Capacity (CEC)	9081	9081	< 125 μg/kg
vi. pH	9045	9045	-
vii. Density	ASTMD 2937	ASTMD 2937	-
viii. Grain Size Analysis	ASTMD 422	ASTMD 422	-

TABLE C-2 (Continued)
PARAMETER LIST FOR INORGANIC AND ORGANIC ANALYSES

	Preparation Method	Analytical Method	Reporting Limits
II. Groundwater and Surface Water Analyses			(ug/L)
A. Inorganics (TAL)			
1. Aluminum	NYSDEC CLP	NYSDEC CLP	200
2. Antimony	NYSDEC CLP	NYSDEC CLP	60
3. Arsenic	NYSDEC CLP	NYSDEC CLP	10
4. Barium	NYSDEC CLP	NYSDEC CLP	200
5. Beryllium	NYSDEC CLP	NYSDEC CLP	5
6. Cadmium	NYSDEC CLP	NYSDEC CLP	5
7. Calcium	NYSDEC CLP	NYSDEC CLP	5,000
8. Chromium	NYSDEC CLP	NYSDEC CLP	10
9. Cobalt	NYSDEC CLP	NYSDEC CLP	50
10 Copper	NYSDEC CLP	NYSDEC CLP	25
11. Iron	NYSDEC CLP	NYSDEC CLP	100
12. Lead	NYSDEC CLP	NYSDEC CLP	3
13. Magnesium	NYSDEC CLP	NYSDEC CLP	5,000
14. Manganese	NYSDEC CLP	NYSDEC CLP	15
15. Mercury	NYSDEC CLP	NYSDEC CLP	0.2
16. Nickel	NYSDEC CLP	NYSDEC CLP	40
17. Potassium	NYSDEC CLP	NYSDEC CLP	5,000
18. Selenium	NYSDEC CLP	NYSDEC CLP	5
19. Silver	NYSDEC CLP	NYSDEC CLP	10
20. Sodium	NYSDEC CLP	NYSDEC CLP	5,000
21. Thallium	NYSDEC CLP	NYSDEC CLP	10
22. Vanadium	NYSDEC CLP	NYSDEC CLP	50
23. Zinc	NYSDEC CLP	NYSDEC CLP	20
24. Cyanide, total	NYSDEC CLP	NYSDEC CLP	10
B. Organics			
1. TCL Volatile Organics	NYSDEC CLP	NYSDEC CLP	Table C-3
2. TCL Semivolatile Organics	NYSDEC CLP	NYSDEC CLP	Table C-4
3. TCL Pesticide/PCBs	NYSDEC CLP	NYSDEC CLP	Table C-5
4. Explosives	8330	8330	Table C-6
5. Herbicides	8150	8150	Table C-7
6. Volatile Organics	-	524.2	Table C-8
C. Other Analytes			
1. Nitrate/Nitrite	353.2	353.2	10
2. Fluoride	340.2	340.2	100
3. Total Petroleum Hydrocarbons	8015	8015	100
4. TOC	9060	9060	
5. BOD	405.1	405.1	
6. Alkalinity	310.2	31.02	
7. Chloride	325.2	325.2	
8. Sulfate	375.2	375.2	
9. Total Hardness (as $CaCO_3$)	130.2	130.2	
10. COD	410.2	410.2	
11. TDS	160.1	160.1	
12. TSS	160.2	160.2	
13. Sulfide	376.2	376.2	20
14. TOC	415.1	per sulf. digestion	50
15. COD	410.1	Digestion	5000
16. Ammonia-N	350.2	350.2	20
17. Phosphate-P (Total)	365.2	365.2	5
18. Turbidity	180.1	180.0	50 NTU
19. pH	150.1	150.1	

TABLE C-2 (Continued)
PARAMETER LIST FOR INORGANIC AND ORGANIC ANALYSES

	Preparation Method	Analytical Method	Reporting Limits
III. Oil Analyses			
1. Total Petroleum Hydrocarbon	8015	8015	-
2. PCBs	8080	8080	1 ug/kg[3]
3. Herbicides	8150	8150	Table C-7
IV. Asbestos		PLM[2]	
V. Air Analyses			
A. Organics			
1. Volatile Organics (SUMMA)	TO-14	TO-14	
2. Volatile Organics (VOST)	Appropriate Method	Appropriate Method	

---

1. Mix a known quantity of soil in known volume of water, stir, then filter to form aqueous extract.
2. Polarized light microscopy in EPA 600/M4-82-020.
3. Detection limit is 1 ug PCB per Kg oil for each of the following Aroclors: 1016, 1221, 1232, 1242, 1248, 1254, and 1260.
4. *Chromium screening will be performed using the NYSDEC CLP Method, however, for the chromium screening a NYSDEC ASP Category A deliverable will not be prepared.

TABLE C-2 (Continued)
PARAMETER LIST FOR INORGANIC AND ORGANIC ANALYSES

	Preparation Method	Analytical Method	Reporting Limits
III. Oil Analyses			
1. Total Petroleum Hydrocarbon	8015	8015	-
2. PCBs	8080	8080	1 ug/kg[3]
3. Herbicides	8150	8150	Table C-7
IV. Asbestos		PLM[2]	
V. Air Analyses			
A. Organics			
1. Volatile Organics (SUMMA)	TO-14	TO-14	
2. Volatile Organics (VOST)	Appropriate Method	Appropriate Method	

---

1. Mix a known quantity of soil in known volume of water, stir, then filter to form aqueous extract.
2. Polarized light microscopy in EPA 600/M4-82-020.
3. Detection limit is 1 ug PCB per Kg oil for each of the following Aroclors: 1016, 1221, 1232, 1242, 1248, 1254, and 1260.

TABLE C-3
CONTRACT REQUIRED QUANTITATION LIMITS* FOR VOLATILE ORGANIC COMPOUNDS (VOCs)

		Quantitation Limits**	
	VOCs	Water (ug/L)	Low Soil/Sediment[a] (ug/Kg)
1.	Chloromethane	10	10
2.	Bromomethane	10	10
3.	Vinyl Chloride	10	10
4.	Chloroethane	10	10
5.	Methylene Chloride	5	5
6.	Acetone	10	10
7.	Carbon Disulfide	5	5
8.	1,1-Dichloroethene	5	5
9.	1,1-Dichloroethane	5	5
10.	1,2-Dichloroethene (total)	5	5
11.	Chloroform	5	5
12.	1,2-Dichloroethene	5	5
13.	2-Butanone	10	10
14.	1,1,1-Trichloroethane	5	5
15.	Carbon Tetrachloride	5	5
16.	Vinyl Acetate	10	10
17.	Bromodichloromethane	5	5
18.	1,2-Dichloropropane	5	5
19.	cis-1,3-Dichloropropene	5	5
20.	Trichloroethene	5	5
21.	Dibromochloromethane	5	5
22.	1,1,2-Trichloroethane	5	5
23.	Benzene	5	5
24.	trans-1,3-Dichloropropene	5	5
25.	Bromoform	5	5
26.	4-Methyl-2-pentanone	10	10
27.	2-Hexanone	10	10
28.	Tetrachloroethene	5	5
29.	Toluene	5	5
30.	1,1,2,2-Tetrachloroethane	5	5
31.	Chlorobenzene	5	5
32.	Ethyl Benzene	5	5
33.	Styrene	5	5
34.	Xylenes (Total)	5	5
	Methyl Tertiary Butyl Ether	10	10

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[a] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRQL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

** Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight based as required by the contract, will be higher.

TABLE C-4

CONTRACT REQUIRED QUANTITATION LIMITS* FOR SEMIVOLATILE COMPOUNDS (SVOs)

SVOs	Quantitation Limits** Water (ug/L)	 Low Soil/Sediment[a] (ug/Kg)
35. Phenol	10	330
36. bis (2-Chloroethyl) ether	10	330
37. 2-Chlorophenol	10	330
38. 1,3-Dichlorobenzene	10	330
39. 1,4-Dichlorobenzene	10	330
40. Benzyl alcohol	10	330
41. 1,2-Dichlorobenzene	10	330
42. 2-Methylphenol	10	330
43. bis (2-Chloroisopropyl) ether	10	330
44. 4-Methylphenol	10	330
45. N-Nitroso-di-n-dipropylamine	10	330
46. Hexachloroethane	10	330
47. Nitrobenzene	10	330
48. Isophorone	10	330
49. 2-Nitrophenol	10	330
50. 2,4-Dimethylphenol	10	330
51. Benzoic acid	50	1600
52. bis (2-Chloroethoxy) methane	10	330
53. 2,4-Dichlorophenol	10	330
54. 1,2,4-Trichlorobenzene	10	330
55. Naphthalene	10	330
56. 4-Chloroaniline	10	330
57. Hexachlorobutadiene	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330
59. 2-Methylnaphthalene	10	330
60. Hexachlorocyclopentadiene	10	330
61. 2,4,6-Trichlorophenol	10	330
62. 2,4,5-Trichlorophenol	50	1600
63. 2-Chloronaphthalene	10	330
64. 2-Nitroaniline	50	1600

TABLE C-4 (cont.)

CONTRACT REQUIRED QUANTITATION LIMITS* FOR SEMIVOLATILE COMPOUNDS (SVOs)

	Quantitation Limits**	
SVOs	Water (ug/L)	Low Soil/Sediment[a] (ug/Kg)
65. Dimethylphthalate	10	330
66. Acenaphthylene	10	330
67. 2,6-Dinitrotoluene	10	330
68. 3-Nitroaniline	50	1660
69. Acenaphthene	10	330
70. 2,4-Dinitrophenol	50	1600
71. 4-Nitrophenol	50	1600
72. Dibenzofuran	10	330
73. 2,4-Dinitrotoluene	10	330
74. Diethylphthalate	10	330
75. 4-Chlorophenyl-phenyl ether	10	330
76. Fluorene	10	330
77. 4-Nitroaniline	50	1600
78. 4,6-Dinitro-2-methylphenol	50	1600
79. N-nitrosodiphenylamine	10	330
80. 4-Bromophenyl-phenylether	10	330
81 Hexachlorobenzene	10	330
82. Pentachlorophenol	50	1600
83. Phenanthrene	10	330
84. Anthracene	10	330
85. Di-n-butylphthalate	10	330
86. Fluoranthene	10	330
87. Pyrene	10	330
88. Butylbenzylphthalate	10	330
89. 3,3-Dichlorobenzidine	20	660
90. Benzo(a)fluoranthene	10	330
91. Chrysene	10	330
92. bis(2-Ethylhexyl)phthalate	10	330
93. Di-n-octylphthalate	10	330
94. Benzo(b)fluoranthene	10	330
95. Benzo(k)fluoranthene	10	330
96. Benzo(a)pyrene	10	330

TABLE C-4 (cont.)

CONTRACT REQUIRED QUANTITATION LIMITS* FOR SEMIVOLATILE COMPOUNDS (SVOs)

	Quantitation Limits**	
SVOs	Water (ug/L)	Low Soil/Sediment[a] (ug/Kg)
97. Indeno(1,2,3-cd)pyrene	10	330
98. Dibenz(a,h)anthracene	10	330
99. Benzo(g,h,i)perylene	10	330

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[a] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for semivolatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

** Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight based as required by the contract, will be higher.

TABLE C-5
CONTRACT REQUIRED QUANTITATION LIMITS* FOR PESTICIDES AND POLYCHLORINATED BIPHENYLS (PCBs)

		Quantitation Limits**	
		Water	Low Soil/Sediment[a]
Pesticides/PCBs		(ug/L)	(ug/Kg)
100.	alpha-BHC	0.05	8.0
101.	beta-BHC	0.05	8.0
102.	delta-BHC	0.05	8.0
103.	gamma-BHC (Lindane)	0.05	8.0
104.	Heptachlor	0.05	8.0
105.	Aldrin	0.05	8.0
106.	Heptachlor epoxide	0.05	8.0
107.	Endosulfan I	0.05	8.0
108.	Dieldrin	0.10	16.0
109.	4,4-DDE	0.10	16.0
110.	Endrin	0.10	16.0
111.	Endosulfan II	0.10	16.0
112.	4,4-DDD	0.10	16.0
113.	Endosulfan sulfate	0.10	16.0
114.	4,4-DDT	0.10	16.0
115.	Methoxychlor	0.5	80.0
116.	Endrin Ketone	0.10	16.0
117.	alpha-Chlordane	0.5	80.0
118.	gamma-Chlordane	0.5	80.0
119.	Toxaphene	1.0	160.0
120.	Aroclor-1016	0.5	80.0
121.	Aroclor-1221	0.5	80.0
122.	Aroclor-1232	0.5	80.0
123.	Aroclor-1242	0.5	80.0
124.	Aroclor-1248	0.5	80.0
125.	Aroclor-1254	1.0	160.0
126.	Aroclor-1260	1.0	160.0

[a] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for pesticide/PCB TCL Compounds are 15 times the individual Low Soil/Sediment CRQL.

[*] Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

[**] Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight based as required by the contract, will be higher.

TABLE C-6
METHOD 8330 QUANTITATION LIMITS FOR EXPLOSIVES

Compound	Quantitation Limits** Water (ug/L)		Soil/Sediment[a] (ug/g)
	Low Level	High Level	
HMX	--	13.0	2.2
RDX	0.836	14.0	1.0
1,3,5-TNB	0.258	7.3	0.25
1,3-DNB	0.108	4.0	0.25
Tetryl	--	4.0	0.65
2,4,6-TNT	0.113	6.9	0.25
4-AM-DNT*	0.0598	--	--
2-AM-DNT*	0.0349	--	--
2,6-DNT	0.314	9.4	0.26
2,4-DNT	0.0205	5.7	0.25

[a] See Table C-3 for a discussion of Quantitition Limits

** See Table C-3 for a discussion of Soil Quantitation Limits

* Breakdown Degradation Products

TABLE C-7
METHOD 8150 QUANTITATION LIMITS FOR HERBICIDES

Parameter	Quantitation Limits Water (ug/L)	Soil/Sediment (ug/g)
2,4-D	0.029	0.003
2,4-DB	0.029	0.003
2,4,5-T	0.029	0.003
2,4,5-TP/Silvex+der.	0.029	0.003
Dicamba (banvel)	0.029	0.003
Dalapon	0.029	0.003
Dichlorprop	0.029	0.003
Dinoseb	0.029	0.003
MCPA	0.588	0.050
MCPP	0.588	0.050

TABLE C-8
METHOD 524.2 QUANTITATION LIMITS FOR VOLATILE ORGANIC COMPOUNDS (VOCs) IN GROUNDWATER

VOCs	Quantitation Limits ug/l
Benzene	0.5
Bromobenzene	0.5
Bromochloromethane	0.5
Bromodichloromethane	0.5
Bromoform	0.5
Bromomethane	0.5
n-Butylbenzene	0.5
sec-Butylbenzene	0.5
tert-Butylbenzene	0.5
Carbon tetrachloride	0.5
Chlorobenzene	0.5
Carbon tetrachloride	0.5
Chlorobenzene	0.5
Chloroethane	0.5
Chloroform	0.5
Chloromethane	0.5
2-Chlorotoluene	0.5
4-Chlorotoluene	0.5
Dibromochloromethane	0.5
1,2-Dibromo-3-chloropropane	0.5
1,2-Dibromoethane	0.5
Dibromomethane	0.5
1,2-Dichlorobenzene	0.5
1,3-Dichlorobenzene	0.5
1,4-Dichlorobenzene	0.5
Dichlorodifluoromethane	0.5
1,1-Dichloroethane	0.5
1,2-Dichloroethane	0.5
1,1-Dichloroethene	0.5
cis-1,2 Dichloroethene	0.5
trans-1,2-Dichloroethene	0.5
1,2-Dichloropropane	0.5
1,3-Dichloropropane	0.5
2,2-Dichloropropane	0.5
1,1-Dichloropropene	0.5
cis-1,2-Dichloropropene	0.5

TABLE C-8 (cont.)

VOCs	Quantitation Limits ug/l
trans-1,2-Dichloropropene	0.5
Ethylbenzene	0.5
Hexachlorobutadiene	0.5
Isopropylbenzene	0.5
4-Isopropyltoluene	0.5
Methylene chloride	0.5
Naphthalene	0.5
n-Propylbenzene	0.5
Styrene	0.5
1,1,1,2-Tetrachloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
Tetrachloroethene	0.5
Toluene	0.5
1,2,3-Trichlorobenzene	0.5
1,2,4-Trichlorobenzene	0.5
1,1,1-Trichloroethane	0.5
1,1,2-trichloroethane	0.5
Trichloroethene	0.5
Trichlorofluoromethane	0.5
1,2,3-Trichloropropane	0.5
1,2,4-Trimethylbenzene	0.5
1,3,5-Trimethylbenzene	0.5
Vinyl chloride	0.5
o-Xylene	0.5
m-Xylene	0.5
p-Xylene	0.5

(COD); Method 160.1 for total dissolved solids (TDS); and Method 160.2 for total suspended solids (TSS);

4. "Methods for the Determination of Organic Compounds in Drinking Water," EPA 600\4-88-039: Method 524.2 for Volatile Organic Compounds;

5. EPA Method 901.1, Gamma Spectrometry, from EPA 600/4-80-032; and

6. EPA 600/M4-82-020, Asbestos analysis using polarized light microscopy with dispersion staining.

7. EPA Method T0-14 for volatile organic compounds collected using SUMMA air sampling canisters; VOST samples will be analyzed using the appropriate analytical methods depending of the target compounds for the analyses.

8. ASTM Method D:422-63 (Reapproved 1972) or similar Method for grain-size analysis; the analysis will include particle-size distribution of silt and clay [< No. 200 (75mm) sieve].

NYSDEC CLP methods will be used for the analysis of inorganic and organic constituents in soil, sediment, groundwater, and surface water. SW-846 Method 8330 will be used for the analysis of explosives. SW-846 Method 8150 will be used to analyze for herbicides. SW-846 Method 8015 is a gas chromatographic method to analyze for the type and quantity of petroleum hydrocarbons. Nitrate will be analyzed using Method 353.2, an automated cadmium reduction method. SW-846 Method 8080 will be used to analyze for PCBs in oil. Fluoride will be analyzed using Method 340.2.

Asbestos will be analyzed using polarized light microscopy (PLM) as discussed in EPA 600/M4-82-020 to determine the type of asbestos materials, their quantity, and fiber length. Initial analysis of asbestos bulk samples will be Polarized Light Microscopy with dispersion staining (PLM-DS) and performed in a National Institute for Standards and Technology (NIST) accredited laboratory participating in the National Laboratory Accreditation Program (NVLAP). Sample results will be reviewed by the inspector for sample result consistency. The lab may be contacted on a case-by-case basis if the results are judged to be questionable (i.e., significant discrepancies between split samples) by the inspector for sample result consistency, and in some instances reanalysis may be requested - guidance does not specify a value (or RPD) for asbestos samples. Re-analysis may also be requested for samples identified as containing between 1% and 5% asbestos because of inherent inaccuracies for non-friable materials at low concentrations using the PLM method.

Transmission Electron Microscopy (TEM) analysis will be required for nonfriable organically bound (NOB) samples (i.e., non-friable materials, such as floor tile and roofing with tightly bound matrices).

Volatile and semivolatile organic constituents will be analyzed on GC/MS Systems. Pesticides/PBCs will be analyzed by GC/ECD. Inorganic metallic elements will be analyzed on the Inductively Coupled Plasma Spectrophotometer (ICP), the Graphite Furnace Atomic Absorption Spectrophotometer (GFAA), and the Cold Vapor Atomic Absorption Spectrophotometer (CVAA) according to the NYSDEC CLP Statement of Work. Explosives will be analyzed on a High Pressure Liquid Chromatography (HPLC) system by Method 8330.

Instrument detection limits are determined quarterly for inorganic parameters according to NYSDEC Protocol. Method detection limits for organic parameters are determined by analyzing seven replicates as a sample with a low analyte concentration, three to five times the instrument detection limit. The standard deviation of the results are calculated. The Method Detection Limit is calculated as:

$$\text{MDS} = (t_{n-1})_a \text{ (std.dev)}$$

where:

t_{n-1} = Student's t-value with n-1 degrees of freedom
a = Probability of a type I error (use a = 0.005)
n = number of replicates in standard deviation calculation

The reporting limits listed in Table C-3 are above the instrument detection limits but well below the health based limits for ingestion published by USEPA.

7.3 QUALITY CONTROL REQUIREMENTS

The precision, accuracy, and completeness goals for each compound analyzed by the laboratory are presented in Table C-9.

7.3.1 TAL and Conventional Inorganic Analyses

At a minimum, the following general QC measures will be employed by the laboratory, as appropriate for the methods for TAL constituents, fluoride and nitrate:

TABLE C-9

Precision, Accuracy, and Completeness Goals for Laboratory Data

Measurement Parameter	Method Reference	Precision RPD		Accuracy % Rec.		Completeness
TCL-VOC		Water	Soil	Water	Soil	
	NYSDEC CLP					
1,1-Dichloroethene	Statement of Work	14	22	61-145	59-172	90%
Trichloroethene		14	24	71-120	62-137	
Benzene		11	21	76-127	66-142	
Toluene		13	21	76-125	59-139	
Chlorobenzene		13	21	75-130	60-133	
VOCs	Method 524.2	20	-	80-120	-	90%
TCL-SVO		Water	Soil	Water	Soil	
	NYSDEC CLP					
Phenol	Statement of Work	42	35	12-110	26-90	90%
2-Chlorophenol		40	50	27-123	25-102	
1,4-Dichlorobenzene			28	27	36-97	28-104
N-Nitroso-di-n-Propylamine		38	38	41-116	41-126	
1,2,4 Trichlorobenzene			28	23	39-98	38-107
4-Chloro-3-Methylphenol			42	33	23-97	26-103
Acenaphthene		31	19	46-118	31-137	
4-Nitrophenol		50	50	10-80	11-114	
2,4-Dinitrotoluene			38	47	24-96	28-89
Pentachlorophenol			50	47	9-103	17-109
Pyrene		31	36	26-127	35-142	
TCL-PESTICIDES/PCB		Water	Soil	Water	Soil	
	NYSDEC CLP					
Gamma-BHC	Statement of Work	15	50	56-123	46-127	90%
Heptachlor		20	31	40-131	35-130	
Aldrin		22	43	40-120	34-132	
Dieldrin		18	38	52-126	31-134	
Endrin		21	45	56-121	42-139	
4,4'-DDT		27	50	38-127	23-134	
TAL METALS		Water	Soil	Water	Soil	
23 Metals	NYSDEC CLP					
and Cyanide	Statement of Work	25	50	50-150	20-180	90%

TABLE C-9

Precision, Accuracy, and Completeness Goals for Laboratory Data

Measurement Parameter	Method Reference	Precision RPD		Accuracy % Rec.		Completeness
		Water	Soil	Water	Soil	
Explosives	Method 8330	25	50	70-130	50-150	90%
Herbicides	Method 8150					
2,4-D		30	50	63-87	63-87	90%
2,4,5-TP		30	50	73-103	73-103	
Total Petroluem Hydrocarbons	Method 8015	25	50	60-140	60-140	90%
Nitrate	Method 353.2	10	10	75-125	75-125	90%
Fluoride	Method 340.2	10	10	75-125	75-125	90%
PCBs in Oil	Method 8080	40 (in oil)	-	35-159 (in oil)	-	90%

Calibration - Prior to each round of analyses, the analytical instrument will be calibrated to define the linear range of the instrument. Calibration will be performed each day prior to sample analysis as specified for each method in Table C-10.

Check Standards - Check standards, at concentrations near the mid-point of the calibration curve, will be analyzed at a frequency of once every 10 samples or as specified in the method. Results will be used to verify the standard calibration curve being used as specified for each methods in Table C-10.

Matrix Spike - An aliquot of at least one out of every 20 samples per matrix will be spiked with a known quantity of standard. This fortified sample will be prepared and analyzed to assess the accuracy of the analytical method for that matrix. Recovery of the matrix spike will be in conformance with these specified on Table C-9.

Duplicate - One duplicate analysis will be performed at a minimum frequency of one for every 20 samples per matrix. Relative percent difference of duplicate samples will be in conformance with these specified on Table C-9.

Method Blank - At least one blank for every 20 samples will be prepared and analyzed to detect possible interferences introduced in the laboratory. Results of the method blank should be less than the reporting limit for all inorganics of interest, or the blank and all associated samples must be re-prepared and re-analyzed.

7.3.2 TCL and Other Organic Analyses

At a minimum, the following general QC measures will be employed by the laboratory for TCL constituents, VOCs by Method 524.2, explosives, herbicides, and petroleum hydrocarbons.

Initial Calibration - The instrument performances must be evaluated before samples are analyzed. A successful initial calibration will conform to method specifications for resolution, retention time, and %RSD as specified for each method in Table C-10.

TABLE C-10
CALIBRATION CRITERIA

METHOD	INSTRUMENT	CALIBRATION FREQUENCY	CALIBRATION POINTS	CRITERIA FOR PASSING
NYSDEC CLP Statement of Work Metals by ICP	Jarrell-Ash Enviro II	Calibration at the beginning of each analytical series Calibration check every 10 samples	3-t initial calibration standards	correlation > 0.995 calibration check within 10% of true value
NYSDEC CLP Statement of Work Mercury by Cold Vapor	Leeman Labs PS2000	Calibration at the beginning of each analytical series Calibration check every 10 samples	4 initial calibration standards + 1 blank	correlation >0.995 calibration check within 20% of true value
NYSDEC CLP Statement of Work Metals by Graphite Furnace AA	Perkin Elmer 5100 Graphite Furnace AA	Calibration at the beginning of each analytical series Calibration check every 10 samples	3 initial calibration standards + 1 blank	correlation >0.995 calibration check within 10% of true value
Explosive by Method 8330	Waters High Pressure Liquid chromatograph with UV and Fluorescence detectors	Calibration at the beginning of each analytical series calibration check daily	4 initial calibration standards + 1 blank	Correlation >0.995 calibration check within 2 sd of initial standard

TABLE C-10
CALIBRATION CRITERIA

METHOD	INSTRUMENT	CALIBRATION FREQUENCY	CALIBRATION POINTS	CRITERIA FOR PASSING
Herbicides by Method 8150	Hewlett Packard 5890	Calibration at the beginning of each analytical series calibration check	Initial calibration linearity characterization over 100 fold range	Refer to NYSDEC SOW
PCBs only by Method 8080	Hewlett Packard 5840 GC/ECD	Calibration check Std.	Initial calibration linearity characterization over 100 fold range	Refer to NYSDEC SOW
NYSDEC CLP TCL Volatile Organics Statement of Work	Hewlett Packard HP5971A MSD GC/MS	Tune Verification and check calibration every 12 hours	5 initial calibration standards 10,50,100, 150, 200 ppb On-going calibration 50 ppb standard	Refer to NYSDEC Statement of Work
NYSDEC CLP TCL Semivolatile Organics Statement of Work	Hewlett Packard HP5971A MSD GC/MS	Tune Verification and check calibration every 12 hours	5 initial calibration standards 20,50,80, 120, 160 ng On-going calibration 50 ng standard	Refer to NYSDEC Statement of Work

TABLE C-10
CALIBRATION CRITERIA

METHOD	INSTRUMENT	CALIBRATION FREQUENCY	CALIBRATION POINTS	CRITERIA FOR PASSING
NYSDEC CLP Cyanide	Bausch and Lomb UV/VIS Spec. 2000	Calibration at the beginning of each analytical series Calibration check every 10 samples	4 initial calibration standards	check standard within 15% of true value
NYSDEC CLP TCL Statement of Work Pesticides/PCBs	Hewlett Packard 5890 GC/ECD	Calibration at the beginning of each analytical series Calibration check every 10 samples	Initial calibration linearity characterization over 100 fold range	Refer to NYSDEC SOW
Nitrate Alpkem RFA 300	Calibration check every 10 samples	5 initiated + blank	Correlation >0.995 check std. 10% of true value	
Fluoride	Ion specific electrode	Calibration check every 10 samples	5 initiated + blank	Correlation >0.995 check std. 10% of true value
SID, S3 Total Organic Carbon	Carlo Erba EA1108 elemental analyzer	Calibration at the beginning of each analytical series Calibration check every 10 samples	1 calibration std + 1 blank	Within 10% of true value

TABLE C-10
CALIBRATION CRITERIA

METHOD	INSTRUMENT	CALIBRATION FREQUENCY	CALIBRATION POINTS	CRITERIA FOR PASSING
Hardness, EDTA Titrimetric Method, EPA Method 130.2	Titration Burette	Calibrate Titrant at the Beginning of each analytical Areas	Not Applicable	None
Nitrate, Cadmium Reduction Method, EPA Method 353.3	Spec. 20	Calibration at the beginning of each analytical series Calibration check every 10 samples	5 Calibration stds. and 1 blank	Within 10% of true value
Level II Analysis for Volatile Organics	Hewlett Packard 5890 GC FID and PID in series	Calibration daily every 24 hours	1 calibration standard + 1 blank	None
Level II Analysis for Lead	Perkin Elmer Plasma II ICP	Calibration daily every 24 hours	1 calibration standard + 1 blank	None
Level II Analysis for Explosives	Spec. 20	Calibration daily every 24 hours	1 calibration standard + 1 blank	None

Continuing Calibration Checks - A calibration check will be performed at the beginning and end of each day. The response of the continuing calibration check standard must be within those specified for each method in Table C-10, or the system is out-of-control and must be re-calibrated. Additional samples cannot be analyzed until another satisfactory initial calibration is achieved.

Method Blank - A method blank is carried through the entire analytical procedure as a sample. One method blank will be generated for every extraction batch of 20 samples or less per matrix. Results of the method blank should be less than the reporting limit for all elements of interest, or the blank and all associated samples must be re-extracted and re-analyzed.

Matrix Spike/Matrix Spike Duplicate/Matrix Spike Blank (MS/MSD/MSB) - An MS/MSD/MSB set of samples will be analyzed at least once for every 20 field samples per matrix. Known concentrations of compounds will be added to identical aliquots from a field sample. The percent recovery of the spiked compounds must be in conformance with those specified on Table C-9. Matrix spike samples will be prepared for TCL constituents, VOCs by Method 524.2, explosives, herbicides, and petroleum hydrocarbons.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

8.1 INTRODUCTION

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the appropriate manufacturer's specifications or project-specific requirements.

8.2 LABORATORY EQUIPMENT

The procedures for instrument calibration, calibration verification, and the frequency of calibrations are described in the NYSDEC CLP Statements of Work. Calibration of other instruments required for measurements associated with these analyses will be in accordance with the manufacturer's recommendations and the standard operating procedures of the laboratory. Calibration methods for tests not included in the CLP Statements of Work will be in accordance with the procedures of the analytical method, and laboratory standard operating practices (Table C-10).

8.3 FIELD EQUIPMENT

Calibration of field instruments will be performed at intervals recommended by the manufacturer or more frequently as conditions dictate. Field instruments include pH meters, thermometers, specific conductivity meters, a field gas chromatograph, water level probes, turbidity meters, geophysics instruments, and health and safety equipment (organic vapor detectors, Draeger tube pumps, and geiger counters).

Calibration of health and safety equipment is discussed in the Health and Safety Plan (Appendix B of this Work Plan). Calibration of geophysics instruments will be provided by the subcontractor(s) selected to conducted these determinations. These procedures will be provided once this contractor is designated and included in the SOP for Field Data Collection (Volume III, Appendix A). Geophysics equipment is not calibrated because the data is compared to itself.

The pH meter will be calibrated with standard buffer solutions prior to each day or partial day of field use. A full calibration sequence for field pH meters will involve use of three standardized buffer solutions (e.g., pH 4, pH 7, and pH 10) which bracket the full range of measurements

expected to be made during the day of use. Additional calibration sequences will be commissioned if field measurements fall outside the range of calibration conducted at the start of each day, or when intermediate calibration checks that the response of the field meter is changing.

During the day, the meter will be periodically checked against one of the selected pH buffers. Typically, meters will be checked once or twice daily to assure that the meter is continuing to operate according to specifications. Fresh, traceable buffer solution will be used for each determination. Calibration results will be recorded in a field log book, along with the information describing the lot numbers of the buffers.

The calibration of the pH meter will also be verified at the completion of each day of use. The meter will be used to measure the pH of three fresh, standard buffer solutions and all readings will be documented in the field notes. Any indication that the response of the pH meter has decayed during use will be used to flag or reject data that has been collected with the meter in question. If the pH meter calibrates to within 0.5 pH units then the data will be considered acceptable. If the meter calibrates to within 0.5 and 1.0 pH units then the data will be flagged with a "J" indicating that it is estimated. If the meter calibrates to greater than 1.0 pH unit then the data will be rejected ("R").

Thermometers used for field determinations will be calibrated daily against ice water, tepid water, and other temperature measuring devices not used for field determinations. Each thermometer or temperature measuring device will also be calibrated in the office prior to its use in the field. Office calibrations will include measurements against ice water, tepid water and boiling water, as well as other temperature measuring devices not taken to the field.

The specific conductivity meter will be cleaned prior to use in the field. This cleaning will occur in the home office. Each conductivity meter will also be electronically calibrated in the office if manufacturer specifications indicate that such checks should be periodically completed.

In the field, the accuracy of conductivity meters will be assessed by calibrating the meter against a minimum of two standardized solutions before each day of use. These solutions will be selected to bracket the range of all measurements anticipated to occur. In the field, the instrument will be periodically checked against standard solutions of known concentrations. Any indication that the conductivity meter is drifting will necessitate the performance and documentation of a complete calibration cycle in the field. The accuracy of the conductivity meter will also be checked at the end of each day. These measurements will be used to confirm the accuracy of all measurements made with the device during the day and to validate or discredit measurements recorded in the field notes.

The portable GC utilized for the soil vapor survey will be calibrated daily using methods recommended by the manufacturer.

Depth marks on the water level probes and oil/water interface probes will be compared to a steel tape on a monthly basis.

Calibration forms for the SUMMA canister or VOST equipment for air sampling will be kept in a three-ring notebook maintained at the site. Copies of all field-generated forms will be made and kept by the Project Manager. All calculations for determining sample volumes will be performed on spreadsheets that have been fully validated by OC personnel prior for this effort. The validation worksheets will be kept by the Project Manager as a permanent part of the project file. All forms generated as a result of this effort will be completed, then reviewed and initiated by at least one other project participant.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 DATA REDUCTION

Data reduction, validation, and reporting of this project will primarily involve the analytical laboratory and any contracted data validation services. General data reduction and validation procedures used by the contracted laboratory's personnel are contained in their QAPP. Sample calculations are contained in their Standard Operating Procedures, and the method specifications.

All concentration data shall be expressed in units of micrograms per liter (ug/L) or micrograms per kilogram (ug/Kg) dry weight, as appropriate for the matrix. The field measurements of pH, conductivity, turbidity, and temperature shall be reported in standard logarithmic, umho/cm, NTUs, and degrees Celsius, respectively.

All analytical results are carefully reviewed and formatted into final submittal form by experienced quality control personnel. Each result reported by the laboratory undergoes four levels of data review. The analysts and technicians provide primary data review at the bench level, secondary and tertiary review is performed by independent experienced quality control personnel, and the final data packages are reviewed by the laboratory's customer service representative or project contact before submission to the AE. Data submittals will be in the format specified in NYSDEC CLP Protocols Level IV for CLP analyses and Level III for other analyses.

9.2 DATA VALIDATION

9.2.1 Data Quality Review

Data validation shall be conducted by trained, qualified and experienced chemists, and the Project QA officer.

Consistent data quality for this project will be obtained by the application of a standard data analysis and validation process. Critical review of data is designed to isolate spurious values. Data will be reviewed at a minimum by the analyst, laboratory QC personnel, laboratory Project Manager, and the Project QA Officer

9.2.2 Field Data

Screening data will be validated using one of three procedures:

1. Routine checks will be made during the processing of data. For example, the field work will be observed and documentation will be checked for completeness and accuracy.

2. Checks for consistency of the data set over time will be performed. This can be accomplished by visually comparing data sets against gross upper limits obtained from historical data sets, or by testing for historical consistency. Anomalous data will be identified and evaluated.

3. Checks may be made for consistency with parallel data sets, that is, data sets obtained presumably from the same population (for example, for the same region of the aquifer or volume of soil.

The purpose of these validation checks and tests is to identify outliers; that is, an observation that does not conform to the pattern established by other observations. Outliers may be the result of transcription errors or instrument malfunctions. Outliers may also be manifestations of a greater degree of spatial or temporal variability than expected.

After an outlier has been identified, a decision concerning its fate will be rendered. Obvious mistakes in data (e.g., transcription errors) will be corrected when possible, and the correct value will be inserted. If the correct value cannot be obtained, the data may be excluded.

An attempt will be made to explain the existence of the outlier. If no plausible explanation can be found for the outlier, it will be included in the data set, but a note highlighting its presence and associated concerns will be included in the report. Also, an attempt will be made to determine the effect of the outlier when both included and excluded from the data set. A determination will be made whether it is appropriate to resample.

9.2.3 In-House Laboratory Review

The contracted laboratory will follow data evaluation procedures recommended and approved by the U.S. EPA and NYSDEC. The EPA Region II Standard Operating Procedures (SOPs) for Evaluating Organic and Inorganic Data will be used to evaluate the data produced. Chemical

analysis data will be reviewed based on the analysis results of the duplicate, spiked, and blank samples obtained by the laboratory. The laboratory will issue the chemical analysis data and associated QA/QC data in reports and the chemical analysis data summarized in computer spreadsheets.

9.2.4 Data Review and Validation

When the chemical analysis reports are received from the laboratory, the AE will examine the reports and computerized tables for errors and problems with the analysis. Typical errors include incorrect sample numbers as compared to the sampling records and Chain of Custody; holding time exceedances; recoveries outside acceptable ranges; number of laboratory blanks, duplicates, and spikes do not meet criteria; and typographic errors in analysis results.

The tabulated chemical analysis data will be sorted by site, then type of medium. When an analyte is not detected in a sample, the detection limit, as defined below, will be included in the table. Also the type of detection limit will be noted in the table. Contract Required Quantitation Limits (CRQLs) will be reported for organics and Contract Required Detection Limits (CRDLs) will be reported for inorganics. Estimated values are reported between the instrument detection limit and the CRQL or CRDL, whichever is appropriate.

The chemical analysis data will be validated according to the EPA Region II SOP for Evaluating Organic Analyses (SOP No. HW-6), the EPA Region II SOP for Evaluating Inorganic Analyses (SOP No. HW-2, Revision XI), the EPA Region II SOP for Validating Chlorinated Herbicides by GC (SOP No. HW-17, Revision 1.3), and EPA Region II SOP for Validating Nitroaromatics and Nitramines by HPLC (SOP No. HW-16, Revision 1). The most current revisions of SOP No. HW-6 will be used at the time the data validation is performed. Based upon the finalization of the analyte list, additional SOPs may be necessary. As a note, the correction for % moisture for soil/sediment samples will be verified during data validation. Chemical analysis data of the field-generated QA/QC samples will be included when validating the data.

The Project Manager will be kept informed of all non-conformance issues and ensure that corrective action is taken prior to data manipulation and assessment routines. Once the QA/QC review has been completed, the Project Manager may direct the team leaders or others to initiate and finalize the analytical data assessment.

9.3 REPORTING

9.3.1 Field Data

Field data and other information will be documented on forms designated in the FSAP (Appendix A) and in field notebooks assigned to the project. The forms, shown in Appendix A, will be used for routine procedures such as sampling, borings, well installation, water level measurements, and test pitting. The field notebook shall be used to describe the overall work for the day and any deviations from the standard operating procedures.

9.3.2 Laboratory Data Reports

Reports from the analytical laboratory will include a tabulation of sample results, dates of analysis, method references, completed chain-of-custody forms, blank analysis data, precision and accuracy information for each method, and narrative discussion of any difficulties experienced during analysis. The analytical laboratory report submitted by the laboratory will be in the format specified in NYSDEC CLP analytical services protocol for Level IV analyses - the NYSDEC data deliverable package is the Analytical Services Protocol Category A and Category B. Attachment C-3 contains the blank data reporting forms that specify the format of the analytical laboratory report. A copy of each data package will be sent by the laboratory to the Project Manager. The Project Manager will immediately arrange for making additional copies of the data packages including copies for the Document Controller and Project Quality Assurance Officer. The sample analysis data will be tabulated by the laboratory and presented to the Project Manager on computer diskettes. These tables will be used to prepare a working database for assessment of the site contamination condition. Level III data requires a high degree of confidence in the compound identification and quantification. The frequency of QA/QC checks and standardization are often less stringent than for Level IV analysis. Level III reporting typically consists of some internal quality control results reported; these include reference standards, surrogate spike recoveries, and method blank results.

9.3.3 Monthly Field Activity Reports

While field work associated with the response activities is being conducted at the site, a monthly Field Activity Report to the EPA and NYSDEC will be submitted no later than the 10th day of the month addressing the following:

1. A summary of work completed in the field,
2. Anticipated or actual delays,
3. Discovery of significant additional contaminants other than expected,
4. Quantum increase in concentration of hazardous substances of any media beyond that expected,
5. Determination of any specific or potential increase of danger to the public, the environment, or to individuals working at the site, and

6. Copies of all Quality Assured Data and sampling test results and other laboratory deliverables received during the month.
7. A copy of the laboratory's chemical analysis reports received during the month will be sent to the Corps of Engineers' QA Laboratory.

9.3.4 Sampling Letter Reports

At the completion of the first round of field work sampling, a letter report characterizing the site will be furnished by the Project Manager. This report will at a minimum list the locations and quantities of contaminants at the site. Should additional sampling rounds be required to confirm initial sampling, additional letter reports will also be required.

9.3.5 Quarterly Reports

Quarterly Reports will be submitted to EPA and NYSDEC no later than the 10th day of January, April, July, and October. The quarterly reports shall address the following:

1. Minutes of all formal Project Manager, Technical Review Committee (TRC) and other formal meetings held during the preceding period,
2. Status report on all milestones on schedule, report and explanation for milestones not met, and assessment of milestones to be met during the next period,
3. Outside inspection reports, audits and other administrative information developed,
4. Permit status, as applicable,
5. Personnel staffing status or update,
6. Copies of all Quality Assured Data and sampling test results and all other laboratory deliverables received during that quarter, and
7. A community relations activity update.

9.3.6 Final Report

At the conclusion of the RI/FS program as described in the appropriate Scoping Document that serves as a supplement to this Generic Workplan, a report will be generated that documents the field work and data interpretation performed during the RI/FS. A section on data quality will be included that discusses the results of data validation, describes how well the data quality objectives were met, and summarizes the results of any audits performed during the RI/FS.

10.0 PERFORMANCE AND SYSTEM AUDITS

QA system performance shall be performed under the direction and approval of the PQAO. Functioning as an independent body and reporting directly to project and company management, the PQAO will select personnel to conduct the audit as well as plan and schedule system and performance audits based upon company and project-specific procedures and requirements. These audits may be implemented to evaluate the capability and performance of project and subcontractor staff and their compliance with the QA/QC Plan, in addition to the effectiveness of or impact to the existing project QA/QC Plan and its associated governing documents. Each performance and system audit shall be conducted by a trained and qualified head auditor and designated trained and qualified auditors.

At times, the PQAO may request additional staff with specific expertise from the company and/or project groups to assist in conducting performance audits. In these instances, however, the responsibility for the performance audit will remain with the head auditor and auditors, with the additional staff expertise responsible for clarifying and delineating technical requirements.

The PQAO and auditors shall maintain accurate records of the scope of the audit, identification of items subject to the audits, and results. Quality assurance audits may be initiated by the Project Manager, the PQAO, or the Site Manager, if, in their opinion, a situation exists that warrants an audit. The EPA states "such audits should be performed at sufficiently required intervals during the field investigation."

10.1 PERFORMANCE AUDITS

A field audit may be performed by the PQAO or designated auditor during collection of the field samples to verify that field samplers are following established sampling procedures. A laboratory audit may be performed by the PQAO or designated auditor during analysis of the field samples to verify that the laboratory is following established procedures.

Performance audits shall be scheduled twice per each year of the field investigation.

10.2 SYSTEM AUDITS

System audits, performed by the PQAO or designated auditors, will evaluate the effectiveness of the procedures used to collect data. In addition, field and laboratory quality control procedures and associated documentation may be system audited. System audits shall be scheduled twice per each year of the field investigation. The Project Manager or Site Manager may request the PQAO to perform unscheduled audits if conditions adversely affecting data quality are detected.

10.3 FORMALIZED AUDITS

Formalized audits refer to any system or performance audit that is documented and implemented by the PQAO. The auditors will use a written procedure or checklist to objectively verify that quality assurance requirements have been developed, documented, and instituted in accordance with the Work Plan. Formalized audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by the PQAO or his designee after gathering and evaluating all resultant data. Items, activities, and documents determined by lead auditors to be in non-conformance shall be identified at exit interviews conducted by the involved management. Non-conformances will be logged and documented using audit findings listed in the audit report. These audit findings will be directed to the Project Manager to institute corrective actions in a specified and timely manner. All audit findings and acceptable resolutions will be approved by the PQAO prior to issue. Implementation of acceptable resolutions may be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the PQAO will close out the audit report and findings. Section 13, Corrective Action, outlines in detail methods for corrective action.

11.0 PREVENTIVE MAINTENANCE

11.1 PREVENTIVE MAINTENANCE PROCEDURES

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations or written procedures developed by the operators. Documentation should be generated in support of these activities.

11.2 SCHEDULES

Project-specific written procedures will identify, where applicable, the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule and to arrange any necessary and prompt service as required. Service to the equipment, instruments, tools, and gauges shall be performed by qualified personnel. These procedures shall be reviewed and approved by the Project Manager and PQAO and shall be subject to audit.

In the absence of any manufacturer's recommended maintenance criteria, a maintenance procedure will be developed by the operator based upon experience and previous use of the equipment.

11.3 RECORDS

Logs will be established to record and control maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories and by the data and sample control personnel when, and if, equipment, instruments, tools, and gauges are used at the sites. The PQAO shall audit these records to verify complete adherence to these procedures.

11.4 SPARE PARTS

A list of critical spare parts will be identified by the operator. These spare parts will be stored for availability and use in order to reduce the downtime. In lieu of maintaining an inventory of spare parts, a service contract for rapid instrument repair or back-up instruments will be available.

12.0 DATA ASSESSMENT PROCEDURES

12.1 CALCULATION OF MEAN VALUES AND ESTIMATES OF PRECISION

The mean, C of a series of replicate measurements of concentration C_i, for a given surrogate compound or analyte will be calculated as:

$$C = \frac{1}{n} \sum_{i=1}^{n} C_i$$

Where: n = number of replicate measurements; C, C_i are both in mg/L or mg/kg.

The estimate of precision of a series of replicate measurements will usually be expressed as the relative standard deviation, RSD:

$$RSD = \frac{SD \ x \ 100\%}{C}$$

Where: SD = Standard Deviation

$$SD = \frac{\sum_{i=1}^{n} (C_i - C)^2}{(n-1)}$$

Alternatively, for data sets with a small number of points the estimate of precision may be expressed as a range percent, R:

$$R = \frac{(C_1 - C_2) \ x \ 100\%}{C}$$

Where: C_1 = highest concentration value measured in data set
C_2 = lowest concentration value measured in data set

Precision is also measured by calculating the relative percent difference (RPD) between duplicate analyses. The following equation is used:

$$\%RPD = \frac{D_1 - D_2}{(D_1 + D^2)/2} \times 100$$

where:

RPD = Relative Percent Difference
D_1 = First Sample Value
D_2 = Second Sample Value (duplicate)

12.2 ASSESSMENT OF ACCURACY

Accuracy will be evaluated by comparing the recovery of surrogate and matrix spike compounds the goals identified in Section 7. The recovery of a surrogate compound will be defined as:

$$\text{Recovery, \%} = \frac{Cs \times Vs \text{ (or Ws)}}{Q} \times 100$$

Where: C_s = measured concentration of surrogate compound in sample, mg/L (or mg/kg)
$V_s(W_s)$ = Total volume (or weight) of sample to which surrogate was added, L (or kg)
Q = Quantity of surrogate compound added to sample, mg

The individual component recoveries for the matrix spike sample are defined as:

$$\text{Matrix Spike Percent Recovery} = \frac{SSR - SR}{SA} \times 100$$

where:

SSR = Spike Sample Results
SR = Sample Results
SA = Spike Added (concentration)

12.3 VERIFICATION OF MASS SPECTRA

Mass spectra is visually verified by a laboratory staff member experienced in mass spectral interpretation. The GC/MS laboratory data reviewers use the guidelines that are specified in the USEPA CLP Statement of Work. These guidelines are paraphrased as follows:

1. All ions present in the standard mass spectra at a relative intensity greater than 10% (most abundant ion in the spectrum equals 100%) are to be present in the sample spectrum.

2. The relative intensities of those ions are to agree within plus or minus 20% between the standard and sample spectra.

3. Ions greater than 10% in the <u>sample</u> spectrum are considered and accounted for by the analyst making the comparison.

For target analytes (TCL) the laboratory uses the spectra generated from the working calibration standard as the primary spectral reference. The National Bureau of Standards (NBS) spectral library is the primary reference for non-target analytes, tentatively identified compounds, (TIC).

The laboratory commonly used spectral subtraction to resolve interferences arising from closely eluting compounds. The laboratory has a system of independent review and evaluation of spectral analysis. Any decisions made by the primary reviewer as to the identification and confirmation of mass spectra will be independently reviewed by a secondary data reviewer. Any points of discrepancy are discussed and a resolution reached.

13.0 CORRECTIVE ACTION

Corrective action may be initiated at any time by any person performing work in support of the field investigation.

All project personnel have the responsibility, as part of the normal work duties, to promptly report these situations and implement the corrective action as required. The following procedures have been established to assure that situations such as malfunctions, deficiencies, deviations, and errors are promptly investigated, documented, evaluated, and corrected. When a situation is identified, the cause will be evaluated and a corrective action will be proposed to preclude repetition. The corrective action will be approved by the PQAO and the Project Manager. The situation, cause, and resulting corrective action will be documented and reported to the Field Supervisor, Chief Discipline Engineers and Scientists, the Corporate QA Manager, and involved subcontractor management, as appropriate. Corrective actions may be initiated as a result of any of the following:

1. When predetermined acceptance standards are not attained;
2. When procedure or data compiled are determined deficient;
3. When equipment or instrumentation is found faulty;
4. When samples and test results are questionably traceable;
5. When quality assurance requirements have been violated;
6. When designated approvals have been circumvented;
7. As a result of a management assessment; and
8. As a result of laboratory comparison studies.

Corrective action required as a result of performance, system, and formalized audits shall require formal documented corrective action procedures.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

As discussed in Section 9.3.3 of this appendix, a monthly Field Activity Report will be prepared while field work associated with the RI/FS programs is occurring. A copy of the contracted laboratory's chemical analysis reports received during the month will be sent to the Corp of Engineer's QA Laboratory when the monthly report is distributed. Information regarding the true identify of field-generated samples, such as trip blanks, duplicates, splits, and equipment blanks, will also be sent to the QA Laboratory.

A section on data quality will be included in the final report that discusses the results of the data validation and that describes how well the data quality objectives were met. The precision, accuracy, and completeness of the data will be calculated based on a review of laboratory and field QC samples and summarized in the report. The results of any audits will also be summarized in this section. Information will include: purpose of the audit, items audited, audit results, recommended solutions, and actions resulting from audit recommendations.

ATTACHMENT C-1

Contract Laboratory's Quality Assurance Program Plan (QAPP)

INCHCAPE TESTING SERVICES
AQUATEC LABORATORIES

QUALITY ASSURANCE
PROGRAM PLAN

Prepared by

Inchcape Testing Services
Aquatec Laboratories
55 South Park Drive
Colchester, VT 05446

Revision 11
April 10, 1995

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Approval Signatures
Revision 11
April 10, 1995

4/12/95
Neal E. Van Wyck Date
General Manager

Karen R. Chirgwin 04/10/95
Karen R. Chirgwin Date
Laboratory Operations Director

Philip C. Downey 4/13/95
Philip C. Downey, Ph.D. Date
Biology Laboratory Director

Martha E. Roy 4/10/95
Martha E. Roy Date
Quality Assurance Officer

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INCHCAPE TESTING SERVICES LABORATORY LOCATIONS

Corporate Office
1 Tech Drive
Andover, MA 01810
(508) 689-7954 Phone
(508)689-9433 FAX

Baton Rouge
7979 GSRI Avenue
Baton Rouge, LA 70820
(504) 769-4900 Phone
(504) 767-5717 FAX

Beaumont
808 Memorial Hgwy. #106B
Nederland, TX 77627
(409) 722-3657 Phone
(409) 722-6443 FAX

Boston
150 Herman Melville Blvd.
New Bedford, MA 02740
(508) 990-3400 Phone
(508) 990-3445 FAX

Burlington
55 South Park Drive
Colchester, VT 05446
(802) 655-1203 Phone
(802) 655-1248 FAX

Burlington
75 Green Mountain Drive
South Burlington, VT 05403
(802) 655-1203 Phone
(802) 658-3189 FAX

Dallas
1089 E. Collins Blvd..
Richardson, TX 75081
(214) 238-5591 Phone
(214) 238-5592 FAX

Houston
11155 S. Main Street
Houston, TX 77025
(713) 661-8150 Phone
(713) 661-2661 FAX

New Orleans
4909 Transcontinental Avenue
Metarie, LA 70002
(504) 736-9602 Phone
(504) 733-5442 FAX

Oklahoma City
7416 North Broadway
Oklahoma City, OK 73116
(405) 842-9788 Phone
(405) 840-4628 FAX

San Jose
1961 Concourse Dr., Suite E
San Jose, CA 95131
(408) 432-8192 Phone
(408) 432-8198 FAX

Europe
Lancots Lane, St. Helens
Merseyside, WA93ES
United Kingdom
(44) 744 611553 Phone
(44) 744 611470 FAX

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QUALITY ASSURANCE POLICY STATEMENT

Objective

The main objective of Inchcape Testing Services-Aquatec Laboratories is to provide our clients with consulting and laboratory services of the highest quality possible. We are dedicated to providing analytical data and services that conform to our clients specified requirements. This Quality Assurance Program Plan details facilities, personnel, and equipment necessary for accomplishing this objective along with general procedures and practices which will be followed to maintain adherence to the objective.

There is a firm commitment from all members of this laboratory to follow a comprehensive Quality Assurance Program Plan (QAPP). This commitment and dedication to quality is fully supported from the bench level to upper management in order to meet the objectives of our analytical laboratory and best serve our clients. The following Quality Assurance Program Plan is an embodiment of the current practices of quality assurance/quality control implemented by Inchcape Testing Services to ensure the production of accurate, consistent data of known quality.

Inchcape's approach to Quality Assurance starts with the General Manager who delineates policy and sets goals in conjunction with senior management personnel. Policies are implemented by management staff and laboratory personnel. Each department assists in the process by providing assessment of operating procedures along with recommendations for improvements or corrections.

Secondly, a Quality Assurance Officer, who reports directly to the General Manager, oversees prevention, assessment, and control procedures for the analytical laboratory and various associated departments within the organization. These three functions; prevention, assessment, and control, comprise the foundation of the laboratory's approach to Quality Assurance.

In addition to implementing the policies and practices established in this QAPP, each laboratory section is responsible for keeping an updated version of Standard Operating Procedures (SOP) applicable to their section to ensure continuity of analysis throughout the laboratory. Specifics in the areas such as sample handling, instrument calibration, quality control measures, injection technique, data acquisition, data processing, and autosampler procedures are thoroughly outlined and explained in each SOP. By continuously updating and following the guidelines stated in the QAPP and SOPs, the laboratory is able to generate data of a consistently high quality.

The policies and practices of quality assurance/quality control presented in the following text are set forth as minimums. Any additional measures that a project or investigation requires can be incorporated into the project specific Quality Assurance Project Plan (QAPjP).

FACILITY DESCRIPTION AND CAPITAL EQUIPMENT

Laboratory Facilities

Inchcape Testing Services - Environmental (ITS) is made up of environmental laboratories with facilities located throughout the United States and Europe. ITS is currently ranked as one of the top ten largest environmental laboratories in the country with high-capacity facilities located in Texas, Louisiana, California, Vermont, Massachusetts, and England. The unique affiliation of well established laboratories within the group provides a complete set of testing capabilities on a large scale.

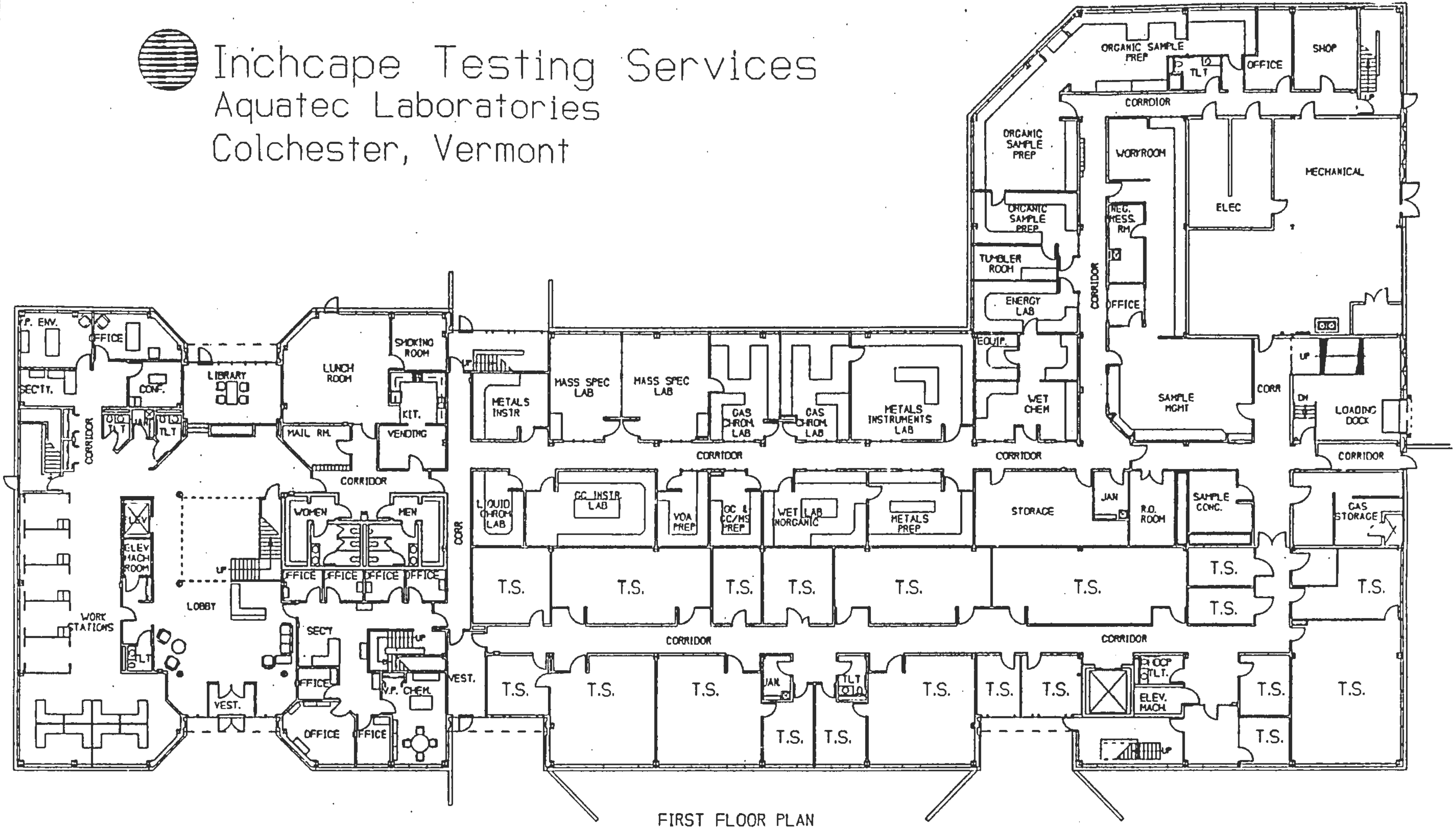
The Vermont facility (Inchcape Testing Services - Aquatec Laboratories) has been active in environmental analysis since its founding in 1970 and offers a full range of analytical services to cover the environmental industry. The Vermont facilities are located at 55 South Park Drive, Colchester and 75 Green Mountain Drive, South Burlington. These facilities are located approximately 10 miles apart and share common computer, and phone systems, and management personnel. The facility located in Colchester houses chemistry laboratories with additional laboratory space available in South Burlington. Aquatec's bioassay laboratory is located at the South Burlington facility. In total, the physical facilities available for analytical work at Aquatec are comprised of approximately 50,000 square feet with expansion possibilities at each location.

The layout of the Colchester facility is presented in Figures 1 and 2. Approximately 36,000 square feet of floor space is utilized by Aquatec for analytical work and corporate support. The chemistry laboratories are compliant with all current Vermont Occupational Safety and Health Administration regulations and equipped with unique environmental control systems, such as air flow and monitoring, solvent recovery systems, utilization of waste heat, and building security. The laboratories are outfitted with instrumentation exhibiting advanced technology and automation.

The floor plans in Figures 3 and 4 show the location, size, and utilities available in the South Burlington facility. Over 12,000 square feet are utilized by the chemistry division; approximately 3,500 square feet are devoted to analytical activities. The entire facility is air conditioned, has overhead fluorescent lighting, and the flooring is comprised of tile or raised computer flooring depending on the needs of the work space. The gas chromatography/mass spectrometry laboratory has a positive pressure air system with make-up air drawn through activated carbon filters. All other laboratories utilize a negative pressure air system.

All Vermont laboratory facilities have the resources necessary to support the analytical effort in the form of reverse osmosis systems, deionization systems, and computer networking. Our Colchester facility High Purity Water System operates out of the Reverse Osmosis (RO) /

Inchcape Testing Services
Aquatec Laboratories
Colchester, Vermont



FIRST FLOOR PLAN

Key
T.S. = Tenant Space

Figure 1	
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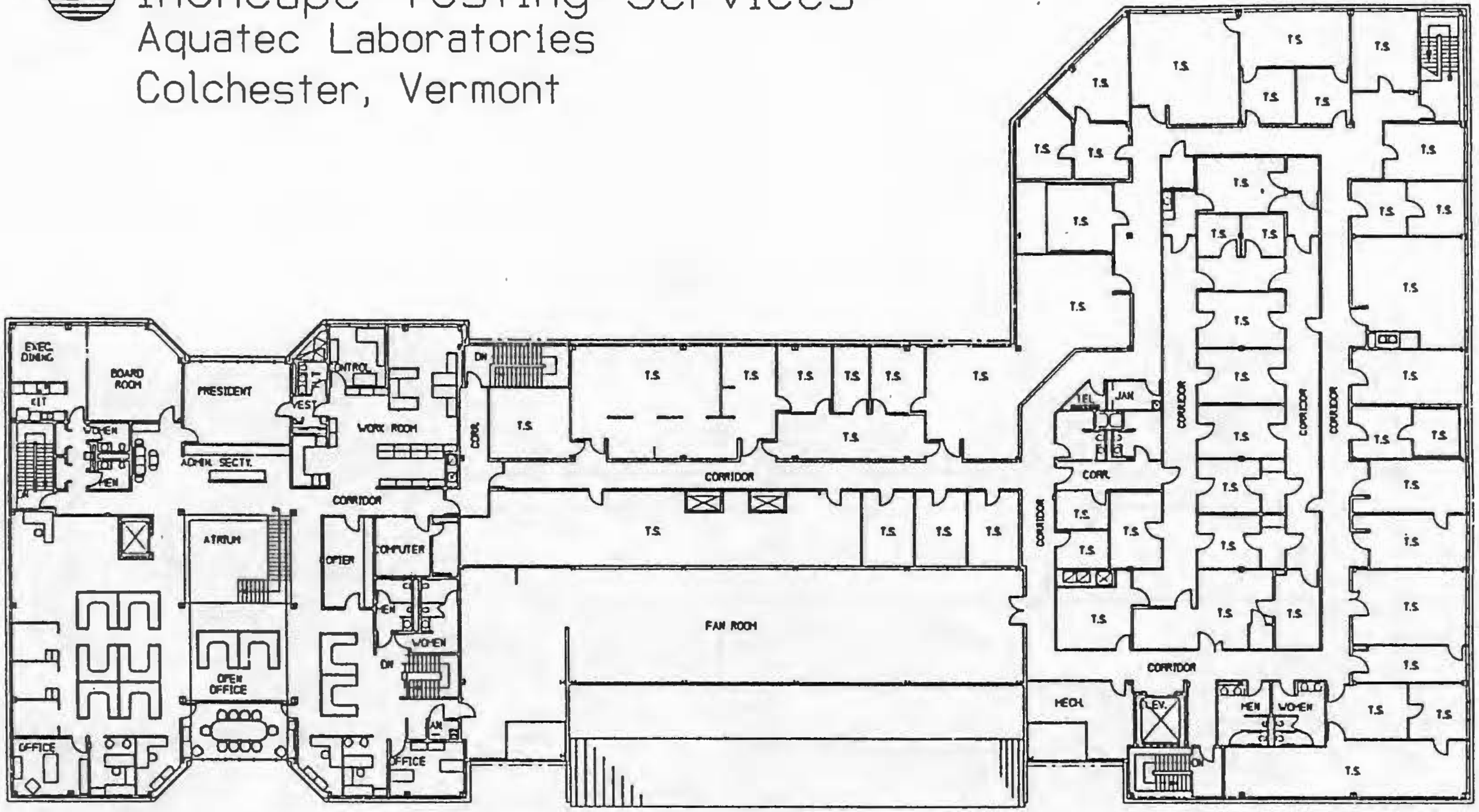
Inchcape Testing Services
Aquatec Laboratories
Colchester, Vermont



Key

T.S. = Tenant Space

Figure 2

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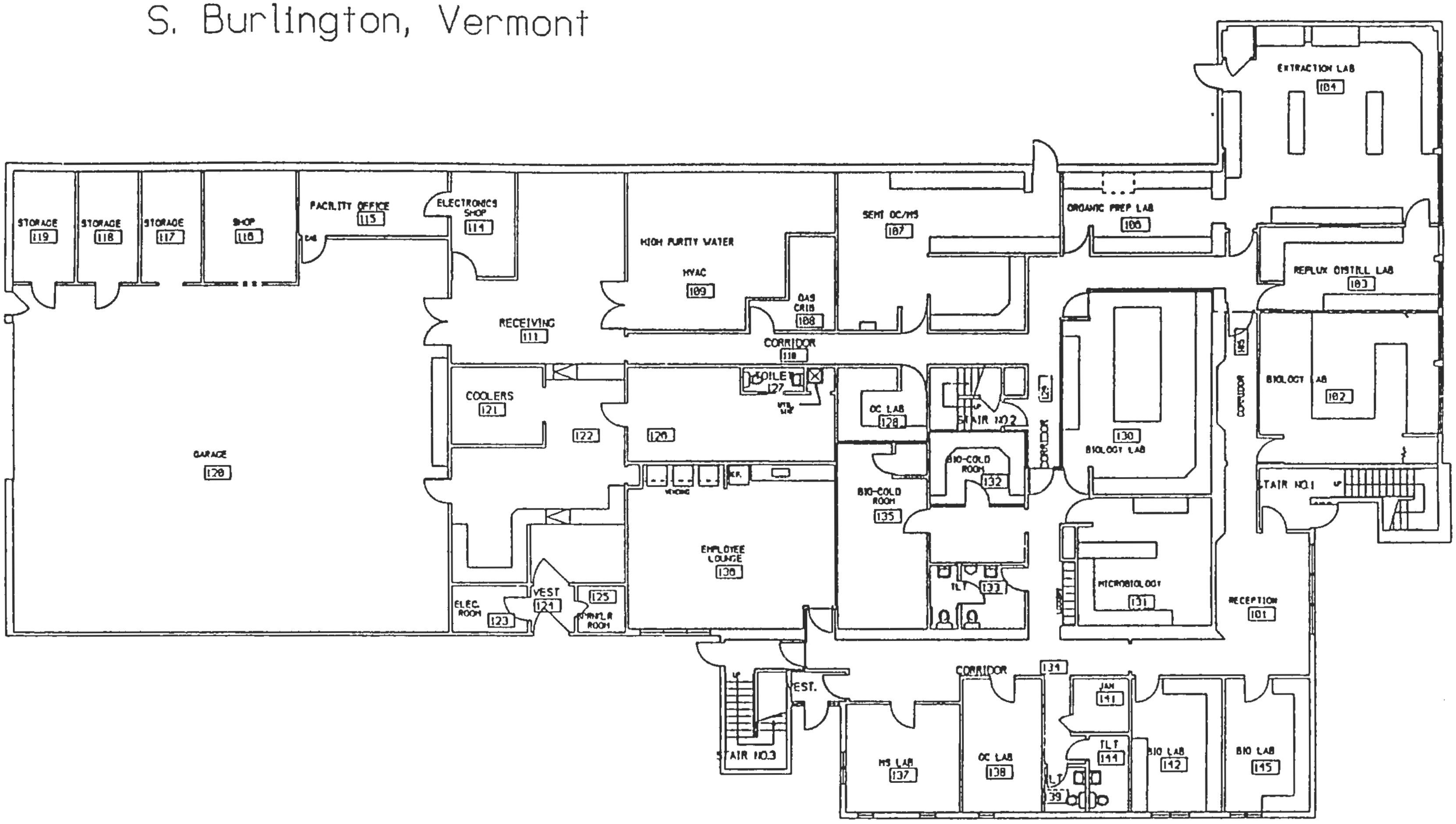
Inchcape Testing Services
Aquatec Laboratories
S. Burlington, Vermont



First Floor

Figure 3	
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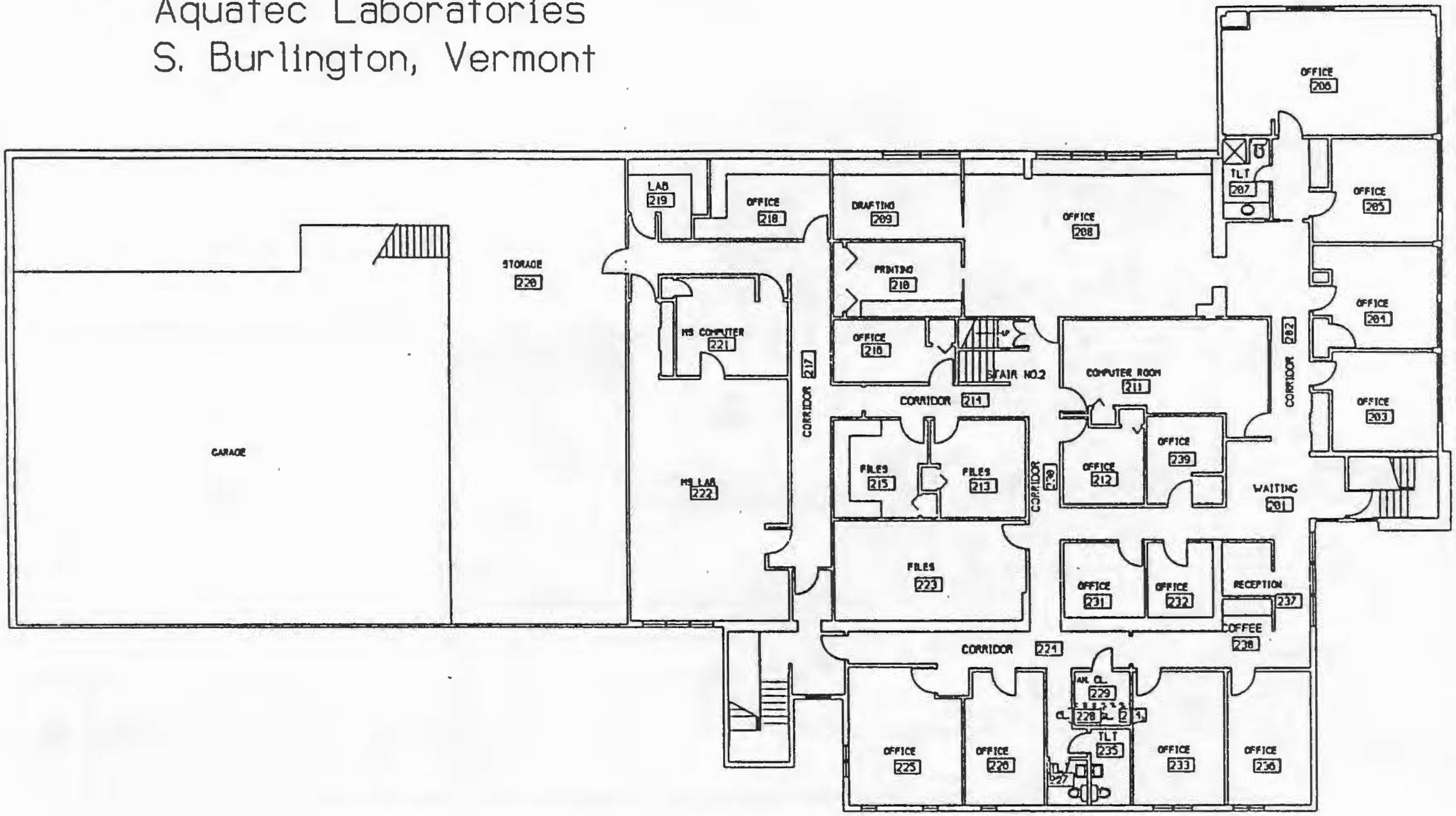
Inchcape Testing Services
Aquatec Laboratories
S. Burlington, Vermont



Second Floor

Figure 4	
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Continuous Deionization (CDI) Room which contains all the equipment to process, store and circulate RO/CDI water throughout the building. City water enters the room where it is blended to the proper temperature, filtered, softened, and then processed by Reverse Osmosis and Continuous Deionizer units to equal or surpass ASTM1 standards at a rate of 1440 gallons per day. Each system stores 300 gallons of product water which is continuously polished by Mixed Beds and circulated through 500 linear feet of high purity piping to service 15,000 square feet of laboratory space as well as providing make-up water for the central Steam-to-Steam humidifiers.

The laboratory gas distribution system is comprised of the following elements: 1) A centralized gas storage facility and 2) a High purity gas piping system. The centralized gas storage facility contains all the necessary speciality gases that are required for specific analytical equipment. The speciality gases are arranged in a manifold system that has either an automatic or manual changeover capability. The specialty gases leave the centralized gas storage facility through a series of high purity piping that resides above the laboratory corridor. This piping is utilized by approximately 13,200 square feet of laboratory space.

A summary of the Vermont facilities is presented in Table 1.

Table 1 Vermont Laboratory Facility Statistics

Characteristic	South Burlington	Colchester
Chemistry Division	7,577 sq. ft.	20,934 sq. ft.
Laboratories	2,146 sq. ft.	7,628 sq. ft.
Sample Management	1,364 sq. ft.	1,944 sq. ft.
Linear bench space	317 ft.	802 ft.
Security system	combination locked doors	electronic access cards

Because of the nature of our work at Aquatec, adequate security of the facilities, methodologies, and project files is necessary. Access to the main buildings is controlled through a system of electronic access cards at the Colchester facility, and combination-locked doors at the South Burlington facility. Visitors register upon entering the building and are accompanied by an employee while visiting the facility. In addition, anti-intrusion devices and key-control are employed to secure access to the facilities and its contents. Laboratory Section Heads insure that their personnel are familiar with Aquatec's security policies.

Inchcape associates are expected to be familiar with and adhere to standards of confidentiality mandated by individual contracts and common sense business practices. In addition, all our associates, have been asked to sign an ethics policy to outwardly show our commitment to quality.

Equipment Inventory

Laboratory equipment and instrumentation are maintained in compliance with manufactures' or suppliers' manuals. All equipment is kept in working condition to allow for conformity to each approved method. Key instrumentation such as Gas Chromatographs, Mass Spectrometers, Autosamplers, Inductively Coupled Plasma and Atomic Absorption Spectrometers have maintenance contracts with their respective suppliers or are maintained by qualified in-house technicians. The following is a comprehensive list of major instrumentation available along with supporting and miscellaneous equipment.

Information Systems:

- One Vax 4300, One Vax 4505, Two Vax 3100's, Three MicroVAX II's, approximately 130 terminals, 35 printers, and 50 personal computers. All terminals, most PC's and printers are connected on an integrated ethernet series of Local Area Networks (LANS) via network switches, routers and wide area links. Six HP GC/MS's with HP computers and 4 X-terminals; and HP-UX computers for GC Envisions with 3 X-terminals.

- Custom designed DMS Bitlab Laboratory Management System (LMS).

- Eight V. G. Laboratories, 4-Channel Chromservers.

- Eight Finnigan Mass Spectral Data Processors supporting super Incos software on Nova 4X, and DG10 computers with VAX networking.

- Extensive variety of software to aid in data analysis and presentation: System 1032 Datadase, Lotus 1-2-3, dBase IV, AutoCAD, TurboCAD, Surfer, Amipro, Microsoft Word, WordPerfect, Excel, Systat, in addition to Fortran, C, and Basic programming environments.

- Our GC division utilizes Maxima and Multichrom systems. Inorganic CLP or CLP-like data for our Metals division uses the Ward software package. Formaster software generates Organic CLP or CLP-like data for the GC/MS Finningan laboratory. The Envision System is used by the GC/MS Hewlett Packard lab and GC Lab. All our other systems have been custom designed by our Information Systems Department.

For example, our metals laboratory utilizes software created to interface with VAX based management systems. The data is autoloaded to a central VAX where it undergoes a rigorous QC review.

Analytical Instrumentation:

Gas Chromatography/Mass Spectrometry

- Four (4) Hewlett Packard HP5971A MSD GC/MS Systems with HP5890II GCs. Each system has a Tekmar LSC-2000 purge and trap and Tekmar ALS 2050 or ALS 2015 autosampler. [(3/92), (3/92), (3/92), 3/92)]

- Three (3) Hewlett Packard HP5971A MSD GC/MS systems with HP5890II GCs. Each system includes an HP7673A autosampler and HP7673A controller. [(3/92), (3/92), (3/92)]

- Two (2) Finnigan 5100 Series GC/MS systems with subambient temperature control, chemical ionization, negative ion and high resolution capillary column chromatography capabilities. Nova 4X data systems and Micro VAX file server networking. Configured with CTC200s autosamplers (semi-volatile analysis) and Varian 3400 Series GC's. [(4/91),(7/91)]

- One (1) Finnigan OWA 1050 Series GC/MS system, configured with a packed column, Tekmar LSC-2000 liquid sample concentrator, and a Tekmar ALS 2050 autosampler. Data system includes the Nova 4X Computer and Micro VAX file server networking. (volatile analysis) [(10/82)]

- Two (2) Finnigan INCOS 50B GC/MS systems with positive and negative ion capability. Configured with high resolution capillary columns, Varian 3400 series GC's, CTC200s autosamplers (semi-volatile analysis) and Micro Nova data systems. [(4/91),(6/94)]

- Three (3) Finnigan INCOS 50B GC/MS systems with positive and negative ion capability. Configured with high resolution capillary columns, jet separators, Varian 3400 series GC's, Tekmar LSC-2000 liquid sample concentrators, and Tekmar ALS-2050 (or a Dynatech PTA w/s-30) autosamplers. Data systems are the Micro Novas (volatiles). [(4/91),(4/91),(4,91)]

Gas/Liquid Chromatography

- Four (4) Hewlett Packard 5890II gas chromatographs equipped with dual electron capture (ECD) detectors and autosamplers. Data is collected on Fisons multichrom data stations. [(4/91),(4/91), (3/92), (3/92)]

- Two (2) Fisons Carlo Erba 8000 gas chromatographs equipped with dual electron capture (ECD) detectors and CTC 200 autosampler. Data is collected on a Fisons Multichrom data station. [(3/92),(4/93)]

- Eight (8) Hewlett Packard 5890 and 5890II gas chromatographs equipped with autosamplers and subambient temperature controllers. Detectors include FID, ECD, PID, HWD, FPD and NPD. An Envirochem 850 thermal desorber and Tekmar LSC-2 provide specialized sample introduction. Data is handled by Fisons multichrom or Waters Maxima 820 computer data stations. [(5/84),(5/84),(3/85),(3/85),(4/85),(6/87),(7/88), (7/88)]

- Two (2) Tracor 565 gas chromatographs each equipped with a photoionization detector (PID) and an electroconductivity detector (HALL). For sample introduction, a Tekmar LSC2000 purge and trap and Tekmar LSC2050 autosampler. Data is collected using a Fisons Multichrom Data station. [(4/91),(4/91)]

- Two (2) Tracor 540 gas chromatographs each equipped with a photoionization detector (PID) and an electroconductivity detector (HALL). For sample introduction, a Tekmar LSC2000 purge and trap and Dynetech autosampler are connected. Data is collected using a Fisons Multichrom Data station. [(3/85),(12/87)]

- Two (2) Waters 600 multi-solvent delivery system liquid chromatograph. Lambda-Max LC UV-VIS spectrometer and Kratos 980 programmable fluorescence detection system. 742 WISP autosampler. Data is collected on a Maxima 820 computer data station with networked VAX 3100 file serving. [(1/88),(4/91)]

- Post Column reaction System for HPLC including Waters Post Column Reagent Delivery System, Waters temperature control module and heater, and Waters two stage post column reactor consisting of reaction core, heater, and mixing tees. (5/92)

- Two Finnigan ITS-40 Ion Trap detectors each equipped with Varian 3400 GC's.

- Perkin-Elmer 1330 infrared spectrometer with data station.(8/81)

Organic Sample Preparation

- Three (3) Analytical bio-chemistry 1000 gel permeation chromatographs with UV detector. [(3/92),(3/92), (5,94)]

- Two analytical bio-chemistry 1002B autoprep gel permeation chromatographs with UV detector. [(8/90),(5/93)]

- Two dual horn Tekmer 600 sonicators. [(11/91), (3/94)]

- One (1) Tekmar 500 sonicator (5/87)

- Forty Organomation Soxhlet extraction vessels. (Various)

- Forty-five conventional Soxhlet extraction vessels. (Various)

- HP5890 Dual FID GC for Semi-volatile screening. (7/88)

- HP 5890 GC with Tekmar 7000 Headspace Autosampler for volatile screens. [(11/91)]

- Ten (10) Millipore Zero Headspace Extractors (ZHE) for TCLP VOA Extraction. [(1/87), (1/87), (2/88), (2/88), (2/88), (2/88), (2/88), (2/88), (8/90), (8/90), (8/90), (8/90), (8/90)]

- Thirty-five (35) Corning one step continuous liquid-liquid extractors. (1/92)

Atomic Spectroscopy/Metals Analysis

- Jarrell-Ash trace simultaneous inductively coupled plasma emission spectrometer. System includes 150 position autosampler and computer control. (3/94)

- Jarrell-Ash Enviro II simultaneous and sequential inductively coupled plasma emission spectrometer. System includes 150 position autosampler and computer control. (1/92)

- Perkin-Elmer Z5100 Graphite Furnace atomic absorption spectrometer. System includes an AS60 autosampler and personal computer. (9/91)

- Perkin-Elmer ZL5100 Graphite Furnace atomic absorption spectrometer. System includes an AS60 autosampler and personal computer. (2/92)

- Two (2) Jarrell-Ash SHZ1 atomic absorption spectrometers with Smith-Hieftje correction. System includes dedicated graphite furnace, atomizer, data station, and autosampler. [(8/90),(8/90)]

- Leeman Labs PS2000 Mercury auto-analyzer. System includes an autosampler and a personal computer. (10/91)

- CEM Corporation MDF 80 microwave digestion system includes Teflon vessels and constant torque lapping station.(4/87)

Wet Chemistry/Inorganic Analysis

- Alpkem RFA 300 auto-analyzer system for chloride, nitrate/nitrite and sulfate. (4/92)
- Leeman Labs PS1214 automated cyanide analyzer. System includes an autosampler and a personal computer. (3/93)
- Dionex 2000i/SP ion chromatograph.(10/85)
- Dionex DX500 ion chromatograph.(4/95)
- Bausch and Lomb 2000 scanning UV-visible spectrometer used for colorimetric analysis.(4/81)
- Carlo Erba EA-1108 CHNS-O Elemental Analyzer with data station. (3/91)
- Buck Scientific Total Hydrocarbon Analyzer Model HC404. (12/93)
- Beckman Φ45 pH Meter. (11/91)
- Fisher Accumet pH Meter model 620 for fluoride analysis. (12/93)
- LECO AC-300 automatic calorimeter.(6/84)
- Tecator Soxtec System 1043 Extraction Unit. (2/92)
- Oceanography International Model 700 total organic carbon analyzer.(12/78)
- Two (2) Dohrman total organic halogen analyzers. [(6/81),(2/91)]
- Two (2) Labconco Rapid Still II distillation units. [(11/92),(4/93)]
- Tecator Digestion system 20; 1015 digestor. (9/91)
- Two YSI Model 58 Dissolved Oxygen Meters with 5905 BOD Probes. (3/95)

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Biological and Toxicity Analyses

- Two Turner Designs Model 10 Fluorometer.
- Eberbach Model 2700 microprojection instrument. Adapted for computer digitizing (3/73).
- Microtox System Model 500 (8/93).
- Ten (10) microscopes including one Zeiss DRC Dissecting Microscope (11/87), one Olympus I MT-100 Trinocular Inverted Tissue Culture Microscope(1/82), two (2) Zeiss Lab 16 Compound Microscopes with high pressure mercury lamp for epifluorescent capabilities [(11/85),(12/86)] and three (3) American Optical Binocular Microscopes [(4/70),(6/73),(4/81)].
- Eleven (11) incubators.
- Four (4) temperature controlled environmental chambers.
- One Magnavox GPS MX200.
- Two Coffelt Electofishing Boat (18 foot).
- One Brinkman PT3000 Tissue Miser.
- Two Omni-Mixer Homogenizer.

Sample Management

- Sixteen Hobart three door refrigerator units with temperature probe connected to VAX System for automatic temperature measurement. Max/Min Thermometer back-up. (Various).
- Hobart two door refrigerator unit with temperature probe connected to VAX System for automatic temperature measurement. Max/Min Thermometer back-up. (Various).
- Two Hobart one door refrigerator units with temperature probe connected to VAX System for automatic temperature measurement. Max/Min Thermometer back-up. (Various).
- Two Hobart one door freezer units with temperature probe connected to VAX System

for automatic temperature measurement. Max/Min Thermometer back-up. (Various).

- Signature one door freezer unit with Max/Min Thermometer.
- Wood's one door freezer unit with Max/Min Thermometer.
- Walk-in freezer.
- Omega 0552 IR Temperature Gun
- Negative Pressure Room for storage of high hazard samples.

PREVENTATIVE MAINTENANCE

Preventative Maintenance

In order to prevent system down time, minimize corrective maintenance cost and to help ensure data validity, Inchcape uses a system of preventative maintenance. Specific operator manuals are used to pinpoint steps in the preventative maintenance scheme for individual instruments. All routine maintenance is performed as recommended by the manufacturer. The manuals also assist in identification of commonly needed replacement parts so that an inventory of these parts can be properly maintained. Maintenance contracts are purchased for large, complex or very sensitive instruments and equipment or maintained by our qualified, in-house service technicians. This ensures periodic preventative maintenance visits by factory authorized service representatives and immediate service for corrective actions if required.

A maintenance and repair log notebook is associated with each instrument. Notation of the date and maintenance activity is recorded every time special or routine service procedures are performed. This includes routine service checks by laboratory personnel as well as factory service calls. Routine service checks by laboratory personnel would include such things as the replacement of a nebulizer, cleaning a mixing chamber, changing gas fittings, or replacing a column. More extensive maintenance is performed by authorized representatives of the instrument manufacturer or by our in-house service technicians.

Optimization of service-calibration intervals are assigned to all instruments as part of the preventative maintenance program. Routine method validation, calibration and process control protocols are designed to detect the need for unscheduled maintenance and are used to insure that the instrument produces acceptable results following repair or service-calibration.

Monitoring worksheets are used for ovens, refrigerators, incubators and other temperature controlled equipment. Temperature logs provide a written record of operating consistency for monitored equipment and help to immediately identify or even prevent equipment malfunctions which might compromise sample integrity or data quality.

All balances are serviced by an external certified service engineer on an annual basis. Analytical balances are calibrated daily using class S weights. All calibrations are recorded on the monitoring worksheet and filed with the QA Officer.

All mercury thermometers are calibrated annually at ambient as well as actual use temperatures against an NBS traceable reference thermometer. All thermometer calibrations are maintained by the Quality Assurance Officer. A computer based system to continuously monitor the temperatures inside the refrigerator/freezer units is used in addition to the manual daily thermometer reading. Each refrigeration unit contains a temperature probe packed in sand and is connected to the microVAX system to continuously record the temperature of the unit. Acceptable temperature excursion limits have been established and set within the VAX program. Sample storage refrigerators are maintained at 4 ± 2°C. Each temperature reading is immediately compared to the limits, and if three consecutive values fall outside of the established limits, a buzzer will sound and corrective action will be initiated immediately. Provisions have been made to contact facilities personnel during off hours to ensure that the refrigeration systems do not remain out-of-control. The refrigerator monitoring system prompts the printing of a daily control chart showing the previous 24 hours of temperature readings with respect to their control limits. Every two weeks, a summary control chart showing the previous two weeks temperature readings is printed. This summary chart is bound with the daily monitoring worksheets.

The conductivity of the laboratory deionized water is monitored daily by checking a conductivity meter attached to the deionization system. This meter is checked against a conductivity probe once a month for accuracy. This information is recorded in a notebook which is maintained by the Wet Chemistry Section Head.

ADMINISTRATIVE ORGANIZATION

PERSONNEL QUALIFICATIONS

Inchcape Testing Services - Environmental employs more than 500 people within its six main laboratory facilities in the United States. Of those, approximately 160 staff the Vermont facilities. The corporate office, located in Andover, Massachusetts includes experienced professionals who are available to provide support to the individual laboratories wherever necessary. Trading of experienced analysts between the laboratories occurs at a reasonable frequency to facilitate the trading of procedural innovations and cross training.

The management structure within the Vermont facility is presented in Figure 5. Figure 6 is an organizational chart of key chemistry personnel and Figure 7 is an organizational chart of key biology personnel. The laboratory structure provides a means for communication from the bench level up to the Laboratory Director. This organization facilitates the generation of data, several levels of data review, and the monitoring of the overall quality of the data produced in the laboratory before it is reported to the client. The Quality Assurance Program within the laboratory is operated independently of the laboratory sections generating data and reports directly to upper management levels. If discrepancies are found in the performance of any section of the laboratory, it is reported to the QA Officer who is responsible for initiating corrective action within the laboratory section. In this way, objectivity in the evaluation of laboratory operations can be obtained. Appendix A provides resumes of our key staff and experience and educational profiles for the entire laboratory.

Roles and Responsibilities

Each section within the laboratory has specific roles and responsibilities in terms of producing a product of known quality. All laboratory personnel are expected to have a working knowledge of the Quality Assurance Program Plan (QAPP). It is expected that associates at every level will ensure that data is generated in compliance with this QAPP.

The General Manager is directly and ultimately responsible for assuring data quality at Inchcape Testing Services. The General Manager develops policies and general quality assurance strategies in collaboration with the Laboratory Director, the Quality Assurance Officer and the Section Heads.

The Quality Assurance Officer is responsible for the preparation, maintenance, and implementation of the QAPP and will assist the Section Heads in the preparation, revision, and distribution of SOPs. Internal audits will be conducted periodically to monitor compliance to this QAPP and SOPs within the laboratory sections. The results of internal audits are reported to the General Manager and Laboratory Director for corrective action. A follow-up audit is performed to ensure that the problem has been corrected. The Quality Assurance Officer's responsibilities include:

Inchcape Testing Services-Aquatec
Organizational Structure

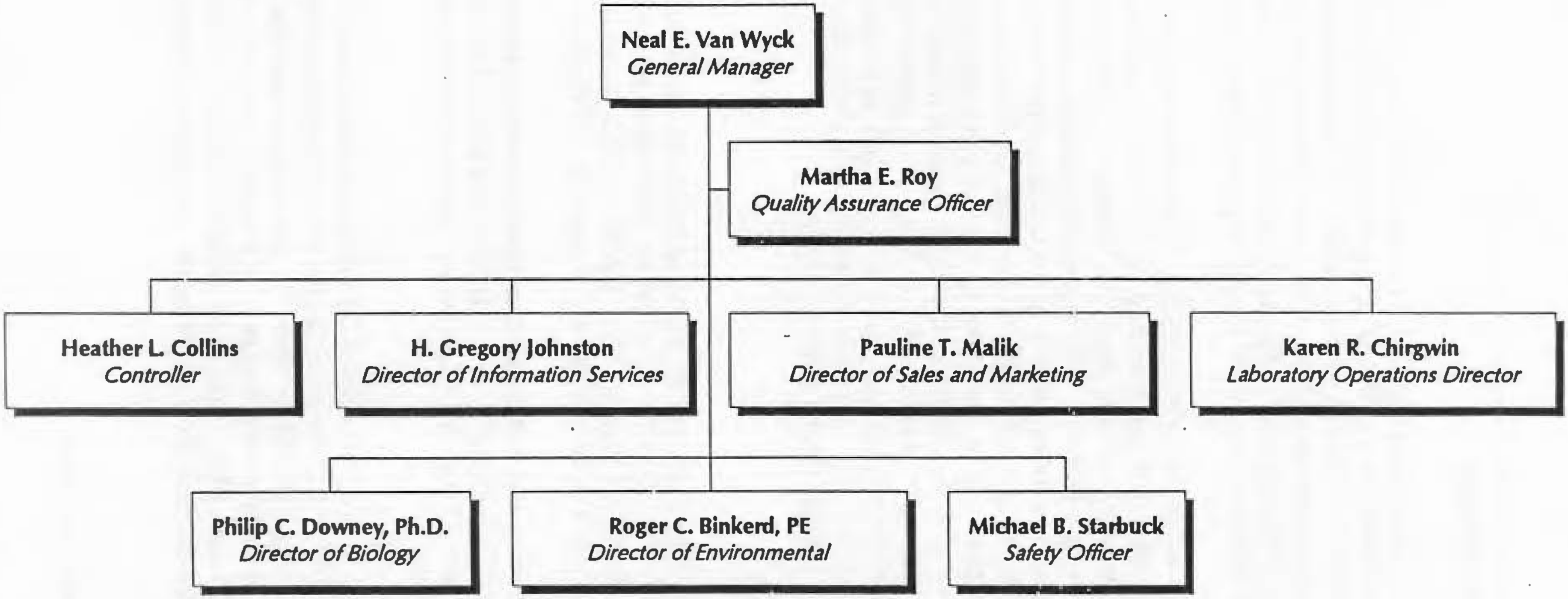

Figure 5

Inchcape Testing Services- Aquatec Laboratory
Chemistry Division Organization

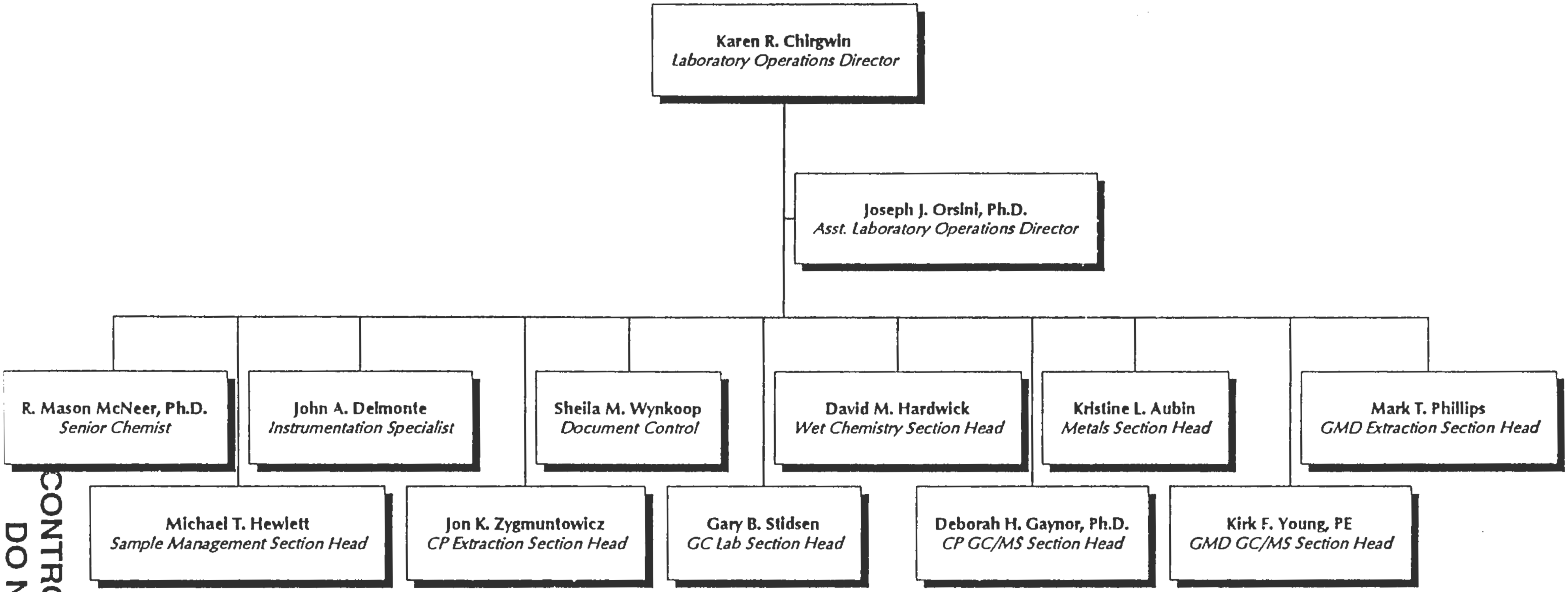

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Figure 6

Inchcape Testing Services - Aquatec Laboratory
Biology Division

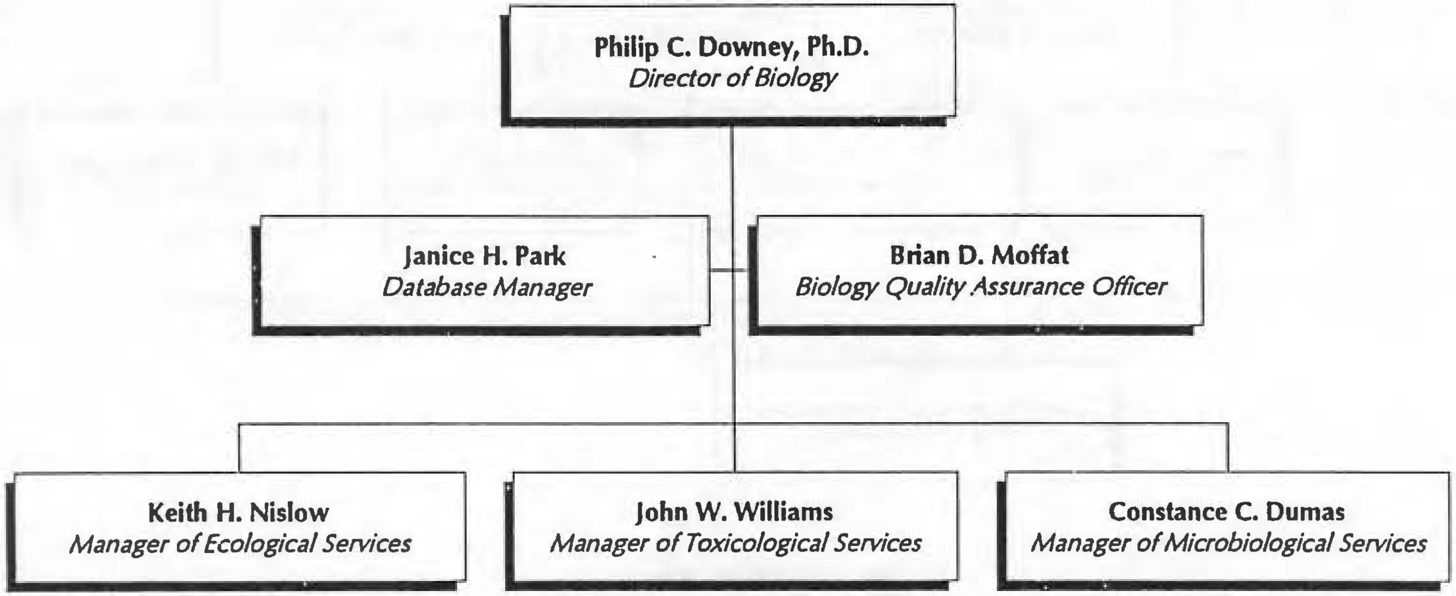

Figure 7

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- Being the official organizational contact regarding QA matters for the laboratory.
- Providing assistance in the development of standard operating procedures.
- Identifying areas where corrective action is required and then ensuring implementation and completion of the resulting action.
- Ensuring that data and system audits are performed within the laboratory.

The Laboratory Operations Director reports to the General Manager and is responsible for the data that is produced and reported by the laboratory. Any discrepancies in methodology, procedures, QC criteria, or reporting will be communicated to the Laboratory Director. When the Quality Assurance Officer detects discrepancies or problems, they are reported to the Laboratory Director who is responsible for developing a corrective action procedure. The Laboratory Director bears the following responsibilities:

- General management of the laboratory.
- Scheduling and execution of testing.
- Release of testing data and results.

The Sales and Marketing Director is responsible for overseeing all projects that are in-house, coordinating proposals, providing guidance and support to the Project Directors and ensuring consistency in all sales and marketing activities. All external and internal marketing activities are the direct responsibility of the Sales and Marketing Director. In addition, the Sales and Marketing Director is responsible for coordinating the design and development of all publications and marketing tools for the laboratory. The Sales and Marketing Director's responsibilities include:

- Ensuring consistency in all sales and marketing activities.
- Overseeing the Project Directors.
- Ultimate responsibility for coordinating all in-house projects.

Project Directors report directly to the Sales and Marketing Director and are instrumental in interfacing and assisting both the laboratory and the client in resolving any difficulties that may arise during the course of a project. Project Directors are responsible for dealing directly with the clients. They are technically oriented and well versed in analytical methodologies enabling them to effectively communicate the clients' needs to the laboratory. Project Directors are selected for specific projects based upon their past experiences and qualifications in relation to the proposed scope of work. Roles of the Project Directors include shipping proper sampling containers to the job site, inspection of samples and shipping containers upon arrival at the laboratory, overseeing the log-in procedures, monitoring the progress of the analytical work, and reviewing the final data packages before submittal to the client. The Project Director's responsibilities include:

- Serving as a liaison between laboratory staff and client personnel.
- Review of reports generated for the project.
- Notifying clients regarding specific non-conformance, changes or difficulties encountered within the laboratory.

Laboratory Section Heads are responsible for the overall flow of work and data in and out of the laboratory. The Section Heads report directly to the Laboratory Director. They are responsible for the maintenance of accurate SOPs and the enforcement of the QAPP and SOPs in their laboratory section to ensure that the data produced by the analysts is of known quality and legally defensible. Each Section Head has analysts and data review personnel who work directly for them. Any discrepancies in QC criteria will be brought to their attention, and a decision reached as to whether or not the data is acceptable. If, in their judgment, there are technical reasons which warrant the acceptance of what appears to be out-of-control data, these reasons should be well documented and discussed with the Laboratory Director and Quality Assurance Officer before the sample data is reported. Individual Section Heads have the following responsibilities:

- General management of all activities within their departments.
- Ensuring that all instrumentation and equipment meet performance criteria and calibration requirements.
- Training of laboratory staff.

At the bench level, analysts are responsible for the generation of data by analyzing samples according to written SOPs. They are also responsible for ensuring that all documentation related to the sample is complete and accurate. The analyst should provide their Section Head with immediate notification of quality problems within the laboratory. The analysts have the authority to accept or reject data based on compliance with well-defined QC acceptance criteria - thus providing the initial primary review of all data. The acceptance of data, which falls outside of QC criteria or is questionable in nature, must be approved by the Laboratory

Section Head.

Data Review Personnel are responsible for providing secondary review of the raw data presented by the analysts. All calculations, calibrations, and QC criteria are evaluated against the objectives of the project to ensure nothing has been overlooked in the generation of the data. Any discrepancies found in the data should be reported to the appropriate Laboratory Section Head for corrective action. The data reviewers are also responsible for publishing the final product submitted to the senior personnel for final review. In the data presentation, the proper forms and formats must be observed.

The Information Systems Department Head is responsible for the design and maintenance of the company's computer hardware and software. Implementation of new data systems is also the direct responsibility of this Department. This group also aids the Sections in review and implementation of diskette deliverables.

The Environmental Department Head is responsible for the engineering division of the laboratory which includes hydrogeologists, air quality, water quality, and permits and modeling engineers.

The Director of Biology has ultimate responsibility for all biological testing performed by the laboratory. He is actively involved in coordinating the activities of data analysts and QC personnel to ensure consistently high data quality. The Director of Biology also provides technical support to our biology staff, which include macro invertebrate ecologists, fisheries biologists, aquatic toxicologists and microbiologists.

The Safety Officer is responsible for maintaining the company Safety Manual, chairing the company Safety Committee and doing periodic safety inspections of the laboratory.

The Controller is responsible for payroll, accounts receivable, and client billing.

Training

<u>Orientation</u>:

Personnel training procedures begin with an established orientation program designed to familiarize the new employee with safety and chemical hygiene issues, the importance of quality assurance/quality control in the analytical laboratory, and company policies and benefits. Once an employee has undergone the complete orientation procedure, they are given an employee identification code, and a computerized access card enabling them to have access to the relevant laboratories.

Basic Training:

The level of training necessary to perform analytical tasks is derived from academic background and past experience, technical courses, and on-the-job training with specific methods or instrumentation. The responsibilities for formal academic training lies foremost with the individual. The responsibility for the additional specialized skills obtained through in-house training or external workshops is a shared obligation of the individual, their supervisor, and the Company. An individual's academic and professional experience are kept on file including an initial statement of qualifications or resume and any additional documentation concerning subsequent training. Copies of certificates of completion, transcripts, diplomas, or other documentation will be included in the files as appropriate.

The process of quality assurance/quality control training is an integral part of the analytical training. Trainees are under the supervision of experienced analysts who are responsible for showing them the analytical procedures including applicable QA/QC measures. A new analyst will not be permitted to perform an analysis until their supervisor is confident that the analytical and QA/QC procedures can be carried out correctly. Training is summarized on Form F-0341 (Figure 8) and included in the training files of each associate. Training record summaries are available for inspection from the personnel department.

New employees for all departments undergo the same orientation procedure. Laboratory personnel also undergo an extended basic training procedure involving lecture tapes, manufactured by International Video Distributors, covering basic laboratory functions. New employees must complete the viewing of these tapes within their first 90 days of employment. The basic training functions covered by the twelve lecture tapes include:

* Weighing
* Pipeting
* Safety
* pH Measurement
* Titration
* Representative Sampling
* Filtration
* Understanding Data
* Use of Syringes
* Glassware Use/Practices
* Math and the Metric System
* Use of General Lab Equipment

Safety Training

Inchcape has a fundamental responsibility to provide facilities, equipment, maintenance, and an organized program to make necessary improvements to ensure a safe working environment. Unless employees fulfill their responsibilities for laboratory safety, the safety-related features of the facility and established safety programs will be ineffective. Aquatec's Safety Manual provides a complete discussion of the safety policies enforced by Aquatec, Inc. A copy of the

F - 0341

INCHCAPE RECORD OF INDIVIDUAL TRAINING

Week Ending:

Individual employees are to submit this form with their weekly time cards to substantiate all hours charged to project 9X903 (Training & Education) or 9X920-1 (Safety Training). Copies of all certificates, diplomas, transcripts, or other documentation should be attached.

Payroll ID

Employee Name (Print)

MA or VT
Division

Project #

Title

Department Code

THE ABOVE NAMED PERFORMED
TRAINING OR INSTRUCTION ON THE DATES AND FOR THE HOURS INDICATED.

Date	Hours	NATURE OF DUTIES, TRAINING OR INSTRUCTION	Code

I hereby certify that I have completed and understand the training listed above.

Employee Signature / Date

Trainer or Supervisor Signature / Date

Figure 8

CONTROLLED DOCUMENT
DO NOT DUPLICATE

Safety Manual is distributed to each employee during their orientation training session. Updates are distributed as they occur.

The Vermont facilities are equipped with many structural safety features. Each employee must be familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. To protect employees from potential workplace hazards, Aquatec provides and requires the use of certain items of protective equipment. These include safety goggles, protective clothing, gloves, respirators, etc. For a complete description of the types of personal safety equipment available and applicable to a particular workspace, refer to the Safety Manual.

Material Safety Data Sheets

Precautions to be taken in the transportation, storage, and use of chemical substances are contained in Material Safety Data Sheets (MSDS) provided by chemical supply companies. Employees using chemical substances are to become familiar with the Material Safety Data Sheets, especially those pertaining to routinely handled chemicals in their section. The original MSDS are maintained on file at the Colchester Park facility. Additionally, a master log of MSDS sheets is maintained by the Safety Officer and the applicable MSDS sheets in each laboratory.

QUALITY ASSURANCE MANAGEMENT

Responsibility

The direct and ultimate responsibility for assuring data quality at Inchcape Testing Services rests with the General Manager. The General Manager develops policies and general quality assurance strategies in collaboration with the Laboratory Director, the QA Officer and the Section Heads (GC/MS, GC, Metals, Organic Extraction, Wet Chemistry, Sample Management). The QA Officer assists laboratory management and analysts by defining specific QA/QC requirements, ensuring concordance between lab policies, regulations and contract requirements and by monitoring compliance with established QA/QC policies through the use of audits and statistical data.

Inchcape's Quality Assurance Management process involves five major areas or functions of the laboratory:

1. Sample Custody and Receipt
2. Preparation and Sample Screening
3. Calibration and Analysis
4. Data Reduction, Validation, and Reporting
5. Quality Control

The Quality Assurance Officer supports the entire process through record keeping, auditing, and statistical data compilation.

Sample Custody and Receipt

Inchcape understands that sample integrity is a vital part of Quality Assurance. Samples submitted to the laboratory are logged in immediately. If there must be a delay in this process, log-in personnel are made aware of those samples requiring refrigeration and store them accordingly. Any sample that is suspected of being contaminated, improperly stored or preserved, or improperly prepared, is reported to the Project Director and/or client immediately.

Chain-of-Custody Procedures

The critical nature of chain-of-custody procedures cannot be overemphasized. These procedures record the history of the samples' custody from acquisition to final disposal.

Samples are physical evidence and should be handled according to certain procedural safeguards. For some legal proceedings, proof that the laboratory is a secure repository for the sample is sufficient to ensure that the analytical data will be admitted as evidence. However, in some cases a court may require a showing of the hand-to-hand custody of samples while at the laboratory. In such instances, the laboratory must be able to produce documentation that traces the in-house custody record of the samples from the time of sample receipt to the completion of sample analysis.

The National Enforcement Investigations Center (NEIC) of EPA defines custody of evidence in the following ways:

- It is in your actual possession, or
- It is in your view, after being in your physical possession, or
- It was in your possession and then you locked or sealed it up to prevent tampering, or
- It is in a secure area.

The chain-of-custody procedures employed at Aquatec are implemented through the Sample Management Office. An example chain-of-custody form is presented in Figure 9 (F-0058). The following procedures have been established to satisfy contractual obligations.

- To guarantee that samples are in a secure area, access to the laboratory is through a monitored reception area with all other access doors locked. Visitors sign-in with the receptionist and are escorted by an Inchcape associate during their stay in the laboratory. Refrigerators, freezers, and other sample storage areas are kept locked, and only sample custodians and supervisory personnel have keys to the sample storage area(s) during the hours of 8 am to 7 pm. Analysts working in the laboratory between the hours of 7 pm and 8 am have access to the keys in order to get the sample portions that they need for analysis out of storage.
- Samples remain in locked sample storage until removal for sample preparation or analysis.
- If requested, transfers of samples into and out of the storage area(s) can be documented on an internal chain-of-custody record shown in Figure 10 (F-0169A). Inchcape Testing Services has a Sample Custodian on staff to control the internal custody of samples received. The Sample Custodian ensures that samples are stored in the appropriate locations according to the nature of the specific sample. Most samples are

Inchcape Testing Services
Aquatec Laboratories

Chain-of-Custody Record

55 South Park Drive
Colchester, VT 05446

TEL: (802) 655-1203
FAX: (802) 655-1248

PAGE ____ OF ____

COMPANY INFORMATION

Name: ________________
Address: ________________
____
____
Telephone: ________________
Facsimile: ________________
Contact Name: ________________

COMPANY'S PROJECT INFORMATION

Project Name: ________________
____
Project Number: ________________
Sampler Name(s): ________________
____
____

SHIPPING INFORMATION

Carrier: ________________
Airbill Number: ________________
Date Shipped: ________________
Hand Delivered: ☐ yes ☐ no

INCHCAPE LABORATORY INFORMATION

Quote #:
Client Code:

VOLUME/CONTAINER TYPE/ PRESERVATIVE (NOTE 4)

—	—	—	—	—	—
—	—	—	—	—	—

SAMPLE IDENTIFICATION (NOTE 1)	COLLECTION		GRAB	COMPOSITE	MATRIX	ANALYSIS/REMARKS (NOTE 2,3)	NUMBER OF CONTAINERS					
	DATE	TIME										

Figure 9

Relinquished by: *(signature)*	DATE	TIME	Received by: *(signature)*
Relinquished by: *(signature)*	DATE	TIME	Received by: *(signature)*
Relinquished by: *(signature)*	DATE	TIME	Received for Laboratory by: *(signature)*

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 21 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.: MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.: 40 ml/glass/H_2SO_4

Notes to Lab: ________________
____
____
____

CONTROLLED DOCUMENT
DO NOT DUPLICATE

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

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INTERNAL CHAIN OF CUSTODY
INCHCAPE TESTING SERVICES - AQUATEC LABORATORIES

ETR Number: ______________ Case : ______________

Project Number: ______________ SDG Number: ______________

Memo: ______________

LABORATORY SAMPLE NUMBER	REMOVED BY	DATE AND TIME REMOVED	REASON	DATE AND TIME RETURNED

Figure 10

kept in cold storage.

When a sample is taken for analysis, it is first logged out by noting the analysis to be run and the date and time the sample is removed from storage. This information is recorded on the Internal Chain of Custody Form. The sample is returned to its original location following use and the date and time of return are noted again. The use of the Internal Chain of Custody method allows Inchcape Testing Services - Aquatec Laboratories to track samples from beginning to end and has proven to be an effective method of sample control.

- After a sample has been removed from storage for the analyst, the analyst is responsible for returning the sample to the storage area before the end of their working day.
- All sample transfers between Aquatec's laboratory facilities are recorded on transfers records which serve as chain-of-custody documentation. An example of this record is found as Figure 11 (F-0047).

Sample Receipt

Inchcape utilizes a Laboratory Management System (LMS) custom designed Data Management System to track samples and analytical data throughout the facilities. The LMS system is initiated by the log-in personnel when the following information is entered into the computer:

- Quote number (unique to this job or set of samples)
- Sample number (unique to this sample)
- Date received
- Bottle/Volume information
- Date analytical results due
- Sample descriptions
- Additional comments
- Client's name
- Client's address

F - 0047

Laboratory Transfer Record

Sample Management — Inchcape Testing Services

ETR:

Date:

Laboratory I. D.	Fraction / Analysis

Relinquished @ ____________ by ____________ Time: ____________

Transported by ____________

Received @ ____________ by ____________ Time: ____________

Figure 11

- Client's job number (if available)
- Notation of any special handling instructions or priority assignments
- Billing information - purchase order numbers
- Analyses requested

This information then becomes an Environmental Test Request (ETR). The ETR is generated in the Laboratory Management System for each sample or series of samples. The ETR contains all of the specific information relative to a particular sample. The ETR number is recorded in the laboratory's master log as a reference to the laboratory identification numbers. The ETR's are reviewed and then maintained in a file of work in progress.

Once the ETR has been generated, method specific analytical worksheets are generated for distribution to the analysts. When the laboratory section is ready to analyze a sample, an analyst requests the appropriate sample portion from the Sample Custodian by presenting their analytical worksheet. The analyst may be required to sign an internal chain-of-custody form when removing the sample portion from the sample management area. When the analysis is complete, the analyst returns the sample to the custodian and relinquishes custody. Once the samples have been completely analyzed, they are stored until their established disposal date.

The quality of analytical data is reflected directly by the quality of sample handling. Receipt of samples should be scheduled with the Project Director or designee before samples are shipped. This is important because certain parameters require prompt analysis and the Project Directors must coordinate their arrival with Laboratory Section Heads to ensure that the appropriate staff and facilities are available to perform the required analyses.

Samples are received at the Colchester Park facility in an area specifically established for sample receipt and storage. Upon receipt, the coolers are opened in a ventilated area. The sample management area contains a hood for this purpose. Individual samples are unpacked and checked to ensure that they are in proper containers and have been properly preserved for the requested analysis. The samples are assigned a laboratory identification number which is then physically affixed to the sample container(s).

The paperwork accompanying the samples is checked for consistency and transcription accuracy. If all the information agrees, then the samples can be logged into the Laboratory Management System. Any discrepancies in the information are reported to the project director for corrective action. The resolution of discrepancies will be noted either on the chain of custody record, the log-in sheet, or an individual phone log. In general, samples will not be logged in until all discrepancies are resolved.

The laboratory number, along with basic information (including client code, project number, date received, and general sample description), is recorded in the sample management's master log and the computer based Laboratory Management System (LMS). Aquatec uses the LMS to track samples from quote through log-in, analysis, reporting, and finally invoicing. The laboratory's master log is maintained as a parallel paper system backup.

Subcontracted Analyses

Aquatec does not routinely subcontract analytical services with the exception of dioxin, asbestos, and radiological analyses. Prospective subcontracting firms are thoroughly reviewed with an emphasis on their overall quality control practices and the quality of their data. Aquatec will ensure that the subcontracting firm has all the information necessary to perform the analyses to satisfy the objectives of the client. Aquatec will not subcontract any samples without permission from the client. When permission is granted, samples are shipped to a subcontracting firm from Aquatec's sample management department and the results of the analyses are transmitted back to Aquatec for review. These results will be synthesized into Aquatec's report and presented to the client.

Preparation and Sample Screening

Samples are prepared according to standardized methods consistent with the analytical methods required for a given sample. Batches are generated in the prep lab according to preparation method, analytical method, and matrix.

Metals

Samples for metals analyses are prepared in batches containing a maximum of 20 samples of the same or similar matrix. Possible exceptions to this batch size would be encountered when contract-specific protocol requires smaller or larger analytical batch sizes. Microwave digestion is not routinely performed.

Organics

Samples for organics analyses are prepared in batches containing a maximum of twenty samples of the same or similar matrix. Aquatec currently has an extraction lab dedicated for waters and another dedicated to all other matrices. The organic extraction labs are equipped for handling many matrices and various clean-up requirements including Florisil, GPC, silica gel, acid-base and sulfur.

Re-preparation

Occasionally, re-preparation or re-analysis is required. In such cases, a QC request form is filled out by the data review personnel or other appropriate individual and then the request is forwarded to the appropriate department.

Screening

Many samples within the laboratory must be screened before analysis. Screening helps to prevent unnecessary re-runs and lower instrument re-calibration, re-tune and analyst labor time. All GC and GC/MS volatiles are screened prior to analysis by headspace GC ECD and FID detectors. Soil Semi-volatiles are prescreened prior to extraction to determine if they require low or medium level extraction procedures. All semi-volatile extracts are screened prior to analysis using GC FID detectors. Similarly, all pesticide extracts are screened prior to analysis using GC ECD detectors

Calibration and Analysis

Calibration Standards

Analytical standards used for calibration include pure (reference) materials, stock solutions, working solutions, calibration standards, surrogate standards and check standards.

Pure or Primary Standard grade (reference) materials used for preparation of other standards are only purchased from suppliers capable of providing certificates of analysis or similar proof of purity. Where applicable, EPA certified reference materials or client-supplied certified analytical reference materials are used. All standard materials are marked with the receiving date, lot number and expiration date upon receipt. Expiration dates are checked before any reference material is used within the laboratory. When appropriate, standards are dated with the date they are opened.

Stock solutions are prepared by dissolving known amounts of reference materials(s) in a suitable solvent. Alternatively, stock solutions may be purchased from vendors capable of supplying appropriately certified solutions. Whether prepared in the laboratory or purchased from a suitable source, the following items must be recorded on the bottle containing the stock solution: Contents; Concentration(s); Date prepared (date received if purchased) and Expiration Date.

Other information regarding the stock solution is entered into a standards log book specific to the analysis or area where the analysis is performed. The items recorded in the log book include.

* Preparation procedure
* Solvent used
* Lot number of solvent used
* Source, Purity and Lot number of Reference Material used
* Expiration Date
* Date prepared
* Witness initials
* Concentration(s)
* Analyst's initials

All stock solution preparations are witnessed. The solution is then assayed to assure proper makeup. Once prepared and verified, standards are stored in separate refrigerator/freezer areas away from samples and extracts.

Instrument Calibration

The calibration and standardization procedures for analytical instrumentation is defined in the respective sectional SOPs. The procedures can be modified and revised as required by contractual obligations and special projects. Analytical balances and thermometers are calibrated against NBS, or NBS traceable, materials.

The sectional and method specific SOPS discuss in detail how each instrument is calibrated, including frequency for calibration and re-calibration, and the source or grade of the calibration materials. The range of analyses performed and instrumentation utilized by Inchcape Testing Services - Aquatec Laboratories is extensive and the calibration procedures are instrument specific, varying from analysis to analysis. The calibration procedures usually include an initial system performance check and some type of initial calibration with each analytical series. On-going and closing calibration checks are also included in most analytical series. For each type of calibration standard or performance check there are specific criteria to meet before sample analyses begin. These criteria are established in the methodologies as they are written in the referenced texts or by contract specifications.

Analysis

Detailed descriptions of accepted procedures for the analysis of organic, inorganic, and biological parameters are maintained in the individual laboratory sectional SOPs. Appendix C of this QAPP presents a summary of the methods employed by Aquatec's chemistry and biology laboratories. Detection limits for individual parameters are dependent upon the methodologies employed. Some methods can be modified to achieve desired detection limits to accommodate difficult sample matrices or client specifications.

As stated previously, it is important to the validity of the analytical results that samples be collected and stored in properly prepared containers to eliminate sources of contamination arising from sample containers. Aqueous samples are preserved, chemically or by refrigeration, as specified in EPA methodologies. Soil and sediment samples are unable to be uniformly chemically preserved, therefore the preservation for these samples will be limited to storage at 4°C.

Internal Quality Control Checks

This section describes specific routine procedures used to monitor laboratory method performance and substantiate validation of data. Monitoring procedures include method validations, detection limit studies, and routine analysis of quality control check samples.

Method Validation

Method validation studies are carried out on new methods, new instruments, repaired or serviced instruments, or when dealing with unusual matrices and detection requirements. Method validation is also frequently required for new analysts as part of training procedures. The procedure for method validation is based upon quality control guidelines cited in EPA methods and involves the replicate analysis of at least four check samples. Statistical results from the check sample analyses are compared with acceptability criteria derived within the laboratory or specified within the analytical method. All criteria are met before the method is used to generate reportable data.

Data from initial method validation studies is maintained in files with the Quality Control Officer. Files may also contain method references and SOPs along with any special information pertinent to the validation procedure. Subsequent validation studies are compared and maintained along with the initial study.

Method Detection Limits

Method detection limits (MDLs) are determined in accordance with federal guidelines contained in 40CFR Part 136 Appendix B (revision 1.11). The detection limit is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix. The statistical procedure allows for computation of method detection limits based upon a minimum of seven replicate analyses of a check sample which is prepared at a concentration between 3 and 5 times the estimated MDL. MDL studies are carried out on all pertinent analytical methods on an annual basis.

Method detection limit studies are normally performed during initial method validations or when special detection limits are required. If operating conditions during the course of the year do not require an MDL study for a specific method, a study will be performed at least once per year for most methods to maintain adequate records of the method's performance.

Inorganic instrument detection limits (IDLs) are determined in accordance with EPA CLP procedures outlined in the *Statement of Work for Inorganic Analyses* (Document number ILM02.0). The instrument detection limit is determined by multiplying by 3, the average of the standard deviations obtained on three non-consecutive days from the analysis of a standard solution at a concentration of three to five times the instrument manufacturer's suggested IDL, with seven consecutive measurements per day. IDL's are then calculated by hand. Instrument detection limit studies as applied to inorganic methods such as AA and ICP techniques are determined at least once per quarter or more often if special detection limits are required.

Instrument detection limits are also performed semi-annually for each semi-volatile and volatile instrument for EPA CLP organic analysis. The instrument detection limit studies for organics are based upon a minimum of seven replicate analyses of a check sample. This check sample is at a concentration of three to five times the estimated IDL.

Data Reduction, Validation and Reporting

Each laboratory section provides extensive data review prior to reporting results to the client. In general, there are three levels of review as outlined below. For a complete description of review steps and processes, refer to the sectional SOPs.

The analyst is responsible for primary review of data generated from sample analysis. If the instrument calibration and recoveries of all quality control samples are within specified tolerances, then the data are presented to data reviewers for secondary review. If instrument calibration or the recoveries of any quality control samples exceed specified tolerances, then affected sample results are evaluated and generally the samples are submitted for re-analysis.

Secondary review is conducted by data reviewers to determine if analytical results are acceptable. All calibrations, manual calculations and transcriptions are checked for accuracy and quality control sample results are evaluated against specified tolerances. If instrument calibration and recoveries of all quality control samples are within specified tolerances, then the data are presented to for final review. This third level of review is conducted by senior management personnel, to confirm that there is reasonable agreement in the findings from a technical perspective.

At any time during this review process analytical data may be rejected. When analytical results are complete they are presented in a final report to the client. If discrepancies or deficiencies exist in the analytical results, then corrective action is taken. Periodic audits of final reports by the Quality Assurance Officer will be conducted to determine that precision, accuracy, completeness, and representativeness goals of the sample analyses are being satisfied.

Data Reporting

After all analytical data has been reviewed, the final report can be assembled for submission to the client. Inchcape Testing Services - Aquatec Laboratories offers five levels for reporting analytical results based on Data Quality Objectives (D.Q.O.).

Level I

Level I data consists of measurements taken during field analysis with the report consisting of results only. Since the Vermont facility has a full staff of environmental engineers much of this work may be done in the field including volatile screening with a field GC.

Level II

Level II data requires a specified degree of confidence in the compound identification and quantitation. Compound identification specificity can range from group identification to single compound identification. Level II reporting consists of an analytical report with internal quality control results retained on file.

Level III

Level III data requires a high degree of confidence in the compound identification and quantification. The frequency of QA/QC checks and standardization are often less stringent than for level IV analysis. Level III reporting consists of an analytical report with some internal quality control results reported; these include reference standards, surrogate spike recoveries, and method blank results.

Level IV

Level IV data requires the highest degree of confidence in the compound identification and quantitation. Level IV is defined by the submission of QA/QC supporting material similar to that provided with a CLP Regular Analytical Services Request. The high degree of confidence in the data are achieved by a thorough examination of the raw laboratory data and strict laboratory QA/QC controls. These controls include frequent standardization, spikes, duplicates, blanks, and strict compound identification criteria.

Components of Level IV Data Package

There are five (5) general sections to any Level IV data package. Sections may be added or deleted depending on the scope of work.

Section 1 - Narrative

The information contained in the narrative consists of (a) client name and address; (b) cross reference to Aquatec's ETR #; (c) date of receipt of samples; (d) cross reference of Aquatec's lab number to clients sample ID; (e) a discussion of the analytical work.

Section 2 - Analytical Results

The results of all analyses will be contained in this section including any external quality control as specified by contractual obligations.

Section 3 - Supportive Documentation

This section contains any printouts, chromatograms, and raw data generated from the analyses

Section 4 - Sample Preparation

Extraction sheets, digestion sheets, % solids, logbook pages, and runlog pages are found in this section.

Section 5 - Sample Handling

All documentation accompanying samples such as sample receipt sheets, internal Chain-of-Custody forms, correspondence, and telephone logs.

Once the document is assembled, the sections are distinguished with colored paper with their respective titles. The pages are paginated in numerical order and photocopied. Copy(s) of the documentation are sent to the client, and the original document is retained at Inchcape in storage for a minimum of seven (7) years.

Level V

Level V data has unique requirements in either compound identification, quantitation, detection limits, cleanup or QA/QC requirements. Level V analytical procedures are generally defined through the use of Special Analytical Services (SAS) requests for CLP. The procedures and QA/QC are specified through these requests. The QA/QC for Level V data usually requires frequent standardization, spikes, duplicates, blanks, and strict compound identification criteria.

QUALITY CONTROL

Data Quality Objectives

The data quality objectives discussed below ensure that data will be gathered and presented in accordance with procedures appropriate for its intended use, and that the data will be of known and documented quality able to withstand scientific and legal scrutiny. The quality of the measurement data can be defined in terms of completeness, accuracy, precision, and traceability.

Completeness

Completeness is defined as the percentage of measurements that are judged to be valid measurements. Factors negatively affecting completeness include the following: sample leakage or breakage in transit or during handling, missing prescribed holding times, losing sample during laboratory analysis through accident or improper handling, improper documentation such that traceability is compromised, or rejection of sample results due to failure to conform to QC criteria specifications. A completeness objective of at least 90% of the data specified by the statement of work is the goal established for most projects.

Accuracy

Accuracy is the measure of agreement between an analytical result and its "true" or accepted value. Deviations from a standard value represent a change in the measurement system. Potential sources of deviations include (but are not limited to) the sampling process, sample preservation, sample handling, matrix effects, sample analysis, and data reduction. Sampling accuracy is typically assessed by collecting and analyzing field and trip blanks for the parameters of interest. Analytical laboratory accuracy is determined by comparing results from the analysis of matrix spikes, surrogates, or check standards to their known values. Accuracy results are generally expressed as percent recovery. Accuracy goals are presented in method specifications.

Precision

Precision is the determination of the reproducibility of measurements under a given set of conditions, or a quantitative measure of the variability of a group of measurements compared to their average value. Precision is typically measured by analyzing field duplicates and laboratory duplicates (sample duplicate, matrix spike duplicate, check standard duplicate, and/or laboratory duplicate). Precision is most frequently expressed as standard deviation, percent relative standard deviation, coefficient of variation, or relative percent difference. Precision goals for the parameters to be analyzed are presented in the method specifications.

Traceability

Traceability is the extent to which reported analytical results can be substantiated by supporting documentation. Traceability documentation exists in two essential forms: those which link the quantitation process to authoritative standards, and those which explicitly describe the history of each sample from collection to analysis and disposal. The traceability goal for Aquatec's laboratories is 100%.

Quality Control Measures

This section describes specific routine procedures used to monitor laboratory method performance and substantiate validation of data. Monitoring procedures include the routine analysis of quality control check samples. Controls analyzed in conjunction with samples are essential in the evaluation of the quality of the generated data. The following quality control procedures are employed by the laboratory. Although, in many cases, this satisfies only the minimum requirements, the laboratory is continually working within quality control programs initiated by its clients. These programs may include any of the following quality controls in addition to other project obligations.

The quality control program implemented in the laboratory includes the analysis of method blanks, check standards, analytical spikes, and surrogate spikes. Every analytical series includes some of these controls, depending upon the analysis. The combination of controls used in an analysis must be completely representative of the analytical task including all aspects of sample preparation and sample analysis.

Method Blanks

Sources of contamination in the analytical process, whether a contribution of specific analytes or a source of interferences need to be identified, isolated, and corrected. The intent of the method blank is to identify possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompass all aspects of the analytical work. This will include glassware, reagents, instrumentation, or other sources of contamination that could affect sample analysis. Laboratory section SOPs as well as contractual obligations define the frequency of method blank analysis. A method blank is prepared with each analytical batch. In the absence of a specified frequency, a method blank is analyzed with each analytical series at a frequency of one method blank associated with no more than twenty samples.

The holding blanks associated with volatile organics analyses, whether by GC or GC/MS, is also considered a method blank. The results of the analysis of holding blanks provide an indication of whether any contaminants may have affected the sample during storage at the laboratory. Because of the possibility of cross contamination of samples held in closed storage, a holding blank specific to each group of samples received for volatile analysis will be generated and stored with the samples. These holding blanks will be analyzed for all Level IV samples, and for Level II and III samples when circumstances indicate that there may have been some contamination of the samples during storage at the laboratory.

The analysis of field blanks, trip blanks and equipment blanks, add more insight into interpreting the results of sample analysis. Equipment blanks are generated as part of the sampling process in the field. Field and trip blanks indicate which contaminants may have affected the samples during sampling or in transit to the laboratory. Analysis of these type of blanks are not routine, but they can be performed at a client's request or as specified by a contract or project

Analytical Spikes (Matrix Spikes)

The intent of the analytical spike is to provide insight into the efficiency and proficiency of an analytical series including quantitation standards, sample preparation, instrument set-up, and the premises inherent in quantitation. This control reflects the efficiency of sample analysis within an analytical series while it is less sensitive in reflecting the conditions which are within the control of the analyst. When analytes are spiked directly into the original sample, they are called matrix spikes. Within an analytical series, a representative sample portion is designated as a separate sample and spiked with known concentration(s) of the analyte(s) under consideration. The advantages to this approach lies in the fact that the spiked sample portion is handled and prepared in exactly the same manner as the samples. Sample related interferences affecting an analysis will be reflected in the results from the spiked sample portion. Results of analytical spikes exceeding the specified tolerances need to be evaluated thoroughly in conjunction with other measures of control, and re-analysis of the sample with additional controls or different analytical methodologies may be necessary. The recovery limits of the Matrix Spike and Matrix Spike Duplicate may be set by the use of control charts.

Laboratory Control Samples or Spike Blanks

Laboratory Control Samples (LCS) or spike blank are prepared for each batch. LCS or spike blanks are a control of known composition. LCS contain all the single peak compounds of interest while spike blanks typically contain only the matrix spike compounds. Aqueous and solid laboratory control samples are analyzed using the same sample preparation, reagents, and analytical methods employed for the samples received.

LCS's or Spike Blanks are standards of known concentration and independent in origin from the calibration standards and are available through the U.S. Environmental Protection Agency, the National Bureau of Standards, or commercial sources. The intent of these standards is to provide insight into the proficiency within an analytical series including the preparation of calibration standards, the validity of calibration, sample preparation, instrument set-up, and the premises inherent in quantitation. The results of these standards analysis exceeding specified tolerances may have major implications with respect to the associated sample result, thus requiring the re-extraction/re-analysis of samples. The recovery limits for the LCS or Spike Blank may be determined by control charts.

Surrogate Spikes

Another type of analyte spike is a surrogate spike, which are compounds unlikely to be found in nature that have properties similar to the analytes of interest. This type of control is primarily used in the GC/MS and GC laboratories. The intent of a surrogate spike is to provide broader insight into the proficiency and efficiency of an analytical method on a sample specific basis. This control reflects analytical conditions which may not be attributable to sample matrix. If results of surrogate spike analysis exceed specified tolerances, then the analytical results need to be evaluated thoroughly in conjunction with other control measures, and re-analysis with additional controls or different analytical methodologies may be necessary. In the absence of other control measures, the integrity of the data cannot be verified. Every sample and method blank that goes through an extraction procedure will be spiked with surrogate. The control limits for surrogate spikes are set for each method.

Internal Standards

Internal standard areas are monitored in GC/MS and some GC analyses. The internal standard solution is compromised of several compounds and is spiked into all GC/MS acquisitions with the exception of performance standards (decafluorotriphenylphosphine and p-bromofluorobenzene). The tolerance ranges for the recovery of these compounds are as follows: the area of any compound cannot fall below 50% of its value in the preceding check standard nor can it rise above 100% of its value. Different criteria for control limits may be established in specific methodologies or contractual agreements. If internal standard areas in one or more samples exceeds the specified tolerances, then the instrument will be recalibrated and all affected samples reanalyzed. The control limits for internal standards are set by the individual methods.

Replicate Analysis

Replicate analysis is a measure of analytical precision and can be limited in its scope and application. If used in conjunction with reference standards or analytical spikes, replicate analyses can give a measure of the reliability of the analytical systems. Replicate analyses can be significant in the interpretation of analytical results for samples which have complex matrices. In general replicate analyses are performed for metals and inorganic tests.

Calibration Check Standards

Calibration check standards analyzed within a particular analytical series will provide information about the analytical system's stability. The frequency for analysis of calibration check standards is defined in the methodologies. Calibration check standards are analyzed at the frequencies stated in the methods. For metals, GC, and Wet Chemistry analyses calibration check standards are analyzed at a frequency of 10%, or after every ten samples. For GC/MS analyses the frequency of the calibration check standard is every 12 hours. If results of the calibration check standard exceed specified tolerances, then all samples analyzed since the last acceptable calibration check standard are reanalyzed following corrective action.

Control Limits and Control Charts

The laboratory has the capability to provide laboratory derived limits for clients upon request. The use of control charts is provided in these cases. Limits are based upon at least twenty (20) observations. The warning limits are set at ± 2 standard deviations from the mean with the control limits being set at ± 3 standard deviations from the mean.

When a reference standard value exceeds established limits, careful scrutiny is given to the operating system, standards preparation, and procedures that were used in obtaining the result. The analytical sequence is stopped and appropriate corrective action is taken. All samples analyzed since the last passing reference standard will be reanalyzed following recalibration of the instrument. Permanent records of all reference standard determinations are filed with the Quality Assurance Officer.

Biological Standards

Microbiological Standards

All equipment and supplies used in the microbiological analyses are routinely checked for sterility. Laboratory deionized water is monitored monthly for bacterial densities and required water quality characteristics. If any of the parameters are out of the specified tolerances, the personnel responsible for the deionized water system are notified and corrective action is taken. The laboratory water is tested annually for suitability for culturing bacteria. Glassware is tested annually using the inhibitory test to insure that the glassware cleaning procedures do not inhibit bacterial growth. Bacteria sample containers are prepared in lots and each lot is checked for sterility. If the tested container is not sterile, then all the associated containers will be re-sterilized and re-tested.

A positive and negative control sample is run with each daily set of water quality bacteriological samples. Positive and negative controls are conducted monthly or every ten samples (whichever is more frequent) for all other bacteriological samples. The negative control is conducted using the dilution water appropriate for the test. This dilution water is typically sterile phosphate rinse buffer. The positive control consists of the use of a target bacteria for the specified test, such as Escherichia coli, Salmonella spp., or Enterobacter sp., which are routinely maintained in the laboratory. Positive controls are diluted to an appropriate concentration and are carried through the entire analysis to insure that proper culture conditions are maintained. If the results of the negative or positive control samples indicate contamination or culture problems, then all affected samples will be re-sampled and reanalyzed.

Bioassay Standards

The sensitivity of the lineages of all test organisms used in the bioassay studies are routinely evaluated using reference toxicants obtained from USEPA Quality Assurance Program and/or internal toxicant standards. Test organism sensitivities are compared to specified tolerances. Fresh and saltwater test organisms cultured in our laboratory are maintained under the recommended environmental conditions and monitored daily by laboratory personnel.

In accordance with toxicity testing methods, each test concentration and control samples are analyzed in replicate. A control sample consisting of the dilution water used in the toxicity test are analyzed with every test series. If the response of the control test organisms are outside control limits, the test conditions are scrutinized for out-of-control situations. The response of the control test organisms and the test conditions are reported with each toxicity test. The interpretation of the response and test conditions may influence the final report. If the test is judged by the Biological Laboratory Director as unacceptable due to organism response and/or laboratory conditions, the test results will be rejected and a new sample analyzed.

Software Quality Control

Inchcape's Information Systems Department develops software for data reduction and reporting. Software programs are requested and specified by the laboratory in terms of valid assumptions, calculations, and presentation of data. All software requests are presented to the Laboratory Director who will evaluate the request in terms of applicability and pass it on to Information Systems personnel. After the programs are developed, but before they are put into general use by the laboratory, they are checked and approved by a laboratory representative. Once the programs have been approved, they are introduced to the laboratory personnel and the appropriate SOPs are updated to reflect changes in procedures for an analytical method. Records of all software requests, developments, improvements, and approvals are filed in the project files.

Audits

Audits from Regulatory Agencies

As a participant in state and federal certification programs, the laboratory sections at Inchcape are audited by representatives of the regulatory agency issuing certification. Audits are usually conducted on an annual basis and focus on laboratory conformance to the specific program protocols for which the lab is seeking certification. The auditor reviews sample handling and tracking documentation, analytical methodologies, analytical supportive documentation, and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action.

Internal Audits

All laboratory sections of the Chemistry Division at Aquatec are required to participate in periodic internal audits which are administered by the Quality Assurance Officer. The findings of these audits are formally documented and submitted to the Laboratory Director and to the General Manager. The Laboratory Director will have the responsibility for resolving points at issue or for effecting necessary changes to the laboratory's practices.

The audit program focuses on the following areas:

- Maintenance of acceptable and complete SOPs in company format.
- Maintenance of training records.
- Maintenance of notebooks.
- Maintenance of instrument records.
- Evaluation of standards control records.
- Evaluation of sample handling procedures.
- Evaluation of data handling and storage procedures.

Audit Response

The laboratory is required to respond with corrective action to the audit findings and recommendations of the regulatory agencies before certification for a particular program can be granted. If a recommendation is related to document format (for example, laboratory name is absent from a pre-printed benchsheet), then the laboratory personnel will revise the document format and a copy of the revised document format will be submitted to the appropriate representatives of the regulatory agency. If a recommendation is related to an actual procedure (for example, error correction), then the recommendation will be communicated to the laboratory personnel informing them of the correct procedure and a record of this communication will be submitted to the appropriate representatives of the regulatory agency. If a recommendation is related to the written procedures (for example, written SOPs), then the laboratory personnel will revise the written SOPs and a copy of the new SOPs will be submitted to the appropriate representatives of the regulatory agency. The Laboratory Quality Assurance Officer will conduct a follow-up audit to verify that corrective action has been implemented within one to two weeks of the audit report. Observations made during this follow-up audit will be submitted to the appropriate representatives of the regulatory agency.

Corrective Action

When deficiencies or out-of-control situations exist, the Quality Assurance Program provides a means of detecting and correcting these situations. Samples analyzed during out-of-control situations are reanalyzed prior to reporting of results. There are several levels of out-of-control situations that may occur in the laboratory during analysis.

A Corrective Action Report, Aquatec Form F-0089 (Figure 12), will be completed and filed for situations which represent either singular or systematic quality assurance problems. For example, samples broken in transit to the laboratory, missed holding times, suspect standard/reagent lot, non-compliant calibration, or software problems will be documented on these reports. The culmination of all corrective action reports for a particular sample set will be used to assist the project director in preparing a narrative to accompany the sample delivery group.

The individual responsible for detecting the corrective action will initiate the report. For example, if samples were broken in transit, then the sample custodian unpacking the cooler would initiate the report. If the person initiating the report is uncertain as to what would constitute appropriate corrective action for the situation, then they could identify the problem and submit the incomplete report to the Quality Assurance Officer for resolution. Incomplete corrective action reports that involve two or more laboratory sections should also be brought to the attention of the Quality Assurance Officer to recommend corrective action in several laboratory sections.

Copies of all corrective action reports will be submitted to the Quality Assurance Officer for review. The original corrective action reports will be filed with the Quality Assurance Officer. Copies of corrective action reports that are specific to a sample or set of samples will be filed with the sample documentation.

Bench Level

Corrective action procedures are often handled at the bench level. If an analyst finds a non-linear response during calibration of an instrument, then the instrument is recalibrated

F - 0089

INCHCAPE TESTING SERVICES - AQUATEC LABORATORIES
CORRECTIVE ACTION REPORT

Fraction: ______________________ Contract: ______________________
Date: ________________ Case: ______________________
Initiated by: ______________________ SDG: ______________________

Summary of Problem:

Summary of Investigation and Findings:

Resolution/Recommended Corrective Action:

Date of Implementation: ____________________

Follow - up

Date: ____________________
Follow-up by: ____________________

Follow-up Findings:

Figure 12

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before sample analysis commences. The instrument will also be recalibrated if reference or internal standard results are outside of specified tolerances. The problems are often corrected by a careful examination of the preparation or extraction procedure, spike and calibration mixes, or instrument sensitivity. If the problem persists, it is brought to the attention of management personnel.

Management Level

If resolution at the bench level was not achieved or a deficiency is detected after the data has left the bench level, then corrective action becomes the responsibility of the Laboratory Section Head or Laboratory Director. Unacceptable matrix or surrogate spike recoveries detected by data review groups are reported to the Laboratory Section Head. A decision to reanalyze the sample or report the results is made depending on the circumstances of the sample and analysis. Documentation procedures for sample re-analysis are initiated at this point if necessary.

Receiving Level

If discrepancies exist in either the documentation of a sample or its container, a decision must be made after consulting with the appropriate management personnel. Examples of container discrepancies are broken samples, inappropriate containers, or improper preservation. In these cases, corrective action involves the Project Director contacting the client to resolve the problems. All resolutions must be fully documented and filed with the sample results.

Statistical Events

An out-of-control situation is defined as data exceeding control limits, unacceptable trends detected in the charts, or unusual changes in the instrument detection limits. When these situations arise, it is brought to the attention of the Laboratory Section Head or Laboratory Director who will initiate the appropriate corrective action. Corrective action may take the form of instrument maintenance, recalibration, or re-analysis of the sample.

Customer Feedback

If a client or validator has a question or finds a deficiency concerning the data submittal, the Project Director, is responsible for communicating and implementing the corrective action in the laboratory. The analytical results and all supportive documentation in question are submitted to the appropriate section for evaluation. Should a reanalysis be necessary it will be initiated if the sample is still available. If revisions are necessary, corrections are made, page(s) are renumbered, initialed and dated.

Hard copies and revised electronic deliverables (where applicable) are given to the Project Director for re-submission to the client or validator. Revision of the case narrative should it become necessary is the responsibility of the Project Director. In some instances, clients request that sample handling information, recalculations or qualitative judgements are re-checked in order to ensure data integrity. In this case, resubmission of the data may not be necessary unless a problem is found.

Customer problems that persist in the laboratory are brought to the attention of the Laboratory Operations Director by the Project Director.

Inter-laboratory Testing

The analytical laboratory participates in the EPA inter-laboratory performance evaluation program for water (WS) and wastewater (WP) in addition to evaluations conducted by the state of New York. In some cases, extenuating circumstances will require more frequent evaluations.

Inventory Procedures

Purchasing guidelines for all equipment and reagents effecting data quality are well defined and documented in the sectional SOPs. Similarly, performance specifications are documented for all items of equipment having an effect on data quality. Any item critical to the analysis, such as an instrument or reagent, received and accepted by the organization is documented. This includes type, age, and acceptance status of the item. Reagents are dated upon receipt to establish their order of use and to minimize the possibility of exceeding their shelf life.

Requests for equipment affecting the quality of analytical data will be submitted in writing to the Laboratory Director for technical approval. After approval, the requisition will be submitted to the General Manager for purchase approval.

STORAGE OF RECORDS

Data Storage

Level II and III Data

Worksheets containing the supportive documentation for level II and III analyses are stored by method number in the file cabinets for one year. After this time period, the worksheets are placed in cardboard boxes. These boxes are labeled and stored for a minimum of seven (7) years.

Level IV Data

The completed data package including supportive documentation for level IV data is packed in a cardboard file box and retained at Aquatec for a minimum of seven (7) years. Every box is assigned a unique identification number which is logged into a database to record the location and contents of each box for easy retrieval. If requested, data can be stored for longer periods of time. Requests for extended storage should be placed at the beginning of the project if possible.

Storage of Tapes

Magnetic computer tapes are stored in the environmentally controlled computer room. Corresponding tape streamer logbooks are maintained for a minimum of seven (7) years.

Sample Disposal

Aquatec's sample management department is supervised by a waste specialist who oversees the storage and disposal of all samples. Unused sample portions and extracts are stored for the amount of time specified by contractual obligations and project specifications after the submission of the data package. When their storage period expires, the samples are removed from the refrigerator/freezer and stored in a secured storage area. All unused sample portions removed from the refrigerators are drummed, packed, and disposed of as if they were hazardous waste regardless of the results of the analyses.

Each of the Vermont facilities has a hazardous waste storage room containing 55 gallon drums for sorting and packing lab waste. Once packed according to specifications outlined in Federal Regulations and Department of Transportation regulations, an approved hazardous waste hauler is contracted to periodically transport the waste to an appropriate facility.

A complete discussion of the storage and disposal procedures for laboratory waste generated at Aquatec is included in Appendix B of this document.

Laboratory Documentation

Workbooks, bench sheets, instrument logbooks, and instrument printouts, are used to trace the history of samples through the analytical process and to document and relate important aspects of the work, including the associated quality controls. All logbooks, bench sheets, instrument logs, and instrument printouts are part of the permanent record of the laboratory. Completed workbooks and instrument logbooks are submitted to the Data Review Groups for review and then to the Document Control group for storage.

Each page or, as required, each entry is to be dated and initialed by the analyst at the time the record is made. Errors in entry are to be crossed out in indelible ink with a single stroke and corrected without the use of white-out or by obliterating or writing directly over the erroneous entry. All corrections are to be initialed and dated by the individual making the correction. Pages inserted into logbooks are to be stapled to a clean, bound page. The analyst's initials are to be recorded in such a manner that the initials overlap the inserted page and the bound page. A piece of non-removable transparent tape is then to be placed over the initials as a seal. Pages of logbooks that are not completed as part of normal record keeping should be completed by lining out unused portions. Specific information on the types of logbooks, format of entry, and other pertinent information are contained in the appropriate sectional SOPs.

Laboratory notebooks are periodically reviewed by the Laboratory Section Heads for accuracy, completeness, and compliance to this QAPP. If all entries on the pages are correct, then the Laboratory Section Head initials and dates the pages. Corrective action is taken for erroneous entries before the Laboratory Section Head signs off with their approval.

STANDARD OPERATING PROCEDURES AND DOCUMENT CONTROL

Standard Operating Procedures

Inchcape Testing Services maintains a Standard Operating Procedure (SOP) for every analytical procedure routinely performed within the laboratory. The SOP is formatted depending upon the specific type of analyses involved but uniformly contains the following minimum components:

- Description of the Method
- Materials and Equipment
- Reagents
- Sample Preparation
- Specific Procedural Steps
- Calculations
- Quality Control Requirements

The principal purpose of the Standard Operating Procedure (SOP) is to provide consistent documentation of analytical procedures so that uniform methods are applied. The SOP provides information on traceability of standards, instrumental functions, and analytical processes and is especially beneficial during the training process for new personnel. SOPs also provide basic descriptions of the actual analytical procedures for purposes of comparison between laboratories or between related methods.

Method cards are written procedures for standardized methods (i.e. SW-846, EPA-600 methods) and are supplied primarily to document specific laboratory procedures used to satisfy the general requirements specified in the individual methods and to explain any differences between the application of the established method and the published procedure. If any difference exists between Inchcape's SOP and a standard method's specific procedures, method validation studies are performed to document the fact that the change does not adversely affect the applicability of the method. In general, every effort is made to adhere to the protocols of the standard method.

SOPs are controlled documents. Each sectional SOP undergoes a review on at least an annual basis. A master copy of each document is maintained by the QA Officer. This master copy bears the approval signatures of the QA Officer, the Laboratory Director, and the Section Head appropriate for the area where the SOP volume will be used. Controlled copies are

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available from the QA Officer. When requesting copies of SOPs, please specify the complete analytical method reference.

Document Control

Security and control of documents is necessary to insure that confidential information is not distributed and to make sure that all current copies of a given document are from the latest applicable revision. Controlled documents have a header placed in the upper right hand corner of each page. This header provides enough information to unambiguously identify each page as part of a single compiled document. In some cases, the information may be distributed elsewhere in the margins of the page in order to facilitate readability but, at a minimum, the following information will be supplied:

Document Name:
Revision Number:
Revision Date:
Page ___ of ___

The following documents for Inchcape Testing Services are controlled by the Vermont Facilities QA Officer:

Quality Assurance Program Plan

Quality Assurance Project Plans

Safety Manual

Standard Operating Procedures

Documents are controlled at the Inchcape Testing Services Vermont Facilities through means of a colored stamp marking process combined with a registration and circulation record for controlled documents. The following stamp is used to mark the approval pages plus any other pages considered critical to the document integrity:

CONTROLLED DOCUMENT
COPY No. ______________
DO NOT DUPLICATE
If this stamp is not colored red,
this is not a controlled copy.

The unstamped originals of the controlled documents are maintained by the QA Officer. Every time a controlled copy is produced from a master document, it is stamped and tracked using the Document Control Inventory Form (F-0127) shown in Figure 13. Revisions of documents are distributed only to the original recipients of controlled copies as noted in the inventory forms. All recipients will be requested to either destroy out-dated copies or, in some cases, to return them before the revision can be issued.

DOCUMENT CONT - INVENTORY

DOCUMENT ____________

CLIENT NAME/ LOCATION	COMPANY	RELEASED TO:	DATE RELEASED	REVISION NUMBER	COPY NUMBER	PAGES COPIED

EGEND: (M) - Master Copy, located in QA/QC Office.

Document SOP - Standard Operating Procedure document only
QAM - Quality Assurance Manual
QAPP - Quality Assurance Program Plan
QAPjP - Quality Assurance Project Plan
CQAP - Corporate Quality Assurance Plan

Figure 13

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APPENDIX A: Resumes of Key Personnel, Qualifications of Personnel

Key Personnel

Resumes for the following specific key personnel are included in the following pages. Concise educational and experience profiles for the entire laboratory are also provided.

Lori T. Arnold-
Project Director

Kristine L. Aubin -
Metals Laboratory Section Head

Roger C. Binkerd, P.E. -
Environmental Division Head

Joseph A. Blersch, Ph.D. -
GC Senior Scientist

Karen R. Chirgwin -
Chemistry Laboratory Operations Director

Joseph K. Comeau, Ph.D. -
ITS Vice President, Technical Division

Philip C. Downey, Ph.D. -
Director of Biology

Joseph Edwin, Ph.D. -
Organic Data Review

Peter N. Gale - Project Director

Deborah H. Gaynor, Ph.D. -
CP GC/MS Laboratory Section Head

Richard T. Gomez - Project Director

David M. Hardwick -
Wet Chemistry Laboratory Section Head

Michael T. Hewlett -
Sample Management Section Head

H. Gregory Johnston -
Director of Information Services

James W. Madison - Project Director

Pauline T. Malik -
Director of Sales and Marketing

R. Mason McNeer, Ph.D. -
Senior Scientist

Brian D. Moffat -
Biology QA Officer

Joseph J. Orsini, Ph.D. -
Asst. Laboratory Operations Director

Mark T. Phillips -
GMD Extraction Laboratory Section Head

David S. Robinson -
Business Development

Martha E. Roy -
Quality Assurance Officer

Gary B. Stidsen -
GC Laboratory Section Head

Scot P. Swanborn - Project Director

Neal E. Van Wyck -
General Manager

John W. Williams -
Manager of Toxicological Services

Kirk F. Young, P.E. -
GMD GC/MS Laboratory Section Head

Jon K. Zygmuntowicz -
CP Extraction Laboratory Section Head

Inchcape Testing Services
Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

LORI T. ARNOLD

Current Position: **Project Director, Inchcape Testing Services/Aquatec Laboratories - Colchester, Vermont, 1995 to present.**

Ms. Arnold serves as the director of several large analytical support projects on behalf of premier engineering firms and corporate clients. She also serves as one of Aquatec's customer service representatives for the Chemistry Division, successfully providing assistance and guidance to existing and potential clients through the integration of her laboratory experience with a sound working knowledge of current EPA methodologies and environmental regulations.

Previous Experience: **Quality Control Specialist, Chemist, Inchcape Testing Services/Aquatec Laboratories - Colchester, Vermont, August 1991 to 1995**

Responsible for the review and validation of volatile and semi-volatile organic GC/MS data. Methods of analyses followed include U.S. EPA 500, 600, and SW846, U.S. EPA Contract Laboratory Program (CLP) protocols, and methods established by the State of New York. Responsibilities include generating report forms, assembling data packages, and electronic diskette deliverables.

Chemist/Expert Witness, Vermont Department of Health Laboratory, Burlington, Vermont, December 1990 - August 1991

Performed blood alcohol concentration (BAC) determinations on breath samples using a Mark IV Gas Chromatograph Intoximeter. Provided expert witness testimony in driving while intoxicated (DWI) court trials. Installed, certified, and maintained thirty National Patent Datamaster infrared breath analyzers throughout the state. Screened drinking water samples for priority pollutants using purge and trap methods.

Gas Chromatography Data Review Supervisor, Aquatec, Inc., Colchester, Vermont, April 1988 - October 1990

Directed the review, validation, and publication of gas chromatography data. Established quality assurance measures and evaluated analytical data for both technical and contractual performance. Analytical data commonly reviewed included U.S. EPA 500, 600, 8000 methods, CLP, and contracted New York State methods.

Previous Experience (continued): **Chemist, September 1985 - April 1988**

Responsible for the operation and maintenance of Hewlett Packard gas chromatographs in the analyses of volatile and non-volatile priority pollutants in air, water, soil, and other miscellaneous samples. Sample analyses involved sample preparation, standard preparation, and development of analytical procedures.

Laboratory Technician, Spectrum Laboratory, Inc., Montpelier, Vermont, June to September 1985

Performed wet chemistry analyses for the following parameters: B.O.D., C.O.D., ph, phosphate, total Kjeldahl nitrogen, and cyanide. This position also included microbiological testing and sample collection/compositing at municipal wastewater treatment facilities.

Education: Bachelor of Arts in Chemistry, University of Vermont, Burlington, Vermont, June 1985

Professional Courses:

Mass Spectral Interpretation, P.A.C.S.	June, 1994
Capillary Chromatography Training, Restek Corporation	March, 1995

Inchcape Testing Services
Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

KRISTINE L. AUBIN

Current Position: **Metals Laboratory Section Head/Inchcape Testing Services/Aquatec Laboratories - Colchester, Vermont, 1994-present**

Ms. Aubin is responsible for coordinating the overall activities of the metals laboratory on a daily basis and providing direction. Responsibilities include scheduling work and coordinating with Project Directors to ensure that client and project objectives are met. She is also responsible for the final review and reporting of all inorganic data (wet chemistry and metals).

Previous Experience: **Data Review and Report Preparation, Aquatec Laboratories - 1989 to 1995**

Ms. Aubin is responsible for the review of data generated by the inorganic laboratory. She checks all calculations and summary forms generated by the analysts. She is responsible for knowing US EPA Contract Laboratory Program, ILM01 and SW846 methods and assuring those methods are properly performed by the analysts. Ms. Aubin also coordinates the completion of laboratory results and supportive documentation in order to assemble corresponding data packages.

Chemist, Aquatec Laboratories, Colchester, Vermont, 1987-1988

Ms. Aubin was responsible for analyzing samples on the Perkin-Elmer 5000 and Zeeman 3030B AA/graphite furnaces and the Perkin-Elmer Inductively Coupled Plasma (ICP) analyzer. She was also responsible for interpretation of raw data from these instruments and quantitation calculations which she reported using the US EPA Contract Laboratory Program and SW846 methods.

During this time, Ms. Aubin was responsible for inorganic sample preparation including EPTOX sample preparation. She was also responsible for mercury analysis using a Perkin-Elmer 306 analyzer.

Education: Bachelor of Science in Biochemistry/Biophysics, State University of New York at Plattsburgh, Plattsburgh, NY, 1987

Specialized Training: Ward Scientific Training for Contract Laboratory Program (CLP), 1990

Professional Associations: American Chemical Society, past member

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55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

ROGER C. BINKERD, P.E.

Current Position: **Vice President, Environmental Division, Inchcape Testing Services/ Aquatec Laboratories - Colchester, Vermont, 1985 to present.**

Mr. Binkerd has had U.S. EPA courses on risk assessment, sampling, remediation and mitigation alternatives, and specialized courses in groundwater. With these specific courses and his previous broad background in environmental issues, Mr. Binkerd manages response operations and investigations at hazardous waste sites. These investigations range from preliminary assessments to remedial investigations and feasibility studies.

Previous Experience: **Environmental Division Head, Aquatec Laboratories, Inc., 1978-1985**

During these years, analysis included environmental impacts related to hydroelectric power station operation and discharge of oxygen consuming waste from sewage treatment plants. The emphasis on oxygen dynamics included physical effects and also those related to biological processes. Relationships between physical, chemical, and biological components of complex systems were investigated using computer models for impact determination for projects ranging from sewage discharge into mountain streams in Vermont to discharge of tailings from mining operations in Alaska. During this period, a major environmental investigation was conducted that resulted in a NPDES discharge permit for Vermont Yankee, which increased their net generation by 175,000 MW-hr per year. Mr. Binkerd was appointed Vice President of the Environmental Division in 1982.

Engineer, Aquatec Laboratories, Inc., 1974-1978

Mr. Binkerd has had extensive experience in hydrographics and dye diffusion studies throughout the east coast and northeast, working on headwater streams, rivers, reservoirs, estuarine, and near coastal environments. This work is ongoing; for example, in 1990, operational studies were conducted at Seabrook, New Hampshire to investigate the thermal plumes from a nuclear power station; in 1991, dye was used to simulate the transport of PCBs in New Bedford Harbor; and in 1992, dye was used to investigate combined sewage overflow discharge into Boston Harbor.

Previous Experience (Continued): **Engineer, Stone & Webster Engineering Corporation, Boston, Massachusetts, 1972-1974**

During these two years, Mr. Binkerd was responsible for the environmental engineering design of intake and discharge facilities for circulating water for condenser cooling. He worked closely with experts from M.I.T. on final diffuser design using analytical and physical model studies for the Maine Yankee Nuclear Power Station.

Volunteer, Peace Corps, Africa, 1967-1969

Education:

Master of Science in Ocean Engineering University of Rhode Island	1972
Bachelor of Science Civil Engineering Worcester Polytechnic Institute	1967

Professional Certifications: Professional Engineer, Vermont, No. 3338
Professional Engineer, New Hampshire, No. 6689

Specialized Training:

Dive Master, NAUI	1992
U.S. Coast Guard Marine and Inland Water License	1991
Lakes Modeling Short Course, NEIWPCC	1989
Waste Testing and Quality Assurance Symposium, EPA	1988
Groundwater Pollution and Hydrology, Princeton Associates	1986
Instream Flow Incremental Methodology (IFG-200)	1984
Emergency Medical Technician-Ambulance Course	1980
CPR & Advanced First Aid	Current

U.S. EPA Specialized Training:	Risk Assessment Guidance for Superfund, EPA Course 165.06	1990
	Response Safety Decision-Making, EPA Course 165.8	1987
	Hazardous Materials Incident Response Operations, EPA Course 165.5	1986
	Incident Mitigation & Treatment Methods, EPA Course 165.3	1986

Professional Associations:
American Society of Limnology and Oceanography, Inc.
The Marine Technology Society
The Hydrographic Society
Hazardous Materials Control Research Institute

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JOSEPH A. BLERSCH, PH.D.

Current Position: **Chemist, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1991 to present**

Dr. Blersch is experienced in several types of analytical techniques including Gas Chromatography (GC), Pesticide/PCB, volatile, and GC/Ion trap methods. He is familiar with EPA 8000, 600, and 500 series methods as well as EPA OLM01 procedures. Other responsibilities include data review, troubleshooting and maintenance of analytical instrumentation, and preparation of Level 4 data reporting forms. He has recently been involved in the method development for PCB congeners for GC/ion trap detection.

Previous Experience: **Postdoctoral Research Associate, University of Vermont, Burlington, Vermont, 1990-1991**

Dr. Blersch performed Raman spectroscopy and computational chemistry.

Visiting Assistant Professor of Chemistry, Hamilton College, Clinton, New York, 1989-1990

Taught undergraduate physical chemistry including thermodynamics, statistical thermodynamics and kinetics Advanced laboratory techniques, an integrated laboratory course including topics in instrumentation, organic, and inorganic synthesis, and physical chemistry.

Teaching Assistant, University of Vermont, Burlington, Vermont, 1983-1988

He taught general organic and physical chemistry.

Education: Doctor of Philosophy in Physical Chemistry, University of Vermont, Burlington, Vermont, 1989

Bachelor of Science in Natural Science, Daemen College, 1980

Relevant Course Work: While an undergraduate, Dr. Blersch studied mercury content in soil, fish, and water by cold-vapor atomic absorption spectroscopy.

Specialized Training: Mass Spectral Interpretation, Professional Analytical and Consulting Services, Inc., June, 1994.

Publications: Bugay, D.E., C.H. Bushweller, C.T. Danehey, Jr., S. Hoogasian, J.A. Blersch, and W.R. Leenstra. "A Complimentary IR/NMR Approach for the Determination of IR Extinction Coefficients and Thermodynamic Parameters for Conformers in Rapid Equilibrium. The Halocyclohexanes." J. Phys. Chem., 1989, 93, 3908.

Blersch, J.A., K. Vinodgopal, and W.R. Leenstra. "Secondary Structure Equilibrium in Bilirubin", accepted for publication in J. Chem. Soc. Chem. Comm.

Blersch, J.A., and W.R. Leenstra. "Secondary Solution Structure and Localization of Triplet State Excitation in Bilirubin." Accepted with revisions for publication in J. Am. Chem. Soc.

Blersch, J.A., and W.R. Leenstra. "A MNDO Computational Study of Bilirubin and Half-Bilirubin." In Preparation.

Blersch, J.A., and W.R. Leenstra. "ODMR Investigation of the Structural and Configurational Photoisomerization of Bilirubin," presented at the 192nd ACS National Meeting in Anaheim, California, September 1986. (Paper 118)

Blersch, J.A., and W.R. Leenstra. "Secondary Solution Structure and Localization of Triplet State Excitation in Bilirubin, " presented at the 17th Northeast Regional Meeting of the ACS in Rochester, New York, November 1987. (Paper 369)

Blersch, J.A., and W.R. Leenstra. "A Fluorescence and ODMR Spectroscopic Study of Structural and Triplet State Features of Bilirubin," presented at the Photochemistry and Spectroscopy in Medicine Symposium, Worchester Polytechnic Institute, October 1988.

Blersch, J.A., and W.R. Leenstra. "MNDO Calculations on Half-Bilirubin," presented at the Photochemistry and Spectroscopy in Organized Media Symposium, Worchester Polytechnic Institute, October 1990. (Paper P-7)

Blersch, J.A., and W.R. Leenstra. "MNDO Calculations on Half-Bilirubin," presented at the 201st ACS National Meeting, Atlanta, Georgia, April 1991.

Inchcape Testing Services
Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

KAREN R. CHIRGWIN

Current Position: **Laboratory Operations Director, Inchcape Testing / Aquatec Laboratories - Colchester, Vermont, June 1993 to present.**

Responsible for coordinating the overall activities of the analytical laboratories on a daily basis and providing long-term direction. Responsibilities include scheduling and execution of analytical testing as well as developing any neccessary corrective action procedures. Ms. Chirgwin is responsible for all laboratory personnel and for the release of testing data and results.

Previous Experience: Quality Assurance Officer, Aquatec Laboratories, Inc., 1989-1993

As Quality Assurance Officer, Ms. Chirgwin is responsible for the continuous development and implementation of the Quality Assurance Program for inorganic and organic analyses of environmental samples. She prepares and maintains the Laboratory Quality Assurance Program Plan (QAPP), the Quality Assurance Project Plan (QAPjP), and work plans for large environmental projects. Other responsibilities include participating in and responding to audits from government and regulatory agencies, conducting audits of the laboratory, and monitoring the use of quality controls within the laboratory sections. In addition, she oversees the development, revision, and implementation of Aquatec's standard operating procedures.

Analytical Chemist 1987-1989

Ms. Chirgwin analyzed volatile and semivolatile organic contaminants in environmental samples. She performed analyses by using GC/MS methodologies including EPA 500, 600, SW846, and EPA and New York State Contract Laboratory Protocols (CLP).

Graduate Teaching Fellow, University of Vermont - Department of Mathematics and Statistics, Burlington, Vermont 1986-1988

Ms. Chirgwin's responsibilities included lecturing, preparing exams, and grading students in introductory level statistics courses.

Previous Experience (Continued): Environmental Science, Inc., Middletown, Connecticut, Analytical Chemist 1986

She prepared and analyzed environmental samples for inorganic contaminants using atomic spectroscopy and conventional wet chemistry methods. She also developed and implemented a program for total halogen analysis in contaminated oil samples, using the Parr Bomb, for 45-50 samples daily. She supported the organic chemists by preparing BNA extracts for analysis by GC/MS and setting up autosampler runs for GC analysis of PCBs and VOAs in contaminated oil samples.

Education: Master of Science in Biostatistics,University of Vermont,Burlington, Vermont 1988.

Bachelor of Arts in Biology with a second major in Mathematics ,University of Vermont, Burlington, Vermont 1985.

JOSEPH K. COMEAU, PH.D.

Current Position: **Vice President, Technical Director of Inchcape Testing Services, Andover, Massachusetts June, 1993-Present**

Dr. Comeau is responsible for the transfer of technical capabilities and assuring consistent excellence between the laboratories. He is the chair of the Corporate QA committee and manages the blind interlaboratory performance studies for the organization. He assists in the training of personnel at individual laboratory locations in all operational aspects. In addition, Dr. Comeau provides a national presence for technical issues within the industry and regulatory agencies. He is currently involved in consultation on Gas Chromatography, GC/MS, industrial waste treatment, high purity water production, process control and technical insurance matters. He is active in trace mass spectrometry and congener analysis of PCBs and PAHs.

Previous Experience: **Vice President, Aquatec, Inc., Colchester, Vermont 1985 to 1993**

Dr. Comeau was responsible for the continuous growth and expansion of Aquatec's analytical capabilities. As Vice President of the Chemistry Division, he was responsible for overall work flow and project direction for a group of one hundred scientists and technicians. His duties included goal setting, resource planning, staffing and client contact. He was also active in method design and implementation.

Laboratory Director, Aquatec, Inc., Colchester, Vermont, 1976 to 1990

Dr. Comeau was responsible for all technical aspects leading to Aquatec's entry into the EPA organic Contract Laboratory Program (CLP) in 1983. He was responsible for development of technology for gas chromatography and GC/MS

Chemist, Aquatec, Inc., Colchester, Vermont, 1973 to 1976

Dr. Comeau was responsible for performing conventional inorganic and metals analyses. In addition, he supported Aquatec's Environmental Division for establishing, monitoring, and maintaining field analytical systems for various projects. These projects encompassed a geographical region ranging from Florida to Alaska.

Previous Experience: (Continued):	**Vermont Water Resources Laboratory, Montpelier, Vermont, Summer1972**	
	Chemist	
	Ayerst Laboratories, Rouses Point, New York Summers 1965-1971	
	Chemist	
Education:	Ph.D in Analytical Chemistry State University of New York	1975
	Bachelor of Science in Chemistry Manhattan College	1968
Specialized Training:	Restek Expert Gas Chromatogtaphy Course with Konrad Grob	1994
	Incos Applications Programming, Finnigan Institute	1985
	Infrared Spectroscopy, Perkin Elmer Corporation	1981
	Infrared Data Station Operation, Perkin Elmer Corporation	1981
	Capillary Chromatography for GC/MS, Finnigan Institute	1980
	Analysis of Priority Pollutants, Finnigan Institute	1980
	Miniranger Operation and Electronic Maintenance, Motorola Government Electronics Division	1975
	Other: General Radiotelephone Operator License	1987
Professional Associations:	American Chemical Society	

Expert
Witness
Experience: **New York State Department of Law, 1988-1992**

Various civil and criminal cases involving laboratory analysis of environmental samples.

USEPA, 1988-1989

Depositions and Testimony on New Bedford Harbor Food Chain Modelling Data.

Massachusetts Attorney General's Office, 1990

Natural Resource Damage Assessment in New Bedford Harbor.

New York State of Environmental Conservation, 1986-1992

Various civil and criminal cases involving laboratory analysis of environmental samples.

Private 1983-1992

Cases dealing with formaldehyde, defective building materials, tire related problems leading to an accident, product contamination, negligence in industrial processes relating to reverse osmosis.

Publications: Krol, G., G. Boyden, R. Moody, B. Kho, and J. Comeau. "Thin Layer Separation and Detection of Free Estrogens," J. Chromatogr. 61, 1971.

Bruckenstein, S., and J. Comeau. "Electrochemical Mass Spectrometry," Intermediates in Electrochemical Reactions, The Chemical Society, Faraday Division 56, 1973.

Proposed Methods for Treatment of Plating Waste Discharge. Prepared for Fairbanks-Morse Weighing Systems, Division of the Colt Industries Operating Corporation, 1974.

A Study of the Anodic Behavior of Propane Using Techniques of Electrochemical Mass Spectrometry, Ph.D. Thesis, SUNY at Buffalo, 1975.

Chemical Characterization and Treatability Study of Industrial Waste Effluent. Prepared for RCA Corporation, Mountaintop, PA, 1975.

Publications:
(Continued): Binkerd, R., H.G. Johnston, and J.K. Comeau. Physical Impact Evaluation of the Discharge of Heated Water from the C.P. Crane Generating Station. Prepared for State of Maryland Department of Natural Resources, 1978.

Physical Impact Evaluation of Chalk Point Generating Station's Cooling Water System of the Patuxent River. Prepared for the State of Maryland Department of Natural Resources, 1979.

The Analysis of Fish for Trace Organic Contaminants Using Liquid Chromatography and Capillary GC/MS. Prepared for the State of Vermont Department of Health, 1981.

The Analysis of Polynuclear Aromatic Hydrocarbons in the Burlington Barge Canal Using Liquid Chromatography and Capillary GC/MS. Prepared for the State of Vermont Department of Health, 1981.

Identification and Quantification of PCB's As Isomer Groups by Gas Chromatography/Electron Capture Detection on Low Level Extracts. Prepared for EPA Region 1, 1986.

Standard Operating Procedures for Sample Preparation and Analysis for PCB

Congeners in Water, Sediment and Particulates Samples, prepared for Phase 2A

Remediation Investigation Studies of the Hudson River under contract 68-S9 - 2001 with TAMS Consultants Inc., 1992

Downey, P.C., Comeau, J.K., Binkerd, R.C. and Williams, J.W., Bioaccumulation of Selected Organic Compounds in Mussels Deployed near Deer Island Discharge and In Massachusetts Bay, Environmental Quality Department Technical Report Series No. 93-8, Massachusetts Water Resources Authority, Boston, MA 02129, April 1993

Comeau, J and Stidsen, G, Environmentally Altered PCBs, Analytical Issues *The Inchcape Edge* , Issue 2, 1994

Maney, J., Miller, G., Comeau, J. et al, "Misidentification of Organophosphate Esters during GC and GC/MS Analysis", Environmental Science and Technology, to be published Aug. 1995

Inchcape Testing Services
Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

PHILIP C. DOWNEY, Ph.D., CFS

Current Position: **Director - Biological Division, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1985 to present.**

Dr. Downey is responsible for managing the environmental, microbiological, and toxicity laboratories, as well as directing field sampling and organism collections. He has had considerable experience managing complex biological projects involving electrofishing, rapid bioassessment techniques, radio-telemetry behavioral investigations, and synoptic surveys of fish communities. Project responsibilities have included study design, statistical analyses, biological interpretation, and reporting.

Representative Project Director experience includes:

- 316 Demonstration for alternate thermal criteria.
- Freshwater and saltwater bioaccumulation studies of vertebrates and invertebrates.
- Feasibility studies and biological evaluation of a new State fish culture facility.
- Fish enhancement studies conducted at several hydroelectric facilities.
- Biological evaluation and conceptual renovation designs of the State of Vermont's five Fish Culture Stations.
- Field fish collection support to the USEPA for a pilot lake monitoring study for the Environmental Monitoring and Assessment Program (EMAP).
- Expert Witness Testimony. He provided a deposition for a lawsuit filed in the U.S. Federal Court concerning a paper mill's discharge.

Previous Experience: **Biologist, Aquatec Laboratories, Inc., 1981-1984**

Dr. Downey developed a comprehensive fisheries and aquatic biology investigative program to assess potential impacts of thermal effluent discharged during the summer to the Connecticut River. These studies concentrated on fish health, growth, survival and species composition of representative resident fishes. Other projects included feasibility studies for hydroelectric sites and fish health inspections for bait dealers in the State of New Hampshire.

Lecturer, Unity College, Unity, Maine, August 1982

Independent Work, 1978-1981

He represented the United States as a delegate to the North Pacific Aquaculture Symposium, an international technical and scientific exchange program. Selected delegates from the United States, Canada, Japan and Union of Soviet Socialist Republics attended this biannual meeting.

Instructor, Washington State University/University of Idaho Summer Institute, June 1981

Consultant, Sterling H. Nelson and Sons, Inc., 1979

Dr. Downey was a co-author of a manual for trout and salmon production.

Education: Ph.D. in Forestry Wildlife and Range Sciences; Field of Specialization - Fisheries Resources, University of Idaho, 1982

Master of Science in Fisheries, Louisiana State University, 1978

Bachelor of Science in Natural Resources;, Field of Specialization - Fisheries, University of Michigan, 1975

Bachelor of Science in Biology, Marietta College, 1975

Certification:Certified Fisheries Scientist (Certification No. 1970)

Specialized Training:

Hydroacoustic Assessment Techniques, Biosonics, Inc.	1986
Habitat Evaluation Procedures (HEP), Certified	1984
Hazardous Materials Incident Response Operations (165.5)	1990
SCUBA, NAUI Certified	1976
SCUBA, NAUI Advanced Certification	1991
Dale Carnegie-Effective Speaking and Human Relations	1991

Professional Associations:

Phi Sigma Biology Honor Society
American Fisheries Society (AFS)
    * Atlantic International Chapter
    * Bioengineering Section
    * Fish Culture Section
    * Fish Health Section
Vermont Subcommittee on Endangered Fishes (since 1985)

Publications:

Hall, . and Philip Downey, 1994. Selected Organic and Metal Contaminant Bioaccumulation in Mussels deployed in Boston Harbor and Massachusetts Bay. Poster presented at the Ninth Annual Boston Harbor/Massachusetts Bay Symposium. Boston, Massachusetts

Downey, P. and Joseph Comeau, 1993. Bioaccumulation of Organic Compounds in Mussels deployed at selected locations in Boston Harbor (abstract only). Paper presented at the SETAC 14th Annual Meeting, Houston, Texas

Downey, P., Maury Hall, and John Williams, 1993. Organic Contaminant Bioaccumulation in mussels deployed in Boston Harbor and Massachusetts Bay. Poster presented at the SETAC 14th Annual Meeting, Houston, Texas

Downey, P., Joseph Comeau, Roger Binkerd, and John Williams, 1993. Bioaccumulation of selected organic compounds in mussels deployed near Deer Island discharge and Massachusetts Bay, 1992. Massachusetts Water Resources Authority (MWRA) Environmental Quality Department Technical Report Series No. 93-8, MWRA, Boston, Massachusetts

Inchcape Testing Services
Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

JOSEPH EDWIN, Ph.D

Current Position: Chemist, Inchcape Testing Services / Aquatec Laboratories - Vermont, 1988 to present

Validate data of GC/MS analysis of organic chemicals (volatile, semivolatiles and pesticides/PCBs) in compliance with QA/QC requirements of EPA CLP Methodologies and Special Analytical Services. Provide technical and scientific support to GC/MS laboratory and data review personnel in method development, electronic data analysis, spectral interpretation and identification of organic compounds.

Previous Experience: Post-doctoral Research Associate, Research Associate, University of Vermont, Burlington, Vermont, 1981-1988

Post-doctoral Research Associate, Philipps University, Marburg, West Germany, 1979-1981

Chemist, Chemiequip Pvt., Ltd., Bombay, India, 1973-1974

Technical Assistant, Indian Institute of Technology, Bombay, India, 1966-1970

Chemist, Sarabhai Merck Ltd., Baroda, India, 1964-1966

Education: Ph.D. in Inorganic Chemistry, Minor in Analytical Chemistry, Philipps University, Marburg, West Germany, 1979

M.S. in Chemistry, Kerala University, India, 1972

B.S. in Chemistry, Minor in Physics, Kerala University, India, 1964

Professional Associations: American Chemical Society, since 1982.

Publications: 19 Publications in JACS, J. Organomet, Chem., Angew. Chem., Organometallics, Chem. Ber. and Z. Naturforsch, and four conference and seminar presentations.

Topics: Electrochemistry and Coordination Chemistry of Organometallics, Mass-Spectra, NMR, DNMR and IR-spectra of organic and organomatallic compounds.

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Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

PETER N. GALE

Current Position: **Project Director, Inchcape Testing Services/Aquatec Laboratories, Colchester, Vermont, 1994-present**

Mr. Gale has multiple responsibilities in the business stream of Aquatec Laboratories. These responsibilities include internal project direction for new market development, contract administration, receivables management and marketing and sales.

Previous Experience: **Founder and President of Target Reservoir Analysis Inc., Oklahoma City, Oklahoma, 1982-1994**

Target Reservoir Analysis is a formation evaluation group providing a variety of technical and laboratory services to the oil and gas industry. Services are provided in the areas of sedimentology, petrography, log interpretation, core and special core analysis, petrophysics and well completion engineering. Responsible for all administrative operations of the company including review of all project reports, development of new technologies to solve oil and gas industry problems and business development through marketing and sales activities.

Research Assistant, Department of Pathology, University of Vermont Medical School, Burlington, Vermont 1979-1982

Co-writer and Co-investigator of selected research grants investigating mineral dust lung diseases. Responsible for managing an analytical laboratory consisting of light and petrographic microscopes, scanning and transmission electron microscopes, wavelength and energy dispersive spectrometers; image analyzer and x-ray diffractometer. Supervisor of three technicians.

Project Leader, Engelhard Corporation, Edison, New Jersey, 1978-1979

Responsible for development and application of analytical techniques to characterize ore deposits and industrial mineral products. The work employed the use of a petrographic microscope, x-ray diffraction and x-ray fluorescence units and both scanning and transmission electron microscopes. Supervisor of two technicians.

Previous Experience (continued): **Teaching Assistant, University of Vermont, Burlington, Vermont, 1975-1978**

Responsibilities included preparation of lectures and supervision of laboratory sections in mineralogy.

Education: Bachelor of Science in Geology
St. Lawrence University, Canton, New York 1974

Master of Science in Geology
University of Vermont, Burlington, Vermont 1980

Publications: Doolan, B.L., Gale, M.H., Gale, P.N. and Hoar, R.S., "Geology of the Quebec Re-entrant: Possible constriants from early rifts and the Vermont-Quebec Serpentine Belt," in <u>Major Structural Zones and Faults of the Northern Appalachians</u>, Geological Association of Canada Special Paper 24, P. St. Julien and J. Beland, Editors, p. 85-115, 1982.

Gale, P.N. and Doolan, B.L., "The Bolton Igneous Group and its Plate Tectonic Significance in North-Central Vermont and Adjacent Quebec," Vermont Geological Society Abstract, V. 4, Nov. 4, 1978.

Gale, P.N., Carpenter, B.N., Nick, K.E., "Comparison of Borehold Image Logs and Conventional Cores in Fractured Sandstones" AAPG Abstract June 1994.

Gale, P.N., Conway, M.C., Nick, K.E., Carpenter, B.N., Byrnes, A.B., "Characterization of Cretaceous and Jurassic Reservoirs, Vat Yegan Field Western Siberia, Solutions to Reservoir Production Problems" AAPG Abstract June 1994.

Hemenway, D.R., Sylwester, D., Gale, P.N., Vacek, P. and Evans, J.N., Sources of Variability of Deposited Inhaled Dust in Aerosol Exposure Chambers, American Industrial Hygene Association, V. 44, p. 655-658, Sept. 1983.

Lapenas, D.J., Davis, G.S., Gale, P.N., Brody, A.R., Mineral Dusts as Etiologic Agents in Pulmonary Fibrosis: the Diagnostic Role of Analytical Scanning Electron Microscopy. American Journal of Clinical Pathology, V. 78, N. 5, Nov., 1982.

Publications (continued):

Lapenas, D.J. and Gale, P.N., Kaolinite Pneumoconiosis: A Case Report, Radiologic, Pathologic and Mineralogical Findings, Am Rev Respir Dis, 1984 130: 282-288.

Nick, K.E., Gale, P.N., Carpenter, B.N., King, E.L., Siemers, C.T., Peck, C., Elmore, R.,D., "Reservoir Characterization of the Deep Upper Morrow Puryear Sequence in the Anadarko Basin Western Oklahoma and Texas Panhandle" AAPG Abstract June 1992.

Peck, C.J., Elmore, R.D., Gale, P.N., Carpenter, B.N., "Porosity Preservation and Development in the Prairie Du Chien Sandstone Michigan Basin" AAPG Abstract June 1989.

Stanley, R.S., Doolan, B.L., Gale, P.N., Hoar, R.S. and Hollis, M.A., "Plate Tectonic Interpretation of the Cambrian and Ordovician Rocks in North-Central Vermont," Vermont Geological Society Abstract, V. 4, Nov. 4, 1978.

Specialized Training: Sales School-Real World Selling Skills, Rick Alan and Associates, January 1995.

Inchcape Testing Services
Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

DEBORAH H. GAYNOR, Ph.D.

Current Position: Gas Chromatography/Mass Spectrometry Laboratory Section Head, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1992 to present.

Manages a seven instrument GC/MS laboratory analyzing volatile and semivolatile samples according to EPA Superfund and standard methods. Responsible for overseeing daily laboratory operations such as sample handling, analysis, data processing and review, and report generation.

Previous Experience: **Chemist - GC/MS Data Analysis Section, Aquatec Laboratories, 1991-1992**

Interpreted GC/MS semivolatiles analysis, reviewed data, and generated reports according to EPA Superfund and New York State methods.

Research Fellow, Dartmouth College - Department of Chemistry, 1987-1991

Developed an analysis of pesticides at trace levels in cloudwater samples. Techniques used included solid phase extraction and capillary GC/FID (HP5890A), and GC/MS (Finnigan 4000) with use of selected ion monitoring.

Research Assistant, Dartmouth College - Department of Chemistry, 1986

Managed a laboratory for an 8-member research group and developed an HPLC separation of chromium:DNA adducts.

Research Assistant, University of Vermont - Department of Medicine, 1981-1985

Performed structural investigation of circulating insulin in diabetic and control patients using techniques of affinity and gel filtration chromatography, gel electrophoresis, and HPLC.

Laboratory Technician, University of Pennsylvania - Diabetes Research Center, 1979-1981

Prepared tissue for quantitative microhistochemical analysis and performed enzyme assays in tissues of diabetic and control animals.

Specialized Training:	Mass Spectral Interpretation, Professional Analytical and Consulting Services, Inc., June, 1994.
Education:	Ph.D. in Chemistry, Dartmouth College, 1991
	Thesis: Pesticides in Cloudwater at Low and High Elevation Sites in New England
	B.A. in Biology, Middlebury College, 1977
Professional Associations:	American Chemical Society

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55 South Park Drive
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Fax. 802-655-1248

RICHARD T. GOMEZ

Current Position: **Project Director, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1987 to present.**

Mr. Gomez serves as the director of several large analytical support projects on behalf of premier engineering firms and corporate clients. He also serves as Aquatec's primary sales representative for the Chemistry Division, successfully providing assistance and guidance to existing and potential clients through the integration of his laboratory experience with a sound working knowledge of current EPA methodologies and environmental regulations.

Chemist, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1985-1987

Work centered around conducting special chemistry projects for corporate clients, as field studies involving high purity water pilot testing and troubleshooting, and cooling tower monitoring programs. Mr. Gomez conducted a laboratory pilot study to determine the potential for biodegradation of fuel oil in contaminated soil following application of nutrients to stimulate endogenous and exogenously applied bacteria. He was also the project director for the New York State DEC contract lab program at this time.

Analytical Chemist, 1982-1985

Mr. Gomez analyzed water, soil/sediments, and hazardous waste samples. Analytical techniques performed during this time included gas chromatography (GC), gas chromatography/mass spectrometry (GC/MS), infrared, ion chromatography, inductively coupled plasma and flame atomic absorption techniques for metals determination, bomb calorimetry, flashpoints, and a multitude of wet chemistry and bacteriological testing.

Analytical Chemist, Parke-Davis Co., Holland, Michigan, 1980-1982

Duties included the analysis of all raw materials used in chemical manufacturing, as well as intermediary reaction products formed during the synthesis of specialty chemicals and pharmaceutical products. Analytical techniques routinely performed included gas chromatography, high pressure liquid chromatography, infrared, UV-Visible spectrophotometry, and nuclear magnetic resonance, as well as other tests listed in the U.S. Pharmacopoeia.

Previous Experience (Continued):

Technician in the Electron Microscope Facility, University of Vermont - Department of Pathology, 1979-1980

Duties included tissues preparation and thin sectioning of the plasticized tissue, electron microscopy (EM) of thin sections, photographic plate developing of the EM pictures taken, and printing the pictures by standard darkroom techniques.

Research Technician - National Childhood Development Grant, 1975-1979

Project goals centered on establishing a link between fetal kidney damage and pulmonary hypoplasia. Experimental methods performed included the use of radioisotopic techniques and electrolytic radiorespirometry to biochemically evaluate chick embryo metabolism after administering nephrotoxic polyamines to damage the kidneys. Electron microscopy of fetal tissues was performed to provide morphological support of this theory.

Analytical Chemist, International Business Machines, Corp., Essex Junction, Vermont, Summer 1974

Education: Master of Science in Cell Biology, University of Vermont, 1982

Bachelor of Science in Biochemistry, University of Vermont, 1975

Specialized Training: Waters Associates Liquid Chromatography School, 1982

Hewlett Packard High Resolution Capillary Chromatography School, 1984

Sales School-Real World Selling Skills, Rick Alan and Associates, October 1993; June 1994 and January 1995.

Professional Associations: American Chemical Society, past member

Inchcape Testing Services
Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

DAVID M. HARDWICK

Current Position: **Wet Chemistry Laboratory Section Head, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1991 to present.**

Mr. Hardwick is responsible for the efficient operation of the inorganics laboratory. His extensive experience as an analyst enables him to take on more managerial responsibilities as the laboratory increases in number of employees and the range of analyses performed. He coordinates with Project Directors and clients to ensure that project objectives are met and reviews data for quality control.

Chemist, Wet Chemistry Laboratory, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont 1987-1991

As an analyst in the Wet Chemistry Section Mr. Hardwick was primarily responsible for ion chromatography, organic/inorganic carbon analysis, organic halide analysis and a wide variety of spectrophotometric and titrimetric procedures.

Upper Level Technician - Department of Pathology, University of Vermont, Burlington, Vermont, 1984-1987

Studied asbestos toxicity. Extensive experience with tissue/organ culture, radioimmunoassays, and enzymatic measurement. Routine use of carcinogens and radioisotopes. Graphics and photographics production.

Laboratory Administrator and Technologist - Department of Psychiatry, 1984-1987

Studied blood platelet activation and differentiation of neuroblastoma hybrid cells. Research responsibilities included tissue culture, drawing human blood donors, monoclonal antibody production, column chromatography and radioimmune procedures. Administration duties related to 4-6 lab personnel and their associated projects, equipment, set-up and maintenance; equipment and supply ordering. Laboratory Photographer.

Previous Experience (continued): **Laboratory Technician, St. Francis Hospital, Colorado Springs, Colorado, 1981 to 1984**

Processed all routine and STAT blood chemistry tests, and drew venous and arterial blood specimens. During employment, assumed increased responsibilities for quality control and instrument maintenance. The nature of the work stressed individual precision, accuracy, and organization, while demanding the ability to function as part of a team.

Laboratory Technician - Department of Pathology, University of Vermont, Burlington, Vermont, 1977-1981

Investigated secretory mechanisms of tracheal organ cultures as pertaining to cystic fibrosis. Work involved tissue and organ culture techniques, bacterial toxins, carcinogenic and radioactive compounds. Preparation of samples of scanning and transmission electron microscopy. Use of JEOL 35 SEM. Extensive photographic responsibilities.

Laboratory Technician - Department of Biochemistry, 1977-1981

Beryllium toxicity in murine fibroblast monolayers in culture. Laboratory Photographer.

Education: Bachelor of Science in Biochemistry, University of Vermont, 1977

Professional Associations: Alpha Zeta Honorary Society

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MICHAEL T. HEWLETT

Current Position: Sample Management Section Head, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1991 to present.

Mr. Hewlett oversees the sample management section. He is responsible for sample log-in and maintaining chain-of-custody protocol of the samples from time of receipt until disposal. He is also responsible for ensuring that all instrumentation and equipment in sample management meet performance criteria and calibration requirements.

Previous Experience: **Environmental Chemist, Aquatec Laboratories, 1989-1991**

Mr. Hewlett managed the in-house hazardous waste stream and prepared hazardous waste management/environmental regulatory compliance programs for clients. He also performed site assessments, site remediations, and waste management audits at client locations.

Field Supervisor/Project Manager, Rollins ChemPak, Inc., East Fishkill, New York, 1988-1989

As Field Supervisor/Project Manager at a major IBM plant, Mr. Hewlett monitored an annual million dollar operation and a complete "lab-pack" system. He managed several complex waste streams and supervised four employees in chemical distribution and hazardous waste regulatory compliance.

Field Chemist, Rollins ChemPak, Inc., Chadds Ford, Pennsylvania, 1987-1988

Mr. Hewlett supervised other field chemists in the identification, classification, segregation/packing and documentation of hazardous waste for disposal. He also dealt with federal regulatory agencies and worked extensively with a variety of large and small generators in over fifteen states.

United States Marine Corps., 1986-1987

Participated in Officer Candidate School (OCS) upon graduation from college. Served at Quantico, Virginia until a severe elbow fracture ended his participation in the program.

Education:	Bachelor of Science in Biochemistry Indiana University	1986
	Master of Business Administration University of Vermont	1995
Specialized Training:	Hazardous Materials Incident Response Operations (165.5), 1989	
	Hazardous Waste Handling, Rollins Environmental Service, 1987	
	Advanced First Aid, Red Cross, 1988	
Profesional Associations:	American Chemical Society	

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55 South Park Drive
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Fax. 802-655-1248

H. GREGORY JOHNSTON

Current Position: Director of Technical Services Division, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1975 to present.

Overall responsibility for the design, implementation, operation, and maintenance of computer network, support systems, and laboratory instrumentation. Currently involved in development of computer systems for laboratory automation and electronic delivery and management of data. He is also responsible for the development of software, automation techniques, and mathematical models for project applications.

U.S. Air Force, 1970-1972

Education: Master of Science in Mathematics, University of Vermont, 1976
Bachelor of Science in Mathematics, University of Vermont, 1974

Specialized Training: Incos Application Programming, Finnigan Institute, 1985
Miniranger Operation and Electronic Maintenance, Motorola, Government Electronics Division, 1978

Professional Associations: American Association of Computing Machinery

Publications: Binkerd, R., H.G. Johnston, and J.K. Comeau. Physical Impact Evaluation of the Discharge of Heated Water from the C.P. Crane Generating Station. Prepared for State of Maryland Department of Natural Resources, 1978.

Determination of Optimal Setting of Condenser Cooling System Facilities. Prepared for Vermont Yankee Nuclear Power Corporation, 1983.

Diffuser Performance Investigation at Indian Point NuclearGenerating Station. Prepared for Consolidated Edison Company of New York, 1978.

Publications (continued): Hydrographic Study of Hawk Inlet using Fluorescence Tracer Techniques. Prepared for Martin Marietta Corporation, 1980.

Operational and Biological Studies. Prepared for Vermont Yankee Nuclear Power Corporation, 1983.

Physical Impact Evaluation of Chalk Point Generating Station's Cooling Water System of the Patuxent River. Prepared for the State of Maryland Department of Natural Resources, 1979.

Turbine Discharge Determination, Sawmill Station. Prepared for James River Corporation, 1981.

Turbine Discharge Determination, Shawmut Station. Prepared for Central Maine Power Company, 1982.

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Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

JAMES W. MADISON

Current Position: **Project Director, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1993 to present.**

Mr. Madison serves as the director of several large analytical support projects on behalf of premier engineering firms and corporate clients. As one of Aquatec's customer service representatives, he is a liaison between the clients needs and laboratory capabilities. He provides assistance and guidance to clients through the integration of his laboratory experience with a sound knowledge of current EPA methodologies and environmental regulations.

Previous Experience: **Chemist, Inchcape Testing Services-Aquatec Laboratories, 1988 - 1993**

Mr. Madison was responsible for GC analysis of various pesticide, herbicide and PCB compounds in water, soil, air and biota samples using EPA 500, 600 and 8000 methods and EPA CLP protocols. He was also responsible for organizing the analysis of soil, water and biota for the presence of PCB congeners.

Environmental Field Technician, Inchcape Testing Services-Aquatec Laboratories, 1987-1988

Mr. Madison was responsible for ground water monitoring well installation and subsequent sample collection. He was also a team member on numerous sampling projects at industrial sites requiring full TCL/TAL analyses.

Laboratory Technician, Inchcape Testing Services-Aquatec Laboratories, 1985-1987

Mr. Madison performed sample extraction for pesticide/PCBs, base/neutral acids, herbicides, and other organic contaminants. He was a special project team member for the Love Canal Habitability Study.

Education: Bachelor of Science in Geology/Environmental Science, St. Lawrence University, Canton, New York, 1983

Awards: Recipient of the Inchcape Excellence Award for outstanding contribution to Inchcape for the second half of 1994

Specialized Training: Sales School-Real World Selling Skills, Rick Alan and Associates, March 1994.

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55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

PAULINE T. MALIK

Current Position: **Sales and Marketing Director, Chemistry Project Director, Inchcape Testing Services/Aquatec Laboratories - Colchester, Vermont, June 1993 to present.**

Ms. Malik directly oversees the Project Directors and Sales Personnel at Inchcape Testing Services- Aquatec Laboratories. As Sales and Marketing Director, Ms. Malik is responsible for overseeing all projects that are in-house, coordinating proposals, providing guidance and support to the Project Directors and ensuring consistency in all sales and marketing activities. All external and internal marketing activities are the direct responsibility of the Sales and Marketing Director. In addition, she is responsible for coordinating the design and development of all publications and marketing tools for the laboratory.

Previous Experience: **Project Director, Aquatec Laboratories, Inc., 1988-1993**

As a project director, Ms. Malik's responsibilities included communicating information to clients concerning sample handling and applicability of EPA methodologies, relaying their needs to the laboratory personnel, and interpreting results when requested. Ms. Malik managed many large environmental projects. As needed, Ms. Malik is responsible for soliciting Aquatec's services to environmental consulting and engineering firms. She is also responsible for responding to RFP/RFQs requiring technical expertise.

Graduate Teaching Assistant, University of Vermont, Burlington, Vermont, 1982-1987

Ms. Malik was responsible for instructing the advanced freshman inorganic chemistry laboratory.

Undergraduate Research Assistant, State University of New York at Buffalo, Buffalo, New York, 1981-1982

Ms. Malik synthesized organometallic compounds with subsequent kinetic studies.

Education: Graduate Studies in Inorganic Chemistry, University of Vermont, Burlington, Vermont

B.S. in Chemistry, State University of New York at Buffalo, Buffalo, New York, 1982

Specialized Training: Executive Development Program, Cornell University-The Johnson School. Intensive Management Training Course sponsored by Inchcape Testing Services. August 1994.

Sales School-Real World Selling Skills, Rick Alan and Associates, October 1993; June 1994; March 1994 and January 1995.

Professional Associations: American Chemical Society

Women in Science

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Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

R. MASON McNEER, Ph.D.

Current Position: Senior Chemist, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1974 to present.

Dr. McNeer evaluates the analytical work performed for clients in private industry, including the detailed review of analytical data produced by the organic and inorganic laboratories. With over forty years of experience in environmental studies and analytical chemistry, he serves as a technical resource for the laboratory in the fields of organic and inorganic analytical chemistry. He also provides reports and consultation to clients in private industry by applying various methods of chemical analysis and interpreting analytical results.

Previous Experience: **Project Director, Ecological Studies, Vermont Yankee Nuclear, Power Station, Vernon, Vermont, 1974-1983**

During this time Dr. McNeer provided annual reports which assessed the environmental impact of Vermont Yankee's open cycle cooling process on the local waterway. The object of the project was to monitor water quality and the impact on biological fauna from the open cycle cooling process.

Chemist, Summers 1970-1973

He was responsible for field studies and chemical analysis of water quality for the Vermont Yankee Nuclear Power Station. The data gathered on water conditions and biological fauna downstream from Vermont Yankee formed the basis for assessing the future environmental impact of open cycle cooling.

Chemist - Biological Division, Webster-Martin, Inc., South Burlington, Vermont, Summers 1968-1970

He performed environmental field work and chemical analysis.

Chemist - Department of Water Resources, State of Vermont, Summers, 1952-1967

Dr. McNeer performed environmental field work and chemical analysis of water from lakes throughout the State of Vermont. The object of such studies was to establish baseline data for water quality standards and to monitor the effects of sewage effluent discharge into rivers and lakes.

Previous Experience (Continued): Professor, Norwich University, Department of Chemistry, Northfield, Vermont, 1951-1974

Education: Ph.D. in Organic Chemistry, University of Chicago, 1952

Bachelor of Science in Chemistry, University of Chicago, 1948

Professional Associations: American Chemical Society

Phi Beta Kappa

The Society of the Sigma Xi

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55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

BRIAN D. MOFFAT

Current Position: **Biology Quality Assurance Officer, Inchcape Testing Services/Aquatec Laboratories, Colchester, Vermont, 1994 to present**

The position of Biology QA Officer provides administrative and technical support to the toxicity and microbiology laboratories. Administrative support involved the development of new laboratory protocols and the refinement of existing protocols. Administrative support also includes the creation and management of all Biology SOPs as well as data verification on final client reports. Technical support includes various laboratory duties as needed; e.g., macroinvertebrate identifications and toxicity testing.

Previous Experience: **USF Public Health Traineeship, University of South Florida, 1990-1993**

Master of Science in Public Health Program, with emphasis on environmental health, thesis work on the toxicity of disinfected municipal wastewater and developed in vivo enzyme inhibition assay for marine rotifers.

Thornton Laboratories-Bioassay Department, 1992-1993

Developed and implemented a quality control plan, trained and supervised student interns, maintained cultures of Daphnia, Ceriodaphnia, Pimephales and Cyprinella and conducted acute and chronic toxicity tests using aquatic vertebrates and invertebrates.

University of Tampa-Biology Department, 1989-1991

Developed in vivo & in vitro toxicity tests using aquatic animals, managed data collection and conducted statistical analyses, monitored and maintained rotifer and algae cultures and supervised and trained undergraduate lab technicians.

University of Tampa-Biology Department, 1986-1988
Conducted various mating experiments between geographically isolated polychaetes, collected data and conducted statistical analyses, monitored and maintained polychaete cultures and assisted in specimen collection.

Education:

Master of Science in Public Health University of South Florida	1993
Bachelor of Science in Marine Science/Biology University of Tampa	1988

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Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

JOSEPH J. ORSINI JR., Ph.D.

Current Position: **Assistant Laboratory Operations Director, Inchcape Testing Services/ Aquatec Laboratories, Colchester, Vermont, 1994 to present.**

Responsible for assisting the Laboratory Operations Director in all of the overall activities of the analytical laboratories. Additional responsibilities include management of the laboratories, Diskette Deliverable System, general process, development and assistance in solving the technical problems of the laboratory.

Previous Experience: **Metals Laboratory Section Head, Inchcape Testing Services/Aquatec Laboratories, Colchester, Vermont, 1988 to 1994.**

Dr. Orsini's responsiblities included personnel management, ICP analysis and development for ICP, furnace and cold vapor analyses

Dr. Orsini developed ICP hydride methodologies for the analysis of arsenic and selenium in difficult matrices.

Ph.D. Program, University of Vermont, Burlington, Vermont, 1982-1988

He developed an expertise in modern electroanalytical techniques including voltammetric and coulometric methods and in the synthesis of organometallic, inorganic and organic compounds. He is experienced with nuclear magnetic resonance spectroscopy including use of fourier transform instruments to study various nuclei in static and dynamic environments and in the use and interpretation of mass spectral data. Strong background in manipulations of air sensitive materials by schlenk and vacuum line techniques and in spectroscopic techniques including electron paramagnetic resonance, ultraviolet, visible and infrared spectroscopy. He utilized gas chromatography in the analysis of organics from organometallic decomposition reactions. Working knowledge of computerized data analysis and simulations of cyclic voltammograms and nuclear magnetic resonance spectra.

Teaching Assistantship at University of Vermont, 1982-1988

Teaching Assistantship at Plattsburgh State College, 1981-1982

Undergraduate Research Assistant with Professor Gerald F. Kokoszka,.

Summers of 1980, 1981 and 1982

Education: Ph.D. in Analytical Chemistry, University of Vermont, 1989

Candidate for Dr.of Philosophy under Professor William E. Geiger. Specializing in the electrochemistry of organometallic rhodium, palladium and manganese compounds. Included speciation studies of rhodium hydrogenation catalysts via high speed cyclic voltammetry.

Three semester course in atomic spectroscopy, 1983

B.A. in Chemistry, Plattsburgh College of Arts and Science, State University of New York, 1982

Studied mixed-valence benzotriazolato copper clusters using electron paramagnetic resonance spectroscopy.

Specialized Training: Mass Spectral Interpretation, Professional Analytical and Consulting Services, Inc., June, 1994.

Publications: Kokoszka, G.F., J. Baranowski, C. Goldstein, J. Orsini, A.D. Mighell, V.L. Himes, and A.R. Siedle. "Two-Dimensional Dynamic Jahn-Teller Effects in a Mixed-Valence Benzotriazolato Copper Cluster, Cu5 (BTA)6 (RNC)4." J. Am. Chem. Soc. 1983, 105, 5627.

Karlin, K.D., P.M. Cruse, G.F. Kokoszka, and J.J. Orsini. "ESR Spectra of New Dicopper (II) Complexes of Novel Binucleating Ligands." Inorg. Chim. Acta 1982, 66, L57.

Professional Associations: American Chemical Society, Division of Inorganic Chemistry

Analytical Chemistry, and Industrial and Engineering Chemistry

Green Mountain Section of American Chemical Society

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55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

MARK T. PHILLIPS

Current Position: **Organic Extraction Laboratory Section Head, Inchcape Testing Services/ Aquatec Laboratories - So. Burlington, Vermont, 1994-present.**

Mr. Phillips manages the water extraction laboratory. He is responsible for the planning and scheduling of the various extraction methods, and for managing the personnel in the lab. He is also responsible for technological improvements and method development for the extraction lab.

Previous Experience: **Water Extraction Group Leader, Inchcape Testing Services/Aquatec Laboratories - Colchester, Vermont, January 1992 - 1994.**

He is responsible for preparing samples for gas chromatography analysis, including pesticides/PCBs, base/neutral acids, and herbicides. He is experienced in EPA, New York State, and OLM01 contract laboratory protocols for low and medium level media. His other experience includes PCB congeners, continuous liquid- liquid extractors, and gel permeation cleanup operations.

Chemist, Aquatec Laboratories, Inc., July 1991 - January 1992

Mr. Phillips is a chemist in the organic extraction laboratory. His primary duties include preparing soil and water samples for gas chromatography and mass spectroscopy analysis, including pesticides/PCB's, base/neutral and herbicides. He is experienced in TCLP and EPTOX procedures; EPA, New York State, and OLM01.8 contract laboratory protocols for low and medium level media; and PCB congeners continuous liquid-liquid extractors, and gel permeation cleanup operation.

On-Site Technician, Vermont Association of Conservation Districts On-Site Sewage, Program, Montpelier, Vermont, 1989-1991

Provided 14 towns with expert technical data regarding on-site sewage disposal technology. Evaluated and interpreted soils and groundwater movement in facilitating designs for sewage disposal systems. Creating contour maps and used technical writing as well as drafting skills to develop precise blueprints.

Education: Bachelor of Arts in Environmental Studies, Johnson State College, Johnson, Vermont, May 1988

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Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

DAVID S. ROBINSON

Current Position: **Business Development Representative, Mid-Atlantic Region, Philadelphia, PA, April 1995 to present**

Responsibilities include establishing business relationships with Architectural/Engineering and industrial firms in the Mid-Atlantic states and servicing existing clients in the region.

Previous Experience: **Project Director, Inchcape Testing Services/Aquatec Laboratories - Colchester, Vermont, 1993 to 1995.**

Mr. Robinson served as the director of several large analytical support projects on behalf of premier engineering firms and corporate clients. He also served as one of Aquatec's customer service representatives for the Chemistry Division, successfully providing assistance and guidance to existing and potential clients through the integration of his laboratory experience with a sound working knowledge of current EPA methodologies and environmental regulations.

Chemist, Aquatec Laboratories, 1992-1993

Mr. Robinson is a specialist in the analysis of volatile and semivolatile organic compounds in water, soil, and air samples using EPA and ASTM methods. Method development in fuel oil analysis.

Applications Specialist, Sentex Sensing Technology, Inc., Ridgefield, New Jersey, 1989-1992

Mr. Robinson was primarily responsible for design and development of portable gas chromatographs for field environmental analysis. Customer interaction including on-site consulting and training in the use of instrument. Application and method development for unique analytical problems and radiation safety officer.

Research Chemist, University of Vermont, Burlington, Vermont, 1986-1989

Mr. Robinson did research in Atomic Spectrometry and development of instrumentation for direct solid sample analysis of inorganic pollutants.

Previous Experience (continued): **Laboratory Technician, Baker Instruments Corporation, Allentown, Pennsylvania, 1985-1986**

Mr. Robinson was responsible for the initial studies and characterization in newly developed reagent for the quantitative determination of calcium in human serums. Developed assay method for automated clinical instrument.

Education: Master of Science in Analytical Chemistry, University of Vermont, 1989

Bachelor of Science in Chemistry, Muhlenberg College, 1986

Publications: D. Robinson, A. Linenberg, R. Davis, "Hazardous Waste-site Measurements of Low Levels of Chlorinated Hydrocarbons using a Portable G.C." Hazardous Materials Control, May/June 1991.

David Robinson, Kelly Mason, Frank Dorman, and Joel Goldberg, "Evaluation of a Commercially Available Laser Scanning Microdensitometer for Emmission Spectrographic Measurements" Applied Spectroscopy, Volume 44-9, 1990.

A. Linenberg, R.K. Davis, and D.S. Robinson, "On-Site Use of Purge-and-Trap Technique for Instantaneous Groundwater Analysis", Hazardous Wastes and Hazardous Materials, December 1990.

Presentations: "Analytical Studies of a Plasma Gun Direct Solid Sampling Atomic Emission Source", Joel M. Goldberg, David S. Robinson, Lisa Lanning, Garrett J. McGowan and James L. McKinstry, 1990 Winter Conference on Plasma Spectrochemistry, St. Petersburg, FL (1990).

A. Linenberg, R.K. Davis, and D.S. Robinson, "Hazardous Waste-Site Measurements of Low Levels of Chlorinated Hydrocarbons Using a Portable G.C.", HMCRI Seventh National RCRA/Superfund Conference, St. Louis, MO (1990).

A. Linenberg, R.K. Davis, and D.S. Robinson, "On-Site Use of Purge-and-Trap Technique for Instantaneous Groundwater Analysis", HMCRI Seventh National RCRA/Superfund Conference, St. Louis, MO (1990).

Presentations (continued):

David S. Robinson and Joel M. Goldberg, "Spectroscopic Characterization of a Plasma Gun Source for Atomic Spectrometry", Fifteenth FACSS Conference, Detroit, MI (1988).

David S. Robinson, Kelly J. Mason, and Joel M. Goldberg, "Evaluation of a Commercially Available Laser Scanning Microdensitometer for Emmission Spectrographic Measurements", Fourteenth FACSS Conference, Detroit, MI (1987).

Specialized Training:

Sales School-Real World Selling Skills, Rick Alan and Associates, March 1994.

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55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

MARTHA E. ROY

Current Position: **Quality Assurance Officer, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, June 1993 to present.**

As Quality Assurance Officer, Ms. Roy is responsible for the continuous development and implementation of the Quality Assurance Program for inorganic and organic analyses of environmental samples. She prepares and maintains the Laboratory Quality Assurance Program Plan (QAPP), Quality Assurance Project Plans (QAPjP) and work plans for large environmental projects. Other responsibilities include participating in and responding to audits from government and regulatory agencies, conducting internal audits of the laboratory and monitoring the use of quality controls within the lab. In addition, she oversees performance evaluations, certifications, reviewing analytical reports, following up on corrective action reports and project coordinating. Ms. Roy is also an active member of the Corporate QA Committee, which is responsible for compliance to corporate quality assurance standards and other QA matters.

Previous Experience: **Inorganic Reporting Supervisor, Aquatec Laboratories, Inc., 1991-1993**

Primary responsibility included the review and reporting of all inorganic data (wet chemistry and metals). Developed use of the Ward inorganic software for metals CLP forms and diskette deliverables.

Project Director, 1988-1993

Project Director of several New York State and Superfund affiliated projects. Responsibilities include client contact, initiation of required analysis, and coordination of results and supportive documentation into a data package for the client.

QA/QC Assistant, 1985-1988

Ms. Roy was primarily responsible for the review of inorganic data generated at Aquatec. Other duties included some review of GC and GC/MS data, communicating with clients, organizing final client reports, and supervising two large government contracts.

Previous Experience (continued): **Laboratory Instructor and Research Technician, University of Vermont - Department of Zoology, 1983-1985**

Duties included teaching laboratory sessions, supervising work study students, collecting water and benthic samples as part of an acid rain study, and doing extensive data analysis on the information gathered.

Student Teacher, St. Michael's College, Winooski, Vermont, 1981-1982

Education: Master of Science in Limnology, University of Vermont, Burlington, Vermont, 1985

Bachelor of Arts in Biology, St. Michael's College, Winooski, Vermont, 1983

Specialized Training: Quality Assurance for Environmental Laboratories, National Laboratory Training Network, 1994

Ward Scientific Training for Contract Laboratory Program (CLP), 1990

Professional Affiliations: Water Environment Federation

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55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

GARY B. STIDSEN

Current Position: **Gas Chromatography Laboratory Section Head, Inchcape Testing Services/Aquatec Laboratories, Colchester, Vermont, 1993 to present.**

Mr. Stidsen is responsible for the efficient operation of the gas chromatography laboratory. His extensive experience as an analyst enables him to manage a large number of employees performing a wide range of analyses performed. He must coordinate with the clients and project directors to ensure project objectives are met.

Previous Experience: **Section Head - Organic Laboratory (Extraction Laboratory and the Gas Chromatography Laboratory), 1982-1993**

Areas of analysis include pesticides/PCBs, base/neutral/acids, herbicides, volatile organic compounds in water, soil, air, and biota samples. Methods of analysis followed are the EPA 500, 600, 800 and NIOSH methods and methods according to protocols set by New York State, EPA Superfund, etc. Responsible for training of personnel, flow of samples through the laboratory and instrument maintenance. Provide technical input for collection of air, soil and water samples designed for organic analysis.

Responsible for the sample preparation of soils for the Love Canal Habitability Study performed by New York State. The object of the project was to compare the concentration of targeted organic compounds from the Emergency Declaration Area around Love Canal to other areas in Niagara Falls and Buffalo, New York.

Chemist - Extraction and Gas Chromatography Laboratories, 1983-1986

In the Extraction Laboratory samples were prepared for organic analysis, including pesticide/PCBs, base/neutral/ acids, and herbicides. Analysis performed in the Gas Chromatography Laboratory included pesticide/PCBs, herbicides, base/neutral/ acids by GC, and volatile organic compounds.

Responsible for the sample preparation and gas chromatograph analysis for PCBs as Congeners of 1700 water, soil and biota samples from the New Bedford Harbor, Massachusetts area under the EPA Superfund. Work in the Extraction Laboratory included extraction and extensive clean up of the sample extracts. In the Gas Chromatography Laboratory the sample extracts were analyzed for PCBs as Congeners using electron capture detection with low parts per trillion detection limit in the sample extracts.

Previous Experience (Continued): Chemist - Inorganic Laboratory, 1982-1983

Analysis performed included COD, BOD, nitrate, nitrite, phosphate, sulfur, pH, turbidity, oil and grease, solids, metals by flame atomic adsorption, formaldehyde, hardness, alkalinity, fluoride, and TOC. Also during this time period collected air samples using the techniques in EPA Method 5, and organic compounds in air using techniques in EPA Method 25.

Surveyor, 1982

Built layouts and horizontal control for power lines. Instrumentation used included a one second Theodolite, Kern DM502, and a KNE Range IV for determining distances.

Education: Bachelor of Science in Environmental Engineering Technology, Norwich University, Northfield, Vermont, 1981

Specialized Training: Finnigan Mat Institute "ITD Data System Operation" Training Course, 1988

Hewlett Packard High Resolution Capillary Chromatography School, 1984

Mass Spectral Interpretation, Professional Analytical and Consulting Services, Inc., June, 1994.

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SCOT P. SWANBORN

Current Position: **Project Director, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1993 to present.**

Mr. Swanborn serves as a link between clients and the laboratory personnel. He ensures that the client's needs are met and specified methodologies are adhered to. He is responsible for the final publication and delivery of data packages.

Previous Experience: **Chemist, Aquatec, Inc., Colchester, Vermont, 1990 - 1993.**

Mr. Swanborn analyzes water, soil, and air samples for volatile organic compounds base/neutral acids in the Gas Chromatography/ Mass Spectroscopy Laboratory. He is experienced in EPA Methods 624, 8240, 524.2, 625, 8270 and EPA CLP protocols for analysis of low/medium and high concentration samples.

Analyst, Industrial and Environmental Analysts, Essex Junction, Vermont, 1987-1989

Mr. Swanborn is knowledgeable of sampling procedures, analytical methods, and results of testing required for wastewater treatment facilities, landfills, and public and domestic drinking waters. In this position, he had consulting experience in laboratory technique, procedure, quality control, and safety. His responsibilities included regulating on-site hazardous wastes, ordering supplies and equipment for the laboratory, and managing the laboratory automation project. He also was responsible for the research and development, program implementation, establishing quality control guidelines, training analysts, and data management for the nutrient and mineral chemistries program.

Analyst, Aquatec, Inc., South Burlington, Vermont, 1985-1986

Mr. Swanborn analyzed samples and provided reports in accordance with EPA Contract Laboratory Protocol. He conducted all minerals and nutrient analyses and had extensive experience in traditional wet-lab analyses and procedures for qualifying hazardous waste. His broad analytical experience includes organic extractions, gas chromatography, atomic absorption, TOX, and energy lab.

Education: Bachelor of Science in Environmental Science, Johnson State College, Johnson, Vermont, 1984

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Fax. 802-655-1248

NEAL E. VAN WYCK

Current Position: **General Manager, Vice President of Inchcape Testing Services, President of Aquatec Laboratories, Inchcape Testing Services/Aquatec Laboratories, Colchester, Vermont, June 1993 to Present**

Mr. Van Wyck directs the functional areas of marketing, finance, chemistry and administration for ITS Aquatec Laboratories. He has broad based experience in the management of environmental programs and extensive knowledge of methodologies.

His operational duties include contract administration, scheduling, corporate liaison, program administration and client consultation.

Previous Experience: **Laboratory Director, Aquatec Laboratory, Inc., 1990 to 1993**
GC/MS Section Head, 1990 to 1992

Responsible for coordinating the overall activities of the analytical laboratories on a daily basis and providing long-term direction. Responsibilities include scheduling analytical work and personnel, developing new methods and technologies and working with Technical Support to develop procedures to automate the review and reporting of analytical data.

Managed a GC/MS laboratory analyzing volatile and semivolatile samples according to EPA Superfund and Standard Methods. Responsible for overseeing daily laboratory operations, such as sample handling, analysis, data processing and review and report generation.

Assistant Laboratory Director, 1988 to 1990

Responsible for assisting the Laboratory Director in coordinating the overall activities of the analytical laboratories on a daily basis. Assists in hiring and daily scheduling.

Metals Laboratory Section Head, 1986 to 1988

Specific laboratory analysis responsibilities included the supervision of the Analytical Atomic Spectroscopy Group and the development of Inductively Coupled Plasma Emission Spectrometry for trace metals determination.

Neal E. Van Wyck
Page 2

Previous Experience (Continued): **Chemist - GC/MS Laboratory, 1985 to 1986**

GC/MS analyst responsible for the analysis of volatile and semivolatile organics in water and soil samples utilizing EPA 500, 600 and SW846 methods in addition to New York State and EPA Contract Laboratory Protocols for low/medium and high concentration media. Additional responsibilities include the preparation of standards, maintaining and troubleshooting instrumentation, and documenting daily analyses, standard formulas, quality control information and instrument maintenance.

Research and Teaching Assistant in the University of Arizona Department of Chemistry, 1982 to 1985

Teaching responsibilities included preparation of lectures and supervision over general and advanced physical chemistry laboratory sections. Research activities centered about nonlinear optical investigations of thin films and surfaces. Various multiphoton techniques were explored and developed. They are surface coherent Anti-Stokes Raman Spectroscopy, Surface Second Harmonic Generation Spectroscopy and Two Photon Spectroscopy in Film Organic Optical Waveguides.

Education: M.S. in Physical Chemistry
University of Arizona 1985

B.A. in Chemistry
University of Vermont 1982

Specialized Training: Executive Development Program, Cornell University-The Johnson School. Intensive Management Training Course sponsored by Inchcape Testing Services. August 1994.

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55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

JOHN W. WILLIAMS

Current Position: **Toxicology Laboratory Director, Inchcape Testing Services-Aquatec Laboratories, Colchester, Vermont, 1990-present**

Mr. Williams is responsible for the overall work flow and operation of the aquatic toxicology laboratory. His responsibilities include management of toxicity laboratory personnel and supervision of testing activities. Mr. Williams is also responsible for staff training, client relations, data analysis, interpretation and reporting. Representative Project Experience includes: NPDES effluent testing, marine and freshwater; Whole sediment toxicity evaluation, marine and freshwater; Whole soil toxicity evaluation; and, Toxicity Identification Evaluation.

Previous Experience: **Toxicology Laboratory Director, Cosper Environmental Services, Northport, New York, 1989-1990**

Mr. Williams managed the operation of an aquatic toxicity testing and consulting laboratory located on Long Island in Northport, New York. His work focused on marine and freshwater NPDES biomonitoring.

Environmental Scientist, Battelle Ocean Sciences, Duxbury, Massachusetts, 1973-1989

Mr. Williams managed marine toxicity studies including NPDES biomonitoring, FIFRA pesticide registrations, sediment, sludge, and interstitial water toxicity evaluations. He performed and supervised continuous flow and static toxicity tests under Good Laboratory Practices (GLP) regulation. He also authored technical reports in relation to marine toxicological investigations, marine and estuarine biological surveys, and sediment collection procedures. Other responsibilities included managing SCUBA diving operations and supervising marine field collection activities.

Education:	Bachelor of Science in Marine Fisheries Biology University of Massachusetts	1968
Professional Associations:	Society of Environmental Toxicology and Chemistry	1989-Present
	National Association of Underwater Instructors	1973-1989

Specialized Training: Operation of research vessels up to 42' in marine and freshwater environments.

Operation of water, sediment, and biological sampling apparatus.

Supervisor of SCUBA operations, NAUI certified instructor.

Organism culture including Mysidopsis bahia, Cyprinodon variegatus, Arbacia punctulata, Champia parvula, Ceriodaphnia dubia, Daphnia pulex, and Daphnia magna, Hyalella azteca, Chironomus tentans.

At-sea and mobile laboratory marine toxicity testing.

Publications: J.W. Williams, "Narragansett Bay Project, wet and dry weather toxicity testing with the sea urchin (Arbacia punctulata) and the red macroalga (Champia parvula)." 1990.

Jop, K.M., J.W. Williams, and R.B. Foster. "Toxicity evaluation of the proposed secondary and primary effluents discharged to Massachusetts Bay." Bull. Environ. Toxicol. 45:399-407, 1990.

Carr, R.S., J.W. Williams, and C.T.B. Fragata. "Development and evaluation of a novel marine sediment pore water toxicity test the Polychaete Dinophilus gyrociliatus." Environ. Toxicol. Chem. 8:533-543, 1989.

Battelle (J.W. Williams, Author). "Chronic toxicity to sea urchin (Strongylocentrotus purpuratus) and inland silverside minnow (Menidia beryllina) to final effluent samples." 1989.

Strobel, C.J., J.H. Gentile, S.C. Schimmel, R.S. Carr, J.W. Williams, D. Redford. "Proposed Biological Testing Methods for the United States Incineration-at-Sea Research Program." Mar. Pollut. Bull. 19:605-610, 1988.

Battelle (J.W. Williams, Study Director and Author). "Final Report, XXX Insecticide: Acute toxicity to grass shrimp (Palaemonetes pugio) and inland silverside minnow (Menidia beryllina) in a flow-through system." FIFRA Guideline 72-3, 1988.

Battelle (J.W. Williams, Study Director and Author) "Acute Toxicity of XXX to Mysid (Mysidopsis bahia)." FIFRA Guideline 72-3, 1986.

Carr, R.S., J.W. Williams, F.I. Saksa, R.L. Buhl, and J.M. Neff. "Bioenergetic alterations correlated with growth, fecundity, and body burden of cadmium for mysids (Mysidopsis bahia)." Environ. Toxicol. Chem. 4: 181-188, 1985.

Battelle (J.W. Williams Task Leader and Co-Author). "Acute toxicity of used drilling mud sample XXX." 1985.

Hillman, R.E., J.W. Williams, F.I. Saksa, R.A. McGrath, and L.S. Gomez. "Aquatic bioassays of FUSRAP Soils." Proceedings, Oceans 83, 1983.

Battelle (J.W. Williams, Project Manager and Co-Author). "Solid Phase Bioassay and Bioaccumulation Studies on Sediments from the Reserved Channel, Boston Harbor." 1983.

Battelle (J.W. Williams, Task Leader and Author). "Acute toxicity of used lignosulfonate freshwater drilling mud." 1983.

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55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

KIRK F. YOUNG, P.E.

Current Position: **Gas Chromatography/Mass Spectrometry Laboratory Section Head, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1992 to present.**

Mr. Young manages the Finnigan GC/MS laboratory. He is responsible for overseeing daily laboratory operations such as sample handling, analysis, data processing and review, and report generation.

Previous Experience: **QC Supervisor, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, 1981-1992**

As QC Supervisor, Mr. Young was responsible for the daily operation of the laboratory, with a focus on detailed project planning and the implementing specialized project work. In addition to this, he also directed the efforts of detailed review, validation, and publication of analytical data from the GC/MS laboratory and coordinated activities associated with data validation services.

From 1983 to 1988, he was responsible for the daily administration of Aquatec's work within U.S. Environmental Protection Agency's Contract Laboratory Program. He coordinated related laboratory activities and directed the effort of detailed review, validation and publication of the analytical data. During this period, the laboratory participated extensively in special analytical services work in support of EPA regional needs and national program development.

Professional Engineer, Donald L. Hamlin, Consulting Engineers, Inc., Essex Junction, Vermont, 1978-1981

Mr. Young was the Project Engineer for the design and construction of municipal wastewater treatment facilities, with experience in the design of secondary and advanced treatment processes, site planning, and construction supervision.

Previous Experience (Continued):	Engineer, Commonwealth of Virginia/Northern Regional Office of the State Water Control Board, 1974-1978 Mr. Young shared responsibility for conducting engineering inspections and reviewing plans and specifications of municipal and industrial wastewater treatment facilities. His responsibilities included regulatory duties, engineering review of industrial waste treatment proposals, and coordinating the industrial wastewater program within the region. During this time he also administered the Construction Grants Program established under Public Law 92-500, involving Virginia municipalities within the Washington, D.C. metropolitan area. This work included planning new facilities, reviewing treatment designs, and allocating grant funds.
Education:	Bachelor of Science in Civil Engineering, Lehigh University, Bethlehem, Pennsylvania, 1973 Virginia Military Institute, Lexington, Virginia, 1969-1970
Specialized Training:	Mass Spectral Interpretation, Professional Analytical and Consulting Services, Inc., June, 1994.
Professional Associations:	Certified as a Professional Engineer in the Commonwealth of Virginia and the State of Vermont

Inchcape Testing Services
Aquatec Laboratories

55 South Park Drive
Colchester, VT 05446
Tel. 802-655-1203
Fax. 802-655-1248

JON K. ZYGMUNTOWICZ

Current Position: **Organic Extraction Laboratory Section Head, Inchcape Testing Services/ Aquatec Laboratories - Colchester, Vermont, 1994-present.**

Mr. Zygmuntowicz manages the soil extraction laboratory. He is responsible for the planning and scheduling of the various extraction methods, and for managing the personnel in the lab. He is also responsible for technological improvements and method development for the extraction lab. He is experienced in USEPA, New York State and SW846 protocols for a wide variety of matrices and levels.

Previous Experience: **Soil Extraction Laboratory Group Leader, Inchcape Testing Services / Aquatec Laboratories - Colchester, Vermont, September 1993 to 1994.**

Mr. Zygmuntowicz was responsible for scheduling and organizing daily work flow. He was responsible for preparing extracts for Gas Chromatography and Mass Spectroscopy. Including Pesticide/PCB's, Base Neutral Extractables, Polynuclear Aromatics, Organophosphorus Pesticides, TPH Extractables as well as many others.

Chemist, Aquatec Laboratories, Inc., August 1991 - September 1993

Mr. Zygmuntowicz was a chemist in the organic extraction laboratory. His primary duties include preparing soil and water samples for analysis. He is experienced in TCLP and EPTOX procedures; PCB congeners, continuous liquid-liquid extractors, gel permeation cleanup operation.

Stowe Police Officer, Stowe, Vermont. Part-time. 8/93-Present

Received 240 hours of training in police work including specialized training in DWI enforcement, fingerprinting, Doppler radar, domestic abuse and VNI. He maintains his annual training and works approximately 8-15 hours a week as a patrolman. Responsible for knowledge of all police procedures.

Pipeliner, Mobil Pipeline Company, Malvern, Pennsylvania, August 1990 - August 1991

Responsible for the maintenance of an underground pipeline running from Paulsboro, NJ to Malvern, PA north to the New York border and west to Altoona, PA. Also, received specialized training as a gauger, which included a thorough knowledge of all pipeline products, delivery systems, and storage tanks. Sampled and analyzed all fuel oil products.

Education: Bachelor of Science in Ecology, Johnson State College, Johnson, Vermont, May 1990

Specialized Training: ABC Instruments Training Course, March 1994. Intensive training course on the operations and maintenance of the GPC instruments.

Restek Training Course, March, 1995. Training on GC instrumentation.

INCHCAPE TESTING SERVICES
AQUATEC LABORATORIES Vermont Division

FULL NAME	DEGREE/AREA OF STUDY	DUTIES	WORK AREA	YRS/EXPERIENCE TYPE*	
ALBERS, WALTER M	AAS Env Technology	Chem Tehnician	EXT	2.00	E
AMES, BENNYE A	BS Gen Agriculture	Chemist C	MET	14.00	U/E
ANDERSON, CHRISTOPHER J	BA Natural Science	Field Technician	ENC	4.00	E
ARNOLD, LORI T	BA Chemistry	Data Analyst D	CMS	10.00	E
AUBIN, KRISTINE L	BS Biochemistry	Section Head	MET	8.00	E
BAILEY, GERALD C	BS Chemistry	Chem Tehnician	EXT	1.00	
BANKS JR., DAVID L	BS Computer Science	Programmer	CMS	12.00	E
BANKS, JANINE L	HS General Studies	Sample Custodian	SMG	11.00	E
BARTON, RICHARD W	HS General Studies	Bio Technician	BIL	5.00	E
BESSETTE, FRANK N	HS General Studies	Sample Custodian	SMG	3.00	E
BESSETTE, TRACIE A	HS General Studies	Receptionist	ADG	2.00	E
BIERCEVICZ, MARK P	BS Nat Res Conserv	Biologist C	BIC	7.00	E
BINKERD, ROGER C	MS Ocean Engineer	Lab Director	ENC	25.00	U/E
BISSONETTE, DONALD J	BS Chemistry	Chemist	OMS	5.00	U/E
BLAIR, BRIAN W	HS General Studies	Chem Tehnician	OMS	0.00	
BLERSCH, JOSEPH A	PhD Phil/Phys Chem	Chemist	OGC	6.00	U/E

* EXPERIENCE TYPE: U (University/Gov't Lab); H (Hospital); I (Industry); E (Envionmental Lab); 1 (Degree Pending)

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INCHCAPE TESTING SERVICES
AQUATEC LABORATORIES Vermont Division

FULL NAME	DEGREE/AREA OF STUDY		DUTIES	WORK AREA	YRS/EXPERIENCE	TYPE*
BOUDREAU, EARL R	HS	General Studies	Chem Tehnician	EXT	1.00	E
BRINKMAN, STANLEY G	BA	Applied Science	Chemist	INO	10.00	E
BROOKS, KEVIN W	MA	Biology	Chemist	EXT	4.00	E
CAMARA, CAROLINE P	BS	Biochemistry	Data Analyst D	CMS	7.00	E
CAMPBELL, IAN E	BA	Biology	Biologist	BIL	4.00	E
CARNEY, LINDA J	BS	Enviro Chemistry	Chemist	OGC	3.00	E
CARTY, KATHLEEN C	HS	General Studies	HR Assistant	ADG	8.00	I
CHEVALIER, ANN M	AAS	Liberal Studies	Purchaser	ADG	5.00	E
CHIRGWIN, BRADLEY W	BS	Biochem Sciences	Chemist	OGC	7.00	E
CHIRGWIN, KAREN R	MS	Biostatistics	Lab Director	GEN	9.00	E
CHOINIERE, CONRAD J	BS	Chem Engineering	Engineer	ENC	4.00	U/I/E
CHOINIERE, ERIC J	BA	Zoology	Chem Tehnician	EXT	1.00	U/E
CLEMENTS, JENNIFER L	BS	Biological Sci	Chem Tehnician	OGC	3.00	U/I
COLLINS, HEATHER L	BS	Business Admin	Controller	ADA	8.00	U/H/I/E
COMEAU, JOSEPH K	PhD	Analyt Chemistry	Vice President	GEN	30.00	E
COMEAU, RACHAEL A	BA	English	Marketing Asst.	GEN	4.00	E
COMEAU, VAUGHN S	BA	Chem/Intl Stud.	Chem Tehnician	EXT	4.00	E

* EXPERIENCE TYPE: U (University/Gov't Lab); H (Hospital); I (Industry); E (Envionmental Lab); 1 (Degree Pending)

FULL NAME	DEGREE/AREA OF STUDY		DUTIES	WORK AREA	YRS/EXPERIENCE TYPE*	
COTA, FREDERICK P	HS	General Studies	Chem Tehnician	MET	7.00	E
DAUM, BRIAN E	HS	General Studies	Courier	ADF	1.00	E
DAVIN, JEFFREY L	BS	Bio/Chemistry	Chem Tehnician	EXT	5.00	E
DAWICKI, JR., DONALD C	HS	General Studies	Sample Custodian	SMG	5.00	E
DELMONTE, JOHN A	AS	Elec Engineering	Service Specialis	GEN	17.00	U/I/E
DESJARDINS, WILLIAM	BS	Biology	Chemist	EXT	15.00	E
DESMOND, CATHERINE J	BA	Biology	Biologist	BIL	2.00	E
DEVINE, DOUGLAS P	AA	Chemistry	Data Analyst	CMS	1.50	U/E
DEYO, LISBETH M	AA	Chemistry	Biologist	BIL	30.00	H/I/E
DORMAN, FRANK L	PhD	Analytical Chem	Chemist	GEN	4.00	E
DOWNEY, PHILIP C	PhD	Analytical Chem	Lab Director	BIG	14.00	E
DOWNING, DAVID P	BS	Enviro Science	Chemist	OGC	3.00	E
DUMAS, CONSTANCE C	BS	Medical Tech	Microbiologist	BIB	28.00	H/E
EDWIN, JOSEPH	PhD	Ino/Analyt Chem	Senior Chemist	OMS	14.00	U/E
ELLIS, SHARON E	BC	Transp/Compu Sys	Dir, Info. Tech.	ISG	13.00	I/E
ENGLISH, CHRISTOPHER M	BS	Enviro Science	Chemist	OMS	1.00	U/E

*EXPERIENCE TYPE: U (University/Gov't Lab); H (Hospital); I (Industry); E (Envionmental Lab); 1 (Degree Pending)

FULL NAME	DEGREE/AREA OF STUDY	DUTIES	WORK AREA	YRS/EXPERIENCE TYPE*	
EVARTS, JOHN L	AS Mech Engin Tech	Facil. Engineer	ADF	8.00	I/E
FARLEY, ROBERT G	BS Geology	Geologist	ENC	8.00	E
FINCK, LAURA L	BS Bio/Marine Sci	Field Biologist	BIC	3.00	U/E
FLUCK, STEVEN J	BS Biology	Chemist C	OGC	8.00	U/E
GALE, PETER N	MS - Geology	Project Director	SAM	16.50	U/I
GAYNOR, DEBORAH H	PhD Chemistry	Section Head	CMS	9.00	U/E
GODDETTE, JOYCE M	HS Secretarial Sci	Executive Secreta	ADG	17.00	I/E
GOLDMAN, ANNE S	HS General Studies	Personnel Diretor	ADG	11.00	U/I/E
GOMEZ, RICHARD T	MS Cell Biology	Project Director	SAM	20.00	U/I/E
GRANT, CASEY J	BA Chemistry	Chemist	INO	1.00	U/E
GRATTON, ANGELA M	HS General Studies	Tech. Assistant	OGC	5.00	E
GUAY, GARY W	BA Enviro Science	Chemist	CMS	4.00	E
GUILLETTE, NATALIE L	AAS Office Mgmt	Accountant	ADA	8.00	I/E
HALPORN, DOUGLAS A	BA Chemistry	Chemist	CMS	4.00	E
HARDWICK, DAVID M	BS Biochemistry	Section Head	INO	18.00	U/E
HARNISH, DAVID W	MS Chemistry	Chemist C	OMS	4.00	U/E

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FULL NAME	DEGREE/AREA OF STUDY		DUTIES	WORK AREA	YRS/EXPERIENCE TYPE*	
HENRY, MAUREEN R	HS	General Studies	Sample Custodian	SMG	7.00	E
HEWLETT, MICHAEL T	BS	Biochemistry	Section Head	SMG	8.00	E
HIGHTER, CLEMENT A	HS	General Studies	Facil. Technician	ADF	7.00	E
HOPKINS, DENISE P	BS	Biology	Biologist	BIB	4.00	E
HULBERT, JOHN W	BS	Engineering Tech	Engineer A	ENC	12.00	U/E
JEFSON, HEATHER L	BA	Enviro Science	Chem Tehnician	INO	2.00	E
JOHNSTON, HERBERT G	MS	Mathematics	Info Sys Director	ISG	20.00	E
KING, DAVID E	BS	Forest Mgmt	Operations Super.	ISG	20.00	E
LAMBERT, KELLY T	BA	Chemistry	Chemist C	OGC	11.00	E
LAURICELLA, ROBERT J	BA	Enviro Science	Chem Tehnician	OGC	3.00	E
LEMNAH, LISA M	HS	General Studies	Admin Assistant	SAM	0.00	
LESCARBEAU, GREGORY R	BS	Marine Biology	Biologist	BIC	13.00	E
LEUSCHNER, JR., EDWARD T	BS	Chemistry	Data Analyst	OMS	1.00	E
LUXENBERG, ROLAND R	MS	Civ Engineering	Engineer A	ENC	15.00	U/E
MADISON, JAMES W	BS	Enviro Studies	Project Director	SAM	9.00	E
MAGNANT, BRADLEY C	HS	General Studies	Data Analyst B	OMS	21.00	E
MALIK, PAULINE T	BS	Chemistry	Marketing Dir.	SAM	7.00	E

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FULL NAME	DEGREE/AREA OF STUDY	DUTIES	WORK AREA	YRS/EXPERIENCE TYPE*	
MANOS, CHRISTOPHER P	BS Chemistry	Chemist	MET	3.00	E
MCKINSTRY, JAMES L	BS Analytical Chem	Chemist C	OMS	3.00	E
MCMAHON, JEFFREY R	BS Enviro Science	Field Technician	ENC	5.00	U/E
MCNEER, RICHARD M	PhD Chemistry	Senior Chemist	OMS	44.00	U/E
MILES, GARY R	BS Bio Fisheries	Field Supervisor	BIC	4.00	E
MILLER, PATRICIA D	HS Account/Finance	Accountant	ADA	17.00	I/E
MOFFAT, BRIAN D	MS Public Health	QC Officer	BIL	1.00	U/E
MOFFAT, CAROLINE	BS Marine Sci/Bio	Chemist	INO	4.50	I/E
MULHOLLAND, CHRISTINE	BA Bio/Chem	Data Analyst	CMS	6.00	E
MUZZY, CHRISTOPHER D	BA Bio/Env Science	Chemist	OGC	1.50	E
NEEDHAM, DANIEL E	BS Enviro Science	Chemist	INO	9.00	E
NERBER, DEBORAH I	AAS General Business	Admin Assistant	ADG	4.00	I/E
NIES, KATHERINE S	BA Chemistry	Chemist	OGC	4.00	E
NISLOW, KEITH H	PHD Biology	Biologist	BIC	3.00	U/E
NOBLE, MATTHEW E	HS General Studies	Chem Tehnician	EXT	6.00	U/I/E
O'HARA, KATHLEEN R	BS Enviro Studies	Data Analyst C	MET	16.00	E

* EXPERIENCE TYPE: U (University/Gov't Lab); H (Hospital); I (Industry); E (Envionmental Lab); 1 (Degree Pending)

FULL NAME	DEGREE/AREA OF STUDY	DUTIES	WORK AREA	YRS/EXPERIENCE TYPE*	
OPFERMAN, CHARLES F	HS General Studies	Chem Tehnician	EXT	3.00	E
ORSINI JR., JOSEPH J	PhD Analytical Chem	Ass't Director	GEN	7.00	E
OUELLETTE, CHRISTOPHER A	BA Biology	Field Technician	ENC	10.00	U/I/E
PAGE, CAROLYN S	BA Chemistry	Chemist	OGC	3.00	E
PARK, JANICE H	BS Comp Sci/Math	Database Manager	BIG	12.00	U/E
PETERSON, CINDY M	BA Biology	Chemist C	CMS	9.00	E
PETERSON, DAVID J	BS Env Engineering	Chemist C	EXT	8.00	E
PETTIT, DANIEL R	BS Bio/Aquatic Ecol	Biologist	BIL	2.00	E
PHILLIPS, MARK T	BA Enviro Studies	Section Head	EXT	4.00	E
PLOOF, NANCY L	HS Acct/Secretarial	Accountant	ADA	11.00	H/I
POWERS, ANNE T	BA Home Economics	Tech. Assistant	GEN	5.00	E
ROBBINS, DARRELL W	BA Physics	Chemist	OMS	4.00	I/E
ROBINSON, DAVID S	MS Analytical Chem	Project Director	SAM	6.00	E
ROBINSON, WALLACE B	BA Enviro Studies	Data Analyst	OGC	5.00	E
ROORDA, RICHARD D	HS Auto Mechanics	Facil. Technician	ADF	9.00	I/E
ROSS, ROBERT J	BS Hydrology	Hydrogeologist	ENC	12.00	E

* EXPERIENCE TYPE: U (University/Gov't Lab); H (Hospital); I (Industry); E (Envionmental Lab); 1 (Degree Pending)

FULL NAME	DEGREE/AREA OF STUDY	DUTIES	WORK AREA	YRS/EXPERIENCE TYPE*	
ROY, MARTHA E	MS Zoology	QA/QC Officer	GEN	10.00	E
RUSIK, JEFFREY J	BS Chemistry	App. Engineer A	ISG	18.00	U/I/E
RUTH, TIMOTHY M	BS Chemistry	Chemist	OGC	4.00	E
SCHMIDT, WILLIAM A	AAS Civ Engineering	Chemist	OGC	6.00	E
SMITH, LISA T	BS Biochem Science	Data Analyst	OGC	4.00	E
SMITH, MATTHEW J	BS Business Admin	Programmer	OMS	4.00	E
SMITH, ROBERT L	MA Biology/Chem	Field Biologist	BIC	3.50	U/I/E
ST. PIERRE, RICHARD W	HS General Studies	Chem Tehnician	INO	8.00	E
STANTON, ANNE L	HS General Studies	Tech. Assistant	GEN	7.00	i
STARBUCK, MICHAEL B	BS Mech Engineering	Facil. Manager	ADF	10.00	E
STEARNS, BRYCE E	BS Enviro Science	GCMS Inst Coordin	OMS	12.00	U/E
STIDSEN, GARY B	BS Env Engineering	Section Head	OGC	13.00	E
SULLIVAN, CAROL M	BA Chemistry	Chemist	CMS	7.00	E
SWANBORN, SCOT P	BS Enviro Science	Project Director	SAM	10.00	E
TAM, PUY N	HS General Studies	Chem Tehnician	INO	8.00	E
TILLOTSON, KEVIN D	AA Accounting	File Clerk	ADA	2.00	I
TRUAX, JENNIFER	BA Sociology	Tech. Assistant	OMS	6.00	U/I

* EXPERIENCE TYPE: U (University/Gov't Lab); H (Hospital); I (Industry); E (Envionmental Lab); 1 (Degree Pending)

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FULL NAME	DEGREE/AREA OF STUDY	DUTIES	WORK AREA	YRS/EXPERIENCE TYPE*	
VAN WYCK, ALICE G	BS Math/Comp Scienc	Ass't Director	ISG	12.00	U/H/E
VAN WYCK, NEAL E	MS Phys Chemistry	General Manager	ADG	10.00	E
VANDEVORD, CHRISTA L	BS Business Admin	Accountant	ADA	2.00	E
VEILLEUX, MICHAEL R	BS Ecology	Chemist	OGC	8.00	E
VOSE, JAMES C	BA Chemistry	Chemist B	OMS	18.00	I/E
WAKEMAN, JON S	AAS Forestry	Field Engineer C	ENC	14.00	I/E
WARD, BETH A	BS Chem Engineering	Chemist	INO	3.00	E
WILKINSON, JON P	BS Enviro Science	Chemist	OGC	11.00	E
WILLIAMS, JOHN W	BS Marine Biology	Toxicity Lab Mgr	BIL	22.00	E
WYNKOOP, JAMES E	BS Enviro Science	Chemist	MET	4.00	E
WYNKOOP, SHEILA M	BS Business Mgmt	Doc Cntrl Officer	GEN	3.00	E
YOUNG, KIRK F	BS Civ Engineering	Section Head	OMS	21.00	E
ZYGMUNTOWICZ, JON K	BS Ecology	Section Head	EXT	4.00	E

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APPENDIX B: Laboratory Waste Storage and Disposal

Laboratory Wastes Generated at Aquatec Laboratories and the Associated Storage and Disposal Methods

Facilities:

55 South Park Drive
Colchester, VT 05446
(802)655-1203
VTD988366167

75 Green Mountain Drive
South Burlington, VT 05403
VTD050421940

Metals Group

The metals group uses hydrochloric, nitric, and sulfuric acids in the preparation and analysis of samples. Waste acids and acid-containing preparations are accumulated in specially designated and acid-compatible one gallon containers located near each workstation. When a container is full, the container is transported in a secure transport device or a secondary outer container to the Hazardous Waste Room where it is bulked in a polypropylene-lined 55 gallon drum (DOT 6D). The "Acid Waste" drum is properly marked with all appropriate labels. Typical concentrations of metals found in this waste stream are listed in Attachment 1. Plastic and glass containers used during sample preparation are cleaned and recycled whenever possible.

Disposal of the "Acid Waste" is coordinated through Laidlaw Environmental Services (North East), Inc. (Laidlaw). Expected volume is seventy-five 55 gallon drums per year.

Organic Extraction Group

The organic extraction group uses methylene chloride, acetone, hexane, methanol, and ethyl ether in the preparation of samples for analysis. Solvents are recovered from the concentration process by distillation. Estimated solvent recovery is 90%.

Waste solvent is collected in one gallon glass containers. Full containers are transported to the Hazardous Waste Room in rubber bottle carriers or on an corrosion-resistant utility cart designed to prevent spills or leaks. Waste solvent is bulked in a 55 gallon metal drum (DOT 17E) labeled "Solvent Waste". The "Solvent Waste" drum is marked with all appropriate labels.

Disposal of the "Solvent Waste" is coordinated through Safety-Kleen. Expected volume is ninety 55 gallon drums per year.

Aqueous waste from the Base/Neutral/Acid extraction of liquid samples and herbicide extractions is bulked in the "Acid Waste" drums as described previously.

Solids/soils, sodium sulfate, and filter paper from the extractions of solid samples are bulked in a 55 gallon drum (DOT 17H) labeled "Soil Waste". The "Soil Waste" drum is marked with all appropriate labels. Disposal of the "Soil Waste" is coordinated through Laidlaw. Expected volume is ten 55 gallon drums per year.

GC and GC/MS Group

Laboratory waste from the GC and GC/MS group consists of small glass vials (2 mLs to 40 mLs) containing methylene chloride, hexane, acetone, methanol, ethyl ether, and carbon disulfide. Some vials may also contain a small percentage of solid material, mainly soil from a mini-extraction process. Glass vials are accumulated near each work station in 5 gallon polypropylene pails. Full pails are transported to the Hazardous Waste Room where they are bulked into 55 gallon drums (DOT 17H) labeled "Bulk Vials". The "Bulked Vials" drum is marked with all appropriate labels.

Disposal of "Bulked Vials" is coordinated through Laidlaw. Expected volume is fifteen 55 gallon drums per year.

In some circumstances, elemental mercury is used as a "clean-up" step in preparing extracts for analysis. Glass vials containing mercury are collected in a separate pail near each work station. Mercury containing debris (pipettes, chem-wipes, etc,) are collected in a separate pail. Full pails are transported to the hazardous waste room.

This group also generates a small volume of acetonitrile waste (about 0.5 gallons per month). Acetonitrile is bulked with the "Solvent Waste" as described previously.

Wet Chemistry Group

The wet chemistry group generates the following types of waste: acidic, basic, and Pyridine-Barbituric Acid Reagent.

Acidic waste is bulked in the "Acid Waste" drum as previously described.

Basic waste is bulked in a polypropylene-lined 55 gallon drum (DOT 6D). The "Caustic Waste" drum is properly labeled; disposal is coordinated through Laidlaw. Anticipated volume is eleven 55 gallon drums per year.

Pyridine-Barbituric Acid Reagent is accumulated near each workstation in one gallon containers. Full containers are transported to the Hazardous Waste Room in secure transport devices or secondary containers and bulked in a properly labeled 55 gallon drum (DOT 17E) marked "Pyridine-Barbituric Acid Waste". Disposal is coordinated through Safety-Kleen. Anticipated volume is three 55 gallon drums per year.

Biology Group

Biotoxicity tests are conducted on industrial waste waters and river, lake and ocean water. Occasionally, these samples contain components that must be disposed of through a certified facility. These samples are bulked in the "Aqueous Waste" drum. The "Aqueous Waste" drum is marked with all appropriate labels. Disposal is coordinated through Laidlaw. Anticipated volume is thirty-five 55 gallon drums per year.

Cultures from bacteria and coliform tests along with pipettes, gloves and other disposable equipment are autoclaved before being disposed of at a solid waste facility.

Sample Management

Disposal of unused sample volume is coordinated through the Sample Management Office. After analytical results have been sent to the client, samples are held for a specific period of time. Typical sample holding times are as follows:

- New York State: 90 days (except samples designated PA-------; these samples are held until a letter from the State of New York allows for disposal)
- EPA: 60 days
- Level 4: 60 days
- Commercial: 21 days

Other sample holding times are dependent upon contractual arrangements.

When the holding time for a sample has expired, samples are removed from the sample management area and taken to the Hazardous Waste Storage Area. Disposal is dependent upon three factors: preservation, level of contamination, and information provided by the client.

Depending upon the analyses, certain aqueous samples are preserved with either acid or base. For example, metals are preserved with nitric acid and cyanides are preserved with sodium hydroxide. Samples preserved with acids are bulked in the "Acid Waste" drum as described previously. Samples preserved with base are bulked in the "Caustic Waste" drum as previously described. Non-preserved aqueous samples are bulked in the "Aqueous Waste" drum described previously.

Disposal methods for the remaining samples are dependent upon the level of contamination detected during the course of the requested analytical work and information provided by the client. These samples are "lab-packed". "Lab packs" are prepared by Rollins ChemPak, Inc.

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APPENDIX C: Analytical Methodologies

Biology Methods

Method #	Method Name
BAM1:HGMF	Coliform, Total (CFU/g)
BAM2:HGMF	Coliform, E. Coli (CFU/g)
BAM3:HGMF	Bacteria, Total (CFU/g)
BAM4:HGMF	Salmonella Spp (P/A)
BAM5	Salmonella Spp (P/A)
ISOGRID1:HGMF	Yeast & Mold, Total (Col/g)
ISOGRID2:HGMF	Bact.,Gram Neg. (CFU/g)
ISOGRID3:HGMF	Staph. aureus (Col/g)
907A:PP	Bacteria, Total (CFU/ml)
907C:MF	Bacteria, Total (CFU/ml)
908A:MPN	Coliform, Total(col/100ml)
908C:MPN	Coliform, Fecal (col/100ml)
909A:MF	Coliform, Total(col/100ml)
909C:MF	Coliform, Fecal (col/100ml)
910B:MF	Strep., Fecal (col/100ml)
918A	Bact., Iron (qualitative)
918C2	Bact, Iron Prof (col/100ml)
918C2A	Bact, Spha/Lept (col/100ml)
918C2D	Bact, Het. Iron (col/100ml)
9213D:MF	E. Coli (CFU/100ml)
1000.0:1	P. Promelas Growth
1001.0:1	P. Promelas Embryo/Larval
1002.0:1	C. Dubia Reproduction
1003.0:1	S. Capricornutum Growth
1004:1	C. Variegatus Embryo
1005:1	C. Variegatus Embryo
1006:1	M. Beryllina Growth
1007:1	M. Bahia Growth/Fecundity
1008:1	A. Punctulata Fertiliz.
1009:1	C. Parvula Reproduction
288701:1	Toxicity Id. Evaluation
485131:1	C. Dubia 48-H Static AC
485131:2	C. Dubia 96-H Renewal AC
485132:1	D. Pulex 48-H Static AC
485132:2	D. Pulex 96-H Renewal AC
485133:1	D. Magna 48-H Static AC
485133:2	D. Magna 96-H Renewal AC
485134:1	P. Promelas 48-H Stat. AC
485134:2	P. Promelas 96-H Renew AC
485135:1	M.Bahia 48-H Static AC
485135:2	M. Bahia 96-H Renewal
485136:1	C. Variegatus 48-H Static
485136:2	C. Variegatus 96-H Renew.
485137:1	M. Beryllina 48-H Static
485137:2	M. Beryllina 96-H Renewel
ASTM89:1	C. Tentans Sediment Test
ASTM90:2	H. Azteca Sediment Test
Beckman1:1	Microtox Screen (no dil)
Beckman2:2	Microtox Dilution Series
100262:1	Chlorophyll a, corrected
100262:2	Chlorophyll a, uncorrected
100262:FLUO	Chlorophyll a (ug/l)
1002CIF:SED	Phytoplankton (units/l)

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Extraction Lab Methods

hod #	Method Name
505:EXW	Ext. Pest/PCB
508:EXW	Ext. Pest/PCB
515:EXW	Ext. Herbicide Water
604:EXW	Ext. Phenols Water
606:EXW	Ext. Phthalate Ext. Water
607:EXW	Ext. Nitrosamines Water
608:EXLW	Ext. Low Level P/PCB Water
608:EXW	Ext. Pest/PCB Water
608_PCB:EXLW	Ext. Low Level PCB Water
608_PCB:EXW	Ext. PCB only Water
609:EXW	Ext. Nitroaromatics/Isophoron Water
610:EXW	Ext. Polynuclear Aromatic Water
611:EXW	Ext. Haloethers Water
612:EXW	Ext. Chlorinated Hydrocarbons
615:EXW	Ext. Chlorinated Herbicide Water
619:EXW	Ext. Triazine Pesticide Water
622:EXW	Ext. Organophosphorus Water
625:EXW	Ext. Semivolatile Organics Water
_MWRA:EXW	Ext., SVOA Water
8040:EXS	Ext. Phenols Soil
8040:EXW	EXT. Phenols Water
8060:EXS	Ext. Phthalate Esters Soil
8060:EXW	Ext. Phthalate Esters Water
8080:EXLW	Ext. P/PCB Low level Water
8080:EXS	Extraction, P/PCB Soil
8080:EXW	Extraction, P/PCB Water
8080_AP9:EXS	Ext. A9 Chl. P/PCB Soil
8080_AP9:EXW	Ext. A9 Chl. P/PCB Water
8080_EPTOX:EX	Ext. EPTOX Pest Water
8080_PCB:EXB	Extraction, PCB Biota
8080_PCB:EXF	Extraction, PCB Filter
8080_PCB:EXLW	Extraction, PCB Low Water
8080_PCB:EXO	Ext. PCB's in Oil
8080_PCB:EXS	Extraction, PCB Soil
8080_PCB:EXSL	Ext. PCB's in sludge
8080_PCB:EXW	Extraction, PCB Water
8080_PCB:EXWI	Ext. PCB's on Wipes
)_TCLP:EX	Ext. TCLP Pesticides
8100:EXS	Ext. PNA's Soil
8100:EXW	EXT PNA's Water
8120:EXS	Ext. Chlorinated Hydrocarbons Soil

Method #	Method Name
8120:EXW	Ext. Chlorinated Hydrocarbons Water
8140/8141:EXS	Ext. Organophosphorus Pest. Soil
8140/8141:EXW	Ext. Organophosphorus Pest. Water
8140/8141_AP9:EXS	Ext. A9 Organophosphorus Pest. Soil
8140/8141_AP9:EX	Ext. A9 Organophosphorus Pest. Wat
8150:EXS	Ext. Chlorinated Herbicide Soil
8150:EXW	Ext. Chlorinated Herbicide Water
8150_AP9:EXS	Ext. AP9 Herbicide Soil
8150_AP9:EXW	Ext. AP9 Herbicide Water
8150_EPTOX:EX	Ext. EPTOX Herbicide Water
8150_TCLP:EX	Ext. TCLP Herbicides
8270:EXS	Ext. Semivolatile Soil
8270:EXW	Ext. Semivolatile Water
8270_AP9:EXS	Ext. A9 Semivolatile Soil
8270_AP9:EXW	Ext. A9 Semivolatile Water
8270_TCLP:EX	Ext. TCLP Semivolatiles
8310:EXS	Ext. PNA's Soil
8310:EXW	Ext. PNA's Water
8330:EXW	Ext. Explosives Water
8330:EXS	Ext. Explosives Soil
OLC.PPCB:EXW	Extraction, PPCB Water Low Level
OLC.SEMI:EXW	Extraction, SVOA Water Low Level
OLM01.PPCB:EXS	Extraction, PPCB Soil
OLM01.PPCB:EXW	Extraction, PPCB Water
OLM01.SEMI:EXS	Extraction, SVOA Soil
OLM01.SEMI.EXW	Extraction, SVOA Water
OLMNY.PPCB:EXS	Extraction, NY PPCB Soil
OLMNY.PPCB:EXW	Extraction, NY PPCB Water
OLM01.SEMI:EXS	Extraction, NY SVOA Soil
OLM01.SEMI.EXW	Extraction, NY SVOA Water
OR215:EXS	Ext. TPH as Diesel Soil
OR215:EXW	Ext. TPH as Diesel Water
OR530:EXB	Ext. PCB-C Biota
OR530:EXBW	Ext. PCB-C Water Rinse
OR530:EXDW	Ext. PCB-C Wat. Deca
OR530:EXF	Extract, PCB-C Filter
OR530:EXS	Extract, PCB-C Solid
OR530:LVW	Extract, PCB-C Lg. Vol.

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Metals Methods

Method #	Method Name
Prep	
1310:M	EP Tox Extraction (metals)
200:1T	Digestion, ICP, fu Sb
200:2T	Digestion, fu, ICP Ag
3005:1T	Digestion, ICP W, D/R
3010:1T	Digestion, ICP W,T
3020:1T	Digestion, fu W, ICP Ag
3020:2T	Digestion, fu W, As/Se
3040	Dissolution
3050:1T	Digestion, ICP O
3050:2T	Digestion,fu O, ICP Ag
ILM02:FS	Digestion Furnace Soil
ILM02:FW	Digestion Furnace Water
ILM02:IW	Digestion ICP Water
ILM02:IS	Digestion ICP Soil
IN200.	NaOH Fusion
1311:EXTM	TCLP Metals Extraction
ICP	
200.7:AG	Silver, Total
200.7:AL	Aluminum, Total
200.7:AS	Arsenic, Total
200.7:B	Boron, Total
200.7:BA	Barium, Total
200.7:BE	Beryllium, Total
200.7:CA	Calcium, Total
200.7:CD	Cadmium, Total
200.7:CO	Cobalt, Total
200.7:CR	Chromium, Total
200.7:CU	Copper, Total
200.7:FE	Iron, Total
200.7:K	Potassium, Total
200.7:LI	Lithium, Total
200.7:MG	Magnesium, Total
200.7:MN	Manganese, Total
200.7:MO	Molybdenum, Total
200.7:NA	Sodium, Total
200.7:NI	Nickel, Total
200.7:PB	Lead, Total
200.7:SB	Antimony, Total
200.7:SE	Selenium, Total
200.7:SI	Silicon, Total
200.7:SN	Tin, Total
200.7:SR	Strontium, Total
200.7:TI	Titanium, Total
200.7:TL	Thallium, Total
200.7:V	Vanadium, Total
200.7:ZN	Zinc, Total
6010:AG	Silver, Total
6010:AL	Aluminum, Total
6010:AS	Arsenic, Total
6010:B	Boron, Total
6010:BA	Barium, Total
6010:BE	Beryllium, Total
6010:CA	Calcium, Total
6010:CD	Cadmium, Total
6010:CO	Cobalt, Total
6010:CR	Chromium, Total
6010:CU	Copper, Total
6010:FE	Iron, Total
6010:K	Potassium, Total
6010:LI	Lithium, Total
6010:MG	Magnesium, Total
6010:MN	Manganese, Total
6010:MO	Molybdenum, Total
6010:NA	Sodium, Total
6010:NI	Nickel, Total
6010:PB	Lead, Total
6010:SB	Antimony, Total
6010:SE	Selenium, Total
6010:SI	Silicon, Total
6010:SN	Tin, Total
6010:SR	Strontium, Total
6010:TI	Titanium, Total
6010:TL	Thallium, Total
6010:V	Vanadium, Total
6010:ZN	Zinc, Total
ILM02:AG	Silver, Total
ILM02:AL	Aluminum, Total
ILM02:AS	Arsenic, Total
ILM02:B	Boron, Total
ILM02:BA	Barium, Total
ILM02:BE	Beryllium, Total
ILM02:CA	Calcium, Total
ILM02:CD	Cadmium, Total
ILM02:CO	Cobalt, Total
ILM02:CR	Chromium, Total
ILM02:CU	Copper, Total
ILM02:FE	Iron, Total
ILM02:K	Potassium, Total
ILM02:LI	Lithium, Total
ILM02:MG	Magnesium, Total
ILM02:MN	Manganese, Total
ILM02:MO	Molybdenum, Total
ILM02:NA	Sodium, Total
ILM02:NI	Nickel, Total
ILM02:PB	Lead, Total
ILM02:SB	Antimony, Total
ILM02:SE	Selenium, Total
ILM02:SI	Silicon, Total
ILM02:SN	Tin, Total
ILM02:SR	Strontium, Total

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Metals Methods

Method #	Method Name
[illegible] (Continued)	
.02:TI	Titanium, Total
iLM02:TL	Thallium, Total
ILM02:V	Vanadium, Total
ILM02:ZN	Zinc, Total
IN202	Lead in Air
IN714	Strontium
Furnace	
202.2	Aluminum, Total
204.2	Antimony, Total
206.2	Arsenic, Total
208.2	Barium, Total
210.2	Beryllium, Total
213.2	Cadmium, Total
218.2	Chromium, Total
220.2	Copper, Total
236.2	Iron, Total
239.2	Lead, Total
243.2	Manganese, Total
246.2	Molybdenum, Total
249.2	Nickel, Total
270.2	Selenium
.2	Silver
273.2	Sodium
279.2	Thallium, Total
282.2	Tin, Total
286.2	Vanadium, Total
289.2	Zinc, Total
7041	Antimony, Total
7060	Arsenic, Total
7091	Beryllium, Total
7131	Cadmium, Total
7191	Chromium, Total
7211	Copper, Total
7421	Lead, Total
7521	Nickel, Total
7740	Selenium
7761	Silver
7841	Thallium, Total
7911	Vanadium, Total
7951	Zinc, Total

Method #	Method Name
Cold Vapor	
245.1	Mercury, Total
7470:AQ	Mercury, Total
7471:S	Mercury, Total
ILM02:HG	Mercury, Total
TCLP	
TCLPMET	TCLP Metals
TCLPMET:VT	TCLP Metals- Vt
EPTOX	
EPM	Metals on EPTOX Extract
EPV	Metals on EPTOX Extract-VT

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GC Methods

Method #	Method Name
501.1:GC	Trihalomethanes
502.2	Volatile Organics
503.1	Volatile Aromatics
504	EDB and DBCP
505:AN	Pesticide/PCB's
507:AN	Organophosphorus Pest.
508:KIT	Pesticide/PCB
515:AN	Herbicides
531.1:C	Carbamate Pesticides
601:AN	Purgeable Halocarbons
602:AN	Purgeable Aromatics
604:AN	Phenols
606:AN	Phthalate Esters
607:AN	Nitrosamines
608:AN	Pesticides/PCB's
608_PCB:AN	PCB's Only
609:AN	Nitroaromatics/Isophorone
610:AN	Polynuclear Aromatics
611:AN	Haloethers
612:AN	Chlorinated Hydrocarbons
615:AN	Chlorinated Herbicides
619:AN	Triazine Pesticides
622:AN	Organophosphorus Pest.
8010:S	Halogenated Volatiles
8010:W	Halogenated Volatiles
8015	Nonhalogenated Volatiles
8015_AP9:ANS	An. Ap9 Solvent Scan Soil
8015_AP9:ANW	An. Ap9 Solvent Scan Water
8015_GAS:S	TPH- Gasoline
8015_GAS:W	TPH- Gasoline
8015_LUFT:S	B.T.E.X., TPH (gas)
8015_LUFT:W	B.T.E.X., TPH (gas)
8020:S	Aromatic Volatiles
8020:W	Aromatic Volatiles
8021:S	Halogenated Volatiles
8021:W	Halogenated Volatiles
8040:AN	Phenols
8060:AN	Phthalate Esters
8080:AN	Analysis, Pesticides/PCB's
8080_AP9:AN	Analysis A9 Chlor. P/PCB
8080_EPTOX:AN	Analysis, EPTOX Pesticides
8080_PCB:AN	Analysis, PCB's
8080_TCLP:AN	TCLP Pesticides

Method #	Method Name
8100:AN	Polynuclear Aromatics
8120:AN	Chlorinated Hydrocarbons
8140:AN	Organophosphorus Pest.
8141_AP9:AN	Analysis, A9 OP Pest
8150:AN	Chlorinated Herbicides
8150_AP9:AN	Analysis, Chlor. Herb.
8150_EPTOX:AN	EP Tox Herbicides
8150_TCLP:AN	TCLP Herbicides
8310:AN	Polynuclesr Aromatics
8318:AN	Carbamate Pesticides
8330:KIT	Nitroaromatics
OLC.PPCB:AN	Analysis, PPCB
OLM01.PPCB:AN	Analysis, PPCB, Revision 9
OLMNY.PPCB:AN	Analysis, NY_PPCB, Rev 9
OR215:AN	Analysis TPH as Diesel
OR530_PEST:AN	Pest/Congener Analysis

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GC/MS Methods

Method #	Method Name
Volatiles	
524.2 :AN	Volatile Organics
624 :AN	Volatile Organics
8240 :AN	Volatile Organics
8240_AP9:AN_G	A9 Volatiles
8240_TCLP:AN	TCLP Volatiles
8240NY:AN_G	Volatile Organics_NY
8260 :AN	Volatile Organics
OLC.VOL	Analysis, VOL
OLM01.VOL:AN_G	Analysis, VOL, Revision 9
OLMNY.VOL:AN_G	Analysis, NY_VOL, Revision 9
Semivolatile Organics	
625 :AN	Semivolatile Organics
8270 :AN	Semivolatile Organics
8270_AP9:AN	Analysis A9 Semivolatiles
8270 :B	Base Neutral Extractables
8270_TCLP:AN	TCLP Semivolatiles
8270NY:AN_G	Semivolatile Organics_NY
OLM01.SEMI :AN_G	Analysis, SVOA, Revision 9
OLMNY.SEMI :AN_G	Analysis, NY_SVOA, Rev 9

Wet Chemistry Methods

Method #	Method Name
110.2	Color
120.1	Conductivity
130.2	Total Hardness as CaCO3
150.1	pH (std units)
160.1	Total Dissolved Solids
160.2	Total Suspended Solids
160.3	Total Solids
160.4	Volatile Total Solids
160.5	Settleable Solids (ml/l)
180.1	Turbidity (NTU)
300.0:IC	Chloride, Fluoride, Sulfate, Nitrate
300.0:BR	Bromide by Ion Chromatography
300.0:P	O-Phosphate by IC
305.2	Acidity uequiv/L
310.1	Alkalinity (as CaCO3)
310.1:Kit	Alkalinity with Breakdown
325.2	Chloride
330.4:DPD	Total Residual Chlorine
335.1	Cyanide, Total and Amenable
335.2	Cyanide, Total
340.2	Fluoride
350.2:DIS	Ammonia-Nitrogen
351.3	Total Kjeldahl Nitrogen
353.2	Nitrate/Nitrite Nitrogen
354.1	Nitrite Nitrogen
360.2	Dissolved Oxygen
365.2:ORTH	Orthophosphate as P
365.2:TOTL	Total Phosphate as P
375.2	Sulfate
376.2	Sulfide
377.1	Sulfite
405.1	BOD5
410.1	Chemical Oxygen Demand
413.1:GRAV	Oil and Grease
413.2:IRW	Oil and Grease
415.1	Total Organic Carbon
418.1:IRW	Petroleum Hydrocarbons
420.1:EXT	Total Phenols
425.1	MBAS (mg LAS/L)
450.1	Total Organic Halides
1010	Ignitability (F)
1110:COU	Corrosivity by Steel Coupon
1110:PH	Corrosivity by pH
7196:L	Hexavalent Chromium
7196:S	Water Extract Hex. Chromium
9010:A	Total Cyanide

Method #	Method Name
9010:B	Cyanide, Amenable to Chlorine
9020	Total Organic Halides
9030:TITR	Sulfide
9036	Total Sulfate
9040	pH (std. units)
9041	pH Paper Method
9045:DI	Soil pH (std. units)
9045:SLT	Soil pH (std. Units)
9050	Conductivity (umhos/cm)
9060	Total Organic Carbon
9065	Phenols, Total
9070:AQ	Oil/Grease, Total Recoverable
9070:SLG	Oil and Grease
9080	Cation-Exch. (Am.Acetate)
9095	Paint Filter Liquids
9250	Chloride, Total
ILM02:CN	Cyanide, Total
IN101	Air Particulate Mass
IN166:SLG	Ammonia-Nitrogen
IN177	% Ash
IN266	Heating Value (BTU/lb)
IN316:OIL	Water Ext. Ino Chloride
IN368	Chlorine, Total by Bomb
IN423:PYC	Density (g/ml)
IN425:SOL	Density (g/g)
IN460:DIS	Distilled Fluoride
IN526:AIR	Formaldehyde (ppm at 25 C)
IN530:Soil	Formaldehyde (mg/kg)
IN532	Formaldehyde (Qualitative)
IN623	Total Solids
IN625	Moisture/Ash
IN630	Moisture/Ash in Woodchips
IN633:SLG	Nitrate-Nitrite-N H2O Extraction
IN634:SLG	Nitrite-N (H2O Ext)
IN636	Odor (Qualitative)
IN661:OTH	Oil and Grease
IN662:Soil	Oil and Grease (mg/kg)
IN670:IRS	Petroleum Hydrocarbons
IN688:SLG	pH (std Units)
IN701:SLG	Phosphorus, Total
IN703	Reactivity Sulfide and Cyanide
IN715	Sulfide in Soil
IN780:SLG	Total Kjeldahl Nitrogen
IN847:Soil	TOC by Lloyd Kahn
IN849:Low	TOC low level
IN899	Total Organic Halide

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APPENDIX D: Certifications

Certifications

As of June 1995

ITS-Burlington began operations in 1970 to provide commercial and public organizations with chemical analytical services. The following list is a summary of the professional certifications held by our laboratory. Actual certificates are available upon request.

Vermont Department of Health Laboratory
Certified for Inorganic, Organic and Bacteria in Drinking Water
Contact Person: Mr. Harold Stowe
Certification ID: VT008
Expiration Date: 09/30/95

The Naval Facilities Engineering Service Center (NFESC)
Recommended for approval for organic and inorganic analyses
Contact Person: Naval Engineering Field Division
Approval Expiration Date: 6/96

United States Army Corps of Engineers
Certified for inorganic and organic determinations
Contact Person: Ms. Elena Webster
Approval Expiration Date: 12/27/96

California Department of Health Services
Certified for Inorganic, Organic, and Bio-Toxicity for
Drinking Water, Wastewater, and Hazardous Waste
Contact Person: Mr. J.B. Dornan
Certification ID Number 1929
Expiration Date: 08/31/95

State of Connecticut Department of Health Services
Approved Public Health Laboratory
Certified for Inorganic, Organic, and Bacteria in Potable Water
and Wastewater
Contact Person: Mr. Nicholas Macelletti
Certificate Number PH-0751
Expiration Date: 09/30/95

Florida Department of Health and Rehabilitative Services,
Certified for Inorganic and Organic Parameters in Wastewater
and Hazardous Waste
Contact Person: Mr. Carl C. Kircher
Certificate No's 94404 and 94405
Expiration Date: 06/30/96

State of Maine Department of Human Services
Certified for Inorganic, Organic and Bacteria in Drinking Water
Contact Person: Mr. Michael Sodano
Certificate ID: VT008
Expiration Date: 11/14/95

The Commonwealth of Massachusetts
Department of Environmental Protection
Certified for Inorganic and Organic Parameters in Drinking Water
and Wastewater
Contact Person: Ms. Anne Marie Allen
Laboratory ID Number M-VT008
Expiration ID: 06/30/96

New Jersey Department of Environmental Protection and Energy
Certified for Inorganics, Organics and Biotoxicity in Water and Wastewater
Contact Person: Mr. Michael Miller
Laboratory ID Number 85972
Expiration Date: 06/30/95

State of New Hampshire Department of Environmental Services
Certified for Inorganics, Organics and Microbiology in Water and Wastewater
Contact Person: Mr. Charles Dyer
Certificate No.'s 200694-A and 200694-B
Expiration Date: 12/18/95

New York State Department of Health
Certified for Inorganics, Organics and Microbiology in Water and Wastewater
Certified for Inorganics and Organics in Air and Emissions, Solid and
Hazardous Waste and CLP
Contact Person: Mr. Mathew Caruso
Lab ID number 10391
Expiration Date: 06/01/95

State of Pennsylvania Department of Environmental Resources
Certified for Inorganics and Organics in Drinking Water
Contact Person: Mr. Edward Maser
ID # 68-489
Expiration Date: 04/28/96

State of Rhode Island and Providence Plantations Department of Health
Certified for Inorganics and Organics in Potable, Non-Potable,
and Wastewater
Contact Person: Mr. Raymond Lundgren
license #81
Expiration Date: 06/30/97

ATTACHMENT C-2

Non-Standard Analytical Methods

If warranted, additional non-standard Analytical Methods that may be a part of the RI of the subject site may be contained in the appropriate RI/FS Project Scoping Plan that serves as a supplement to this Generic Installation RI/FS Work Plan.

EPA METHOD 8330

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METHOD 8330

NITROAROMATICS AND NITRAMINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)

This method is intended for the analysis of explosives residues. This Method is limited to use by analysts experienced in handling and analyzing explosive residues.

1.0 SCOPE AND APPLICATION

1.1 Method 8330 is used to determine the concentration of the following compounds in a water, soil or sediment matrix:

Compounds	Abbrev.	CAS No.[a]
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4
1,3-Dinitrobenzene	1,3-DNB	99-65-0
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8
Nitrobenzene	NB	98-95-3
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7
4-Amino-2,6-dinitrotoluene	4-Am-DNT	1946-51-0
2-Amino-4,6-dinitrotoluene	2-Am-DNT	355-72-78-2
2,6-Dinitrotoluene	2,6-DNT	606-20-2
2,4-Dinitrotoluene	2,4-DNT	121-14-2
2-Nitrotoluene	2-NT	88-72-2
4-Nitrotoluene	4-NT	99-99-0
3-Nitrotoluene	3-NT	99-08-1

[a] Chemical Abstracts Service Registry number

1.2 Method 8330 provides a salting-out extraction procedure for low concentration (parts per trillion or nanograms per liter) of explosives residues in surface or ground water. Direct injection of diluted and filtered water samples can be used for water samples of higher concentration (See Table 1).

1.3 All of these compounds are either used in the manufacture of explosives or are the degradation products of

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compounds used for that purpose. When making stock solutions for calibration, treat each compound as if it were extremely explosive.

1.4 The practical quantitation limits (PQLs) of target analytes determined by Method 8330 in water and soil are presented in Table 1.

1.5 This method is restricted to use by or under the supervision of analysts experienced in the use of HPLC, skilled in the interpretation of chromatograms, and experienced in handling explosive materials. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 Method 8330 provides high performance liquid chromatographic (HPLC) conditions for the detection of ppb levels of certain explosives residues in water, soil and sediment matrix. Prior to use of this method, appropriate sample preparation techniques must be used.

2.2 Low-Level Salting-out Method: Aqueous samples of low concentration are concentrated by a salting-out extraction procedure with acetonitrile and sodium chloride. The acetonitrile extract is further concentrated to less than 1.0 mL using a Kuderna-Danish evaporator and brought to 1.0 mL using acetonitrile. The concentrated extract is diluted with 3.0 mL of reagent grade water, filtered, separated on a C-18 reverse phase column, determined at 254 nm, and confirmed on a CN reverse phase column.

2.3 High-Level Direct Injection Method: Aqueous samples of higher concentration can be diluted 1/1 (v/v) with methanol or acetonitrile, filtered, separated on a C-18 reverse phase column, determined at 254 nm, and confirmed on a CN reverse phase column. If HMX is an important target analyte, methanol is preferred.

2.4 Soil and sediment samples are extracted using acetonitrile in an ultrasonic bath, filtered and chromatographed as in Section 2.3.

3.0 INTERFERENCES

3.1 Solvents, reagents, glassware and other sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from

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interferences, under the conditions of the analysis, by running method blanks. Specific selection of reagents and purification of solvents by distillation in all-glass systems may be required.

3.1 2,4-DNT and 2,6-DNT elute at similar retention times (retention time difference of 0.2 minutes). A large concentration of one isomer may mask the response of the other isomer. If it is not apparent that both isomers are present (or are not detected), an isomeric mixture should be reported.

3.2 Tetryl decomposes rapidly in methanol/water solutions, as well as with heat. All aqueous samples expected to contain tetryl should be diluted with acetonitrile prior to filtration. All samples expected to contain tetryl should not be exposed to temperatures above room temperature.

3.3 Degradation products of tetryl appear as a shoulder on the 2,4,6-TNT peak. Peak heights rather than peak areas should be used when tetryl is present in concentrations that are significant relative to the concentration of 2,4,6-TNT.

4.0 APPARATUS AND MATERIALS

4.1 HPLC system

4.1.1 HPLC - equipped with a pump capable of achieving 4000 psi, a 100-µL loop injector and a 254-nm UV detector (Perkin Elmer Series 3 or equivalent).

4.1.2 C-18 Reverse phase HPLC column, 25-cm x 4.6-mm (5 µm), (Supelco LC-18 or equivalent).

4.1.3 CN Reverse phase HPLC column, 25-cm x 4.6-mm (5 µm), (Supelco LC-CN or equivalent).

4.1.4 Strip chart recorder.

4.1.5 Digital integrator (optional).

4.1.6 Autosampler (optional).

4.2 Other Equipment

4.2.1 Temperature controlled ultrasonic bath.

4.2.2 Vortex mixer.

4.2.3 Kuderna-Danish evaporator - 40 mL, micro Kuderna-Danish evaporator (Supelco #64718 or equivalent).

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4.2.4 Water bath - Heated, with concentric ring cover, capable of temperature control (±5°C). The bath should be used in a hood.

4.2.5 Balance - ± 0.1 mg.

4.3 Materials

4.3.1 High pressure injection syringe - 500 µL, (Hamilton liquid syringe or equivalent).

4.3.2 Disposable cartridge filters - 0.45 µm Teflon filter.

4.3.3 Pipettes - 50 mL, 10 mL, 5 mL, 4 mL, 2 mL, 1 mL, volumetric, Class A, glass.

4.3.4 Pasteur pipettes.

4.3.5 Scintillation Vials - 20 mL, glass.

4.3.6 Vials - 15 mL, glass, Teflon-lined cap.

4.3.7 Vials - 40 mL, glass, Teflon-lined cap.

4.3.8 Disposable syringes - Plastipak, 3 mL and 10 mL or equivalent.

4.3.9 Separatory funnel - 500 mL.

4.3.10 Volumetric flasks - 10 mL, 20 mL, 50 mL, 100 mL, 200 mL and 250 mL.

4.3.11 Vacuum desiccator - Glass.

4.3.12 Mortar and pestle - Steel.

4.3.13 Boiling chips - Solvent extracted, approximately 10/40 mesh (Teflon or equivalent).

4.3.14 Sieve - 30 mesh.

4.3.15 Oven - Forced air, without heating.

4.4 Preparation

4.4.1 Prepare all materials to be used as described in Chapter 4 for semivolatile organics.

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5.0 REAGENTS

5.1 HPLC grade chemicals shall be used in all tests. It is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination.

5.2 General

5.2.1 HMX - Standard Analytical Reference Material.

5.2.2 RDX - Standard Analytical Reference Material.

5.3.2 1,3-DNB - Standard Analytical Reference Material.

5.2.4 Tetryl - Standard Analytical Reference Material.

5.2.5 2,4,6-TNT - Standard Analytical Reference Material.

5.2.6 2-Am-DNT -

5.2.7 4-Am-DNT - Reagent grade (Aldrich Chemical or equivalent).

5.2.8 2,4-DNT - Standard Analytical Reference Material.

5.2.9 2,6-DNT - Standard Analytical Reference Material.

5.2.10 1,3,5-TNB - Standard Analytical Reference Material.

5.2.11 NB - Standard Analytical Reference Material.

5.2.12 2-NT - Reagent grade.

5.2.13 3-NT - Reagent grade.

5.2.14 4-NT - Reagent grade.

5.2.15 Reagent water - All references to water in this method refer to water in which an interference is not observed at the method detection limit of the compounds of interest. Reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionized water.

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5.2.16 Acetonitrile - HPLC grade.

5.2.17 Methanol - HPLC grade, distilled in glass.

5.2.18 Sodium Chloride, NaCl - Reagent grade. If possible use NaCl from glass bottles. High background levels have been observed from NaCl shipped in plastic containers.

5.2.19 Calcium Chloride, $CaCl_2$ - Reagent grade. Prepare an aqueous solution of 5 g/L.

5.3 Stock Standard Solutions

5.3.1 Dry each analyte standard to constant weight in a vacuum desiccator in the dark. Place about 100 mg (weighed to the nearest 0.1 mg) of a single analyte into a 100-mL volumetric flask and dilute to volume with acetonitrile. Invert flask several times until dissolved. Store in refrigerator at 4°C in the dark. Calculate the concentration of the stock solution from the actual weight used (nominal concentration = 1,000 mg/L). Stock solutions may be used for up to one year.

5.4 Intermediate Standards Solutions

5.4.1 If both 2,4-DNT and 2,6-DNT are to be determined, prepare two separate intermediate stock solutions containing (1) HMX, RDX, 1,3,5-TNB, 1,3-DNB, NB, 2,4,6-TNT, 2,4-DNT and 2-Am-DNT and (2) tetryl, 2,6-DNT, 4-Am-DNT, 2-NT, 3-NT and 4-NT. Dilute the intermediate stock standard solutions to prepare two solutions at 1,000 µg/L in acetonitrile.

5.4.2 Dilute the two intermediate stock concentrate solutions with acetonitrile to prepare intermediate standard solutions that cover the range of 2.5 - 1,000 µg/L. These solutions should be refrigerated on preparation and stored in the dark, and may be used for 30 days.

5.4.3 For the low-level method, the analyst must conduct a detection limit study and devise dilution series appropriate to the desired range. Standards for the low level method must be prepared immediately prior to use.

5.5 Working Standards

5.5.1 Calibration standards at a minimum of five concentration levels should be prepared through dilution of the intermediate standards solutions by 50% (v/v) with 5 g/L calcium chloride solution (Section 5.2.19). These solutions must be refrigerated and stored in the dark, and prepared fresh on the day of calibration.

5.6 Surrogate Standards

5.6.1 The analyst should monitor the performance of the extraction and analytical system and the effectiveness of the method in dealing with each sample matrix by spiking each sample, standard and reagent water blank with one or two surrogates (e.g., analytes not expected to be present in the sample).

5.7 Eluent

5.7.1 To prepare 1 liter of eluent, add 500 mL of methanol to 500 mL of reagent water.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 Grab samples must be collected and stored in glass containers. Follow conventional sampling procedures.

6.2 Samples must be kept below 4°C and in the dark from the time of collection through analysis, except during drying.

6.3 Soil and sediment samples should be air dried to constant weight at room temperature or colder after collection.

6.4 All water samples must be extracted within 7 days of collection and analyzed within 40 days after extraction. All soil and sediment samples must be extracted within 14 days of collection and analyzed within 40 days after extraction.

7.0 PROCEDURE

7.1 Sample Preparation

7.1.1 Aqueous Samples: It is highly recommended that all samples of this type be screened with the high-level method (>50 µg/L) to determine if the low-level method (1-50 µg/L) is required.

7.1.1.1 Low-Level Method (salting-out extraction)

7.1.1.1.1 Place a 400 mL aliquot of water sample in a 500 mL separatory funnel and add 130 g of NaCl. Vigorously shake the sample until all of the NaCl is completely dissolved. Be sure to

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dissolve all salt before adding acetonitrile, or the dissolution process takes much longer.

7.1.1.1.2 Add a 100 mL volume of acetonitrile using a glass volumetric pipette. Shake the separatory funnel vigorously for 5 minutes. Allow the funnel to stand undisturbed for 30 minutes while the two phases separate. Discard the water (lower) layer and collect the acetonitrile (upper) layer (approximately 23 mL) in a 40 mL Teflon-capped vial. Rinse the separatory funnel with 5 mL of acetonitrile and add the rinsate to the extract.

7.1.1.1.3 If the collected sample was turbid, centrifuge the 40 mL vial at 4000 rpm's for 5 minutes. Remove the acetonitrile (upper) layer with a Pasteur pipette and transfer it to a clean vial.

7.1.1.1.4 Reduce the acetonitrile extract to less than 1.0 mL using a Kuderna-Danish evaporator and bring the total volume to 1.0 mL using acetonitrile. Dilute this concentrated extract with 3.0 mL of reagent water.

7.1.1.1.5 Filter the diluted extract through a 0.45-µm Teflon filter. Discard the first 0.5 mL of filtrate, and retain the remainder in a Teflon-capped vial for RP-HPLC analysis as in Section 7.4.

7.1.1.2 High-Level Method

7.1.1.2.1 Sample filtration: Place a 5 mL aliquot of each water sample in a scintillation vial, add 5 mL of acetonitrile, shake thoroughly, and filter through a 0.45-µm Teflon filter. Discard the first 3 mL of filtrate, and retain the remainder in a Teflon-capped vial for RP-HPLC analysis as in Section 7.4. HMX quantitation can be improved with the use of methanol rather than acetonitrile for dilution before filtration.

7.1.2 Soil and Sediment Samples

7.1.2.1 Sample homogenization: Dry soil samples in air at room temperature or colder, being careful not to expose the samples to direct sunlight. Grind and homogenize the dried sample thoroughly in an acetonitrile rinsed mortar to pass a 30 mesh sieve.

7.1.2.2 Sample extraction

7.1.2.2.1 Place a 2.0 g subsample of each soil sample in a 15 mL glass vial. Add 10.0 mL of acetonitrile, cap with Teflon-lined cap, vortex swirl for one minute, and place in an cooled ultrasonic bath for 18 hours.

7.1.2.2.2 After sonication, allow sample to settle for 30 minutes. Remove 5.0 mL of supernatant, and combine with 5.0 mL of calcium chloride solution (Section 5.2.19) in a 20 mL vial. Shake, and let stand for 15 minutes.

7.1.2.2.3 Place supernatant in a disposable syringe and filter through a 0.45-μm Teflon filter. Discard first 3 mL and retain remainder in a Teflon-capped vial for RP-HPLC analysis as in Section 7.4.

7.2 Chromatographic Conditions

Primary Column:	C-18 reverse phase HPLC column, 25-cm x 4.6-mm, 5 μm, (Supelco LC-18 or equivalent).
Secondary Column:	CN reverse phase HPLC column, 25-cm x 4.6-mm, 5 μm, (Supelco LC-CN or equivalent).
Mobile Phase:	50/50 (v/v) methanol/organic-free reagent water.
Flow Rate:	1.5 mL/min
Injection volume:	100-μL
UV Detector:	254 nm

7.3 Calibration of HPLC

7.3.1 All electronic equipment is allowed to warm up for 30 minutes. During this period, at least 15 void volumes of mobile phase are passed through the column (approximately 20 min at 1.5 mL/min) and continued until the baseline is level at the UV detector's greatest sensitivity.

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7.3.2 Analyze working standards in triplicate, using the chromatographic conditions given in Section 7.2. Prepare calibration curve using peak heights or peak areas, as appropriate. The calibration curve should be linear with zero intercept.

7.3.3 Initial Calibration. Triplicate injections of each calibration standard over the concentration range of interest are sequentially injected into the HPLC in random order. Peak heights or peak areas are obtained for each analyte. Experience indicates that a linear calibration curve with zero intercept is appropriate for each analyte. Therefore, a response factor for each analyte can be taken as the slope of the best-fit regression line.

7.3.4 Daily Calibration. Analyze midpoint calibration standards, at a minimum, in triplicate at the beginning of the day, singly at the midpoint of the run and singly after the last sample of the day. Obtain the response factor for each analyte from the mean peak heights or peak areas and compare it with the response factor obtained for the initial calibration. The mean response factor for the daily calibration must agree within ±25% of the response factor of the initial calibration for the first seven daily calibrations and within two standard deviations of the initial calibration for subsequent calibrations. If this criterion is not met, a new initial calibration must be obtained.

7.4 HPLC Analysis

7.4.1 Analyze the samples using the chromatographic conditions given in Section 7.2. All positive measurements observed on the C-18 column must be confirmed by injection onto the CN column.

7.4.2 In limited applications (e.g., aqueous process wastes) direct injection of filtered and diluted sample into the HPLC system with a 100-µL loop may be appropriate. The quantitation limits are high, therefore, it is only permitted where concentrations in excess of 50 µg/L are expected.

7.4.3 Follow Section 7.6 in Method 8000 for instructions on the analysis sequence, appropriate dilutions, establishing daily retention time windows, and identification criteria. Include a mid-level standard after each group of 10 samples in the analysis sequence. If column temperature control is not employed, special care must be taken to ensure that temperature shifts do not cause peak misidentification.

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7.4.4 Table 2 summarizes the estimated retention times on both C-18 and CN columns for a number of analytes analyzable using this method. An example of the separation achieved by Column 1 is shown in Figure 1.

7.4.5 Record the resulting peak sizes in peak heights or area units. The use of peak heights is recommended to improve reproducibility of low level samples.

7.4.6 Calculation of concentration is covered in Section 7.8 of Method 8000.

7.4.7 If analytical interferences are suspected, or for the purpose of confirmation, analysis using the second HPLC column is required.

8.0 QUALITY CONTROL

8.1 Prior to preparation of stock solutions, acetonitrile, methanol, and water blanks should be run to determine possible interferences with analyte peaks. If the acetonitrile, methanol, or water blanks show contamination, a different batch should be used.

8.2 Refer to Chapter One for specific quality control procedures. Quality control to validate sample extraction is covered in Method 3500.

8.3 Mandatory quality control to validate the HPLC system operation is found in Method 8000, Section 8.6.

8.4 The laboratory must, on an ongoing basis, analyze a method blank, a matrix spike, and a matrix spike duplicate/ duplicate for each analytical batch (up to a maximum of 20 samples/batch) to assess accuracy. For laboratories analyzing one to ten samples per month, at least one spiked sample per month is required.

8.5 A minimum of one duplicate sample shall be run with each analytical batch. If the samples are generally non-detect samples, a matrix spike duplicate must be run with the analytical batch.

8.6 Method Blanks

8.6.1 Method blanks for the analysis of aqueous samples should be reagent water carried through all sample storage, preparation and handling procedures.

8.6.2 Method blanks for the analysis of soil samples should be uncontaminated soil carried through all sample storage, extraction, and handling procedures.

9.0 METHOD PERFORMANCE

9.1 Method 8330 was tested by six laboratories. The results of this testing indicate that the results presented in Tables 3 through 5 are to be expected.

10.0 REFERENCES

1. Bauer, C.F., T.F. Jenkins, S.M. Koza, P.W. Schumacher, P.H. Miyares and M.E. Walsh (1989). Development of an analytical method for the determination of explosive residues in soil. Part 3. Collaborative test results and final performance evaluation. USA Cold Regions Research and Engineering Laboratory, CRREL Report 89-9.

2. Grant, C.L., A.D. Hewitt and T.F. Jenkins (1989) Comparison of low concentration measurement capability estimates in trace analysis: Method Detection Limits and Certified Reporting Limits. USA Cold Regions Research and Engineering Laboratory, Special Report 89-20

3. Jenkins, T.F., C.F. Bauer, D.C. Leggett and C.L. Grant (1984) Reversed-phase HPLC method for analysis of TNT, RDX, HMX and 2,4-DNT in munitions wastewater. USA Cold Regions Research and Engineering Laboratory, CRREL Report 84-29.

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5. Jenkins, T.F., P.H. Miyares and M.E. Walsh (1988a) An improved RP-HPLC method for determining nitroaromatics and nitramines in water. USA Cold Regions Research and Engineering Laboratory, Special Report 88-23.

6. Jenkins, T.F., P.W. Schumacher, M.E. Walsh and C.F. Bauer (1988b) Development of an analytical method for the determination of explosive residues in soil. Part II: Further development and ruggedness testing. USA Cold Regions Research and Engineering Laboratory, CRREL Report 88-8.

7. Leggett, D.C., T.F. Jenkins and P.H. Miyares (1990) Salting-out solvent extraction for preconcentration of neutral

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polar organic solutes from water. Analytical Chemistry, 62: 1355-1356.

8. Miyares, P.H. and T.F. Jenkins (1990) Salting-out solvent extraction for determining low levels of nitroaromatics and nitramines in water. USA Cold Regions Research and Engineering Laboratory, Special Report 90-30.

11.0 SAFETY

11.1 Standard precautionary measures used for handling other organic compounds should be sufficient for safe handling of the analytes targeted by Method 8330.

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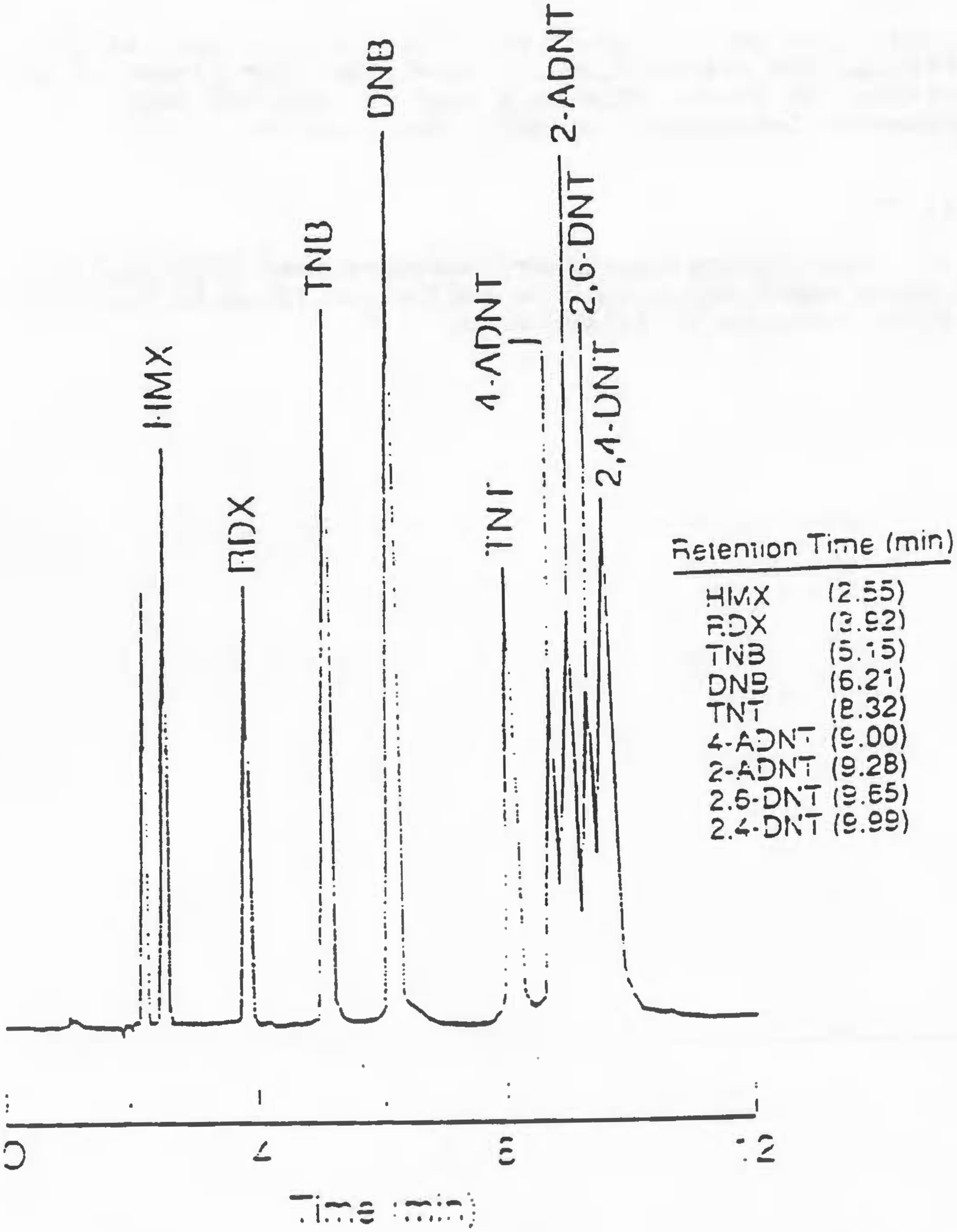
Column: C-18 (25 cm x 4.6 mm, 5 µm)
Mobile Phase: 1/1 (v/v) Methanol/Water, 1.5 mL/min
Detector: UV



Retention Time (min)	
HMX	(2.55)
RDX	(3.92)
TNB	(5.15)
DNB	(6.21)
TNT	(8.32)
4-ADNT	(9.00)
2-ADNT	(9.28)
2,6-DNT	(9.65)
2,4-DNT	(9.99)

Figure 1. Liquid Chromatogram of Explosives Residues.

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TABLE 1
PRACTICAL QUANTITATION LIMITS

Compounds	Water (µg/L) Low-Level	Water (µg/L) High-Level	Soil (µg/g)
HMX	-	13.0	2.2
RDX	0.836	14.0	1.0
1,3,5-TNB	0.258	7.3	0.25
1,3-DNB	0.108	4.0	0.25
Tetryl	-	4.0	0.65
NB	-	6.4	0.26
2,4,6-TNT	0.113	6.9	0.25
4-Am-DNT	0.0598	-	-
2-Am-DNT	0.0349	-	-
2,6-DNT	0.314	9.4	0.26
2,4-DNT	0.0205	5.7	0.25
2-NT	-	12.0	0.25
4-NT	-	8.5	0.25
3-NT	-	7.9	0.25

TABLE 2
RENTION TIMES FOR ANALYTES ON C-18 AND CN COLUMNS

C-18		CN	
Compounds	Retention Time (min)	Compounds	Retention Time (min)
HMX	2.4	NB	3.8
RDX	3.7	1,3,5-TNB	4.1
1,3,5-TNB	5.1	1,3-DNB	4.2
1,3-DNB	6.2	2-NT	4.4
Tetryl	6.9	4-NT	4.4
NB	7.2	3-NT	4.5
2,4,6-TNT	8.4	2,6-DNT	4.6
2,6-DNT	9.8	2,4-DNT	4.9
2,4-DNT	10.1	2,4,6-TNT	5.0
2-NT	12.3	RDX	6.2
4-NT	13.3	Tetryl	7.4
3-NT	14.2	HMX	8.4

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TABLE 3
INTRALABORATORY PRECISION OF METHOD FOR SOIL SAMPLES

	Spiked Soils			Field-Contaminated Soils		
	Mean Conc. (µg/g)	SD	%rsd	Mean Conc. (µg/g)	SD	%rsd
HMX	46	1.7	3.7	14	1.8	12.8
				153	21.6	14.1
RDX	60	1.4	2.3	104	12	11.5
				877	29.6	3.4
1,3,5-TNB	8.6	0.4	4.6	2.8	0.2	7.1
	46	1.9	4.1	72	6.0	8.3
1,3-DNB	3.5	0.14	4.0	1.1	0.11	9.8
Tetryl	17	3.1	17.9	2.3	0.41	18.0
TNT	40	1.4	3.5	7.0	0.61	9.0
				669	55	8.2
2,4-DNT	5.0	0.17	3.4	1.0	0.44	42.3

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TABLE 4
INTRALABORATORY ERROR OF METHOD FOR SOIL SAMPLES

	Spiked Soils			Field-Contaminated Soils		
	Mean Conc. (µg/g)	SD	%rsd	Mean Conc. (µg/g)	SD	%rsd
HMX	46	2.6	5.7	14	3.7	26.0
				153	37.3	24.0
RDX	60	2.6	4.4	104	17.4	17.0
				877	67.3	7.7
1,3,5-TNB	8.6	0.61	7.1	2.8	0.23	8.2
	46	2.97	6.5	72	8.8	12.2
1,3-DNB	3.5	0.24	6.9	1.1	0.16	14.5
Tetryl	17	5.22	30.7	2.3	0.49	21.3
TNT	40	1.88	4.7	7.0	1.27	18.0
				669	63.4	9.5
2,4-DNT	5.0	0.22	4.4	1.0	0.74	74.0

TABLE 5
INTERLABORATORY VARIANCE OF METHOD FOR WATER SAMPLES[a]

Compounds	Mean Conc. (µg/L)	SD	%rsd
HMX	203	14.8	7.3
RDX	274	20.8	7.6
2,4-DNT	107	7.7	7.2
2,4,6-TNT	107	11.1	10.4

[a] Nine laboratories.

DEVELOPMENT OF A SIMPLIFIED FIELD METHOD FOR THE DETERMINATION OF TNT IN SOIL.

Special Report 90-38

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U.S. Army Corps
of Engineers
Cold Regions Research &
Engineering Laboratory

Development of a Simplified Field Method for the Determination of TNT in Soil

Thomas F. Jenkins

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Prepared for
USA TOXIC AND HAZARDOUS MATERIALS AGENCY
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APPENDIX A: METHOD DOCUMENTATION (USATHAMA 1987)
FORMAT CERTIFICATION
FIELD METHOD FOR THE DETERMINATION OF 246 TNT IN SOIL

I. Summary

A. Analytes: This method is suitable for determining the concentration of 246 TNT in the field using battery-operated equipment.

B. Matrix: This method is suitable for the determination of 246 TNT in soil or sediment.

C. General Method: A 20-g subsample of undried soil is placed in a 4-oz (120-mL) glass bottle and 100 mL of acetone added. The bottle is capped and shaken manually for three minutes. The bottle is then allowed to stand for 5 minutes to allow the particles to settle, and then a 25-mL aliquot of the extract is filtered through a 0.5-mm Millex SR filter into a 25-mL cuvette. The absorbance of this solution is obtained at 540 nm. About 0.1 to 0.5 g of sodium sulfite (Na_2SO_3) and one pellet of potassium hydroxide (KOH) are added, the cuvette capped and shaken for 3 minutes. The resulting solution is immediately poured into the barrel of a 50-mL plastic syringe and filtered through another Millex SR filter into a clean cuvette. The absorbance is again measured at 540 nm as soon as possible (within 60 minutes) after filtration. The initial absorbance difference is doubled and subtracted from the final reading and this is proportional to 246 TNT concentration.

II. Application

A. Calibration Range:

The calibrated range over which measurement can be made is 1.11 to 22.3 µg/g. Concentrations in excess of 22.3 µg/g can be obtained by volumetric dilution of the extract with acetone such that the measured absorbance is less than 0.6 absorbance units. Whenever dilutions are made, a small amount of water is added (3 mL to 100 mL of solution) to ensure that sufficient solubility of the reagents is maintained. When this is done, the background absorbance is obtained after the addition of water.

B. Tested Concentration Range: This method was tested over the range of 246 TNT concentration from 1.11 to 22.3 µg/g.

C. Sensitivity: The absorbance per µg/g of 246 TNT was found to be 0.029 absorbance units, resulting in 0.032 absorbance units at the certified reporting limit (1.11 µg/g).

D. Interferences: A number of other nitroaromatic compounds were found to develop a visible color as well as 246 TNT. The colors observed are given below:

Tetryl—Orange
TNB—Red
DNB—Purple
2,4-DNT—Blue
2,6-DNT—Pink

No color development was observed for: RDX, HMX, Nitrobenzene, o-nitrotoluene, m-nitrotoluene, p-nitrotoluene, nitroglycerine, 4-amino-2,6-dinitrotoluene or 2-amino-4,6-dinitrotoluene. Humic organic matter, normally present in soil, is extracted to some degree and will result in a yellow extract that becomes darker yellow on addition of the reagents. The contribution to the absorbance at 540 nm is small but can be corrected by doubling the absorbance reading before addition of reagents and subtracting from the absorbance after addition of KOH and Na_2SO_3.

E. Safety Information: The normal safety precautions associated with the use of a flammable organic solvent should be employed. If acetone containing KOH is spilled on the skin, it should be rapidly rinsed off with water. Eye protection is recommended when shaking bottles or cuvettes to protect against splash from poorly sealed containers.

III. Apparatus and Chemicals

A. Instrumentation

1. Field portable, battery-operated colorimeter (HACH DR2 spectrophotometer or equivalent, bandpass 20 nm).
2. Mechanical balance, to measure soil weights.

B. Analyte

246 TNT (2,4,6-trinitrotoluene)
BP: 280°C (explodes)
MP: 80.1°C
Solubility in water: 130 mg/L
Octanol/water partition coefficient: 68
CAS # 118-96-7.

C. Reagents and SARMs:

1. 246 TNT (SARM quality)
2. Acetone
3. Potassium hydroxide, reagent grade pellets
4. Sodium sulfite, reagent grade.

D. Glassware/Equipment

1. 4 oz (Qorpak or equivalent) glass bottles with caps
2. Glass volumetric pipets
    - 0.50 mL
    - 1.00 mL
    - 2.00 mL
    - 5.00 mL
    - 10.00 mL
    - 25.0 mL
3. 100-mL graduated cylinder
4. Cuvette bottles with caps (25-mL capacity), 25-mm path length.
5. Glass volumetric flask (2)—50 mL.
6. Filters (Millex SR, 0.5 µm)
7. Syringes (Plastipak), 20 and 50 mL.
8. Forceps.
9. Spatula.

IV. Calibration

A. Initial Calibration:

1. Preparation of Standards

Solid TNT (SARM or reagent grade) was dried to constant weight in a vacuum desiccator in the dark. About 0.1 g is weighed out to the nearest 0.1 mg, transferred to a 250-mL volumetric flask and diluted to volume with acetone. The TNT concentration of this stock standard is about 400 mg/L. This stock standard should be prepared in the laboratory before going to the field.

A working stock standard is prepared by diluting 25.0 mL of the stock TNT standard to 250 mL in a glass volumetric flask and bringing to volume with acetone. The concentration of this working stock standard is about 40 mg/L.

Calibration solutions are prepared as described in Table A1. Glass volumetric pipettes are used to dispense the working stock standard and the distilled water, and a 100-mL graduated cylinder is used to add the acetone. Each solution is prepared in a 4-oz glass bottle, capped and shaken.

2. Instrument Calibration

Approximately 0.2 g of sodium sulfite (excess) and one pellet of potassium hydroxide are added to a 25-mL aliquot of each standard; samples are shaken for 3 minutes and allowed to stand 2 minutes. The solutions are then filtered into a 25-mL glass cuvette bottle (19-mm path length) and the absorbance measured at 540 nm using a battery-operated spectrophotometer. The zero absorbance setting was first established using pure acetone, and the instrument was zeroed according to manufacture's instructions.

Table A1. Preparation of calibration solutions.

Solution	*Volume of working std. (mL)*	*Volume of acetone added (mL)*	*Volume of distilled water added (mL)*	*Approx.[*] conc. (mg/L)*	*Associated[†] soil conc. (µg/g)*
A	0	100	3.00	0.0	0.0
B	0.50	99.5	3.00	0.2	1.0
C	1.00	99	3.00	0.4	2.0
D	2.00	98	3.00	0.8	4.0
E	5.00	95	3.00	2.0	10.0
F	10.00	90	3.00	4.0	20.0

[*] Does not include volume of water. The reason is that all field soils will contain water of an unknown quantity and all calculations will ignore this small volume contribution.

[†] This concentration is the comparable soil RDX concentration if 20 g of soil is used and 100 mL of acetone used for extraction. The concentration is based on wet weight of soil.

3. Calculations

Absorbance readings for solutions A-F should be in a range from 0.0 to 0.7 absorbance units. If so, the absorbance should be linear with TNT concentration on either a milligram per liter basis or an equivalent microgram per gram of wet soil basis. The slope of this relationship (or the response factor) was found to average about 0.15 absorbance units per mg/L in the extract (or about 0.029 absorbance units per µg/g of wet soil).

B. Daily Calibration

Since a linear relationship with zero intercept is the expected result for initial calibration, daily calibration is obtained using solution E (Table A1) and calculating a response factor as described above.

V. Certification Testing

A. Preparation of Spiking Solutions:

The spiking stock standard is prepared in an identical manner to the calibration stock standard described in Section IV-A-1. The soil spiking solution is prepared in an identical manner to the working stock standard also described in Section IV-A-1.

B. Soil Spiking

Subsamples of 20.0 g of USATHAMA Standard Soil are placed in each of six 4-oz glass bottles. A 3.00-mL aliquot of water is added to each since the standard soil has been previously dried. The six bottles are labeled, blank, 0.5X, 1X, 2X, 5X and 10X. Aliquots of the TNT spiking solution are added to these bottles as described in Table A2. The spiked soils are allowed to stand for 1 hour capped prior to extraction.

Table A2. Preparation of spiked soils.

Designation	*Volume of TNT Spiking solution added (mL)*	*TNT concentration[*] (µg/g)*
Blank	—	0.0
0.5 X	0.50	.0
1 X	1.00	2.0
2 X	2.00	4.0
5 X	5.00	10.0
10 X	10.00	20.0

C. Soil Extraction and Analysis

A volume of acetone is added to each bottle in a manner to make the total solution volume added (spike + acetone addition) equal 100 mL. The bottles are capped and shaken vigorously by hand for 3 minutes. The soil is allowed to settle for 5 minutes and a 25-mL aliquot filtered through a 0.5-µm Millex SR syringe filter into a 25-mL glass cuvette using a 50-mL Plastipak syringe. The absorbance of this solution is measured on the portable spectrophotometer at 540 nm relative to pure acetone. The cuvette is removed from the instrument, about 0.1–0.5 g of Na_2SO_3 added along with one pellet of potassium hydroxide, and the bottle is capped and manually shaken for 3 minutes. The solution is immediately poured into the barrel of a 50-mL Plastipak syringe equipped with a Millex SR filter. The plunger is replaced and the solution filtered into a fresh 25-mL glass cuvette. The absorbance is again read at 540 nm. The glass cuvette bottles must be thoroughly rinsed with water and acetone between samples.

D. Calculations

The absorbance of the soil extract at 540 nm prior to the addition of the reagents is doubled and subtracted from the absorbance of the extract after addition of the reagents:

TNT absorbance = (Absorbance after) –2 (Absorbance before).

The doubling of the absorbance before the reagents are added takes into account an increase in absorbance due to the reaction of KOH with extracted soil humic materials.

The soil concentration is then obtained by dividing the TNT absorbance by the response factor obtained by analysis of solution E:

$$\text{Soil conc. } (\mu g/g) = \frac{\text{TNT absorbance (absorbance units)}}{\text{Response factor (absorbance units}/\mu g/g)}.$$

VI. Sampling Handling

This method is designed to be used with field soils that have not been previously dried. If dried soils are used, 3.0 mL of distilled water should be added to the 20-g soil sample before extraction.

The soil sample is mixed as thoroughly as possible, a 20-g subsample added to a 4-oz glass bottle and the bottle capped until extraction is conducted. The samples should be kept cold (4°C) and in the dark until extraction takes place. Samples should be analyzed the same day they are collected.

VII. Procedure

A. Sample Processing

A 20-g subsample of soil is added to a 4-oz glass bottle and 100 mL of acetone are added using a graduated cylinder. The bottles are capped and shaken manually for 3 minutes. The soil is allowed to settle for 5 minutes and a 25-mL aliquot is filtered into a 25-mL glass cuvette bottle through a Millex SR syringe filter using a 20-mL Plastipak syringe. The absorbance is obtained at 540 nm relative to pure acetone.

About 0.1–0.5 g of Na_2SO_3 and one pellet of KOH is then added to the cuvette bottle; the bottle capped tightly and shaken manually for 3 minutes to allow full color development. The solution is poured into the barrel of a 50-mL Plastipak syringe which is equipped with a Millex SR filter and filtered into a fresh 25-mL glass cuvette bottle. The absorbance is again obtained at 540 nm. The glass cuvettes must be thoroughly rinsed with water and acetone between samples. If the measured absorbance is greater than 0.7 A.U., an aliquot of the unreacted extract should be diluted with acetone to achieve an absorbance between 0.1 and 0.7 A.U. when reacted with KOH and Na_2SO_3. When dilutions are made, a small volume of water (about 3 mL to a total volume of 100 mL) should be added to ensure that sufficient reagent solubility is maintained.

VIII. Calculations

The TNT absorbance is obtained by subtracting twice the absorbance at 540 nm prior to addition of the reagents from the absorbance after addition of the reagents and dividing by the response factor obtained from analysis of solution E (Table A1) as described in Section V-D.

IX. Daily Quality Control

A blank and a spiked soil at 1X (2 µg/g) are analyzed each day. Results are maintained on a control chart and control limits are established as described in the USATHAMA Installation Restoration Quality Assurance Program.

X. Reference

Jenkins, T.F. (1990) Development of a simplified field method for the determination of TNT in soil. USA Cold Regions Research and Engineering Laboratory, Special Report. (in prep).

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FINAL DRAFT

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Thomas F. Jenkins

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U.S. Army Cold Regions Research and Engineering Laboratory
72 Lyme Road
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13. ABSTRACT (*Maximum 200 words*)

A simple field method was developed for determining the concentration of 2,4,6-trinitrotoluene (TNT) in soil. The method involves extraction of the soil with acetone, generation of the red-colored Jackson–Meisenheimer anion by addition of potassium hydroxide and sodium sulfite, and measurement of color intensity at 540 nm using a battery-operated spectrophotometer. The method was shown to follow the Beer–Lambert law with linear calibration through an absorbance of 0.9 absorbance units, and was found to be both precise and accurate in tests with spiked soils, providing a detection limit of about 1 µg/g. The extraction step recovered a mean of 96% of the TNT recoverable by a more exhaustive laboratory extraction procedure. A comparison was made of concentration estimates from the field method with those from the standard RP-HPLC laboratory procedure using a set of field-contaminated soils. An excellent correlation existed between the two when both 1,3,5-trinitrobenzene and TNT concentrations from the laboratory measurements were included. The method is susceptible to interference from a number of polynitroaromatic compounds including the following: 1,3,5-trinitrobenzene (red), tetryl (orange), 2,6-dinitrotoluene (pinkish purple), 2,4-dinitrotoluene (blue) and 1,3-dinitrobenzene (purple). No color was observed for nitramine explosives, such as RDX or HMX, or nitrate esters such as nitroglycerine or pentaerythritol tetranitrate.The method was field tested at Umatilla Army Depot and found to provide a simple, rapid method for estimating TNT concentrations in the field. Concentration estimates from field analysis correlated well with laboratory analyses of the same samples.

14. SUBJECT TERMS

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eld analysis methods	Soil contamination	

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ATTACHMENT C-3

NYSDEC CLP Data Reporting Forms

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

Lab Name: ____________________ Contract: __________

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: __________

Sample wt/vol: _____ (g/mL) _____ Lab File ID: __________

Level: (low/med) _____ Date Received: __________

% Moisture: not dec. _____ Date Analyzed: __________

GC Column: _____ ID: _____ (mm) Dilution Factor: __________

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) _____	Q
74-87-3	Chloromethane		
74-83-9	Bromomethane		
75-01-4	Vinyl Chloride		
75-00-3	Chloroethane		
75-09-2	Methylene Chloride		
67-64-1	Acetone		
75-15-0	Carbon Disulfide		
75-35-4	1,1-Dichloroethene		
75-34-3	1,1-Dichloroethane		
540-59-0	1,2-Dichloroethene (total)		
67-66-3	Chloroform		
107-06-2	1,2-Dichloroethane		
78-93-3	2-Butanone		
71-55-6	1,1,1-Trichloroethane		
56-23-5	Carbon Tetrachloride		
75-27-4	Bromodichloromethane		
78-87-5	1,2-Dichloropropane		
10061-01-5	cis-1,3-Dichloropropene		
79-01-6	Trichloroethene		
124-48-1	Dibromochloromethane		
79-00-5	1,1,2-Trichloroethane		
71-43-2	Benzene		
10061-02-6	trans-1,3-Dichloropropene		
75-25-2	Bromoform		
108-10-1	4-Methyl-2-Pentanone		
591-78-6	2-Hexanone		
127-18-4	Tetrachloroethene		
79-34-5	1,1,2,2-Tetrachloroethane		
108-88-3	Toluene		
108-90-7	Chlorobenzene		
100-41-4	Ethylbenzene		
100-42-5	Styrene		
1330-20-7	Xylene (total)		

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

ame: ______________________ Contract: __________

Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

rix: (soil/water) ______ Lab Sample ID: ____________

ple wt/vol: ______ (g/mL) ____ Lab File ID: ____________

vel: (low/med) ______ Date Received: ____________

Moisture: ______ decanted: (Y/N) ___ Date Extracted: ____________

ncentrated Extract Volume: ______ (uL) Date Analyzed: ____________

jection Volume: ______ (uL) Dilution Factor: ________

C Cleanup: (Y/N) ___ pH: ____

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ________	Q
108-95-2	Phenol		
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	2,2'-oxybis(1-Chloropropane)		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-3	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene		
99-09-2	3-Nitroaniline		
83-32-9	Acenaphthene		

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

Name: ______________ Contract: __________

ab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

atrix: (soil/water) ______ Lab Sample ID: __________

ample wt/vol: ______ (g/mL) ______ Lab File ID: __________

evel: (low/med) ______ Date Received: __________

Moisture: ______ decanted: (Y/N) ___ Date Extracted: __________

oncentrated Extract Volume: ______ (uL) Date Analyzed: __________

njection Volume: ______ (uL) Dilution Factor: __________

PC Cleanup: (Y/N) ___ pH: ____

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ______	Q
51-28-5	2,4-Dinitrophenol		
100-02-7	4-Nitrophenol		
132-64-9	Dibenzofuran		
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
86-74-8	Carbazole		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate		
117-84-0	Di-n-octylphthalate		
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene		

(1) - Cannot be separated from Diphenylamine

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SA

ame: ______________ Contract: __________

ode: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

x: (soil/water) ______ Lab Sample ID: ______________

e wt/vol: ______ (g/mL) ______ Lab File ID: ______________

sture: ______ decanted: (Y/N) ___ Date Received: __________

ction: (SepF/Cont/Sonc) ______ Date Extracted: __________

entrated Extract Volume: ______ (uL) Date Analyzed: __________

ction Volume: ______ (uL) Dilution Factor: __________

Cleanup: (Y/N) ___ pH: ______ Sulfur Cleanup: (Y/N) ___

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ________	Q
319-84-6	alpha-BHC		
319-85-7	beta-BHC		
319-86-8	delta-BHC		
58-89-9	gamma-BHC (Lindane)		
76-44-8	Heptachlor		
309-00-2	Aldrin		
1024-57-3	Heptachlor epoxide		
959-98-8	Endosulfan I		
60-57-1	Dieldrin		
72-55-9	4,4'-DDE		
72-20-8	Endrin		
33213-65-9	Endosulfan II		
72-54-8	4,4'-DDD		
1031-07-8	Endosulfan sulfate		
50-29-3	4,4'-DDT		
72-43-5	Methoxychlor		
53494-70-5	Endrin ketone		
7421-36-3	Endrin aldehyde		
5103-71-9	alpha-Chlordane		
5103-74-2	gamma-Chlordane		
8001-35-2	Toxaphene		
12674-11-2	Aroclor-1016		
11104-28-2	Aroclor-1221		
11141-16-5	Aroclor-1232		
3469-21-9	Aroclor-1242		
2672-29-6	Aroclor-1248		
097-69-1	Aroclor-1254		
096-82-5	Aroclor-1260		

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

Name: ______________________ Contract: __________

Lab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

Matrix: (soil/water) ______ Lab Sample ID: __________

Sample wt/vol: ______(g/mL)____ Lab File ID: __________

Level: (low/med) ____ Date Received: ________

% Moisture: not dec. ______ Date Analyzed: ________

GC Column: ________ ID: ______(mm) Dilution Factor: ________

Soil Extract Volume: ______(uL) Soil Aliquot Volume: _____(uL)

Number TICs found: ______

CONCENTRATION UNITS:
(ug/L or ug/Kg) ________

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
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27.				
28.				
29.				
30.				

1F

EPA SAMPLE NO.

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

ab Name: ______ Contract: ______

ab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

atrix: (soil/water) ______ Lab Sample ID: ______

ample wt/vol: ______ (g/mL) ______ Lab File ID: ______

evel: (low/med) ______ Date Received: ______

Moisture: ______ decanted: (Y/N) ______ Date Extracted: ______

oncentrated Extract Volume: ______ (uL) Date Analyzed: ______

njection Volume: ______ (uL) Dilution Factor: ______

C Cleanup: (Y/N) ______ pH: ______

CONCENTRATION UNITS:
(ug/L or ug/Kg) ______

umber TICs found: ______

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
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28.				
29.				
30.				

2A

WATER VOLATILE SYSTEM MONITORING COMPOUND RECOVERY

b Name: ____________________ Contract: __________

Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

	EPA SAMPLE NO.	SMC1 (TOL) #	SMC2 (BFB) #	SMC3 (DCE) #	OTHER	TOT OUT
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

		QC LIMITS
SMC1 (TOL)	Toluene-d8	(88-110)
SMC2 (BFB)	Bromofluorobenzene	(86-115)
SMC3 (DCE)	1,2-Dichloroethane-d4	(76-114)

Column to be used to flag recovery values

* Values outside of contract required QC limits

D System Monitoring Compound diluted out

page __ of __

2B

SOIL VOLATILE SYSTEM MONITORING COMPOUND RECOVERY

ab Name: ______________________ Contract: __________

ab Code: ________ Case No.: ______ SAS No.: _______ SDG No.: ________

evel:(low/med) _____

	EPA SAMPLE NO.	SMC1 (TOL) #	SMC2 (BFB) #	SMC3 (DCE) #	OTHER	TOT OUT
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
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25						
26						
27						
28						
29						
30						

	QC LIMITS
SMC1 (TOL) = Toluene-d8	(84-138)
SMC2 (BFB) = Bromofluorobenzene	(59-113)
SMC3 (DCE) = 1,2-Dichloroethane-d4	(70-121)

Column to be used to flag recovery values

* Values outside of contract required QC limits

D System Monitoring Compound diluted out

2C

WATER SEMIVOLATILE SURROGATE RECOVERY

e: ______________________ Contract: ______________

ode: ________ Case No.: ______ SAS No.: _______ SDG No.: ________

	EPA SAMPLE NO.	S1 (NBZ) #	S2 (FBP) #	S3 (TPH) #	S4 (PHL) #	S5 (2FP) #	S6 (TBP) #	S7 (2CP) #	S8 (DCB) #	TOT OUT
01										
02										
03										
04										
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
15										
16										
17										
19										
20										
21										
22										
23										
24										
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26										
27										
28										
29										
30										

		QC LIMITS	
S1 (NBZ)	= Nitrobenzene-d5	(35-114)	
S2 (FBP)	= 2-Fluorobiphenyl	(43-116)	
S3 (TPH)	= Terphenyl-d14	(33-141)	
S4 (PHL)	= Phenol-d5	(10-110)	
S5 (2FP)	= 2-Fluorophenol	(21-110)	
S6 (TBP)	= 2,4,6-Tribromophenol	(10-123)	
S7 (2CP)	= 2-Chlorophenol-d4	(33-110)	(advisory)
S8 (DCB)	= 1,2-Dichlorobenzene-d4	(16-110)	(advisory)

\# Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogate diluted out

2D
SOIL SEMIVOLATILE SURROGATE RECOVERY

Lab Name: ____________________ Contract: __________

b Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

Level:(low/med) _____

	EPA SAMPLE NO.	S1 (NBZ) #	S2 (FBP) #	S3 (TPH) #	S4 (PHL) #	S5 (2FP) #	S6 (TBP) #	S7 (2CP) #	S8 (DCB) #	TOT OUT
01										
02										
03										
04										
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
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16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										

	QC LIMITS	
S1 (NBZ) = Nitrobenzene-d5	(23-120)	
S2 (FBP) = 2-Fluorobiphenyl	(30-115)	
S3 (TPH) = Terphenyl-d14	(18-137)	
S4 (PHL) = Phenol-d5	(24-113)	
S5 (2FP) = 2-Fluorophenol	(25-121)	
S6 (TBP) = 2,4,6-Tribromophenol	(19-122)	
S7 (2CP) = 2-Chlorophenol-d4	(20-130)	(advisory)
S8 (DCB) = 1,2-Dichlorobenzene-d4	(20-130)	(advisory)

Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogate diluted out

page of

2E
WATER PESTICIDE SURROGATE RECOVERY

Name: ______________________________ Contract: ____________

Lab Code: _____ Case No.: ______ SAS No.: _______ SDG No.: ________

GC Column(1): __________ ID: _____(mm) GC Column(2): __________ ID: _____(mm)

	EPA SAMPLE NO.	TCX 1 %REC #	TCX 2 %REC #	DCB 1 %REC #	DCB 2 %REC #	OTHER (1)	OTHER (2)	TOT OUT
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

	ADVISORY QC LIMITS
TCX = Tetrachloro-m-xylene	(60-150)
DCB = Decachlorobiphenyl	(60-150)

\# Column to be used to flag recovery values
* Values outside of QC limits
D Surrogate diluted out

page __ of __

2F
SOIL PESTICIDE SURROGATE RECOVERY

Name: ______________________ Contract: __________

Code: _______ Case No.: ______ SAS No.: _______ SDG No.: ________

Column(1): _________ ID: _____(mm) GC Column(2): _________ ID: _____(mm)

	EPA SAMPLE NO.	TCX 1 %REC #	TCX 2 %REC #	DCB 1 %REC #	DCB 2 %REC #	OTHER (1)	OTHER (2)	TOT OUT
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

		ADVISORY QC LIMITS
TCX = Tetrachloro-m-xylene		(60-150)
DCB = Decachlorobiphenyl		(60-150)

\# Column to be used to flag recovery values
* Values outside of QC limits
D Surrogate diluted out

3A
WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Name: ______________________ Contract: __________

Lab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

Matrix Spike - EPA Sample No.: __________

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC. LIMITS REC.
1,1-Dichloroethene					61-145
Trichloroethene					71-120
Benzene					76-127
Toluene					76-125
Chlorobenzene					75-130

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS	
					RPD	REC.
1,1-Dichloroethene					14	61-145
Trichloroethene					14	71-120
Benzene					11	76-127
Toluene					13	76-125
Chlorobenzene					13	75-130

\# Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: ______ out of ______ outside limits
Spike Recovery: ______ out of ______ outside limits

COMMENTS: ____
____

3B

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Name: ______________________ Contract: __________

Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

rix Spike - EPA Sample No.: __________ Level:(low/med) _____

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC. LIMITS REC.
1,1-Dichloroethene					59-172
Trichloroethene					62-137
Benzene					66-142
Toluene					59-139
Chlorobenzene					60-133

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS	
					RPD	REC.
1,1-Dichloroethene					22	59-172
Trichloroethene					24	62-137
Benzene					21	66-142
Toluene					21	59-139
Chlorobenzene					21	60-133

Column to be used to flag recovery and RPD values with an asterisk

Values outside of QC limits

PD: ______ out of ______ outside limits
pike Recovery: ______ out of ______ outside limits

OMMENTS: ____
____

3C

WATER SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Name: ______________________ Contract: __________

. Code: _______ Case No.: _____ SAS No.: ______ SDG No.: _______

Matrix Spike - EPA Sample No.: __________

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC. LIMITS REC.
Phenol					12-110
2-Chlorophenol					27-123
1,4-Dichlorobenzene					36- 97
N-Nitroso-di-n-prop.(1)					41-116
1,2,4-Trichlorobenzene					39- 98
4-Chloro-3-methylphenol					23- 97
Acenaphthene					46-118
4-Nitrophenol					10- 80
2,4-Dinitrotoluene					24- 96
Pentachlorophenol					9-103
Pyrene					26-127

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS	
					RPD	REC.
Phenol					42	12-110
2-Chlorophenol					40	27-123
1,4-Dichlorobenzene					28	36- 97
N-Nitroso-di-n-prop.(1)					38	41-116
1,2,4-Trichlorobenzene					28	39- 98
4-Chloro-3-methylphenol					42	23- 97
Acenaphthene					31	46-118
4-Nitrophenol					50	10- 80
2,4-Dinitrotoluene					38	24- 96
Pentachlorophenol					50	9-103
Pyrene					31	26-127

(1) N-Nitroso-di-n-propylamine

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: _____ out of _____ outside limits

Spike Recovery: _____ out of _____ outside limits

MMENTS: ____

____

3D

SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

ab Name: ____________________ Contract: __________

ab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

atrix Spike - EPA Sample No.: __________ Level:(low/med) _____

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC. LIMITS REC.
Phenol					26- 90
2-Chlorophenol					25-102
1,4-Dichlorobenzene					28-104
N-Nitroso-di-n-prop.(1)					41-126
1,2,4-Trichlorobenzene					38-107
4-Chloro-3-methylphenol					26-103
Acenaphthene					31-137
4-Nitrophenol					11-114
2,4-Dinitrotoluene					28- 89
Pentachlorophenol					17-109
Pyrene					35-142

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Phenol					35	26- 90
2-Chlorophenol					50	25-102
1,4-Dichlorobenzene					27	28-104
N-Nitroso-di-n-prop.(1)					38	41-126
1,2,4-Trichlorobenzene					23	38-107
4-Chloro-3-methylphenol					33	26-103
Acenaphthene					19	31-137
4-Nitrophenol					50	11-114
2,4-Dinitrotoluene					47	28- 89
Pentachlorophenol					47	17-109
Pyrene					36	35-142

(1) N-Nitroso-di-n-propylamine

\# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: ______ out of ______ outside limits
Spike Recovery: ______ out of ______ outside limits

COMMENTS: ____
____

FORM III SV-2 3/90

3E
WATER PESTICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: ____________________ Contract: __________

Lab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

Matrix Spike - EPA Sample No.: __________

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC. LIMITS REC.
gamma-BHC (Lindane)					56-123
Heptachlor					40-131
Aldrin					40-120
Dieldrin					52-126
Endrin					56-121
4,4'-DDT					38-127

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
gamma-BHC (Lindane)					15	56-123
Heptachlor					20	40-131
Aldrin					22	40-120
Dieldrin					18	52-126
Endrin					21	56-121
4,4'-DDT					27	38-127

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: ______ out of ______ outside limits
Spike Recovery: ______ out of ______ outside limits

COMMENTS: ____
____

3F
SOIL PESTICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

ab Name: ______________________ Contract: __________

ab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

atrix Spike - EPA Sample No.: __________

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC. LIMITS REC.
gamma-BHC (Lindane)					46-127
Heptachlor					35-130
Aldrin					34-132
Dieldrin					31-134
Endrin					42-139
4,4'-DDT					23-134

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
gamma-BHC (Lindane)					50	46-127
Heptachlor					31	35-130
Aldrin					43	34-132
Dieldrin					38	31-134
Endrin					45	42-139
4,4'-DDT					50	23-134

\# Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: ______ out of ______ outside limits
Spike Recovery: ______ out of ______ outside limits

COMMENTS: ____
____

EPA SAMPLE NO.

4A
VOLATILE METHOD BLANK SUMMARY

Name: ____________________ Contract: __________

Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

Lab File ID: ____________ Lab Sample ID: ____________

Date Analyzed: ________ Time Analyzed: ________

GC Column: ________ ID: _____(mm) Heated Purge: (Y/N) ___

Instrument ID: ________

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

COMMENTS:

Page of

4B

SEMIVOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

Lab Name: ______________________ Contract: __________

Lab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

Lab File ID: ____________ Lab Sample ID: ____________

Instrument ID: __________ Date Extracted: __________

Matrix: (soil/water) ______ Date Analyzed: __________

Level: (low/med) ______ Time Analyzed: __________

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

COMMENTS:

____

____

ge __ of __

4C

PESTICIDE METHOD BLANK SUMMARY

Name: ______________ Contract: __________

Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

Sample ID: ______________ Lab File ID: ______________

trix:(soil/water) ______ Extraction:(SepF/Cont/Sonc) ______

lfur Cleanup: (Y/N) __ Date Extracted: __________

te Analyzed (1): __________ Date Analyzed (2): __________

me Analyzed (1): __________ Time Analyzed (2): __________

strument ID (1): __________ Instrument ID (2): __________

Column (1): __________ ID: _____(mm) GC Column (2): __________ ID: _____(mm)

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				

MENTS: ____

____

age __ of __

5A
VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: ______________________ Contract: __________

Lab Code: ________ Case No.: ______ SAS No.: ______ SDG No.: ________

Lab File ID: ______________ BFB Injection Date: __________

Instrument ID: __________ BFB Injection Time: __________

GC Column: ________ ID: ______(mm) Heated Purge: (Y/N) ___

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	8.0 - 40.0% of mass 95	
75	30.0 - 66.0% of mass 95	
95	Base peak, 100% relative abundance	
96	5.0 - 9.0% of mass 95	
173	Less than 2.0% of mass 174	( )1
174	50.0 - 120.0% of mass 95	
175	4.0 - 9.0 % of mass 174	( )1
176	93.0 - 101.0% of mass 174	( )1
177	5.0 - 9.0% of mass 176	( )2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01					
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

5B
SEMIVOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Name: ______________________ Contract: __________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

Lab File ID: ____________ DFTPP Injection Date: ________

Instrument ID: __________ DFTPP Injection Time: ________

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	30.0 - 80.0% of mass 198	
68	Less than 2.0% of mass 69	( )1
69	Mass 69 relative abundance	
70	Less than 2.0% of mass 69	( )1
127	25.0 - 75.0% of mass 198	
197	Less than 1.0% of mass 198	
198	Base Peak, 100% relative abundance	
199	5.0 to 9.0% of mass 198	
275	10.0 - 30.0% of mass 198	
365	Greater than 0.75% of mass 198	
441	Present, but less than mass 443	
442	40.0 - 110.0% of mass 198	
443	15.0 - 24.0% of mass 442	( )2

1-Value is % mass 69 2-Value is % mass 442

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01					
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

page __ of __

VOLATILE ORGANICS INITIAL CALIBRATION DATA

ab Name: ______________________ Contract: __________

ab Code: _______ Case No.: _____ SAS No.: ______ SDG No.: _______

nstrument ID: _________ Calibration Date(s): _________ _________

eated Purge: (Y/N) ___ Calibration Times: _________ _________

C Column: ________ ID: _____(mm)

LAB FILE ID: RRF10 = ____________ RRF20 = ____________

RRF50 = ____________ RRF100= ____________ RRF200= ____________

COMPOUND	RRF10	RRF20	RRF50	RRF100	RRF200	$\overline{RRF}$	% RSD
Chloromethane							
Bromomethane *							*
Vinyl Chloride *							*
Chloroethane							
Methylene Chloride							
Acetone							
Carbon Disulfide							
1,1-Dichloroethene *							*
1,1-Dichloroethane *							*
1,2-Dichloroethene (total)							
Chloroform *							
1,2-Dichloroethane *							*
2-Butanone							
1,1,1-Trichloroethane *							
Carbon Tetrachloride *							*
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) *							*
Toluene-d8							
Bromofluorobenzene *							
1,2-Dichloroethane-d4							

* Compounds with required minimum RRF and maximum %RSD values. All other compounds must meet a minimum RRF of 0.010.

SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: ____________________ Contract: __________

Lab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

Instrument ID: __________ Calibration Date(s): __________ __________

Calibration Times: __________ __________

LAB FILE ID: RRF20 = __________ RRF50 = __________
RRF80 = __________ RRF120= __________ RRF160= __________

COMPOUND	RRF20	RRF50	RRF80	RRF120	RRF160	$\overline{RRF}$	% RSD
Phenol *							*
bis(2-Chloroethyl)ether *							*
2-Chlorophenol *							*
1,3-Dichlorobenzene *							*
1,4-Dichlorobenzene *							*
1,2-Dichlorobenzene *							*
2-Methylphenol *							*
2,2'-oxybis(1-Chloropropane)							
4-Methylphenol *							*
N-Nitroso-di-n-propylamine *							*
Hexachloroethane *							*
Nitrobenzene *							*
Isophorone *							*
2-Nitrophenol *							*
2,4-Dimethylphenol *							*
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 *							*

Compounds with required minimum RRF and maximum %RSD values.
All other compounds must meet a minimum RRF of 0.010.

SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

ab Name: ____________________ Contract: __________

ab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

nstrument ID: ________ Calibration Date(s): ________ ________

Calibration Times: ________ ________

LAB FILE ID: RRF20 = __________ RRF50 = __________
RRF80 = __________ RRF120= __________ RRF160= __________

COMPOUND	RRF20	RRF50	RRF80	RRF120	RRF160	$\overline{RRF}$	% RSD
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 *							*
Nitrobenzene-d5							*
2-Fluorobiphenyl *							*
Terphenyl-d14 *							*
Phenol-d5 *							*
2-Fluorophenol *							*
2,4,6-Tribromophenol							
2-Chlorophenol-d4 *							*
1,2-Dichlorobenzene-d4 *							

(1) Cannot be separated from Diphenylamine

* Compounds with required minimum RRF and maximum %RSD values.
All other compounds must meet a minimum RRF of 0.010.

6D

PESTICIDE INITIAL CALIBRATION OF SINGLE COMPONENT ANALYTES

Name: ______________________ Contract: __________

ode: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

strument ID: _________ Level (x low): low _____ mid _____ high _____

Column: _________ ID: _____(mm) Date(s) Analyzed: ________ ________

COMPOUND	RT OF STANDARDS LOW	MID	HIGH	MEAN RT	RT WINDOW FROM	TO
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						
Tetrachloro-m-xylene						
Decachlorobiphenyl						

* Surrogate retention times are measured from Standard Mix A analyses.

Retention time windows are ± 0.05 minutes for all compounds that elute before Heptachlor epoxide, ±0.07 minutes for all other compounds, except ±0.10 minutes for Decachlorobiphenyl.

PESTICIDE INITIAL CALIBRATION OF SINGLE COMPONENT ANALYTES

Name: ______________________ Contract: __________

Code: _______ Case No.: _____ SAS No.: _______ SDG No.: _______

strument ID: __________ Level (x low): low _____ mid _____ high _____

Column: __________ ID: _____(mm) Date(s) Analyzed: ________ ________

	CALIBRATION FACTORS				
COMPOUND	LOW	MID	HIGH	MEAN	%RSD
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					
Tetrachloro-m-xylene					
Decachlorobiphenyl					

Surrogate calibration factors are measured from Standard Mix A analyses.

SD must be less than or equal 20.0 % for all compounds except the rrogates, where %RSD must be less than or equal to 30.0%. Up to o target compounds, but not surrogates, may have %RSD greater than .0% but less than or equal to 30.0%.

PESTICIDE INITIAL CALIBRATION OF [illegible]

ame: ____________________ Contract: __________

e: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

ument ID: ______ Date(s) Analyzed: ______ ______

lumn: ______ ID: ______(mm)

COMPOUND	AMOUNT (ng)	PEAK	RT	RT WINDOW		CALIBRATION FACTOR
				FROM	TO	
Toxaphene		*1				
		*2				
		*3				
		4				
		5				
Aroclor 1016		*1				
		*2				
		*3				
		4				
		5				
Aroclor 1221		*1				
		*2				
		*3				
		4				
		5				
Aroclor 1232		*1				
		*2				
		*3				
		4				
		5				
Aroclor 1242		*1				
		*2				
		*3				
		4				
		5				
Aroclor 1248		*1				
		*2				
		*3				
		4				
		5				
Aroclor 1254		*1				
		*2				
		*3				
		4				
		5				
Aroclor 1260		*1				
		*2				
		*3				
		4				
		5				

* Denotes required peaks

Lab Name: ____________________ Contract: __________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

GC Column (1): ________ ID: _____ (mm) Instrument ID (1): ________

EPA Sample No. (Standard 1): _________ Lab Sample ID (1): __________

Date Analyzed (1): __________ Time Analyzed (1): ________

	ANALYTE	RT	RESOLUTION (%)
01			
02			
03			
04			
05			
06			
07			
08			
09			

GC Column (2): ________ ID: _____ (mm) Instrument ID (2): ________

EPA Sample No. (Standard 2): _________ Lab Sample ID (2): __________

Date Analyzed (2): __________ Time Analyzed (2): ________

	ANALYTE	RT	RESOLUTION (%)
01			
02			
03			
04			
05			
06			
07			
08			
09			

Resolution of two adjacent peaks must be calculated as a percentage of the height of the smaller peak, and must be greater than or equal to 60.0%.

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: ____________ Contract: ____________

Lab Code: ________ Case No.: ______ SAS No.: ________ SDG No.: ________

Instrument ID: ________ Calibration Date: ________ Time: ________

Lab File ID: ________ Init. Calib. Date(s): ________ ________

Heated Purge: (Y/N) ___ Init. Calib. Times: ________ ________

GC Column: ________ ID: ______(mm)

COMPOUND	$\overline{RRF}$	RRF50	MIN RRF	%D	MAX %D
Chloromethane					
Bromomethane			0.100		25.0
Vinyl Chloride			0.100		25.0
Chloroethane					
Methylene Chloride					
Acetone					
Carbon Disulfide					
1,1-Dichloroethene			0.100		25.0
1,1-Dichloroethane			0.200		25.0
1,2-Dichloroethene (total)					
Chloroform			0.200		25.0
1,2-Dichloroethane			0.100		25.0
2-Butanone					
1,1,1-Trichloroethane			0.100		25.0
Carbon Tetrachloride			0.100		25.0
Bromodichloromethane			0.200		25.0
1,2-Dichloropropane					
cis-1,3-Dichloropropene			0.200		25.0
Trichloroethene			0.300		25.0
Dibromochloromethane			0.100		25.0
1,1,2-Trichloroethane			0.100		25.0
Benzene			0.500		25.0
trans-1,3-Dichloropropene			0.100		25.0
Bromoform			0.100		25.0
4-Methyl-2-Pentanone					
2-Hexanone					
Tetrachloroethene			0.200		25.0
1,1,2,2-Tetrachloroethane			0.500		25.0
Toluene			0.400		25.0
Chlorobenzene			0.500		25.0
Ethylbenzene			0.100		25.0
Styrene			0.300		25.0
Xylene (total)			0.300		25.0
Toluene-d8					
Bromofluorobenzene			0.200		25.0
1,2-Dichloroethane-d4					

All other compounds must meet a minimum RRF of 0.010.

SEMIVOLATILE CONTINUING CALIBRATION CHECK

ame: ______________________ Contract: __________

ode: ________ Case No.: ______ SAS No.: ________ SDG No.: ________

ument ID: __________ Calibration Date: __________ Time: __________

File ID: ____________ Init. Calib. Date(s): __________ __________

Init. Calib. Times: __________ __________

COMPOUND	$\overline{RRF}$	RRF50	MIN RRF	%D	MAX %D
Phenol			0.800		25.0
bis(2-Chloroethyl)ether			0.700		25.0
2-Chlorophenol			0.800		25.0
1,3-Dichlorobenzene			0.600		25.0
1,4-Dichlorobenzene			0.500		25.0
1,2-Dichlorobenzene			0.400		25.0
2-Methylphenol			0.700		25.0
2,2'-oxybis(1-Chloropropane)					
4-Methylphenol			0.600		25.0
N-Nitroso-di-n-propylamine			0.500		25.0
Hexachloroethane			0.300		25.0
Nitrobenzene			0.200		25.0
Isophorone			0.400		25.0
2-Nitrophenol			0.100		25.0
2,4-Dimethylphenol			0.200		25.0
bis(2-Chloroethoxy)methane			0.300		25.0
2,4-Dichlorophenol			0.200		25.0
1,2,4-Trichlorobenzene			0.200		25.0
Naphthalene			0.700		25.0
4-Chloroaniline					
Hexachlorobutadiene					
4-Chloro-3-methylphenol			0.200		25.0
2-Methylnaphthalene			0.400		25.0
Hexachlorocyclopentadiene					
2,4,6-Trichlorophenol			0.200		25.0
2,4,5-Trichlorophenol			0.200		25.0
2-Chloronaphthalene			0.800		25.0
2-Nitroaniline					
Dimethylphthalate					
Acenaphthylene			1.300		25.0
2,6-Dinitrotoluene			0.200		25.0
3-Nitroaniline					
Acenaphthene			0.800		25.0
2,4-Dinitrophenol					
4-Nitrophenol					
Dibenzofuran			0.800		25.0
2,4-Dinitrotoluene			0.200		25.0

All other compounds must meet a minimum RRF of 0.010.

7C

SEMIVOLATILE CONTINUING CALIBRATION CHECK

Name: ______________________ Contract: __________

ode: ________ Case No.: ______ SAS No.: ________ SDG No.: ________

strument ID: __________ Calibration Date: __________ Time: __________

File ID: ____________ Init. Calib. Date(s): __________ __________

Init. Calib. Times: __________ __________

COMPOUND	$\overline{RRF}$	RRF50	MIN RRF	%D	MAX %D
Diethylphthalate					
4-Chlorophenyl-phenylether			0.400		25.0
Fluorene			0.900		25.0
4-Nitroaniline					
4,6-Dinitro-2-methylphenol					
N-Nitrosodiphenylamine (1)					
4-Bromophenyl-phenylether			0.100		25.0
Hexachlorobenzene			0.100		25.0
Pentachlorophenol			0.050		25.0
Phenanthrene			0.700		25.0
Anthracene			0.700		25.0
Carbazole					
Di-n-butylphthalate					
Fluoranthene			0.600		25.0
Pyrene			0.600		25.0
Butylbenzylphthalate					
3,3'-Dichlorobenzidine					
Benzo(a)anthracene			0.800		25.0
Chrysene			0.700		25.0
bis(2-Ethylhexyl)phthalate					
Di-n-octylphthalate					
Benzo(b)fluoranthene			0.700		25.0
Benzo(k)fluoranthene			0.700		25.0
Benzo(a)pyrene			0.700		25.0
Indeno(1,2,3-cd)pyrene			0.500		25.0
Dibenz(a,h)anthracene			0.400		25.0
Benzo(g,h,i)perylene			0.500		25.0
Nitrobenzene-d5			0.200		25.0
2-Fluorobiphenyl			0.700		25.0
Terphenyl-d14			0.500		25.0
Phenol-d5			0.800		25.0
2-Fluorophenol			0.600		25.0
2,4,6-Tribromophenol					
2-Chlorophenol-d4			0.800		25.0
1,2-Dichlorobenzene-d4			0.400		25.0

(1) Cannot be separated from Diphenylamine

All other compounds must meet a minimum RRF of 0.010.

PESTICIDE CALIBRATION VERIFICATION SUMMARY

Lab Name: ______________________________ Contract: ____________

Lab Code: ________ Case No.: ______ SAS No.: ________ SDG No.: ________

GC Column: __________ ID: _____(mm) Init. Calib. Date(s): ________ ________

EPA Sample No.(PIBLK): __________ Date Analyzed : __________

Lab Sample ID (PIBLK): ____________ Time Analyzed : __________

EPA Sample No.(PEM): __________ Date Analyzed : __________

Lab Sample ID (PEM): ____________ Time Analyzed : __________

PEM COMPOUND	RT	RT WINDOW FROM	TO	CALC AMOUNT (ng)	NOM AMOUNT (ng)	RPD
alpha-BHC						
beta-BHC						
gamma-BHC (Lindane)						
Endrin						
4,4'-DDT						
Methoxychlor						

,4'-DDT % breakdown (1): ________ Endrin % breakdown (1): ________

Combined % breakdown (1): ________

QC LIMITS:

RPD of amounts in PEM must be less than or equal to 25.0%

4,4'-DDT breakdown must be less than or equal to 20.0%

Endrin breakdown must be less than or equal to 20.0%

Combined breakdown must be less than or equal to 30.0%

PESTICIDE CALIBRATION VERIFICATION SUMMARY

Name: ______________ Contract: ______________

Code: ________ Case No.: ________ SAS No.: ________ SDG No.: ________

Column: ________ ID: ______(mm) Init. Calib. Date(s): ________ ________

PA Sample No.(PIBLK): ____________ Date Analyzed : ____________

ab Sample ID (PIBLK): ____________ Time Analyzed : ____________

PA Sample No.(INDA): ____________ Date Analyzed : ____________

ab Sample ID (INDA): ____________ Time Analyzed : ____________

INDIVIDUAL MIX A COMPOUND	RT	RT WINDOW FROM	RT WINDOW TO	CALC AMOUNT (ng)	NOM AMOUNT (ng)	RPD
alpha-BHC						
gamma-BHC (Lindane)						
Heptachlor						
Endosulfan I						
Dieldrin						
Endrin						
4,4'-DDD						
4,4'-DDT						
ethoxychlor						
etrachloro-m-xylene						
Decachlorobiphenyl						

EPA Sample No.(INDB): ____________ Date Analyzed : ____________

Lab Sample ID (INDB): ____________ Time Analyzed : ____________

INDIVIDUAL MIX B COMPOUND	RT	RT WINDOW FROM	RT WINDOW TO	CALC AMOUNT (ng)	NOM AMOUNT (ng)	RPD
beta-BHC						
delta-BHC						
Aldrin						
Heptachlor epoxide						
4,4'-DDE						
Endosulfan II						
Endosulfan sulfate						
Endrin ketone						
Endrin aldehyde						
alpha-Chlordane						
gamma-Chlordane						
Tetrachloro-m-xylene						
Decachlorobiphenyl						

QC LIMITS: RPD of amounts in the Individual Mixes must be less than or equal to 25.0%.

8A
VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: ______________________ Contract: __________

Lab Code: ________ Case No.: ______ SAS No.: _______ SDG No.: _______

Lab File ID (Standard): _____________ Date Analyzed: __________

Instrument ID: __________ Time Analyzed: __________

GC Column: ________ ID: ______(mm) Heated Purge: (Y/N) ___

		IS1(BCM) AREA #	RT #	IS2(DFB) AREA #	RT #	IS3(CBZ) AREA #	RT #
	12 HOUR STD						
	UPPER LIMIT						
	LOWER LIMIT						
	EPA SAMPLE NO.						
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = +100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = +0.50 minutes of internal standard RT
RT LOWER LIMIT = -0.50 minutes of internal standard RT

\# Column used to flag values outside QC limits with an asterisk.
* Values outside of QC limits.

SEMIVOLATILE INTERNAL [illegible]

ab Name: ______________________ Contract: ____________

Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

ab File ID (Standard): ______________ Date Analyzed: ____________

Instrument ID: __________ Time Analyzed: ____________

		IS1(DCB) AREA #	RT #	IS2(NPT) AREA #	RT #	IS3(ANT) AREA #	RT #
	12 HOUR STD						
	UPPER LIMIT						
	LOWER LIMIT						
	EPA SAMPLE NO.						
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

IS1 (DCB) = 1,4-Dichlorobenzene-d4
IS2 (NPT) = Naphthalene-d8
IS3 (ANT) = Acenaphthene-d10

AREA UPPER LIMIT = +100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = +0.50 minutes of internal standard RT
RT LOWER LIMIT = -0.50 minutes of internal standard RT

Column used to flag internal standard area values with an asterisk.
* Values outside of QC limits.

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SEMIVOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: ______________________ Contract: __________

Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ________

Lab File ID (Standard): ______________ Date Analyzed: ____________

Instrument ID: __________ Time Analyzed: ____________

		IS4(PHN) AREA #	RT #	IS5(CRY) AREA #	RT #	IS6(PRY) AREA #	RT #
	12 HOUR STD						
	UPPER LIMIT						
	LOWER LIMIT						
	EPA SAMPLE NO.						
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

IS4 (PHN) = Phenanthrene-d10
IS5 (CRY) = Chrysene-d12
IS6 (PRY) = Perylene-d12

AREA UPPER LIMIT = +100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = +0.50 minutes of internal standard RT
RT LOWER LIMIT = -0.50 minutes of internal standard RT

Column used to flag internal standard area values with an asterisk.
* Values outside of QC limits.

PESTICIDE ANALYTICAL SEQUENCE

Name: ______________________ Contract: __________

Code: ________ Case No.: ______ SAS No.: _______ SDG No.: _______

umn: __________ ID: _____(mm) Init. Calib. Date(s): ________ ________

trument ID: __________

HE ANALYTICAL SEQUENCE OF PERFORMANCE EVALUATION MIXTURES, BLANKS, SAMPLES, AND STANDARDS IS GIVEN BELOW:

MEAN SURROGATE RT FROM INITIAL CALIBRATION

TCX: ______ DCB: ______

	EPA SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED	TIME ANALYZED	TCX RT #	DCB RT #
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						

	QC LIMITS
TCX = Tetrachloro-m-xylene	(± 0.05 MINUTES)
DCB = Decachlorobiphenyl	(± 0.10 MINUTES)

\# Column used to flag retention time values with an asterisk.

* Values outside of QC limits.

ge __ of __

9A
PESTICIDE FLORISIL CARTRIDGE CHECK

Name: ______________________ Contract: __________

Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

orisil Cartridge Lot Number: ______ Date of Analysis: __________

Column(1): __________ ID: ______(mm) GC Column(2): __________ ID: ______(mm)

COMPOUND	SPIKE ADDED (ng)	SPIKE RECOVERED (ng)	% REC #	QC LIMITS
alpha-BHC				80-120
gamma-BHC (Lindane)				80-120
Heptachlor				80-120
Endosulfan I				80-120
Dieldrin				80-120
Endrin				80-120
4,4'-DDD				80-120
4,4'-DDT				80-120
Methoxychlor				80-120
Tetrachloro-m-xylene				80-120
Decachlorobiphenyl				80-120

\# Column to be used to flag recovery with an asterisk.
* Values outside of QC limits.

IS CARTRIDGE LOT APPLIES TO THE FOLLOWING SAMPLES, BLANKS, MS, AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				

PESTICIDE GPC CALIBRATION

Lab Name: ______________________ Contract: ________

Code: ______ Case No.: _____ SAS No.: ______ SDG No.: _______

GPC Column: ________ Calibration Date: ________

GC Column(1): ________ ID: _____(mm) GC Column(2): ________ ID: _____(mm)

COMPOUND	SPIKE ADDED (ng)	SPIKE RECOVERED (ng)	% REC #	QC. LIMITS REC.
gamma-BHC (Lindane)				80-110
Heptachlor				80-110
Aldrin				80-110
Dieldrin				80-110
Endrin				80-110
4,4'-DDT				80-110

\# Column to be used to flag recovery values with an asterisk

* Values outside of QC limits

THIS GPC CALIBRATION APPLIES TO THE FOLLOWING SAMPLES, BLANKS, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				

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10A

PESTICIDE IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

Lab Name: ______________ Contract: ________

Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

Lab Sample ID : ________ Date(s) Analyzed: ______ ______

Instrument ID (1): ________ Instrument ID (2): ________

GC Column(1): ________ ID: _____(mm) GC Column(2): ________ ID: _____(mm)

ANALYTE	COL	RT	RT WINDOW FROM	TO	CONCENTRATION	%D
	1					
	2					
	1					
	2					
	1					
	2					
	1					
	2					
	1					
	2					
	1					
	2					
	1					
	2					
	1					
	2					

page __ of __

PESTICIDE IDENTIFICATION
FOR MULTICOMPONENT ANALYTES

ab Name: ______________ Contract: __________ __________

ab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

ab Sample ID : __________ Date(s) Analyzed: ________ ________

nstrument ID (1): __________ Instrument ID (2): __________

C Column(1): __________ ID: _____(mm) GC Column(2): __________ ID: _____(mm)

			RT WINDOW			MEAN	
ANALYTE	PEAK	RT	FROM	TO	CONCENTRATION	CONCENTRATION	%D
	1						
______	2						
	3						
COLUMN 1	4						
	5						
	1						
	2						
	3						
COLUMN 2	4						
	5						
	1						
______	2						
	3						
COLUMN 1	4						
	5						
	1						
	2						
	3						
COLUMN 2	4						
	5						
	1						
______	2						
	3						
COLUMN 1	4						
	5						
	1						
	2						
	3						
COLUMN 2	4						
	5						

\t least 3 peaks are required for identification of multicomponent analytes

p. ,e __ of __

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COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

ab Name: ______________________ Contract: __________

ab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

W No.: ______

EPA Sample No.	Lab Sample ID.

re ICP interelement corrections applied? Yes/No ___

re ICP background corrections applied? Yes/No ___
If yes-were raw data generated before
application of background corrections? Yes/No ___

mments:

____

____

____

____

certify that this data package is in compliance with the terms and nditions of the contract, both technically and for completeness, for other n the conditions detailed above. Release of the data contained in this rdcopy data package and in the computer-readable data submitted on skette has been authorized by the Laboratory Manager or the Manager's signee, as verified by the following signature.

gnature: ______________________ Name: ______________________

______________________ Title: ______________________

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1

INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO. ______

ab Name: ______ Contract: ______

ab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

atrix (soil/water): ______ Lab Sample ID: ______

evel (low/med): ______ Date Received: ______

Solids: ______

Concentration Units (ug/L or mg/kg dry weight): ______

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum				
7440-36-0	Antimony				
7440-38-2	Arsenic				
7440-39-3	Barium				
7440-41-7	Beryllium				
7440-43-9	Cadmium				
7440-70-2	Calcium				
7440-47-3	Chromium				
7440-48-4	Cobalt				
7440-50-8	Copper				
7439-89-6	Iron				
7439-92-1	Lead				
7439-95-4	Magnesium				
7439-96-5	Manganese				
7439-97-6	Mercury				
7440-02-0	Nickel				
7440-09-7	Potassium				
7782-49-2	Selenium				
7440-22-4	Silver				
7440-23-5	Sodium				
7440-28-0	Thallium				
7440-62-2	Vanadium				
7440-66-6	Zinc				
	Cyanide				

olor Before: ______ Clarity Before: ______ Texture: ______

olor After: ______ Clarity After: ______ Artifacts: ______

omments:

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2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

ab Name: ____________________________ Contract: ___________

b Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

nitial Calibration Source: ____________

ntinuing Calibration Source: ____________

Concentration Units: ug/L

	Initial Calibration			Continuing Calibration					
nalyte	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	M
luminum									
ntimony									
rsenic									
Barium									
Beryllium									
dmium									
ium									
omium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Nickel									
Potassium									
elenium									
ilver									
odium									
hallium									
anadium									
inc									
yanide									

) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

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2B
CRDL STANDARD FOR AA AND ICP

Lab Name: ______________________ Contract: __________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

AA CRDL Standard Source: ____________

ICP CRDL Standard Source: ____________

Concentration Units: ug/L

	CRDL Standard for AA			CRDL Standard for ICP				
Analyte	True	Found	%R	True	Initial Found	%R	Final Found	%R
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead								
Magnesium								
Manganese								
Mercury								
Nickel								
Potassium								
Selenium								
Silver								
Sodium								
Thallium								
Vanadium								
Zinc								

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3
BLANKS

Lab Name: ____________________ Contract: __________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

Preparation Blank Matrix (soil/water): ______

Preparation Blank Concentration Units (ug/L or mg/kg): _____

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Prepa-ration Blank	C	M
Aluminum											
Antimony											
Arsenic											
Barium											
Beryllium											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Nickel											
Potassium											
Selenium											
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											
Cyanide											

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4

ICP INTERFERENCE CHECK SAMPLE

Lab Name: ______________________ Contract: __________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

ICP ID Number: ____________ ICS Source: ____________

Concentration Units: ug/L

	True		Initial Found			Final Found		
Analyte	Sol. A	Sol. AB	Sol. A	Sol. AB	%R	Sol. A	Sol. AB	%R
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead								
Magnesium								
Manganese								
Mercury								
Nickel								
Potassium								
Selenium								
Silver								
Sodium								
Thallium								
Vanadium								
Zinc								

U.S. EPA - CLP

5A
SPIKE SAMPLE RECOVERY

EPA SAMPLE NO.

b Name: ____________ Contract: ____________

Lab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

Matrix (soil/water): ______ Level (low/med): ______

% Solids for Sample: ______

Concentration Units (ug/L or mg/kg dry weight): ______

Analyte	Control Limit %R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R	Q	M
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
[illegible]pper									
[illegible]on									
Lead									
Magnesium									
Manganese									
Mercury									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									
Cyanide									

Comments:

U.S. EPA - CLP

5B
POST DIGEST SPIKE SAMPLE RECOVERY

EPA SAMPLE NO.

Lab Name: ____________ Contract: ________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

Matrix (soil/water): ______ Level (low/med): ______

Concentration Units: ug/L

Analyte	Control Limit %R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R	Q	M
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									
Cyanide									

Comments:
____
____
____
____

FORM V (PART 2) - IN

ILM02.0

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6
DUPLICATES

EPA SAMPLE NO.

Name: ______________

Contract: ______

Lab Code: ______

Case No.: ______

SAS No.: ______

SDG No.: ______

Matrix (soil/water): ______

Level (low/med): ______

% Solids for Sample: ______

% Solids for Duplicate: ______

Concentration Units (ug/L or mg/kg dry weight): ______

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead								
Magnesium								
Manganese								
Mercury								
Nickel								
Potassium								
Selenium								
Silver								
Sodium								
Thallium								
Vanadium								
Zinc								
Cyanide								

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7

LABORATORY CONTROL SAMPLE

Lab Name: ______________________ Contract: __________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

Solid LCS Source: ___________

Aqueous LCS Source: ___________

	Aqueous (ug/L)			Solid (mg/kg)					
Analyte	True	Found	%R	True	Found	C	Limits		%R
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									
Cyanide									

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STANDARD ADDITION RESULTS

Lab Name: ______________________________ Contract: ____________

Lab Code: _______ Case No.: ______ SAS No.: _______ SDG No.: _______

Concentration Units: ug/L

EPA Sample No.	An	0 ADD ABS	1 ADD		2 ADD		3 ADD		Final Conc.	r	Q
			CON	ABS	CON	ABS	CON	ABS			

U.S. EPA - CLP

9
ICP SERIAL DILUTIONS

EPA SAMPLE NO

Lab Name: ______________________ Contract: __________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

Matrix (soil/water): ______ Level (low/med): ______

Concentration Units: ug/L

Analyte	Initial Sample Result (I)	C	Serial Dilution Result (S)	C	% Difference	Q	M
Aluminum							
Antimony							
Arsenic							
Barium							
Beryllium							
Cadmium							
Calcium							
Chromium							
Cobalt							
Copper							
Iron							
Lead							
Magnesium							
Manganese							
Mercury							
Nickel							
Potassium							
Selenium							
Silver							
Sodium							
Thallium							
Vanadium							
Zinc							

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10
INSTRUMENT DETECTION LIMITS (QUARTERLY)

Lab Name: ______________________ Contract: __________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

ICP ID Number: ____________ Date: __________

Flame AA ID Number: ____________

Furnace AA ID Number: ____________

Analyte	Wave-length (nm)	Back-ground	CRDL (ug/L)	IDL (ug/L)	M
Aluminum			200		
Antimony			60		
Arsenic			10		
Barium			200		
Beryllium			5		
Cadmium			5		
Calcium			5000		
Chromium			10		
Cobalt			50		
Copper			25		
Iron			100		
Lead			3		
Magnesium			5000		
Manganese			15		
Mercury			0.2		
Nickel			40		
Potassium			5000		
Selenium			5		
Silver			10		
Sodium			5000		
Thallium			10		
Vanadium			50		
Zinc			20		

Comments:

U.S. EPA - CLP

11A
ICP INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: ____________ Contract: ________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

ICP ID Number: __________ Date: ________

Analyte	Wave-length (nm)	Interelement Correction Factors for:				
		Al	Ca	Fe	Mg	__
Aluminum						
Antimony						
Arsenic						
Barium						
Beryllium						
Cadmium						
Calcium						
Chromium						
Cobalt						
Copper						
Iron						
Lead						
Magnesium						
Manganese						
Mercury						
Nickel						
Potassium						
Selenium						
Silver						
Sodium						
Thallium						
Vanadium						
Zinc						

Comments:

U.S. EPA - CLP

11B
ICP INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: ____________________ Contract: __________

Lab Code: ______ Case No.: _____ SAS No.: ______ SDG No.: ______

ICP ID Number: ____________ Date: ________

Analyte	Wave-length (nm)	Interelement Correction Factors for:				
		__	__	__	__	__
Aluminum						
Antimony						
Arsenic						
Barium						
Beryllium						
Cadmium						
Calcium						
Chromium						
Cobalt						
pper						
ron						
Lead						
Magnesium						
Manganese						
Mercury						
Nickel						
Potassium						
Selenium						
Silver						
Sodium						
Thallium						
Vanadium						
Zinc						

Comments:

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ICP LINEAR RANGES (QUARTERLY)

Lab Name: ______________________ Contract: __________

Lab Code: ________ Case No.: ______ SAS No.: ______ SDG No.: ______

ICP ID Number: ____________ Date: ________

Analyte	Integ. Time (Sec.)	Concentration (ug/L)	M
Aluminum			
Antimony			
Arsenic			
Barium			
Beryllium			
Cadmium			
Calcium			
Chromium			
Cobalt			
Copper			
Iron			
Lead			
Magnesium			
Manganese			
Mercury			
Nickel			
Potassium			
Selenium			
Silver			
Sodium			
Thallium			
Vanadium			
Zinc			

Comments:

13
PREPARATION LOG

Lab Name: ____________________ Contract: ____________

Code: ________ Case No.: ______ SAS No.: _______ SDG No.: ________

Method: __

EPA Sample No.	Preparation Date	Weight (gram)	Volume (mL)

U.S. EPA - CLP

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ANALYSIS RUN LOG

Lab Name: ____________ Contract: ________

Lab Code: ______ Case No.: ______ SAS No.: ______ SDG No.: ______

Instrument ID Number: ____________ Method: __

Start Date: ________ End Date: ________

EPA Sample No.	D/F	Time	% R	Analytes																						
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN

1

CHLORINATED HERBICIDES ANALYSIS DATA SHEET

EPA SAMPLE NO.

Lab Name: Aquatec, Inc. Contract:

Lab Code: AQUAI Case No.: SAS No.: SDG No.:

Matrix: (soil/water) Water Lab Sample ID:

Sample wt/vol: (g/mL) mL Lab File ID:

Level: (low/med) Low Date Received:

% Moisture: not dec. dec. Date Extracted:

Dilution Factor: 1.0 Date Analyzed:

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
94-75-7	2,4-D	1.0	U
94-82-6	2,4-DB	1.0	U
93-76-5	2,4,5-T	0.10	U
93-72-1	2,4,5-TP(Silvex)	0.10	U
75-99-0	Dalapon	2.3	U
1918-00-9	Dicamba	0.10	U
120-36-5	Dichloroprop	1.0	U
88-85-7	Dinoseb	0.50	U
94-74-6	MCPA	100	U
93-65-2	MCPP	100	U

1

CHLORINATED HERBICIDES ANALYSIS DATA SHEET

EPA SAMPLE NO.

Lab Name: Aquatec, Inc. Contract: ______

Lab Code: AQUAI Case No.: ______ SAS No.: ______ SDG No.: ______

Matrix: (soil/water) Soil Lab Sample ID: ______

Sample wt/vol: ______ (g/mL) g Lab File ID: ______

Level: (low/med) Low Date Received: ______

% Moisture: not dec. ______ dec. ______ Date Extracted: ______

Dilution Factor: 1.0 Date Analyzed: ______

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
94-75-7	2,4-D	50	U
94-82-6	2,4-DB	50	U
93-76-5	2,4,5-T	5.0	U
93-72-1	2,4,5-TP(Silvex)	5.0	U
75-99-0	Dalapon	120	U
1918-00-9	Dicamba	5.0	U
120-36-5	Dichloroprop	50	U
88-85-7	Dinoseb	25	U
94-74-6	MCPA	5000	U
93-65-2	MCPP	5000	U

CHLORINATED HERBICIDES SURROGATE RECOVERY

Lab Name: Aquatec, Inc.
Lab Code: AQUAI
SAS No.: ____

Contract: ____
Case No.: ____
SDG No.: ____

	EPA SAMPLE NO.	% REC 2,4-DA #
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

	QC LIMITS
2,4-DA	(40-150)

\# Column to be used to flag recovery values
* Values outside of QC limits
D Surrogates diluted out

page ____ of ____

3

WATER CHLORINATED HERBICIDES
MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: Aquatec,Inc. Contract: ____________

Lab Code: AQUAI Case No.: _____ SAS No.: __________ SDG No.: ____________

Matrix Spike - Sample No.: _______________ Level: (low/med) LOW

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC LIMITS REC.
2,4-D					25-135
Silvex					25-135

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS	
					RPD	REC.
2,4-D					30	25[illegible]5
Silvex					30	25-1[illegible]

#Column used to flag recovery and RPD values with an asterisk
*Values outside of QC limits

RPD: _____________ out of 2 outside limits
Spike Recovery: _________ out of 4 outside limits

FORM III

SOIL CHLORINATED HERBICIDES
MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: Aquatec, Inc. Contract: ____________

Lab Code: AQUAI Case No.: _____ SAS No.: __________ SDG No.: ____________

Matrix Spike - Sample No.: _______________ Level: (low/med) LOW

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
2,4-D					25-135
Silvex					25-135

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
2,4-D					30	25-135
Silvex					30	25-135

#Column used to flag recovery and RPD values with an asterisk
*Values outside of QC limits

RPD: ____________ out of 2 outside limits
Spike Recovery: __________ out of 4 outside limits

4

CHLORINATED HERBICIDES
METHOD BLANK SUMMARY

Lab Name: Aquatec,Inc. Contract: ____________

Lab Code: AQUAI Case No.: _____ SAS No.: __________ SDG No.: __________

Lab Sample ID: ______________ Lab File ID: ______________

Matrix: (soil/water) __________ Level: (low/med) LOW

Date Extracted: ______________

Date Analyzed (1): ____________ Date Analyzed (2): ____________

Time Analyzed (1): ____________ Time Analyzed (2): ____________

Instrument ID (1): ____________ Instrument ID (2): ____________

GC Column ID (1): ____________ GC Column ID (2): ____________

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				

Page 1 of 1

8

CHLORINATED HERBICIDES EVALUATION STANDARDS SUMMARY
Evaluation of Retention Time Shift for 2,4-DB

b Name: Aquatec,Inc. Contract: ______

Lab Code: AQUAI Case No.: ______ SAS No.: ______ SDG No.: ______

Instrument ID: ______ GC Column ID: ______

Dates of Analyses: ______ to ______

	EPA SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED	TIME ANALYZED	% D	*
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						

* Values outside of QC limits (2.0% for packed columns, 0.3% for capillary columns)

Page __ of __

FORM VIII

9

CHLORINATED HERBICIDES
CONTINUING CALIBRATION CHECK

Lab Name: Aquatec,Inc. Contract: ___________

Lab Code: AQUAI Case No.: _____ SAS No.: _________ SDG No.: ____________

Instrument ID: _______________ Column ID: _______________

Init. Calib. Date(s): ____________ ________________

COMPOUND	INITIAL RESPONSE File: Date: Time:	CONTINUING RESPONSE File: Date: Time:	%D
Dalapon			
Dicamba			
MCPP			
MCPA			
Dichlorprop			
2,4-D			
2,4,5-TP(Silvex)			
2,4,5-T			
2,4-DB			
Dinoseb			
2,4-DA			

1

NITROAROMATICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

Lab Name: Aquatec, Inc. Contract: ________

Lab Code: AQUAI Case No.: ______ SAS No.: ______ SDG No.: ______

Matrix: (soil/water) Soil

Lab Sample ID: ________

Sample wt/vol: ______(g/mL) g

Lab File ID: ________

Level: (low/med) LOW

Date Received: ________

% Moisture: not dec. ______ dec. ______

Date Extracted: ________

Extraction: (SepF/Sonc) Sonc

Date Analyzed: ________

Dilution Factor: ________

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/Kg	Q
2691-41-0	HMX	130	U
121-82-4	RDX	130	U
99-35-4	1,3,5-Trinitrobenzene	130	U
99-65-0	1,3-Dinitrobenzene	130	U
479-45-8	Tetryl	130	U
118-96-7	2,4,6-Trinitrotoluene	130	U
1946-51-0	4-amino-2,6-Dinitrotoluene	130	U
355-72-78-2	2-amino-4,6-Dinitrotoluene	130	U
606-20-2	2,6-Dinitrotoluene	130	U
121-14-2	2,4-Dinitrotoluene	130	U

1

NITROAROMATICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

Lab Name: Aquatec, Inc. Contract: ____________

Lab Code: AQUAI Case No.: ________ SAS No.: ________ SDG No.: ____________

Matrix: (soil/water) Water

Lab Sample ID: ____________

Sample wt/vol: ______ (g/mL) mL

Lab File ID: ____________

Level: (low/med) LOW

Date Received: ____________

% Moisture: not dec. _______ dec. ______

Date Extracted: ____________

Extraction: (SepF/Sonc) SepF

Date Analyzed: ____________

Dilution Factor: ____________

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/L	Q
2691-41-0	HMX	0.13	U
121-82-4	RDX	0.13	U
99-35-4	1,3,5-Trinitrobenzene	0.13	U
99-65-0	1,3-Dinitrobenzene	0.13	U
479-45-8	Tetryl	0.13	U
118-96-7	2,4,6-Trinitrotoluene	0.13	U
1946-51-0	4-amino-2,6-Dinitrotoluene	0.13	U
355-72-78-2	2-amino-4,6-Dinitrotoluene	0.13	U
606-20-2	2,6-Dinitrotoluene	0.13	U
121-14-2	2,4-Dinitrotoluene	0.13	U

FORM 2
NITROAROMATICS SURROGATE RECOVERY

Lab Name: Aquatec, Inc.
Lab Code: AQUAI
Matrix: ____________

Contract: ____________
Case: ____________
SDG No: ____________

	LAB ID	CLIENT ID	NB %REC
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

ADVISORY
QC LIMITS (%)

NB = Nitrobenzene

(35-114) water
(23-120) soil

page _____ of ______

3

WATER NITROAROMATICS

MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: Aquatec, Inc.
Lab Code: AQUAI
SAS No.: ____________
Contract: ____________
Case No.: ____________
SDG No.: ____________

Matrix Spike - Sample No.: ____________
Level: (low/med) ________

Compound	SPIKE ADDED (UG/L)	SAMPLE CONCENTRATION (UG/L)	MS CONCENTRATION (UG/L)	MS % REC #	QC LIMITS REC.
HMX					50-150
RDX					50-150
1,3,5-Trinitrobenzene					50-150
1,3-Dinitrobenzene					50-150
2,4,6-Trinitrotoluene					50-150
2-amino-4,6-Dinitrotoluene					50-150
2,4-Dinitrotoluene					50-150

Compound	SPIKE ADDED (UG/L)	MSD CONCENTRATION (UG/L)	MSD % REC #	% RPD #	QC RPD	LIMITS REC.
HMX					25	50-150
RDX					25	50-150
1,3,5-Trinitrobenzene					25	50-150
1,3-Dinitrobenzene					25	50-150
2,4,6-Trinitrotoluene					25	50-150
2-amino-4,6-Dinitrotoluene					25	50-150
2,4-Dinitrotoluene					25	50-150

\# Column used to flag recovery and RPD values with an asterisk
* Values outside ofQC limits

RPD: ____________ out of ____7____ outside limits
Spike Recovery: ____________ out of ____14____ outside limits

3

SOIL NITROAROMATICS
MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: Aquatec, Inc.
Lab Code: AQUAI
SAS No.: ____________

Contract: ____________
Case No.: ____________
SDG No.: ____________

Matrix Spike - Sample No.: ____________

Level: (low/med) ________

Compound	SPIKE ADDED (UG/KG)	SAMPLE CONCENTRATION (UG/KG)	MS CONCENTRATION (UG/KG)	MS % REC #	QC LIMITS REC.
					50-150
HMX					50-150
RDX					50-150
1,3,5-Trinitrobenzene					50-150
1,3-Dinitrobenzene					50-150
2,4,6-Trinitrotoluene					50-150
2-amino-4,6-Dinitrotoluene					50-150
2,4-Dinitrotoluene					50-150

Compound	SPIKE ADDED (UG/KG)	MSD CONCENTRATION (UG/KG)	MSD % REC #	% RPD #	QC RPD	LIMITS REC.
HMX					50	50-150
RDX					50	50-150
1,3,5-Trinitrobenzene					50	50-150
1,3-Dinitrobenzene					50	50-150
2,4,6-Trinitrotoluene					50	50-150
2-amino-4,6-Dinitrotoluene					50	50-150
2,4-Dinitrotoluene					50	50-150

Column used to flag recovery and RPD values with an asterisk
* Values outside ofQC limits

RPD: ____________ out of 7 outside limits
Spike Recovery: ____________ out of 14 outside limits

3QC
NITROAROMATICS
QUALITY CONTROL CHECK SAMPLE RECOVERY

Lab Name: Aquatec, Inc.
Lab Code: AQUAI
SAS No.: ______

Contract: ______
Case No.: ______
SDG No.: ______

QC Sample Filename: ______

Level: (low/med) ______

Compound	SPIKE ADDED (UG/L)	QC SAMPLE CONCENTRATION (UG/L)	% REC #	QC LIMITS (%)
HMX				50-150
RDX				50-150
1,3,5-Trinitrobenzene				50-150
1,3-Dinitrobenzene				50-150
2,4,6-Trinitrotoluene				50-150
2-amino-4,6-Dinitrotoluene				50-150
2,4-Dinitrotoluene				50-150

Column used to flag recovery and RPD values with an asterisk
* Values outside ofQC limits

Spike Recovery: ______ out of 7 outside limits

3QC
NITROAROMATICS
QUALITY CONTROL CHECK SAMPLE RECOVERY

Lab Name: Aquatec, Inc.
Lab Code: AQUAI
SAS No.: ________

Contract: ________
Case No.: ________
SDG No.: ________

QC Sample Filename: ________

Level: (low/med) ________

Compound	SPIKE ADDED (UG/KG)	QC SAMPLE CONCENTRATION (UG/KG)	% REC	#	QC LIMITS (%)
HMX					50-150
RDX					50-150
1,3,5-Trinitrobenzene					50-150
1,3-Dinitrobenzene					50-150
2,4,6-Trinitrotoluene					50-150
2-amino-4,6-Dinitrotoluene					50-150
2,4-Dinitrotoluene					50-150

\# Column used to flag recovery and RPD values with an asterisk
* Values outside ofQC limits

Spike Recovery: ________ out of 7 outside limits

FORM4

NITROAROMATICS METHOD BLANK SUMMARY

Lab Name: Aquatec, Inc.
Lab Code: AQUAI
Lab Sample ID: ____
Matrix: ____
Date Analyzed(1): ____
Time Analyzed(1): ____
LC ID(1): ____
LC Column(1): ____

Contract: ____
Case: ____
SDG No: ____
Date Extracted: ____
Date Analyzed(2): ____
Time Analyzed(2): ____
LC ID(2): ____
LC Column(2): ____

	LAB ID	CLIENT ID	DATE ANALYZED 1	DATE ANALYZED 2
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

FORM 8
NITROAROMATICS ANALYTICAL SEQUENCE

Lab Name: Aquatec, Inc.
Lab Code: AQUAI
LC ID: ____________
LC Column: ____________

Contract: ______________
Case: ______________
SDG No: ______________
Initial Date Analyzed: ______________

	LAB ID	CLIENT ID	DATE ANALYZED	TIME ANALYZED	RT NB1	RT NB2
1	EXPL A 12.5ppb					
2	EXPL A 25ppb					
3	EXPL A 62.5ppb					
4	EXPL A 166.7ppb					
5	EXPL A 500ppb					
6	EXPL B 12.5ppb					
7	EXPL B 25ppb					
8	EXPL B 62.5ppb					
9	EXPL B 166.7ppb					
10	EXPL B 500ppb					
11	EXPL A 12.5ppb					
12	EXPL A 25ppb					
13	EXPL A 62.5ppb					
14	EXPL A 166.7ppb					
15	EXPL A 500ppb					
16	EXPL B 12.5ppb					
17	EXPL B 25ppb					
18	EXPL B 62.5ppb					
19	EXPL B 166.7ppb					
20	EXPL B 500ppb					
21	EXPL A 12.5ppb					
22	EXPL A 25ppb					
23	EXPL A 62.5ppb					
24	EXPL A 166.7ppb					
25	EXPL A 500ppb					
26	EXPL B 12.5ppb					
27	EXPL B 25ppb					
28	EXPL B 62.5ppb					
29	EXPL B 166.7ppb					
30	EXPL B 500ppb					
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						

SURROGATE RT FROM INITIAL CALIBRATION

NB1:________ NB1 = Nitrobenzene (LC-18)

QC LIMITS
(+/- 0.08 minutes)

9A
NITROAROMATICS
CONTINUING CALIBRATION CHECK

Lab Name: Aquatec, Inc.
Lab Code: AQUAI
SAS No.: ______
Instrument ID: LC1488
Init. Calib. Date(s): ______ to ______

Contract: 91118
Case No.: ______
SDG No.: ______
Column: ______
Detector: UV @ 254nm
Standard Mix: A

COMPOUND	INITIAL CAL. MIDPOINT STANDARD #1 File: Date: Time:	INITIAL CAL. MIDPOINT STANDARD #2 File: Date: Time:	INITIAL CAL. MIDPOINT STANDARD #3 File: Date: Time:	INITIAL CAL. MEAN RESPONSE
HMX				
RDX				
1,3-Dinitrobenzene				
2,4,6-Trinitrotoluene				
2-amino-4,6-Dinitrotoluene				
2,4-Dinitrotoluene				
Nitrobenzene				

9B

NITROAROMATICS

CONTINUING CALIBRATION CHECK

Lab Name: Aquatec, Inc.

Contract: 91118

Lab Code: AQUAI

Case No.: ______

SAS No.: ______

SDG No.: ______

Column: ______

Instrument ID: LC1488

Detector: UV @ 254nm

Init. Calib. Date(s): ______ to ______

Standard Mix: B

COMPOUND	INITIAL CAL. MIDPOINT STANDARD #1 File: Date: Time:	INITIAL CAL. MIDPOINT STANDARD #2 File: Date: Time:	INITIAL CAL. MIDPOINT STANDARD #3 File: Date: Time:	INITIAL CAL. MEAN RESPONSE
1,3,5-Trinitrobenzene				
Tetryl				
4-amino-2,6-Dinitrotoluene				
2,6-Dinitrotoluene				
Nitrobenzene				

9C

NITROAROMATICS

CONTINUING CALIBRATION CHECK

Lab Name: Aquatec, Inc.

Lab Code: AQUAI

SAS No.: ______

Instrument ID: LC1488

Init. Calib. Date(s): ______ to ______

Contract: 91118

Case No.: ______

SDG No.: ______

Column: ______

Detector: UV @ 254nm

Standard Mix: A

COMPOUND	INITIAL CAL. MEAN RESPONSE	CHECK STANDARD RESPONSE File: Date: Time:	%D
HMX			
RDX			
1,3-Dinitrobenzene			
2,4,6-Trinitrotoluene			
2-amino-4,6-Dinitrotoluene			
2,4-Dinitrotoluene			
Nitrobenzene			

Page ______ of ______

9D
NITROAROMATICS
CONTINUING CALIBRATION CHECK

Lab Name: Aquatec, Inc.
Lab Code: AQUAI
SAS No.: ______
Instrument ID: LC1488
Init. Calib. Date(s): ______ to ______

Contract: 91118
Case No.: ______
SDG No.: ______
Column: ______
Detector: UV @ 254nm
Standard Mix: B

COMPOUND	INITIAL CAL. MEAN RESPONSE	CHECK STANDARD RESPONSE File: Date: Time:	%D
1,3,5-Trinitrobenzene			
Tetryl			
4-amino-2,6-Dinitrotoluene			
2,6-Dinitrotoluene			
Nitrobenzene			

Page ______ of ______

9E
NITROAROMATICS
DAILY CONTINUING CALIBRATION CHECK

Lab Name: Aquatec, Inc.

Lab Code: AQUAI

SAS No.: ____

Instrument ID: LC1488

Init. Calib. Date(s): ____ to ____

Contract: 91118

Case No.: ____

SDG No.: ____

Column: ____

Detector: UV @ 254nm

Standard Mix: A

COMPOUND	DAILY MIDPOINT STANDARD #1 File: Date: Time:	DAILY MIDPOINT STANDARD #2 File: Date: Time:	DAILY MIDPOINT STANDARD #3 File: Date: Time:	DAILY MEAN RESPONSE
HMX				
RDX				
1,3-Dinitrobenzene				
2,4,6-Trinitrotoluene				
2-amino-4,6-Dinitrotoluene				
2,4-Dinitrotoluene				
Nitrobenzene				

9F
NITROAROMATICS
DAILY CONTINUING CALIBRATION CHECK

Lab Name: Aquatec, Inc.

Lab Code: AQUAI

SAS No.: ________

Instrument ID: LC1488

Init. Calib. Date(s): ______ to ______

Contract: 91118

Case No.: ________

SDG No.: ________

Column: ________

Detector: UV @ 254nm

Standard Mix: B

COMPOUND	DAILY MIDPOINT STANDARD #1 File: Date: Time:	DAILY MIDPOINT STANDARD #2 File: Date: Time:	DAILY MIDPOINT STANDARD #3 File: Date: Time:	DAILY MEAN RESPONSE
1,3,5-Trinitrobenzene				
Tetryl				
4-amino-2,6-Dinitrotoluene				
2,6-Dinitrotoluene				
Nitrobenzene				

9G

NITROAROMATICS

DAILY CONTINUING CALIBRATION CHECK

Lab Name: Aquatec, Inc.

Lab Code: AQUAI

SAS No.: ______

Instrument ID: LC1488

Init. Calib. Date(s): ______ to ______

Contract: 91118

Case No.: ______

SDG No.: ______

Column: ______

Detector: UV @ 254nm

Standard Mix: A

COMPOUND	INITIAL CAL. MEAN RESPONSE	DAILY MEAN RESPONSE Date:	%D
HMX			
RDX			
1,3-Dinitrobenzene			
2,4,6-Trinitrotoluene			
2-amino-4,6-Dinitrotoluene			
2,4-Dinitrotoluene			
Nitrobenzene			

9H
NITROAROMATICS
DAILY CONTINUING CALIBRATION CHECK

Lab Name: Aquatec, Inc.

Lab Code: AQUAI

SAS No.: ______

Instrument ID: LC1488

Init. Calib. Date(s): ______ to ______

Contract: 91118

Case No.: ______

SDG No.: ______

Column: ______

Detector: UV @ 254nm

Standard Mix: B

COMPOUND	INITIAL CAL. MEAN RESPONSE	DAILY MEAN RESPONSE File: Date: Time:	%D
1,3,5-Trinitrobenzene			
Tetryl			
4-amino-2,6-Dinitrotoluene			
2,6-Dinitrotoluene			
Nitrobenzene			

Page ______ of ______

APPENDIX D

United States Department of Interior
Fish and Wildlife Service
Endangered and Threatened Species Letter

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, New York 13045

June 21, 1994

Mr. Michael Duchesneau
Project Manager
Engineering-Science, Inc.
Prudential Center
Boston, MA 02199

Dear Mr. Duchesneau:

This responds to your letter of May 12, 1994, requesting information on the presence of endangered or threatened species in the vicinity of the Seneca Army Depot located at Romulus, Seneca County, New York.

Except for occasional transient individuals, no Federally listed or proposed endangered or threatened species under our jurisdiction are known to exist in the project impact area. Therefore, no Biological Assessment or further Section 7 consultation under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) is required with the U.S. Fish and Wildlife Service (Service). Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered. A compilation of Federally listed and proposed endangered and threatened species in New York is enclosed for your information.

The above comments pertaining to endangered species under our jurisdiction are provided pursuant to the Endangered Species Act. This response does not preclude additional Service comments under the Fish and Wildlife Coordination Act or other legislation.

For additional information on fish and wildlife resources or State-listed species, we suggest you contact:

New York State Department of
Environmental Conservation
Region 8
6274 East Avon-Lima Road
Avon, NY 14414
(716) 226-2466

New York State Department of
Environmental Conservation
Wildlife Resources Center - Information Serv.
New York Natural Heritage Program
700 Troy-Schenectady Road
Latham, NY 12110-2400
(518) 783-3932

The National Wetlands Inventory (NWI) maps of the Dresden, Geneva South, Ovid, and Romulus Quadrangles are now available in draft form and there may be wetlands in the project vicinity. Copies of NWI maps may be obtained through:

CLEARS
Cornell University
464 Hollister Hall
Ithaca, NY 14853
(607) 255-6520

An order form listing the topographic quadrangles that have been mapped in New York State is enclosed for your information. However, while the NWI maps are reasonably accurate, they should not be used in lieu of field surveys for determining the presence of wetlands or delineating wetland boundaries for Federal regulatory purposes.

Work in certain waters and wetlands of the United States may require a permit from the U.S. Army Corps of Engineers (Corps). If a permit is required, in reviewing the application pursuant to the Fish and Wildlife Coordination Act, the Service may concur, with or without stipulations, or recommend denial of the permit depending upon the potential adverse impacts on fish and wildlife resources associated with project implementation. The need for a Corps permit may be determined by contacting Mr. Paul Leuchner, Chief, Regulatory Branch, U.S. Army Corps of Engineers, 1776 Niagara Street, Buffalo, NY 14207 (telephone: (716) 879-4321).

If you have any questions regarding this letter, contact Tom McCartney at (607) 753-9334.

Sincerely,
Mark W. Clough
ACTING FOR
David A. Stilwell
Acting Field Supervisor

Enclosures

cc: NYSDEC, Avon, NY (Regulatory Affairs)
NYSDEC, Latham, NY
COE, Buffalo, NY
EPA, Chief, Marine & Wetlands Protection Branch, New York, NY

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN NEW YORK

Common Name	Scientific Name	Status	Distribution
FISHES			
Sturgeon, shortnose*	*Acipenser brevirostrum*	E	Hudson River & other Atlantic coastal rivers
REPTILES			
Turtle, green*	*Chelonia mydas*	T	Oceanic summer visitor coastal waters
Turtle, hawksbill*	*Eretmochelys imbricata*	E	Oceanic summer visitor coastal waters
Turtle, leatherback*	*Dermochelys coriacea*	E	Oceanic summer resident coastal waters
Turtle, loggerhead*	*Caretta caretta*	T	Oceanic summer resident coastal waters
Turtle, Atlantic ridley*	*Lepidochelys kempii*	E	Oceanic summer resident coastal waters
BIRDS			
Eagle, bald	*Haliaeetus leucocephalus*	E	Entire state
Falcon, peregrine	*Falco peregrinus*	E	Entire state - re-establishment to former breeding range in progress
Plover, piping	*Charadrius melodus*	E T	Great Lakes Watershed Remainder of coastal New York
Tern, roseate	*Sterna dougallii dougallii*	E	Southeastern coastal portions of state
MAMMALS			
Bat, Indiana	*Myotis sodalis*	E	Entire state
Cougar, eastern	*Felis concolor couguar*	E	Entire state - probably extinct
Whale, blue*	*Balaenoptera musculus*	E	Oceanic
Whale, finback*	*Balaenoptera physalus*	E	Oceanic
Whale, humpback*	*Megaptera novaeangliae*	E	Oceanic
Whale, right*	*Eubalaena glacialis*	E	Oceanic
Whale, sei*	*Balaenoptera borealis*	E	Oceanic
Whale, sperm*	*Physeter catodon*	E	Oceanic
MOLLUSKS			
Snail, Chittenango ovate amber	*Succinea chittenangoensis*	T	Madison County
Mussel, dwarf wedge	*Alasmidonta heterodon*	E	Orange County - lower Neversink River

* Except for sea turtle nesting habitat, principal responsibility for these species is vested with the National Marine Fisheries Service.

Region 5 - 05/07/93 - 2 pp.

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN NEW YORK (Cont'd)

Common Name	Scientific Name	Status	Distribution
BUTTERFLIES			
Butterfly, Karner blue	*Lycaeides melissa samuelis*	E	Albany, Saratoga, Warren, and Schenectady Counties
PLANTS			
Monkshood, northern wild	*Aconitum noveboracense*	T	Ulster, Sullivan, and Delaware Counties
Pogonia, small whorled	*Isotria medeoloides*	E	Entire state
Swamp pink	*Helonias bullata*	T	Staten Island - presumed extirpated
Gerardia, sandplain	*Agalinis acuta*	E	Nassau and Suffolk Counties
Fern, American hart's-tongue	*Phyllitis scolopendrium* var. *americana*	T	Onondaga and Madison Counties
Orchid, eastern prairie fringed	*Platanthera leucophea*	T	Not relocated in New York
Bulrush, northeastern	*Scirpus ancistrochaetus*	E	Not relocated in New York
Roseroot, Leedy's	*Sedum integrifolium* ssp. *Leedyi*	T	West shore of Seneca Lake
Amaranth, seabeach	*Amaranthus pumilus*	T	Atlantic coastal plain beaches

E=endangered T=threatened P=proposed

EPA Comments for the Final Generic Installation RI/FS Work Plan that were Grouped with Comments (provided on May 10, 1996) on the Draft SEAD-4 Project Scoping Plan for Performing a CERCLA Remedial Investigation/ Feasibility Study (RI/FS) at the Munitions Washout Facility and Leach Field

Generic Work Plan-Field Sampling Plan

Comment #3 **WP Tables 3-11 and 3-12**

These tables have been revised as per prior EPA comments and ACE responses to incorporate the laboratory reporting limits for each analyte of interest. However, it is evident upon reviewing these tables that the reporting limits listed exceed ARARs for certain parameters. The prior response to EPA comments states that alternate analytical procedures are being evaluated in conjunction with the contracted lab. However, no alternate methods are mentioned further in the Generic FSP/CDAP. Prior to commencement of field activities, the analytical scheme necessary to achieve ARARs must be finalized. If the lab proceeds using the methodologies currently stated in the CDAP, data will be acquired which exceeds ARARs for certain parameters.

Response #3 Acknowledged. We recognize and have pointed out that for some constituents the analytical method detection limits are above the ARAR. This is an unfortunate limitation of the protocols. It should be noted that at the beginning of the Superfund program at SEDA, ACE , EPA and NYSDEC agreed that NYSDEC Analytical Services Protocols would be used for the remedial investigations at SEDA. These are the identical protocols used by NYSDEC in their Superfund work throughout New York State. Special analytical services could be arranged with the contracted laboratory to reduce the detection limits, however, this would involve an R&D program that the ACE believes is outside of what should be performed. But, if alternative methods were developed, then these methods would no longer be NYSDEC ASP Methods (which the laboratory is currently contracted to perform) and also, they would require EPA, NYSDEC and MRD approval prior to being used. No changes were made to the text.

Comment #4 **FSP: Section 3.6.5, Page A-56**

This section states that low flow centrifugal or bladder pumps will be used for groundwater purging and sampling. The following comments must be incorporated into this section of the FSP which outlines purging and sampling with a low flow pump. Note: while the Region II SOP for Low Flow Purging and Sampling is included as Attachment A-3 to the Generic WP FSP, it is a draft document which is still evolving. Region II personnel remain dedicated to producing a thorough and technically sound SOP, thus warranting approval of its use on a case by case basis.

Comment #4 a. Will the pumps used be dedicated and/or permanently installed in each groundwater well? If the pumps and associated tubing are dedicated to each well, decontamination is unnecessary except prior to installation into the well. At this time, an equipment rinsate blank must be collected. Equipment blanks are intended to assess the potential introduction of contamination during sample collection and handling. Therefore,

demonstrated analyte-free deionized water must be circulated through all pumps and associated tubing to collect a representative equipment blank. In conjunction, we recommend rinsing the outside of the pumps and tubing as well. This will ensure that the pumps and tubing are contaminant-free.

*Please note that when decontaminating centrifugal pumps manufactured by GRUNDFOS, the motor coolant chamber contains water and potential contaminants from prior usage. Therefore, to avoid cross contamination, the coolant fluid must be removed and replaced. See manufacturers installation and operating instructions for further details.

Response #4

a. Agreed. The pumps will not be dedicated or permanently installed in the wells; this has been specified on page A-57 of Appendix A of the Generic Work Plan. At this time we anticipate using a bladder pump to sample groundwater, which is driven by a controller at the ground surface. Also, we will collect equipment blanks (or rinse blanks) at the rate specified in the Generic Work Plan. Also, we have added the note about the motor coolant chamber of the Grundfos pumps to page A-62a of Appendix A of the Generic Work Plan.

Comment #4

b. Actual sampling flow rate must be accomplished with a gradual reduction in the flow rate down to 0.1 liters per minute and sustained hydraulic head pressure within the sampling tube. A gradual reduction in association with sustained hydraulic head pressure will minimize aeration, bubble formation, turbulent filling of sample bottles, and loss of volatiles due to extended residence time in the tubing. Hence, this coincides with the USEPA Region II Quality Assurance Manual (October 1989) and the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (OSWER Directive #9950.1, September 1986), which state that when collecting samples where volatile constituents are of concern using a bladder pump, pumping rates should not exceed 100 milliliters per minute (mls/min). If problems are encountered trying to maintain a uniform 100 mls/min flow rate during sampling, we recommend that the inside diameter (I.D.) of the sampling tube be reduced as it reaches the well head to ensure hydraulic head pressure is maintained. A reducer coupling (0.5 inch to 0.25 inch) installed approximately six feet from the actual sample port would suffice. Proper fitting installation, including the use of Teflon tape, will eliminate connection problems. Therefore, the text must be amended accordingly.

Response #4

b. Agreed. The recommended text regarding the sampling flow rate has been added to pages A-58 and A-59 of Appendix A of the Generic Work Plan.

Comment #4

c. The document should state how the flow rate will be measured. For example, the actual apparatus, i.e., graduated cylinder and stopwatch, may be used. Therefore, the text must be amended accordingly.

Response #4

c. Agreed. The flow rate will be measured with a graduated cylinder and a stop watch.. The text on page A-57 of Appendix A of the Generic Work Plan has been amended to include the actual apparatus that will be used to measure the flow rate.

Comment #4

d. While step 3 on page A-58 states that the field parameters to be monitored are turbidity, temperature, specific conductance pH, Eh, and dissolved oxygen, the text does not delineate the order of equilibration for each water quality indicator parameter identified. In general, the order of equilibration is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. However, it should be noted that temperature and pH, while often used as equilibration indicators, are actually quite insensitive in terms of distinguishing between formation water and stagnant casing water. Therefore, the text must be amended accordingly.

Response #4

d. Agreed. The recommended text has been added to Section 3.6.5., page A-56.

Comment #4

e. The text specifies that the field parameters should not vary more than ± 10% in order for the well to be considered stable. However, the following criteria, which is parameter specific, should be used. Three successive readings must be within ± 0.05 for pH, ±3% for conductivity, and ± 10% for dissolved oxygen and Eh, and 5 NTUs for turbidity. The variability within each water quality indicator parameter is the current recommendation out of the EPA Office of Research and Development and has been adopted by Region II.

Response #4

e. Agreed. The recommended text has been added to Section 3.6.5, page A-56.

Comment #4

f. To remain consistent with comment #4b, it is recommended that the inside diameter (I.D.) of the sampling tube be reduced as it reaches the well head to ensure hydraulic head pressure is maintained. A reducer coupling (0.5 inch to 0..25 inch) installed approximately six feet from the actual sample port would suffice. Proper fitting installation, including the use of Teflon tape, will eliminate connection problems. Therefore, the text must be amended accordingly. Consequently, sample discharge must be a continuous flow of 100 ml/minute for volatile organics and up to 500 ml/minute for other analytical parameters of interest. However, to increase sample collection time for the other analytical parameters, a normal 0.5 inch coupling and previous tubing should replace the reducer coupling and 0.25 inch tubing. Therefore, a stoppage in flow could occur after the collection of volatile organic samples in order to change the coupling/tubing. In addition, a caveat should be added to reiterate that static water column level drawdown is minimal during sampling.

Response #4 **f.** Agreed. The recommended text has been added to page A-58 of Appendix A of the Generic Work Plan

Comment #4 **g.** The outlined procedures do not delineate the placement of the gas powered generator, in the proximity of the well, to drive the pump motor If a gas powered generator is utilized, the generator must be placed, at a minimum of 25 feet, downwind of the well to limit the incidence of cross-contamination. Therefore, the text must be amended to incorporate this scenario.

Response #4 g. Agreed. The recommended text has been added to page A-57 of Appendix A of the Generic Work Plan

Comment #4 **h.** Amend page A-59 to include collection of samples for explosives analysis.

Response #4 h. Agreed. The text on page A-59 of Appendix A of the Generic Work Plan has been modified as recommended in the comment.

Comment #5 **FSP: Section 4.3, Page A-154**

Remove the reference to using plastic bottles for metals and water quality parameters. Polyethylene is the material of choice for these samples. In addition, all glass bottles used should have Teflon lined caps, except those for VOC samples which require Teflon septa with separate cap.

Response #5 Agreed. The word "plastic" has been replaced with the word "polyethylene" on page A-154.

Comment #6 **FSP: Section 4.4, Page A-155**

The sampling equipment decontamination procedure listed must be modified as follows: add a tap water rinse after the nitric acid rinse and prior to the use of methanol/hexane.

Response #6 Agreed. A tap water rinse has been added to the sampling equipment decontamination procedure on page A-155.

Generic Work Plan-Chemical Data Acquisition Plan

Comment #7 **CDAP: Section 3.2, Page C-4**

The first paragraph here incorrectly references the NYSDEC data deliverables packages. The NYSDEC Analytical Services Program (ASP) is intended to support the Superfund Program and defines two types of deliverables packages: ASP Category A and ASP Category B.

In this investigation, use of ASP Category B warranted. Please replace the text with the correct NYSDEC terminology.

Response #7 Agreed. The terminology has been replaced. As a note, for Level IV data, the NYSDEC ASP Category A deliverables will be used, and for Level III data the NYSDEC ASP Category B deliverables will be used.

Comment #8 **CDAP: Section 4.1, Page C-5**

The second paragraph here states that the details of the project organization are contained in the correlating Scoping Plan. However, the Scoping Plan for SEAD-4 does not list this information. Please modify the SEAD-4 Plan appropriately.

Response #8 Agreed. The details of the project organization have been added to the SEAD-4 Scoping Plan. No change was made to the Generic Work Plan.

Comment #9 **CDAP: Section 4.3, Page C-6**

The second paragraph here states that a discussion on the contracted laboratory is contained in the correlating Scoping Plan. However, the Scoping Plan for SEAD-4 does not list this information. Please modify the SEAD-4 Plan appropriately. This applies to CDAP Section 5.3, bullet (a) as well.

Response #9 Agreed. In response to this comment we have modified the second paragraph to read: "...to this appendix. The contracted laboratory is identified in Section 6.0 of the appropriate RI/FS Project Scoping Plan..." In addition, the contracted laboratory is identified in Section 6.0 of the SEAD-4 Project Scoping Plan (page 6-1).

Comment #10 **CDAP: Section 5.3, Page C-8**

The frequency for collecting replicate and rinse blank samples must be specified. The correct frequency is as follows. Replicate samples must be collected at a rate of one per twenty environmental samples or less per matrix. This is a separate replicate from that prepared and analyzed by the laboratory. Rinse blanks must be collected at a rate of one rinse blank per type of equipment used each day a decontamination event is carried out. It is permissible to use the same aliquot of water on all equipment associated to a particular matrix for analysis of Semi-VOCs, pesticides, PCBs, Explosives, and inorganics. This rinse must be performed sequentially on all sampling equipment. However, a separate rinse blank is required for each piece of equipment used to collect a sample of a particular matrix undergoing VOC analysis.

Also, trip blanks are only required when sampling aqueous samples undergoing VOC analysis.

Response #10

Agreed with most of the comment, but disagree with a few aspects of it. We agree with the comment on replicates. We agree with most of comments on rinse blanks, except we disagree with the frequency for groundwater rinsates. For groundwater samples we feel that this frequency is not reasonable. This is because the site-specific geologic conditions at SEDA (i.e., relatively impermeable till) typically result in slow recharging wells translates into long periods of time for sampling. Thus, if we obtain anywhere from 2 to 4 groundwater samples in a day, under the recommended frequency, we would obtain an unnecessary large percentage of QC samples (up to 50 percent). Therefore, were believe that a frequency of one rinsate sample for every two days of groundwater sampling is more reasonable for SEDA. Also we disagree that a separate rinse blank is required for each piece of equipment used to collect a sample of a particular media undergoing VOC analysis. We intend to use the same aliquot of water on all equipment associated to a particular matrix for all analyses. Lastly, we agree with the comment on trip blanks. The text changes were made to pages A-8 and A-9 of Appendix C of the Generic Work Plan.

Comment #11

CDAP: Section 5.4.1, Page C-10

When acidifying an aqueous VOC sample, use 12N HCL to prepare the 1:1 preservation solution.

Response #11

Agreed. The recommended text has been added to page C-10 of Appendix C of the Generic Work Plan.

Comment #12

CDAP: Table C-1, Page C-11

Comment #12

a. Prior EPA Comment 4 on this Appendix stated that the holding time must be specified from Verified Time of Sample Receipt (VTSR). However, the holding time specified for explosives, pesticides/PCBs, and Semi-VOCs in groundwater/surface water, soil and fish tissue (explosives only) specifies a holding time of 7 days to extraction, which is correct from the time of collection. If VTSR is used, the correct holding time to extraction is 5 days, which considers shipping time. Amend this table appropriately.

Response #12

a. Agreed. Table C-1 has been amended as recommended in the comment. Also, footnote 4 now indicates 5 days from VTSR.

Comment #12

b. Specify a holding time for cyanide in groundwater/surface water samples.

Response #12

b. Agreed. A holding time of 14 days for Total Cyanide has been added Table C-1.

Comment #12 c. The containers listed for semi-VOCs and pesticides/PCBs in water (footnote 6 to table C-1) are incorrect. Four liters per sample are required for aqueous samples for extractable analyses.

Response #12 c. Agreed. We agree that the cited footnote incorrectly states the volume of sample required. However, the contracted laboratory stated that they require at least 2 liters of water for each analysis. Therefore, Table C-1 has been modified so that footnote 3 now reads "2 1 liter amber glass containers with Teflon-lined cap."

Comment #12 d. The containers listed for semi-VOCs and pesticides/PCBs in soil (footnote 3 to table C-1) are incorrect. Footnote 6 is appropriate for soil samples for extractable analyses.

Response #12 d. Agreed. Table C-1 has been amended so that footnote 6 is referenced for the semivolatile and pesticides/PCBs analyses.

Comment #12 e. Correct the VOC soil holding time to 10 days.

Response #12 e. Agreed. The VOC soil holding time has been changed to 10 days.

Comment #13 **CDAP: Section 5.4.3.5, Page C-15**

The correct frequency of collecting a rinse blank is stated in Comment 10 above. A field equipment rinse blank is required for dedicated equipment. It should be collected prior to placement at the particular sampling location. Also, field QC samples, i.e. rinse blank, trip blank, and replicate samples, must be prepared and analyzed by the laboratory in conjunction with their associated samples. Results of these QC samples must be reported with the associated field samples for use during data validation. Also the field forms containing dates and times of sample collection must be available to the data validation personnel in order to correctly correlate the QC samples to their associated environmental samples.

Response #13 Agreed with most of comment on QC samples, but disagree with a few aspects of the comment (as explained in the response to Comment #10 above). We agree that for soil, sediment, surface water rinse blank samples should be collected at a frequency of one rinse blank per type of equipment used each day a decontamination event is performed. However, for groundwater samples we feel that this frequency is not reasonable. This is because the site-specific geologic conditions at SEDA (i.e., relatively impermeable till) typically result in slow recharging wells translates into long periods of time for sampling. Thus, if we obtain anywhere from 2 to 4 groundwater samples in a day, under the recommended frequency, we would obtain an unnecessary large percentage of QC samples (up to 50 percent). Therefore, were believe that a frequency of one rinsate sample for every two days of sampling is more reasonable for SEDA. Also we disagree that a separate rinse blank

is required for each piece of equipment used to collect a sample of a particular media undergoing VOC analysis. We intend to use the same aliquot of water on all equipment associated to a particular matrix for all analyses. Lastly, we agree with the comment on trip blanks

No dedicated sampling equipment is planned at this time, however, should it be used, a field equipment rinse blank will be taken for dedicated equipment (It will be collected prior to placement at the particular sampling location).

Agreed. field QC samples, i.e. rinse blank, trip blank, and replicate samples, will be prepared and analyzed by the laboratory in conjunction with their associated samples.

Agreed. results of these QC samples will be reported with the associated field samples for use during data validation. Also the field forms containing dates and times of sample collection will be available to the data validation personnel in order to correctly correlate the QC samples to their associated environmental samples.

Comment #14 **CDAP: Section 5.4.3.6, Page C-15**

Analytical results for the demonstrated analyte free water (whether originating at the lab or the site) must be made available upon request. Also, if this water is shipped on-site, store away from any organic solvents in order to avoid extraneous contamination.

Response #14 Agreed. The results of the analysis of the demonstrated-free water are available upon request - this statement has been added to Section 5.4.3.5. Also, if the demonstrated analyte-free water is stored on-site, it will be kept away from organic solvents to avoid extraneous contamination - this text was added to Section 5.4.3.6.

Comment #15 **CDAP: Table C-2**

a) Comment 3 above regarding reporting limits exceeding ARARs applies here as well.

b) Information pertaining to the screening for chromium to be performed at SEAD 4 should be on this table.

c) Method 524.2 is only applicable to aqueous samples, therefore correct the listing in Part IB, (vi) of this table. This also applies to Part IC, (i) and (ii).

d) Correct Part IIC, (1) and (2) as incorrect entries are listed for the preparative method, analytical method and reporting limit.

Response #15

a) Acknowledged. We recognize and have pointed out that for some constituents the analytical method detection limits are above the ARAR. This is an unfortunate limitation of the protocols. It should be noted that at the beginning of the Superfund program at SEDA, ACE , EPA and NYSDEC agreed that NYSDEC Analytical Services Protocols would be used for the remedial investigations at SEDA. These are the identical protocols used by NYSDEC in their Superfund work throughout New York State. Special analytical services could be arranged with the contracted laboratory to reduce the detection limits, however, this would involve an R&D program that the ACE believes is outside of what should be performed. But, if alternative methods were developed, then these methods would no longer be NYSDEC ASP Methods (which the laboratory is currently contracted to perform) and also, they would require EPA, NYSDEC and MRD approval prior to being used. No changes were made to the text.

b) Agreed. Because chromium screening will be performed using the same method used for the normal Level IV samples (i.e., NYSDEC CLP Method), a parenthetical note indicating this has been added to the chromium listing on page 2 of Table C-2. Also, a note at the end of the Table C-2 explains that a NYSDEC ASP Category A deliverable will not be generated for the chromium screening results.

c) Agreed. The reference to Method 524.2 has been deleted from the soil and sediment analyses listing for Part IB. Also, the entries for Part IC (I) and (ii) have been corrected.

d) Agreed. The entries for the preparative method, analytical method and reporting limits have been corrected.

Comment #16 **CDAP: Section 7.2, Pages C-20 and C-33**

a) The most recent (at the time of analysis) revisions of the analytical methods must be employed. As per comment 3 above, ARARs must be achieved.

b) Note-when using any method from SW-846, all requirements specified in the method as "recommended" are required (for example but not limited to analysis/reporting of VOC and Semi-VOC TICs, and other QA/QC requirements). Other specifications contained in Chapter One of SW-846 are also required to be performed. The data should be reported in a format equivalent to the NYSDEC ASP Category B package. This includes but is not limited to all raw data, quantitation reports, sample and standard spectra and QA/QC information.

c) The last paragraph on page C-33 states that asbestos "re-analysis will be requested for questionable results, i.e. significant discrepancies between spilt samples" is unclear. An acceptable RPD should be specified here.

Response #16

a) Agree with the first part of the comment and acknowledge the second part of the comment. A statement that the most recent (at the time of the analysis) revisions of the analytical methods will be employed has been added to Section 7.2. However, we recognize and have pointed out that for some constituents the analytical method detection limits are above the ARAR. This is an unfortunate limitation of the protocols. It should be noted that at the beginning of the Superfund program at SEDA, ACE , EPA and NYSDEC agreed that NYSDEC Analytical Services Protocols would be used for the remedial investigations at SEDA. These are the identical protocols used by NYSDEC in their Superfund work throughout New York State. Special analytical services could be arranged with the contracted laboratory to reduce the detection limits, however, this would involve an R&D program that the ACE believes is outside of what should be performed. But, if alternative methods were developed, then these methods would no longer be NYSDEC ASP Methods (which the laboratory is currently contracted to perform) and also, they would require EPA, NYSDEC and MRD approval prior to being used. No changes were made to the text.

b) Agreed. The recommended text has been added to item number 2, which concerns SW-846.

c) Agree. The text has been clarified as much as possible. However, we are not aware of any value (i.e., RPD) in the guidance that can be used in this situation. Thus, this statement has changed to read "the lab may be contacted on a case by case basis if the results are judged to be questionable (i.e., significant discrepancies between split samples) by the inspector for sample result consistency, and in some instances reanalysis may be requested - guidance does not specify a value (or RPD) for asbestos samples.

Comment #17

CDAP: Table C-10, Page C-42

This table should specify information regarding the chromium screening to be employed, i.e. at SEAD 4.

Response #17

Disagree. We do not believe that is appropriate to incorporate the chromium screening method into this table because in previous responses (that have been incorporated into the Generic Work Plan) we have stated that chromium screening will be performed using NYSDEC CLP Methods, but the results will not be reported using a NYSDEC ASP Category A deliverable. Thus, the calibration criteria for the chromium screening is the same as that for the Level IV chromium analyses, which is already included in the Table C-10.

Comment #18

CDAP: Section 7.3.2, Page C-43

An MS/MSD/MSB should be prepared and analyzed for parameters in addition to explosives. See the individual analytical method for required frequency.

Response #18

Agreed. This paragraph is not meant to indicate that explosives are the only compounds for which MS/MSD/MSB samples will be prepared - other compounds have always been included in the analytical program as indicated in the first sentence of Section 7.3.2. We agree it is not clear in this instance. Thus, the text has been clarified.

Comment #19

CDAP: Section 8.3, Page C-45

If calibration of the pH meter indicates that the response of this meter has decayed, all data collected with the meter in question should be rejected. Remove reference to "adjusting" the data as this is undefined.

Response #19

Agreed. The word "adjust" has been removed from the sentence as recommended - we do not intend to adjust any pH data. However, we have included a description of acceptable data. If pH meter calibrates to within 0.5 pH units then the data collected prior to this will be considered acceptable . If the meter calibrates to within 0.5 and 1 pH unit then the data will be flagged with a "J" indicating that it is estimated . If the meter calibration indicates that it deviates by greater than 1 pH unit then the data will be rejected ("R"). This text has been added to the second full paragraph on page C-45.

Comment #20

CDAP: Section 9.2.4, Page C-49

a) The second paragraph here states that the "detection limit" will be included in the tabulated results for those analytes not found. Specify whether this is the Contract Required Quantitation Limits in the NYSDEC CLP SOWs or the PQLs or the Instrument Detection Limits (inorganics only). In addition, the results and quantitation limits for soil/sediment samples must be corrected by the lab % Moisture and this correction verified during data validation. All tabulated results should note the % Moisture per sample.

b) The following SOPs must also be used for data validation of herbicide and explosive results:

Attachment 3: SOP No. HW-17, Rev. 1.3, November 1994
SOP for Validating Chlorinated Herbicides by GC
Attachment 4: SOP No. HW-16, Rev. 1, September 1994
SOP for Validating Nitroaromtics and Nitramines by HPLC

Response #20

a) Agreed. The type of detection limit has been specified in paragraph two of Section 9.2.4. Also, the results and quantitation limits for soil/sediment analyses will be corrected by the lab % moisture and -this has always been done by the lab for samples at SEDA. And, the

correction for % moisture will be verified during the data validation. In addition, the tabulated results will note the percent moisture per sample.

b) Agreed. These two SOPs were added to paragraph three of Section 9.2.4.

Comment #21 **CDAP: Section 9.3.2, Page C-50**

Comments 1 and 7 above apply here as well.

Response #21 Agreed. Text has been added to the paragraph one of Section 9.3.2 that states that the data deliverable packages will be NYSDEC ASP Category A and Category B .

Comment #22 **CDAP: Attachment C-2**

This attachment states that the non-routine analytical methods are contained in the individual Scoping Plan for the subject site. This is not true. The Scoping Plan for SEAD 4 does not contain any information regarding non-standard analytical methods. Please correct the Scoping Plan appropriately.

Response #22 Disagree. The italicized statement says that "additional non-standard analytical methods may be a part of the RI of the subject site are contained in the appropriate RI/FS Project Scoping Plan..." This statement was included in the Generic Workplan to account for any additional methods that may be use on sites at SEDA in the future - by including any additional method in the Project Scoping Plan it avoids having to continually update the Generic Work Plan. However, it is not meant to imply that all Project Scoping Plans contain non-standard analytical methods. None are listed in Appendix C of the SEAD-4 Project Scoping Plan because all of them are covered in the Generic Work plan

To avoid confusion in the future, the statement has been amended to read "If warranted, additional non-standard...may be contained in the ..." Also, a statement has been added to the SEAD-4 Scoping Plan that reads "The Generic Work Plan contains standard and non-standard analytical methods - no additional non-standard analytical methods have been added to this Project Scoping Plan."

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CLARIFICATIONS TO
COMMENTS AND RECOMMENDATIONS FROM
ENVIRONMENTAL PROTECTION AGENCY (EPA) - REGION II
DRAFT GENERIC RI/FS WORK PLAN
SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK

General Comments

Appendix A

Comment #6 The response to this comment is not complete. We recommend that two measurements at 90° to each other be conducted at every location. The collection of these data will aid in evaluate heterogeneities in the subsurface.

Response #6 Agreed. For the EM data collection, readings will be measured both parallel and at 90 degrees to the transect line at every location. The text on page A19, paragraph 2 has been revised to state this.

Comment #15 The text clearly states that the monitoring wells are to be installed in accordance with NYSDEC Part 360 requirements. NYSDEC Part 360 states on page 2-13, Section 360-2.11(8)(ii)(b), "All screens used must be factory constructed nonsolvent welded/bonded ...". If ES does not intend to use continuous slot wire wrap PVC screens, the text referring to the compliance with NYSDEC Part 360 regulations should be deleted. Wire wrapped screens are preferred to machine slotted screens. The difference in cost is minor.

Response #15 Agreed. Monitoring wells will be installed using PVC continuous slot wire wrap screens as described in the NYSDEC Part 360, Section 360-2.11(8)ii(b). The text on page A-36 of Appendix A has been revised to state that wire wrapped screens will be used.

Comment #21 The revised purging criteria, are reasonable. However, the volume calculation should be based on borehole volumes and not well volumes, since monitoring for stabilization will be conducted every volume and this volume will vary based on the method used for calculation.

Response #21 This comment no longer appears to be necessary. While borehole volume calculations are used for the well development procedure, the Draft SOP for Groundwater Sampling using Low Flow Pump Purging and Sampling (EPA May 15, 1995) states that monitoring for stabilization during the purging process will be conducted at 3 to 5 minute time intervals and not every volume.

Groundwater Sampling Sequence

As we discussed during a conference call with the EPA, NYSDEC, and the ACOE on September 12, 1995, the groundwater sampling sequence will have metals collected third, after the VOCs and SVOCs. The text on page A-59 of the Generic Workplan has been revised to clearly indicate this sampling order.

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COMMENTS AND RECOMMENDATIONS FROM
ENVIRONMENTAL PROTECTION AGENCY (EPA) - REGION II
DRAFT GENERIC RI/FS WORK PLAN
SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK

GENERAL COMMENTS

Section 2.0

Comment #1 Figure 2-4. Figure has the title of Figure 2-6 placed within it.

Response #1 Agreed. The title block information for Figure 2-6 has been removed from Figure 2-4.

Comment #2 Figure 2-5. The text on this figure is hard to read.

Response #2 Agreed. The text on Figure 2-5 has been reprinted in a more legible format.

Comment #3 Table 2-1. This table appears to have been taken from the Ash Landfill Report, as shown by the title at the head of the Table.

Response #3 Agreed. Table 2-1 was obtained from an Ash Landfill Report, however, the information in the table regarding background concentrations of elements in soils of the eastern United States with specific data for New York State correctly applies to the area in the vicinity SEDA. Reference to the Ash Landfill has been removed from the title.

Comment #4 Page 2-12, p1. The average pumping rate for the domestic and farm wells in the area is given as 0.35 gpm. This is a very low pumping rate and it would be useful to know the approximate range of pumping rates for these wells. The locations of the public water supply wells for the villages of Ovid and Interlaken should be shown on a map along with the Seneca Army Depot property. Alternatively, their distance from SEAD should be stated.

Response #4 Agreed. The pumping rates for wells in the area range from 0.5 gpm to 150 gpm for domestic and farm wells. Wells used for domestic supply, though of low yield, generally furnish an adequate amount of water for normal cooking, drinking, laundering, and sanitary needs. On a farm stocked with only a few animals, one well may be adequate for both farm and household needs, but on heavily stocked farms an additional well generally is needed to meet the greater demand for water.

The village of Ovid obtains its water from two wells located approximately 1,000 feet south of the village center. Ovid is located approximately 5 miles south of SEDA. Interlaken obtains its water from one well located 1-1/2 miles northeast of the village. Two wells, which are used for a backup water supply only, are located approximately 1-1/2 miles southwest of the village.

Interlaken is located approximately 11 miles south of SEDA. This information has been added to the text on page 2-12.

Comment #5 Figure 2-8. The source of the information as given in this figure should be reviewed for completeness. The source of the information provided in this figure is unclear.

Response #5 Acknowledged. SEDA provided the locations of private drinking water wells presented in Figure 2-8. Additional information on how the map information was generated by SEDA is not available. Discussion with Seneca County Department of Health, Soil and Water Conservation District, and Department of Economic Development did not provide any information on the location of private drinking water wells near SEDA.

<u>Section 3.0</u>

Comment #1 Page 3-2, p1. Organic content is listed twice as a media-specific property is this a typographical error or are there intended to be two "organic contents"?

Response #1 Agreed. Organic content was listed twice; once in reference the soil/sediment media, and also in reference to the groundwater/surface water media. The sentence has been revised to clarify that for the soils and sediment media, organic carbon content, moisture content, and mineralogy are media-specific properties; for the groundwater and surface water media, organic content, charge balance, redox condition, and pH are the media-specific properties.

Comment #2 Page 3-2, p2. The units for the Henry's Law constant are not given in the text.

Response #2 Agreed. The units for the Henry's Law constant referenced in the text have been added.

Comment #3 Table 3-1. There is no discussion within the text of the basis for the selection of the organic compounds shown on the table. A detailed rationale should be provided for the selection of the chemicals shown.

Response #3 Agreed. The organic compounds presented in Table 3-1 were those compounds commonly found during investigations conducted to date at SEDA including RIs and ESIs, or are suspected to have been released to the environment based on historical usage of the sites. This rationale has been added to the text on page 3-2.

Comment #4 Page 3-5, p5. Groundwater is not listed as a major or a secondary pathway of concern for contaminant transport and concern at SEDA since on-site and off-site groundwater have been affected by contamination.

Response #4 Agreed. Groundwater has been added to the list of major potential pathways of concern at SEDA.

Comment #5 Page 3-7, p3. Table 3-1 was referenced in several ways and in the text, as compounds of concern and here as compounds detected at SEDA. The table should be referenced consistently to limit confusion.

Response #5 Agreed. The text on page 3-7 has been revised to refer to Table 3-1 as presenting selected organic compounds of concern at SEDA.

Comment #6 Page 3-9, p4. Again Table 3-1 is referenced as being the contaminants detected at the Ash Landfill.

Response #6 Agreed. The referenced text on page 3-9 has been revised to refer to Table 3-1 as presenting selected organic compounds of concern at SEDA.

Comment #7 Page 3-28, p1. It is unclear why only suspected pesticides and PCBs are discussed here. On what basis have compounds been eliminated since this is a generic plan? This comment pertains to all compounds and analytes discussed in the text.

Response #7 Agreed. Those compounds that have been commonly found during previous investigations conducted at SEDA to date including RIs and ESIs or are suspected to have been released to the environment at SEDA based on the historical usage of the sites have been included in the discussion of the environmental fate of constituents.

Comment #8 Table 3-9. Several federal ARARs have been listed under the state ARARs list.

Response #8 Agreed. The federal ARARs including SARA, OSHA, and Clean Air Act, have moved to the proper listing under Federal ARARs.

Comment #9 Table 3-10. The NYS TAGM for soil clean-up levels is not referenced as a "To Be Considered".

Response #9 Agreed. The NYS TAGM titled Determination of Soil Cleanup Objectives and Cleanup Levels (November 16, 1992) has been added to the list of Potential Surveys of Items "To Be Considered".

Comment #10 Table 3-11. This table appears to be incomplete since organics are not listed.

Response #10 Agreed. Table 3-11 has been revised to include organic compounds. As part of this revision, ARARs for groundwater have been updated and surface water ARARs have been added to the table.

Comment #11 Table 3-12. This table appears to be incomplete since organics are not listed.

Response #11 Agreed. Table 3-12 has been revised to include organic compounds. In addition, ARARs for soils have been updated and ARARs for sediments have been added to the table.

Section 3.2 Identification of Potential Receptors and Exposure Scenarios

Comment #1 General Comment. The section is useless as written. An overall conceptual site model should be prepared that identifies likely contaminant release mechanisms, secondary contaminant sources, environmental media providing exposure pathways, exposure routes, and human and ecological receptors. While generic, such a model will demonstrate an overall knowledge of the site and provide a basis for the generic exposure assessment provided in Section 4.4. The generic model can then be refined, on an area-by-area basis, in the "appropriate RI/FS Project Scoping Plan".

Response #1 Agreed. Section 3.2 has been revised to present an overall conceptual site model. More detailed conceptual site models will be presented in each RI/FS Project Scoping Plan.

Comment #2 Page 3-109, p4. The text states that Lead is a suitable indicator for the presence of heavy metals at a site, based on the OB Grounds. This may not be appropriate for all sites and other potential indicators should be evaluated since this is a generic work plan.

Response #2 Agreed. The use of lead as an indicator for the presence of heavy metals is not appropriate for all sites. This sentence has been revised to state that indicators will be developed on a site by site basis. It is beyond the scope of this workplan to develop indicator compounds for each site involved in the RI. This will be developed in the RI/FS Scoping Plans.

Section 4.0

Comment #1 Page 4-2. The bullets listed under soils data indicate that Level II data will be validated along with Level IV and V data. This should be clarified by discussing Level II data independently from the other levels of data since Level II cannot be validated in the same manner as Level IV and V data.

The generic workplan should define the contents of the Level II, IV and V data packages as per NYSDEC. In addition, the data validation effort for each data deliverables package must be defined (provide example SOPs etc.).

Response #1 Agreed. Validation of Level II data has been moved to a separate bulleted line on page 4-2. It is acknowledged that Level II data cannot be validated in the same manner as Level IV and V data.

The contents of data packages as per NYSDEC are described in Section 9.3.2 of Appendix C, the Chemical Data Acquisition Plan. A description of the data validation effort is discussed in Sections 3.2 and 9.2.4 of Appendix C. Reference to these sections in Appendix C has been added to the text on page 4-2.

Comment #2 Page 4-3. The groundwater section discusses identifying and evaluating groundwater characteristics, including "pumping capacity". It is unclear what is meant by pumping capacity.

Response #2 Agreed. Pumping capacity as used in the text on page 4-3 refers to the relative recharge of the monitoring wells. The wording in the text has been changed to clarify this point.

Comment #3 Page 4-3. The hydrogeologic data section discusses the vertical direction and gradient of groundwater flow. This can only be determined if well pairs are installed at a site. Please clarify if this will be done during each site investigation.

Response #3 Agreed. Determination of the vertical direction and gradient of groundwater flow will be conducted at a limited number of sites, where well pairs are to be installed. In general, only individual monitoring wells will be installed at each location. The bulleted item referring to vertical direction and gradient determinations has been revised to indicate that this will be conducted as required.

Comment #4 Page 4-5, p1. The first sentence should be revised to include "..and related guidance." The third sentence should be revised to read, "The assessment will be based on evaluation..." The fourth sentence should be revised to read, "...andthe degree of exposure to human and ecological receptors."

Response #4 Agreed. Sentences 1, 3 & 4 have been revised accordingly.

Comment #5 Page 4-6, Section 4.4.1. The section title and all text should be revised to include the USEPAs terminology: "chemicals of potential concern". "Essential nutrients" should be added to the list of selection criteria. Chemical of potential concern should be selected based on the listed criteria, regardless of whether the risk characterization will be quantitative or qualitative. The risk posed by chemical of potential concern without available toxicological criteria should be evaluated qualitatively.

Response #5 Agreed. The changes have been made.

Comment #6 Page 4-6, p4. "A preliminary evaluation of the potential populations at risk and the most likely exposure routes" are not presented in Section 3.2 as indicated. The text should be revised accordingly. As written, however, while Section 3.2.3 identifies residential development of the site as a future use scenario for risk assessment purposes, this scenario is not presented in Section 4.4.2.

Response #6 Agreed. Paragraph 4 has been revised to reflect exactly what Section 3.2 contains. In addition, receptors for current and future use scenarios have

been added to the text and include on-site residents as one of the receptors in the future use scenarios.

Comment #7 Page 4-9, p1. Item 2. should be revised to read: "Inhalation of ...and volatile organic emissions from soil and surface water". If potable use of the groundwater is to be evaluated in a future use scenario, dermal contact with groundwater and inhalation of chemicals volatized from groundwater should be included in Item 4. as potential pathways of human exposure.

Response #7 Agreed. The change has been made.

Comment #8 Page 4-9, p2. The sentence as written is not clear. If appropriate, the sentence might be revised to read: "The identification of potentially exposed populations will consider the surrounding land use, locations of nearby residences and sensitive subpopulations.

Response #8 Agreed. Paragraph 2 has been revised accordingly.

Comment #9 Page 4-9, p3. A survey of agricultural and livestock farming in the vicinity of the site should also be conducted. The survey could be conducted through a review of available maps and drive-by surveys. The text should be revised accordingly.

Response #9 Agreed. Agriculture and livestock farming surveys have been added to the text.

Comment #10 Page 4-9, p4. Possible inhalation exposure to volatile chemicals released from surface water should be included in the first sentence. The third sentence should be revised to read: "Ingestion of edible fish..."

Response #10 Agreed. The changes have been made.

Comment #11 Page 4-9, p5. The first sentence should be revise to read: "...vehicular traffic or wind erosion", as "high" winds are not necessary to generate fugitive dust. The third sentence implies that a simple "loading" analysis will be conducted in which chemical concentrations sorbed to particulates in air" will be estimated based on "typical values for particulates in air" and "the concentration of contaminants in the surficial soils". Based on the availability and appropriateness of the "typical values for particulates in air", such an approach may be acceptable as a screening level analysis. An analogous screening level approach is not provided for potential vapor emissions, identified earlier as a potential exposure pathway. The text should be revised to indicate that pending the results of the screening level analysis, a more sophisticated analysis (including emissions estimation and dispersion estimation using screening level or refined modeling analysis) may also be conducted.

Response #11 Agreed. The recommended edits have been made. Also, the "loading" analysis for particulates based on available representative values, is now presented as

a screening step. Follow-up with a more sophisticated approach, if necessary, is now discussed. A similar discussion for vapor emissions has also been added.

Comment #12 Page 4-9, p6. This paragraph should be revised to indicate that more sophisticated analyses will be conducted following the guidance provided in the USEPAs Air/Superfund National Technical Guidance Study Series, including but not limited to the Guideline for Predictive Baseline Emissions Estimation Procedures for Superfund Sites (Interim Final. EPA-450/1-92-002. January 1992). As "ingestion of food crops...exposed to fugitive dusts..." is identified as a potential of human exposure, the text should indicate that air pathway models that can estimate both dispersion and deposition impacts may be needed.

Response #12 Agreed. Paragraph 6 on page 4-9 has been revised to include the use of the referenced USEPA guidance study series for air pathway analyses. In addition, the text has been revised to indicate that the air pathway models which can estimate both dispersion and deposition impacts will be used as required at the site.

Comment #13 Page 4-10, Top of Page. It is inappropriate to state that an explanation is not provided because it would be "too lengthy". The text should be revised to include a statement indicating that the air pathway methodology will be developed further in the RI/FS Project Scoping Plan or other appropriate document.

Response #13 Agreed. The change has been made.

Comment #14 Page 4-10, p1. If appropriate, the first sentence should be revised to indicate that excavation workers who visit the site are the only population, currently, with the potential for exposure to surface soil. Consistent with USEPA, Region II guidance, dermal exposure to soil should be quantified for cadmium, PCBs, and dioxins/furans, as appropriate. The USEPA's Dermal Exposure Assessment: Principles and Applications. (Interim Report. EPA/600/8-91/011B. January 1992) should also be consulted for general guidance. The third sentence should be revised to include possible inhalation of volatile chemical emissions in addition to fugitive dusts.

Response #14 Agreed. The first and third sentences of this paragraph have been revised to reference excavation workers as the only population with the potential for exposure to surface soil, and to add possible inhalation of volatile chemical emissions. In addition, the USEPA document has been referenced for guidance and the quantifications of the referenced compounds has been added to the text.

Comment #15 Page 4-10, p3. The sentence should be revised to read: "Where appropriate based on the available data, the upper 95% ...of the log transformed data... used to estimate exposure point concentrations". The future use scenarios

discussed here state that the use of the facility is not expected to change. As approved then other future use scenarios should be considered and should be discussed in the text.

Response #15 Agreed. The first sentence has been revised as recommended. As future uses are approved, other future use scenarios will be considered.

Comment #16 Page 4-10, p4. The second sentence should be rewritten as the term "reasonable maximum exposure" is used incorrectly. Following USEPA guidance, "reasonable maximum exposure" is generally estimated based on average concentration data and upper tendency (e.g., 90th or 95th percentile) exposure parameters, which taken together produce reasonable maximum exposure estimates. The USEPA's RAGS Supplemental Guidance, published in 1991, is not "newly developed". The text should be revised accordingly.

Response #16 Agreed. The changes have been made.

Comment #17 Page 4-11, Top of Page. The text should be revised to clarify how exposure during childhood will be estimated. In estimating cancer risk, exposure during childhood should be incorporated into the lifetime average intake estimates. In evaluating the potential for adverse, non-cancer health effects, childhood and adult exposures should be considered separately.

Response #17 Agreed. The text has been rewritten to clarify how carcinogenic and noncarcinogenic childhood exposures will be calculated.

Comment #18 Table 4-1. This table should be eliminated from the Work Plan; the information contained in the table is incomplete, inaccurate, and of little use in this generic work plan. For example, the parameters for ingestion of and dermal contact with soil do not consider the excavation worker identified in the text, the skin surface area for an adult in a bathing/showering scenario (also not identified in the text) should be 19,400 cm^2, and the soil-to-skin adherence factor for dermal contact with soil should be 1.00 mg/cm^2 (based on the USEPAs dermal exposure assessment guidance noted earlier).

Response #18 Agreed. Table 4-1 has been removed.

Comment #19 Page 4-11, p1. Reference concentrations (RfCs) should be included in the third sentence. The USEPA convention for abbreviating Verified Reference Dose RfD, should be used throughout the text.

Response #19 Agreed. Reference concentrations (RfCs) and the proper abbreviation for Verified Reference Dose (RfD) have been implemented.

Comment #20 Page 4-11, p2. The information hierarchy indicated in the last sentence should be followed (Heast should be corrected to HEAST and USEPA ECAD should be corrected to USEPA ECAO). Other published toxicological criteria (e.g., ATSDR MRLs) or toxicological criteria derived using route-to-

route extrapolation or structure activity analogies should not be used without the approval of the USEPA, Region II.

Response #20 Agreed. The changes have been made.

Section 4.4.4 - Risk Characterization

Comment #1 A subsection on uncertainty should be added that presents how the uncertainty in the human health evaluation process will be addressed. The USEPA, Region II guidance call for inclusion of a "central tendency analysis" for those exposure pathways/routes exhibiting cancer risks greater than 10^{-4} or hazard indices greater than 1.0. In the central tendency analysis, central tendency (i.e., 50th percentile) exposure parameters are combined with the average (i.e., 95% UCL) exposure point concentrations in a reanalysis of chemical intakes and health risks.

Response #1 Agreed. A subsection addressing uncertainty as it relates to the human health evaluation process has been added.

Comment #2 Page 4-14, p2. In assessing potential impacts to aquatic organisms, available sediment guidelines and criteria should be considered in addition to water quality criteria. For example, USEPA has recently developed sediment criteria for five organic compounds (USEPA, 1993a,b,c,d,e),New York State has developed sediment criteria for various organic and inorganic constituents (NYSDEC, 1994), and the National Ocean and Atmospheric Administration had developed "Effects Range" values for several inorganics, pesticides, PCBs and PAHs (NOAA, 1991).

Response #2 Agreed. Sediment guidelines and criteria will be considered in assessing potential impacts to aquatic organisms. The references for sediment guidelines and criteria have been added to the text on page 4-14.

Comment #3 Page 4-14, pg5. It is not clear whether terrestrial organisms (e.g., earthworms, mice, shrews) are being considered for tissue analysis, or if only aquatic organisms (shellfish, fish) are being considered (based on Section 3.12, no terrestrial organisms will be sampled and analyzed). If tissue sampling is to be conducted, both aquatic and terrestrial species should be included to fully characterize the potential impacts to higher level consumers. Terrestrial organism analyses may be conducted following the review of soil analytical results, however, the text should be revised to indicate this phased approach.

Response #3 Agreed. Terrestrial tissue sampling has been added in the text on page 4-14 and a terrestrial sampling program has been included in Section 3.12. In addition, a statement discussing the phased approach to terrestrial organism analyses has been added to the text.

Comment #4 Page 4-14, p5. The second sentence of this paragraph states that "Quantitative exposure doses will not be determined for organisms not

sampled." If toxicity testing will be done, as outlined in Section 3.12, site-related effects on earthworms, vegetation-consuming birds, small mammals, Daphina or fish, and plants will be effectively addressed. However, the evaluation of potential exposure to higher level consumers (e.g., raptors, carnivorous mammals) should not be omitted. Tissue analysis of lower level organisms (e.g., fish, earthworms, mice) would allow the use of USEPA's Wildlife Exposure Factors Handbook" (USEPA), 1993f) to calculate potential exposure of such receptors.

Response #4 Agreed. The second sentence has been removed from the paragraph because toxicity testing will be conducted, as outlined in Section 3.12. A sentence has been added to include the evaluation of potential exposure to high level consumers. The USEPA handbook has also been referenced in regard to potential exposure calculations.

Section 4.4 - Baseline Risk Assessment

Comment #1 General Comment. Key elements of the human and environmental health evaluations should be summarized and submitted to the USEPA, Region II before proceeding with the quantitative aspects of the evaluations. These elements should include 1) the rationale for and selection of chemicals of potential concern, 2) an exposure pathway analysis, 3) modeling approaches for estimating exposure point concentrations, 4) the specific parameters and assumptions to be used in quantifying exposure, and 5) the toxicological criteria to be used in quantifying risks. The generic workplan text should include a statement that this information, which should be in the form of A risk assessment workplan and pathway analysis (two separate and consecutive deliverables) will be submitted to the USEPA, Region II for review.

Response #1 Agreed. A paragraph presenting elements of a risk assessment workplan and pathway analysis which will be submitted as two separate deliverables has been added to the end of Section 4.4.

Section 5.0

General Comments. The first sentence of Section 5.0 states that the FS will be conducted in accordance with the EPA guidance manual, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final, October 1988, (Guidance). The subtasks listed in this section, however, do no conform to this Guidance. Some of the problems are outlined below:

Comment #1 Terminology. The Guidance uses a rather specific set of terminology to designate the different elements of the FS, such as "Remedial Action Objectives" (RAOs), "General Response Actions" (GRAs) and "Alternatives". The work plan does not use these terms, but rather a variety of terms which are similar to the Guidance terms but not the same, leaving the reader uncertain of which element of the FS is being referenced. As an example, the

subtasks listed in this section are as follows, with possible interpretation in italics:

1. the development of remedial action objectives
2. the development of alternative remedial actions (*General Response Actions?*)
3. the screening of alternative remedial actions (*Remedial Technologies?*)
4. a detailed evaluation of remedial actions (*Alternatives?*)

Response #1 Agreed. Terminology in Section 5 has been revised to use the same terms specified in the USEPA guidance manual. That is, remedial action objectives, general response actions, remedial technologies, and alternatives have replaced the terms used in the draft report.

Comment #2 In addition, the terms are not always internally consistent. For example, in Section 5.2.1, the last sentence in the first paragraph indicates that "The list of *preliminary response action alternatives* is provided below.", then a list of "*remedialtechnologies*" is given for soil/sediment and "*remedialalternatives*" for groundwater.

Response #2 Agreed. Section 5 has been revised to more closely follow the methodology outlined in the USEPA guidance manuals. The list referenced in this comment has been revised and items have been placed under the correct heading of general response actions and remedial technologies.

Comment #3 FS Process Steps. The composition of this section indicates a lack of familiarity with the elements of the FS process. As an example, in Section 5.2.1 Develop Remedial Response Actions, the lists given include general response actions, remedial technologies and process options (as defined by the Guidance) all under the heading of remedial technologies (or remedial alternatives). In addition, this list, which consists mostly of process options is given before the section on identifying and screening applicable technologies and process options (Section 5.2.3). Section 5.4 on the detailed analysis of alternatives is very sketchy and not to the same level of detail as the rest of the section.

Response #3 Agreed. Section 5 has been revised and reorganized to more closely follow the FS process set forth in the USEPA guidance manual referenced at the beginning of Section 5. In addition, the discussion of the analysis of alternatives has been expanded.

Comment #4 Overall, Section 5.0 is not a clear presentation of the FS preparation process as outlined by the Guidance. This section should adhere more closely to the guidance manual regarding both the general steps in the conduct of the FS, and the terminology used to designate the elements of the FS.

Response #4 Agreed. As discussed earlier, Section 5 has been rewritten to more closely follow the FS process outlined in the USEPA guidance manual cited at the beginning of Section 5. The general steps in the FS process and terminology follow the USEPA guidance manual.

Section 7.0

Comment #1 Page 7-1. The updated Bouwer and Rice reference should be used for the evaluation of the data.

Response #1 Agreed. The updated Bouwer and Rice document will be used for the evaluation of the data. This document has been added to the reference list on page 7-1.

Comment #2 Page 7-5. The NYS TAGM should be referenced, see earlier comment.

Response #2 Agreed. The NYS TAGM, Determination of Soil Cleanup Objectives and Cleanup Levels (November, 1992) has been added to page 7-5 of the reference list.

Appendix A

Comment #1 Page A-5, p3. The text should state that the bottleware provided by the laboratory will be cleaned in accordance with USEPA guidance.

Response #1 Agreed. A statement has been added to the text on page A-5 indicating that the sampling glassware and containers which will be used at SEDA will meet the conditions in "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers" (EPA, Office of Emergency and Remedial Response, April 1990).

Comment #2 Page A-5, p4. The paragraph states that samples will be kept in a controlled environment (4°C or room temperature), all samples should be kept at 4°C.

Response #2 Agreed. The text has been revised to state that all samples should be kept at 4°C.

Comment #3 Page A-6, p2. The texts states that water will be obtained from a local water distributor and demonstrated analyte-free, the text should state and/or reference the USEPA guidance for demonstrated analyte-free water.

Response #3 Agreed. The text on page A-6 has been revised to state that demonstrated analyte-free water will meet the criteria set forth in the USEPA Region II CERCLA Quality Assurance Manual (1989).

Comment #4 Page A-7, p1. The text should state that the sample will be transferred directly to the sample jars.

Response #4 Agreed. The text on page A-7 has been revised to state that when obtaining a field blank, the analyte-free water is poured into the sampling device and then transferred directly to the sample container.

Comment #5 Page A-14, p.3. The geophone spacing is cited as five feet, this spacing may need to be reduced to increase resolutions depending on the depth to groundwater and bedrock at each site. The text should state that the geophone spacing may be reduced based on site conditions and in-field evaluation of the data.

Response #5 Agreed. The text on page A-14 has been revised to state that geophones will be spaced at 5 feet or less throughout the survey based on site conditions and in-field evaluation of the data.

Comment #6 Page A-19, p2. The text should state that readings in both modes will be measured both parallel, and at 90° to the transect line. The collection of the data in this manner will aid in determining heterogeneities in the subsurface and give and approximate orientation of anomalies.

Response #6 Agreed. The text on page A-19 has been revised to state that if the orientation of anomalies is required, readings will be measured parallel and at 90° to the transect line.

Comment #7 Page A-21, p2. Excavation is proposed for two feet beyond a geophysical anomaly. A minimum of five feet is appropriate since the depth and orientation of an object causing an anomaly will distort the instrument reading at the surface.

Response #7 Agreed. The text on page A-21 has been revised to state that the excavation will extend to a distance of 5 feet on either side of a subsurface anomaly.

Comment #8 Page A-22. The discussion of drilling techniques does not mention the diameter of the hollow-steam augers to be used. The text also states that two-inch split-spoon samplers will be used for the collection of soil samples. The text should discuss the steps that will be taken to accommodate the collection of split samples by the USEPA, i.e., drilling of a new soil boring or the use of three-inch split-spoons. The use of the three-inch split spoon is preferred since it provides a more representative split as the sample will be collected from the same interval as the sample collected by SEDA.

Response #8 Agreed. The diameter of the hollow stem augers to be used to drill each boring will be 4.25 or 6.25-inches ID. Three-inch split spoons will be used for collection of soil samples. Auger diameter has been added to the text on page A-22. Split-spoon diameter has been changed from two-inch to three-inch in the text on page A-22.

Comment #9 Figure A-3. The figure shows the Burmiester system as the soil classification system, however, the text states that the Unified Soil Classification System will

be used. The text or the figure should be corrected to show the correct classification system. At a minimum, the Unified Soil Classification System should be used.

Response #9 Agreed. The text on page A-23 has been revised to clarify that both a lithologic description of the soil according to the Burmiester system and a soil classification according to the USCS will be provided on the boring logs. The headings on Figure A-3 are correct.

Comment #10 Page A-27, p1. The text states that "...bottom of the boring to approximately 3 below the ..." The text does not state what units are being discussed, i.e., feet.

Response #10 Agreed. The text has been revised to indicate that the distance referenced is 3 feet.

Comment #11 Page A-27. The text should clearly state that samples collected for volatile organic analyses will not be homogenized or composited during the sampling process.

Response #11 Agreed. The text on page A-23 discussing soil sample collection from soil borings has been revised to state that soil samples collected for volatile organic analyses will not be homogenized or composited during the sampling process. The text on page A-28 discussing soil sample collection from test pit excavations has also been revised.

Comment #12 Page A-31. The surface soil sampling text should state that volatile organic samples will be collected as a core sample from a depth of zero to six-inches below the ground surface. This would still be considered a surface soil during the baseline risk assessment process.

Response #12 Agree. Volatile organic samples will be collected as a core sample, however, as per NYSDEC requirements, the sample will be collected from zero to two-inches below the organic matter. The text has been revised accordingly.

Comment #13 Page A-33, p2. The screen lengths of the proposed monitoring wells is stated as being the entire length from the water table to the bottom of the weathered shale. The text should state the maximum length of screen to be used, i.e., ten feet, since this would limit potential dilution effects caused by a long screened interval. The text should also state that if there is sufficient saturated thickness two wells will be installed, one at the water table and the other within the deep till and weathered bedrock.

Response #13 Agreed. The maximum screen length has been changed to ten feet. In addition, the text has been revised to state that if a saturated thickness of greater than 20 feet is encountered, multiple monitoring wells will be installed.

Comment #14 Page A-33, p3. The text should be changed to state that well construction material will be steamcleaned prior to use.

Response #14 Agreed. The text on page A-33 has been revised to state that well construction materials will be steamcleaned prior to use.

Comment #15 Page A-34, p3. The text should state that the screen will be a wire-wrapped type as required by NYCRR Part 360 regulations. The text should also state that the final slot size will be based on the grain-size distribution analyses.

Response #15 Disagree. NYSDEC Bureau of Eastern Remedial Action, Division of Hazardous Waste Remediation, was contacted and stated that the use of wire-wrapped screens is not required at SEDA. Rather, the use of wire wrapped screens will be determined on a site by site basis as required. We have added parathetically to the text on page A-34 that wire wrapped screens will be used if required by NYSDEC and the USEPA Region II.

The slot size for the monitoring wells has been determined and approved as part of an earlier RI at the Ash Landfill at SEDA. NYSDEC, USEPA, and the Army have reviewed the grain size curves for till and weathered shale from the OB Grounds as well as the documentation determining the proper screen size based on these curves. Given the types of formation materials (which were confirmed from visual soil classification at the OB Grounds, Ash Landfill, and 25 ESI sites in various locations at SEDA) the nature of their deposition and their widespread distribution in the area, the till and weathered shale samples are not significantly different from the OB Grounds to preclude the use of these curves from the OB Grounds for slot size selection at the sites involved in this RI/FS program. A 0.010-inch slot size used with a #3Q-ROC filter pack was determined to be appropriate for the monitoring wells on-site.

Comment #16 Page A-37, p2. The text should state that the potable water will be added to the bentonite seal in continuous stream for a period of one hour.

Response #16 Agreed. The text has been revised to state that potable water will be added to the bentonite seal in a continuous stream for one hour.

Comment #17 Page A-41, p2. Hollow-steam augers may not be able to penetrate three to four feet into competent bedrock. An alternate drilling method should be proposed for this eventually. To reduce to the potential short circuiting between the shallow and deep bedrock monitoring wells, an unscreened, vertical zone should be left between the wells so that they each monitor

discrete zones. A typical bedrock well construction detail has not been provided.

Response #17

Agreed. The text has been revised to clarify that the borehole will be advanced through the bedrock using a 5-1/2 inch roller bit and HQ size rock coring equipment. The statement regarding the unscreened vertical zone between shallow and deep bedrock monitoring wells has been added to the text. A typical bedrock well construction detail has been added as Figure A-6b.

Comment #18

Page A-51. The purpose of well development is stated as being to ensure proper hydraulic connection between the borehole and the surrounding aquifer, however the stated method will not determine this. The degree of hydraulic connection can only be determined by using specific capacity tests. ES should indicate if specific capacity tests will be conducted. The text should also state that a surge block, slightly smaller in diameter than the well, will be used during the development process.

Response #18

Agreed. The text on page A-51 has been revised to state that the purpose of well development is to ensure the collection of representative groundwater samples. Proper development of each monitoring well will create an effective filter pack around the well screen, rectify damage to the formation caused by drilling, remove fine particles from the formation near the borehole, and assist in restoring the natural water quality of the aquifer in the vicinity of the well. Specific capacity tests will not be utilized to determine the degree of hydraulic connection, rather the well development will be conducted based on the guidance provided by NYSDEC. The text has been revised to state that a surge block rather than a bailer will be used for higher surging.

Comment #19

Page A-53, Groundwater Sampling Procedures and Analyses. This section should be revised to include the use of low flow pumps for sampling instead of bailers. All purging and sampling should be consistent with the enclosed Draft SOP for Ground Water Sampling using Low Flow Pump Purging and Sampling. This SOP is currently undergoing revision, but will be incorporated into the Region II CERCLA QA Manual when updated. You should contact Ruth Izraeli (EPA Region II) at 212-637-4311 one month prior to sampling in order to obtain the most current version of this SOP.

Response #19

Agreed. The Draft SOP for Groundwater Sampling using Low Flow Pump Purging and Sampling issued on May 15, 1995 by the EPA has replaced the groundwater sampling procedures in Section 3.6.5 of Appendix A. We understand that this SOP is currently undergoing revision and therefore will contact EPA Region II prior to sampling to obtain the most current version.

In addition, the sampling procedure has been forwarded to NYSDEC for review.

Comment #20 Page A-53. The development criteria state that the readings should stabilize over two consecutive readings. However, the frequency of the readings is not stated i.e., every well volume. The text should also state that any water lost during the drilling process will be removed prior to the beginning of the development process.

Response #20 Agreed. A statement has been added to the text on page A-53 indicating that readings of temperature, pH, and specific conductivity will be taken for each well volume. In addition, a statement has been added indicating that any water lost during the drilling process will be removed prior to the beginning of the development process.

Comment #21 Page A-54, p1. The volume of water to be purged prior to sampling should be calculated based on borehole volumes not well casing volumes.

Response #21 Acknowledged. The USEPA Draft SOP for groundwater sampling has replaced the existing sampling protocol. According to the SOP the completion of the purging process is now determined by obtaining consistent readings of the groundwater parameters measured during purging and not the volume of water purged.

Comment #22 Page A-54, p2. The sampling protocol for groundwater could potentially result in the loss of volatile organics. The text should be changed to state that volatile organic samples will be collected as soon as sufficient sample volume is present and the remaining parameters will be collected as shown as possible afterwards.

Response #22 Agreed. The USEPA Draft SOP for Groundwater Sampling has replaced the existing sampling protocol. This SOP states that VOC samples will be collected as soon as sufficient sample volume is present.

Comment #23 Figure A-13. The volumes shown should be borehole volumes not well volumes.

Response #23 Acknowledged. The section heading on Figure A-13 has been changed from Well Diameter Factors to Borehole Diameter Factors. However, volume calculations are not used in the current USEPA sampling methodology. Figure A-13 has been revised to more closely follow the USEPA SOP for groundwater sampling. However, before the sampling program begins, final revisions to the figure will be made based on the most current revision of the SOP.

Comment #24 Page A-59, p1. It is not clear if dilution reruns will also be analyzed three times for confirmation of the results.

Response #24 Agreed. Dilution reruns will also be analyzed three times for confirmation of the results. This information has been added to the text on page A-59, paragraph 1.

Comment #25 Page A-61, p4. The text should state that the surface water samples will be collected prior to the collection of sediment samples. The text should also state that volatile organics samples will not be composited.

Response #25 Agreed. Both statements have been added to the text. The statement referring to volatile organic samples has been added to paragraph 5 on page A-63.

Comment #26 Page A-66, Item 6. The volume of the sampling train should be calculated to determine the length of time required for purging. The flow rate of the pump being used should also be stated in the text.

Response #26 Agreed. The text has been revised to include the procedure for determining the length of time required for purging. The flow rate of the pump will be between 1 and 3 L/min. This information has been added to the text.

Comment #27 Page A-67, p1. The text states "Soil samples...",this should be corrected to soil gas samples.

Response #27 Agreed. This wording has been corrected to read soil gas samples.

Comment #28 Page A-81, p5. The text should state the decontamination procedures to be used during water level data collection.

Response #28 Agreed. Decontamination procedures to be used during water level data collection has been added in a separate paragraph on page A-81.

Comment #29 Page A-97, p1. The text state that a 2.6-inch slug will be used during hydraulic conductivity testing. This slug cannot be used as stated since the proposed wells are going to be two inches in diameter, an alternate should be proposed.

Response #29 Agreed. The text has been corrected to state that a slug with a 1.66-inch diameter, not a 2.6-inch diameter, will be used for the slug test.

Comment #30 Page A-97, p2. The criteria for termination of the hydraulic conductivity test should be based on a percentage, 80 percent, of the original static water level, and not a rate.

Response #30 Agreed. The criteria for termination of the test has been revised to include both the water level reaching 80 percent of the original static water level and stabilizing to within 0.02 feet over a 5-minute time period.

Comment #31 Page A-100. The proposed method for vertical connection testing used a recovery bailer. This should be changed to a pump so that the groundwater withdrawal rate may be increased or decreased to obtain the maximum displacement of the static water level. The method should also state the duration of each test.

Response #31 Agreed. The text has been revised to state that a pump will be used for vertical connection testing. In addition, the duration of the test has been added to the discussion.

Comment #32 Page A-105, p1. Bullet #2 - Does "documentation of terrestrial and aquatic habitats and organisms" include the potential presence of threatened and/or endangered species and significant habitats?

Response #32 Please refer to Appendix D. The letter dated June 21, 1994 from the United States Department of the Interior states that "no federally listed or proposed endangered or threatened species under our jurisdiction are known to exist in the project impact area".

Comment #33 Page A-105, p1. Bullet #4 - Why aren't terrestrial organisms (e.g., earthworms, shrews) included for tissue analysis? See earlier comment Page 4-15, p5.

Response #33 Terrestrial organisms have been included for tissue analysis.

Comment #34 Page A-105, p3 (and top of Page A-106). The statement beginning on the bottom of page A-105, "Following an analysis of these results..."is misleading. A WET analysis will not enable one to determine the necessity of tissue sampling. WET gives functional values of wetland areas. To determine whether tissue analysis should be done, baseline biological conditions should be evaluated and contaminant levels in the various media (e.g., water, sediment, soil) should be evaluated and compared with available criteria and background levels.

Response #34 Agreed. The evaluation of baseline biological conditions and contaminant levels from the various media have been added to the text.

Comment #35 Page A-106, p2. This paragraph is confusing and appears to contain information on several different types of field study (upland and wetland vegetation mapping, wetland delineation, biota sampling and toxicity studies), rather than focusing only on wetland delineation, as the heading for this section suggests. It would be clearer if this paragraph were subdivided and given distinct headings. Also, although Figure A-22 presents an adequate data sheet for a general vegetation survey, a more appropriate data form to present in this section would be that used for delineation of wetlands (e.g., with space for information on soils and hydrology as well as wetland indicator status of the plant species found).

Response #35 Agreed. Paragraph 2 has been reorganized to become more specific. In addition, Figure A-22 has been replaced and now includes sections for information on soils, hydrology, and wetland indicator status of plants.

Comment #36 Page A-106, p4. This sentence mentions that "Ecologists will use appropriate collection procedures as described in Section 3.12.4.2 to evaluate the terrestrial biota at the subject site." However, the cited Section only deals with sampling of aquatic biota.

Response #36 Agreed. The terrestrial sampling program will be conducted and is described in Section 3.12.3. This section has been referenced in the text.

Comment #37 Page A-109, p1. No mention is made of sampling and terrestrial organisms. If this is not proposed, a rationale should be given for this decision.

Response #37 Agreed. Reference to terrestrial organism collection has been added to the paragraph.

Comment #38 Page A-109, p2. It is assumed that "subsequent collection" of tissue sample (last sentence in paragraph) will occur after soil, sediment and water samples have been analyzed and evaluated. This should be clarified in the text.

Response #38 Agreed. The change has been made.

Comment #39 Page A-109, p3. General note: If amphipods are used, very large numbers of amphipods would be required in order to supply an adequate sample size for analysis.

Response #39 Agreed. Amphipods have been taken out as possible microinvertebrates to be sampled.

Comment #40 Page A-110, p2. The rationale for conducting toxicity tests on earthworms, rats, mice, and plants should be provided, considering that none of these organisms are proposed for collection and tissue analysis. Aquatic organisms are proposed for both tissue analysis and toxicity testing.

Response #40 Agreed. Toxicity testing rationale has been provided for earthworms, rats, mice, and plants in this section.

Comment #41 Page A-111, p3. Will the age of the captured fish be determined as well as weighed and measured?

Response #41 The last sentence of paragraph 3 has been revised to reflect age determination. Approximate age determination will be based on length-weight frequencies.

Comment #42 Page A-111, p4. Tissue analysis of fish filets is not useful for the evaluation of risk to wildlife, since wildlife consumers of fish would use the entire fish,

not just the filet. Whole-body analysis of a forage fish species would be more appropriate for the environmental evaluation.

Response #42 Agreed. Fish filets have been replaced by whole body analyses in tissue analysis.

Comment #43 Page A-112, p1. The hierarch of fish collection for tissue analysis is more appropriate for human health evaluation than for evaluation of potential risk to wildlife receptors. See previous comment.

Response #43 Agreed. The hierarchy of fish collection has been changed to reflect a better evaluation of potential risk to wildlife receptors.

Comment #44 Page A-114, p1. First bulleted item on this page indicated that invertebrate samples will be taken "if necessary". However, previous text indicates that this sampling will be conducted as part of the sampling program. The text should clarify what will be involved in the initial site reconnaissance, and in subsequent biological sampling.

Response #44 Agreed. Invertebrate samples will be taken as part of the sampling program. The change has been made. The paragraph has been expanded in order to describe what will be involved in the initial site reconnaissance and in subsequent sampling.

Comment #45 Page A-114, p2. This paragraph implies that tissue sampling and toxicity tests will only be conducted if the initial qualitative field surveys indicate a need for this work. Surface water, sediment and surface soil sampling results also need to be considered.

Response #45 Agreed. The importance that the various media has on tissue sampling and toxicity testing has been added.

Comment #46 Page A-115, p2. It is unclear how many replicates are proposed for macroinvertebrate sampling (Bullet #4)? Also, what is the proposed method of subsampling (Bullet #6)?

Response #46 Agreed. The appropriate information has been added to Bullets #4 and #6.

Comment #47 Page A-116, p3. This sentence states that "Shellfish captured in ponar grab samples may be used for tissue analysis ...as needed." However, previous text describes tissue analysis as being subsequent to the macroinvertebrate sampling. Will the shellfish be held over for analysis? How will they be preserved? If analysis will be performed immediately, what analyses will be conducted?

Response #47 A more specific explanation has been added to paragraph 3.

Comment #48 Page A-120, p2. Taxa should not be combined for analysis.

Response #48	Agreed. The statement suggesting combining different taxa has been deleted.
Comment #49	Page A-124, p3. How will the section of stream or shoreline be "isolated"?
Response #49	An explanation as to how the particulate section of stream or shoreline will be isolated has been added.
Comment #50	Page A-127, p2 and 4. Bullet #9 states that a "qualitative" evaluation will be made during electroshocking. However, paragraph 4 states that electroshocking will be considered void or "non-quantitative" under certain conditions. This discrepancy should be resolved.
Response #50	Agreed. The discrepancy no longer exists.
Comment #51	Page A-130, p2. Will fish ages be determined? Also, as in previous comment, fish filet is not appropriate for environmental evaluation. Whole-body analysis is recommended to evaluate potential risk to wildlife consumers of fish.
Response #51	Rough age determination will be performed based on weight-length frequency distributions. Fish filets have been changed to whole-body analysis.
Comment #52	Page A-136. The text for IDWs should state that purge water will also be containerized during sampling.
Response #52	Agreed. The text on page A-136 paragraph 1, has been revised to include the containerization of purge water generated during sampling.
Comment #53	Page A-148. The text which discusses compositing should state that no volatile organic samples will be composited.
Response #53	Agreed. The text in Section 4.1 has been revised to state that no volatile organic samples will be composited.
Comment #54	Page A-150. The reference to Nitric acid should be changed to show 10 percent nitric acid will be used on stainless steel equipment and not 1 percent.
Response #54	Agreed. The text on page A-50 has been revised to state that 10 percent nitric acid will be used on stainless steel equipment. If, however, split spoon sampling devices are composed of carbon steel instead of stainless steel, the nitric acid rinse may be lowered to a 1 percent concentration to reduce the possibility of leaching metals from the split spoons. This is in accordance with the USEPA Region II CERCLA QA Manual.
Comment #55	Page A-152. The sample packing procedures should state the thickness of the bottom layer of packing material that will be used.
Response #55	Agreed. The thickness the bottom layer of packing material varies between 2 and 6 inches. This information has been added to the text on page A-152.

Appendix C

Comment #1 The document should be reviewed to determine if the proposed analytical methods are capable of resulting in reporting limits which are equal to or lower than the corresponding ARAR. For example, the Class GA Standard for Antimony is 3 ug/L and the reporting limit in Table C-2 is 60 ug/L. It would be most useful to include an ARAR column, or columns, on Tables C-2, C-4 and C-5 for comparison. In instances where the proposed analytical methods have reporting limits above ARAR values, alternate analytical methods should be evaluated.

Response #1 Agreed. Reporting limits and corresponding ARARs for the analytes in this study have been reviewed. Reporting limits have been added to Tables 3-11 and 3-12 which present various ARARs for all media. Alternate analytical methods for those analytes that have reporting limits above the ARAR are being evaluated in conjunction with the lab.

Comment #2 Page C-1. The USEPA Region II Quality Assurance Guidance Manual should also be used as reference for the generation of the CDAP.

Response #2 Agreed. The USEPA Region II Quality Assurance Guidance Manual has been added as a reference for the CDAP.

Comment #3 Page C-10, p3. The text should state that the presence of residual chlorine will be checked in each sample and the method should be presented in the text.

Response #3 Acknowledged. Chlorinated drinking water supplies will not be sampled. Since residual chlorine is only present in treated drinking water, this statement has been removed from the text.

Comment #4 Table C-1. The maximum NYS holding time for volatile organics is ten days, this should be corrected in the table. The holding times for Mercury should be changed to 26 days. All sample holding times should be stated as being from Verified Time of Sample Receipt (VTSR). Footnotes for the maximum holding times should be cross-referenced and corrected since some are incorrectly referenced, e.g., TCL semi-volatiles, and TCL pesticides/PCBs.

Response #4 Agreed. Table C-1 has been revised to indicate that sample holding times are from VTSR, and to correct maximum holding times and footnotes. The holding time for volatile organics has been confirmed with NYS as being 7 days, not 10 days.

Comment #5 Table C-9. The columns in this table are off-set making it difficult to read.

Response #5 Agreed. The columns in Table C-9 have been adjusted to allow for easier reading.

Comment #6 Page C-49. It should be stated in the text under Data Review and Validation, that the percentage to be validated will be mutually agreed upon by SEDA, EPA and NYSDEC at the time of sampling.

Response #6 Disagree. 100 percent of the analytical data will be validated following the USEPA Region II guidelines.

Comment #7 The SOPs cited in section 9.2.4 are incorrectly titled. The text should be corrected to read "EPA Region II SOP for Evaluating Organic Analyses" and "EPA Region II SOP for Evaluating Inorganic Analyses".

Response #7 Agreed. The text on page C-49, Section 9.2.4 has been revised to reference the correct SOP titles.

Comment #8 Page C-49. The data validation SOPs discussed are among the ones to be used for data validation, however, based upon the finalization of the analyte list, additional SOPs may be necessary. This should be stated in the text. The SOP for evaluating organic analyses has been superseded by revision 9 but the text says revision 8 is the most current. The text should state that the most current revision will be used at the time the data validation is performed and revision numbers should not be included in this generic workplan.

Response #8 Agreed. The text has been revised to state that additional SOPs may be necessary and that the most current revision of SOP No. HW-6 will be used.

EPA'S HAZARDOUS WASTE FACILITIES BRANCH

Comment #1 Section 3.4.2 Preliminary Identification of ARARs and TBCs: Table 3-9 lists Sources of Action Specific ARARs. The following two listed RCRA requirements reference the incorrect applicable CFR:

RCRA Generator Requirements for Manifesting Waste for Offsite Disposal (40 CFR 263). The correct reference is (40 CFR 262).

RCRA Transporter Requirements for Off-Site Disposal (40 CFR 270). The correct reference is (40 CFR 263).

Response #1 Agreed. Table 3-9 has been revised to show the correct CFR references.

EPA'S BIOLOGICAL TECHNICAL ASSISTANCE GROUP

Comment #1 According to the Fish and Wildlife Management Plan (July 1988) prepared by the U.S. Army Material Command (page 3-99), ten areas have been designated as freshwater wetlands by the NYSDEC. In the Ecological Investigation Section of the Field Sampling and Analysis Plan, a description of how the wetlands will be delineated, as per the Federal 1987 Manual, is provided in Appendix A, Section 3.12.1. The site area maps in the subsequent RI reports should depict the locations of these wetlands. As per the

discussion provided in this document, wetlands represent depositional areas and are frequently found to be contaminant sinks. Therefore it is essential that potential pathways for contaminants to migrate into wetlands be properly delineated. To characterize these pathways, the BTAG recommends that groundwater discharge points and surface drainage patterns be identified and illustrated in accompanying site figures. A definition of the surface water pathways and the cumulative effects that contaminants associated with each site may have on the watershed should be completed. Topographical maps should be developed for all the sites, along with a determination of common drainage areas to help evaluate surface water systems. Also note that a wetlands assessment and restoration plan will be needed for any wetlands impacted or disturbed by contamination or remedial activities.

Response #1 Agreed. BTAGs recommendations have been incorporated into the text.

Comment #2 Basewide reference sample locations for all media of concern should be identified for the entire site, rather than for each specific area of concern. All reference sampling points should be properly chosen to assure that the locations are not influenced by site contaminants, roadways and the rail line. Due to the difficulty of locating a reference surface water and sediment sample in a drainage swale with intermittent flow which has not been influenced by site activities, we recommend that the reference stream sample be used in lieu of a drainage swale. Table 2-1, "Background Concentrations of Elements in Soils on the Eastern United States with Specific Data for New York State," provides an overview of soil inorganic reference concentrations for metals should be site-specific, rather than representative of regional concentrations. Therefore, reference soil and sediment samples should undergo a full TCL and TAL analysis. Reliance on base-wide reference locations should preclude the need for reference samples to be collected in association with site-specific investigations.

Response #2 Disagree. Background soil, surface water, sediment, and groundwater sample locations have been established on a SEAD by SEAD basis as per CERCLA guidelines.

Comment #3 a) In Appendix A, the Field Sampling and Analysis Plan, a distinction is made between soil sampling that will occur in the top 12" and surficial soil sampling which will occur in the top 2". A discussion should be included to review what scenarios would necessitate sampling in the top 2" rather than the top 12", which the BTAG advocates.

b) The BTAG also recommends that sediment sampling be obtained from the top 6".

c) Total organic carbon and grain size analysis should be conducted on all sediment samples.

d) For intermittent streams, surface water and sediment sampling should be scheduled and occur during high flow conditions in order to assure that water is present for collection (i.e., that samples can be obtained), as well as to characterize stormwater runoff patterns.

e) The analysis of both filtered and unfiltered surface water samples, as well as total suspended solids, is recommended.

f) In addition, drainage patterns should be clearly delineated in the figures accompanying the site specific project scoping plans.

Response #3

a) Disagree. As per previous agreement with NYSDEC and USEPA, surface soil samples are collected from a depth of zero to 2-inches below the organic matter.

b) Agreed. Sediment samples will be obtained from the top 6-inches. This requirement has been added to the text in the Sediment Sampling Procedures.

c) Agreed. Total organic carbon and grain size analysis will be conducted on all sediment samples. This requirement has been included in the RI/FS Scoping Plans, and is included on Table C-2 of Appendix C.

d) Agreed. Surface water and sediment sampling will be scheduled to occur during high flow conditions. This has been added to the Objectives section of the text discussing surface water and sediment sampling.

e) Disagree. As per NYSDEC requirements, the analysis of surface water samples will not include filtered samples. However, total suspended solids will be analyzed for in surface water samples; this has been specified in Table C-2, Parameters List for Inorganic Analyses, of Appendix C.

f) Agreed. Drainage patterns will be clearly delineated in the figures in each RI/FS Scoping Plan.

Comment #4

In the Ecological Investigation section of Appendix A, there are indepth discussions of biota sampling, specifically fish tissue sampling and toxicity testing. However, it is more appropriate to conduct benthic surveys, sediment bioassays or toxicity tests to determine if there are risks to the benthic community and organisms at the lower trophic level, prior to fish tissue analysis. Benthic samples should be collected in the same locations as the surface water and sediment samples. In the event that fish are collected for ecological purposes, the whole body should be used, not just the fish fillets. The fish tissue data should be reviewed to determine whether fish tissue contaminant concentrations pose a risk as prey items to ecological receptors.

Response #4 Agreed. Emphasis on benthic surveys and toxicity testing has been added to the sampling program. Regarding tissue analysis, whole body analysis has also been added to replace fish fillets.

Comment 5 On page A-110 there is a listing of proposed organisms which would be chosen for toxicity testing. The organisms selected should include animals other than herbivores and piscivores, such as a hawk or red fox, to better characterize the effects of bioaccumulation and organisms at higher trophic levels. Likewise, either the bobwhite or pheasant should be replaced by the woodcock, which feeds primarily on invertebrates. A good reference document is the Wildlife Exposure Factors Handbook Volumes I&II (EPA/600/R-93/187a & 187b). Root elongation tests are recommended rather than seed germination tests. Hazard indices should be calculated for the potential ecological receptors based on the sample data. More information is provided in "Framework for Ecological Risk Assessment" (EPA/630/R-92/001, February 1992) and "Ecological Assessment of Superfund Sites: An Overview" (EcoUpdate Volume 1, Number 2, December 1991).

Response #5 Agreed. The changes have been made.

Comment #6 i) In Table 3-12 "Preliminary Identification of ARARs for Surface Water," the USEPA, Quality Criteria for Water, May 1986 is referenced. The BTAG recommends the use of the acute and chronic effect levels from the federal ambient water quality criteria (AWQC) appearing in the Federal Register, Volume 57, No. 246, Dec. 22, 1992. However, where specific contaminants have been dropped (e.g., 2,4-DNT), the 1987 criteria values may still be considered for guidance levels.

ii) In addition, for freshwater sediments, we recommend screening against the lowest effect levels (LELs) and severe effect levels (SELs) taken from "Guidelines for the Protection and severe effect levels (SELs) taken from "Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario" (Persaud, et.al., 1993).

ii) On the first page of Table 3-4, "Remedial Action Objectives (RAO), General Response Actions, Technology Types and Examples of Process Options," the environmental RAO for soil should include preventing exposure via inadvertent uptake of contaminants by terrestrial biota.

Response #6 Agreed. i) Tables 3-11 and 3-12 have been revised and updated. Table 3-11 now presents ARARs for analytes in groundwater and surface water. Table 3-12 presents guidance and standards for analytes in soil and sediment. For surface water, the acute and chronic effect levels from the federal AWQC have been used in Table 3-11. The USEPA Water Quality Criteria Summary which includes updates from the Federal Registers up to and including 1992 was the source of the AWQC data for Table 3-11.

ii) Table 3-12 incorporates LELs and SELs for freshwater sediments. The source of these criteria was the NYSDEC document Technical Guidance for Screening Contaminated Sediment (Nov. 1993) which lists LELs and SELS from the Persaud reference.

iii) Agreed. The RAO concerning terrestrial biota has been added to Table 3-4.

D#13

COMMENTS AND RECOMMENDATIONS FROM
ENVIRONMENTAL PROTECTION AGENCY (EPA) - REGION II
DRAFT GENERIC RI/FS WORK PLAN
SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK

General Comments

Section 3.0

Comment #3 While it may be appropriate to present only those organic compounds commonly found during other investigations, or those compounds which are suspected of being released, it is not clear why benzene, for instance, is not included, due to the high potential of being present at SEDA.

Response #3 Agreed. Benzene was originally omitted from Table 3-1. The table has been revised to include more compounds which were found during investigations at the 25 SWMUs. Benzene as well as some additional VOCs, SVOCs, herbicides, and pesticides was added.

Comment #11 It is unclear from Table 3-12 what "sed" represents adjacent to the PCB Aroclors. The units of the TAGM values should be stated in the table. The TAGM values for the inorganic analytes should be corrected to show site background concentrations, and not those reference values which appear in NYSDEC TAGM 4046.

Response #11 Agreed. "Sed" in Table 3-12 indicates that the TAGM value applies to sediments. A footnote has been added to the table to clarify this. In addition, units of the TAGM values have been placed at the top of each column.

Background metals test results have been obtained from 57 background soil samples collected from the Phase I and II RI/FS investigations at the Ash Landfill and the Open Burning Grounds, and from the ESI investigations at 12 AOCs. New data collected from the proposed RI/FS investigations will become part of this data set. Combining the background data from all sites will provide a more representative statistical database for determining background metal concentrations. The 95th upper confidence of the mean will be used as the site background values and will be compared with the TAGM values as part of the RI report preparation for the AOCs.

Appendix A

Comment #6 The response to this comment is not complete. We recommend that two measurements at 90° to each other be conducted at every location. The collection of these data will aid in evaluate heterogeneities in the subsurface.

Response #6

Disagree. After further review and consultation, Parsons ES does not feel that this additional work is warranted. This effort would double the labor hours required to collect, process, and interpret the EM data while not significantly adding to the overall data set. Parsons ES believes that based upon the present grid dimensions utilized at SEDA, i.e., 5'x10', and based upon the subsurface objects of investigation, this additional labor effort is not warranted.

Comment #15

The text clearly states that the monitoring wells are to be installed in accordance with NYSDEC Part 360 requirements. NYSDEC Part 360 states on page 2-13, Section 360-2.11(8)(ii)(b), "All screens used must be factory constructed nonsolvent welded/bonded continuous slot wire wrap screens...". If ES does not intend to use continuous slot wire wrap PVC screens, the text referring to the compliance with NYSDEC Part 360 regulations should be deleted. Wire wrapped screens are preferred to machine slotted screens. The difference in cost is minor.

While we agree to the text contained within the second paragraph of the response, it would be appropriate to add this text to the work plan to give the reader an understanding of the process used for the screen slot selection.

Response #15

Disagree. The end of the referenced statement in NYSDEC Part 360 Section 360-2.11(8)(ii)(b) says the intended use of the specified screens is "for long term monitoring." The intended use of the monitoring wells for this RI is not long term monitoring. If long term monitoring wells are installed, welded/bonded continuous slot wire wrap screens will be used.

The paragraph referenced above describing the process used for screen slot selection has been added to the text on page A-36.

Comment #17

A statement should be added to the text to indicate what the vertical separation between the shallow and deep bedrock wells will be.

Response #17

Agreed. The vertical separation between the shallow and deep bedrock wells will be 20 feet. This statement has been added to the text on page A-44.

Comment #18

Text should be added stating that the surge block will be slightly smaller in diameter than the well.

Response #18

Agreed. A sentence has been added on page A-54 stating that the diameter of the surge block will be slightly smaller than the diameter of the well.

Comment #21

The revised purging criteria, are reasonable. However, the volume calculation should be based on borehole volumes and not well volumes, since monitoring for stabilization will be conducted every volume and this volume will vary based on the method used for calculation.

Response #21

Disagree. According to the Draft SOP for Groundwater Sampling using Low Flow Pump Purging and Sampling (EPA May 15, 1995) monitoring for stabilization during the purging process will be conducted at 3 to 5 minute time intervals and not every volume. Reference to volume calculations has been removed from the discussion.

time intervals and not every volume. Reference to volume calculations has been removed from the discussion.

Comment #51 The age of the fish should be based on fish scale samples.

Response #51 Agreed. Where practical, the age of fish will be based on fish scale samples. As part of an ecological assessment for the RI at the OB Grounds at SEDA, fish were collected from Reeder Creek, which is adjacent to the OB Grounds. Most of the fish found in Reeder Creek were small fish such as minnows and dace. For these types of small fish, age will determined by weight-length frequency distribution. Larger fish, such as white suckers and pumpkinseeds, will be aged using fish scale samples. The text on page A-137 has been revised accordingly.

Comment #53 The text states that the <u>laboratory</u> may composite volatile organic samples. This text should be corrected to state that no compositing of samples for volatile analysis will take place.

Response #53 Agreed. The sentence in Section 4.1, Compositing, has been revised to state that samples collected for volatile organic analysis will not be composited by the laboratory.

<u>Appendix C</u>

Comment #5 Some of the columns within Table C-9 are still off-set.

Response #5 Agreed. The columns in Table C-9 have been adjusted.

<u>Additional Comments</u>

Comment #1 **Section 1.1. Purpose of Report.** The following statement should be added to this section. "As required, this generic workplan will be updated and/or revised to incorporate specific field sampling procedures and/or analytical methodologies or test procedures used for environmental investigation/construction developments at the Seneca Army Deport Activity, in order to comply with location (area or site) specific Data Quality Objectives and ARARs."

Response #1 Agreed. The statement has been added to Section 1.1.

Comment #2 Section 3.2.3. states "the Army has no plans to change the use of the facility or transfer ownership." This is not true. As everyone is aware, SEDA has been identified for closure. The document should be corrected in this section and any others that state or infer the same error.

Response #2 Acknowledged. A discussion has been added to Section 3.2.3 concerning the recommendation of the BRAC Commission to close SEDA. It is important to note that the recommendation does not become law until it is approved by

Congress. At this time, no vote has been conducted.

Appendix C: Chemical Data Acquisition Plan

Comment #1 **Section 2.0 Project Description.** The text should be revised to include the following: "All activities required under Article 24. of the Federal Facility Agreement between SEDA, EPA and NYSDEC shall be performed in conjunction with tasks described in this Chemical Data Acquisition Plan."

Response #1 Agreed. The statement has been added to Section 2.0.

These comments refer to new tables and text included in the Final Draft Document.

Comment #2 **Table 3-4**. For groundwater and surface water, the Remedial Action Objectives for human health should include prevention of dermal contact and inhalation of volatilized contaminants in addition to prevention of ingestion.

Response #2 Agreed. Dermal contact and inhalation of volatilized contaminants have been added to the list of Remedial Action Objectives for groundwater and surface water.

Section 3.2 Identification of Potential Receptors and Exposure Scenario

General Comment:

Comment #1 As there are a number of inconsistencies (and incomplete discussions) between the figures and text and between the text in this section and the text in Section 4.4, this section should be review and revised accordingly. As examples, the potential for inhalation of VOCs released from surface water and the potential for exposure of recreationalists to contaminants in off-site surface water and sediment are presented in the text but not indicated in the corresponding figure. While current and future on-site use of the groundwater is discussed, discussion should also be provided on the potential for off-site use of the groundwater for potable water or irrigation.

Response #1 Agreed. Section 3.2 has been reviewed and the text and figures have been revised. As part of this revision, off-site receptors have been added to the figures and the groundwater discussion has been expanded to include potential off-site use of groundwater.

Section 4.4 Baseline Risk Assessment

Comment #1 **Page 4-6, p3:** As per the comment on the Draft Work Plan, chemicals of potential concern should be selected based on the listed criteria, regardless of whether the risk characterization will be quantitative or qualitative. The risk posed by chemicals of potential concern without available toxicological criteria should be evaluated qualitatively.

Response #1 Agreed. The risk posed by chemicals of potential concern without available toxicological criteria will be evaluated qualitatively. This statement has been added to the text on pg 4-9.

Comment #2 **Page 4-10, p3:** "...test pits as part of the investigation" should be deleted as it does not reflect baseline conditions in the absence of remedial action.

Response #2 Agreed. Reference to "test pits as part of the investigation" has been removed from the text.

Comment #3 **Page 4-11, p4:** While the text in Section 3.2 and elsewhere in Section 4.4 considers on-site residents as a potentially exposed population in the future, the text here indicates that "light industrial use" will be considered for the future case as "the most minimally restrictive use". Again, although generic, the contemplated risk assessment approach should be outlined more clearly.

Response #3 Agreed. The discussion of the risk assessment approach regarding the future land use is not clear. The text has been revised to indicate that on-site residents and construction workers will be evaluated as the exposed populations under future land use scenarios. Although future land use of the sites will be considered to be residential for the purpose of worst case considerations, the possibility of this actually occurring is remote since the Army intends to continue using the sites for light industrial use. In addition, although the risk due to future residential land use will be calculated in this risk assessment, the decision to perform a remedial action will be based upon an intended land use scenario.

Comment #4 Page 4-12, p3: "Cancer risk during childhood.. "should be replaced with "Exposure during childhood..."

Response #4 Agreed. The text on page 4-12 has been revised.

Comment #5 **Page 4-13, p1:** As per the comment on the Draft Work Plan, the hierarchy indicated in the last sentence of the second paragraph should be followed in obtaining toxicological criteria. Provisional toxicological criteria derived by the risk assessors using route-to-route extrapolations or structure-activity analogies should not be used without the approval of the USEPA, Region II.

Response #5 Agreed. A sentence has been added to page 4-13, p.2, stating that provisional toxicological criteria will not be used without USEPA Region II approval.

Comment #6 **Page 4-14, p3:** In additional to the central tendency analysis, the uncertainty associated with each element of the risk assessment process (e.g., the limitations of the analytical data, the applicability of the toxicological criteria) should be discussed, at least qualitatively, in the uncertainty analysis.

Response #6 Agreed. A qualitative discussion of the uncertainty associated with each element of the risk assessment has been added to Section 4.4.4.1,Uncertainty

	Analysis.
Comment #7	Page 5-6, Section 5.3, p1: Detailed Analysis of Alternatives, states: "In this stage of the FS, alternatives brought through screening are further defined based on site characterization or treatability studies." All refinement of the alternatives should take place in the steps before the detailed analysis of the alternatives. This sentence should be moved to the previous section or deleted.
Response # 7	Agreed. The statement has been removed from the text.

COMMENTS AND RECOMMENDATIONS FROM THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION DRAFT GENERIC RI/FS WORK PLAN SENECA ARMY DEPOT ACTIVITY ROMULUS, NEW YORK

COMMENTS BY: KAMAL GUPTA

Comment #1 Section 3.2.3 Potential Land Use Exposure Pathways and Receptors - Future Uses.

The statement that "the Army has no plans to change the use of this facility or to transfer ownership" seems to be contrary to the March 1995 announcement by the Department of Defense of the intended closure of the Seneca Army Depot Activity. It is our understanding that one of the goals of the Base Realignment and Closure Act is to transfer the military property to private ownership.

Section 3.2.3 should be revised to reflect the above. It should be stated that future use of each site would be considered based on possible use by the perspective private owner and will be in the specific RI/FS scoping plan. Statements like "future residential scenario will not be considered..." should be removed from this section. In addition, the generic work plan should include a description of closure procedures, a projected timetable of closure, a discussion of the Army's future intentions for the site or portions of the site, and a detailed account of methods to notify prospective purchasers of the Depot's environmental status.

Response #1 Acknowledged. As of this date, SEDA was among the installations the Department of Defense proposed to close as part of the Base Realignment and Closure Act (BRAC 95). However, until the BRAC Commission submits recommendations to the President and the list of recommendations is approved by Congress, BRAC does not apply to SEDA and the installation will remain open.

The BRAC Commission is scheduled to submit recommendations to the President by July 1, 1995. The President must approve the entire list by July 15, 1995 at which time the list is forwarded to Congress. If Congress approves the recommendations, they will become public law on October 1, 1995. If BRAC applies to SEDA future use of the sites will be determined by the Army. In accordance with BRAC regulations, the Army will perform any additional investigations and remedial actions to assure that any change in intended land use is protective of human health and new environment. However, not all sites at SEDA will be turned over for residential use.

At this time the specific details for closure procedures, projected timetables of closure, discussion of the Army's future intention for the sites, and a detailed account of notification methods to prospective purchasers are unavailable for inclusion in this Workplan. If it is decided that the base will be closed, then closure procedures will be obtained.

Comment #2

Section 3.4.2.2 Potential Sources of Items "To Be Considered" (TBC) as Alternative Sources of ARARs Table 3-10.

i) The New York State 1989 document, Habitat Based Assessment Guidance Document for conducting Environmental Risk Assessment at Hazardous Waste Sites has been replaced by "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites, October 1994" (copy enclosed). Please correct Table 3-10.

ii) Please include the NYSDECs Technical and Administrative Guidance Memorandums (TAGMs) HWR-4001 through 4056. These TAGMs are related to conducting investigation and remediation at hazardous waste sites.

Response #2

Agreed i). The new 1994 NYS guidance document has replaced the 1989 NYS guidance document in Table 3-10.

Agreed ii). The TAGMs HWR-4001 through 4056 have been added to Table 3-10 as "To Be Considered" items.

Comment #3

Field Sampling and Analysis Plan 3.5.3 Well Installation, Page A-38.

Please provide Figure A-7, which is stated to depict the shallow bedrock well details.

Response #3

Agreed. A typical shallow bedrock well construction detail has been added as Figure A-6b.

APPENDIX F

SCOPE OF WORK

29 Aug 94
SEDAWP.SOW

ANNEX AL
PREPARATION OF WORK PLANS FOR REMEDIAL INVESTIGATIONS AND FEASIBILITY STUDIES AT VARIOUS SITES AT SENECA ARMY DEPOT ACTIVITY, ROMULUS, NEW YORK

1.0 GENERAL STATEMENT OF SERVICES

1.1 Background. As part of its continuing program of evaluating its hazardous waste management practices, the Army will perform Remedial Investigations/Feasibility Studies (RI/FS) at various sites on Seneca Army Depot Activity (SEDA). The RI/FS investigations are to be conducted to determine the magnitude of environmental contamination and appropriate remedial actions. The US Army Corps of Engineers, Huntsville Division, on behalf of SEDA, will contract for the required work.

1.2 Location. Seneca Army Depot Activity is a US Army facility located in Seneca County, New York. SEDA occupies approximately 10,700 acres. It is bounded on the west by State Route 96A and on the east by State Route 96. The cities of Geneva and Rochester are located to the northwest (14 and 50 miles, respectively); Syracuse is 53 miles to the northeast and Ithaca is 31 miles to the south. The surrounding area is generally used for farming.

1.3 Regulatory Status. SEDA was proposed for the Federal Facilities National Priorities List on 13 July 1989. Consequently, all work to be performed under this contract shall be performed according to CERCLA guidance as put forth in the Interim Final "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA", dated October 1988 (Reference 11.13). Additionally, all work performed as part of this contract shall be performed according to the Interagency Agreement negotiated between Seneca Army Depot, the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (USEPA), Region II (Reference 11.10).

1.4 Previous Investigations. Previous investigations have been performed at various SEDA units. In general, an "Installation Assessment and Update" (USATHAMA Reports No. 157 (1980) and 157(U) (1987), respectively) (References 11.1 and 11.3) was conducted by the U.S. Army Toxic and Hazardous Materials Agency. The purpose of the assessment was to identify potentially contaminated areas at the Depot. The U.S. Army Environmental Hygiene Agency's Groundwater Contamination Survey No. 38-26-0868-88, "Evaluation of Solid Waste Management Units, Seneca Army Depot" (Reference 11.4) identified and described all solid waste management units (SWMU's) at SEDA at the time of its preparation. More recently, a "SWMU Classification Report" (Reference 11.5) was prepared to present the results of records searches at all currently identified SWMU's at SEDA and, based on its recommendations, site investigations have been completed at twenty five SWMU's where additional work was recommended as being necessary (References 11.6,11.7, 11.8 and 11.9). A complete list of previous investigations is presented as References in Section 11.0.

1.5 Units to be Investigated Under this Contract. Work Plans for RI/FS investigations will be prepared for the following four operable units:

* 1) the abandoned and existing deactivation furnaces (SEAD-16 and SEAD-17); 2) the fire demonstration pad and the fire training pit (SEAD-25 and SEAD-26); 3) the old construction debris landfill (SEAD-11) and 4) the Open Detonation Grounds (SEAD-45).

1.6 Security Requirements. Compliance with SEDA security requirements is mandated. These requirements are presented in Section 9.0.

2.0 OBJECTIVE

The objectives of this Statement of Work are to prepare: a) A generic Work Plan which presents the generic requirements of an RI/FS and which may be used to refer to any and all future RI/FS's conducted at the installation and b) site specific Project Scoping Plans for each of the four operable units of concern in this contract. At completion, the two portions of the plans, taken together, shall form a complete Work Plan for implementing an RI/FS at each site. All Work Plans shall be developed as defined by Office of Solid Waste and Emergency Response Directive 9355 (Reference 11.13, beginning with the RI/FS scoping process and ending with a regulatorally approved Work Plan at the identified site. Additionally, this Work Plan shall maintain the basic format of the Work Plan developed for the SEDA Ash Landfill and Open Burning Grounds RI/FS (References 11.11 and 11.12). *

3.0 DETAILED DESCRIPTION OF SERVICES

3.1 General Requirements. All work performed by the AE shall be designed and implemented in a manner which complements earlier investigations and shall conform to this Statement of Work (SOW). * The AE, through the Work Plans, shall present a complete description of the RI/FS process as applied to each operable unit. All work shall be performed under the general supervision of a Professional Engineer registered in the State of New York.

3.2 (Task 1) Site Visit and Review Existing Data. The AE shall perform a visual inspection of the sites, review records, reports and other data provided by the Contracting Officer and the facility, or made available to the AE from sources such as public records, the USEPA, the State Regulators, the State Geological Survey, or from interviews with local residents and officials who have knowledge of past site activities.

3.3 (Task 2) RI/FS Work Plan Preparation.

3.3.1 General. The AE shall prepare multiple documents; a generic, installation-wide, RI/FS Work Plan Document and four site specific Project Scoping Plans which are intended to do the following: (1) to provide a consolidated report on site history, current site activities, and resulting environmental impacts; (2) to familiarize personnel who will be working on the project with site conditions; and (3) to provide project plans and proposed tasks by which RI/FS activities shall be conducted. The documents shall be prepared as follows:

3.3.2 (Task 2a) Generic Work Plan.

3.3.2.1 Generic Work Plan Preparation.

3.3.2.1.1 The A-E shall prepare a generic RI/FS Work Plan in which the generic portion of the overall RI/FS process, as it relates to the installation, shall be presented. When completed, this plan shall be applicable to the performance of any RI/FS, regardless of which site on the depot is being considered. The generic plan may follow the outline presented in Figure 1, keeping in mind that in this portion of the plan, discussions shall be limited to short, generalized discussions that relate to the installation as a whole.

FIGURE 1 : GENERIC WORK PLAN

WORK PLAN OUTLINE

PROJECT SCOPING DOCUMENT

generic

INTRODUCTION ✓
- Background

SITE CONDITIONS ✓
- Physical Setting
- Geological Setting
- Hydrogeology
  - Regional
  - Local
- Results of Previous Investigations

SCOPING OF THE RI/FS
- Conceptual Site Model
  - Physical Site Characterization
  - Environmental Fate of Constituents at SEAD
  - Identification of Potential Receptors and Exposure Scenarios
  - Potential Source Areas and Release Mechanism
  - Potential Exposure Pathways and Receptors - Current Uses
  - Potential Exposure Pathways and Receptors - Future Uses
- Scoping of Potential Remedial Action Alternatives
  - No Action
  - Capping
  - Excavation and Landfilling
  - In Situ Detoxification and Solidification
  - Resource Reclamation
  - Institutional Controls
  - Composting
  - Soil Washing/Soil Flushing
  - Excavation, Incineration and Disposal

FIGURE 1 (CONTINUED)

- Carbon Adsorption
- Ion Exchange
- Chemical Oxidation
- Reverse Osmosis

Preliminary Identification of Applicable or Relevant and Appropriate Requirements (ARARs)
  - Introduction
  - Preliminary Identification of ARARs and "To Be Considered" (TBCs)
    - Potential ARARs
    - Potential Sources of Items To Be Considered" (TBC) as Alternative Sources of ARARs
    - Potential Chemical-Specific ARAR and TBC Levels

Data Quality Objectives (DQO's)
  - Intended Use of Data
  - Data Quality
  - Data Quantity

Data Gaps and Data Needs

> TASK PLAN FOR THE RI

- Pre-Field Activities
- Field Investigations
    - Geophysical Investigation
    - Soils Investigation
    - Surface Water and Sediment Investigation
    - Groundwater Investigation
    - Ecological Investigation
    - Surveying
- Data Reduction, Assessment and Interpretation

FIGURE 1 (CONTINUED)

- Baseline Risk Assessment
    - Identification of Contaminants of Concern
    - Exposure Assessment
    - Toxicity Assessment
    - Risk Characterization
    - Environmental Assessment
    - Identification of ARARs
- Data Reporting
    - Preliminary Reports
    - Quarterly Reports
    - Monthly Report

TASK PLAN FOR THE FS

- Development of Remedial Action Objectives
- Develop Remedial Action Alternatives
- Screening of Remedial Action Alternatives
- Detailed Analysis of Remedial Action Alternatives

3.3.2.1.2 As part of the overall generic RI/FS Work Plan, the A-E shall include the following plans:

3.3.2.1.2.1 Health and Safety Program Plan (HSP). The AE shall develop and maintain a Health and Safety Program Plan in compliance with the requirements of OSHA standard 29 CFR 1910.120 (b)(1) through (b)(4). Written certification that the HSP has been developed and implemented shall be submitted to the Contracting Officer and the plan shall be made available upon request.

3.3.2.1.2.2 Quality Assurance Project Plan. The AE shall prepare and submit a Quality Assurance Project Plan (QAPP) according to the requirements of Section 6 of this SOW. This portion of the RI/FS Work Plan shall also describe in detail, the following: 1) Site Background; 2) Quality control and quality assurance procedures to be exercised including organization and responsibilities; 3) QA objectives; 4) Sampling procedures; 5) Sample custody; 6) Calibration procedures; 7) Analytical procedures; 8) Data reduction, validation and reporting; 9) Internal quality control; 10) Performance and system audits; 11) Preventive maintenance; 12) Data assessment procedures; 13) Corrective actions; and, 14) Quality assurance reports.

3.3.3 (Task 2b) RI/FS Project Scoping Plans.

3.3.3.1 General. In conjunction with the Generic Installation RI/FS Work Plan, the AE shall prepare and submit a RI/FS Project Scoping Plan for each of four operable units to be investigated. This scoping plan shall provide a summary of site specific conditions, give an overview of the RI/FS process at each operable unit and describe how the process will be implemented at each. The plans shall conform to the outline presented in Figure 1. There may be some overlap with information presented in the Generic Work Plan; however, wholesale repetition is not expected. All detailed information required to implement a thorough RI/FS investigation at each operable unit shall be presented in these Project Scoping Plans.

3.3.3.2 Site Specific Health Plan. The AE shall develop a Site-Specific Safety and Health Plan (SSHP), as part of the HSP, in accordance with the requirements of Section 5.0 of this SOW. The SSHP shall be submitted to the Contracting Officer for review and approval prior to any field work.

3.3.3.3 Field Sampling Plan. The AE shall prepare and submit, as part of the Project Scoping Plans, a Field Sampling Plan (FSP). The FSP shall describe in detail all sampling and analysis activities to be exercised including site background, sampling objectives, sampling locations and frequency, designations, equipment and procedures and handling and analysis requirements to be applied at each site. It is intended that the AE, in the Field Sampling Plan, propose and justify how the field investigation activities will be allocated. As part of the FSP, the A-E shall discuss specific plans to meet all QA/QC requirements.

3.4 (Task 3) Project Management. The AE shall manage the delivery order in accordance with Appendix A of the basic contract statement of work. All project management associated with the delivery order, with the exception of the direct technical oversight of the work described in the preceding tasks, shall be accounted for in this task.

4.0 SUBMITTALS AND PRESENTATIONS

4.1 Format and Content. All submittals identified in the SOW shall be prepared in accordance with the suggested RI/FS Format as presented in the RI/FS Guidance Manual. Each submittal shall be accompanied by an EPA completeness checklist (where applicable), completed by the AE, which references the specific location of each required item within the submitted document. All drawings shall be of engineering quality in drafted form with sufficient detail to show interrelations of major features on the installation site map. When drawings are required, data may be combined to reduce the number of drawings. The documents shall consist of 8-1/2" x 11" pages with drawings folded, if necessary, to this size. A decimal paragraphing system shall be used, with each section and paragraph of the documents having a unique decimal designation. The document covers shall consist of vinyl 3-ring binders and shall hold pages firmly while allowing easy removal, addition, or replacement of pages. A document title page shall identify the AE, the Corps of Engineers, Huntsville Division, and the date. The AE identification shall not dominate the title page. Each page of draft and draft-final documents shall be stamped "DRAFT" and "DRAFT-FINAL" respectively. Each document shall identify the members and title of the AE's staff which had significant, specific input into the document's preparation or review. Submittals shall include incorporation of all previous review comments accepted by the AE as well as a section describing the disposition of each comment. Disposition of comments submitted with the final document shall be separate from the document itself. All final submittals shall be sealed by both the registered Professional Engineer-In-Charge.

4.2 Presentations. The AE shall make presentations of work performed according to the schedule in paragraph 4.6. Each presentation will consist of a summary of the work accomplished and anticipated followed by an open discussion among those present. The AE shall provide a minimum of two persons at the meetings which are expected to last one day each.

4.3 Conference Notes. The AE will be responsible for taking notes and preparing the reports of all conferences, presentations, and review meetings. Conference notes will be prepared in typed form and the original furnished to the Contracting Officer (within five (5) working days after date of conference) for concurrence and distribution to all attendees. This report shall include the following items as a minimum:

a. The date and place the conference was held with a list of attendees. The roster of attendees shall include name, organization, and telephone number.

b. Written comments presented by attendees shall be attached to each report with the conference action noted. Conference action as determined by the Government's Project Manager shall be "A" for an approved comment, "D" for a disapproved comment, "W" for a comment that has been withdrawn, and "E" for a comment that has an exception noted.

c. Comments made during the conference and decisions affecting criteria changes, must be recorded in the basic conference notes. Any augmentation of written comments should be documented by the conference notes.

4.4 Confirmation Notices. The AE will be required to provide a record of all discussions, verbal directions, telephone conversations, etc., participated in by the AE and/or representatives on matters relative to this contract and the work. These records, entitled "Confirmation Notices", will be numbered sequentially and shall fully identify participating personnel, subject discussed, and any conclusions reached. The AE shall forward to the Contracting Officer as soon as possible (not more than five (5) work days), a reproducible copy of said confirmation notices. Distribution of said confirmation notices will be made by the Government.

4.5 Progress Reports and Charts. The AE shall submit progress reports to the Contracting Officer with each request for payment. The progress reports shall indicate work performed, and problems incurred during the payment period. Upon award of this delivery order, the AE shall, within 15 days, prepare a progress chart to show the proposed schedule for completion of the project. The progress chart shall be prepared in reproducible form and submitted to the Contracting Officer for approval. The actual progress shall be updated and submitted by the 15th of each month and may be included with the request for payment.

4.6 Schedule of Deliverables and Review Meetings. Deliverables shall be submitted according to the following schedule.

Deliverable/Meeting	Days following NTP	30 Sept 94
Preliminary-Draft, Generic RI/FS Work Plan and Project Scoping Plans for OU 1-4	60	7 Dec ~~95~~ 94 ~~30 Nov~~
Comments Provided by the Army	80	9 Jan 95
Draft, Generic RI/FS Work Plan and Project Scoping Plans for OU 1-4	110	13 Feb 95
Regulatory Comments Provided	140	~~20~~ ~~15~~ 20 Mar 95
Draft-Final, Generic RI/FS Work Plan and Project Scoping Plans for OU 1-4	185	1 May 95
Final, Generic RI/FS Work Plan and Project Scoping Plans for OU 1-4	215	5 Jun 95
Project Review Meetings (3) now 5	TBD	
Contract completion		1 Sept 95

4.7 Submittals.

4.7.1 General Submittal Requirements.

4.7.1.1 Distribution. The AE is responsible for reproduction and distribution of all documents. The AE shall furnish copies of submittals to each addressee listed in paragraph 4.7.3 in the quantities listed in the document submittal list.

Submittals are due at each of the addressees not later than the close of business on the dates shown in paragraph 4.6.

4.7.1.2 Partial Submittals. Partial submittals will not be accepted unless prior approval is given.

4.7.1.3 Cover Letters. A cover letter shall accompany each document and indicate the project, project phase, the date comments are due, to whom comments are submitted, the date and location of the review conference, etc., as appropriate. (Note that, depending on the recipient, not all letters will contain the same information.) The contents of the cover letters should be coordinated with CEHND-PM-ED prior to the submittal date. The cover letter shall not be bound into the document.

4.7.1.4 Supporting Data and Calculations. The tabulation of criteria, data, circulations, and etc., which are performed but not included in detail in the report shall be assembled as appendices. Criteria information provided by CEHND need not be reiterated, although it should be referenced as appropriate. Persons performing and checking calculations are required to place their full names on the first sheet of all supporting calculations, and etc., and initial the following sheets. These may not be the same individual. Each sheet should be dated. A copy of this scope of work shall be included as appendix A in the Draft RI/FS report only.

4.7.1.5 Reproducibles. One camera-ready, unbound copy of the final submittal of each document shall be provided to the Contracting Officer in addition to the submittals required in the document and submittal list. All final submittals shall also be provided on 3.5-inch floppy disks compatible with the Intel 310/80286 computer in ASCII format and in WordPerfect 5.1/5.2 format.

4.7.3 Addressees.

Commander
U.S. Army Corps of Engineers
Huntsville Division
ATTN: CEHND-PM-ED (Mr. Suever)
PO Box 1600
Huntsville, AL 35807-~~4301~~ 1957

Commander
U.S. Army Depot Systems
Command (DESCOM)
ATTN: AMSDS-EN-FD
(Mr. Biernacki)
Chambersburg, PA 17201

Commander
U.S. Army Environmental
Hygiene Agency (USAEHA)
ATTN: HSHB-ME-SR (Mr. Hoddinott)
Building 1677
Aberdeen Proving Ground
MD 21010-5422

Commander
U.S. Army Corps of Engineers
Missouri River Division
ATTN:CEMRD-ED-GL
(Ms. Percifield)
420 South 18th Street
Omaha, Nebraska, 68102

Commander
U.S. Army Material Command (USAMC)
ATTN: AMCEN-A (Mr. Bob King)
5001 Eisenhower Ave.
Alexandria, VA 22333-0001

Commander
US Army Corps of Engineers,
New York District
ATTN: CENAN-PP-E
26 Federal Plaza
New York, New York, ~~22222~~ 10278-0090

Commander
U.S. Army Environmental Center
ATTN: CETHA-IR-D (Dr. Buchi)
Aberdeen Proving Ground,
MD 21010-5401

Commander
Seneca Army Depot Activity
ATTN:SDSSE-HE(Randy Battaglia)
Romulus, New York,14541

Commander
U.S. Army Corps of Engineers,
North Atlantic Division,
ATTN: CENAD-CO-EP (Mr. Pickett)
90 Church Street
New York, NY 10007-9998

4.6.4 Document and Submittal List.

	No. of Copies			↓
	Preliminary-Draft	Draft	Draft-Final	Final
CEHND-ED-PM	4	4	4	4
DESCOM	2	2	2	2
AEC	1	1	1	1
CEMRD-EA-GL	1	1	1	1
SDSSE-HE	2	23	23	23
CENAD-CO-EP	1	1	1	1
CENAN-??-?? -PP-E	2	2	2	2
AMC	1	1	1	1
USAEHA	8	8	8	8
TOTAL	22	43	43	43

5.0 SAFETY REQUIREMENTS

The AE shall prepare and submit the Site-Specific Safety and Health Plan (SSHP), as part of the Project Scoping Plan, for each operable unit, for the Contracting Officer (CO) for review and acceptance according to the schedule in paragraph 4.6. The SSHP shall be prepared in accordance with the requirements specified in this Section and shall be complete and in a form such that, as a stand alone document, it may be implemented immediately in the field. No field work (other than the initial visual inspection) may be performed until all plans are reviewed and approved by the CO. All work shall be performed according to the approved plans.

5.1 The SSHP shall be prepared by a board certified or board eligible Industrial Hygienist with at least 2 years hazardous waste site operations experience. Board certification or eligibility shall be documented by written confirmation by the American Board of Industrial Hygiene (ABIH) and submitted to the Contracting Officer. A fully trained and experienced health and safety officer (SSHO), responsible to the AE and the AE's Industrial Hygienist may be delegated to implement the on-site elements of the SSHP.

5.1.1 The SSHP shall be in a form usable by Corps of Engineers or U.S. Government management personnel and all other visitors to the site during site operations. The following topics shall be discussed at a minimum in the SSHP:

5.2. Site Description and Contamination Characterization. A description of the site, including a complete summary of contaminants anticipated onsite (chemical/biological names, concentration ranges, media in which found, locations onsite and estimated quantities/volumes) shall be provided.

5.3 Staff Organization, Qualifications and Responsibilities. The operational and health and safety responsibilities of each key person shall be discussed. The organizational structure, including lines of authority for safety and health and overall responsibilities of the AE and all subcontractors shall be provided. An organizational chart showing the lines of authority from the site level up through corporate management shall be provided.

5.4 Hazard Assessment and Risk Analysis. The AE shall identify the chemical, physical, safety and biological hazards of concern for each task and or operation to be performed. Include routes and sources of exposure, anticipated onsite and off-site exposure potential levels, and the applicable regulatory or recommended protective exposure standards. Action levels shall be specified and justified for the protection of onsite personnel and for the prevention or minimization of hazards/exposures to the off-site public from site activities.

5.5 Accident Prevention. All Accident Prevention Plan topics required by EM 385-1-1, Appendix Y, but not specifically covered by these elements shall be addressed in this section of the SSHP.

5.6 Training. Training for all onsite personnel as well as site specific, supervisory, refresher and visitor training shall be in accordance with 29 CFR 1910.120 Final Rule. The content, duration, and frequency, of training shall be described. Written certification that the required training has been received by affected personnel shall be submitted to the contracting officer prior to engaging in onsite activities.

5.7 Personal Protective Equipment. A written Personal Protective Equipment (PPE) Program shall be provided in the SSHP. The program shall address all the elements of 29 CFR 1910.120 (g)(5) and 29 CFR 1910.134. Specify minimum levels of protection necessary for each task/operation to be performed based on the hazard assessment/risk analysis required in paragraph 5.4. Include specific types and materials for protective clothing and respiratory protection. Establish and justify upgrade/downgrade criteria based upon the action levels established as required by paragraph 5.4.

5.8 Medical Surveillance. All personnel performing onsite activities shall participate in an ongoing medical surveillance program meeting the requirements of 29 CFR 1910.120 and ANSI Z-88.2. The medical examination protocols and results shall be overseen by a licensed physician who is certified in Occupational Medicine by the American Board of Preventive Medicine, or who by necessary training and experience is board eligible. Exam content and frequency shall be provided in the SSHP.

5.9 Air Monitoring. Specify for onsite and perimeter the types and frequency of air monitoring/ sampling to be performed. When applicable NIOSH and or EPA sampling and analytical methods shall be used. Personnel samples shall be analyzed only by laboratories successfully participating in and meeting the requirements of the American Industrial Hygiene Association's (AIHA) Proficiency Analytical Testing (PAT) or laboratory Accreditation Program. Include as appropriate real-time (direct-read) monitoring and integrated Time Weighted Average (TWA) sampling for specific contaminants of concern. Discuss instrumentation and calibration to be performed. All air monitoring results shall be compared to action levels to determine the need for corrective actions.

5.10 Site Control. The SSHP shall include a site map, description of work zone delineation, on/off site communication systems, site access controls, and security procedures.

5.11 Personnel and Equipment Decontamination. Specify decontamination procedures and equipment for personnel, personal protective equipment, sampling equipment and heavy equipment. Specify necessary facilities and their locations.

5.12 Emergency Response; Equipment and Procedures. An Emergency Response Plan as required by 29 CFR 1910.120 shall be prepared. Specify the emergency equipment and the location of such equipment to be present on site. Provide telephone numbers and points of contact for emergency services and the USACE Representative. Provide a map showing the route to the hospital that has been contacted and informed of the type of work and potential hazards on the site. At least one person trained and certified in first aid/CPR is to be on site at all times during site operations. Documentation of certification is to be submitted with documentation of other required training.

5.13 Standard Operating Procedures, Engineering Controls and Work Practices. Discuss and site rules and prohibitions for safe work practices. Include such topics as use of the buddy system, smoking restrictions, material handling procedures, confined space entry, excavation safety, heat/cold stress monitoring, illumination, sanitation, daily safety inspections. This list of topics is not intended to be all inclusive.

5.14 Logs, Reports and Recordkeeping. Describe recordkeeping procedures for training logs, daily safety inspection logs, employee/visitor registers, medical surveillance records and certifications and air monitoring results and personal exposure records. All personnel exposure and medical monitoring records shall be maintained in accordance with applicable OSHA standards, CFR 1910 and 1926.

5.15 Unexploded Ordnance. The facility is a military installation and has been used for storage, evaluation and disposal of ordnance and/or explosive materials as well as for military training. More specifically, the OB Grounds was used for the purpose of burning munitions and explosive wastes. Consequently, the potential for encountering unexploded ordnance does exist. If unexploded ordnance is ever encountered at any time during operations at the site the AE shall mark the location, immediately stop operations in the affected area, and notify the CO. The Government will make appropriate arrangements for evaluation and proper disposal. It is anticipated that in the event that such conditions arise, they will be overcome with only slight delays to the AE. It is the express intention of the Government that the AE is not to drill, excavate, or otherwise disturb the subsurface in areas where ordnance or explosives may reasonably be suspected unless specific, detailed plans to do so are prepared and approved.

5.16 Suggested SHERP Format.

STAFF ORGANIZATION

- Principal Engineer
- Program Manager
- Certified Industrial Hygienist
- Certified Safety Professional
- First Aid/CPR Personnel
- Field Personnel
- Subcontractor Personnel

HAZARD COMMUNICATION AND TRAINING

- Comprehensive Health and Safety Indoctrination
- Specialized Training
- Visitor Training
- Pre-Investigation Health and Safety Briefing
- Post-Investigation Health and Safety Briefing
- Morning Safety Meetings

MEDICAL SURVEILLANCE

- Medical Surveillance
- Licensed Occupational Physician
- Medical Examinations

EXPOSURE MONITORING

- Environmental and Personnel Monitoring
- Meteorological Monitoring
- Sampling and Analytical Methods
- Heat/Cold Stress Monitoring

HEALTH AND SAFETY EQUIPMENT

- Personal Protective Equipment
- Environmental Monitoring Equipment
- Decontamination Equipment
- Emergency Equipment
- Emergency-Use Respirators
- Spill Control Equipment

Fire Extinguishers
First Aid Equipment and Supplies
Emergency Eye Wash/Shower (ANSI Z358.1)
Personnel Hygiene
Personnel Decontamination
Communications

STANDARD OPERATING PROCEDURES
Health and Safety Site Plan
Site Description
Site Inspection
Site Security
Site Entry Procedures
Responsibilities
Work Zones
Hazard Evaluation
Activity Hazard Analysis
Accident Prevention
Accident Reporting
Safe Work Practices
Confined Space Entry Procedures
Material Handling Procedures
Levels of Protection
Decontamination Procedures
Emergency Information
Emergency Response Plan
Illumination
Sanitation
Well Installation/Logging
Sampling
Land Survey
Laboratory

6.0 CHEMICAL DATA AND LABORATORY REQUIREMENTS

6.1 General. All chemical data and laboratory requirements shall follow the requirements in the Ash Landfill and Open Burning Grounds Work Plans which have already been approved and implemented.

7.0 SOIL BORING AND MONITORING WELL REQUIREMENTS

7.1 General. All soil boring and monitoring well installation and sampling requirements shall follow the requirements contained in the Ash Landfill and Open Burning Grounds Work Plans which have already been approved and implemented.

8.0 SURVEY REQUIREMENTS.

8.1 General. All survey requirements shall follow the requirements contained in the Ash Landfill and Open Burning Grounds Work Plans which have already been approved and implemented.

9.0 SECURITY REQUIREMENTS

9.1 The following requirements must be followed by the AE at Seneca Army Depot to facilitate entry and exit of AE employees and to maintain security.

9.1.1 Personnel Registration:

9.1.1.1 A list of all AE employees, sub-contractors and suppliers indicating firm name and address will be furnished through POC/COR to the Counterintelligence Division, Building 710, 72 hours prior to commencement of work.

9.1.1.2 A confirmation of employment SDSSE-SC Form 268 will be executed by the AE concerning each employee, to include all sub-contractors and their personnel. No forms will be transferred to another file if the AE has other on-going contracts at SEDA. The AE will provide a list of personnel who are authorized to sign Form 268 for the firm. A sample of each signature is required. Counterintelligence Division must be notified, in writing, of any changes to this list. All completed forms will be provided through COR/POC to the Counterintelligence Division 72 hours prior to commencement of work. Failure to complete Form 268 correctly will result in employee's denial of access to Seneca. The Counterintelligence Division must be notified, in writing through POC/COR to Counterintelligence, at least 72 hours prior to requesting any action. The chain of command for all AE actions will be through POC/COR to Counterintelligence Division. There will be no exceptions.

9.1.1.3 Camera permits require written notice from the POC/COR prior to access. Open camera permits will not be issued. The following information is required:

(a) Camera make, model and serial number.

(b) Contract name and name of individual responsible for the camera.

(c) Dates camera will be used.

(d) Where it will be used.

(e) What will be photographed and why.

9.1.1.4 If a rental, leased or privately owned vehicle is required in place of a company vehicle, the following information is needed.

(a) Name of individual driving.

(b) Year, make, model, color and license plate of the vehicle.

(c) Typed letter on company letterhead indicating that the company assumes responsibility for rental, leased or privately owned vehicles.

9.1.1.5 All access media will be destroyed upon expiration date of contract. If an extension is required a list of employee names and new expiration date must be furnished to the Counterintelligence Division. Contract extensions must be made prior to the contract expiration date or new Form 268s will be required for each individual that requires an extension.

9.1.2 Traffic Regulations:

9.1.2.1 Traffic Laws, State of New York, apply with emphasis on the following regulations.

9.1.2.2 Speed Limit: Controlled Area - as posted

Ammo Area - 5 mph

Limited/Exclusion Area - 25 mph

9.1.2.3 All of the above are subject to change with road conditions or as otherwise posted.

9.1.3 Parking: AE vehicles (trucks, rigs, etc.) will be parked in areas designated by the Director of Law Enforcement and Security. Usually parking will be permitted within close proximity to the work site. Do not park within 30 feet of a depot fence, as these are clear zones.

9.1.4 Gates:

9.1.4.1 Post 1, Main Gate - NY Highway 96, Romulus, New York is open for personnel entrance and exit 24 hours daily, 7 days a week.

9.1.4.2 Post 3, entrance to North Depot Troop Area, located at end of access road from Route 96-A is open 7 days a week for personnel and vehicle entrance and exit.

9.1.5 Security Regulations:

9.1.5.1 Prohibited Property:

9.1.5.1.1 Cameras, binoculars, weapons and intoxicating beverages will not be introduced to the installation, except by written permission of the Director/Deputy Director of Law Enforcement and Security.

9.1.5.1.2Matches or other spark producing devices will not be introduced into the Limited/Exclusion or Ammo Area's except when the processor of such items is covered by a properly validated match or flame producing device permit.

9.1.5.1.3 All vehicles and personal parcels, lunch pails, etc. are subject to routine security inspections at any time while on depot property.

9.1.5.1.4 All building materials, equipment and machinery must be cleared by the Director of Engineering and Housing who will issue a property pass for outgoing equipment and materials.

9.1.6 AE Employee Circulation:

9.1.6.1 AE employees are cleared for entrance to the location of contract work only. Sight-seeing tours or wandering from work site is NOT AUTHORIZED.

9.1.6.2 Written notification will be provided to the Counterintelligence Division (Ext. 30202) at least 72 hours prior to overtime work or prior to working on non-operating days.

9.1.6.3 Security Police (Ext. 30448/30366) will be notified at least two hours in advance of any installation or movement of slow moving heavy equipment that may interfere with normal flow of traffic, parking or security.

9.1.7 Unions: Representatives will be referred to the Depot Industrial Labor Relations Officer (Ext. 41317).

9.1.8 Offenses: (Violations of law or regulations)

9.1.8.1 Minor: Offenses committed by AE personnel which are minor in nature will be reported by the Director of Law Enforcement and Security to the Contracting Officer who in turn will report such incidents to the AE for appropriate disciplinary action.

9.1.8.2 Major: Serious offenses committed while on the installation will be reported to the FBI. Violators may be subject to trial in Federal Court.

9.1.9 Explosive Laden Vehicles:

9.1.9.1 Vehicles such as vans, cargo trucks, etc. carrying explosives will display placards or signs stating "EXPLOSIVES".

9.1.9.2 Explosive ladened vehicles will not be passed.

9.1.9.3 When an explosive laden vehicle is approaching, pull over to the side and stop.

9.1.9.4 When catching up with an explosive laden vehicle, slow down and allow that vehicle to remain at least 100 feet ahead.

9.1.9.5 When approaching an intersection where an explosive laden vehicle is crossing - STOP - do not enter the intersection until such time as the explosive carrier has passed thru, and cleared the intersection.

9.1.9.6 When passing a vehicle that is parked, and displaying "Explosive" signs, slow down to 10 miles per hour, and take every precaution to allow more than ample clearance.

9.1.10 Clearing Post: All AE employees are required to return all identification badges, and passes on the last day of employment on the depot. The AE is responsible for the completion of all turn-ins by his employees, and informing the Counterintelligence Division and the depot organization administering the contract, for termination of any employee's access to the depot.

10.0 PUBLIC AFFAIRS.

The AE shall not publicly disclose any data generated or reviewed under this contract. The AE shall refer all requests for information to CEHND. Reports and data generated under this contract shall become the property of the Department of Defense and distribution to any other source by the AE, unless authorized by the Contracting Officer, is prohibited.

11.0 REFERENCES

11.1 U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Initial Installation Assessment of Seneca Army Depot, N.Y. Report no. AMXTH-IR-A-157, 1980.

11.2 U.S. Army Environmental Hygiene Agency (USAEHA), Final Report, Army Pollution Abatement Program Study No. D-1031-W, Landfill Leachate Study, Seneca Army Depot, 1981.

11.3 U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Update of the Initial Installation Assessment of Seneca Army Depot, N.Y. Report no. AMXTH-IR-A-157(U), 1988.

11.4 "Evaluation of Solid Waste Management Units, Seneca Army Depot", Interim Final Report, Groundwater Contamination Survey No.38-26-0868-88, U.S. Army Environmental Hygiene Agency.

11.5 "SWMU Classification Report, Seneca Army Depot Activity.", ERC Environmental (Draft), Engineering Science (Final), June 1994.

11.6 "Draft, Expanded Site Investigation, Seven High Priority SWMU's (SEAD-4,16,17,24,25,26 and 45).", Engineering Science, Inc., June 1994.

11.7 "Draft, Expanded Site Investigation, Three Moderate Priority SWMU's (SEAD-11,13 and 57).", Engineering Science, Inc., August 1994.

11.8 "Preliminary-Draft, Expanded Site Investigation, Eight Moderately Low Priority SWMU's.", Engineering Science, Inc., {to be submitted shortly}

11.9 "Preliminary-Draft, Expanded Site Investigation, Seven Low Priority SWMU's.", Engineering Science, Inc., {to be submitted shortly}.

11.10 "Federal Facility Agreement Under CERCLA Section 120, Seneca Army Depot, Romulus, New York" , 1990.

11.11 "Final Work Plan, Remedial Investigation/Feasibility Study at the Ash Landfill, Seneca Army Depot, Romulus, New York", Environmental Science and Engineering, Inc., 1990.

11.12 "Final Work Plan, Remedial Investigation/Feasibility Study at the Open Burning Grounds, Seneca Army Depot, Romulus, New York", Engineering Science, Inc., 1990.

11.13 Interim Final, "Guidance For Conducting Remedial Investigations and Feasibility Studies Under CERCLA", OSWER Directive 9355.3-01, U.S. EPA, Office of Emergency and Remedial Response, October 1988.

11.14 "Chemical Data Quality Management For Hazardous Waste Remedial Activities", ER 1110-1-263, 1 March 1989.

11.15 "U.S. Corps of Engineers Safety and Health Requirements Manual," U.S. Army Engineering Manual No. EM-385-1-1, April 1981.