LEGGETTE, BRASHEARS & GRAHAM, INC.
PROFESSIONAL GROUND-WATER CONSULTANTS

REMEDIAL INVESTIGATION REPORT

VOLUME I

ROWE INDUSTRIES GROUND-WATER CONTAMINATION SITE

SAG HARBOR, NEW YORK

JULY 1992

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REMEDIAL INVESTIGATION REPORT
ROWE INDUSTRIES
GROUND-WATER CONTAMINATION SITE
SAG HARBOR, NEW YORK

Prepared For

Nabisco Brands, Inc.

July 1992

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PROJECT TEAM

The Remedial Investigation (RI) was conducted under the overall supervision of Facility Coordinator, Mr. Robert Lamonica of Leggette, Brashears & Graham, Inc. (LBG). The field operations and report preparation were completed under the supervision of Mr. Jeffrey Lennox, Project Officer from LBG. The onsite RI leader and co-author of this report was Ms. Karen Billick, Hydrogeologist from LBG.

Analytical services were provided by NET Atlantic, Inc., Cambridge Division, Bedford, Massachusetts; data validation was performed by Trillium, Inc., Coatesville, Pennsylvania, under the direction of Dr. James Smith and drilling was performed by Delta Well and Pump Company, Inc. of Ronkonkoma, New York. The United States Environmental Protection Agency (EPA) oversight contractor was Alliance Technologies Corporation, Bedford, Massachusetts. The EPA site manager was Ms. Linda Wood.

We wish to acknowledge the cooperation extended throughout the program by the owners and staff of Sag Harbor Industries and the residents of Sag Harbor, New York.

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1.0 INTRODUCTION

1.1 Purpose of Report

The Rowe Industries site, located in Sag Harbor, New York (plate 1), was first investigated as a potential source of ground-water contamination in 1983. The Suffolk County Department of Health Services (SCDHS) conducted a study between 1983 and 1984 at the site and the nearby vicinity to determine the extent of ground-water contamination. Their study included sampling nearby residential wells, as well as installing forty 2-inch diameter monitor wells in the area and sampling the ground water at discrete depths.

The purpose of the Remedial Investigation (RI), described herein, was to fill any existing data gaps concerning this site, including determination of the areal and vertical extent of the ground-water plume and an investigation of possible source areas, so that the need for further remedial actions can be assessed and the feasibility of the remedial alternatives can be evaluated. Existing data gaps included the following:

1. The SCDHS study defined a ground-water contamination plume, and appeared to isolate the source as the Rowe Industries property (now owned by Sag Harbor Industries (SHI)). They did not, however, fully define the source areas on the site, nor did they fully investigate other potential contributors to the plume.

Further onsite investigations were conducted, as part of the RI, to determine if any residual sources of contamination exist which are contributing, or may contribute in the future to the ground-water contamination.

2. The plume was characterized in the SCDHS Interim Report as being composed of volatile organic chemicals. The primary constituents found during the SCDHS study, based on

frequency of occurrence and concentration, were tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1-trichloroethane (TCA) and 1,1-dichloroethene (DCE). Organic chemicals that were detected at lesser concentrations were 1,1-dichloroethane, chlorodibromomethane, 1,2-dichloroethene, Freon 113 and BTX (benzene, toluene and total xylene). However, a comprehensive analytical program was never performed. The presence of substances which were not previously identified could have an effect on treatability studies and could implicate other potential contributors. In addition, there was no data on the current nature of the plume, relative to its characteristics in 1984. The RI addressed the chemical characteristics of the current plume through an extensive and comprehensive chemical study.

3. In the SCDHS study, the plume was defined by chemical data without the concurrent use of ground-water flow data. A study of ground-water flow direction, rate and volume was completed as part of this RI to determine the level of risk associated with the plume and to facilitate the analysis of remedial alternatives.

1.2 Site Background

The Rowe Industries site (plate 1) has been the focus of preliminary investigations and corrective actions since 1983, when private well contamination was first discovered in the area. Public water supply was brought into the affected area in March of 1985, which removed any imminent health threat.

1.2.1 Site Setting

The Rowe Industries site is located in the Town of Southampton on the South Fork of Long Island (figure 1). The site is on the east side of the Sag Harbor-Bridgehampton Turnpike in the Town of Southampton, approximately 1,500 feet south of the Village of Sag Harbor boundary (see plate 2).

The property is about 8.5 acres in size. Approximately one acre is covered by a building and an additional one acre of the property is paved. The land slopes downward towards the northeast.

There are two ponds near the building, located 300 and 700 feet to the northeast. Sag Harbor Cove is about 3,000 feet to the northwest. Ligonee Brook, which flows into Sag Harbor Cove, is to the east and north of the site. The closest public supply well is about 5,000 feet northeast of the site, hydraulically cross-gradient of the plume.

The site vicinity is largely undeveloped to the east and west. There is a small industrial area to the southwest and residential/commercial areas to the northwest, north and south. The entire area is served by private wells and onsite sewage disposal systems, with the exception of the area which was connected to the public water supply as a result of the contamination problem.

1.2.2 History of Ownership

The site history from 1950 until 1982 was investigated and compiled by Nabisco Brands, Inc. (NBI) and was reported to the United States Environmental Protection Agency (EPA) in response to a Request for Information. A summary of the site history is presented below:

The property was originally owned by Henry and Jeannette Klein and Helene Bates. In 1950, they divided the property into four parcels; Parcels 1 and 2 owned by the Klein's and Parcels 3 and 4 owned by Ms. Bates.

On April 11, 1955, the Klein's sold Parcels 1 and 2 to Robert Rowe and Ethel Beck. On July 16, 1956, they sold Parcel 1 to Playmakers, Inc. On January 10, 1961, Robert Rowe and Ethel Beck sold Parcel 2 to Rowe Industries, Inc. ("Old Rowe"). On August 18, 1964, Playmakers, Inc. acquired Parcel 4 and on October 20, 1964, Parcel 3. On March 3, 1965, Playmakers, Inc. merged into Old Rowe.

On or before March 4, 1966, Old Rowe changed its name to RI Liquidation Corporation. A new company called Rowe Industries, Inc. ("Rowe") was incorporated on March 4, 1966. RI Liquidation Corporation sold its assets, including Parcels 1 and 4, to Rowe on March 7, 1966. The owners of Old Rowe were Robert L. Rowe, Ethel Beck and Ralph Schwenk; the owner of Rowe was Aurora Plastics Corporation. Aurora Plastics Corporation changed its name to Aurora Products Corporation, sometime between March 4, 1966 and May 28, 1971.

On January 4, 1971, a company called A Products Corporation was incorporated and on May 28, 1971, merged with Aurora Products Corporation. The sole owner of A Products Corporation and, after the merger, Aurora Products Corporation, was Nabisco Aurora, Inc., a wholly-owned subsidiary of NBI. NBI believes that ownership of Rowe was held by Aurora Holding Company, Inc., a wholly-owned subsidiary of Aurora Products Corporation. NBI's relationship to Rowe began on May 28, 1971 when NBI acquired 100 percent of shares of Aurora.

Nabisco Aurora, Inc. was dissolved on or about November 20, 1974. NBI believes that Aurora Holding Company, Inc. was dissolved on or about December 30, 1974, and that its assets, including all shares in Rowe, were distributed to Aurora Products Corporation.

Rowe ceased doing business on the site in 1974. On December 31, 1974, ownership of Rowe was transferred to Aurora Products Corporation. Nabisco, Inc. sold Rowe's assets, with the exception of the Sag Harbor premises, to a California corporation, Allegretti & Company, on July 14, 1978. The Sag Harbor site was sold to Sag Harbor Industries on July 3, 1980. Rowe was dissolved on April 20, 1982.

The site was not in use from 1974 until it was sold in 1980.

Historical aerial photographs of the property illustrate the various changes of the site over the years. The photographs date back to 1947, up to and including 1984. Plate 3 is a compilation of the various features observed during the study. Direct quotes and summaries of information noted in an EPA study using these photographs are listed below. The actual photographs can be found in the EPA study entitled "Site Analysis, Rowe Industries, Southampton, New York".

- *February 19, 1954 "The site is shown prior to the construction of the Rowe Industries facility."* The site is located in an undisturbed residential area. An area of disturbed ground was located west of the small onsite pond which appears throughout the years.

- *May 17, 1961 "New roads, new buildings, the Rowe Industries facility and evidence of other human activities are now onsite."* A number of vehicles are observed around the facility. A possible vertical tank and excavation area south of the building are visible.

- *October 2, 1965 "Imagery from this year indicates activity near Pond A (onsite pond). This activity includes an area of disturbed ground and a probable fill area. The area of disturbed ground is not the same one cited in 1954. Southeast of the Rowe Industries building is a possible debris pile with a ground stain. This ground stain appears to have been created by a fluid that flowed in the direction of Pond A (onsite pond)."*

- *April 28, 1972 "Probable drums are now visible in the area where possible debris was seen in 1965. A ground stain is evident in association with the probable drums. East of the probable drums are two unidentified objects with a ground* *stain extending to the north." "Next to the east side of the building is an open storage area containing unidentifiable materials. Just to the south is a small trailer with possible drums."* Also noted from this photograph were two possible sheds, a platform and various vehicles in the area around Pond A (onsite pond). A debris pile of unknown composition was located southwest of the pond.

- *Spring 1974 "Three notable changes have been detected onsite since 1972. Disturbed ground is seen at the revegetating fill area west of Pond A (onsite pond), possibly indicating additional filling. North of this area is an area of possible drums. A possible trench is visible downslope and east of an area of probable drums and ground staining. This is the same area that was noted as probable drums and staining in 1972 and possible debris and staining in 1965. An area of possible drums is located to the north."*

- *March 28, 1978 "Two areas of ground scarring and one of debris are seen just southwest of the revegetated area. The scars and debris could be related to the structure, platform and disturbed ground that were apparent in the 1972 imagery. Uphill and to the southwest is a ground stain; staining has been noted in this area since 1965. A ground scar is also visible in this area. The possible trench visible east of this area in the 1974 imagery is not apparent."*

- *March 24, 1984 "Directly east of the Rowe Industries building are an area of open storage and a new structure; neither of these features were present in 1978. The structure appears to be a large shed and is in the area of the possible tractor trailer seen in 1972. The open storage area contains three stacks of material, possibly in crates. There is a possible*

> *ground stain northwest of the structure. Southeast of the plant is a probable waste disposal area with a ground stain on its southwestern side and possible ground staining on its south and southwestern sides."*

1.2.3 History of Site Use

The site was used for the manufacture of small motors that were sold for incorporation into appliances such as tools and hairdryers. In addition, Rowe used the site to manufacture transformers that were incorporated into Aurora's model racing car sets. All sludge containing solvents or other chemicals were, by contract, to be disposed of by Hogan Chemical Company.

A deposition by a former employee of Rowe Industries, Mr. Anthony Fabiano, revealed waste disposal practices utilized at Rowe Industries. He indicated that many types of organic solvents were used to degrease oil-coated metal, and these solvents were discharged directly from two vats into drains leading east from the building, either into cesspools or directly onto the land surface or to a small onsite pond further east. Occasionally, the cesspool in the wooded area (Dry Well A) would back-up and overflow. Discoloration of the soil around the pond and cesspool (Dry Well A) was observed by Mr. Fabiano.

The building was completely destroyed in 1964 by a catastrophic fire. According to Mr. Fabiano's deposition, approximately 40 to 50 drums of chemicals were buried beneath the east parking lot during the razing of the building. A copy of this deposition can be found in Appendix I.

In 1972, the Suffolk County Department of Environmental Control conducted an industrial waste inspection of the Rowe Industries facility. Oakite, a detergent mixture, and Tri-Clene, a trade name for the degreasing agent trichloroethene were identified as chemicals used at the site.

1.2.4 <u>Current Site Activities</u>

Currently, there are empty drums, various abandoned vehicles and a small trailer along the fence east of the building. Two trailers, located southwest of the onsite pond, were removed from the wooded portion of the property and brought to the parking area on October 23 and 24, 1991. One trailer is situated parallel with the former drum storage area fence. The second trailer is located in the parking area, east of the building. A debris pile of metal and wood scrap, first located southwest of the pond in 1972, still exists.

SHI continues to occupy the site and conduct manufacturing operations, primarily coil winding. This includes electronic assembly, wire winding and stripping, a limited varnish vacuum process, epoxy pour, wave soldering and coating wire moldings. In addition, part of the property is leased for manufacturing art restoration tables, and for an electronics laboratory.

In 1983, SHI was issued a permit to construct an outdoor storage shed. The storage shed was constructed to conform to Article 12 of the Suffolk County Sanitary Code for storage of toxic or hazardous materials. The shed, which was completed in 1984, was used for storing Freon, varnish, isopropyl alcohol, gun cleaner, waste flux, waste oil and naptha.

The current site activities generate some waste from general cleaning. The small electronic parts are cleaned with NaOH and Freon 113. In addition, waste flux is generated by a wave soldering machine. Both the waste flux and Freon waste are containerized and stored. The injection molding machine discharges non-contact cooling water into leaching pools east of the building. The electronic parts are dipped into three open process tanks which hold varnish to coat the parts and the parts are then oven-baked. The varnish is diluted with Naptha and is reportedly reused, leaving very little waste.

Because of reduced production, the varnishing process currently used at this facility is approximately 10 percent of the volume used in 1984, therefore, there has been a reduction in the quantity of waste stored in the shed. In addition, gun cleaner is no longer used at this site.

1.2.5 History of Preliminary Investigations and Remedial Actions

The following chronological account of the history of environmental concern at the site was developed from information contained in the files of the SCDHS and the New York State Department of Environmental Conservation (NYSDEC):

By letter of January 27, 1983, from the SCDHS, Mr. Charles Soffel (House 1 on plate 2) was notified that a sample of the water from his residence on Noyack Road in Sag Harbor revealed contamination by three chlorinated solvents and iron (table 1). He then had a new 95-foot deep well drilled on his property, to replace the existing 40-foot well. Both wells were sampled on June 8, 1983, the results of which were transmitted to him in a letter dated July 5, 1983 (table 1). The results showed that the solvent levels in the shallow well had decreased from a total of 3,600 ppb (parts per billion) to 1,270 ppb and that the deeper well had solvent levels of 9 ppb (it is conceivable that this low level of contamination resulted from the drilling operation itself, due to passing the well through the contaminated shallow zone).

In July 1983, the SCDHS undertook a survey to try to determine the source of the Soffel well contamination. The survey consisted of inspecting several establishments in the area which could conceivably use or store solvents. The inspected properties were: Sag Harbor Village Highway Department, John Peters Service Station, TC's Automotive, David L. Harry Collision, Spring Farm, Jerome C. Jose Services, Inc., Dippel Fuel Oil Company and New York Telephone Company. According to the inspection reports, none of these establishments used or stored the solvents found in the Soffel well. Samples of the septic systems were taken at the New

York Telephone building and at John Peters Service Station. The results from the former sample were not in the file; the results of the latter sample revealed the presence of gasoline constituents, but no solvents. Samples were not obtained from other inspected properties because the septic systems were buried. This effort appears to have been the extent of source identification investigations that were conducted through onsite testing. A field memorandum describing the inspections concluded that the SHI property could be the origin of the ground-water contamination.

In December 1983, an interoffice SCDHS request was made to install monitor wells in the area to determine the source of ground-water contamination. The investigation was conducted from March to June 1984, which included the installation of 21 observation wells and the sampling of 43 water-supply wells. The wells were installed using a Mobil B-53 hollow-stem auger drilling rig. Each well was drilled to a certain depth below grade, temporarily set with a two-foot screen and a sample was collected at that discrete depth. The screen and augers were pulled out of the hole to the next sampling interval where the screen was again set temporarily. After the last sample was collected from each hole, a 2-inch diameter well with galvanized steel casing was installed at the upper-most sampling depth. The augers were removed from the hole and the annular space allowed to fill with the natural formation. Records indicate that ground-water samples were collected at 20-foot intervals and sent to the SCDHS laboratory for analysis. This investigation and its results are described in a report which was first drafted in July 1984. A second phase of the investigation was conducted from July to October 1984, the results of which were incorporated in the previous report and re-dated December 1984. During the second phase, 18 additional wells were installed to define the plume and locate source points on the Rowe Industries property. The latter report is presented in Appendix II.

The results of these investigations purportedly isolate the property currently occupied by SHI as the sole source of the industrial solvents in the ground-water plume. Until the RI, no further efforts were made by any agency to identify other contributors to the ground-water problem.

In July and August of 1984, Mr. Doroski of the SCDHS conducted site inspections of the SHI property and operations and interviewed the owner, Mr. Paul Scheerer, and an employee who had worked for three previous owners of the site. The purpose of Mr. Doroski's inspection was to locate the source, or sources on the property, of any continuing discharge of solvents to the plume. The inspection revealed information on the site history which is included in Section 1.2.2. He also sampled sludge from two 4-inch pipes which led from the building to the dry well (Dry Well A) in the woods east of the building (figure 2). The sludge contained several organic compounds, including 1,1,1-trichloroethane (TCA), trichloroethene (TCE) and tetrachloroethane (PCE) (table 2).

By letter dated August 22, 1984, when the extent of residential well contamination was becoming evident, Dr. David Harris of the SCDHS requested the assistance of the NYSDEC in seeking Superfund money to abate the problem. After a request by the NYSDEC for further information was satisfied by Dr. Harris, the request was forwarded to EPA Region II. A December 7, 1984 Action Memorandum from the EPA Site Mitigation Section to the Regional Administrator presented the case for an immediate removal action (in this case, providing public water supply to the affected area).

In January 1985, the EPA contracted with the Suffolk County Water Authority to extend their public water supply mains into the affected area, and contracted with the Town of Southampton to install the individual hookups to the mains. This work was completed in March 1985.

Subsequently, the EPA initiated a cost recovery action by issuing requests for information from the present and former site owners. The information revealed led to formulation of a negotiated Order on Consent entered into by SHI and NBI on September 30, 1988. One of the conditions of the Order was to conduct a Remedial Investigation/Feasibility Study (RI/FS).

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2.0 STUDY AREA INVESTIGATION

2.1 Field Investigation

This report has several references to "onsite" and "offsite" investigations. The onsite study area refers to the SHI property, formerly known as Rowe Industries. Houses and wells located within the previously-delineated plume, up to and including Ligonee Brook and Sag Harbor Cove, were included in the offsite study investigation. Both the onsite and offsite areas encompass the study area for these investigations.

The field investigation was performed during two separate phases, Phase I conducted in 1989 to 1990 and Phase II conducted in 1991.

Phase I

The field investigations were conducted to generate data required to evaluate the need for, and the feasibility of, remedial action at the site. The field investigation was structured to confirm and build on the previous SCDHS studies. The first phase of the RI was designed to determine if ground-water contamination was still present at the site, and if so, how the concentrations compare to the 1984 SCDHS study. In addition, several potential onsite source areas were investigated as part of the Phase I study. The work plan was designed so that little, if any, further investigation would be required if the contamination had dissipated. However, a second phase of the RI would be necessary if contamination was at levels comparable to those observed during the SCDHS study.

The onsite portion of the Phase I study consisted of searches for, and evaluations of, potential sources of ground-water contamination. A geophysical investigation, disposal system sampling, pond sediment sampling, soil-gas survey and soil and ground-water sampling were performed in an effort to discover the extent and location of source areas.

In addition, offsite studies were conducted to determine the areal and vertical extent of the plume. Two offsite well clusters were drilled and constructed and ground water was sampled from them, as well as from existing SCDHS and select homeowner wells. Surface water and sediment sampling of Ligonee Brook and Sag Harbor Cove was completed to determine the potential effect of the plume on these receiving surface-water bodies.

Phase II

The Onsite Phase II study involved a more comprehensive study of potential source areas sustaining the plume concentrations since 1984 and a more thorough study of the vertical extent of the plume. The study included a geophysical investigation, soil-vapor survey, installation of twelve wells at varying depths, more detailed sampling of active and inactive waste disposal systems, and soil and ground-water sampling.

The Offsite Phase II study was conducted to define the vertical distribution and extent of the plume, to determine vertical flow gradients in the vicinity of Ligonee Brook, confirm the upgradient water quality and determine the seasonal plume constituent occurrence in Sag Harbor Cove.

Because the ground-water analyses conducted during the 1984 SCDHS investigation were restricted to volatile organic compounds (VOCs), a more comprehensive chemical characterization of the plume was conducted. The determination of ground-water flow direction, rate, volume and chemical characterization will be used to evaluate remedial alternatives.

All field work was performed by Leggette, Brashears & Graham, Inc. (LBG) personnel and observed by Alliance Technologies Corporation, the EPA oversight contractor.

Details of the field investigation are discussed in Section 2. All work was conducted in accordance with the procedures presented in Appendices A, B and C in the Field

Operations Plan (FOP) (Section 2) of the Project Operations Plan (POP).

All samples were sent to NET Atlantic - Cambridge Division, an EPA contract laboratory, and analyzed by CLP methodology. Target compound list (TCL) volatile organics, semivolatiles, Freon 113, pesticides/PCB's in soil and water matrices were analyzed using CLP-SOW 2/88 methodology. TCL metals and cyanide in soil and water matrices and TCL mercury in water were analyzed by CLP-SOW 7/87, revised 12/88, methodology.

2.1.1 Site Mapping and Surveying

The surface features of the site were examined using a variety of sources. A new detailed site map (1 inch = 50 feet) was prepared for this RI. This map was prepared from aerial photographs which were taken on April 12, 1989. Geomaps International, Inc. produced the detailed base map with 2-foot contour intervals, and Squires, Holden, Weisenbacher and Smith were responsible for all of the onsite and offsite surveying. The surveyor's report is included in Appendix III. The wetland boundary for the onsite pond was mapped by Inter-Science Research Associates, Inc. in May of 1989.

In addition to the onsite base map, the existing Suffolk County Department of Public Works map of the Five Eastern Towns, Sheet AA-42, prepared by Lockwood, Kessler, Bartlett, Inc. (scale 1 inch = 200 feet), was utilized for the offsite study area. This county map has 5-foot contour intervals and covers the entire study area.

2.2 PHASE I INVESTIGATIONS

2.2.1 Introduction

The Phase I Investigation was performed following the scope of work presented in the September 1988 RI Work Plan and June 1989 POP.

2.2.2 Contaminant Source Investigation

The data generated in the SCDHS studies suggested that a continuing source of ground-water contamination exists on the SHI property. In an effort to identify any buried drums, an electromagnetic survey was conducted. The formerly and currently active septic and dry well disposal systems were sampled to locate any continuing source. To determine if there is any soil contamination in the unsaturated zone, a soil-vapor survey was performed, followed by drilling soil borings. Sediment from the pond immediately east of the SHI building was sampled to determine if any residual levels of solvents were present.

2.2.2.1 Geophysical Survey

A geophysical survey was conducted in the eastern portion of the Rowe Industries site during the week of August 2, 1989. The purpose of the survey was to locate any possible buried drums. The parking lot adjacent to the eastern border of the building and the wooded area near the pond were included in the survey. Also included in this survey were all of the "possible" and "probable" disturbed areas delineated in the EPA aerial photographic analysis except for the possible trench (Spring 1974) and debris (April 28, 1972) shown on plate 3. These two areas were inadvertently omitted from the survey, but were investigated during Phase II of the RI (see Section 2.3.7). The survey encompassed the area between the SHI building and the onsite pond (plate 3). The former drum storage area was not included in the survey because it is located off of the property boundary.

An EM-31 electromagnetic terrain conductivity meter was used for the survey. The instrument has a penetration depth of approximately 6 meters (20 feet) below grade. A recording device was connected to the EM-31 which marked the measurements received by the EM-31. Both the EM-31 and the recorder were calibrated prior to the survey. Careful monitoring of both devices ensured accuracy and consistency between the two during the survey.

Two grids were marked out, one in the parking lot area behind the building and one in the wooded area near to, and including, the pond. Both grids were arranged with lines spaced 20 feet apart with 20 feet between each station.

The pond area grid was comprised of thirteen lines (Lines A-M). Lines F through J were not extended further to the southeast because of interference caused by two semi-trailers located in this area. Lines L and M were situated directly in the pond. The parking lot grid was comprised of five lines (Lines N-R). These lines did not extend the whole length of the parking area because of interference with empty drums, abandoned cars and a fence. Locations of all stations are shown on figure 3.

The terrain portion of the survey was conducted by walking at a steady and even pace, along each line, stopping at each station to mark the location on the recording sheets. The pond portion of the survey was conducted in a non-metallic inflatable (rubber) boat. A rope was attached to one end of the boat and the boat was pulled across the pond, along each line, at a constant speed. Each station was marked off at 20-foot intervals and recorded on the data sheet.

2.2.2.2 Disposal System Studies

Six dry wells are located on the SHI property (plate 1). Currently, only three are actively used, Dry Wells B, E and F.

In order to determine source locations connected to each dry well or septic tank, piping studies were performed on August 8, 1989. The studies were conducted by introducing water in basins, floor drains, etc., while the dry wells and septic systems were observed. The piping configuration is shown on figure 2.

The unused lavatory located in the central part of the bottom floor of the SHI building was tracked to Dry Well D. Upon inspection for Dry Well C, it was determined that it is an overflow well for Dry Well D. The lavatory located in the far north part of the bottom floor, as well as the lavatory located above it on the second floor, connect to Dry Well E. The men's and women's lavatories on the second floor of SHI empty into Dry Well F.

Floor drains on the first floor were directed to Dry Well A in the past, but are no longer connected to the dry well. This dry well was reportedly used for the disposal of solvents. In 1984, the SCDHS collected samples from the Orangeburg piping that led from these floor drains, under the parking lot to Dry Well A. During this study, the pipes under the parking lot were severed and never repaired. The floor drains connected to Dry Well A are in an inactive portion of the building and access to the floor drains are obstructed. Therefore, any continuing source to Dry Well A from inside of the SHI building has been cut off. The two pipes connected to the dry well are visible in the wooded area although they are not completely intact.

Dry Well B consists of two dry wells which are buried under the grass and parking lot on the east side of the building. These two dry wells were installed in 1983-1984 for the purpose of collecting roof runoff and coolant water used on the coiling machines. (Personal communication with Mary Scheerer and Jamie Forrester).

Leach samples of piping leading to Dry Wells D, E, and F were obtained on August 22, 1989. Deionized water was poured through the system and collected at the point of discharge using a Teflon sampler. Between collection of each sample, the Teflon sampler was cleaned with Alconox, rinsed with tap water, followed by an acetone rinse with a final deionized water rinse. The samples were analyzed for TCL volatile organics and Freon 113.

Because the pipes directed to Dry Well A were severed during the SCDHS study in 1984, a sample was not taken for this system. The Dry Well B system was installed after Rowe Industries occupied the property and is only used for roof storm-water runoff and noncontact coolant water; therefore, these sample points were omitted from the leach sampling. Because Dry Well C is directly connected to Dry Well D, the short pipe connecting the two wells was not sampled.

On November 27, 1989, sediment samples were obtained from the soil or sludge in Dry Wells A, C, D, E and F (see plate 1). The sample from Dry Well A, previously used for chemical waste disposal, was analyzed for the complete TCL, plus tentatively identified compounds (TIC's) and Freon 113. The samples from the remaining dry wells were analyzed for TCL VOCs and Freon 113. The Dry Well B system was not sampled for the reasons previously discussed.

Volatile samples were obtained from the top 6 inches of the dry wells by hand-augering with a stainless-steel auger or sludge sampler, into the well sediment. The sludge was sampled directly from the auger using a stainless-steel spatula. The samples for the remaining TCL compounds were obtained from several core samples that were homogenized in a stainless-steel bowl.

In between sampling points, the sampling equipment was decontaminated according to procedures outlined in the approved Standard Operating Procedures (SOP) of the POP. Samples were stored on ice overnight and shipped the following day, exceeding the approved POP shipping time limit by a few hours. However, the samples were received by the laboratory, and were analyzed for all parameters except semivolatiles, within the prescribed holding time.

2.2.2.3 Pond Sediment Sampling

Sediment samples were obtained from three locations in the pond behind SHI on November 28, 1989. The first sample was collected from underneath a submerged and partially buried drum near the center of the pond (EM-survey Location M-80, see figure 4). This sample, analyzed for the TCL parameters and Freon 113, was obtained by boring into the top 6 inches of the pond sediment with a stainless-steel hand auger using a rubber raft for flotation. The volatile organic samples were collected first using a stainless-steel spatula to remove sample from the auger. The remaining sample jars were filled with sediment that had been homogenized in a stainless-steel bowl using a stainless-steel spoon.

The second pond sample was taken from the south shore of the pond (near EM-survey Location L-20) for the analysis of TCL volatiles and Freon 113. The samples were collected by wading into the water and hand-augering into the sediment. The bottles were filled directly from the auger using a stainless-steel spatula. The third pond sample was taken off of the north shore of the pond (near EM-survey Location L-100). Sampling was completed following the same procedure as described for the second sample.

Between sampling locations, the equipment was cleaned in the manner described in the approved SOP of the POP.

2.2.2.4 Soil-Vapor Survey

A soil-vapor investigation was performed at the Rowe Industries property to identify any residual source areas of VOCs onsite. The results from this investigation were used to determine the drilling locations for the eight onsite soil borings.

The survey was conducted using an HNU photoionization detector (PID) and a portable Sentex gas chromatograph with an argon ionization detector (GC/AID) utilizing a purge and trap loop. Seventy-two stations were located along the property and initially analyzed with a PID. Locations of these stations are shown on figure 5. Sixty-three of the 72 locations were analyzed using the portable GC. Nine stations could not be analyzed with the portable GC because total subsurface volatile organic vapor concentrations were detected above 10 ppm by the PID. This concentration exceeds the practical instrumentation limits of the GC. To avoid the need for excessive purging, use of the GC was limited to samples with PID concentrations of less than 10 ppm.

Sixty-seven locations were sampled during the week of August 14, 1989. The proposed 40-foot grid pattern in the approved POP was followed wherever possible. However, the elevated ground-water table west of the pond limited the soil-vapor survey points beyond Line E. Additional points were located near the fence at the eastern edge of the parking lot and along the southeast edge of the building to better define areas exhibiting elevated readings. Five more stations were sampled on September 28, 1989. These additional points were included to close out the investigation along the southern border of the property, although they were not specified in the approved POP.

Most samples were obtained by using a penetration probe to produce a one-half inch hole to depths of 3.5 to 4 feet. Samples B-7; C-2, C-4; D-7; E-9; E-11; W-9, W-10 were collected at depths between 2 and 2.5 feet as a result of subsurface obstructions or a shallow water table. A one-half inch stainless-steel sampling probe, connected to a vacuum hose, was inserted into the hole and sealed against the ambient air using aluminum foil with bentonite on top in the paved areas and soil in the unpaved areas. The aluminum foil with bentonite and native soil created a more effective seal than the bentonite plug described in the POP. The hole was purged of 1.25 liters of vapor using a peristaltic pump with the discharge directed to a Tedlar bag. After purging, the gas was sampled with a PID. For the locations without excessive concentrations of organic vapors, the sample was injected into the GC via needle extraction through the vacuum hose, immediately above the stainless-steel probe, using the GC's internal sampling pump. To avoid cross-contamination, the tubing was replaced after every five sampling points. This was a modification to the approved POP which did not require replacing the tubing.

Prior to sampling each day, the GC was calibrated onsite (via injection of a standard consisting of TCA, TCE and PCE of known concentrations). The calibration standard was re-analyzed at an average rate of once every five samples, an increase from the one in twenty samples described in the POP.

After each sample was run, the sampling and penetration probes were decontaminated in soapy distilled water, dried with clean paper towels, rinsed in distilled water and dried with clean paper towels. The sample probe and suction hose were purged with 20 psi (pounds per square inch) of ultra-high purity (UHP) argon for 30 seconds to remove any trace of ambient air. Finally, the probe and vacuum line were purged with in-situ sample gas for 20 dead space volumes of the system to remove the UHP argon.

To ensure analytical quality control, carrier gas blanks and duplicate analyses were run after every tenth sample. An ambient air blank was analyzed at the start of each day and repeated at a rate of one in twenty samples.

2.2.2.5 Onsite Soil Borings

Eight soil borings were drilled on the SHI property between September 27 and 29, 1989. The locations of these borings (see plate 1) were chosen based on an analysis of data from the soil-vapor survey and EM-survey results. The boring locations were picked to investigate whether soil contamination exists in the unsaturated zone at representative locations and to determine the geology of the unsaturated zone. Representative samples were sent to the laboratory for analysis. Table 3 lists the laboratory parameters analyzed for each sample.

All borings were completed using a Failing F-10 hollow-stem auger drilling rig. Three-inch diameter carbon steel split spoons were driven at 2-foot intervals from ground surface to just below the water table. Initially, the sampling procedure was modified from the POP by overdriving the split spoon to two and one half-foot intervals in order to collect additional soil for analysis. However, because recovery was adequate, two-foot sampling intervals were taken beginning with Boring B-2 at the five-foot interval. Immediately upon opening each split spoon, volatile organic samples were taken from the center of the split spoon using a stainless-steel spatula. In addition, a small sample was removed from the center of the split spoon and was placed in a 4-ounce glass jar. This sample was covered with aluminum foil, shiny side out, and stored for a minimum of one hour, before screening the headspace with a PID.

After these two sets of samples for volatile organic analysis were taken, the top 2 to 3 inches of soil in the split spoon were discarded. The remaining soil was geologically logged and then placed in a stainless-steel bowl. Using a stainless-steel spoon, the soil was carefully homogenized and then placed in a 16-ounce glass jar. All samples were stored on ice until each boring was completed.

At the completion of each boring, the PID was used to screen the samples. The PID was calibrated daily, recalibrated when necessary, and operated in the manner described in Appendix B (SOP) of the FOP. In order to ensure accuracy, the PID was cleaned thoroughly at least once a week.

As specified in the approved work plan, the sample exhibiting the highest PID response, and the sample from just above the water table from each boring, were set aside. After all eight borings were completed, the samples with the highest responses from two separate borings were sent to the laboratory for analysis of TCL/TIC's and Freon 113. For the remaining six borings, the sample with the highest response from each boring was analyzed for TCL volatile organics and Freon 113. The sample just above the water table from each of the eight borings was analyzed for TCL volatile organics and Freon 113. Although delaying the shipment of samples until all of the borings were completed was a deviation from the POP, which states that all environmental samples should be shipped within 24 hours of collection, the delay did not affect the integrity of the samples. All samples, with the exception of the semivolatile analysis for a field blank, were analyzed within the prescribed holding time.

All cuttings were containerized in Department of Transportation (DOT) approved 55-gallon drums. Six of the boreholes were grouted with Portland cement. The two shallow borings (BB-7 and BB-8), located in the wetland area near the pond, were backfilled with natural soil. The drilling equipment was steam cleaned between boreholes.

The sampling equipment (split spoons, stainless-steel bowls, spatulas and spoons) were decontaminated between intervals. The equipment was scrubbed in an Alconox solution then rinsed with SHI tap water. This was followed by an ultra-pure grade nitric acid rinse. Initially, a 10-percent solution of HNO_3 was used, but was later downgraded to a 1-percent solution at the recommendations of Pat Sheridan and Laura Scalise during an EPA audit on September 29, 1989. The equipment was thoroughly rinsed a second time with tap water and was immediately followed by an "optima" grade acetone rinse. The final rinse was with analyte-free deionized water which was provided by an LBG in-house system. The equipment was placed on a clean piece of plastic sheeting and allowed to air dry before being utilized. At the end of each day, the clean equipment was wrapped in aluminum foil, shiny side out, and stored in a SHI shed.

The decontamination line was situated upwind of the drill rig at each boring location. On several occasions, the wind direction changed during drilling. When this occurred, the decontamination line was either moved upwind or left in place because there was enough distance between the drill rig and decontamination line.

All work was conducted in Level D and in accordance with the Health and Safety plan. Continuous monitoring of the ambient air quality was performed to ensure that the work space air was within the recommended breathing limits for VOCs.

2.2.3 Surface-Water and Sediment Sampling

A sediment and surface-water study was conducted on Ligonee Brook and Sag Harbor Cove to determine the extent, if any, of contamination as a result of ground-water discharge. The samples were analyzed for TCL VOCs and Freon 113 or the full TCL/TIC's plus Freon 113.

2.2.3.1 Brook and Cove Surface-Water Sampling

Five sets of surface-water samples were obtained at low tide along Ligonee Brook and Sag Harbor Cove on November 28, 1989. Water samples were collected directly above the sediment sample locations prior to collection of the sediment samples.

The sampling locations are shown on plate 2. Two of the samples from Sag Harbor Cove and Ligonee Brook, within the previously identified plume (Stream Point Nos. 2 and 4, respectively), were analyzed for TCL/TIC's and Freon 113. Samples from Ligonee Brook upstream of the plume (Stream Point No. 1); the interface between Ligonee Brook and Sag Harbor

Cove, within the low-tide fresh-water side of the Cove (Stream Point No. 3); and Sag Harbor Cove downstream of the plume area (Stream Point No. 5) were analyzed for TCL VOCs and Freon 113.

Samples were collected by submerging the laboratory prepared bottles approximately 1 foot below the water surface or one-half the total depth. The bottles were gently uncapped and tilted, allowing the water to fill the containers. Preserved volatile organic vials were filled first, followed by the remaining sample containers. All samples were collected during low tide, downstream of the sampling point, facing upstream. After samples were collected at Stream Point No. 2, the remaining samples were collected from the downstream point, working upstream to avoid cross contamination caused by disturbed sediment. The sample taken at the intertidal zone (Stream Point No. 3) was sampled within the fresh-water side of the zone.

2.2.3.2 Brook and Cove Sediment Sampling

Five sets of sediment samples were obtained at low tide along Ligonee Brook and Sag Harbor Cove on November 28, 1989 after the water samples were collected. These samples were taken from the same locations as the surface-water samples using stainless-steel spoons and spatulas. Utilization of these tools was a modification to the method outlined in Appendix A of the POP because of poor recovery from hand augers. Samples were collected from the top 6 inches of each sampling location.

Stream Point No. 2 was sampled first and followed by the remaining points which were sampled downstream to upstream (Stream Point Nos. 5 through 1). The downstream sampling was performed sufficiently long enough after sampling Stream Point No. 2 that there was no sediment in the water at the downstream points. Each sample was obtained from the lowest visible tide mark, which was approximately 10 feet in from the low-tide elevation on the day of sampling. Any notable changes in sediment color, size and appearance were used as indicators in determining the lowest tide mark. Samples were taken while the tide was still going out slightly. The samples were analyzed for the same parameters discussed above for the water samples.

2.2.4 Ground-Water Investigation - New Monitor Well Installations and Refurbishment of SCDHS Monitor Wells

The ground-water investigation consisted of the re-sampling of the previously installed SCDHS monitor wells, resampling homeowner wells and installing two new well clusters. A survey was performed to locate the SCDHS wells. Of the forty wells originally installed, eighteen were located. The remainder were either removed by the SCDHS or buried and lost. The two offsite well clusters were installed between October 2 and 17, 1989, to serve as secure long-term monitoring points. One cluster was drilled in the southeast portion of the plume (on the Gingerbread Bake Shop property) and the second cluster was installed northwest of the first cluster, further downgradient on Carroll Street in the center of the plume. Each cluster is comprised of a shallow, intermediate and deep well. The locations are shown on plate 2. The existing SCDHS wells were redeveloped to re-establish them as viable sampling points.

2.2.4.1 General Drilling Methodology for the New Well Clusters

Prior to well installation, a pilot hole was drilled to observe the underlying stratigraphy and to determine the best screen setting for each individual well. These pilot boreholes were drilled using hollow-stem augers, with an inside diameter of 3 1/4 inches. Split-spoon samples were taken at 5-foot intervals. Split-spoon samples include 2 feet out of each 5-foot interval, leaving a 3-foot gap. Split-spoon samples were collected continuously when major formation changes were observed during drilling and/or sampling. Continuous sampling was performed at the Gingerbread Bake Shop pilot borehole after a clay unit was encountered 81 feet below grade. After the boreholes were completed, a gamma borehole log was run to fill in any gaps from the split-spoon sampling and to provide data to develop a complete stratigraphic record. Both the pilot boreholes and gamma logs represent modifications to the approved POP.

Upon opening the split spoon, a portion of the soil was placed in a 16-ounce jar, covered with aluminum foil and the headspace was screened with a PID after being allowed to equilibrate for a minimum of one hour. The headspace was screened to determine if any offsite soil was contaminated and to assist with making a determination of the proper disposal method for the cuttings. The material in the sampler was geologically logged and the residual soil was placed with the cuttings in DOT approved 55-gallon drums.

Between sample intervals, the split-spoon sampler was scrubbed with a wire brush in a tap water/Alconox solution and then rinsed with deionized water. For the first 76 feet of the Gingerbread Bake Shop pilot borehole, the split spoons were rinsed with tap water. The deionized water rinse was added later.

All drilling equipment was steam-cleaned before use and between boreholes. The equipment was brought back to the SHI property and steam cleaned. Both pilot boreholes were grouted to the surface with Portland cement.

During the entire drilling program, the air in the work area was monitored for volatile organic vapors with a PID. The levels in the breathing zone never exceeded 5 ppm (parts per million). The action level for this site was 10 ppm and, therefore, the well installation phase was completed in Level D protection.

At the conclusion of the drilling stage, all drummed cuttings were conveyed to a designated area on the SHI property. A total of sixty-two drums were used to containerize cuttings from both the onsite and offsite drilling. Five drums were used for the onsite cuttings and 57 drums were used for the offsite cuttings.

2.2.4.2 Installation of Well Cluster MW-42

The first well cluster was installed between October 2 and 10, 1989. Located on the Sag Harbor-Bridgehampton Turnpike, the well cluster is situated along the southwest corner of the Gingerbread Bake Shop property.

The pilot hole was completed to 111 feet on October 4, 1989. The boring was drilled through medium to coarse-grained sand and some finer material. The detailed geologic log for this borehole can be found in Appendix III. The water table was encountered at 16.7 ft bg (feet below grade). An odor was detected from the borehole at an approximate depth of 21 ft bg. The ambient air near the augers measured 4 ppm on the PID, but declined to background levels after water was added to the borehole to prevent the sands from heaving into the augers. This water, supplied by the Suffolk County Water Authority, was obtained from an outdoor faucet at the Gingerbread Bake Shop. A sample of the water was collected and analyzed for TCL/TIC's and Freon 113.

A zone of alternating layers of clay, silt and sand was encountered at 45 feet; however, much coarser material was observed between 55 and 75 feet. This material generated 2 to 3 feet of surging sands inside the augers. Water was added to the hole to maintain a constant force of pressure to keep the surging sands under control.

At 81 feet, another clay layer was encountered. Continuous split-spoon samples were taken from 81 feet to 86 feet to determine the thickness of the clay layer. A portion of the clay was set aside and the headspace was screened for potential contamination. There was only a slight increase in the PID reading above background at the 84 to 86-foot interval. Concentrations increased from 0.0 ppm (81 to 83 feet) to 0.02 ppm (84 to 86 feet).

A gamma-ray geophysical log was run at the completion of the borehole. The log is in Appendix IV. The log was run to provide stratigraphic information between soil samples and to determine the optimum screen settings for the three wells. As shown by the split-spoon samples and confirmed by the geophysical log, the bottom 6 feet of the borehole consisted of finer material. As a result, it was determined to set the deep screen in coarser material from 88 to 98 ft bg. It was determined to set the intermediate well and shallow well screens from 56 to 66 ft bg and 12 to 27 ft bg, respectively. The intermediate screen is located below the alternating layers of clay, silt and fine sand encountered at 45 feet and the shallow screen was placed about 5 feet above and 10 feet below the water table.

The Gingerbread Bake Shop well cluster was installed from west to east, shallow to deep. Well construction diagrams are located in Appendix V.

Each individual well was installed by drilling uninterrupted to the desired depth with 6-inch inside diameter augers. A plywood plug, less than one-inch thick, was hammered into the end of the lead auger to keep any material out of the borehole. Before knocking the plug out with a bailer, water was added to the borehole to maintain a steady equilibrium and prevent sands from heaving into the augers. Once the plug was knocked out, it was covered with 6 inches of gravel pack before the stainless-steel screen and casing were lowered into the well. Using the wood plug was a modification to the POP in order to ensure the quality of the well installation.

All wells were constructed with 2-inch, flush-joint, stainless-steel casings and screens. The wire-wrapped screens have slot openings of 20 thousandths of an inch. The screen and casing were factory cleaned and sealed in plastic wrapping. A rinse blank sample was collected from both the stainless-steel casing and screen to ensure the materials had been properly cleaned.

The screen and casing were set through the augers. The annular space around the screen was filled from the bottom of the well to 2 feet above the top of the screen with clean Morie No. 1 gravel pack. A weighted steel tape was periodically placed down the annulus to measure the depth of the gravel pack to insure accurate well installation. A 2-foot thick bentonite slurry seal was placed above the sand pack. However, a Tremie pipe was not used (as specified in the POP) because the slurry was too thick to properly inject to the required depth. The remaining annular space was filled with a bentonite-cement slurry, which was injected through hoses into the well. The bentonite was added in the amount of 2 to 5 percent by weight of the cement content. The bentonite-cement mixture was prepared with 7 to 8 gallons of clean water per one bag of cement. Each well was secured with a locking cap and covered with a flush-mounted curb box. A 2 to 3-foot diameter cement pad was constructed around the curb box and mounded slightly to direct surface runoff from the casing.

The shallow well (MW-42A) was completed to 27 feet with 15 feet of screen on October 5, 1989. The well was drilled approximately 10 feet south of the pilot borehole. The screened samples between 25 and 31 feet in the pilot borehole had higher readings than others in the shallow zone, thus the screen was set to include a portion of this potentially contaminated zone and the zone where the odors were detected.

The intermediate well (MW-42B) was initially located 5 feet east of the shallow well. However, after drilling down approximately 8 inches from grade, a 2-inch diameter steel pipe was exposed. After confirming that it was neither a water line or gas line, and that the pipe had not been punctured, the rig was moved further east to a second location.

At the second site, a concrete covering was encountered less than 1 foot below grade. The concrete slab was examined and there were no visible punctures or breaks. The ambient air around both the pipe and concrete slab measured 0.0 ppm on the PID. The drilling rig was relocated further south and the excavation around the pipe and concrete slab were backfilled with dirt covered with concrete and cold patch.

The intermediate well (MW-42B) was completed to 67 feet on October 6, 1989. During the well installation, James Bologna and John Conover, of the NYSDEC, arrived to observe the drilling procedures.

The deep well (MW-42C) was completed to 98 feet on October 9, 1989. The well is located approximately 5 feet east of MW-42B. The locations of these three wells are found on plate 2.

The current owner of the Gingerbread Bake Shop, Mr. Michael Tierney, indicated that the property had once been used as a gasoline station, although it has not been independently confirmed. It is possible that the pipe and concrete that were encountered during drilling are related to the former gasoline station.

2.2.4.3 Installation of Well Cluster MW-43

The second well cluster was installed between October 11 and 17, 1989. Located on the northwest side of Carroll Street, the well cluster is situated in the right-of-way by Lot 19.1, next to the William Page property. Location of this cluster is shown on plate 2.

A pilot hole was completed to 112 feet on October 12, 1989. The boring was drilled through fine to coarse-grained sand and some finer material in the upper portion of the borehole above the water table. The detailed geologic log for this borehole can be found in Appendix III. The water table was encountered at 19.0 ft bg.

Water was added to the borehole to keep the sands from heaving into the augers. This water was obtained from a fire hydrant on Carroll Street. At the completion of the well installation, a water sample was collected from the drillers' hosing for analysis of the TCL/TIC's and Freon 113.

Similar to the first pilot borehole, a layer consisting of clay, silt and sand was encountered at approximately 45 ft bg. The entire middle zone was generally finer with more silt than the Gingerbread Bake Shop cluster.

At 95 feet, the borehole experienced approximately 4 feet of heaving. The augers were drilled down an extra 5 feet to complete the geophysical gamma log survey to 111 feet. The optimum screen settings determined from the survey and geologic log were 97 to 107 feet for the deep well, 64 to 74 feet for the intermediate well, and 14 to 29 feet in the shallow well. The geophysical log is in Appendix IV.

The Carroll Street well cluster was installed from west to east, shallow to deep. The wells were set in the same manner as the Gingerbread Bake Shop wells. Well construction diagrams are located in Appendix V.

Each individual well was installed by drilling directly to the desired depth. A wooden maple plug, less than one-inch thick, was hammered into the end of the lead auger to keep all material out of the borehole. Before knocking the plug out with a bailer, water was added to the borehole to maintain a steady equilibrium when the plug was knocked out to prevent sands from heaving into the augers. When the plug was knocked out, it was covered with 6 inches of gravel pack before the screen was lowered into the well. Utilizing the wood plug in the borehole was a modification to the approved POP in order to ensure the quality of the well installation.

The screen and casing were set, gravel pack set and grouted in the manner previously described for the other well cluster.

The shallow well (MW-43A) was completed to 29 feet on October 13, 1989. The well was drilled approximately 7 feet east of the pilot borehole. During the well installation, Ms. Vinh Cam of the EPA arrived to observe the drilling procedures.

The intermediate well (MW-43B) was completed to 74 feet on October 16, 1989. The well is located approximately 5 feet east of MW-43A. During grouting, the borehole collapsed at the water table. The grout did not fill in the borehole so a small amount of cuttings were used to backfill the interval. Headspace concentrations from the pilot borehole did not exceed 0.2 ppm to 74 ft bg and were considered clean. The cuttings from MW-43B had no visual stains or notable odor and were considered clean because of the wells' close proximity to the pilot borehole. The remaining annular space was filled with a thicker grout mix.

The deep well (MW-43C) was completed to 107 feet on October 17, 1989. The well is located approximately 5 feet east of MW-43B. The well locations are shown on plate 2.

2.2.4.4 Well Development and Redevelopment

Twenty-four wells were developed or redeveloped by pumping and surging between October 19 and November 14, 1989. The six newly-installed offsite wells were developed for the purpose of clearing the well screen and sand pack of fine material which can clog the screen. Also, these wells were developed to stabilize the formation material immediately surrounding the well screen and re-establish the hydraulic connection between the well screen and the surrounding aquifer. The remaining previously installed 1984 SCDHS wells were redeveloped to clear the well screens.

The wells were developed using a stainless-steel and Teflon air-drive pump. The pump was lowered and secured a few inches from the bottom of the well. An air source was attached to the pump and sediment was purged from the well.

The pump was shut off and the well was surged by pulling the pump up in the screen and letting it resettle. The pump was turned back on and left running until all the sediment was purged from the well. This process was continued until the well no longer produced sediment.

After the well screen portion was surged clean, the pump was slowly raised and the standing water was removed from inside the casing. After the air-drive pump was removed from the well, all excess water from the pump and tubing was blown out.

For the new monitor wells, a minimum of double the volume of water introduced during drilling was evacuated and development was not ceased until the turbidity measured less than 50 NTU's (nephelometric turbidity units). Table 4 lists the turbidity measurements taken from the six new wells and most of the SCDHS wells. The table also lists the total volume removed from each of the wells that were developed. The development water from all of the offsite wells was containerized and brought to the SHI property and discharged over the land surface beyond Well N-33 along the western edge of the parking lot (plate 1). This procedure was in accordance with the approved work plan.

The discharge for the majority of the SCDHS wells was initially discolored from iron staining. The orange tint in the discharge cleared after the first 5 gallons of water was pumped. Well N-20, located adjacent to Ligonee Brook, had black organic sediment in the discharge which cleared within several minutes of pumping.

The pump and the outside of the polyethylene tubing were cleaned using Alconox detergent and rinsed with deionized water after redevelopment of each well was completed. The inner check valves and tubing were cleaned in a similar manner.

2.2.5 Ground-Water Investigation - Water Sampling of Monitor Wells and Private Wells

Two sets of ground-water samples were collected during Phase I to quantify the extent and character of the previously-identified ground-water chemistry. In addition to the new offsite wells, all located SCDHS wells, with the exception of Wells N-23 and N-31, and selected private wells were sampled. Well N-23 is damaged and Well N-31 has little to no water available because it is set just at the water table; therefore, these two wells were not included in the ground-water sampling program.

The first round of sampling occurred between November 14 and 20, 1989, and the private wells were sampled between December 6 and 7, 1989. The second round of sampling was conducted between February 5 and 9, 1990. The second set of samples were analyzed for a reduced list of parameters which were based on the results of the first round. Table 5 lists the laboratory parameters analyzed during Phase I of the RI.

2.2.5.1 General Sampling Methodology for Monitor Wells

After each well was opened and the water level was measured to 1 one-hundredth of a foot, by chalk and tape, the standing water volume was calculated. A clean air-drive pump and polyethylene tubing was slowly lowered and secured within the top 5 feet of the water column. The air compressor was situated downwind of the well. At least three times the amount of standing water was purged from the well before sampling. However, the well was not sampled until the pH, conductivity and temperature had stabilized during evacuation and the turbidity was less than 50 NTU's, indicating that the well contained completely fresh formation water. The pH meter and conductivity meter were calibrated daily.

The air-drive pump was removed from the well and all of the residual water was evacuated from the pump and tubing. The pump and tubing were moved to a central decontamination station (for onsite wells) or a minimum of 10 feet away from the well (for offsite wells). The pumping apparatus was cleaned using Alconox detergent and rinsed with deionized water.

New polypropylene monofilament was attached to a dedicated stainless-steel bailer and slowly lowered into the well to prevent degassing of the water upon impact. The bailer was then slowly raised out of the water to prevent surging. After a sample was collected for field measurements of pH, specific conductance and temperature, the containers for volatile organic analysis were filled with the remaining water from the bailer. Prior to collecting these samples, the bottles were preserved with hydrochloric acid in order to ensure a pH of less than 2. The proper amount of preservative was determined by adding hydrochloric acid drop by drop to a filled vial until the pH dropped below 2. The pH of each well location was determined and bottles preserved on that basis. Following the volatiles, samples for metals and cyanide analysis were collected. Metals were collected before the other parameters to prevent collecting any suspended sediment which may have been agitated and released into the well during evacuation of the well. Finally, samples for acid/base/neutral compounds and pesticides analyses were collected by aliquots until each bottle was filled with the necessary quantity.

One field blank was collected per day as described in the POP. The blank was obtained by rinsing the cleaned stainless-steel bailer with deionized water and collecting the rinse water in the appropriate laboratory containers. A trip blank was carried with the samples each day and submitted for analysis of TCL volatiles and Freon 113 only.

During the second round of sampling, filtered and unfiltered samples were collected for metals analysis. The filtered samples were obtained using a peristaltic pump. Approximately 1 foot of Tygon tubing was placed in the pump head and 1 foot of PVC tubing was connected to the pump. After water was transferred from the stainless-steel bailer to a clear plastic, non-preserved metals bottle, the PVC tubing was placed inside the bottle. The water was filtered through a 0.45 micron acrylic copolymer filter directly from the clean, laboratory container into the container pre-preserved by the laboratory with HNO_3. This deviated from the POP which states that the water will be drawn to the filter directly from the well using the peristaltic pump if the water table is within 30 feet of grade. All tubing and filters were discarded after being used to avoid cross contamination.

The analytical parameters are specified on table 5 and are summarized as follows:

1. The six new offsite wells were included in both rounds of sampling. Each well was analyzed for TCL/TIC's and Freon 113 during the first round. Only TCL VOCs and metals were analyzed during the second round. Both filtered and unfiltered metal samples were collected during the second round.

2. Eleven onsite SCDHS wells were sampled during both rounds. The well locations are shown on plate 1. During the first round, Wells N-27 and N-39 were sampled for analysis of TCL/TIC's and Freon 113. During the second round of sampling at these two wells, samples were collected for analysis of VOCs, Freon 113 and filtered and unfiltered metals. For the remaining nine well samples, only TCL volatile organics and Freon 113 were analyzed.

3. Six offsite SCDHS wells were sampled during the first round. The samples from all the wells were analyzed for TCL volatile organics and Freon 113. Wells N-6 and N-17,

however, were sampled for TCL/TIC's and Freon 113. During the second round, only Wells N-11 and N-19 were sampled for analysis of filtered and unfiltered metals.

2.2.5.2 General Sampling Methodology for Private Wells

Eight private wells, including the newer of the two SHI wells, were sampled between December 6 and 7, 1989. Three of the eight wells required temporary pumps and holding tanks, which were installed by Casola Well Drillers, a local drilling firm. Two of the eight wells are at homes on Hildreth Street and are still used for potable water.

The wells were sampled for TCL volatile organic chemicals and Freon 113, except for House 1 and House 6 on plate 2, which were sampled for TCL/TIC's and Freon 113. Private wells designated by Map Nos. 1, 6, 24, 9, 7, 25, 2 and 10 were sampled in that order. Table 6 lists the current homeowner and the associated house location designated for plate 2.

The static water level and well depth could not be measured because there was no access into the wells, thus the wells were assumed to be 40 feet deep with a 15-foot water level. These values are conservative estimates based on homeowners' descriptions of their wells and the predominant water level in the area.

At least three well volumes were purged from each well and a well was not sampled until the pH and conductivity had stabilized. Because a bailer could not enter the wells, a garden hose was attached to the discharge fitting of the pump. Utilizing the garden hose in this manner was a modification to the approved POP. The purge water was containerized in a 55-gallon drum and discharged at the SHI property. Water was sampled from the end of the hose after the well's indicator parameters had stabilized.

Two homes, 9 and 10, are located outside of the plume as mapped by the SCDHS, and still utilize their wells. The sample was taken directly from an outside faucet at House 9.

Since both Houses 9 and 10 actively use their well water, it was not containerized and brought back to the SHI property.

During the second round of sampling, two wells upgradient of SHI were sampled for TCL volatiles and unfiltered metals. These houses (Map Nos. 29 and 31) had not been sampled during the first round. Furthermore, House 44 did not exist in 1984 when the SCDHS first sampled the area.

Samples for these two houses were collected from the end of a garden hose after the pH and conductivity had stabilized, indicating that the sample was representative of the aquifer. Because these upgradient houses actively use their well water, it was not containerized and brought back to the SHI property.

The private well samples were not filtered for metals during either sampling round because all residences had a potable water supply that was, or is, being consumed unfiltered. Therefore, samples were obtained under the condition the water is or was consumed.

2.2.6 Quality Control Sampling

In order to ensure control and accuracy, one field blank was collected per day per type of sampler used. Field blanks were inadvertently not collected during the two-day period when the pond, stream, bay and dry well sediment was being collected, but were collected on the third day.

The blanks were collected at the beginning of the day and shipped with the samples collected that day. The blanks (except for one) were obtained by rinsing the cleaned sampling device with deionized water. During the onsite boring phase, a soil blank was obtained from the split spoon using pre-screened soil. The pre-screened soil was obtained from a nearby sand pit located adjacent to the Gingerbread Bakeshop (plate 2). The sample was collected using a stainless-steel auger sampler. Field blanks were analyzed for TCL volatile organics and Freon 113, except for second round ground-water sampling when metals were also analyzed.

A laboratory-prepared trip blank was shipped with water samples collected per day. A trip blank was not utilized for sediment sampling.

Duplicate and laboratory quality control Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples were collected at a rate of 5 percent per sampling phase. All samples were placed in coolers with ice packs and were shipped within 24 hours of collection in accordance with the Quality Assurance/Quality Control Plan (QA/QC) (Section 4 of the POP). The only exceptions were the samples collected during the onsite boring investigation were not shipped within 24 hours as explained in Section 2.2.2.5. Each cooler contained a chain-of-custody form indicating the analysis required for each sample.

2.3 PHASE II INVESTIGATIONS

2.3.1 Introduction

The Phase II investigations were performed following the scope of work presented in the April 1991 Phase II RI Work Plan. Phase II was necessary because Phase I revealed sustained concentrations in the plume; however, source areas had not been isolated.

2.3.2 Investigation of Former Drum Storage Area

During the Phase I study of the RI, it was discovered that the parcel of land formerly utilized as the drum storage area was not owned by SHI or any of the previous owners of the Rowe Industries site. Permission to perform a subsurface investigation on the property was not obtained until the data from Phase I were analyzed, which indicated a source area was present. The location of this area is shown on plate 1 and figure 6. A soil-vapor survey was performed during the Phase II investigation, followed by the drilling of soil borings. The results from the soil-vapor survey were used to determine the drilling locations for two of the six soil borings in the parcel. In addition, one well cluster and two shallow wells were installed downgradient of the drum storage area to serve as secure long-term monitoring points.

2.3.2.1 Soil-Vapor Survey

A soil-vapor survey was conducted in the former drum storage area on April 4, 5 and 8, 1991. The survey was conducted using an OVM PID and a portable Sentex GC/AID utilizing a purge and trap loop.

Forty-six stations were sampled and initially analyzed with a PID. The locations of these stations are shown on figure 6. Most of the stations were located in a 10-foot grid pattern. The stations were located in a 20-foot grid pattern along the southern transects EE and FF. Stations FF-3 and FF-4 were spaced 100 feet apart because dense brush obstructed the investigation. Twenty-seven of the 46 stations were analyzed using the portable GC. With the exception of the first five stations on transect BB, stations with vapor concentrations exceeding 10 ppm, as measured with the PID, were not analyzed by the portable GC.

The sampling procedure described in Section 2.2.1.4 was utilized during the Phase II Soil-Vapor Survey. Calibration, carrier gas blanks, ambient air blanks and duplicates were analyzed in the manner described in Section 2.2.1.4. The calibration standard was re-analyzed at an average rate of one per ten samples. The sampling and penetration probes, the suction hose and vacuum line were decontaminated after each sample following the protocol outlined in Section 2.2.2.4.

2.3.2.2 Soil Borings

Six soil borings were drilled in the former drum storage area between May 15 and 21, 1991. The locations of these borings are shown on plate 1 and figure 7. Two of the boring locations (B-9 and B-10) were chosen based on the soil-vapor survey results. These borings were completed approximately 25 feet below the water table. The remaining four boring locations were chosen to define the horizontal extent of contamination detected during the drilling of B-10. These four borings were completed above the water table. Representative samples of both the deep and shallow borings were sent to the laboratory for analysis. Table 3 lists the laboratory parameters analyzed for each sample.

All borings were completed using a Failing F-7 hollow-stem auger drilling rig. Continuous split-spoon samples were obtained utilizing three-inch and two-inch diameter carbon steel split spoons driven at 2-foot intervals from ground surface. Boring B-9 was completed to a depth of 45 ft bg and Boring B-10 was completed to 46 ft bg. Borings B-11 through

B-14 were completed above the water table to a depth of 14 ft bg. The three-inch diameter carbon steel split spoon was used to obtain samples through intervals containing gravel.

Immediately upon opening each split spoon, samples for volatile organic analysis were collected from the center of the split spoon using a stainless-steel spatula. In addition, small samples were removed from the ends and middle of the split spoon and placed in a 4-ounce glass jar for headspace screening. Visibly-stained soil was included in the screening sample. All screening sample jars were covered with aluminum foil, shiny-side out, and stored for a minimum of one hour before being screened with a PID.

After these two sets of samples for volatile organic analysis and screening were taken, the top 2 to 3 inches of soil in the split spoon were discarded. The remaining soil was geologically logged. If the remaining soil was visibly contaminated, it was placed in a stainless-steel bowl, carefully homogenized using a stainless-steel spoon and placed in a 16-ounce glass jar for potential full TCL analysis. All samples were stored on ice until each boring was completed.

The headspace of each sample was screened with a PID in the manner described in Section 2.2.1.5. Samples submitted to the laboratory for analysis were chosen based on PID readings, proximity to clay in conjunction with high PID readings, and proximity to the water table. Only one sample was submitted for TCL/TIC's and Freon 113. The sample was submitted from B-10 at the 4 to 6-foot interval because it exhibited one of the highest PID readings observed during the entire drilling program. The remaining samples were submitted for TCL volatile organics and Freon 113 analysis.

All cuttings were containerized in DOT-approved 55-gallon drums. Each borehole was grouted with a bentonite- cement slurry. The downhole drilling equipment was steam-cleaned between boreholes.

All sampling equipment was decontaminated between sampling intervals in the manner described in Section 2.2.1.5. A 1-percent solution of HNO_3 was used to rinse the carbon-steel split spoons and a 10-percent solution of HNO_3 was used to rinse all of the stainless-steel equipment. The location of the decontamination line was positioned upwind of the drill rig for each boring location. Any change in wind direction caused repositioning of the decontamination line, or it was left in place if there was enough distance between the drill rig and decontamination line.

All safety precautions outlined in the Health and Safety Plan and in Section 2.2.1.5 of this report were observed during the subsurface investigation of the former drum storage area. All work was conducted in Level D during the investigation.

2.3.2.3 Ground-Water Investigation at Drum Storage Area

One well cluster, consisting of two wells, and two shallow wells, were installed to serve as secure long-term monitoring points downgradient of the former drum storage area. The cluster consists of one shallow and one intermediate well.

2.3.2.3.1 Pilot Borehole

Prior to well installation at the well cluster, a pilot hole was drilled to observe the underlying stratigraphy and to determine the best screen setting for each individual well. The pilot borehole was installed in the manner described in Section 2.2.2.1 except split-spoon samples were obtained continuously. The pilot hole was completed to 52 feet on May 22, 1991. Each split-spoon sample was screened in the manner described in Section 2.2.2.1 using a 4-ounce glass jar. The headspace for each sample was screened to determine if the soil was contaminated, and if so, to define the vertical extent. The material in the spoon was geologically logged and all cuttings were placed in DOT-approved 55-gallon drums.

Between sample intervals, the split spoons were scrubbed with a brush in a tap water/Alconox solution and then rinsed with deionized water. This is a modification to the SOPs in the POP. All drilling equipment was steam-cleaned before use.

The boring was drilled through medium to coarse-grained sand and some finer sand and silt. The detailed geologic log for this borehole can be found in Appendix III. The water table was encountered at approximately 19 ft bg. The ambient air near the augers measured between 1 and 5 ppm on the PID, but decreased to background levels after water was added to the borehole at 18 ft bg to prevent sands from heaving. This water was obtained from an outdoor tap at the SHI facility which is supplied by an onsite well. A sample of the water, in addition to two soil samples with high headspace PID readings, were submitted to the laboratory for TCL volatile organics and Freon 113 analysis. A rinsate blank collected from the split spoon was submitted for analysis.

Thin silt and clay bands were encountered sporadically above the water table where finer material was observed during drilling. The remainder of the borehole was relatively homogeneous, consisting of medium to coarse sand and fine gravel. Alternating bands of silty clay and medium to fine sand were observed at 51 ft bg.

A gamma-ray geophysical log was run at the completion of the borehole. The log is in Appendix IV. The log was run to confirm the stratigraphy observed during drilling and to determine the optimum screen settings for the two wells. Because bands of silty clay and medium to fine sand were encountered at 51 ft bg, the selected screen setting for the intermediate well was 41 to 51 ft bg. The shallow well screen setting was selected to be from 14 to 29 ft bg, approximately 5 feet above and 10 feet below the water table. The pilot borehole was grouted to the surface with a bentonite- cement grout.

During the entire drilling program, the air in the work area was monitored for volatile organic vapors with a PID. The levels never exceeded 5 ppm, so the drilling was completed in Level D protection.

2.3.2.3.2 Installation of Cluster MW-45

The well cluster (MW-45A and MW-45B) was installed between June 6 to 10, 1991. The location of the well cluster is shown on plate 1.

Both wells were constructed with 2-inch, flush-joint PVC casing and screen with slot openings of 20-thousandths of an inch. The use of PVC was a change from the original POP, and was approved for the Phase II work plan. The screen and casing were factory cleaned and sealed in plastic wrapping.

Both wells were installed similar to the description in Section 2.2.4.2. A stainless-steel plug was used in the intermediate well and a plug was not used for the shallow well. The well construction diagrams are presented in Appendix V.

The intermediate well (MW-45B) was completed on June 6 and 7, 1991. The well was drilled approximately 5 feet west of the pilot borehole and the 10-foot screen was set from 40.5 to 50.5 ft bg.

The shallow well (MW-45A) was completed to 29 feet on June 10, 1991. The well was drilled approximately 5 feet west of MW-45B. The borehole was augered down to 19 ft bg and then continuous split-spoon samples were collected from 19 to 29 ft bg. The geologic log for this sampling interval can be found in Appendix III. This additional sampling was performed to verify the geology in the screened interval. Small clay bands were observed at 21, 25 and 29 ft bg. The 15-foot screen was set approximately 11 feet below and 4 feet above the water table from 13.9 to 28.9 ft bg.

2.3.2.3.3 Installation of Two Shallow Downgradient Wells

After laboratory data were received from MW-45A and MW-45B, two additional downgradient wells were installed to better define the water quality. The installation of the wells was an addition to the Phase II Work Plan.

Two shallow wells (MW-51A and MW-52A) were installed without first completing a pilot borehole. Both wells were installed similar to the description in Section 2.2.4.2 except that split-spoon samples were collected every 5 feet above the water table and continuously below the water table.

Well MW-51A was completed to 28 feet on October 22, 1991. The well was installed through medium-grained sand with some coarse and finer sand. The detailed geologic log for this well is presented in Appendix III. The water table was encountered at approximately 18 ft bg. Water from an onsite SHI well was added to the borehole to prevent heaving sands in the augers.

Thin silt and clay bands were encountered below the water table at 18.5, 22, 24.5 and 27 ft bg ranging from 0.15 to 0.30-foot thick. The screen was set between 18 and 28 ft bg.

Well MW-52A was completed to 29 feet on October 23, 1991. The well was installed through medium to coarse-grained sand and some finer sand. A detailed geologic log for this well is presented in Appendix III. A thin clay band was encountered just above the water table at 18 ft bg. The water table was encountered at approximately 19 ft bg. Water supplied by the onsite SHI well was added to the borehole during drilling to prevent sands from heaving. The well screen was set between 19 and 29 ft bg.

Both wells were constructed with 10 feet of PVC screen and completed with PVC casing. The locations of the two wells are shown on plate 1. The well construction diagrams are presented in Appendix V.

2.3.3 Investigation of Dry Well A

During the Phase I study, elevated soil-vapor concentrations were detected around Dry Well A and at the toe of the slope just west of the dry well. Soil borings in these areas revealed no volatile organics in the unsaturated zone. These potential residual source areas were further investigated during Phase II. Because ground water was determined to be the possible source for vapors, two clusters of monitor wells were installed.

The upper sediment in Dry Well A was sampled during Phase I and only low levels of solvents were detected. Therefore, Dry Well A was resampled at greater depths to determine if volatilization of the shallow sediment had occurred.

2.3.3.1 Dry Well A Sampling

On June 5, 1991, sediment samples were obtained from Dry Well A. Samples were collected using a portable tripod drilling rig which was raised above the dry well. Split-spoon samples from 0 to 2 feet and 2 to 4 feet were collected from the same sample hole. The sediment was sampled directly from the split spoon using a stainless-steel spatula. Samples were analyzed for TCL volatile organics and Freon 113. A portion of the sediment in the split-spoon sampler was placed in a 4-ounce glass jar for screening purposes. Prior to sampling, the equipment was decontaminated according to procedures outlined in the approved SOP of the POP.

2.3.3.2 Ground-Water Investigation Near Dry Well A

Two well clusters were installed between June 17 to 19, 1991 to serve as secure long-term monitoring points. One cluster was drilled west of Dry Well A, the other was installed due north of Dry Well A. Each cluster is comprised of a shallow and intermediate well. Locations of these clusters are shown on plate 1.

Both clusters were installed in the manner described in Section 2.2.4.2. Prior to well installation, a pilot hole was drilled at each cluster as described in Section 2.3.2.3.1.

2.3.3.2.1 Installation of Cluster MW-46

Monitor Well Cluster MW-46 was installed on June 17 and 18, 1991, following the drilling of a pilot borehole on May 29, 1991. The well cluster is located approximately 40 feet west of Dry Well A. This cluster was located as near to Phase I Soil-Vapor Survey Point A-9 as possible.

The pilot borehole was completed to 32 feet on May 29, 1991. The boring was drilled through medium-grained sand. Some finer and coarser material was observed throughout the borehole. The detailed geologic log for this borehole is presented in Appendix III. The water table was encountered at 7.5 ft bg. Water, supplied by the SHI well, was added to the borehole to prevent the sands from heaving into the augers. Throughout drilling, PID measurements of the ambient air near the augers never exceeded background levels.

Silty clay bands, about 0.20-foot thick, were observed at 6.5, 14.5 and 16.5 ft bg. A clay layer, 0.50-foot thick, was observed at 29.5 ft bg. However, no unusual PID readings were observed at these intervals.

A gamma-ray geophysical log was not run at the completion of the borehole because of access problems. Based on an evaluation of the soil samples, a screen setting of 4 to 14 feet was determined for the shallow well. After the boring was completed, it was determined that the intermediate well should be located deeper than the depth of the pilot hole. Additional sampling was performed while drilling the intermediate well.

The shallow well (MW-46A) was completed to 14 feet with 10 feet of screen on June 17, 1991. The well was drilled approximately 10 feet north of the pilot borehole. Because of the small silty clay band observed at 14.5 ft bg, the shallow screen setting was placed above the silty clay, set from 4 to 14 feet. Because of the shallow depth, a plug was not used in the lead auger. A bailer was used to remove any heaving sands from the bottom of the borehole prior to well installation.

The intermediate well (MW-46B) was completed to 43 feet on June 18, 1991. The well is located approximately 5 feet north of MW-46A. The borehole was advanced 10 feet deeper than the pilot borehole. A gamma-ray geophysical log was run to provide data for choosing a screen setting. The geophysical log of this well can be found in Appendix IV. Silty clay was detected at the bottom of the borehole; therefore, the well was installed with the screen just above the clay.

The location of the well cluster is shown on plate 1 and well construction diagrams are presented in Appendix V.

2.3.3.2.2 <u>Installation of Cluster MW-47</u>

Monitor Well Cluster MW-47 was installed on June 19, 1991, following the drilling of a pilot borehole on May 30, 1991. The well cluster is located approximately 15 feet north of Dry Well A. This cluster was located as near Phase I Soil Boring B-7 (Phase I Soil-Vapor Survey Point D-8) as possible.

The pilot borehole was completed to 40 feet on May 30, 1991. The boring was drilled through medium to coarse-grained sand and some finer sand. The detailed geologic log for this borehole can be found in Appendix III. The water table was encountered at approximately 5 ft bg.

A clay band was encountered at 27 ft bg. A portion of the clay was set aside and screened for potential contamination. The PID readings were higher than 15 ppm at 26 feet so a soil sample was submitted to the laboratory for TCL volatile organics and Freon 113 analysis. Below 26 feet, PID readings ranged between 5 and 10.5 ppm. Table 3 lists the laboratory parameters the sample was analyzed for.

A gamma-ray geophysical log was run at the completion of the borehole. The log is in Appendix IV. Based on the geologic samples and geophysical log, screen settings of 4 to 14 feet for the shallow well and 28 to 38 feet for the intermediate well were determined.

The shallow well (MW-47A) was completed to a depth of 14 feet with 10 feet of screen on June 19, 1991. The well was drilled approximately 10 feet northwest of the pilot borehole. Because of the shallow water table, only one foot of the screen was set above the water table.

The intermediate well (MW-47B) was completed to a depth of 38 feet on June 19, 1991. The well is located approximately 5 feet north of MW-47. The screen setting was determined based on the higher PID readings observed between 26 and 40 feet in conjunction with the geophysical data.

The location of the well cluster is shown on plate 1 and well construction diagrams are presented in Appendix V.

2.3.4 Investigation of Dry Wells Adjacent to SHI Building

During Phase I, the dry wells were determined to contain compounds that appear to be related to the current activities at the SHI building. Many of the results were rejected during validation because the solvents are also utilized by laboratories. Although these compounds are not primary plume constituents, they were detected in nearby monitor wells warranting additional investigation during the Phase II study. In addition, Dry Well C contained solvents contained in the plume.

On June 5, 1991 sediment samples were collected from Dry Wells A, C, D, E and F. Section 2.3.2.1 discusses the sampling for Dry Well A. For Dry Wells D and F, a split-spoon sampler was manually lowered into the dry wells, and the sampler was driven 2 feet into the sediment by hand. The F-7 drilling rig was utilized to obtain the 2-foot sample from Dry Wells C and E, which are located in the parking lot. In between sampling points, the sampling equipment was decontaminated according to procedures outlined in the approved SOP of the POP. All samples were sent to the laboratory for TCL volatile organics and Freon 113.

A split sample was sent to a separate laboratory (Technical Testing Laboratories) to verify whether the presence of compounds detected during Phase I, but which were rejected as typical laboratory solvents, were actually present. However, because of problems encountered in transit, the integrity of the samples was questioned. Therefore, on July 9, 1991, sediment and sludge from Dry wells D and F were resampled and split with Technical Testing Laboratories. The dry wells were resampled following the same procedures followed on June 5, 1991.

2.3.5 Investigation of Buried Debris Beneath SHI Facility

Exploration of the unsaturated soils under the northeastern corner of the existing SHI building and northern parking lot was conducted to address the possibility of buried drums acting as a continuing source of contamination to the ground water. These areas are where some of the debris from the fire were allegedly buried.

A geophysical survey was performed in the parking area and a soil-vapor survey inside and immediately outside the eastern side of the current SHI building was performed during the Phase II study. The soil-vapor survey results provided locations for soil borings and soil sampling beneath the building (see Section 4.1.7.2).

2.3.5.1 Geophysical Survey at North Parking Lot

A geophysical survey was conducted in the northern parking lot of the SHI facility on May 1, 1991. The survey was conducted using an EM-31 electromagnetic terrain conductivity meter in the manner described in Section 2.2.1.1.

A grid was marked out with lines spaced 10 feet apart with 10 feet between each station. Five lines were marked-out and labeled A through E. Locations of all stations surveyed during Phase II are shown on figure 8.

2.3.5.2 Soil-Vapor Survey Inside the SHI Building

A soil-vapor investigation was conducted inside the northeastern portion of the SHI building and immediately outside the eastern side of the building. The survey was conducted using an OVM PID and a portable Sentex GC/AID utilizing a purge and trap loop.

On April 9, 1991, five stations were sampled in the parking lot east of the SHI building. Three of the five stations were not analyzed using the portable GC because of elevated vapor concentrations as measured by the PID.

Twelve stations were sampled inside the northeastern portion of the current SHI building on April 9 and 10, 1991. The survey was performed to assist with selecting boring locations. Five of the stations inside of the building were not analyzed using the PID, but all stations were analyzed using the portable GC.

On May 23, 1991 an additional survey was conducted inside of the SHI building to further assist with selecting boring locations. Ten additional stations were sampled. The focus of both surveys were in the northeast corner of the building which is the border between the old Rowe Industries facility and the current SHI building where filling may have occurred. The locations of these survey stations are shown on figure 9.

The soil-vapor survey was conducted in a manner similar to the survey described in Section 2.3.1.1, except holes were drilled through the cement floor. Several locations near Station GG-12 were abandoned because the drill could not penetrate through the concrete foundation.

2.3.5.3 Soil Borings

Two soil borings were drilled in the SHI building on June 4 and 5, 1991. The locations of these borings (see plate 1) were chosen based on an analysis of data from the soil-vapor survey. These locations were picked to investigate contamination in the unsaturated zone and to determine if demolition material from the fire which destroyed the former Rowe Industries building and/or undisturbed drums are buried under the existing building. Boring B-15 was located near soil-vapor Station GG6 and Boring B-16 was located near soil-vapor Station GG5.

Split-spoon soil samples were collected using a portable tripod drill rig. Two-inch diameter carbon steel split spoons were driven through the ground continuously from the surface to 10 feet below the surface. Samples were collected in the manner described in Section 2.3.2.3.1.

One soil sample from each boring was submitted to the laboratory for TCL volatile organics and Freon 113 analysis. The sample was chosen by the highest headspace PID response observed at each boring. Table 3 lists the laboratory parameters analyzed for each sample.

There were no cuttings generated during the sampling procedure. One borehole was filled with cement and the other borehole was backfilled with clean sand and capped with a cement finish. The sampling equipment was decontaminated in the manner outlined in Section 2.2.4.1.

During drilling of B-15, an impenetrable layer was encountered 3 ft bg and water collected in the borehole. Vapors from the borehole measured 67 ppm on the PID. A sample of the water was submitted to the laboratory for TCL volatile organics and Freon 113 analysis. The water was evacuated from the hole which thereafter remained dewatered and it was filled with a layer of bentonite followed by cement. The portable drill rig was relocated 4.5 feet east of the original borehole and a boring was drilled to a depth of 10 ft bg.

Because it was raining the day the rig was inside the building for the drilling of B-15, the decontamination line was set up along the southern edge of the room, approximately 40 feet away.

Because of poor ventilation in the room where B-15 was drilled, a fan was placed in a doorway to direct exhaust fumes out of the room. In between collection of each split spoon, the rig was shut down to allow sufficient time to elapse for residual exhaust fumes to dissipate, and thereby avoid a potential health threat. All work was conducted in Level D and in accordance with the Health and Safety Plan. Continuous monitoring of the ambient air quality was performed to ensure that the work space air was within the recommended breathing limits for VOCs.

2.3.6 Onsite Ground-Water Investigation to Determine Vertical Extent of Plume

To determine the depth of contamination beneath the Rowe Industries property, additional wells at varying depths were installed. These wells serve as permanent monitoring sample points. In addition to the new well clusters referred to in Sections 2.3.1 and 2.3.2, one separate intermediate well and one cluster of three wells were installed.

2.3.6.1 Drilling and Installation of Intermediate Well MW-28B

An intermediate well was installed adjacent to SCDHS Well N-28 to make a two-well cluster. This location was chosen for a deeper well because samples from N-28 have had the highest concentrations of plume constituents of all of the onsite wells. Prior to well installation, a pilot hole was drilled in the manner described in Section 2.3.2.3.1.

The pilot hole was completed to a depth of 50 feet on May 24, 1991. The boring was drilled through medium-grained sand with coarser sand observed below 30 feet and finer sand observed above 30 feet. The detailed geologic log for this borehole can be found in Appendix III. The water table was encountered approximately 18 ft bg. Water, provided by the

SHI well, was added to the borehole to prevent sands from heaving.

Silty clay, 1-foot thick, was observed at 25 ft bg. Smaller bands of silty clay, mixed with fine sand and silt, were observed between 26 and 30 feet, between 34 and 36.5 feet and from 49.5 and 50 ft bg.

During the drilling and installation of the intermediate well and pilot borehole, the ambient air near the augers never exceeded background levels. As a result, the drilling was completed in Level D protection.

A gamma-ray geophysical log was run at the completion of the borehole to confirm the underlying stratigraphy observed during drilling and to aid in determining the screen setting. The log is presented in Appendix IV. Because clay was encountered at 49.5 ft bg, a screen setting of 38 to 48 ft bg was chosen.

Well MW-28B was installed 5 feet northeast of N-28 on June 11, 1991. The location of the well cluster is shown on plate 1.

The well was constructed with 2-inch, flush-joint PVC casing and screen with 20-thousandths of an inch slot openings. The well was installed in the manner outlined in Section 2.2.4.2. The well construction diagram is presented in Appendix V.

2.3.6.2 Drilling and Installation of Well Cluster MW-44

The three-well cluster, consisting of shallow, intermediate and deep wells, was installed near SCDHS Well N-31, at the northern edge of the northern parking lot. This location was chosen for three reasons. First, the new cluster replaces N-31 as a sampling point since the shallow screen setting in N-31 is above the water table. Second, the location is near the center of the plume which emanates from the site. Thirdly, it is downgradient of the area where fire debris was reportedly buried. Therefore, in addition to providing general water-quality information on the plume as it leaves the site, the well cluster would intercept any contamination originating from beneath the building. Prior to well installation, a pilot hole was drilled in the manner outlined in Section 2.3.2.3.1, except split-spoon samples were collected at 5-foot intervals and then continuously from 37 to 57 feet.

The pilot hole was completed to a depth of 69 feet on June 3, 1991. The boring was drilled through fine to coarse-grained sand. The detailed geologic log for this borehole is presented in Appendix III. The water table was encountered approximately 21 ft bg. Water, supplied by the SHI well, was added to the borehole for greater control during drilling.

Silty clay was observed at 36.5 and 44.5 ft bg approximately 0.50-foot thick. Thinner bands were encountered at 43, 48, 55 and 60 ft bg.

Throughout the drilling program, the ambient air near the augers never exceeded background levels. All drilling was completed in Level D protection.

A gamma-ray geophysical log was run at the completion of the borehole to provide stratigraphic information between soil samples and to determine the optimum screen settings for the three wells. The log is presented in Appendix IV.

Because of the deeper water table and the clay encountered at 36 feet. The shallow well was installed just above the clay. The intermediate well was set slightly below the clay encountered at 36 feet. The deep well was set above clay detected by the gamma log at 71 feet.

The location of the well cluster is shown on plate 1. All wells were constructed with 2-inch, flush-joint, PVC casing and screen. The screens have slot openings of 20-thousandths of an inch. The wells were installed in a manner similar to the description outlined in Section 2.2.4.2. The well construction details are presented in Appendix V.

The shallow well (MW-44A) was completed to 36 feet on June 12, 1991. The screen was set slightly above the clay layer encountered in the pilot borehole with approximately 15 feet of screen in the saturated zone. In order to cross the water table and reach the clay layer, 20 feet of screen was utilized.

The intermediate well (MW-44B) was completed to 49 feet on June 13, 1991. The screen was set below the clay layer encountered at 36 feet. Ten (10) feet of screen was set in an interval where higher headspace PID readings were observed in the pilot borehole samples.

The deep well (MW-44C) was completed to 71 feet on June 14, 1991. Prior to well installation, a gamma geophysical log was run to determine if there was any clay below 66 feet. The gamma log is located in Appendix IV. Based on previous gamma logs, the gamma ray geophysical log for MW-44C indicated clay was at approximately 71 feet. The screen was set above the clay unit.

2.3.7 Additional Study of Areas Identified in EPA Aerial Photographic Study

In 1986, the EPA prepared an aerial photographic study identifying "possible" and "probable" disturbed areas warranting further investigation. Plate 3 is a summary of the features identified in the EPA study. Although the first phase of the study was designed to cover all of the identified areas with the EM survey or the soil-vapor survey, site conditions (high water table, metal surface debris) precluded some areas from being investigated by the surveys.

During Phase II of the RI, areas not previously investigated were evaluated based on a soil-vapor survey and visual observations.

2.3.7.1 Soil-Vapor Survey of Areas Identified in Photographic Study

A soil-vapor investigation was conducted at locations that were identified as "possible" and "probable" features in the January 1986 EPA aerial photographic study entitled, "Site Analysis, Rowe Industries, Southampton, New York", but were not evaluated during Phase I of the RI. The survey was conducted using an OVM PID and a GC/AID utilizing a purge and trap loop.

Three stations were sampled in the parking area east of the SHI building on April 9, 1991. The survey was conducted in the manner similar to that described in Section 2.3.1.1.

Seven stations were sampled in the wooded area west of the pond on April 10, 1991. Because of the shallow water table, Stations BK-2 through BK-7 were sampled for ground water and the headspace was analyzed using the portable GC. Locations of all the Phase II soil-vapor stations related to the aerial photographic study are shown on figure 10.

The ground-water headspace samples were collected by purging 35 ml of ground water using a peristaltic pump with the discharge directed to a 40 ml amber vial. After purging, the ground water was injected with UHP Argon which released the volatile organic vapors from the water to the headspace. The vapors from the headspace were introduced into the GC via needle extraction through the vacuum hose using the GC's internal sampling pump.

Calibration, carrier gas blanks, ambient air blanks and duplicates were analyzed in the manner described in Section 2.1.2.4. The calibration standard was re-analyzed at an average rate of once every ten samples.

The sampling and penetration probes, the suction hose and vacuum line were decontaminated after each sample following the protocol described in Section 2.1.2.4.

2.3.7.2 Visual Inspection of Areas Identified in Photographic Study

A visual inspection of features marked as "possible" and "probable" disturbed areas by the EPA study was conducted on April 4, 1991. Areas delineated on plate 3 were carefully inspected for ground stains, ground scars, disturbed ground and a possible trench.

2.3.8 Onsite Surface Soil Sampling

Surface soil samples were collected on July 23, 1991. These samples were collected to provide data necessary for the Risk Assessment. A grid encompassing the SHI property from Sag Harbor Turnpike to slightly east of Pond A was generated. Each square in the grid was assigned a number. Ten sample locations were determined utilizing random number generation. In addition, one sample was collected from the drum storage area and one sample was collected around Dry Well A because these are known areas of prior solvent disposal or spillage.

The samples were obtained from 0 to 6 inches below grade, after surface soil or pavement was removed. All samples were collected using stainless-steel spoons which were decontaminated using an Alconox/tap; nitric/tap; acetone and, finally, a deionized water rinse. All samples were analyzed for TCL volatiles, Freon 113 and TCL metals. Sample locations are shown on figure 11.

2.3.9 Installation of Additional Offsite Wells

Three offsite well clusters were installed. An upgradient cluster was installed to confirm the quality of the ground water that flows into the study area. A cluster was installed in the center of the plume, south of Sag Harbor Cove, to provide data on the plume prior to it discharging into the cove. The third cluster was installed north of the cove to verify that the plume has not crossed the cove.

2.3.9.1 Drilling and Installation of Upgradient Well Cluster MW-48

A well cluster was installed at the edge of Lily Pond Drive between June 21 and 25, 1991. The cluster is located upgradient of the SHI property and consists of a shallow and intermediate well.

The pilot hole was completed to 69.5 feet on June 21, 1991. The boring was drilled through medium to very coarse-grained sand and gravel. Finer sand was encountered above the water table which is approximately 22 ft bg. Silty clay bands were observed between 9 and 14 feet and again at 22 ft bg. The detailed geological log for this borehole is presented in Appendix III. Split-spoon samples were obtained every 5 feet and continuously from 40 ft bg to 52.5 ft bg. The continuous sampling was performed to investigate the possibility of a unit consisting of several layers of clay. Soil samples for TCL metals analysis were collected from 2 to 4 feet, 8 to 10 feet and 14 to 16 feet. These samples were collected to obtain information on natural metals occurrence.

The ambient air near the augers never exceeded 1 ppm on the PID throughout the drilling. Water was added to the borehole during drilling because the coarse material was conducive for heaving sands. The water was supplied by the SHI well and was obtained via hose connected to an outdoor tap at the SHI facility.

A gamma-ray geophysical log was run at the completion of the borehole and is presented in Appendix IV. The log was run to provide stratigraphic information between soil samples and to determine the optimum screen settings for the two wells. The selected intermediate well screen setting was 59 to 69 ft bg.

Both wells were constructed with 2-inch, flush-joint, stainless-steel casings and screens. The wire-wrapped screens have slot openings of 20-thousandths of an inch. The screens and casings were factory cleaned and sealed in plastic wrapping.

The cluster was installed from west to east, intermediate to shallow. Well construction diagrams are located in Appendix V.

The intermediate well (MW-48B) was installed in the pilot borehole location on June 24, 1991. The small 3 1/4-inch diameter augers used for the pilot borehole were removed and replaced with the larger diameter augers for the well. The well was installed to 69 feet in the manner described in Section 2.2.4.2.

The shallow well (MW-48A) was completed to 35 feet on June 25, 1991. The shallow well was completed with 15 feet of screen, with approximately 5 feet of the screen above the water table. The well was drilled approximately 5 feet east of the intermediate well (MW-48B). The location of this well cluster is shown on plate 2.

2.3.9.2 <u>Drilling and Installation of Noyack Road Well Cluster MW-49</u>

A well cluster was installed on Noyack Road south of Sag Harbor Cove between June 26 and July 3, 1991. The cluster was designed to provide data on the vertical distribution of the center of the plume near its discharge point at Sag Harbor Cove.

The pilot hole was completed to 99 feet on June 27, 1991. The boring was drilled through fine to coarse-grained sand. Silty clay, 0.25-foot thick, was encountered at 87 ft bg. Split-spoon samples were collected every 5 feet and continuously from 40 to 52 ft bg to investigate a possible unit containing thin clay layers. The detailed geological log for this borehole can be found in Appendix III.

The water table was encountered approximately 10 ft bg. Water, added to the borehole to control heaving sands as a result of the high water table and coarse material, was obtained from a fire hydrant on Noyack Road. At the completion of the well installation, a water sample was collected from the driller's hosing for analysis of the TCL VOCs and Freon 113.

A gamma-ray geophysical log was run at the completion of the borehole. The log is presented in Appendix IV. The optimum screen settings determined from the survey and geologic log were 8 to 23 feet for the shallow well, 58 to 68 feet for the intermediate well, and 89 to 99 feet for the deep well.

Cluster MW-49 was installed in the same manner as described in Section 2.2.4.2. Well construction diagrams are presented in Appendix V. All wells were constructed with 2-inch, flush-joint, PVC casings and screens with slot openings of 20 thousandths of an inch. The screens and casings were factory cleaned and sealed in plastic wrapping. A rinsate sample was collected from both the PVC casing and screen to ensure the materials had been properly cleaned.

The shallow well (MW-49A) was installed to a depth of 23 feet on June 28, 1991. The well was drilled approximately 5 feet east of the pilot borehole. The well was installed with 15 feet of screen with approximately 3 feet of screen above the water table.

The intermediate well (MW-49B) was completed on July 1, 1991. The well was installed approximately 5 feet west of the pilot borehole. During well installation, the lead auger filled up with silty sand and clay. Because the sediment was tightly packed in the auger, the bailer was not effective in removing the plug. Therefore, the augers were pulled out of the ground, cleaned out and sent back down the same hole. The well was completed to 68 ft bg.

The deep well (MW-49C) was completed to 98.5 feet on July 3, 1991. The well was installed approximately 10 feet west of the pilot borehole. The screen was placed below the clay that was encountered at 87 ft bg. The locations of these three wells are shown on plate 2.

2.3.9.3 Drilling and Installation of Morris Cove Road Well Cluster MW-50

A well cluster was installed on Morris Cove Road north of Sag Harbor Cove between July 9 and 15, 1991. The function of the cluster is to evaluate whether the plume extends beyond Sag Harbor Cove.

The pilot hole was completed to 100 feet on July 10, 1991. The boring was drilled through fine to coarse-grained sand. Silty clay, 0.20-foot thick, was encountered at 12 and 80 ft bg. Clayey sand, 0.50-foot thick, was observed at 90.5 ft bg. Split-spoon samples were collected every 5 feet and continuously from 40 to 52 ft bg. The detailed geologic log for this borehole can be found in Appendix III.

The water table was encountered approximately 8 ft bg. Water, added to the borehole to control heaving sands, was obtained from the fire hydrant on Noyack Road utilized during the installation of Cluster MW-49. The water was containerized in a 1,000-gallon water tank. At the completion of the well installation, a water sample was collected directly from the tank and the sample was analyzed for TCL volatile organics and Freon 113.

A gamma-ray geophysical log was run at the completion of the borehole. The log is presented in Appendix IV. The optimum screen settings determined from the survey and geologic log were 14 to 29 ft bg for the shallow well (below the silty clay encountered at 12 ft bg), 49 to 59 ft bg for the intermediate well (which is just above the clay encountered at 60.5 ft bg), and 75.5 to 85.5 ft bg for the deep well.

Cluster MW-50 was installed in the manner described in Section 2.2.4.2. Well construction diagrams are located in Appendix V. All wells were constructed with 2-inch, flush-joint, stainless-steel screen and casing. The screens have slot openings of 20-thousandths of an inch. The screens and casings were factory cleaned and sealed in plastic wrapping.

A rinsate sample was collected from both the stainless-steel screen and casing to ensure the materials had been properly cleaned.

The shallow well (MW-50A) was installed to a depth of 29 feet on July 11, 1991. The well was installed approximately 5 feet west of the pilot borehole. The cluster is located north of the cove; therefore, it was concluded that the shallow water table would reflect local influences versus impact by the plume because the water table is at a higher elevation than the cove. Any local light non-aqueous phase liquids were not under investigation; thus the well was installed with 15 feet of screen under the clay layer encountered at 12 ft bg, a zone with a better potential for plume impact.

The intermediate well (MW-50B) was installed to a depth of 59 feet on July 12, 1991. The well was installed approximately 10 feet west of the pilot hole, with the screen placed just above the clay encountered 61 ft bg.

The deep well (MW-50C) was installed to a depth of 86 ft bg on July 15, 1991. The well was originally drilled to a depth of 90 feet, just above the clay layer encountered at 90.5 ft bg. However, during well installation, the maple plug at the end of the lead auger was not fully removed and the well was lifted up approximately 5 feet. The locations of these three wells are shown on plate 2.

2.3.10 **Well Development**

All of the newly-installed wells were developed by pumping and surging between June 12 and July 19, 1991. The two shallow wells, MW-51A and MW-52A, were developed on October 22 and 23, 1991. All wells were developed to clear the well screen and sand pack of fine material and to stabilize the formation material immediately surrounding the well screen.

The wells were developed using a stainless-steel and Teflon air-drive pump or a suction pump with dedicated 3/4-inch polyethylene pipe and a check valve. Wells with ground-water levels below suction limits were developed using the air-drive pump. These wells include MW-45A and MW-45B; MW-28B; MW-44A, MW-44B and MW-44C; and MW-48A and MW-48B, which were developed in the manner described in Section 2.2.2.4. The pump and outside of the polyethylene tubing were cleaned in the manner described in Section 2.2.2.4.

The remaining wells, MW-46A and MW-46B; MW-47A and MW-47B; MW-49A, MW-49B and MW-49C; and MW-50A, MW-50B and MW-50C; MW-51A and MW-52A, were developed using the suction pump. Each well had dedicated polyethylene pipe lowered to the bottom of the well. The wells were developed in the same manner as described in Section 2.2.2.4.

All of the new monitor wells were evacuated a minimum of double the volume of water introduced during drilling. Development was not complete (with the exception of MW-52A) until the turbidity measured less than 50 NTUs. Table 4 lists the turbidity measurements taken from the new wells. The table also lists the total volume removed from each of the wells that were developed. The development water from all of the offsite wells was containerized, brought to the SHI property and discharged over the land surface in accordance with the POP.

The discharge for the majority of the new wells was initially a cloudy gray-brown color, but cleared up after pumping several gallons from the well. Because Well MW-47A was more turbid than the other wells, it was developed over a longer period of time. Well MW-52A never cleared, but had a yellow-green discoloration attributed to suspended sediment.

During the well development, odors were detected in the discharge of Wells MW-44A, MW-44B, MW-46A, MW-46B, and MW-47B. Both Wells MW-46B and MW-47B had a strong sulfur odor, Well MW-46A a slight sulfur odor and Wells MW-44A and MW-44B smelled like sewage.

2.3.11 Phase II Ground-Water Investigation - Water Sampling of Monitor Wells and Private Well

All of the new monitor wells and all of the SCDHS monitor wells on the Rowe Industries site were sampled. All of the offsite wells within the plume were sampled. In addition to these wells, one private well was sampled. It was discovered during this sampling phase that SCDHS Well N-26 had been accidentally bent, rendering it useless; SCDHS Well N-25 was buried and paved over and SCDHS Wells N-16 and N-17 were buried by the local utility company when they were replacing underground lines. Wells N-16 and N-17 were relocated in October 1991. Well N-17 was visibly damaged and, therefore, was excluded from the sampling program; however, Well N-16 was sampled during the second round of the Phase II ground-water investigation.

The wells were sampled between July 29 and August 5, 1991. Wells MW-51A and MW-52A were sampled on October 23, 1991. A second round of sampling was performed between November 4 and 7, 1991. Table 7 lists the parameters each sample was analyzed for upon laboratory submittal.

All monitor wells were sampled according to the method outlined in Section 2.2.3.1. Wells with the ground-water level above suction limits were evacuated using the suction pump with dedicated polyethylene tubing. Wells with the ground-water level below suction limits were evacuated using a clean air-drive pump and polyethylene tubing.

Stainless-steel bailers were used to collect the samples. Samples were collected in the manner described in Section 2.2.3.1. Each well was analyzed for TCL VOCs compounds, Freon 113 and TCL metals. All purged water was discharged over the SHI property.

One field blank was collected per day from the stainless-steel bailer. The blank was obtained by rinsing the cleaned bailer with deionized water. Each field blank was analyzed for TCL volatile organics, Freon 113 and TCL metals. A trip blank was carried with the samples each day and submitted for analysis of TCL volatiles and Freon 113 only.

Homes located on Hildreth Street, excluding House 10, voluntarily connected to the public water supply during the winter of 1991. Based on previous laboratory results, these wells were not contaminated by the plume. A sample was taken directly from an outside faucet at House 10. Because the well is actively used, the discharge was not containerized and brought back to the SHI property. The other private wells on Hildreth Street were not sampled because the wells are no longer used for potable supply.

2.4 Surface-Water and Sediment Sampling

A one-year quarterly sampling program was established for Sag Harbor Cove and Ligonee Brook. The same five sampling points utilized during the Phase I investigation were marked out as permanent sampling locations. This seasonal program was initiated to substantiate and document the plume impacts on the bay and stream.

Water and sediment samples were collected on July 24, 1991, November 5, 1991, January 29, 1992 and April 28, 1992 in the manner described in Sections 2.2.4.1 and 2.2.4.2, respectively. All samples were analyzed for TCL VOCs and Freon 113. During the first quarter, the sediment samples were also analyzed for total organic carbon.

2.5 Quality Control Sampling

In order to ensure control and accuracy, one field blank was collected per day per type of sampler used. The blanks were collected at the beginning of the day and shipped with the samples collected that day. The blanks were obtained by rinsing the cleaned sampling device with deionized water.

During the dry well sampling phase, a soil blank was obtained from the split spoon using pre-screened soil. The pre-screened soil was obtained from a nearby sand pit located adjacent to the Gingerbread Bake Shop (plate 2). The sample was collected in the same general area the soil blank from Phase I was collected. The sample was collected using a stainless-steel spoon and storing the soil in a 16-ounce glass sample container. All of the other field blanks collected during the Phase II investigation utilized deionized water. Field blanks were analyzed for TCL volatile organics, Freon 113 and TCL metals.

In addition, a laboratory-prepared trip blank was shipped with water samples collected each day. A set of trip blanks were prepared in the field using laboratory-supplied deionized water during the Ligonee Brook and Sag Harbor Cove study.

Duplicate and laboratory quality control MS/MSD samples were collected at a rate of 5 percent per sampling phase.

In addition to the internal QA/QC, samples were split and sent to different laboratories. Soil samples collected from the dry well study and ground-water samples collected from SCDHS Wells N-27, N-28 and N-24, were sent to Technical Testing Laboratories. These samples were analyzed for TCL volatile organics and Freon 113. The samples were split to determine whether some of the solvents detected during the Phase I sampling (that were rejected during validation) were actually present; acetone, methylene chloride and Freon 113 in particular. Ground-water samples collected from MW-47A, MW-43B and MW-44B were split with Pacific Analytical, Inc. and analyzed for lead. This split was performed to help determine if previously-detected lead was accurately measured.

All samples were placed in coolers with ice packs and a chain-of-custody form was included in the coolers. Each chain-of-custody indicated the analysis required for each sample.

2.6 Water-Level Monitoring

Three complete rounds of water-level measurements were obtained on February 1 and 9 and April 5, 1990. In addition, a short tidal influence study was conducted on February 22, 1990. Wells N-20, N-19, Ligonee Brook and Carroll Street Cluster Well MW-43 were monitored periodically during one tide cycle. Depth to water was measured with steel tape and chalk as specified in the approved POP. Table 8 shows the measurements collected during the short tidal study.

Complete rounds of water-level measurements were obtained on a monthly basis beginning May 24, 1990. Measurements were not collected in June 1990 and December 1990. Tables 9 and 10 are the measurements collected from each monthly round. Well N-25 was not measured after the May 1990 round because it was paved over. Well N-31 was not measured after July 1990 because it contained very little water and was not providing data that was representative of the local water table.

A short tidal influence study was conducted on August 27, 1991. Well Clusters MW-49 and MW-50 were monitored periodically during one tide cycle. Table 11 shows the measurements collected during the short tidal study.

2.7 Permeability Testing

Several wells, installed during both phases of the RI, were selected to determine the permeability of the saturated sediments. On February 22, 1990, slug tests were performed on each of the six Phase I wells. On September 24, 1991, slug tests were performed on twelve of the Phase II RI wells. The slug-out method was employed for both test periods because the wells were slightly beyond suction limits and had high yields, eliminating the pump-out method.

The water depth was measured to one hundredth of a foot using a steel tape and chalk. A 5 psi pressure transducer was lowered into the well until approximately 10 feet of standing water was above it. The water was allowed to resettle and equilibrate. The new static water level was recorded. A 6-foot copper slug, attached by nylon string, was lowered into the well and submerged just under the water table. Again, the water was allowed to resettle and a new static water level was recorded. The data logger was started and the slug was pulled swiftly out of the well. The data logger collected five readings per second for the first fifteen seconds and then one reading per second thereafter. The test was repeated at least once per well to ensure the test's accuracy.

The slug and transducer were removed from the well and decontaminated with Alconox and rinsed with deionized water before being lowered into the next well.

2.8 Air Quality

An air monitoring program was conducted both inside and outside of the SHI building on July 23, 1991. The monitoring program was designed to ensure that workers inside and outside the building are not exposed to solvent vapors.

For the exterior monitoring, one station was set upwind and two stations were set downwind. The upwind station was located near the southwest corner of the SHI building and the two downwind stations were located at the northeast and southeast corners near the fence line. Inside the building, a station was set up in the ground floor where Boring B-15 was drilled. The sampling locations are on plate 1.

The samplers were set up by National Loss Control Service Corporation (NATLSCO) of Illinois. All samples were analyzed for tetrachloroethylene, 1,1,1-trichloroethane and trichloroethylene. Samples were collected in charcoal tubes at a flow rate of 0.05 liter per minute. The flow rates were checked throughout the sampling period using a rotameter. All samples were analyzed by a gas chromatograph. A copy of the air-quality study procedures can be found in Appendix VI.

2.9 Modifications to the POP

Several modifications to the POP were made during both phases of the RI. The majority of the changes were field decisions made to enhance the accuracy and quality of the field activity.

2.9.1 Modifications During Phase I

During the soil-vapor survey, the rate of decontamination and duplicate collection was increased. Additional soil-gas points were included to cover the entire SHI property. These modifications were included in the soil-vapor survey phase to increase the reliability and accuracy of the results and to better define the extent of contamination with emphasis near the former drum storage area.

During the onsite soil boring phase, decontamination of the sampling equipment for Soil Borings B-1 through B-4 consisted of a 10-percent solution nitric acid rinse. This was downgraded, upon request, to a 1-percent solution because the soils were sampled using carbon-steel split spoons.

During the well installation phase, pilot holes were drilled at the two cluster locations. At the completion of each pilot borehole, a gamma borehole log was run. These pilot boreholes were drilled to observe the underlying stratigraphy and determine the best screen setting for each well. Small diameter augers and the introduction of water were used to control the sands from infiltrating the augers. This enabled representative split-spoon samples to be collected at 5-foot intervals. The large augers needed for well installations would have been poor for sampling because significant quantities of sand would have heaved into the augers. The gamma borehole log provided a complete stratigraphic record by filling in any gaps from the split-spoon sampling.

During monitor well sampling, inorganics were collected from a stainless-steel bailer and a second inorganic sample was filtered from a clean laboratory container instead of filtered directly from each monitor well. Sampling was performed in this manner because the water-table depth was determined to be at the suction limit of the peristaltic pump.

2.9.2 Modifications During Phase II

During well development and sampling, a suction pump with dedicated polyethelyne pipe was used at wells with water-table levels above 20 ft bg. This pump was used because of its efficiency.

During well installation, three wells were drilled down an additional 10 ft bg beyond the pilot hole depth. Two of the wells were drilled with a wood plug in the lead auger and a geophysical gamma log was run to the bottom of the borehole. One well was sampled continuously for the 10 feet, but no geophysical gamma log was run. This was done for these three wells, because after analyzing the pilot hole data, it was determined that the deep well should be deeper than the pilot hole.

2.10 Technical Memoranda

The chronology of work performed at the study area and the documents included for each monthly phase are described below.

2.10.1 Chronology

The chronology of work initiated and completed after the EPA approved the POP on June 28, 1989, is listed below:

July 24, 1989	Landscapers clear vegetation.
August 2 through 4, 1989	Electromagnetic survey.
August 8, 1989	Disposal system tracking.
August 15 through 18, 1989	Soil-vapor survey.
August 22, 1989	Disposal system aqueous sampling and SCDHS well location.
August 31, 1989	Surveyors survey soil vapor, electromagnetic survey points and onsite SCDHS wells.
September 26, 1989	Mobilize drill rig to SHI.
September 27, 1989	Soil-vapor survey follow-up.
September 27 through 29, 1989	Drilling of eight soil borings.
October 2, 1989	Mobilize to Gingerbread Bake Shop.
October 3 through 10, 1989	Installation of Gingerbread Bake Shop, Well Cluster MW-42.
October 11 through 17, 1989	Installation of Carroll Street, Well Cluster MW-43.
October 19, through November 14, 1989	Well development and redevelopment.
November 14, through 20, 1989	First round of ground-water sampling.
November 27, 1989	Dry well sediment sampling.
November 28, 1989	Pond and Brook/Cove surface and sediment sampling.
December 6 through 7, 1989	Homeowner well sampling.
February 1, 1990	Complete round of water-level measurements.
February 5 through 9, 1990	Second round of ground-water sampling.

February 9, 1990	Complete round of water-level measurements.
February 22, 1990	Permeability testing - tidal study.
April 5, 1990	Complete round of water-level measurements.
May 23, 1990	LBG submittal of RI report.
May 24, 1990	Complete round of water-level measurements.
July 2, 1990	Complete round of water-level measurements.
August 14, 1990	Complete round of water-level measurements and sample drummed drill cuttings from Phase I.
September 6, 1990	Complete round of water-level measurements.
October 9, 1990	Complete round of water-level measurements.
November 16, 1990	Complete round of water-level measurements.
December 10, 1990	EPA comments of Draft RI Report.
December 13, 1990	LBG submittal of Draft Phase II Work Plan.
January 25, 1991	LBG response to EPA comments of RI report.
January 29, 1991	Complete round of water-level measurements.
January 30, 1991	Meeting with EPA and EPA onsite subcontractor.
February 19, 1991	EPA comments on Phase II Work Plan.
February 26, 1991	Complete round of water-level measurements.

March 28, 1991	Complete round of water-level measurements.
April 4 through 10, 1991	Soil-vapor survey.
April 23, 1991	LBG submittal of final Phase II Work Plan.
April 25, 1991	Complete round of water-level measurements.
May 1, 1991	Electromagnetic survey of northern parking lot.
May 9, 1991	Surveyor survey soil vapor and electromagnetic points.
May 15, 1991	Mobilize drill rig to SHI.
May 16 through 21, 1991	Drilling of six soil borings in former drum-storage area.
May 22 through June 3, 1991	Drilling of onsite pilot boreholes.
May 23, 1991	Soil-vapor survey follow-up.
May 28, 1991	Complete round of water-level measurements.
June 4 through 5, 1991	Indoor drilling of two indoor soil borings.
June 5, 1991	Dry well sediment sampling.
June 6 through 19, 1991	Onsite well installation.
June 12 through 25, 1991	Onsite well development.
June 20, 1991	Resample drill cuttings from Phase I for selected parameters.
June 21 through 25, 1991	Installation of MW-48 Cluster on Lily Pond Road.
June 26 through July 5, 1991	Installation of MW-49 Cluster on Noyack Road.

June 26 through July 1, 1991	Well development of MW-48 Cluster.
July 2, 1991	Complete round of water-level measurements.
July 9, 1991	Resample dry well sediment.
July 9 through 10, 1991	Well development of MW-49 Cluster.
July 9 through 15, 1991	Installation of MW-50 Cluster on Morris Cove Road.
July 18 through 19, 1991	Well development of MW-50 Cluster.
July 22, 1991	Southampton Town Hall record search.
July 23, 1991	Air-quality monitoring, surface soil sampling and installation of three permanent stream piezometers.
July 24, 1991	Brook/Cove surface and sediment sampling.
July 25, 1991	Complete round of water-level measurements.
July 29 through August 5, 1991	First round of ground-water sampling.
August 26, 1991	Sample drill cuttings from Phase II; meet with surveyors.
August 27, 1991	Complete round of water-level measurements; tidal study.
September 24, 1991	Complete round of water-level measurements; permeability testing on select Phase II wells; temporary installation of piezometer in Sag Harbor Cove.
October 15 through 16, 1991	Empty and steam clean designated Phase I 55-gallon drums containing drill cuttings along the slope northeast of N-24.

October 24, 1991	Installation of permanent piezometer in onsite pond.
October 22 through 23, 1991	Installation, development and sampling of shallow Wells MW-51A and MW-52A.
October 25, 1991	Complete round of water-level measurements.
November 4 through 7, 1991	Second round of ground-water sampling.
January 17, 1992	Feasibility Study Work Plan submitted.
January 29, 1992	Complete round of water-level measurements; quarterly sampling of brook and cove locations.
April 10, 1992	Complete round of water-level measurements.
April 28, 1992	Quarterly sampling of brook and cove locations.

2.10.2 Monthly Reports and FOP Changes

Status reports were submitted to the EPA and personnel directly involved with this site on a monthly basis. These reports summarized the monthly progress of the project with regards to the POP. Included with these reports were photocopies of the monthly field data in the field books. Copies of the status reports are in Appendix VII, without the copies of the field books.

During the course of the field operations, there were no changes in field personnel. In addition, there were no major deviations from the FOP or the Health and Safety Plan contained in the POP.

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3.0 PHYSICAL CHARACTERISTICS OF STUDY AREA

3.1 Results of Field Investigations and Description of the Area - Local and Site Specific

The study area, encompassing less than one square mile, is located in Sag Harbor which is on the South Fork of eastern Long Island. The surface features and hydrogeology are products of the regional and site-specific geology.

3.1.1 Climatology

The climate for Sag Harbor is largely affected by the Atlantic Ocean. Summers are moderate with predominant south-westerly winds predominating. Winters are mild with prevailing northwest winds. Climatological data was obtained from Bridgehampton, which is located approximately three miles to the south of Sag Harbor (NOAA, 1932-1988). The average annual temperature is approximately 50.7°F with an average seasonal high of 90°F and an average seasonal low of 30°F. The record for an extreme high temperature of 97°F was set in 1980 and an extreme low of -11°F was set in 1984. The average humidity ranges between 60 and 80 percent, and the average annual precipitation for the area is 46.1 inches per year. The lowest recorded annual precipitation was 25.9 inches in 1965 and the highest was 59 inches in 1897.

3.1.2 Surface Features

The study area is bounded on the northeast by Ligonee Brook, on the north by an inlet from Sag Harbor Cove, on the south by Lily Pond Drive, and on the west by houses on the west side of Carroll Street. The majority of the area is residential with major roads and several private driveways paved.

The highest elevation in the study area is 47 feet above sea level, which is located near the southwest corner of the SHI property. The land surface gradually declines to the north from this point, leveling out to mean sea level (MSL) at Sag Harbor

Cove. Approximately 95 percent of the study area is relatively level with slopes less than 20 percent. The degree of slope found in the area is an important factor when determining ground-water recharge to an area. Slopes in excess of 20 percent are located along the banks of Ligonee Brook, on residential property on the northeast side of Carroll Street and an embankment found on the SHI property.

The SHI property is bounded on the north by the Fabiano property (private residence), on the south by private residences on Lily Pond Road, on the east by Town of Southampton Nature Conservancy land and on the west by the Bridgehampton-Sag Harbor Turnpike. Two acres of the 8.5-acre piece of property are developed and used by SHI. One acre is covered by the SHI building, and an additional acre is paved for use as a parking lot. The remaining 6.5 acres are undeveloped and are wooded with trees and brush indigenous to a wetland, and two ponds which are located east of the building and parking lot.

The western portion of the SHI property is a relatively flat lawn area. The land surface slopes to the northeast and levels out at the parking area directly adjacent to the building. At the eastern border of the parking area, the land surface drops steeply for 30 feet from an elevation of 24 feet down to 16 feet. The land beyond this break in slope is once again relatively level and is wooded and undeveloped. The small pond and wetland area is located on the northeast portion of the property east of the bank. The pond is the lowest point on the SHI property.

3.1.3 Surface-Water Hydrology

Surface-water runoff is water which does not infiltrate into the ground and migrates toward stream channels or other surface-water features. The surface-water runoff is directly influenced by the topography and the geology of the area.

Surface-water runoff rates are higher in areas dominated by steep slopes, which results in a decrease in the ground-water recharge rate. Since there are relatively few dramatic features found in the study area, the runoff responds to the slightest ground-surface gradations. In addition, soils characterized by fine silts and clays reduce the amount of water that penetrates into the ground, whereas sandy soil enhances infiltration which reduces the runoff. The intensity of a storm and the extent of surface pavement are also important. Large storms and paved surficial areas lead to more surface-water runoff.

Peterson (1987) estimates annual direct runoff in Suffolk County to be 0.3 inches during average precipitation years. This value accounts for 0.7 percent of the total precipitation per year. This low runoff value is attributed to the sandy soils in Suffolk County and resulting high recharge rates. On Carroll Street, there is a catch basin/dry well which collects storm-water runoff. This catch basin is located directly across from Well Cluster MW-43 and adds to the recharge rate in the nearby vicinity during periods of intense storms. Storm-water runoff collected on the roof of the SHI building is diverted through gutters and storm drains to two underground dry wells located along the southeast side of the building.

The only stream in the study area is Ligonee Brook. The brook originates in Long Pond which is located southeast of the study area (see plate 2). The brook generally flows to the northwest and discharges into an inlet of Sag Harbor Cove. As discussed above, very little overland flow occurs; however, the flow that does occur would discharge into the brook, cove and the two ponds on the SHI property.

On July 23, 1991, three piezometers were installed in Ligonee Brook to determine vertical flow direction through the stream bed. Locations of the piezometers are shown on plate 2. Measurements taken from these piezometers indicate that there is an upward vertical flow gradient at Piezometers 2 and 3. Each time Piezometer 1 was measured, the stream bed was dry and the water level in the piezometer was below the level of the stream bed. Although the stream was dry, the piezometer provided valuable information on the water-table elevation. Table 12 lists the measurements collected at these three stations.

On September 24, 1991, a temporary piezometer was installed in Sag Harbor Cove. The piezometer was located east of stream sampling Location No. 4 (see plate 2). The piezometer measurements are shown on table 12. The piezometer was installed during low tide and indicates an upward vertical flow gradient. The tidal influence on Well Clusters MW-49 and MW-50 are shown on figures 12 and 13.

3.1.4 Ground-Water Recharge

Ground-water recharge is water from precipitation which infiltrates through the unsaturated sediments to replenish the water-table aquifer. A large portion of the precipitation is returned to the atmosphere by evaporation and transpiration, and a small amount is diverted to streams as surface runoff.

Average annual recharge can be calculated by the following equation: (Nemickas & Koszalka, 1982)

$$\text{Recharge} = \text{Precipitation} - \text{Evapotranspiration} - \text{Overland Runoff}$$

The average annual precipitation for the area is 46.1 inches per year (NOAA, 1932-1988). Because the study area has gentle slopes, the surface-water runoff rate of 0.3 inches per year (Peterson, 1987) was utilized. Using an average annual evapotranspiration of 21.3 inches which Peterson (1987) calculated for Bridgehampton using the Thornthwaite water balance method, and an overland runoff rate of 0.3 inches per year, then:

Recharge = 46.1 - 21.3 - 0.3 or 24.5 inches per year.

The average recharge rate for the area is approximately 1.2 mgd (million gallons per day) per square mile.

3.1.5 Geology

3.1.5.1 Regional Geology

The current surface features and subsurface geology of Long Island are products of glaciation which occurred 10,000 years ago during the Pleistocene Age. Prior to the glaciation, Long Island formed as a coastal plain, receiving vast deposits of unconsolidated material from the northeastern border of the continent (Suter, 1937). During the glacial period, an ice cap extended down and over Long Island. This ice cap deepened Long Island Sound, carved out bays, deposited moraines at the southernmost extension of the glacial ice sheets and formed outwash gravel and sand plains as it retreated. The Ronkonkoma moraine forms the central hills of Long Island and extends from northwestern Nassau County eastward across central Suffolk County to the South Fork where Sag Harbor is located (McClymonds and Franke, 1972).

In Suffolk County, the glacial drift and Cretaceous Age erosional deposits are underlain by the ancient Precambrian crystalline bedrock. Depths to bedrock range from 600 to 2,000 ft bg from the northeast to southwest Suffolk County (Jensen and Soren, 1971). Records of the deepest well logs in the Sag Harbor area do not show bedrock encountered at depths of 650 feet, but it is projected to be at an elevation of 1,200 feet below sea level. Above the bedrock is the Raritan

Formation which is composed of the Lloyd Sand Member and the Raritan Clay Formation. The Lloyd Sand Member ranges from 100 to 500 feet in thickness and consists of sand, gravel and clay/silt beds. Above the Lloyd Sand Member is the Raritan Clay Formation which is 0 to 200 feet thick. Unconformably overlying this is the Matawan Group/Magothy Formation which ranges from 0 to 1,000 feet thick and consists of sand, gravel and clayey sand. Lying unconformably on the Magothy Formation along the eastern edge of the South Fork is the Monmouth Greensand. This marine clay and silt deposit ranges from 0 to 200 feet thick and marks the quiescence from continental deposits to marine deposits prior to the glacier's descent over the island. These formations were deposited during the Cretaceous period.

Above the Monmouth Greensand is a coarse-grained sand and gravel deposit 70 to 125 feet thick. This is the Manetto Gravel Formation, which represents glacial drift from the Pleistocene glaciation, but only occurs near the Nassau-Suffolk County border near the center of the Island. Along the South Fork, the Montauk Till and Ronkonkoma Drift were deposited during the Pleistocene glaciation.

According to Sirkin and Buscheck (1977), the Montauk Till Member and the Ronkonkoma Drift, which sandwich the Gardiner's Clay, are two superimposed drift sheets along the South Fork. They were emplaced by two separate glaciations which occurred during the Wisconsinan Age.

The Montauk Till was deposited over outwash during the early Wisconsinan glaciation. The formation consists of clay and stoney clay loam till which was derived from pre-glacial alluvium (stream outwash) and pro-glacial lake sediments (fine silts and clay). These sediments became incorporated in the till by ice shove.

The Gardiner's Clay, which occurs along the south shore, was deposited during the mid-Wisconsinan during a 22,000-year period of prolonged weathering of the Montauk Till and coastal erosion. The clay, which is non-continuous, ranges from 0 to 75 feet thick and is commonly found 40 to 100 feet below MSL.

Finally, the Ronkonkoma Drift was deposited during the Upper Wisconsinan. The outwash and till formation, as thick as 200 feet in areas, is predominantly sandy with material indigenous of the Connecticut Valley and eastern Connecticut.

Overlying these glacial deposits are the more recent Holocene deposits comprised of beach and marsh deposits, as well as artificial fill. These deposits mantle the glacial deposits, fill valleys or re-define coastal landforms.

Corresponding to the geology of the area are three hydrogeologic units which are the water-bearing units for Long Island. In descending order they are the Upper Glacial Aquifer, the Magothy Aquifer and the Lloyd Aquifer. The Upper Glacial Aquifer includes the Upper Pleistocene glacial deposits. The Magothy Aquifer includes the Matawan Group/Magothy Formation. Finally, the Lloyd Aquifer lies below the Raritan Clay and is comprised of the Lloyd Sand Member (Ku and Simmons, 1986).

Figure 14 is a cross section of the region, taken from the United States Geologic Survey (USGS) Water-Supply Paper 2073, and figure 15 shows the cross-section location. This cross section includes both the north and south shores of the South Fork of Long Island. As indicated on the cross section, there is a marine clay, which could represent the Gardiner's Clay, occurring 100 feet below MSL and extending to Sag Harbor. This undefined clay unit is in the Upper Glacial Aquifer which underlies the entire area. This unit wedges from over 300 feet to 150 feet thick moving from north to south. Underlying this is the Magothy Aquifer which extends beyond 800 feet below MSL.

3.1.5.2 Geology of the Study Area

The study area for this RI is underlain by the Upper Glacial Aquifer which consists of clayey sand, sand and gravel. Throughout the drilling program, two somewhat different lithologies were observed at the SHI property. The upper sediments consist of medium to fine sand with a trace amount of medium to fine gravel. The lower sediments, generally detected below the water table, consist of medium to very fine sand, alternating with intervals of silty clay, silt and clay. The geologic logs for the onsite borings are in Appendices III and XI. Figure 16 is the cross section showing the geology in the vicinity of the former drum storage area. The silty clay bands in the boreholes drilled immediately north of the drum storage area recurred less frequently than those observed elsewhere onsite. Figure 17 is the north-south cross section of the site and figure 18 is the intersecting east-west cross section of the site. Figure 19 shows the locations of the three onsite cross sections

Offsite, the geology varied. The upgradient stratigraphy and the stratigraphy at the Gingerbread Bake Shop and on Carroll Street is characterized by finer material above the water table and coarser material below the water table. The stratigraphy on both sides of the cove is characterized by coarser material with occurrences of silty clay and finer material between 85 and 90 ft bg. This finer material was observed at the Gingerbread Bake Shop pilot borehole (MW-42). In addition, a clay layer was encountered 110 ft bg at the Gingerbread Bake Shop location. Its areal extent is unknown.

Figure 20 shows the surficial geology of the area. Figure 21 is a geologic cross section of the area along the previously-identified plume and figure 22 shows the location of the cross section. Several of the SCDHS 1984 monitor wells were included in determining the local geology. These well logs are included in Appendix III. Although the SCDHS well logs are not detailed, many did suggest the existence of a discontinuous clay or sandy clay layer at approximately 40 ft bg.

It is evident from the cross sections that there are no major laterally-continuous beds or clay layers. The depositional environment of these sediments (glacial meltwaters) results in braided stream channels, localized flood plains, bars and other features which have no areal continuity. It is important to note, however, that the fluvial deposition results in overall horizontal stratification which affects ground-water flow.

3.1.6 Hydrogeology

Based on monthly water-level measurements, presented on tables 9 and 10, the ground water flows to the northwest toward Ligonee Brook and Sag Harbor Cove from the SHI site. The water-level contour map for the study area is shown on figure 23. This map is based on October 25, 1991 depth-to-water measurements taken from the shallow wells, ranging from 20 to 30 ft bg, three shallow piezometers in Ligonee Brook and one shallow piezometer in the onsite pond, installed 2 to 3 ft bg. All of the measurements were converted to elevations above msl and used to determine the water-level contours for the site.

Onsite, the contours indicate a northerly flow pattern behind the SHI building which curves to the northwest at the northern end of the property just beyond the onsite pond. Figure 24 illustrates the onsite water table from measurements collected on October 25, 1991.

The ground-water flow velocity has been calculated based on a variation of Darcy's Law $(V=\frac{Ki}{n})$ where the velocity is calculated in feet per day. K is the hydraulic conductivity of the outwash, i is a dimensionless-unit for the hydraulic gradient, and n is the porosity of the aquifer. To determine K, the hydraulic conductivity indicative of the saturated sediments, slug tests were performed on most of the wells installed during Phases I and II of the RI. The analyses of these tests are presented in Appendix VIII. The calculated hydraulic conductivities are shown on table 13. The hydraulic conductivities correspond well to the geology observed during drilling and are consistent with published values for the area.

A porosity of 0.3 and a K of 230 feet per day were utilized for the velocity calculation. The average horizontal gradient in the plume area, extending from the SHI facility to Sag Harbor Cove, is 0.0021. The resulting average ground-water flow is 1.61 feet per day (588 feet per year).

The average ground-water flow is slightly greater on the SHI property. The average horizontal gradient is slightly steeper at an average value of .0028. Using the same porosity and K values (0.3 and 230 feet per day, respectively), results in an average onsite ground-water flow of 2.15 feet per day (785 feet per year).

It should be noted that hydraulic conductivity values based on slug tests represent the higher permeability sediments, such as sands, in the stratigraphy. Velocity values, derived in part from the hydraulic conductivity values, are also representative of the coarser sediments. Ground water in silts, clays or clayey sands will move at much lower velocities.

In addition to the horizontal flow, vertical gradients must be taken into consideration. Water-level measurements of the well clusters installed throughout the study area indicate both upward and downward gradients. This reflects the non-homogeneous geologic conditions of the site. Table 14 is a list of the vertical gradient per vertical foot for each well based on measurements taken on February 9, 1990 and October 25, 1991. These gradients were calculated by taking the difference between the water-level elevations divided by the difference between the well screen elevations. The elevations of the center of the screens were utilized for the calculation of screen elevation difference, except for the shallow wells where the water-table elevation was utilized.

Onsite Well Clusters MW-47 and MW-45 show downward hydraulic gradients compared to the upward gradients observed at

Well Clusters MW-28 and MW-46. Well Cluster MW-44 varies between an upward gradient and preferential flow towards the intermediate zone. This latter condition is possibly a result of small clay layers below the shallow and deep-screened wells, in conjunction with a fairly coarse material in between.

Offsite, the upgradient Well Clusters MW-48 and MW-43 (Carroll Street) and MW-49 (Noyack Road) all display downward vertical gradients. Offsite Well Clusters MW-42 (Gingerbread Bake Shop) and MW-50 (Morris Cove Road) show upward gradients. Hydrographs of Well Clusters MW-42 and MW-43 showing the gradients are presented on figures 25 and 26, respectively.

In all cases, the differences in hydraulic heads in the well clusters are very small, with localized variations in hydraulic potential being caused by the presence or absence of lower permeability layers, point sources of recharge (dry wells and septic systems), paving and ground-water discharge areas. Although the horizontal and vertical gradients in the area are similar, the ratio of horizontal to vertical hydraulic conductivities has been estimated to be about 10 to 1, resulting in predominantly horizontal ground-water movement. In general, it is expected that ground water is recharged throughout the study area, and discharges to surface-water streams or tidal zones.

3.1.7 Land Use

The majority of the land in the study area is used for residential purposes. Most of these are one-family residences and some are for seasonal use only. Several of the private residences on Carroll Street have small gardens and farm animals. Two portions of land on Carroll Street, near Well Cluster MW-43 and at the corner of Sag Harbor/Bridgehampton Turnpike, are undeveloped and wooded.

There are few industrial buildings aside from SHI (see plate 2). North of the SHI property there is a small commercial bakery which may have formerly been a service station. West of the SHI property there is a New York Telephone Company building. Outside of the study area, further north, are a few gasoline service stations. South of the study area is a service station and a village landfill which is currently being used only as a transfer station. The entire area, aside from the site area, is served by private wells and onsite sewage disposal systems. In January of 1985, public water was extended into the affected area and homeowners were supplied public water by March 1985.

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SECTION 4

4.0 NATURE AND EXTENT OF CONTAMINATION

This section is divided into seven subsections. Section 4.1 presents the results of the onsite source investigation; Section 4.2 presents the results of the ground-water investigation. Sections 4.3 and 4.4 present the results of the stream and bay sampling program and the air quality monitoring, respectively.

Section 4.5 presents the results of analytical testing of surface soils, Section 4.6 discusses the results of QA/QC issues and Section 4.7 discusses applicable or relevant and appropriate requirements (ARAR's).

4.1 Results of Source Investigation

Investigations to locate possible continuing sources of ground-water contamination on the SHI property were conducted during both Phase I and Phase II of the RI. During Phase I, sources in the form of possible buried drums, active waste disposal systems, pond sediments and soils were included as potential onsite contaminant sources. A geophysical survey, waste disposal system analysis, pond sediment and vadose zone investigations were conducted in order to identify and locate possible current sources.

The work plan for the first phase of the RI was designed to determine if there was still a ground-water contamination problem, and if so, how the concentrations changed since the SCDHS study. The work plan also covered the investigation of several potential onsite source areas. If the contamination had dissipated, the plan was designed so that little, if any, further investigation would be required. A second phase of the RI would be required if contamination was at the levels that were found in the SCDHS study.

Despite several types of investigations during Phase I, the cause, or causes, of the continuing levels of solvent concentrations were not isolated in the ground water. However, several of the potential source areas were eliminated from consideration during Phase I.

During Phase II, potential sources of contaminants in the form of possible buried drums and contaminated soils in specific locations were investigated. A geophysical survey, dry well and waste system analysis, a vadose-zone investigation and ground-water investigation were conducted to identify and locate possible continuing sources.

All samples were sent to NET Atlantic Inc., Cambridge Division (NET), a contract laboratory. All samples were analyzed by the Phase I Contract Laboratory Program (CLP) methodology outlined in Section 4 of the POP. All Form 1 data sheets have been included in Appendix IX.

All laboratory CLP data packages were submitted to Trillium, Inc. for validation. All data packages for the soil samples, surface-water samples and ground-water samples collected up to August 5, 1991 have been reviewed by Trillium and validation reports are in Appendix X. The results shown in the tables of this report reflect Trillium's comments.

4.1.1 Initial Screening of Former Rowe Industries Property

During Phase I, several surveys were performed in order to determine if there was gross soil contamination present. These surveys were designed to investigate any probable areas of contamination. The results from these surveys were utilized to determine appropriate locations for soil borings.

4.1.1.1 Phase I Geophysical Survey Results

Figure 27 is a map of the results of the August 3 and 4, 1989 electromagnetic survey. Stations with anomalies have been highlighted on the map; measurements less than 6 mmhos/m (millimhos per meter) were regarded as normal background readings for this site. In some cases, measurements peaked between stations and these peaks are also shown on figure 27. Stations with measurements above background levels that also showed negative deflections on each side of the positive deflection were considered potential areas for buried objects.

The shape of the electromagnetic trend is more important than the magnitude of the readings when interpreting the data.

West of the pond, in the wooded area delineated as "possible and probable" disturbed areas in the EPA Aerial Photograph Study (plate 3), three areas had clusters of stations with measurements above background levels. These clusters were found along the northern border (Lines A to E), along the southern border (Lines A to H) and along the eastern border adjacent to the pond (Lines I to K).

Various metal protrusions, such as lamp posts, metal pipes and cans were observed near the anomalies noted along the northern border (plate 4). The peaks noted along the southern border are attributed to surface metal and debris which was observed. In particular, metal storage trailers and large metal ramps near Lines E to H had significant influences on the nearby stations. The positive anomaly adjacent to the pond (between K5 and K6) is not a result of any visible metal objects; however, the data trend is not indicative of a buried object and heavy growth probably obscured surface metal.

Readings above background were recorded during the pond survey. Two submerged drums were observed in the pond during the spring when the water level was lower. Remnants of a flotation device constructed of metal and foam was floating on the pond surface along the southern edge. The higher readings noted in this pond are attributed to these objects. There were no substantial measurements above background within the pond to positively identify additional submerged drums.

In the parking lot east of the SHI building, readings greater than the background measurements were recorded along the perimeter of the parking area. Several metal items affected the EM readings, including the metal fence which borders the property, a storage trailer, an abandoned car and drums located along the eastern border of the property. The drum storage shed, which is adjacent to the SHI building, created the anomalies which were observed at EM Stations N-5, N-6 and N-7. These stations are located in front of the metal garage door of the drum storage shed.

4.1.1.2 Phase I Soil-Vapor Survey Results

A soil-vapor investigation was conducted on the Rowe Industries property to determine the extent of possible contamination in the vadose zone. The survey encompassed the property with emphasis east of the building towards the pond. The survey did not extend beyond the property boundary and stations west of the pond, where the ground-water table was too high. Stations east of the building that had high PID readings were excluded from the survey because the vapor concentrations exceeded the practical instrumentation limits of the GC. During the survey, each station was analyzed for TCE, PCE and TCA.

A PID reading was obtained at each location prior to analyzing the soil gas with the GC. Figure 28 is a map of the PID readings taken at each station. The highest concentrations were found east of the building along transects N, O and W. Values decreased to the north, east and west from these lines. The highest reading was at Station N-9. Some individual stations below the embankment, near Dry Well A and west of the onsite pond, had values comparable to the ranges noted in the paved area. The area around Station A-9 is just below where breaks were observed in the pipes that lead to Dry Well A. A rusted drum was also at the bottom of the bank.

East of the building at transects W,N,P, most of transect O and Stations A-9 and A-10, the PID readings indicated that volatile organic concentrations would exceed the practical instrumentation limits of the GC. Therefore, the soil vapor was not analyzed by the GC at such stations. Total VOCs detected by the GC are shown on figure 29.

The two most abundant compounds detected during the survey were PCE and TCE. Figure 30 is a map showing the PCE concentrations. Where detected, values for PCE ranged from as high as 24,039 ppb to as low as 7 ppb. The higher concentrations were observed east of the building in the paved parking area where the PID readings were also high. The values decreased to non-detectable levels further east toward the onsite pond.

PCE was also detected on the north side of the building near the loading dock (near Station U-2). The concentrations were considerably lower than those found in the parking lot east of the building. The highest value in the north area was 277 ppb (adjacent to the loading dock), as compared to 24,000 ppb which was found in the parking lot. The values decreased to non-detectable levels to the east and southwest of the loading dock.

Measurements along the southern edge of the property fluctuated between 112 ppb and 2,825 ppb, decreasing to non-detectable levels at Station V-9.

Figure 31 is a map of TCE and TCA concentrations at their respective locations. TCE was generally detected at the same stations as PCE, with TCE concentrations generally lower than PCE in the paved areas around the SHI building and higher in the wooded area east of the parking lot. TCE concentrations ranged between 2 and 2,922 ppb, as opposed to the PCE range of 7 to 24,039 ppb.

TCE values ranged between 28 and 1,097 ppb east of the building in the paved area. Along Row Q, TCE concentrations increased to the north peaking at Q-4, whereas PCE concentrations increased to the south. Station Q-4 is near the location of the two pipes that lead to Dry Well A. The highest TCE concentration (2,922 ppb) onsite was at Location B-9 near Dry Well A.

Along the northeast corner of the building, TCE concentrations ranged between 94 and 189 ppb. PCE was found at trace levels or was non-detectable in this area. These TCE concentrations decreased to non-detectable levels to the west and southwest. Trace levels were detected at discrete points on the each boring were submitted for volatile organic and Freon 113 analysis.

Two additional samples were submitted for analysis. The highest reading, which was noted on the PID during screening of Boring B-2, was within the top two feet. Because there was not enough soil recovered from this interval, the second highest reading taken from the 13 to 15-foot interval was submitted for the full TCL/TIC's and Freon 113. However, the limited soil from the 0 to 2-foot interval was submitted for the TCL volatile organic and Freon 113 analysis.

The second additional sample was taken from Boring B-3. During drilling, a thin clay layer was observed at the 14 to 16-foot interval. This clay had the highest headspace PID reading (60 ppm) for the entire Phase I onsite soil sampling program. Because there was not a sufficient amount of clay available for a full TCL/TIC's analysis, only the TCL volatile organic and Freon 113 parameters were analyzed at this interval.

4.1.2.2 Evaluation of VOA Laboratory Results from Phase I Borings

Figure 32 illustrates the volatile organic analysis (VOA) laboratory results from the onsite unsaturated soil sampling phase. Results of detected VOA's for all samples can be found in table 17.

As the map shows, the plume constituents were detected in three of the eight Phase I borings. These compounds were only detected in the paved area along the eastern border of the building in the upper 6 feet of the soil borings. The highest concentration detected in the samples was 130 ug/kg (micrograms per kilogram) of TCE in Boring B-1. This was the only occurrence of TCE found in the soil borings. PCE was detected in the sample from Boring B-2 at a concentration of 100 ug/kg. Only random occurrences of the compounds identified during the soil-vapor survey were revealed. These occurrences were only in the parking lot east of the SHI building. Neither of the compounds were detected in the loading dock area nor in the soils in the Dry Well A area.

4.1.2.3 Analysis of Non-VOA Laboratory Results from Phase I Borings

The two samples which were submitted for the full TCL/TIC's were obtained approximately 13 to 14 ft bg at Borings B-2 and B-3. Semivolatiles, pesticides and PCB's were not detected in the samples. The inorganic results for the soil borings are presented on table 18. With the exception of aluminum, iron, magnesium, potassium and sodium, the concentrations of metals were similar between samples. The above five elements were detected at higher concentrations in the sample from Boring B-2 than in the sample from Boring B-3. In most cases, the concentrations were greater in the sample from Boring B-2 by an order of magnitude.

4.1.2.4 Summary of Vadose Zone Investigation

The lack of detected parameters, plus a lack of consistency in concentrations and locations, does not provide evidence of soil contamination deeper than 6 feet in the areas investigated during Phase I. The concentrations that were detected do not indicate a continuing source of plume constituents from soils above the water table or that the random occurrences in the soil could be responsible for the vapors that were detected in the soil-vapor survey. Although the results from the soil borings did not indicate that the unsaturated zone is a source, the ground water may be responsible for the vapors that were detected by the PID during the soil-vapor survey. During Phase I of the study, the former drum storage area was inaccessible because it is not on the SHI property. It was investigated during Phase II and is discussed in Section 4.1.6.

Dry Wells D and F. The results from this study are included in table 21.

4.1.4.1 Evaluation of VOA Laboratory Results from Dry Well Sludge

With the exception of PCE found in Dry Well C, the primary plume constituents identified in Section 4.2.2 (PCE, TCE and TCA) were not detected in the dry wells surrounding the SHI building during Phase I. However, during Phase II the primary plume constituents were detected at elevated concentrations in Dry Well D and at lower concentrations in Dry Well C. The plume constituent variability in Dry Wells C and D observed during Phases I and II reflect the nonhomogeneous nature of the sludge, and is not believed to be related to a current source.

Dry Well D

Dry Well D is located inside a garage area where vehicles and various pieces of equipment are stored. The sludge in the dry well contained isolated occurrences of the primary plume constituents. Trichloroethene was detected at a concentration as high as 27,000 ug/kg. The laboratory reported that the samples were nonhomogeneous and concentration differences noted between Phase I and Phase II results supports this. Because of the variability, the concentrations are probably not representative of all of the sludge. The 27,000 ug/kg concentration of TCE probably represents the high end of the range of concentrations.

The dry well sludge also contained elevated levels of aromatic volatile organic constituents, including toluene, xylene, and ethylbenzene. Acetone was detected at 19,000 ug/kg.

The concentrations of solvents in the soil which underlies the sludge were sharply lower than concentrations in the sludge. This indicates that portions of the sludge are acting as a source to the underlying soils and ground water, although significant concentrations are not being retained by the soil.

During the first phase of the RI, concentrations of Freon 113, methylene chloride and acetone were detected in the sludge from Dry Wells F, E and D. Because these compounds were detected in the method blanks, the results were invalidated as common laboratory contaminants. Although other samples from other locations also were reported to contain these compounds, the dry well sample concentrations were significantly higher. Therefore, at the recommendation of the validator, split samples of the sludge were submitted to Technical Testing Laboratory (TTL) to confirm the presence of laboratory solvents in the sludge. Based on the validators' experience, there is little risk of cross-contamination of laboratory solvents at TTL because of the physical layout of the laboratory. Because of this advantage, the detection of Freon 113, methylene chloride and acetone would not be attributed to laboratory interference. Split samples from the sludge and soil in Dry Well D are designated 194T and 195T, respectively.

For Dry Well D, there were Phase I occurrences of methylene chloride and Freon 113 that were rejected or had the detection limits raised by the validator to the detected level. Acetone was not detected. Of the three laboratory solvents, only acetone was detected in the sludge during Phase II. The result from TTL was lower than that of Net-Atlantic, 2,700 ug/kg versus 19,000 ug/kg. This variability in concentration is attributed to the nonhomogeneous nature of each sample. The other laboratory solvents were not detected in the Phase II samples; therefore, the Phase I occurrences of solvents attributed to laboratory contamination could not be confirmed.

Dry Well C

Dry Well C is located in the parking lot east of the SHI building. It is directly connected with Dry Well D, serving as an overflow to Dry Well D. Throughout the RI, Dry Well C was never observed to contain fresh sludge, water or wet soil.

Tetrachloroethene was the only compound detected in the sludge and the soil in the dry well. The sludge sample had a concentration of 6,900 ug/kg and the soil sample had a concentration of 1,100 ug/kg. The soil sample was a composite of both the upper sludge sediment and the underlying soil, thus may not reflect the exact chemical characteristic of the underlying soil.

The presence of PCE in the dry well is attributed to direct discharge from Dry Well D into Dry Well C over time. The chemistry of the sludge in Dry Well D is different than in C; however, it is unknown what chemicals were in use at the times that Dry Well D spilled into Dry Well C, thus the chemistry could be expected to be different. Also, the dry nature of the sludge in Dry Well C would allow the more volatile solvents to be released.

Although the concentrations and chemical occurrences are not as extensive as in Dry Well D, the sludge in Dry Well C can still act as a source to the ground water. A hydrograph of nearby well N-28 (figure 33) shows elevations of the ground water ranging between about 7.5 and 10.0 feet above sea level, a range of 2.5 feet. The bottom of Dry Well C is at an elevation of about 11.75 feet. It is possible that isolated events of high ground water could saturate some of the contaminated soil in Dry Well C and leach PCE into the ground water.

Dry Well E

Dry Well E is located in the parking lot north of the SHI building and is actively used for some of the restrooms. None of the primary plume constituents were detected in either the sludge or the underlying soil of the dry well. The only constituent detected in this dry well was 230 ug/kg of toluene in the upper 6 inches of the sludge during Phase I. Presence of toluene is suspected to be related to current activities.

Dry Well F

Dry Well F is located west of the SHI building and is an active septic disposal system. None of the primary (PCE, TCE and TCA) or secondary (1,1-DCE, 1,1-DCA and 1,2-DCE) plume constituents were detected in the sludge or soil. However, elevated levels of Freon 113, toluene, methylene chloride, xylene, ethylbenzene and 2-butanone were detected in the sludge. Freon 113 was detected at the highest concentration at 230,000 ug/kg, followed by toluene at 27,000 ug/kg. The underlying soil was generally clean. These compounds are not associated with the plume; therefore, they appear to be related to more recent activities.

There were Phase I occurrences of methylene chloride, acetone and Freon 113 that were rejected or had detection limits raised by the validator to the detected level. Split samples from the sludge and soil in Dry Well F are designated as 196T and 197T, respectively. Of the laboratory solvents, only acetone was detected in the sample analyzed by TTL; however, the methylene chloride and Freon 113 were detected in the sample analyzed by NET. These results were validated; therefore, they can be considered to be present in the dry well.

4.1.4.2 Evaluation of VOA Laboratory Results from Dry Well Rinsate

Of the dry wells which were sampled for water during Phase I of the RI, which was obtained by flushing deionized water through the drainage systems, only Dry Well D had a positive detection. One ug/l (microgram per liter) of PCE was reported from the pipe leading to Dry Well D.

4.1.4.3 Summary of Septic Dry Well Study

The septic disposal system study shows that the sludge in Dry Wells D and C are likely contributing the primary and secondary plume constituents to the ground water. The sludge in Dry Well F contains elevated concentrations of other compounds which may be leaching into the ground water. These other compounds appear to be related to current or recent activities because there is no evidence of use of these compounds by Rowe Industries.

The underlying soils in the dry wells do not appear to be retaining significant concentrations of the detected compounds. The investigation of Dry Well A as a potential source is discussed in Section 4.1.5.

4.1.5 Investigation of Dry Well A

Sediment was collected from Dry Well A during both phases of the RI. Samples were analyzed for the complete TCL/TIC's and Freon 113 during Phase I and for VOCs and Freon 113 during Phase II. A summary of detected volatile organics data and all metals data can be found in tables 21 and 18.

In addition to the sediment investigation, two well clusters were installed near the dry well (see plate 1). These wells were installed to serve as permanent monitoring locations to determine residual impacts on ground-water quality from past chemical disposal in the dry well.

4.1.5.1 Evaluation of VOA Laboratory Results From Dry Well A

The sludge collected from Dry Well A during Phase I had plume constituents present. The highest concentrations were for PCE and TCE at 210 and 250 ug/kg, respectively. During the Phase II sampling program, the sludge and sediment collected below the sludge (down to 4 feet) had no plume constituents present.

Because the dry well had a history of continuous use prior to 1975, when manufacturing ceased at the building, the occurrence of plume constituents was not unexpected; however, the concentrations were lower than expected. In the years since disposal to the dry well ceased, the solvents apparently degraded and volatilized in the dry setting of the dry well.

4.1.5.2 Evaluation of Non-VOA Laboratory Results From Dry Well A

Sediments from Dry Well A were analyzed for the full TCL/TIC's and Freon 113. Semivolatiles, pesticides and PCB's were not detected in the sediment. The inorganic data indicated a high iron content in the soil, but not unusual compared to what has been detected throughout the study area. Concentrations of copper, lead, chromium, silver, nickel and zinc were detected in Dry Well A at levels higher than observed in the other samples collected during the RI. Concentrations of chromium were especially high and may be related to the punch presses which Rowe Industries utilized for the manufacturing process. The other metals may be related to wire motor windings and solder.

4.1.5.3 Ground-Water Results Near Dry Well A

In addition to the sediment investigation, ground-water monitor wells were installed near Dry Well A to determine if soil-vapor concentrations detected in this area originated from the ground water. MW-46A and MW-46B were installed to investigate ground water near a pipe break at the toe of a slope, slightly west of the dry well. MW-47A and MW-47B were installed downgradient of the dry well.

During drilling of pilot holes for the two well clusters, soil samples were set aside for PID screening. Results of these measurements are on table 16 and figure 18. The PID readings remained under 10 ppm in B-46 and under 20 ppm in B-47.

The PID readings generally decreased with depth in B-46 and increased with depth in B-47. Because of the higher PID readings observed at B-47, a soil sample was sent to the laboratory for volatile organic compound and Freon 113 analysis. The sample was collected from the 26 to 28-foot interval where a 0.25-foot silty clay layer was observed and the PID measured 16 ppm.

The soil sample submitted from the pilot borehole showed no detection of VOCs or Freon 113. Results from the organic analysis are shown on table 17.

Ground-water samples were collected from the new well clusters on July 30, 1991. Samples were analyzed for TCL VOCs, Freon 113 and TCL metals. The list of parameters each well was analyzed for is presented on table 7. Prior to collecting each sample the pH, conductivity, temperature and turbidity were monitored, and the final stabilized parameter measurements are listed on table 22.

4.1.5.3.1 Evaluation of VOA Laboratory Results for Ground Water Near Dry Well A

The ground-water VOA laboratory results for the samples from Well Clusters 46 and 47 are shown on plate 5. The results of the detected VOA's for all samples can be found in table 23.

As shown on the plate and table, levels of PCE, TCE, TCA and 1,1-dichloroethane were detected in the samples from both shallow wells MW-46A and MW-47A. Concentrations were generally higher in the sample from MW-47A than the sample from MW-46A. The highest concentration in MW-46A was TCE at 18 ug/l, whereas the highest concentration in MW-47A was TCE at 160 ug/l.

The only primary plume constituent detected in the samples from the intermediate depth wells was 3.0 ug/l of PCE found in the sample from MW-47B. Therefore, the higher PID readings at the bottom of the borehole are not explained by the water-quality data.

4.1.5.3.2 Evaluation of Metals Laboratory Results for Ground Water Near Dry Well A

The metals laboratory results from the samples from both well clusters (MW-46 and MW-47) can be found in table 24. The soil samples from the dry well contained elevated concentrations of copper, chromium, lead, silver, nickel and zinc when compared with other samples. In the ground water, copper, chromium, nickel and zinc were not found at concentrations any higher than in other wells, including an upgradient well pair. Silver was not detected.

Most of the lead results were flagged as estimates and therefore are questionable. The samples from the deeper screened wells at each cluster had reported lead results slightly higher than the ARAR of 0.025 mg/l, but similar to the levels in several other wells in the study area. Well Cluster MW-50, north of Sag Harbor Cove, had lead results comparable to other monitor wells in the study area. However, this cluster has not been impacted by the VOC plume implying that the occurrence of lead is a local (natural) phenomenon.

4.1.5.4 Summary of Dry Well A Investigation

The soil and ground-water investigation of Dry Well A indicates that the dry well is not a significant continuing source of contamination. The soils collected from the dry well contained low levels of most of the previously-identified plume constituents in the uppermost sludge. Soils below the top layer were contaminant free.

The ground-water results had residual levels of the plume constituents. As expected, Well Cluster MW-47, which is adjacent to the dry well, had higher concentrations of the plume constituents than Well Cluster MW-46. However, the concentrations detected were not high enough to indicate that a significant continuing source is leaching into the ground water or that ground water in the area is contributing significantly to the plume. In addition, the contaminants, with the exception of trace levels of PCE in MW-47B, were primarily detected in the shallow wells.

There is no indication that the elevated metals detected in the sludge and soil in the dry well are impacting the local ground water.

4.1.6 Investigation of Former Drum Storage Area

During Phase I of the RI, results from the soil-vapor survey showed the highest concentrations of plume constituents in the vicinity of the former drum storage area. However, permission to work in this privately owned area was not obtained until Phase II of the RI. During Phase II, a soil-vapor survey was performed and six soil borings were drilled in the former drum storage area. In addition, three shallow wells and an intermediate depth well were installed slightly downgradient of the drum storage area.

4.1.6.1 Soil-Vapor Survey Results in the Former Drum Storage Area

A soil-vapor investigation was conducted in the former drum storage area to locate potential contamination sources. All stations were analyzed with a PID. For stations where the concentrations were not excessive, a GC was utilized to analyze for TCE, PCE, TCA and total detected volatile organics (sum of area defined by all known and unknown peaks). The chromatographs can be found in Appendix XII. The PID readings are shown on figure 34 and the GC results are shown on figure 35.

The analysis of soil vapor revealed high solvent concentrations in the western portion of the fenced-in area. This area corresponds to the ground stain areas identified in the EPA aerial photographic study. The concentrations of solvents decreased to the east and south. PCE was the dominant compound detected, followed by low to non-detectable levels of TCA and TCE.

Three areas of particular interest were discovered. A zone of high PID readings exists between BB2, CC1 and CC2. An isolated hot spot, the highest of the survey, was detected at Station DD-3. The third area of interest was at Station EE-3, where a stained area was observed.

During the soil-vapor survey and subsequent drilling, a cement pad and cement block wall were discovered. These are shown on figure 7. The location of the wall corresponds well with the limit of high vapor readings. For example, concentrations of volatile organics in the vapor at Station DD-4, which is to the east and on the other side of the wall from Station DD-3, are sharply lower than at Station DD-3.

It appears that the primary portion of the storage area was probably at the cement pad, with the cement block wall defining the limit of the storage area. Cement was not observed between the southern limit of the pad and the wall; therefore, any spillage in this area would directly infiltrate into the ground.

4.1.6.2 Soil Boring Results From the Former Drum Storage Area

As a result of the soil-vapor survey in the former drum storage area, two soil borings were initially planned to determine the vertical extent of contamination and define the underlying stratigraphy. Observations and PID screening measurements made during the drilling resulted in a decision to drill additional borings. Four additional borings were drilled to define the horizontal extent of contamination detected in the drum storage area.

4.1.6.2.1 Selection of Locations and Drilling of Phase II Borings in the Former Drum Storage Area

The six boring locations are shown on plate 1 and figure 7. The borings were drilled in the first two areas of high vapor concentrations discussed above.

Each sample interval from each boring was screened with a PID. Table 16 shows the PID results of the screened samples from each boring. Samples submitted to the laboratory for analysis are indicated on the table. Table 3 lists the parameters each sample was analyzed for and which samples were split with Alliance Technologies, Inc.

Boring B-9 was installed between Stations BB-2, CC-2 and CC-1 on May 16, 1991. The boring was completed to a depth of 45 ft bg with split-spoon samples collected continuously. Clay layers were encountered throughout the boring ranging from 0.35 to 1.05 feet thick. During drilling, the ambient air quality never exceeded 3 ppm but was as high as 23 ppm in the auger headspace. Although no odors were detected and no stains were observed, elevated headspace readings were measured in most of the samples from above the water table.

Three samples were submitted from B-9 for volatile organic and Freon 113 analysis. Samples with the highest measurements detected with the PID from above and below the water table were sent to the laboratory for analysis. In addition, one sample collected just below a clay layer encountered at 25.5 feet was submitted to the laboratory.

Boring B-10 was installed near soil-vapor survey location DD-3 on May 17 to 18, 1991. The boring was completed to a depth of 46 ft bg with split-spoon samples collected continuously. Silty clay was encountered throughout the boring ranging from 0.15-foot thick to 0.70-foot thick.

During drilling of Boring B-10, a green stain was observed between 0 and 2 and again between 4 and 8 ft bg. A red stain was observed between 4 and 6 ft bg. In addition to the staining, the sediment was moist and a strong odor was detected down to the water table which was encountered at 22 ft bg. As with Boring B-10, high headspace readings were measured throughout the unsaturated zone. Three samples below the water table had high headspace PID readings, all occurring above clay and silt layers. The ambient air quality never exceeded 3 ppm but was as high as 20 ppm in the auger headspace.

Four samples from B-10 were submitted for laboratory analysis. The highest PID reading for the screened samples collected at B-10 was detected between 2 and 6 ft bg. A sample from 4 to 6 ft bg was submitted for the full TCL/TIC's and Freon 113 analysis. A sample from 12 to 14 ft bg was submitted for TCL volatile organics and Freon 113 analysis because the soil had a high PID reading and clay was observed in the tip of the split spoon. Two samples were submitted for laboratory analysis from below the water table at 24 to 26 and 42 to 44 ft bg, because high PID readings and clay were observed at these intervals.

The screened soil samples and obvious odor from B-10 led to a field decision to drill additional borings to define the horizontal extent of contaminated soil. All borings were completed to a depth of 14 ft bg, the zone where most of the contamination was detected in B-10.

Boring B-11 was drilled 5 feet southeast of B-10 and Boring B-12 was drilled 5 feet north of B-10 on May 20, 1991. Boring B-13 was drilled 5 feet west of B-10 and Boring B-14 was drilled 10 feet west of B-10 on May 21, 1991. One sample from above the water table was submitted from Boring B-13 for laboratory analysis. The highest PID reading measured during the entire soil investigation was a clay layer 12 ft bg at Boring B-13. A sample of this soil was submitted to the laboratory for analysis of volatile organics and Freon 113.

Portions of the soil from B-11 were stained and had an odor from grade to about 10 ft bg. Boring B-12 penetrated the cement pad. Although no staining was observed, a slight odor was detected and elevated head space PID readings were measured below the pad.

High headspace PID readings were measured throughout B-13, with staining and apparent chemical saturation observed. Although no staining or strong odors were detected in B-14, high headspace readings were measured from 4 to 14 ft bg.

A surface soil sample of the stained area at Station EE-3 was collected manually. Table 15 lists the total drilled depth, a summary of the geology and water-table depth for each boring. The geologic logs for these borings are located in Appendix XI.

4.1.6.2.2 Evaluation of VOA Laboratory Results from Borings

The non-rejected VOA laboratory results from the drum storage area are shown on figure 32. Results of the detected VOA's for all samples can be found in table 17.

As shown on the figure, PCE was detected in all of the samples. An isolated occurrence of TCE was detected in the shallow sample from B-10. In addition to these constituents, toluene and ethylbenzene were detected in B-10, xylene was detected in both B-10 and B-13 and chlorobenzene was detected in B-13.

The highest concentrations of the chemicals were detected in the unsaturated soil. PCE was the most prevalent compound found in the samples. The highest concentration of PCE was 67,000 ug/kg in B-10 (at the 12 to 14-foot interval).

Xylene was detected at concentrations as high as 66,000 ug/kg, which was from the 2 to 4-foot interval from B-10. Ethylbenzene was detected in B-10 as high as 3,800 ug/kg. Toluene was detected at 2,100 ug/kg in B-10 at the shallow 4 to 6-foot interval.

Ten TICs were detected in the sample collected from 4 to 6 ft bg in B-10. Most were unknowns, with the others reported as a substituted alkane, C8H16 isomer, naphthalene and a substituted benzene isomer. Estimated concentrations ranged from 18,000 to 64,000 ug/kg. The TICs are summarized on table 25.

Consistent with the field screening results, the laboratory data show significant concentrations of solvents in the unsaturated soils. All of the borings encountered solvent contamination. Below the water table, the concentrations are sharply lower. At B-10, elevated zones of solvents were detected below the water table, above clay layers.

4.1.6.2.3 Evaluation of Non-VOA Laboratory Results from Borings

One sample, collected from 4 to 6 ft bg at B-10, was submitted for the full TCL/TIC's analysis. One semivolatile organic compound, bis (2-ethylhexyl) phthalate, was detected at a concentration of 360 ug/kg.

The metals results for the soil borings are included on table 18. With the exception of copper, silver and zinc, the metal concentrations in B-10 are similar to concentrations from borings drilled onsite during Phase I. The concentrations of these metals are comparable to concentrations observed in Dry Well A.

Twenty semivolatile organic TIC's were reported in the sample from B-10. The TICs are shown on table 25. Most of the TICs are listed as unknown alkanes. One TIC is an unknown aldol. These estimated concentrations range from 2,500 to 13,000 ug/kg.

4.1.6.3 Former Drum Storage Area Ground-Water Results

A ground-water study immediately downgradient of the former drum storage area was conducted in addition to the soil investigation. Although the MW-45 cluster was originally thought to be downgradient of the drum storage area, water-level data indicated that the cluster was not directly downgradient. Therefore, MW-51A and MW-52A were installed.

During drilling of the wells, soil samples were set aside for screening using a PID. Results of these measurements are on table 16 and are shown on figure 16. In general, the PID readings at Well Cluster 45 remained under 20 ppm with the exception of intervals 4 to 6 feet and 8 to 10 feet which had readings of 90 and 70 ppm, respectively. Samples from these intervals were submitted to the laboratory for TCL volatile organic and Freon 113 analysis. The PID readings remained under 10 ppm in both MW-51A and MW-52A boreholes, with the exception of the 4 to 6-foot interval at MW-52A which had a reading of 20 ppm.

The two samples submitted from the pilot borehole showed no detection of TCL VOCs or Freon 113. Results from the organic analysis are shown on table 17.

Ground-water samples were analyzed for TCL VOCs, Freon 113 and TCL metals. Prior to collecting each sample, the pH, conductivity, temperature and turbidity were monitored. Sampling did not occur until each parameter had stabilized, confirming that representative formation water was sampled. The final stabilized parameter measurements are listed on table 22.

4.1.6.3.1 Evaluation of VOA Laboratory Results for Ground Water Near the Former Drum Storage Area

The non-rejected ground-water VOA laboratory results from the samples from the wells are shown on plate 5. Results of the detected VOA's for all parameters can be found in table 23.

The dominant compound detected in the soil was PCE. PCE was also the primary compound detected in the ground water; however, the concentrations were much lower than anticipated. The highest concentrations were detected in MW-51A.

Data from this investigation and from the SCDHS study indicate that the plume emanating from the former drum storage area is in the upper portion of the aquifer. There are several thin clay layers in the formation beneath the drum storage area. It is possible that the geologic complexity could be creating preferred pathways of migration that are somewhat different than would be expected from a homogeneous formation.

4.1.6.3.2 Evaluation of Non-VOA Laboratory Results for Ground Water Near the Former Drum Storage Area

The non-rejected inorganic laboratory results for the samples from the wells can be found in table 24. The metals that appeared to be above typical levels in B-10 (copper, silver and zinc) were either not detected in the ground water or were at concentrations typical of the area. All other metals, except for antimony, were at concentrations typical of the area.

Antimony was detected in the sample from MW-45A at a concentration of 34.4 ug/l. This result is slightly above the detection limit and is anomalous compared to the other wells in the study area.

4.1.6.4 Summary of the Former Drum Storage Area Investigation

The results of the soils investigation in the former drum storage area reveal an area of about 20 feet by 20 feet, and down to about 16 ft bg, where varying concentrations of solvents, primarily PCE, are present. Some of the soils appear saturated with solvent. There do not appear to be significant concentrations of solvents retained in the soil below the water table.

The concentrations of PCE in the monitor wells immediately downgradient of the drum storage area are surprisingly low when considering the levels of solvent detected in the soil. It is possible that the multiple small clay layers are resulting in preferred pathways of flow that do not precisely intersect the well locations.

4.1.7 Investigation of Buried Fire Debris Beneath SHI Facility

The area beneath, and in the vicinity of, the SHI building was investigated in an effort to locate possible buried drums. This area was razed after the 1965 fire destroyed the former Rowe Industries building. Figure 36 shows the old Rowe building compared to the current SHI facility.

4.1.7.1 Geophysical Survey Results of North Parking Lot

Figure 37 is a map of the May 1, 1991 EM survey results. Stations with anomalies have been highlighted on the map. Because the perimeter of the survey is occupied by a chain-link fence and the northern edge of the SHI building, the EM response considered to be normal background for this area was slightly higher than the Phase I geophysical survey. Measurements less than 7 mmhos/m were regarded as normal background readings for this site. Stations with measurements above background levels were considered potential areas for buried objects. The data from this survey can be found in Appendix XIII.

Readings above background were observed along the southeast corner of the survey (Stations A-9 through A-5). These readings are attributed to the close proximity to the SHI building and the fence. Negative deflections observed at Stations E-4, E-5 and E-6 are directly related to Dry Well E. Stations B-4 and B-3 had high readings that reflected metal-interference from the building. There were no consistent readings indicative of buried drums.

4.1.7.2 Soil-Vapor Results Beneath SHI Building

A soil-vapor survey was conducted beneath and immediately outside the eastern border of the current SHI building. All stations were analyzed for TCE, PCE, TCA and total detected volatile organics (sum of areas defined by all known and unknown peaks). The chromatographs can be found in Appendix XII.

Figure 38 is a map of the PID readings obtained inside the northeastern portion of the building and in the parking area east of the building. Because of instrument difficulty, not all stations were analyzed with the PID inside the building. The highest PID responses were found near Dry Wells C and D and inside the northeast corner of the SHI building.

Figure 39 is a map showing the GC results inside the building and in the parking area east of the building. TCA was the most abundant compound found at sampling locations beneath the building. TCA was also found at the highest concentration in Dry Well D. The highest vapor concentration of TCA was detected at Station GG-5 at 5,846 ppb. TCA concentrations decreased to non-detectable levels east of Station GG-5. Stations GG-12, TT-1, TT-2, TT-3 and TT-4 had relatively high concentrations of TCA. TCA also occurred near Dry Well D. TCA was not detected in any of the stations analyzed in the parking area east of the building.

TCE was the second most abundant compound detected beneath the building. Where detected, TCE concentrations ranged between 614 to 2 ppb. The highest concentrations were detected at Stations TT-3 and TT-4. TCE values decreased to the north, east and west.

The highest concentration of PCE was detected adjacent to Dry Well D at Station GG-7 at 356 ppb. PCE values decreased west and north of Station GG-7 to low to non-detected levels. These PID and GC concentrations are significantly lower than were measured in the drum storage area and beneath a portion of the eastern parking lot.

4.1.7.3 Results of Soil Borings Drilled Beneath SHI Building

Two soil borings were drilled beneath the SHI building to determine if demolition material from the fire which destroyed the former Rowe Industries building and/or undisturbed drums are buried under the existing building.

4.1.7.3.1 Selection of Locations and Drilling of Phase II Borings Inside the SHI Facility

The two boring locations are shown on plate 1. One location was chosen at soil-vapor survey Station GG-12. This location was selected because solvent concentrations as measured by the GC were locally elevated at this station. The second boring location was located at Station GG-5. This location was also selected because of localized high vapor concentrations.

Boring B-15 was initially drilled adjacent to soil-vapor Station GG-12 on June 4, 1991. Drilling was terminated at 3 ft bg when an impenetrable layer was encountered. Water collected above this layer and vapor in the hole measured 67 ppm on the PID. A sample of the water was submitted to the laboratory for TCL volatile organics and Freon 113 analysis. The boring was sealed with bentonite and B-15A was relocated 4.5 feet to the east.

Boring B-15A was drilled to a depth of 10 feet on June 4, 1991. Medium to fine sand with a trace of crushed cobbles and fine gravel were encountered in this borehole.

Boring B-16 was drilled near soil-vapor survey Station GG-5 on June 5, 1991. The boring was completed through medium to fine sand with a trace fine gravel to a depth of 10 ft bg. Neither of the borings revealed any debris.

Each sample interval from both borings were screened with a PID. Table 16 shows the PID results of the screened samples for each boring. All of the PID readings were low (less than 1 ppm). Samples from the 2 to 4-foot interval were submitted from both borings for analysis for TCL VOCs and Freon 113.

4.1.7.3.2 Evaluation of VOA Laboratory Results from Borings

The TCA, TCE and PCE laboratory results from the borings inside the building are shown on figure 32. Results of the detected VOAs for all parameters can be found in table 17.

As shown on the table, only 1 ug/kg of toluene and xylene and 2 ug/kg of ethylbenzene were detected in the sample collected from B-16 and the only parameter detected in B-15A was 1 ug/kg of PCE.

The water sample collected from B-15 did not contain any plume constituents. However, the sample did have aromatic volatile compounds detected with 3,400 ug/kg of toluene, 2,700 ug/kg of xylene, 1,000 ug/kg of benzene and 500 ug/kg of ethylbenzene present. Except for benzene, these compounds were also present in sludge in Dry Well D. Table 26 is a summary of the water results collected in B-15.

4.1.7.3.3 Summary of Buried Debris Investigation

The investigation beneath the SHI facility showed the presence of VOCs in the soil vapor under the building. However, soil samples collected from borings located near the highest soil-vapor survey stations did not contain contamination indicative of a source for the current plume. The aromatic volatile compounds detected in the soil at B-16 are attributed to the current use of the area as a garage which houses landscaping equipment.

The water sample collected from the aborted Boring B-15 may have been stagnant water perched above the impenetrable layer. The origin of this water is unknown. Although it contained aromatic volatile compounds, it appears unrelated to the Rowe activities because the primary plume constituents were not detected. During the soil-vapor survey and drilling of borings, buried debris and/or fill related to the 1965 fire was not observed. Because the soils from the borings contained only trace levels of contaminants, the soil-vapor results are attributed to vapor from the underlying ground-water.

The area north and immediately east of the building did not have EM anomalies that were indicative of buried containers. The negative deflections observed at Stations E4 to E6 are related to the close proximity of Dry Well E. The Phase I soil-vapor survey did not reveal any elevated concentrations indicative of a source beneath the north parking lot.

All studies conducted beneath the building and north parking lot indicate that this area is not a source of continuing contamination.

4.1.8 Additional Investigation of Areas Identified in EPA Aerial Photographic Study

Most of the areas identified in the EPA aerial photographic study of the Rowe Industry site were investigated during Phase I of the RI. These investigations are discussed in Section 4.1.1 and encompass most of the areas delineated in the EPA study (see plate 3). However, a few areas were not thoroughly explored. The Phase II study included a soil-vapor survey and visual inspection of these specific locations.

4.1.8.1 Soil-Vapor Survey Results

A soil-vapor investigation was conducted at locations identified as "possible" and "probable" features in the 1986 EPA aerial photographic study. A ground-water headspace analysis was performed at the stations west of the pond. This area had been excluded from the Phase I soil-vapor survey because of the high water table. All stations surveyed were analyzed for TCE, PCE, TCA and total detected volatile organics (sum of areas defined by all known and unknown peaks). The chromatographs can be found in Appendix XII.

Figure 40 is a map showing the PID and GC results collected during analysis. PID measurements were not collected west of the pond where the water table was near grade. None of the GC results revealed vapor concentrations that could be attributed to anything other than vapors detected on a site-wide basis.

4.1.8.2 Results of Visual Inspections

A visual investigation was conducted at locations identified as ground stains, ground scars, disturbed ground and a possible trench.

Most of these features were not observed during the inspection. Three drum lids with dark staining of the ground under the lids were observed in the former drum storage area south of soil-vapor Station BB-3. The stained ground had a slight fuel-oil odor.

Another dark-stained area was observed in the former drum storage area, 3 feet north of soil-vapor Station EE-3. A sample was collected from the stained area 1 ft bg on May 17, 1991 and sent to the laboratory for TCL volatile organics and Freon 113 analysis. Results from this analysis are shown on table 17. PCE was detected at a concentration of 16 ppb from this sampling location. No other constituents were detected.

4.1.8.3 Summary of Additional Investigation of EPA Aerial Photographic Study

The concentrations found at Station BK-1 are attributed to the close proximity to the former drum storage area. The occurrence of PCE and TCE at locations east of the building do not exceed concentrations detected in the vicinity during both phases of the study. The negligible concentration of TCE west of the pond also does not imply a nearby source. Overall, the results from this phase of the study indicate that there are no potential sources of contamination from the additional features that were investigated.

4.2 Ground-Water Quality

Ground-water samples were collected from the new onsite wells, the new offsite wells, representative existing SCDHS wells and several private homeowner wells. The samples were collected to determine the current extent of the plume and to evaluate changes in concentrations over time.

During Phase I of the RI, two rounds of samples were collected from the new wells, the onsite wells and select offsite wells. Samples were analyzed for the complete TCL/TICs and Freon 113, or TCL VOCs and Freon 113, during the first round. Only TCL VOCs, Freon 113 and dissolved and total metals were collected during the second round of sampling.

During Phase II of the RI, two rounds of samples were collected. Samples were collected from the new onsite and offsite wells, the 1989 offsite wells and select SCDHS offsite wells. Samples were analyzed for TCL VOCs, Freon 113 and total metals.

Tables 5 and 7 list the parameters that the samples from each well were analyzed for during both phases of the RI.

4.2.1 Well Evacuation

During evacuation, prior to collecting ground-water samples, pH, conductivity, temperature and turbidity were monitored. Evacuation of the water was not considered complete until each parameter had stabilized, confirming that representative formation water was sampled. The final stabilized parameter measurements for all of the ground-water samples are listed on table 22.

The new wells were not sampled until the turbidity measurement was below 50 NTUs at each well. In some cases, the evacuated well water prior to sampling was below 50 NTUs, but exceeded the limit when sampled. An attempt was made to achieve less than 50 NTUs for the SCDHS wells; however, the lack of gravel pack in the construction of these wells often made this impossible.

The ground water in the study area is slightly acidic. During the Phase I sampling program the pH values ranged between 5.05 and 6.73, with an average of 5.9. The specific conductance of the ground water in the area ranged between 40 and 760 umhos/cm (micromhos per centimeter) with an average value of 183 umhos/cm. During the Phase II sampling program, the pH values were slightly higher ranging between 6.45 and 6.95.

The intermediate well by the former drum storage area, MW-45B, had an anomalous pH of 9.35 during the first sampling round; however, it dropped to a more typical regional level of 6.80 by the second round. There may have been some residual impacts from grouting during the first round. The specific conductance for the ground water in the area during Phase II ranged between 106 and 338 umhos/cm.

4.2.2 Overview of VOA Results

The studies have established TCE, TCA and PCE as the prevailing compounds on the site. These three constituents are referred to as the current primary plume constituents.

As with the 1984 SCDHS study, the highest concentrations of TCE, TCA and PCE detected during both Phase I and Phase II of the sampling program were located on the SHI property.

Plates 5 and 6 and tables 23, 24 and 27 show the results of both phases of ground-water sampling, on and off the SHI property, respectively. For a comparison to the 1984 data, refer to the tables or figure 1 of the SCDHS report in Appendix II.

Table 27 shows only the results of samples from residential wells with detectable VOCs. Several other private wells (shown on plate 2 with identification numbers) were sampled in 1984, but are not shown on table 27. These wells had no detectable concentrations of organic compounds.

Of the primary compounds found in the study area, PCE was detected at the highest concentrations. The highest concentrations were generally found in the ground water on the SHI property. During Phase I of the RI, the highest concentration of PCE was found in the second-round 1990 sample from Well N-28 (12,000 ug/l). During Phase II of the RI, the highest concentration of PCE was 6,900 ug/l in the sample from Well N-26 which is located northeast of N-28.

The compound found at the second highest concentration during Phase I was TCA. TCA occurred in a similar pattern as PCE. The highest concentration found onsite was 690 ug/l, also from the Well N-28 sample. Finally, TCE was found at the lowest concentrations of the three primary plume constituents during the Phase I sampling program. The highest concentration was detected in the sample from Well N-28 at a concentration of 530 ug/l.

The Phase II results indicated fairly similar concentrations of both TCA and TCE, with TCE levels only slightly lower. The highest level of TCA was detected in the sample from offsite Well MW-49B at a concentration of 330 ug/l. The second highest occurrence of TCA was detected onsite in the sample from Well N-27 at a concentration of 110 ug/l. The highest concentration of TCE was detected in the sample from offsite Well MW-49B at a concentration of 170 ug/l. The highest concentration onsite was 160 ug/l in the sample from Well MW-47A.

4.2.3 Evaluation of Onsite VOA Ground-Water Results

PCE was the compound detected in the ground water at the highest concentrations with much lower concentrations of TCE and TCA. However, the sample from MW-47A, located north of Dry Well A, had higher concentrations of TCE and TCA than PCE, consistent with the Phase I soil-vapor survey results (Section 4.1.1.2).

The highest concentrations of solvents in ground water are in the N-24, N-26, N-27 and N-28A areas similar to the 1984 SCDHS results. Several source areas could be contributing solvents to the ground water in these areas. The chemistry of the soils beneath the former drum storage area, upgradient from these wells, is very similar to the chemistry of the ground water. Another possible source is from the 4-inch pipes which lead from the building to Dry Well A. There is currently no access to the pipes in the building. These pipes were broken in the parking lot area and sampled by SCDHS (table 2). The pipes were reported to be in poor condition and could have leaked and are still in place. The third possible source is from Dry Wells D and C.

The data show that the onsite plume remains in the upper 10 feet of the aquifer upgradient of Monitor Well N-24. At N-24, the plume concentrations increase in the intermediate zone of the aquifer (approximately 25 feet below the water table). At the northern property line, concentrations are highest in the intermediate zone (N-32, N-31 and MW-44).

Well Cluster MW-44 is downgradient of the northeastern corner of the SHI building; therefore, it would intersect ground water passing beneath the building. The chemistry of the ground water from the wells in this cluster appears to be similar to the other wells but at lower concentrations. Wells N-24, N-25, N-26 and N-27 appear to be centered in the plume, with Cluster MW-44 somewhat west of the center of the plume. Water quality at N-25 has lower levels of VOCs compared to Wells N-24, N-26 and N-27. This difference in chemistry may be caused by differences in the local geology surrounding Well N-25, causing the well to not be in the preferred pathway of flow.

Because the chemistry of the water from Cluster MW-44 is similar to that of N-24 and N-25, but at a lower concentration, and because the depth of the plume is similar between these wells, it provides further evidence that a significant source does not exist beneath the building.

The data do not indicate any significant concentrations of plume constituents in the Dry Well A area.

Total detected organic compounds for the onsite wells in 1989 through 1991 generally remained the same or increased compared with the 1984 study. PCE showed an increase in concentration in most wells while both TCE and TCA generally showed a decrease in concentration.

In addition to the primary plume constituents, Freon 113 and methylene chloride were occasionally detected in Wells N-26, N-27 and N-28 at concentrations higher than can be attributed to laboratory contamination and, thus, were validated. These wells are located near Dry Well D, which also contained these compounds. 2-Butanone was detected in the 1990 water samples from Wells N-26 and N-28 at concentrations of 2,200 and 340 ug/l, respectively. 2-Butanone was not detected in any of the onsite wells during the 1989 (first round) sampling round. The Phase II occurrences of 2-butanone, and other occasionally detected compounds are summarized in table 28.

4.2.4 <u>Evaluation of VOAs in the Offsite Ground Water</u>

During the drilling of the all of offsite well cluster boreholes, soil samples were set aside for screening using a PID. Results of the Phase I and Phase II measurements are on table 29. As shown on the tables, the PID readings never exceeded 1.6 ppm, and there was no indication of contamination in the soil at any of the locations.

The samples from the offsite wells had lower concentrations of the plume constituents as compared to the onsite wells. Two of the private wells sampled (House No. 6 and House No. 1, respectively) had the highest of the offsite concentrations. In general, PCE was detected at higher concentrations than TCE and TCA in the offsite wells; however, it is not as dominant as it is in the onsite ground water.

The changes in the offsite plume concentrations are generally similar to the onsite trends. PCE concentrations have generally stayed the same as reported in 1984, with some wells showing higher concentrations and some wells showing lower concentrations. The concentrations of TCE and TCA have decreased throughout the offsite area.

There is no clear trend in the changes in water quality between the two phases of the RI. Some wells exhibit higher concentrations, while others have lower concentrations of solvents when comparing the 1989 and 1990 data with 1991 data.

As discussed in Section 4.2.3, the plume is leaving the Rowe Industries site with the highest concentrations in the intermediate zone (about 25 feet below the water table). An analysis of the 1984 SCDHS data and the data from the new well clusters indicate that the highest concentrations of the plume generally stay in the upper 50 to 60 feet of the aquifer.

Samples from the upgradient intermediate well located on Lily Pond Road (MW-48B) had trace levels of TCE (below the detection limit). No other compounds associated with the plume were detected. This data indicate that the upgradient ground water is not contributing to the plume.

Plume constituents were detected in the well cluster south of the cove (MW-48A, MW-49B and MW-49C), with the greatest concentrations detected in the intermediate well (MW-49B). No plume constituents were detected in the well cluster on Morris Cove Lane (MW-50A, MW-50B and MW-50C). This well cluster is positioned to intersect any ground water which could potentially flow beneath the cove, affecting private wells in the immediate area, and is located approximately 800 feet north of Well Cluster MW-49. Although the water-level data and model data indicate the ground-water may flow toward the northwest on the north side of the cove (and, thus, the MW-50 cluster would not be centered in the plume), the data from the cluster shows that there are no plume impacts where a few homes utilize ground water, near the MW-50 cluster. Based on the strong upward gradient at the cove (see Section 4.2.7), all or most of the plume discharges to the cove. If any deep components bypass the cove, they would discharge into Morris Cove or western portions of the Sag Harbor Cove.

During Phase I, there was an isolated detection of 2-hexanone (30 ug/l) reported in the sample from the shallow well (MW-42A) and carbon disulfide in the samples from the two wells farthest from SHI (0.4 ug/l in N-19 and 46 ug/l in N-20). Chloroform was also detected in the sample from Well N-19 at 1 ug/l. Other isolated occurrences for Phase II are in table 28.

4.2.5 Evaluation of Non-VOA Laboratory Results

A summary of the inorganic results for the private wells and monitor wells is presented on table 24. During the first round of Phase I and Phase II ground-water sampling, only unfiltered samples were collected. During the second round of Phase I ground-water sampling, both filtered and unfiltered samples were collected. The filtered samples represent dissolved concentrations and, thus, do not have interference from fine material that is mobilized around the well screen during sampling. Of the inorganic parameters analyzed during Phase I, only iron, manganese, lead, cadmium and antimony exceeded water-quality standards in some wells. During Phase II, iron, manganese, lead, cadmium and isolated occurrences of antimony, silver and chromium exceeded water-quality standards.

Iron was detected above water-quality standards in many of the wells sampled for metals during both rounds of Phase I sampling. Iron concentrations ranged between non-detectable and

55,200 ug/l in the unfiltered samples. The dissolved iron concentrations were generally much lower.

During the Phase II ground-water sampling, iron was detected above water-quality standards in all of the wells sampled with the exception of Wells MW-49B, MW-50A and MW-42A. Iron concentrations ranged between 340 ug/l and 228,000 ug/l. These high iron concentrations were expected because during drilling, iron staining was noted throughout the sediment. During development and redevelopment, the discharge from almost all of the wells pumped iron-stained water for the first few gallons.

Manganese concentrations ranged from non-detectable to 4,560 ug/l in the unfiltered samples. The dissolved concentrations were similar to the total concentrations, showing that sediment from the well screen area is not the cause of the high manganese levels but are attributed to the ground water. Manganese was detected above water-quality standards in almost all of the SCDHS wells and three of the newer wells during Phase II. The manganese is also a natural occurrence.

During Phase I, lead was detected in several of the unfiltered samples. Some of the occurrences were above water-quality standards. Dissolved levels of lead were somewhat lower than the totals. Elevated levels of lead were noted both onsite and offsite.

The lead has been detected at random locations with little consistency between sampling rounds both on and offsite, as deep as 100 ft bg, and as far as the downgradient well cluster across the Sag Harbor Cove. Most of the results are qualified as estimates. The random and non-uniform occurrence makes it unlikely that activities at the site were the source and it is likely that the source is natural. The occurrences may also be a laboratory anomaly, based on the "J" qualifier.

Cadmium was detected in the upgradient well cluster (MW-48) at a concentration similar to the downgradient wells. This would indicate the occurrences are natural or at least unrelated to the site. As with lead, many of the occurrences are random and inconsistent.

During Phase I, antimony was detected in eight monitor wells at concentrations exceeding the New York guidance value. There is no regulatory level for antimony. Concentrations ranged between 6.4 to 20.8 ug/l and the guidance value is 3 ug/l. Antimony was detected in MW-42A, MW-43A, MW-43B, MW-43C, N-11, N-19, N-27 and N-39. The values are suspect, however, because antimony was detected in the laboratory blank. Antimony was only detected in two wells during Phase II. The concentrations detected in samples collected from MW-45A and N-36 were 34.4 and 40.9 ug/l, respectively. During sampling, the water evacuated from both wells were turbid (greater than 50 NTU) and the samples were not filtered for metals. This added sediment load could have contributed to the antimony concentrations that were detected during sampling.

There was only one isolated occurrence of silver detected during the entire sampling program. Silver was detected in Well MW-45B at a concentration of 54.8 ug/l during the Phase II sampling program, but is qualified as an estimate.

All detections of chromium appear unrelated to site activities because all samples, except at MW-43A, had concentrations lower than in the upgradient well. Very high concentrations were detected in MW-43A; apparently related to a local source.

No pesticides were detected in the ground water during Phase I. The only semivolatile compound that was detected was phenol at 4 and 6 ug/l (duplicate analysis) in the Soffel Well. Semivolatile compounds and pesticides were not analyzed during the Phase II sampling program.

4.2.6 Analytical Results from Offsite Homes Still Using Private Wells

During Phase I, two homes on the south side of Hildreth Street were sampled for TCL VOCs. At the time of the Phase I study, all of the homes on Hildreth Street, which is located just outside of the plume mapped by the SCDHS, still utilized private wells. Both homes had non-detectable or trace (less than 1 ug/l) concentrations of primary plume constituents. The results are summarized on table 27.

All homes on Hildreth Street, with the exception of the Mott residence (No. 10), converted to public water and no longer use their wells as a source for potable consumption. During the Phase II program, the Mott well was sampled and analyzed for VOCs, Freon 113 and TCL metals. No plume constituents were detected in the sample. Trace levels of acetone and methylene chloride were detected but are attributed to laboratory contamination. Of the inorganic data, only iron exceeded water-quality standards, which is not unusual at this site.

Two homes upgradient of SHI were sampled during Phase I, primarily to re-establish upgradient water quality. No VOCs were detected.

4.2.7 Horizontal and Vertical Extent of Plume

The horizontal extent of the plume is the same as that observed during the SCDHS study and is shown on figure 41. The plume clearly intersects, but does not appear to extend beyond Sag Harbor Cove, as shown by the samples obtained from the cove and from the Morris Cove Road Well Cluster MW-50. At the Rowe Industries site, the plume is primarily in the upper 10 feet of the aquifer. As it migrates off the northern property line, the highest concentrations of the plume are in a zone approximately 20 to 25 feet below the water table. The deep well at the property line, MW-44C, indicates only low levels of solvents in a zone about 40 to 50 feet below the water table at Well Cluster MW-49.

As the plume migrates offsite, the highest concentrations generally occur in the upper 50 to 60 feet of the aquifer. At Well Cluster MW-49, 300 feet from the cove, the plume is concentrated in a zone approximately 40 to 60 feet below the water table. At the cluster, there is a slight downward flow gradient; however, over the 300-foot distance, the plume flows upward and discharges into the cove. The vertical flow gradients under the cove are much stronger than those that occur away from the cove. The water level in a temporary piezometer installed only 3 feet below the bottom of the cove was 0.38-foot higher than the surface water. This reflects an upward gradient of 0.1288, about 15 times steeper than the gradients calculated for any of the well clusters.

4.3 Results of Surface-Water and Sediment Sampling

A study to determine the possible occurrence of plume constituents in Ligonee Brook and Sag Harbor Cove was conducted during both phases of the RI. Surface-water and sediment samples were collected at five locations in the stream and bay to determine the extent, if any, of VOCs.

4.3.1 Brook and Cove Surface Water

Five surface-water samples were collected directly above the sediment sampling points. Figure 42 shows the stream point locations and chemical concentrations that were detected during both phases of sampling.

4.3.1.1 Evaluation of VOA Laboratory Results

Table 30 is a summary of the detected VOA's from the five surface-water sample locations. During Phase I, plume constituents were detected within the plume boundary and trace amounts were detected downstream of the plume boundary (Stream Point No. 5). PCE was detected at slightly higher concentrations than the New York State guidance value of 1 ppb at Stream Points 3 and 4 (detected at 3 and 4 ppb, respectively). All other reported concentrations of Phase I VOCs were within the EPA's fresh-water and salt-water aquatic life guidelines. The origin of the trace amounts detected in Stream Point No. 5 was likely from ground-water discharge further upstream which was diluted over distance.

Laboratory solvents (Freon 113, methylene chloride and acetone) were found in some of the Phase I samples at low levels and were rejected during validation. The occurrence of acetone could have been from decontamination of the sampling devices.

During the one-year Phase II program, plume constituents were detected at Stream Point No. 3 at slightly higher concentrations than were observed during Phase I. Concentrations at the other locations were lower or remained the same. Overall, the concentrations in the surface water have been consistent since 1989. Although the center of the plume is closest to Stream Point 4, the concentrations of the plume constituents are lower at this location than at Stream Point 3 because of significantly more dilution that can occur in the cove as compared to the brook.

Carbon disulfide was detected in Stream Points 1, 3 and 4 at concentrations of 10, 41 and 0.6 ug/l, respectively. Table 28 lists additional compounds detected from Phase II that are not included in table 30.

4.3.1.2 <u>Evaluation of Non-VOA Laboratory Results</u>

The TCL surface-water results for Stream Point Nos. 2 and 4 indicate that semivolatiles, pesticides and PCB's were not detected during the 1989 round of sampling. The inorganic results (table 20) for the two separate stream points were relatively similar to each other. All reported concentrations of inorganic compounds are within the EPA's fresh-water and salt-water aquatic life guidelines. The guidelines for mercury are below the detection limits.

4.3.2 Brook and Cove Sediment

Five stream points were sampled in Ligonee Brook and Sag Harbor Cove during both phases of the RI. Two of the points were upstream and downstream of where the previously-identified plume intersected the brook and cove, and three points were within the plume area.

4.3.2.1 Evaluation of VOA Laboratory Results

The primary and secondary plume constituents were found in the sediments at the Brook/Cove interface and within the previously delineated plume area in the cove (Stream Point Nos. 3 and 4, respectively) during Phase I of the RI. Figure 43 shows the chemical concentrations from both phases that were detected in the sediment at their respective sampling points and table 30 shows a summary of the detected VOA's.

The highest concentration detected in the stream and bay sediment during Phase I was 340 ug/kg of PCE at Stream Point No. 4. Concentrations both upstream and downstream were lower. Stream Point 4 is located within the central part of the previously delineated plume boundary. No plume constituents were detected upstream or downstream of the previously-identified ground-water plume. No plume constituents were detected in the brook sediment in areas not influenced by the tides (Stream Point Nos. 1 and 2). Trace amounts of chloromethane (2 ug/kg) were detected in Stream Point No. 2. During the one-year Phase II sampling program of the stream and bay sediment, the primary plume constituent concentrations were variable, with the April 1992 round showing concentrations close to the November 1989 levels.

The sediment likely contains ground water that flows from the east and discharges into the cove. Thus, all the sediment sample results are indicative of the ground water in the sediment and in organic material. Since a study of the bay and stream area was not included in the 1984 SCDHS investigation, the degree of change in concentrations cannot be determined.

The current study, however, shows that the ground-water is discharging to the cove and may be directly related to seasonal influences. The fluctuation in concentrations may be due to seasonal variations.

4.3.2.2 Evaluation of Non-VOA Laboratory Results

Stream Point Nos. 2 and 4 were sampled for the full TCL/TIC's during Phase I of the RI. The semivolatile organic compound analysis for Stream Point No. 2 indicated the presence of benzoic acid (140 ppb), methyl phenol (74 ppb) and pyrene (110 ppb). These compounds were not detected further downstream in the cove area. The occurrence of the semivolatiles upstream may be a direct result of road runoff leading into Ligonee Brook. Pesticides and PCB's were not detected in either sampling point in the brook/cove area.

The inorganic data reveal relatively similar concentrations between stations. Table 20 shows the metal results for the sediment and aqueous samples obtained from Stream Point Nos. 2 and 4. Iron and lead were detected in the sediment concentrations comparable to the range found in the dry well and soil boring samples. The iron is naturally occurring and the lead may be attributable to surface-water runoff from roads and parking areas. All other inorganic parameters were found at concentrations typical of those found in the study area.

4.3.3 Summary of Brook and Cove Study

The brook and cove study shows a close correlation of the occurrence of ground-water plume constituents with the location of the previously-identified plume. No plume constituents were detected upstream of the plume area, which indicates that the plume is the likely source. The results provide evidence that plume constituents are discharging into the stream and bay. It can be assumed that concentrations in the ground water immediately beneath the cove bottom would be much higher than the sediment and surface-water samples show. Concentrations in surface water at Stream Point No. 3 are higher than at Stream Point No. 4 because of significantly more dilution in the cove than the brook.

4.4 Air Quality Results

The results from the air-quality monitoring program were below the detectable limit for the chlorinated hydrocarbons. In addition, no chemicals were detected in the charcoal blanks. All results from the air-quality study are found in Appendix VI.

4.5 Surface Soil Analytical Results

As part of Phase II, a surface soil sampling program was completed at the request of the EPA for risk assessment evaluation as described in Section 2. 1,2-Dichloroethane was detected in Samples S-3 and S-4 at estimated values of 5 and 2 ug/kg, respectively. Several samples contained trace estimated levels of toluene. Samples S-05 and S-09 had elevated levels of the same metals which were above background levels in Dry Well A (table 18). It is likely that overflow of Dry Well A is the cause of these metal occurrences in the surface soils. The organic and inorganic data for this study are shown on tables 17 and 18, respectively.

4.6 Quality Assurance/Quality Control

The results of the QA/QC samples taken during the RI for the VOCs found in the ground water are shown on table 31. Trace amounts of methylene chloride, acetone and Freon 113 were detected in many of the samples. Most of these occurrences were rejected as laboratory contaminants.

Not included on the table are the following detections: during the Phase I sampling program, 1 ug/l and 3 ug/l of bromoform, 2 ug/l of chloroform and 0.9 ug/l of carbon disulfide were detected in the Carroll Street hydrant and Gingerbread Bake Shop faucet samples, respectively. Carbon disulfide was detected in the well screen blank and a bailer blank at 0.6 and

7 ug/l, respectively. Ethylbenzene was detected at 0.5 ug/l in both the well screen and casing of Well MW-43C and later detected at trace amounts in the ground water at both Wells MW-43B and MW-43C. Inorganic results are shown on table 32.

During the Phase II sampling program, PCE was detected in two of the trip blanks, each at a concentration of 0.4 ug/l. In addition, 2-butanone was detected in two trip blanks at concentrations of 44 and 25 ug/l.

Field blanks collected from the split-spoon sampling equipment had one occurrence of 2-butanone at a concentration of 63 ug/l; and carbon disulfide at 2 ug/l.

Field blanks collected from two of the stainless-steel bailers contained chloroform at concentrations of 6 and 0.6 ug/l. However, because chloroform was detected in the laboratory blank the concentrations are suspect. In addition to chloroform, 2-butanone and carbon disulfide were detected in some of the field blanks. 2-Butanone was detected at concentrations of 11, 18 and 21 ug/l. Carbon disulfide was detected at concentrations of 0.3 and 0.6 ug/l. Table 28 summarizes any additional compounds detected from the Phase II results, that are not included in table 31.

TCE and TCA were detected at concentrations of 1 and 2 ug/l in the field blank collected from the gravel pit located behind the Gingerbread Bake Shop.

Chloroform was detected in several of the samples collected from the water sources used during drilling. Because chloroform was detected in the laboratory blank the occurrences of chloroform in the samples are suspect.

Bromoform was detected in the field blank collected from the hydrant supply on Noyack Road at a concentration of 0.5 ug/l. 2-Butanone was detected in the field blanks collected from the PVC and stainless-steel screens and casings as well as the Noyack hydrant water stored in the driller's water tank. Concentrations of 2-butanone were 20 and 22 ug/l from the PVC casing and screen; 26 and 9 ug/l from the stainless-steel casing and screen and 26 ug/l from the driller's water tank. Trace amounts of xylene, toluene and ethylbenzene were detected in the field blanks collected from the screens and casings.

In accordance with the POP, all sample data were reviewed by Trillium Inc. for validation. Validation reports are found in Appendix X. The parameters that were checked during validation of VOCs, semivolatiles and pesticides were:

- Holding times
- GC/MS tuning
- Calibration
    - Initial
    - Continuing
- Blanks
- Surrogate recovery
- Matrix spike/matrix spike duplicate
- Field duplicates
- Internal standards performance
- TCL compound identification
- Compound quantitation and reported detection limits
- Tentatively identified compounds
- System performance
- Overall assessment of data for a case

The parameters that were checked during validation of inorganics were:

- Holding times
- Calibration
    - Initial
    - Initial and continuing calibration
    - Verification
- Blanks
- ICP interference check sample
- Laboratory control sample
- Duplicate sample
- Matrix spike sample
- Furnace atomic absorption QC
- ICP serial dilution
- Sample results verification
- Field duplicates
- Overall assessment of data for a case

4.7 Applicable or Relevant and Appropriate Requirements (ARARs)

Potential ARARs for ground water are presented on tables 34 through 37. Potential ARARs for surface water will be developed for the FS. All ARARs are dependant on the risk assessment and will be developed during the FS process.

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5.0 POTENTIAL TRANSPORT AND FATE OF IDENTIFIED SUBSTANCES

The RI has identified organic compounds in the ground water and, in discrete areas, in the soils of the study area. This section discusses the potential transport mechanisms for the identified compounds and examines their probable fate.

5.1 Properties of the Identified Organic Compounds

The chemical and physical properties of the organic compounds identified in this study are listed on table 33. The compounds included in this table are TCE, TCA, PCE, 1,1-dichloroethene, 1,1-dichloroethane, 1,2-dichloroethene and Freon 113. In addition to these compounds, chlorodibromomethane and xylene have been included in the table because, although they were not detected in the RI, they were identified during the 1984 SCDHS study.

5.1.1 Potential Degradation Mechanisms

In addition to the chemical and physical properties, the inter-relationship between the compounds and the physical elements (air, water, soil) has been addressed.

Of all the plume constituents, PCE will be most readily absorbed in organic-rich sediment but will gradually be released to ground water. PCE is very stable to hydrolysis and decomposes slowly in water to trichloroacetic and hydrochloric acid. Under these conditions, PCE has a half-life of approximately 9 months. When PCE is exposed to the air (ozone) it will decompose to phosgene and trichloroacetyl chloride and has a half-life of 24 minutes.

TCA evaporates rapidly and, therefore, does not persist at high concentrations in either soil or water. At 25°C, TCA hydrolyzes to acetic acid and hydrochloric acid, or vinylidene chloride at 10°C. TCA has an estimated half-life of 6 to 9 months depending on the pH. The major form of decay of TCA is by evaporation. TCA is photo-oxidized first to trichloroactaldehyde, then trichloroacetic acid. The half-life for this process ranges from 23 weeks to 12 years.

TCE decays slowly to hydrochloric acid in water with a half life of 6 months with light and 11 months without light. Exposure to air causes TCE to have a half-life greater than a day but a lifetime of 4 days. TCE is also known to degrade to less chlorinated compounds through physical and biological processes.

1,2-Dichloroethylene gradually decomposes by air, light and moisture to form hydrochloric acid. However, photodissaciation, hydrolysis or oxidation to water does not appear to accelerate the degradation process. Removal of 1,2-dichloroethylene from water is primarily achieved by volatilization. No information regarding adsorption on suspended particles or sediments was found. The lifetime in the troposphere is less than one day.

1,1-Dichloroethylene is practically insoluble in water and decays primarily through volatilization. Once exposed to the atmosphere, 1,1-dichloroethylene photo-oxidizes rapidly to chloroacetyl chloride, phosgene, formic acid, hydrochloric acid, carbon monoxide and formaldehyde. The half-life of the process is estimated to be 25 minutes. 1,1-Dichloroethane behaves similarly to 1,1-dichloroethylene and decays primarily through volatilization. 1,1-Dichloroethane produces hydrochloric acid, formyl chloride and acetyl chloride. Volatilization half lives from water range between 1 and 32 minutes.

5.2 Potential Routes of Migration

Chemicals which were formerly used at the Rowe Industries facility have been identified in the onsite unsaturated soils, dry wells and ground water, and offsite in the ground-water, stream and bay sediment and surface water within the plume discharge area. Potential transport routes for these chemicals to have reached the locations where detected include air, storm-water runoff, water in the vadose zone and ground water in the saturated zones.

5.2.1 Surface-Water Runoff

During light precipitation events, chemicals can be transported in solution. During heavier events, substances can be transported in suspension or on sediment particles. There are no storm-water collection systems on the Rowe Industries/SHI property other than the roof runoff drainage system. The runoff from the building and paved areas east of the building flows towards the wetland area, as governed by the local topography.

The soil borings drilled in the wetland area revealed minimal concentrations of plume constituents. However, any chemical spillage which occurred behind the buildings or the former drum storage area would have been washed toward the wetland area.

The plume constituents have not been detected in the surface soils onsite and there is no offsite transport of surface water from onsite areas; therefore, runoff acts only to redistribute surface sediments and chemicals. This is not considered to be an important mechanism for chemical transport.

5.2.2 Subsurface Transport in the Unsaturated Zone

The unsaturated zone beneath the Rowe Industries site ranges from about 3 to 24 feet thick, consisting of sand with some silt and clay layering. Once the soil-moisture requirements are satisfied, vertical infiltration is fairly rapid through the glacial material, slowing in the silt and clay zones. There is very little organic content in these unsaturated sediments, except in the wetland area. There are no subsurface stratigraphic units in the unsaturated zone which would cause subsurface horizontal movement to offsite locations. Therefore, the fate of soluble substances in the unsaturated zone would ultimately be the ground water, except for any chemicals discharged on the ground surface in the wetland area, where some absorption in the organic material may have occurred.

VOCs may experience some reduction in concentrations as they pass through the unsaturated zone, but over the long-term, will eventually be mobilized to join the ground water. Specifically, TCE is not expected to adsorb to soils in significant concentrations. PCE has a higher affinity for soil, but will be gradually released to ground water (Verschueren, 1983). Therefore, the short-term fate of the VOCs will be to enter the ground-water system.

The few metals present in Dry Well A, not traceable to likely natural occurrences, were not detected in the ground water in any discernible pattern. This shows that attenuation has occurred in the sediment in the dry well.

The unsaturated (vadose zone) soils have been shown in Phase II of the RI to be a significant source of contaminants. Soils in the former drum storage area and in several dry wells contain chemical concentrations at levels that will continue to leach to the ground water with infiltrating precipitation and septic system use. Vertical transport in the unsaturated zone is, therefore, an important mechanism for contaminant transport at the source areas.

5.2.3 Ground-Water Transport

VOCs have been, and are now, migrating off of the SHI property. These substances are subject to dilution, attenuation, volatilization, and biodegradation while moving in the ground-water system.

The RI has confirmed that ground water flows toward the northwest, discharging into Ligonee Brook and Sag Harbor Cove. It has also been shown that the solvent plume has migrated to the cove. There has been no appreciable reduction in VOC concentrations in the plume since 1984, which indicates that continuing sources for these chemicals exist. Migration with ground water is the primary transport mechanism at this site.

5.2.3.1 **Chemical Transport and Fate**

As stated above, the solvents which were discharged on the Rowe Industries property, have migrated offsite and are discharging into Sag Harbor Cove. The discharge into the cove is the ultimate fate of the ground-water plume.

With the exception of some specific volatiles (such as TCE), concentrations in the plume have changed little since the SCDHS study was performed, which implies that the SHI property is still acting as a source area.

5.2.3.2 **Ground-Water Flow and Contaminant Transport Modeling**

A three-dimensional flow and transport model is being developed for the study area.

The purpose of the model is to simulate the steady-state flow system of the solvent plume near Sag Harbor, the shape of the plume, and the future of the plume following hypothetical removal of the source, with and without remedial pumping of contaminated ground water. Field data consists of topographical and surveyed data, observation well bore logs and water-level and water-quality data, and historical information about the plume.

Topographical and surveyed data consist of USGS topographic maps, surveyed elevations of observation wells, and surveyed water-surface elevations of local ponds and selected points on Ligonee Brook.

Observation well data consist of bore logs and numerous rounds of measurements of head and contaminant concentration in all of the observation wells. Vertical head data is provided by 12 of these wells, located in 4 clusters of 3 wells each, giving information at 3 different depths.

Historical information includes water-quality data from a number of the previously-existing observation wells. Previous published studies (Pinder, 1973) give a horizontal permeability of 200 to 300 feet per day (which was verified by the slug tests described in Section 3.1.5), a porosity value of 35 percent, longitudinal dispersivity of 70 feet, and transverse dispersivity of 14 feet in the glacial outwash constituting this area. Vertical permeability is assumed to be on the order of one-tenth the horizontal. Average areal recharge is known to be about 24.5 inches per year in this region (NOAA). SHI property (and a portion of an adjacent property once thought to be a part of the SHI property) is the source of the contamination.

The finite-element grid (based on the Princeton Transport Code) consists of 40 columns, 32 rows, 1,353 nodes and 1,280 elements. It is oriented approximately along the direction of ground-water flow and centered approximately along the axis of the plume. Its northwest edge runs along Morris Cove and Upper Sag Harbor Cove. The northeast edge runs along the northeast side of Upper Sag Harbor Cove, Otter Pond, the swampy area between Otter Pond and Round Pond, Round Pond and Little Round Pond. The southeast edge continues from Little Round Pond through Long Pond and Little Long Pond, with Lily Pond in the grid interior, near the south corner. The surveyed surface elevations of these bodies of water, along with the seacoast, provide control points for model boundary head values.

Other important boundaries are Ligonee Brook, which runs from Long Pond to the sea, two small unnamed ponds east of SHI, and areal recharge, which could concentrate in kettle holes and other depressions.

The southwest edge of the grid has no standing water, and boundary heads for this side of the model must be determined by calibration. These heads should be approximately parallel to the direction of the ground-water flow, adding or subtracting very small amounts of water to the model.

Boundaries take the form of constant head nodes (water-table outcrops), leaky nodes (perched water, coastlines, streams and model edges), or constant flow boundaries (areal recharge and wells).

There are currently five layers in the model. Further division of the top two layers may become necessary as the model is refined. Boundary heads for the deep layers must be determined by calibration.

Work on the model is continuing and will be utilized in the FS to evaluate remedial alternatives.

5.2.4 Air Transport

Near-surface VOCs can be volatilized into the atmosphere. However, no near-surface VOCs were detected, except in the water in Sag Harbor Cove in the plume area. The concentrations in the cove water were at trace levels.

Air monitoring was conducted both inside the current building and outside in areas most likely to detect site-related volatiles. None of the tested parameters were detected, demonstrating that the air pathway is not of concern at this site. Past waste storage, use and disposal practices may have had impacts on air in the immediate site vicinity, but any such impacts are no longer discernible in area soils or in occupied spaces.

Most of the areas exhibiting elevated VOCs in the soil vapor are capped by pavement, the buildings or the concrete structure in the former drum storage area. These obstructions to vapor transport, combined with the negative results of air monitoring, make further analysis of the air pathway unnecessary.

5.2.5 Surface-Water Transport

The only surface water shown to be impacted by the site is Sag Harbor Cove (and Ligonee Brook at the confluence with Sag Harbor Cove at low tide) in which monitoring has demonstrated the presence of site contaminants. The levels of

volatiles observed in the cove in the center of the plume quickly dissipate to non-detectable levels several hundred feet downstream.

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6.0 CONCLUSIONS

6.1 Site History and Use

The history of site ownership and use has been determined to the extent possible and all identified areas of concern have been addressed during the RI. The results of previous investigations have been incorporated in, and confirmed by, the RI.

6.2 Scope of the Investigation

Both Phase I and II of the RI were completed in accordance with Work Plans approved by the EPA. Additional work, beyond that specified in the Phase II Work Plan, was completed to further define areas of concern. Any deviations to specified procedures, documented in this report, were approved by the EPA and were initiated to improve the investigation.

Water-level monitoring and quarterly sampling of surface water in Sag Harbor Cove are continuing tasks.

6.3 Physical Characteristics and Hydrogeology

The data generated by the RI have provided a clear and detailed understanding of the geology, hydrogeology and hydrology in the study area.

6.4 Nature and Extent of Contamination

All potential source areas identified through field observations, historical data, photographic analysis and previous studies have been thoroughly investigated. The RI has identified the following areas of soil contamination which are likely contributing VOCs to the ground water:

- the former drum storage area
- Dry Wells A, C, D, E and F

There is no evidence of a continuing source of VOCs beneath the SHI building.

The extent of ground-water contamination has been shown not to have increased since the 1984 SCDHS study. The concentrations of VOCs have not changed appreciably in the period from 1984 to 1991, and the plume continues to discharge to Sag Harbor Cove at low levels. The fact that concentrations of VOCs onsite continue to remain at the 1984 levels indicates the existence of onsite sources of VOCs, as defined by the RI.

The levels of VOCs in the cove dissipate to non-detectable within several hundred feet of the area of plume discharge.

Air quality has been shown to not be impacted by past waste disposal at the site, and surface soils have been locally impacted by metals near Dry Well A.

No residual contamination was found to exist in the onsite pond.

6.5 Fate and Transport of Site-Related Contaminants

VOCs still present in the unsaturated soils will gradually be leached to the ground water onsite. This ground water will continue to migrate towards Sag Harbor Cove, where the plume and its chemical content discharges. The VOCs are then subject to volatilization, dilution and photoionization.

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