REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT

LARUSSELL'S CLEANERS SITE
LAKE CARMEL
PUTNAM COUNTY, NEW YORK

(SITE REGISTRY NO. 3-40-020)

PREPARED FOR

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

BY

DVIRKA AND BARTILUCCI
CONSULTING ENGINEERS
SYRACUSE, NEW YORK

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LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
REPORT

TABLE OF CONTENTS – VOLUME 1

LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
REPORT

TABLE OF CONTENTS (continued) – VOLUME 1

LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
REPORT

TABLE OF CONTENTS (continued) - VOLUME 1

LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
REPORT

TABLE OF CONTENTS (CONTINUED) - VOLUME 1

List of Tables

List of Tables

LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT

TABLE OF CONTENTS (CONTINUED) - VOLUME 1

List of Tables (continued)

TABLE OF CONTENTS - VOLUME 2

List of Appendices

1.0 INTRODUCTION

As part of New York State's program to investigate and remediate hazardous waste sites, the New York State Department of Environmental Conservation (NYSDEC) has entered into a contract with Dvirka and Bartilucci Consulting Engineers of Woodbury, New York to conduct a Remedial Investigation/Feasiblilty Study (RI/FS) at the LaRussell's Cleaners Site located in Lake Carmel in the Town of Kent, Putnam County, New York. The RI/FS for this site is being performed with funds allocated under the New York State Superfund Program.

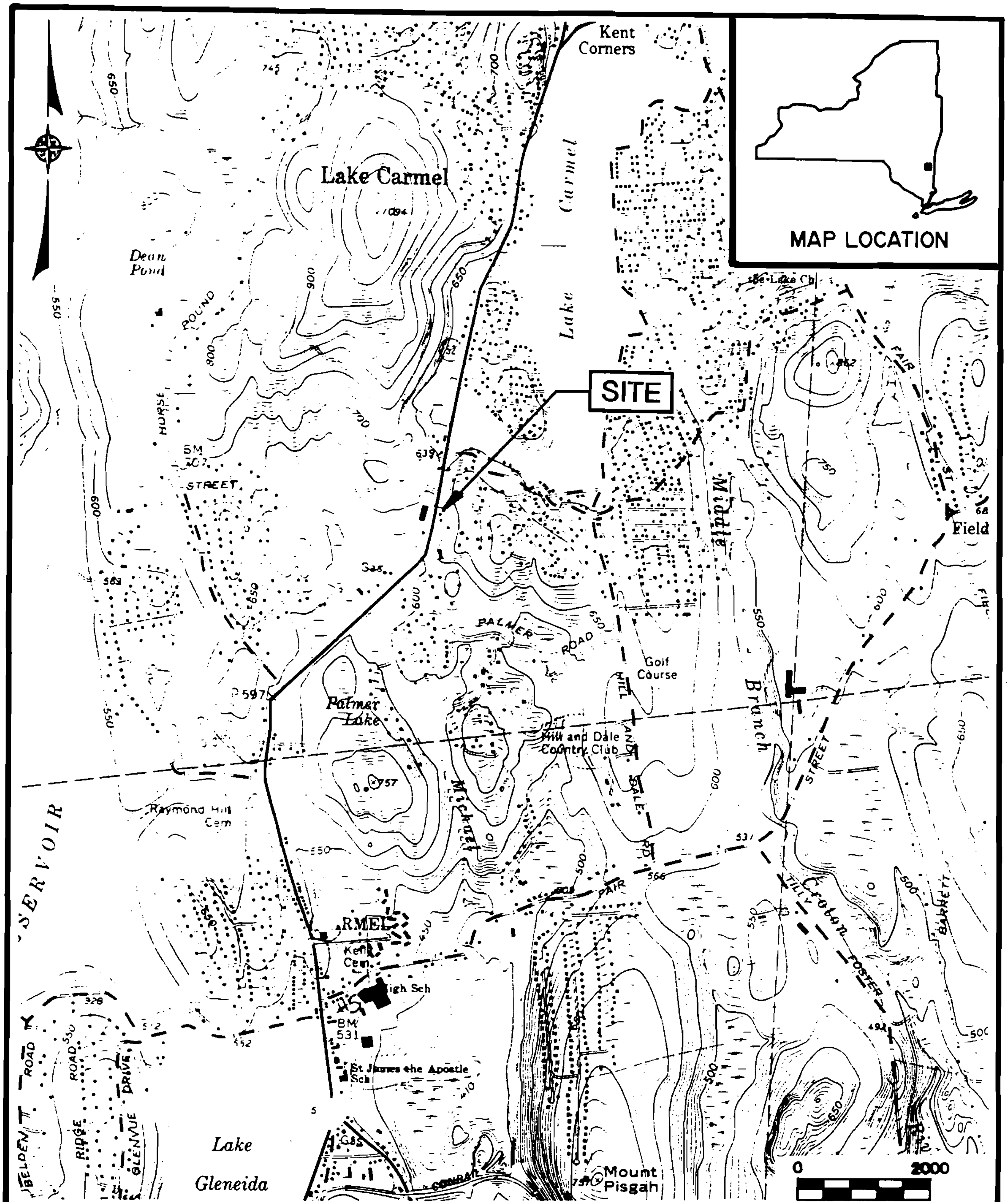
1.1 Project Objective

The objective of this RI/FS is to perform a focused field investigation of the LaRussell's Cleaners Site with emphasis on source identification and determination of the extent of contamination to recommend an Interim Remedial Measure (IRM) or Presumptive Remedy for the site.

This document, entitled "Remedial Investigation Report for the LaRussell's Cleaners Site," presents the activities performed as part of the remedial investigation (RI), which was conducted in accordance with the Federal Superfund Amendments and Reauthorization Act (SARA), the National Contingency Plan (NCP), and the NYSDEC Superfund Program including the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4025, "Guidelines for Remedial Investigations and Feasibility Studies."

1.2 Site Location, Ownership and Access

The LaRussell's Cleaners Site is an active dry cleaning facility located on Route 52 in Lake Carmel, Putnam County, New York (see Figure 1-1). The site is currently owned by a Mr. Eugene LaRussell who purchased the property in 1971. Prior to being purchased by Mr. LaRussell, the building was an empty two-family dwelling. Information about previous owners is not known. On June 10, 1992, the site was listed as a Class 2 site (site number 3-40-020) on the Registry of Inactive Hazardous Waste Disposal Sites in New York State as a result of the



SOURCE: U.S.G.S. LAKE CARMEL, N.Y. QUADRANGLE

LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

SITE LOCATION MAP

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FIGURE 1-1

confirmation of contaminated groundwater associated with the improper disposal of dry cleaning wastes. Access to the site is from Route 52. Only the western 25% of the property is developed. The remaining portion consists of a steeply wooded slope covered with large boulders, bedrock outcroppings and trees. The flat lying parking area north and east of the building is paved.

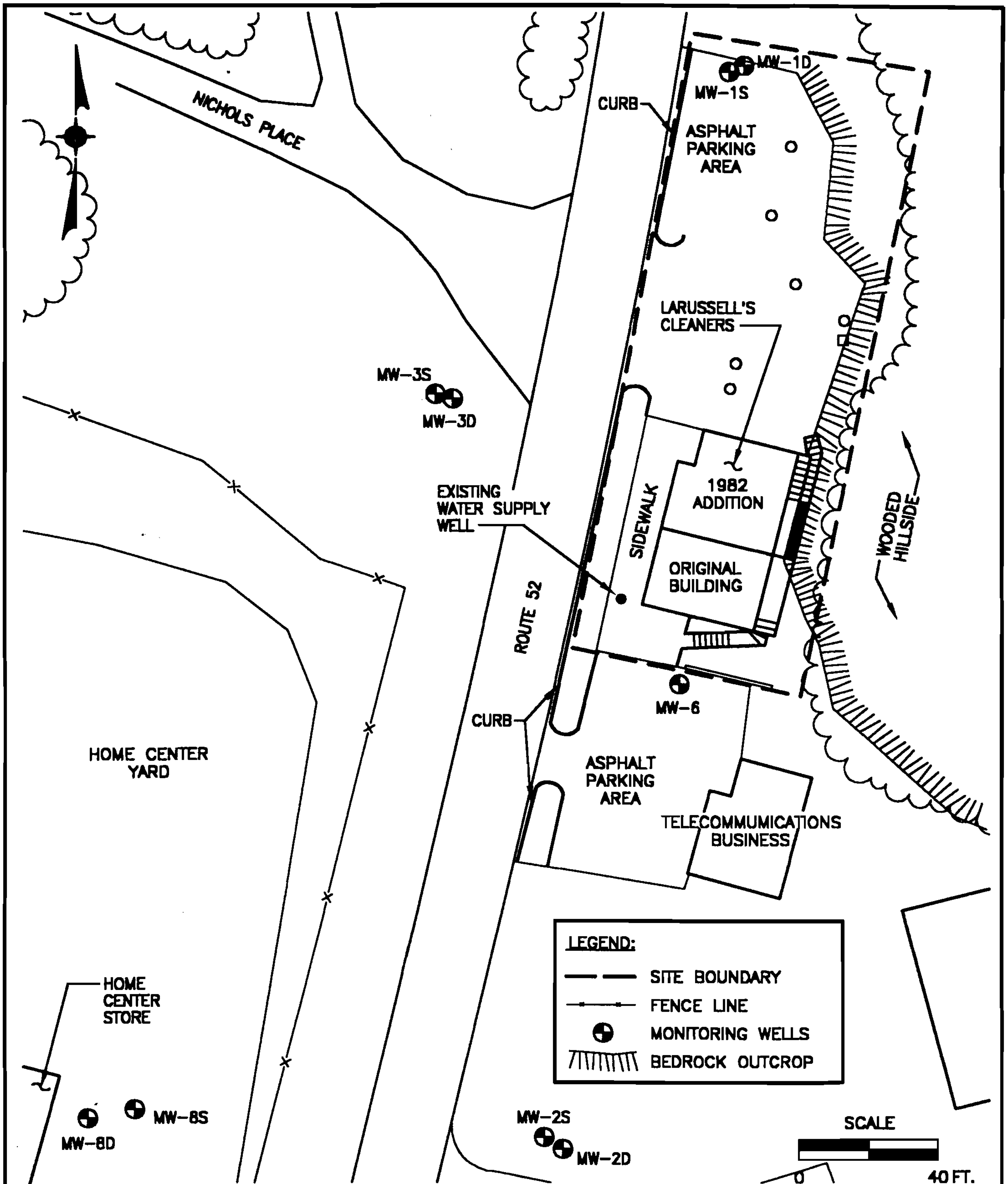
1.3 Site Description

The site is bordered to the north by a vacant wooded lot, to the south by the a property occupied by a telecommunications business which contains a small building, to the west by Route 52 and to the east by a bedrock outcrop (See Figure 1-2). Further east and uphill from the site lie residential homes on Mt. Hope Road. The site is approximately one half acre in size and consists of a two story concrete block and wood frame building. The dry cleaning operation is on the first floor and a storage room for the cleaners and residential apartment are on the second floor. The apartment was occupied at the time of the remedial investigation.

The land at the LaRussell's Cleaners Site is steeply sloping and covered with boulders. A small section has been graded and contains the building and a parking lot. The area is zoned commercial use by the Town of Kent. Due to the nature of the ground surface, the site is relatively undevelopable.

1.3.1 Climate

Climate at the site is classified as continental due to the fact that weather systems that effect the area are continental in origin. The area is also designated as humid due to the abundant moisture carried in atmospheric circulation patterns. Long Island Sound and the Atlantic Ocean influence the climate by moderating winter temperatures and supplying moisture. Humidity in the area tends to be high in the summer months (USDA, 1994).



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LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

SITE MAP

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FIGURE 1-2

The average daily temperature in Carmel, approximately 1.5 miles south of the site, is 49 degrees Fahrenheit. The average annual precipitation is 44.1 inches in Carmel. Average snowfall is 44 inches (USDA, 1994).

1.3.2 Regional Geology

The LaRussell's Cleaners Site lies in the New England Uplands physiographic province of New York State (Muller, 1965). Landforms in the area show a strong correlation to the relative hardness of underlying bedrock. The region consists of ridge and valley topography that is controlled by bedrock folding and subsequent modification by glaciation. Valleys and ridges generally trend north-northeast. Elevations range from about 500 feet above sea level at the Hudson River on the west boundary of the county to over 1000 feet in the interior portions. The water surface of Lake Carmel is 619 feet above sea level and ground surface at the site ranges from 650 to 680 feet above sea level.

The LaRussell's Cleaners Site is located within the Palmer Lake drainage basin and is 30 feet south of the drainage divide separating Lake Carmel (approximately 800 feet north) and Palmer Lake (approximately 2000 feet south). Most of the site is steeply sloping granitic gneiss outcrop and there are no streams or standing water on the site. The parking lot is relatively flat, and drains precipitation to Route 52. Drainage from Route 52 flows south along the east side of the road and into a catch basin located approximately 500 feet south of the site near Adams Lane. From the catch basin, water flows west beneath Route 52 and south via engineered ditches and culverts to a wetland northwest of Palmer Lake. Water from the wetland flows into Palmer Lake from the northwest. Palmer Lake drains southward into Michael Brook. Michael Brook flows into Croton Falls Reservoir (part of the New York City water supply system) at a location approximately 3.75 miles south of the site. Water from Croton Falls Reservoir flows south to the Croton River and eventually discharges into the Hudson River and ultimately the Atlantic Ocean.

Due to steeply sloping topography, low permeability surface soils and large paved areas, most precipitation falling on the site runs off via overland flow and discharges to Route 52. Water that infiltrates at higher elevations, discharges from groundwater seeps in the rock slope and flows over the parking lot. Additionally, the on-site septic system frequently overflows causing waste water to flow over the parking lot and into Route 52.

Soils in Putnam County are derived from weathered granitic gneiss and schist where bedrock is shallow (USDA, 1994). Other soils are derived from glacial sediments deposited in valleys and low lying areas. Bedrock in the region includes a variety of rock types and formations ranging in age from Pre-Cambrian to Mesozoic. The rocks underlying the LaRussell's Cleaners Site are metamorphic granitic gneiss (Fisher, 1970). The mineral content of the gneiss is biotite-quartz-plagioclase (Prucha, 1968). The rocks exhibit banding of the dark minerals and are medium to fine grained. The geologic structure of the area is typified by northeast trending folds and faults. Glaciation has affected the site by scouring valleys and leaving a mantle of low permeability till on hill tops, and lacustrine sand and gravel deposits in valleys.

Groundwater occurs in all geologic formations in Putnam County. Water producing formations are grouped into two major classes including bedrock formations and unconsolidated formations. Bedrock beneath the site is granitic gneiss. Water production from this unit is largely from secondary porosity of fractures and joints. Average yields are about 11 gpm in drilled wells with average depth of 145 feet (Grossman, 1957). Yields are generally higher in valleys, where bedrock is covered by permeable deposits. Groundwater quality is generally good with groundwater being soft and occasionally high in iron. Most drinking water is supplied from individual domestic wells. Lake Carmel is not served by a municipal water system.

1.4 Site History

The following section describes the development of the LaRussell's Cleaners Site since the purchase of the property by Mr. LaRussell. Details as to dates and locations of various activities were obtained from previous reports and publicly available records from the Town of

Kent, New York State Department of Health (NYSDOH) and New York State Department of Environmental Conservation (NYSDEC).

The property currently owned by Mr. Eugene LaRussell is a 1.5 acre lot known in the Town of Kent as property parcel number 33.72 - 1 - 18. The lot and an approximately 24 feet by 30 feet two story building were purchased by Mr. LaRussell in 1971. The building was vacant when purchased by Mr. LaRussell. Prior to that, the building reportedly was used as a residential home and an electrical shop (Pfizer-Jahnig, 1993). The building was also reported to have a dirt floor, a water well and a leaching pool for waste water.

The dry cleaning business began operation at the site in 1971. Clothes were received from customers at the building and were sent out for dry cleaning. On October 29, 1971, a water well was drilled to replace the existing well. The reason for replacement is unknown. On that date, water in the well was measured at 35 feet below ground surface (Putnam County Department of Health, 1987). This replacement well was located approximately three feet south of the original well (Pfizer-Jahnig, 1993).

In 1973, dry cleaning began on site. Tetrachlorethylene (PCE) was reportedly used on-site at this time. Reportedly, waste PCE was disposed with other business related refuse and was removed from the site by a local garbage hauler.

A plan drawing by Cashin Associates indicates that, in July 1982, a septic disposal system was in use at a location adjacent to the original building. The plan also indicated the proposed location for a new sewage disposal system to be located approximately 100 feet north of the existing drinking water supply well in the area of the present parking lot. According to the plan, the original septic system was located between 10 and 35 feet north of the original building adjacent to and presumably beneath an existing parking area. The system appears to have consisted of three branches of leaching pipe running parallel to one and other in a north-south orientation.

In November 1982, the Town of Kent issued a building permit for construction of an addition onto the existing building. According to drawings by Cashin, the addition was 30 feet by 30 feet and attached to the original building along the north side. The addition was constructed over the top of the old sewage disposal system. Presumably the sewage system was renovated at this time. Drawings by Cashin indicate that bedrock, boulders and soil located at the northeast corner of the parking lot were removed to enable proper separation distance between the drinking water supply well and the new septic system leaching tanks. Improvements, including curbing and paving, were made to the parking lot. The Town of Kent issued a certificate of occupancy for the building in July 1984, and presumably the dry cleaning operation expanded into the new addition.

In 1985, the Neighborhood Cleaners Association advised Mr. LaRussell that New York State Law required a documentation of handling and storage of PCE. Since 1985, Mr. LaRussell was provided with 55 gallon drums for temporary on site PCE storage. Waste PCE has been removed from the site by an approved hauler, since 1985.

The water well at LaRussell's Cleaners was re-drilled for the second time in 1987. A well completion report filed with the PCDOH indicates that this well was drilled by P.F. Beal and Sons to a depth of 140 feet and provided a yield of 15 gallons per minute.

In 1995, another septic system was constructed. This system consisted of a new storage tank and leaching galleries. The system was constructed in an effort to increase infiltration rates and prevent septic system overflows.

1.5 Findings of Previous Investigations

In 1981, the Putnam County Department of Health (PCDOH) sampled the private water supply well on the LaRussell property as a result of a county-wide assessment of dry cleaning establishments. The results of the analysis indicated the presence of 360 µg/l tetrachloroethene (PCE). The well was sampled again in 1983, and indicated the presence of 390 µg/l of PCE.

Sampling was also conducted at the adjacent telecommunications business building in 1983. The water collected from the telecommunications business well indicated the presence of PCE at 540 µg/l. Several rounds of sampling were completed by PCDOH between 1983 and 1995 for both properties. Twelve additional private water supply wells in the vicinity of the site were sampled in 1992. Of the twelve sampled, two of the wells indicated the presence of PCE above the drinking water standard of 5 µg/l. One of these wells was at the Sofair Apartments, located approximately 350 feet north of the LaRussell's Cleaners Site. This well contained PCE at 9 µg/l and DCE at 9 µg/l.

In November 1990, PCDOH conducted an anonymous complaint investigation at the LaRussell's Cleaners Site. During the investigation, it was noted that PCE was being stored in filter residue containers outside and behind the building. A portion of the storage area was noted as being deformed and discolored and an odor of PCE was noted.

In October 1991, the PCDOH sampled drinking water from LaRussell's Cleaners tap and the telecommunications business building tap. Results of this sampling yielded the highest concentrations of PCE found at the site to date (6,000 µg/l). In August 1992, the PCDOH sampled the LaRussell's Cleaners and telecommunications business wells again, as well as neighboring residences. PCE was detected in several wells, resulting in the PCDOH request for bottled water for LaRussell's Cleaners and the telecommunications business. In November 1992, PCDOH conducted another round of water sampling and found 200 µg/l of PCE in the LaRussell's Cleaners water supply well.

In response to a NYSDEC notification of PCE contamination in drinking water, LaRussell's Cleaners submitted a report to NYSDEC in March 1993 (Pfizer-Jahnig, 1993). The report described the history of LaRussell's Cleaners and suggested other possible sources of PCE in the area.

In November 1992, a consultant for LaRussell's Cleaners collected a sample of the untreated well water. The results of the analysis indicated the presence of 220 µg/l of PCE. Two effluent saturated soil samples were also collected from approximately 4 feet below grade in the vicinity of the 2,500 gallon waste water leaching pits. Neither of the samples indicated the presence of volatile organic compounds. One soil sample was also collected from an area near the PCE storage area. The sample was collected from 1.5 feet below the asphalt surface. The soil was described as "mottled" at a depth of 0.8 feet below ground surface. This was reportedly a result of saturated conditions from a high water table during the time of sampling. The results of the analysis of the soil sample indicated the presence of 127.2 μg/kg of PCE.

In April 1993, the PCDOH collected two air samples in the apartment above the LaRussell Cleaners. The air samples were collected in response to odors that were noted in the apartment. During the initial collection of the samples, the dry cleaning equipment was reportedly not operating. One sample exhibited the presence of PCE at 1,910 μg/l. The second sample was collected when the equipment was observed to be operating. This sample indicated the presence of PCE at 1,510 μg/l. On December 16, 1997 the New York State Department of Health (NYSDOH) collected air samples in the apartment above the cleaners. TCE was detected in two air samples at concentrations of 4,200 and 4,300 $\mu g/m^3$. Ambient samples collected on the same day were 550 and 650 $\mu g/m^3$. The NYSDOH guideline for residential air quality is 100 μg/l. Based on these results, NYSDOH has recommended that risk management actions be taken at the dry cleaners.

1.6 Remedial Investigation Report Organization

The LaRussell's Cleaners Site Remedial Investigation is designed to locate the source of documented groundwater contamination and provide recommendations for remediation of the site. The approach of the remedial investigation was to utilize existing data obtained from previous investigations as the basis for design of the field investigation. This enabled the investigation to focus on locating the source (source entry area) of the contamination.

This report is presented in a format which allows for a logical and ordered progression of the descriptions and findings of the investigation. Section 1.0 discusses the project objectives, background and review of the site history, including a discussion of previous investigations and a summary of the results. Section 2.0 is a detailed description of the field program. Section 3.0 describes the results of the physical characteristics of the study area, including surface features, geology and hydrogeology. Section 4.0 discusses the nature and extent of the contamination, including a discussion regarding standards, guidelines and criteria for the various sampling media, data validation, the analytical results, and the fate and transport of the contaminants detected. Section 5.0 presents the conclusions of the remedial investigation.

2.0 STUDY AREA INVESTIGATION

The purpose of this section is to document field activities and techniques used to evaluate the LaRussell's Cleaners Site. Field work was performed in accordance with the Site Specific Work Plan (D&B, 1996b) with references to the draft Generic Work Plan for the Investigation of Dry Cleaners Sites (D&B, 1996a).

2.1 Site Facilities

Facilities used during the performance of the field investigation at the LaRussell's Cleaners Site were temporary and short term. Due to the small size of the site (less than 1 acre) and the desire to minimize disturbance to daily business activities at the LaRussell's Cleaners, no on-site office or equipment supply area were established. Field activities were directed from a van that contained equipment and accompanied drillers, samplers and other field personnel during the investigation.

A decontamination pad was constructed on the southeast portion of the home center property, across Route 52 and a few tenths of a mile south of LaRussell's Cleaners. There was no suitable location on the LaRussell's Cleaners property for a decontamination pad. The decontamination pad was constructed of two inch by eight inch lumber and covered with plastic. Wash water was allowed to drain into surrounding soils, with the approval of the NYSDEC, after it became apparent through field screening that drill cuttings did not exhibit contamination.

2.2 Aerial Photography and Topographic Mapping

On December 27, 1996, a stereographic pair of aerial photographs were taken of the LaRussell's Cleaners Site. The scale of the photographs is approximately one inch equals 500 feet. The aerial photography was performed by Lockwood Mapping, Inc. Ground control surveying was conducted by Y.E.C., Inc. A topographic base map with a scale of one inch equals 100 feet and 2 foot elevation contours was produced by Lockwood Mapping. The base map was then used to locate borings, structures and other important site features. The base map, and survey elevation and locations are presented in Appendix A.

2.3 Grid Network Survey

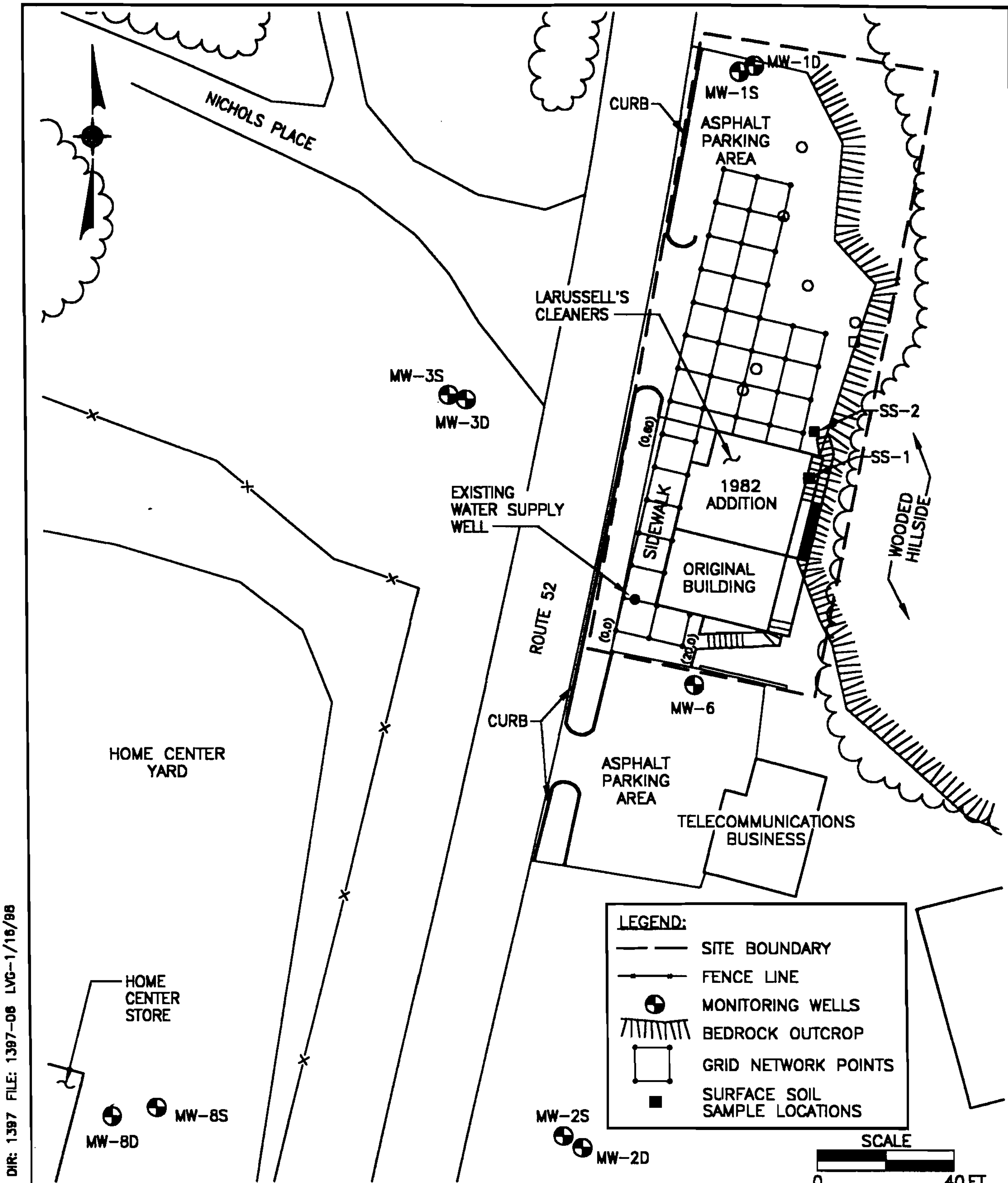
A grid system was installed on the LaRussell's Cleaners property for use in the soil gas survey, and collection of subsurface soil and groundwater samples. The grid origin was established in the southwest corner of the property near a curb adjacent to Route 52 and the telecommunications business north property line. The grid origin was marked with spray paint and a nail in the pavement. The grid was laid out on ten foot node intervals to the north and west of the origin. Grid points were marked outside of the building. The southwest corner of the building is located at coordinate north 10 feet and east 10 feet on the grid (see Figure 2-1). The grid extended 170 feet north and 50 feet east of the origin and included the building and parking lot.

2.4 Geophysical Survey

The geophysical survey described in the Work Plan was omitted from the field investigation. The presence of geophysical interferences on site and a revised scope for invasive investigative techniques (i.e. drilling) were the reasons for elimination of geophysics from the field investigation.

2.5 Surface Soil Sampling

Two surface soil samples were collected from two areas of the site, near the LaRussell's Cleaners building, believed to be possible source areas of contamination. These areas are also the only areas of the site adjacent to the building that are currently unpaved.



LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

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GRID NETWORK

FIGURE 2-1

Surface soil samples SS-1 and SS-2 were collected from exposed soil on the eastern edge of the building, beneath the steps that lead to the second floor landing (see Figure 2-1). The sampling locations are within five feet of a vertical bedrock face that extends 10 feet above the ground surface. The surface soil samples were collected from zero to six inches below ground surface. The samples were preserved on ice and analyzed for Target Compound List (TCL) + 10 volatile organic compounds (VOCs).

2.6 Soil Gas Survey

A soil gas survey was conducted on-site in order to evaluate the concentrations of volatile organic gases in the soil. Anomalously high concentrations were evaluated as possible sources of contamination. Soil gas sampling was performed by advancing a hollow soil probe several feet below the ground surface, withdrawing air from the soil pore-space, and screening the sample in the field using a portable gas chromatograph (GC). The soil gas survey was conducted by drilling a hole through the asphalt using a two inch rotary hammer drill equipped with an 18 inch long, one inch diameter carbide tipped drill bit. After drilling through blacktop a stainless steel soil probe was advanced to a depth ranging from 1 foot to 2.5 feet below ground surface using a slam bar. The final depth of soil probes was determined by refusal of advancement of the probe due to subsurface obstructions. Upon completion of the soil probe installation, total VOC readings of the vapor exhaust from the soil probe were measured and recorded using an Photovac Microtip photoionization detector (PID).

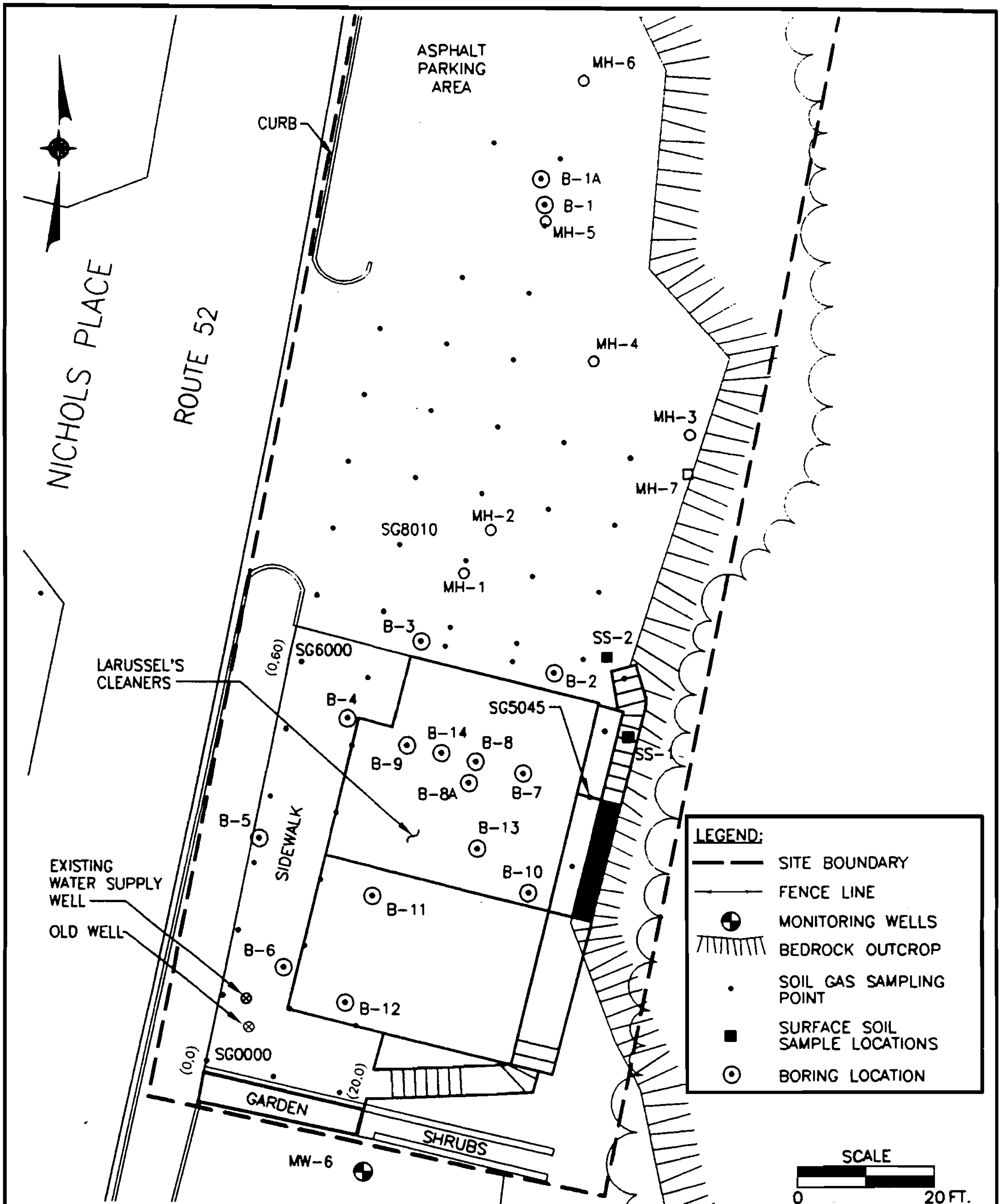
Gas was removed from the soil probes by sealing the probe with a threaded stainless steal cap. One end of tubing was attached to a barbed nipple on the cap and the other attached to a Gillian Personal Air Sampler vacuum pump. The pump was allowed to purge gas from the sampling train for at least five minutes at a rate of 400 ml/min. After purging, a soil gas sample was collected for analysis. The sample was collected using a gas tight 500 μL syringe inserted into the rubber tubing near the stainless steal nipple. Gas in the filled syringe was then extruded until a sample of 250 μL was left in the syringe. The sample was then injected into the portable GC and analyzed. The GC was a Photovac 10S Plus and was calibrated for PCE, trichloroethene

(TCE), and 1,2 - dichloroethene (DCE). Following the injection, the syringe was purged with five to ten volumes of ambient air.

A total of 51 soil gas samples were collected and analyzed over a two day period. Fifty samples were collected from the LaRussell's Cleaners property and one off-site sample was collected from the intersection of Nichols Place and Route 52. All sample probes were decontaminated and air dried after each use. The holes remaining in the ground after sample point removal were filled with soil cuttings and topped with asphalt patch. Figure 2-2 depicts the locations of the soil gas samples.

The GC calibration technique consisted of a single VOC constituent calibration technique, in which a single-constituent calibration gas of a known concentration was prepared from a reference grade VOC in its pure form. The calibration standard concentrations were established by injecting known volumes of each VOC (e.g., PCE or TCE) into a Tedlar bag filled with zero air. The known concentration of the VOC from the Tedlar bag was injected into the GC and the observed concentration and retention time were assigned to the proper library file. If the compound was not identified to be within the GC's preprogrammed retention time window, GC adjustments were made, and the standard was either re-injected and evaluated, or a new single-compound calibration standard was prepared for analysis.

Routine soil gas quality assurance/quality control (QA/QC) included analysis of syringe blanks, equipment (sampling train) blanks and duplicate samples. Syringe blanks consisted of injection of ambient air into the GC following flushing. Sample train blanks included collecting an ambient air sample from a decontaminated sampling train. Syringe and equipment blanks were analyzed periodically and following analysis of samples which exhibited significantly elevated levels of VOCs. These blanks were used to verify the effectiveness of the decontamination procedures and to minimize the possibility of sample cross-contamination.



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LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

SOIL GAS AND SOIL BORING SAMPLING LOCATIONS

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FIGURE 2-2

2.7 Sanitary System Sampling

The existing septic system is located beneath the parking lot north of the LaRussell's Cleaners' building. Several manholes are present in the parking lot. The manholes provide access to two septic tanks, a distribution box and two dissipater tanks. Two sediment samples were collected from this system. The first sediment sample (Sample ID: LC-ST-SD-1) was collected from the first septic tank at manhole MH-1 (see Figure 2-2). This tank holds raw sewage and is the first receptacle in line from the building. This tank receives liquid waste directly from the washing machines, sinks and toilets in the building.

A second sediment sample was collected from the dissipater. The dissipater receives water and sediment pumped from the septic tank that then percolates into the soil through perforations in the pre-cast concrete dissipater tank. Sample LC-LP-SD-1 was collected through manhole MH-4 at the north end of the septic system. This portion of the system is reported to have been installed in 1995, and has very little sediment accumulation. A third sediment sample was attempted at manhole MH-6 between the septic tank and the end of the dissipater, but was unsuccessful due to lack of sediment.

Sediment samples were collected using a decontaminated, long handled polyethylene scoop. Sediment was obtained from the bottom of the tanks. Liquid was decanted from the scoop and sediment placed in a laboratory sample container. Sample containers were preserved in coolers on ice and shipped to the laboratory within 24 hours of collection. Samples were analyzed for TCL + 10 volatile organic compounds.

Sediment samples were not collected from the abandoned sanitary system as described in the Work Plan. The abandoned system could not be located during the investigation. The abandoned system is shown on site development drawings submitted for permit approvals from local agencies. Attempts to locate the abandoned system included the use of a magnetic locator, analyses of soil gas data from the grid network, inspection of all manholes on the site and dye testing of waste water. It is believed that the abandoned system may have been removed or destroyed during the construction of the existing system or the building addition.

2.8 Subsurface Sampling

Subsurface samples were collected by advancing soil borings. The borings were installed in three phases. The first phase occurred in October 1996, and included seven borings in the LaRussell's Cleaners' parking lot and one boring through the floor inside the building. Seventeen soil samples were collected for laboratory analyses during this phase. At least one sample was collected from each boring based upon elevated PID measurements or visual characteristics. All subsurface soil samples were collected from unsaturated soils.

In addition to the collection of surface soil samples from the borings, groundwater samples were also collected. When groundwater was encountered in a boring, the boring was advanced to a depth approximately five feet below the water table. A temporary one inch diameter PVC piezometer with 0.01 inch slotted screen was placed in the open hole and allowed to fill with groundwater. Groundwater samples were collected using a small diameter, disposable or decontaminated bailer. A total of four groundwater samples were collected from four different borings, including B-2, B-3, B-4 and B-6. The samples were analyzed for TCL + 10 volatile organic compounds. Boring locations and specifications are presented in Figure 2-2 and Table 2-1, respectively.

The second phase of subsurface soil sampling occurred in November 1996, after the results of the initial sampling were obtained and no definitive, identifiable source of PCE contamination could be established. The borings in the building were designed to target the location of former septic system reported to have existed beneath the building. This phase consisted of the construction of five borings (B-8, B-9, B-10, B-11 and B-12) through the floor inside the building. Indoor soil samples were collected by coring a hole through the floor using a portable concrete coring machine. The locations of the core holes were limited to open areas of the floor that would not interfere with dry cleaning machinery or stored clothing. Once a hole

Table 2-1
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

BORING SUMMARY

Boring ID	Total Depth*	Sample Intervals Analyzed for TCL+10	Notes
B- 1	3.9	0 - 2 ft	Parking lot boring
B- 1A	9.8	4 - 6 ft	Boring 2 ft east of B-1
B- 2	6.0	0 - 2ft, 2 - 4 ft, 4 - 6 ft	Groundwater sample collected at this location
B- 3	11.5	2 - 4 ft, 6 - 8 ft	Groundwater sample collected at this location
B- 4	9.0	2 - 4 ft, 4 - 6 ft, 6 - 8 ft	Groundwater sample collected at this location
B- 5	6.3	2 - 4 ft	Parking lot boring
B- 6	8.3	4 - 6 ft	Groundwater sample collected at this location
B- 7	2.0	1 - 2 ft	Indoor boring through floor
B- 8	2.0	0.3 - 2.0 ft	Indoor boring through floor
B-8A	2.0***	0.3 - 2.0 ft	Indoor boring through floor, attempted through B-8
B- 9	1.9**	0.3 - 1.9 ft	Indoor boring through floor
B-10	1.5**	0.3 - 1.5 ft	Indoor boring through floor
B-11	1.4**	0.3 - 1.4 ft	Indoor boring through floor
B-12	3.0**	0.3 - 2.0 ft	Indoor boring through floor
B-13	5.9***	4.0 - 5.9 ft	Indoor boring through floor
B-14	4.8***	4.0 - 4.8 ft	Indoor boring through floor
B-15	10.0****	0-2 ft, 2-4 ft, 4-6 ft, 6-8 ft	Off site boring near MW-3

* - Borings advanced with a hydraulic hammer until refusal as aresult of bedrock or boulders unless otherwise noted.
** - Split spoon driven with sledge hammer.
*** - Split spoon driven with 140 lb. hammer using electric cat-head and tower.
**** - Samples collected using 4.25 inch augers and split spoons driven with 140 lb. hammer.

was cored through the floor, a split spoon sampler equipped with an anvil was placed in the hole. The split spoon was advanced by pounding the anvil with a ten pound sledge hammer. Split spoons were driven until the spoon could be driven no further (spoon refusal). Using this method, spoons were advanced to depths of 1.4 feet to 3 feet below the floor. One soil sample was collected from each boring based on elevated PID measurements or visual characteristics.

The third phase of subsurface soil sampling occurred during March 1997. This phase of soil borings also targeted soil beneath the building. A different drilling technique was used to better penetrate the subsurface beneath the building and collect deeper soil samples. An adjustable tower and pulley system were set up inside the building. An electrically powered cat-head has affixed to the base of the tower and a 140 pound hammer connected to the cat-head using one inch diameter rope. The hammer was then connected to a split spoon hammer and driven until spoon refusal occurred.

Three borings (B-8A, B-13 and B-14) were drilled inside the building using the tower. The borings resulted in spoon refusal at depths ranging from 2 feet to 5.9 feet below the floor of the building. These depths are relatively shallow and similar to those reached in earlier attempts. This drilling phase confirmed that the borings conducted in the second phase of the soil boring program were in fact on bedrock or very large boulders on top of rock, and that significant zones of soil were not left unsampled. One sample from each boring in the third phase was selected based upon visual characteristics or elevated PID measurements, and analyzed for TCL + 10 VOCs.

2.9 Monitoring Well Installation Program

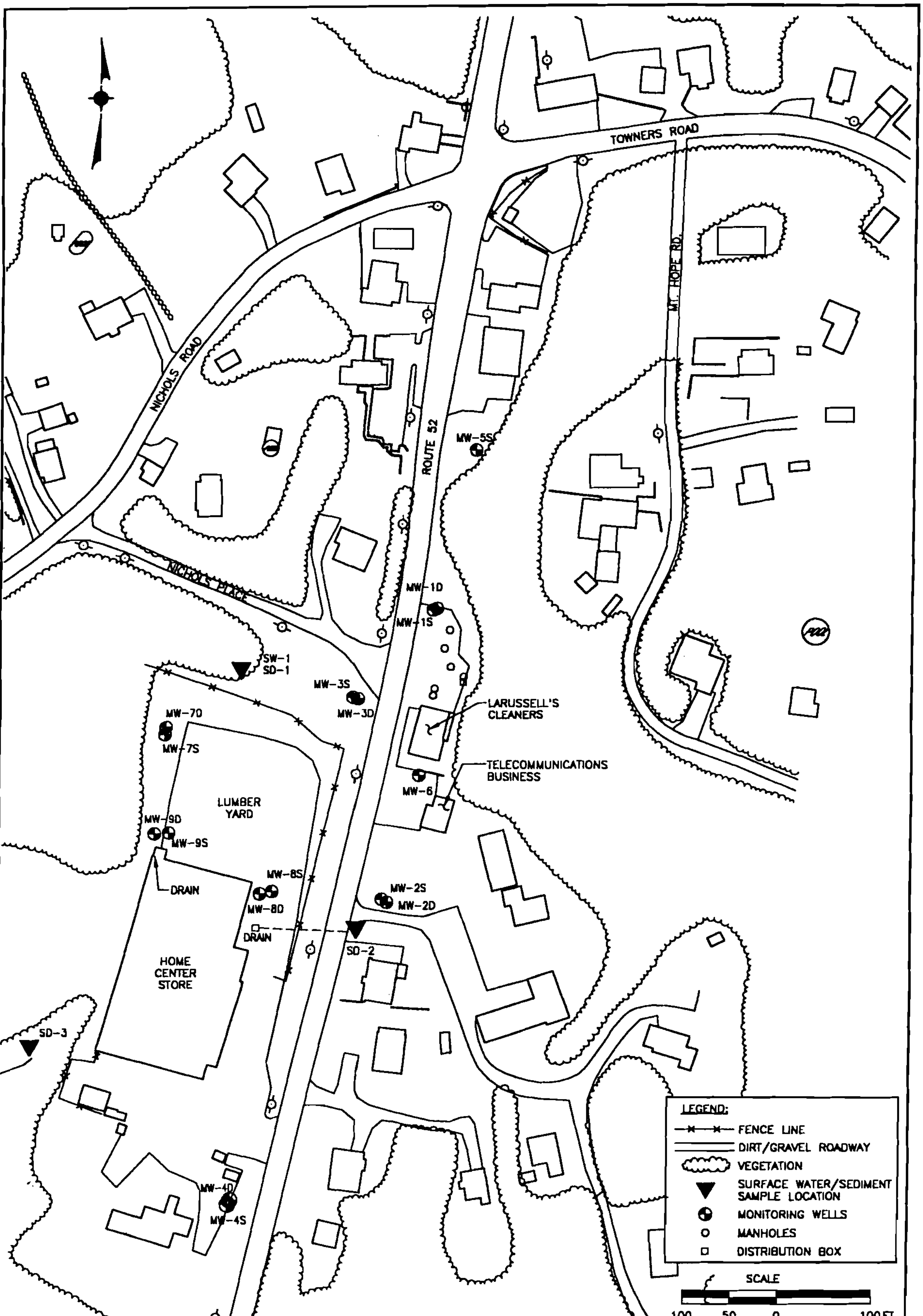
Monitoring wells were installed at the LaRussell's Cleaners Site to provide subsurface geologic data and to allow monitoring of groundwater elevations and quality. This information was necessary to evaluate the direction of groundwater flow and the extent of the groundwater contaminant plume. A total of 16 monitoring wells were installed for this investigation. Drilling was performed in two phases.

The first phase took place in October 1996, and consisted of the installation of 10 monitoring wells. The second drilling phase occurred in March 1997, after the results of the initial groundwater sampling event were reviewed. The second phase consisted of the installation of six additional wells. Fourteen of the wells were installed in seven well couplets consisting of one shallow well and one deep well. Shallow wells were screened at the water table in the overburden and deep wells were completed in bedrock with screened zones beneath the bedrock surface.

Two well locations, MW-5 and MW-6, are not completed in couplets. At MW-5, the depth to bedrock (greater than 40 feet) is significantly deeper than at other locations. The typical depth to bedrock at the other locations was less than ten feet. A deep well was not installed due to the significant difference in depth of bedrock between this location and other locations on and off site. Location MW-6 is a deep well and does not have a shallow well. Bedrock at MW-6 is relatively shallow (10 feet below ground surface), and a shallow well could not be constructed due to the absence of groundwater in the overburden. The locations of the monitoring wells are presented in Figure 2-3.

2.9.1 Monitoring Well Locations

The locations of monitoring wells were chosen to define the extent of contamination migrating from the LaRussell's Cleaners Site. Due to the steep topography in the vicinity of the site and the proximity of the site to a topographic divide, the positioning of representative up- and downgradient wells was difficult. No wells were completed east of the site due to steep topography. MW-5S serves as a background well, since it is across the divide from the site. Due to the presence of fractures in bedrock, up and down gradient relationships are complex. Table 2-2 lists the monitoring wells, the zone screened and the location with respect to the site.



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LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

MONITORING WELL LOCATION MAP

FIGURE 2-3

Table 2-2
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

MONITORING WELL LOCATIONS

Well ID	Hydrogeologic Unit Screened	Location
MW-1S	Water Table	On-site, upgradient*
MW- 1D	Bedrock	On-site, upgradient*
MW- 2S	Water Table	Off-site, downgradient
MW- 2D	Bedrock	Off-site, downgradient
MW- 3S	Water Table	Off-site, side gradient
MW- 3D	Bedrock	Off-site, side gradient
MW- 4S	Water Table	Off-site, down gradient
MW- 4D	Bedrock	Off-site, down gradient
MW- 5S	Water Table	Off-site, background**
MW- 6	Bedrock	Off-site, down gradient
MW-7D	Bedrock	Off-site, down gradient***
MW-7S	Water Table	Off-site, down gradient***
MW-8D	Bedrock	Off-site, down gradient
MW-8S	Water Table	Off-site, down gradient
MW-9D	Bedrock	Off-site, down gradient***
MW-9S	Water Table	Off-site, down gradient***

* Well is upgradient from building , however under certain conditions may be down gradient from septic system seepage galleries
** Well is hydraulically down-gradient from site, however well is located across a topographic divide from the site.
*** Well is hydraulically down gradient, however water elevations indicate well is in a different flow system from the site.

2.9.2 Monitoring Well Installation and Construction

All monitoring wells were installed using a truck mounted drill. Wells constructed during the first phase of drilling were installed using a Mobile B-57 truck rig and wells constructed during the second phase of drilling were installed using a CME 75 truck rig. Generally, well construction consisted of advancing a boring to the top of bedrock using 4.25 inch inside diameter hollow stem augers. Soil samples were collected continuously at two foot intervals until spoon refusal on bedrock. Once on rock, the augers were removed and replaced with 4 inch inside diameter (ID) temporary flush joint casing. Bedrock was then cored using HX diameter core barrel. Core runs of five feet were drilled until the desired well depth was achieved. All split spoon samples and bedrock cores were screened with a PID or Foxboro Century OVA flame ionization detector (FID), and examined and logged by a geologist. Boring logs are presented in Appendix B.

Shallow wells were constructed after completion of the deep wells. Split spoon samples from the shallow wells were collected at the on site geologist's discretion. Shallow wells were typically located within 10 feet of deep wells.

Monitoring well construction consisted of the following technique. The open hole was flushed with clean water after the completion of the final core run in deep wells. Shallow wells were flushed with clean water as necessary depending on the occurrence of groundwater and fine grained sediment. A six inch layer of sand was emplaced on the bottom of the hole, followed by installation of 2 inch inside diameter Schedule 40, 0.010 inch slot PVC well screen and 2 inch ID Schedule 40 riser pipe.

A sand pack was added to the annulus to a depth two feet above the top of the screen. During the construction of deep wells, the temporary casing remained in place during the sand pack installation. (At shallow wells the augers were removed coincidentally with the installation of sand.) A 6 inch fine grained sand layer was installed above the sand pack followed by a

Portland cement and bentonite grout mix to ground surface. All wells were completed with a flush mount curb box or a stick up steel protective casing depending on the location. Protective casings were installed with concrete pads and well caps secured with locks. A summary of well construction details is provided in Table 2-3. Details of well completions are provided on boring logs and presented in Appendix B.

2.9.3 Monitoring Well Development

Monitoring wells were developed by evacuating water until turbidity decreased to less than 50 nephelometric turbidity units (NTU) or until field parameters (conductivity, pH and temperature) stabilized. Water was removed from wells no sooner than 24 hours after well completion. Groundwater was removed using bailers and electric submersible pumps with polyethylene tubing. Table 2-4 summarizes well development procedures.

2.9.4 Groundwater Level Monitoring

Throughout the drilling program, water levels were measured in wells as they were completed. Site wide rounds of water level measurements were conducted periodically. Water level measurements were used with topographic survey data to calculate groundwater elevations. This data was then used to make potentiometric surface maps of groundwater. Groundwater elevation data is presented in Appendix C.

In addition to periodic water level measurements, several wells were monitored over the course of several hours or days to determine the effects of drilling, local water use (i.e. pumpage) and weather conditions on groundwater. A Hermit 1000C data logger and pressure transducers were used to record groundwater elevations at various time intervals. Water levels were recorded as frequently as 1 minute intervals to as much as 15 minute intervals. Data recorded by the data logger is presented in Appendix C.

Table 2-3
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

MONITORING WELL SPECIFICATIONS

(feet above mean sea level)

Boring ID	Total Depth	Depth to Rock or refusal	Screen Top	Screen Bottom	Length	Elevation Surface	Elevation Bedrock	Elevation Screen Top	Elevation Screen Bot
MW- 1S	21.0	16.0	10.4	20.4	10.0	658.6	642.6	648.2	638.2
MW- 1D	40.0	14.5	30.0	40.0	10.0	658.6	644.1	628.6	618.6
MW- 2S	15.5	ne	5.5	15.5	10.0	650.5	na	645.0	635.0
MW- 2D	50.0	16.3	40.0	50.0	10.0	651.0	634.7	611.0	601.0
MW- 3S	13.9	ne	3.9	13.9	10.0	653.4	na	649.5	639.5
MW- 3D	54.5	24.0	44.5	54.5	10.0	653.7	629.7	609.2	599.2
MW- 4S	13.0	ne	3.0	13.0	10.0	631.7	na	628.7	618.7
MW- 4D	30.0	17.0	18.3	28.3	10.0	632.3	615.3	614.0	604.0
MW- 5S	40.0	ne	20.0	40.0	20.0	660.0	na	640.0	620.0
MW- 6	55.5	10.0	35.5	55.5	20.0	653.8	643.8	618.3	598.3
MW-7D	25.3	10.3	12.0	22.0	10.0	644.2	633.9	632.2	622.2
MW-7S	9.0	ne	3.0	9.0	6.0	643.9	na	640.9	634.9
MW-8D	24.5	12.2	13.5	23.5	10.0	640.7	628.5	627.2	617.2
MW-8S	13.2	ne	3.0	13.0	10.0	640.6	na	637.6	627.6
MW-9D	24.2	9.0	13.5	23.5	10.0	640.9	631.9	627.4	617.4
MW-9S	8.7	ne	2.7	8.7	6.0	640.5	na	637.8	631.8

ne - Not encountered
na - Not applicable
* - Refusal

Table 2-4
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

WELL DEVELOPMENT RECORDS

Well	Gallons Removed	Turbidity (NTUs)	Observations
MW-1S	60	615	Clear, but agitation made water turbid.
MW- 1D	65	37	Pumped dry at 1gpm, influenced by LaRussell pumping well.
MW- 2S	30	999	Pumped dry at 1 gpm in 1-2 minutes.
MW- 2D	110	10	Clear water, sustained 1 gpm flow.
MW- 3S	57	140	Sustained 1 gpm flow.
MW- 3D	27	11	Occasionally pumped dry due to interference from LaRussell pumping well.
MW- 4S	38	999	Pumped dry at 1gpm, cloudy gray water.
MW- 4D	110	13	Clear water, sustained 1 gpm flow.
MW- 5S	42	39	Clear, but agitation made water turbid.
MW- 6	55	2	Clear water, sustained 1 gpm flow.
MW-7D	146	101	Clear.
MW-7S	25	999	Light brown.
MW-8D	125	7	Clear, little draw down, sustained 1 gpm flow.
MW-8S	52	406	Clear, but agitation made water turbid.
MW-9D	30	200	Light gray, pumped dry at 1 gpm.
MW-9S	15	999	Light brown, pumped dry at 1 gpm.

2.10 Groundwater Sampling

Two rounds of groundwater sampling were conducted during the investigation. The first round occurred in November 1996, and the second round was conducted in March 1997. Monitoring wells were purged using 12 volt electric pumps or bailers until three volumes or more had been removed. Purge water was monitored for pH, conductivity and temperature. Groundwater samples were collected using dedicated disposable bailers and dedicated polyethylene rope. Samples with groundwater exhibiting high turbidity were allowed to stand overnight before collecting samples for metals analyses. Groundwater samples were analyzed for TCL+10 VOC parameters and iron and manganese for the purpose of evaluating groundwater treatment systems. Field parameters and water levels were also measured at the time of sampling. Sample information records are presented in Appendix D.

2.11 Ambient Air Monitoring

Air monitoring for organic vapors was conducted throughout drilling portions of the investigation in accordance with the Generic and Site Specific Health and Safety Plans. Air monitoring was conducted using a Foxboro model 128 Organic Vapor Analyzer or a Photovac 2020 PID. At no time during the investigation were the action levels of 5 ppm exceeded in the breathing zone during the performance of work. On several occasions, elevated levels of organic vapors were detected downwind of exhaust fans in the dry cleaning area of LaRussell's Cleaners. Air monitoring results were recorded on daily field forms.

2.12 Surveying and Mapping

All borings and monitoring wells were surveyed for location and elevation by a licensed surveyor. Survey data was collected during and following the field activities at the site. Surveying was conducted under the supervision of the field manager. Tabulated survey results are presented in Appendix A.

2.13 Additional Work

During the course of the field investigation, preliminary results of field work and discussions with various residents, workers and the NYSDEC Project Manager led to the addition of several tasks to the work scope. These tasks were not described in the Site Specific Work Plan. These additional tasks included a private well survey, sampling of sediment from surface water catch basins, and a pumping test conducted on an abandoned well discovered beneath the pavement at the site. The additional work is described below.

2.13.1 Private Well Survey

Private wells are the primary source of potable water in Lake Carmel in the vicinity of the LaRussell's Cleaners Site. Since the site is located on the edge of a residential area served by private wells, a well survey was conducted. A one page questionnaire was delivered to over 50 neighbors of the site. Questionnaires were left with homeowners of all dwellings immediately adjacent to the site including homes along Nichols Avenue, Nichols Place, and Mt. Hope Road and its side streets located east of the site. Accompanying the questionnaire were a letter of explanation about the remedial investigation and a stamped reply envelope. Homeowners were asked to provide information regarding their wells. The questionnaire was distributed in October 1996, at the start of the field program. A total of fourteen responses were received. Table 2-5 summarizes the survey results. A blank copy of the questionnaire and accompanying letter are presented in Appendix E.

2.13.2 Storm Water System Sediment Sampling

Observations of surface water flow and septic system overflow at the LaRussell's Cleaners Site during the October field work indicated that contaminated waste water may have flowed through storm drainage systems along the east side of Route 52, into a catch basin near Adams Lane, under Route 52, through the home center property and into a small stream west of

Table 2-5
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

WELL QUESTIONNAIRE RESPONSE SUMMARY

No.	Location	No. of wells	Well use	Well Log Available ?	Total Depth (feet)	Depth to Water	Construction Date	Construction type	Completion zone	Depth to Bedrock (feet)	Well Yield (gpm)	Has well ever run dry ?	Water Quality Problems	Has well ever been tested	Are the results available?	Willing to give water sample	Map of home and well?
1	28 Mount Hope Rd	1	d	no	110	dk	1960	dk	dk	dk	dk	no	hard water	y	y	y	y
2	16 Mount Hope Rd	1	d	no	75	dk	dk	drilled	dk	dk	dk	no	iron staining	y	y	y	y
3	27 Adams Court	1	d	no	dk	dk	dk	dk	dk	dk	dk	no	none	y	n	y	y
4	10 Mt. Hope Drive	1	d	no	80-120	dk	dk	dk	dk	dk	6-20	no	none	y	n	y	y
5	11 Adams CT RD 11	1	d	no	160	dk	dk	dk	dk	dk	dk	no	none	n	n	y	y
6	42 Hillside Rd.	1	d	no	450	150	1986	drilled	dk	dk	dk	no	hard water	y	y	n	y
7	RD 8 Sunset Rd.	1	d	no	480	60-80	1974	drilled	rock	20	0-5	no	hard water	y	n	y	y
8	18 Hillside Drive	1	d	no	400	150	1945	dk	rock	dk	dk	no	hard water	y	y	y	n
9	28 Wingdale Rd.	1	d	no	250	dk	1970	dk	dk	dk	dk	no	hard water	y	y	n	y
10	26 Hillside Rd.	1	d	no	600	275	1975	drilled	dk	dk	6-20	no	hard water	y	n	y	n
11	1 Wingdale Rd.	1	d	no	150	dk	dk	drilled	soil	na	6-20	yes	green staining	y	n	y	y
12	PO Box 159	1	d	no	dk	dk	1950	drilled	dk	dk	dk	no	hard water	y	n	y	n
13	26 Adams Lane	1	d	no	dk	dk	1962	drilled	dk	dk	dk	no	none	n	n	y	y
14	52 Mt. Hope Rd.	1	d	no	160	dk	1950s	drilled	dk	na	20+	no	hard water	y	n	y	y

Notes:

d - domestic
dk - respondent does not know
y - yes
n - no

the home center. Based on the possibility of contaminant flow along this route, sediment samples were obtained. Surface water samples were not collected because it is believed that there is no longer a source of PCE that could escape the building via waste water. Sediment samples were collected from three locations including the catch basin near Adams Lane, a catch basin at the home center and the channel of the small stream west of the home center. Sediment sample locations are shown on Figure 2-3.

Sediment samples were collected by removing the grates from the catch basins and removing sediment using a long handled, decontaminated polyethylene scoop. Sediment samples were placed in laboratory containers and preserved with ice. The samples were shipped to the laboratory within 24 hours and analyzed for TCL + 10 VOCs.

2.13.3 Pumping Test

Water level monitoring conducted during drilling in October 1996 revealed that bedrock monitoring wells at the site are significantly influenced by pumping from water supply wells at the site and adjacent buildings. Water level fluctuations of several feet were observed in monitoring wells MW-1D, MW-2D, MW-3D and MW-6. These fluctuations coincided with the daily opening of businesses and typical water usage patterns by homeowners. The degree and frequency of the observed water level fluctuations indicate a wide area of influence from pumping wells and significant influence of fractures on the bedrock flow system.

A pumping test was performed on April 16 and 17, 1997, to evaluate the effects of sustained pumping on a well located on-site. The abandoned LaRussell's Cleaners well (referred to as the "old well") was used as the pumping well. Water levels were recorded in 12 wells during the pumping test using several data loggers. Water levels were monitored in the existing LaRússell's Cleaners well and the pumping well using a Hermit 1000C data logger. Telog water level monitoring systems provided and operated by NYSDEC were used to log water levels in MW-6, MW-2S, MW-2D and MW-1D. Data was subsequently lost from MW-2S and MW-1D due to a programming error. Water level data was also recorded from MW-7S, MW-7D, MW-

8S, MW-8D, MW-9S and MW-9D using an Instrumentation Northwest Aquistar DL 8 data logger provided and operated by NYSDEC personnel.

The pumping test was initiated at 8:00 p.m. on April 16th so that pumping could be conducted throughout the night without the influence of water withdrawal from the LaRussell's Cleaners' well for business purposes. The existing well occasionally withdrew water during the night, due to water usage from tenants in the second floor apartment. The "old well" was pumped at a rate of 3 gallons per minute (gpm). Discharge water was temporarily stored in a 350 gallon plastic tank. Sediment was allowed to settle out of the water and the water was then pumped through a carbon filtration unit. Treated water was discharged onto the Route 52 drainage ditch near Adams Lane.

The pumping well was shut down and a recovery test begun at approximately 6:00 a.m. the following morning. Recovery occurred uninterrupted for approximately one hour. At 7:00 a.m. the cleaners opened for business and the existing LaRussell's Cleaners well began frequent pumping throughout the day. Water levels were recorded until 4:30 p.m. on April 17th.

A discussion of the pumping test results is presented in Section 3.4. Pumping test data are presented in Appendix F.

2.14 Health and Safety Program

A Site Specific Health and Safety Plan (HASP) was prepared for the work conducted for this investigation. The HASP was prepared to provide site specific health and safety information. The Health and Safety Plan is contained in the draft Generic Work Plan (D&B, 1996a) with site specific updates for the LaRussell's Cleaners Site in the RI/FS Work Plan (D&B, 1996b). Activities conducted as part of the RI/FS field investigation were conducted in accordance with the HASP.

2.15 Quality Assurance/Quality Control Program

The Quality Assurance/Quality Control Plan (QA/QC) is included in the RI/FS Work Plan. Work performed during the field investigation was performed in accordance with procedures described in the QA/QC Plan contained in the RI/FS Work Plan. The QA/QC Plan is designed to maximize the quality and validity of the data collected during the field investigation. The QA/QC Plan describes detailed sampling and analytical procedures, as well as necessary QA/QC sampling and analyses for each sampling matrix investigated. Adherence to QA/QC protocols allows for data validation and usability analyses.

2.16 Data Validation

Enviroscience, Inc. performed the validation of analytical data reported during the remedial investigation. Analyses of samples were provided by Galson Laboratories, Inc. for all environmental samples collected with the exception of total organic carbon analyses. Total organic carbon (TOC) samples were analyzed by NYTest, Environmental, Inc. Galson and NYTest are both New York State Department of Health (NYSDOH) Environmental Laboratory Approved Program (ELAP) certified. Laboratory reporting was performed in accordance with NYSDEC 12/91 Analytical Services Protocol (ASP).

3.0 PHYSICAL CHARACTERISTICS OF STUDY AREA

The LaRussell's Cleaners Site remedial investigation involved the collection of site specific data and observations. The physical characteristics investigated included surface features of the site that may relate to the presence or transport of soil and groundwater contamination. The geology and hydrogeology of the site were also extensively investigated through a series of subsurface soil borings, groundwater monitoring wells, environmental samples and evaluation of physical characteristics of soil and groundwater properties at the site. The following describes the results of the investigation of physical characteristics of the site.

3.1 Surface Features

The LaRussell's Cleaners property parcel can be described as containing two physiographic areas. The first area of is the relatively flat lying parking lot and two story building housing the dry cleaning business. The second area is the steeply sloping, wooded hillside that rises up from the parking lot and building to the north and west. The wooded hillside makes up the majority of the property and is topographically higher in elevation than the other portions of the site. The eastern edge of the parking lot pavement abuts a steep bedrock outcrop. Similarly the east wall of the building is adjacent to the bedrock outcrop. Rock and soil debris occasionally wash down the hill into the parking lot due to surface water erosion and frost heaving. Groundwater seeps are often observed originating from fractures in the bedrock outcrop, and at the soil and bedrock interface. The soil cover on the hill slope is thin.

Surface water flows onto the parking lot from the wooded slope after heavy precipitation or snow melt and groundwater flows onto the parking lot from seeps at bedrock outcrop fractures. Surface water on the parking lot flows southwest to a drainage depression on the east side of Route 52. From this point the water flows southward off-site, parallel to Route 52.

The septic system for the dry cleaners and upstairs apartment is located beneath the parking lot. Seven manholes provide access to various parts of the septic system. The system consists of a 1,000 gallon septic tank located approximately 20 feet north of the north wall of the building. A dye test conducted during the field investigation confirmed that waste water from a utility sink inside the building drains to this tank. Liquid in the septic tank then drains to an adjacent 2,000 gallon, pre-cast concrete pump tank reportedly installed in 1995. Liquid in the second holding tank contains significantly fewer solids than the first tank. The liquid level is controlled by a float system that triggers pumping to the distribution system and dissipaters when the water level rises above a pre-determined height. Water in the septic system gradually percolates through concrete dissipaters and provides storage capacity for the next pumping episode.

The float system also triggers an audible alarm that can be heard inside the building when the liquid level is high. The alarm sounded frequently during the investigation. After several cycles of the washing machines inside LaRussell's Cleaners, the rate of waste water entering the leach field exceeded the capacity to percolate into the soil and liquid levels in the holding tank triggered the alarm. When the alarm sounded, the force pump would pump liquid to the distribution box and into the leaching system. This action typically caused the leaching system to overflow at manhole covers in the parking lot. Water leaking from the manhole covers then runs over the parking lot and follows surface water drainage ditches along Route 52. Once water overflow begins for a particular day, it continues periodically throughout the day. Overflows are most frequent following heavy rains and snow melt. Overflowing water exhibits a septic odor and is sometimes gray to blue in color.

Two water supply wells are known to exist on site and a third is suspected. The well currently used to supply water to the dry cleaning business and second floor apartment is located five feet west of the southwest corner of the building (see Figure 2-2). The well is six inches in diameter and at least partially cased with iron pipe. The well head extends approximately 18 inches above the paved sidewalk area. The well is equipped with a pitless adapter and the pump is hung on a 1.25 inch diameter pipe. The pump is set at approximately 55 feet below ground surface. Water from the well is pumped to a water treatment system inside of the building. The treatment system reportedly consists of a particulate filter and a carbon filter. Well water is used for laundry operations, as well as wash water and toilet water. Workers in the cleaners and in the apartment reportedly drink bottled water.

The second well is located approximately 10 feet south of the functioning well. This well was reportedly abandoned because of sand leakage around the casing into the well. The "old well" is approximately 60 feet deep and constructed of six inch diameter iron casing. A five inch iron pipe has been installed inside the six inch casing. The five inch pipe probably was installed in an attempt to seal off a leak of sediment at the overburden and soil interface. The well had been abandoned by forcing hay and grass clippings into the casing to a depth of approximately two feet and filling the remaining annulus with cement. The well was discovered using a magnetic locator and descriptions provided by Mr. LaRussell. Asphalt in the area of the well was cut and removed. The well casing was extended to ground surface by attaching a neoprene coupling. The well head was secured with a curb box and locking plug. During attempts to develop the well, water removed from the well exhibited a brown to gray stained color and an odor of septic water. It is likely that this well, as well as the LaRussell's Cleaners' well, pumps untreated waste water that has overflowed from the septic system.

The suspected third well is believed to be located approximately 15 feet east of the "old well." An anomalously high magnetic field was identified at this location using a magnetic locator. No attempt was made to dig below the pavement to find this well.

Most utilities at the site are overhead. The telephone lines, electric wires and cable television wires all enter the building from overhead poles. Propane tanks adjacent to the building supply fuel for heating. Water and septage are conveyed onsite as described above. A telephone cable is buried in the Route 52 right-of-way between the building and Route 52. There are no other known buried utilities in the area.

Directly across Route 52 from the site is a poorly maintained side street called Nichols Place. The sides of the intersection of Nichols Place and Route 52 have been filled will boulders and construction debris. Prior to the construction of Route 52, traffic to Lake Carmel is reported to have flowed west, up Nichols Place and then northeast toward Lake Carmel. The fill material between Nichols Place and the home center is probably residue from rock blasting that occurred in the construction of Route52. The elevation of the home center lumber yard is lower than Nichols Place and the LaRussell's Cleaners parking lot.

3.2 Site Geology

The geology of the LaRussell's Cleaners Site has been determined by reviewing the available literature and the construction of 12 soil borings and 16 groundwater monitoring wells on or near the site. Unconsolidated sediments at the site are relatively thin and range from zero feet at bedrock outcrops to over 16 feet. Unconsolidated sediment consists of fine sand and silt, and trace gravel. The sediments are classified as fill and glacial till. Large boulders are frequent in the sediment. Several borings were abandoned and relocated due to the presence of boulders. The sediments are saturated in some areas and not in other areas. Saturation is dependent on the local permeability, the degree of fracturing beneath the sediment and proximity to the septic system. Sediment thickness in off-site borings ranges from nine feet to over 40 feet in borings constructed for monitoring wells. In general, the sediment thickness increases to the west as distance away from steep bedrock hills increases (see Figures 3-1a and 3-1b). Groundwater occurring in the shallow sediments originates from infiltration of precipitation originating from the upland areas and discharge from groundwater flow on top of bedrock and through fractures.

Bedrock beneath the site is granitic gneiss composed primarily of biotite, quartz and plagioclase (Fisher, 1970). The granitic gneiss is highly folded and individual units could not be correlated between borings. The gneiss competency ranges from highly weathered and almost soil-like to extremely competent with no fractures. Fractures observed at ground surface were measured at a strike of N 345 to N 0 degrees and dips ranging from 45 to 63 degrees east. Several fractures were encountered in each of the monitoring wells. Many fractures and fracture zones exhibited staining from oxidation and precipitation of secondary minerals such as calcite. Staining and mineralization are indicators of significant water flow through the bedrock.

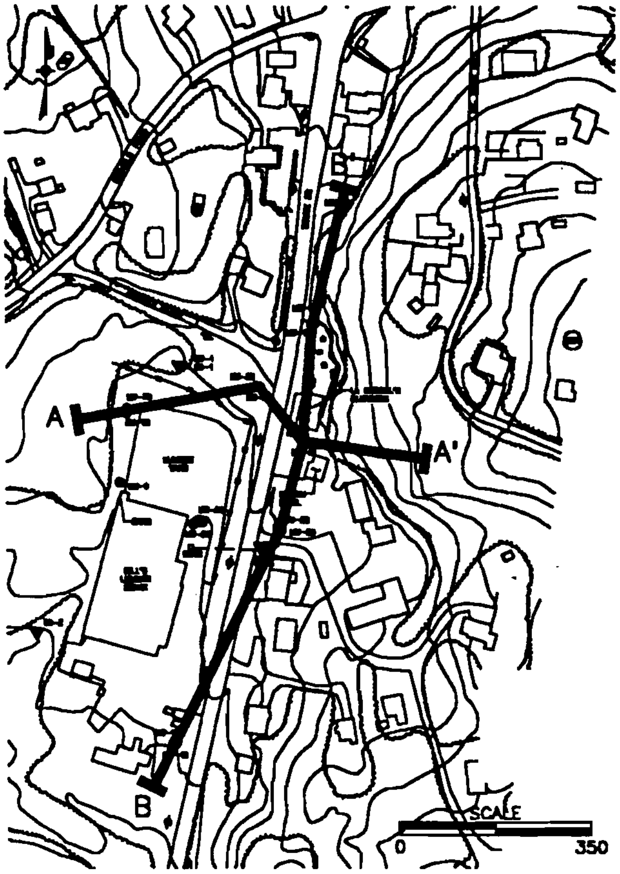

FIGURE 3-2A. CROSS SECTION LOCATIONS

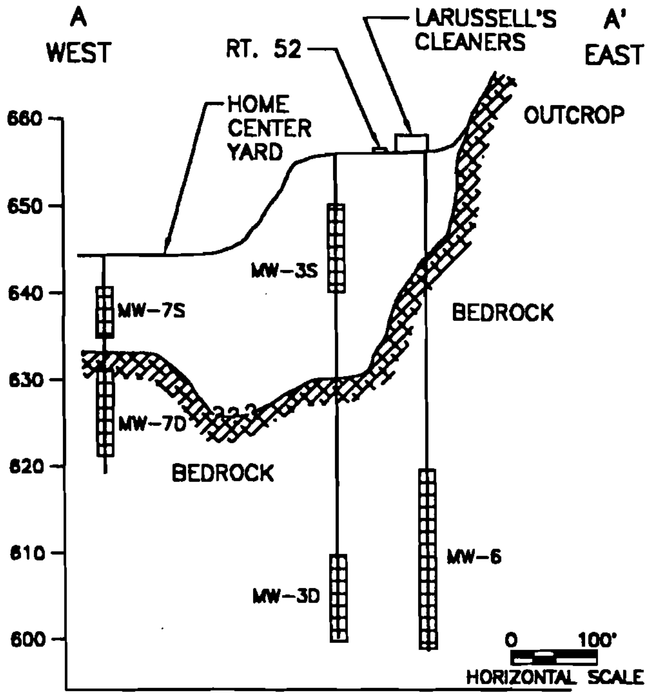

FIGURE 3-2B. GEOLOGIC CROSS SECTION A-A'

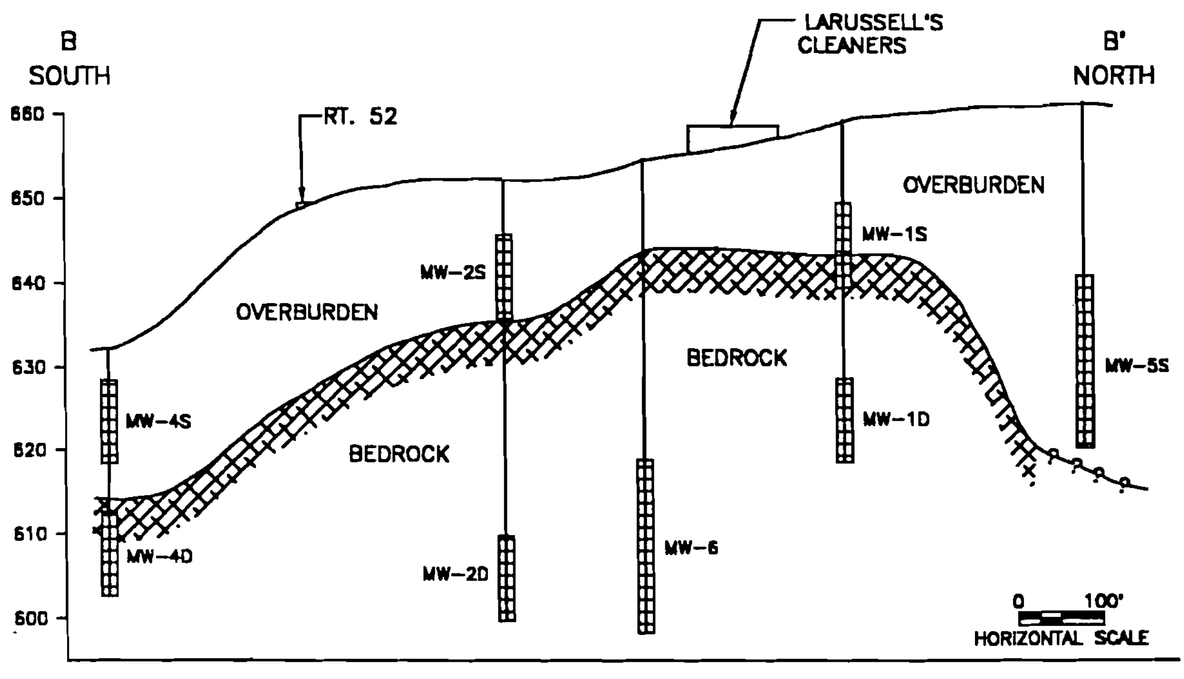

FIGURE 3-2C. GEOLOGIC CROSS SECTION B-B'

LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

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GEOLOGIC CROSS SECTIONS

FIGURE 3-1

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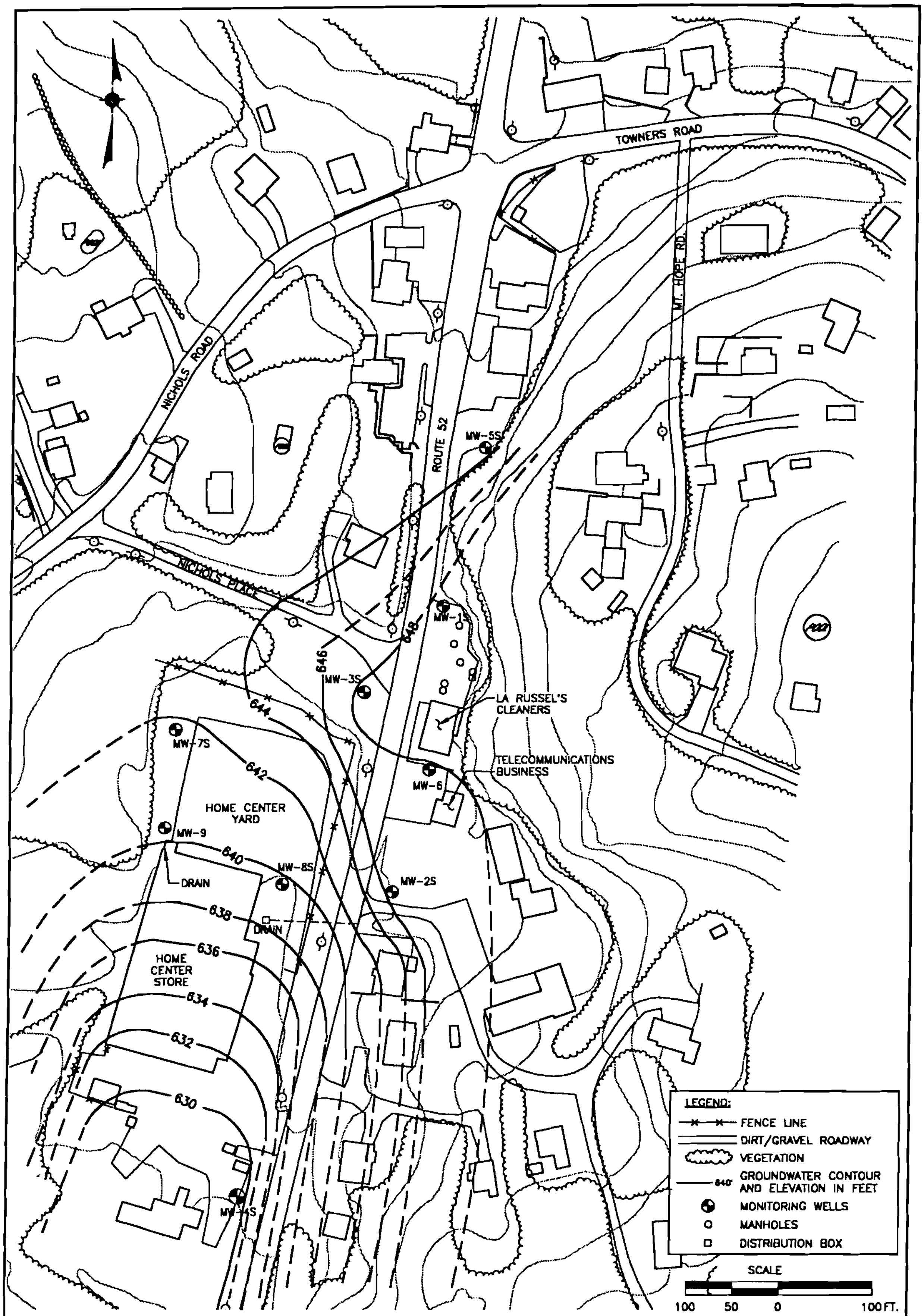
The bedrock surface is irregular, as can be observed in outcrops adjacent to the site and in the boring logs for the monitoring wells and borings. The bedrock surface forms a trough with axis trending roughly north - south parallel to Route 52 (see Figure 3-1c). The axis of the trough runs through the home center property and is coincident with the topographic low lying area. The bedrock surface elevation begins to rise again, west of the home center lumber yard. The trough plunges to the south.

3.3 Site Hydrogeology

The remedial investigation at the LaRussell's Cleaners Site focused on two groundwater flow systems consisting of unconsolidated sediments and bedrock. Groundwater characteristics were determined using several techniques, including observation of soil and rock characteristics during drilling, installation of groundwater monitoring wells, measurement of water level depths and determination of water elevations, groundwater sampling and a pumping test.

Shallow groundwater flow at the site is to the southwest (see Figure 3-2). Generally, groundwater flow follows the direction of decreasing topographic elevation. Shallow groundwater generally flows downward into the deeper bedrock system. Under certain circumstances these relationships reverse. For example, the vertical movement of groundwater at MW-1D is upward toward MW-1S . Here MW-1D exhibits an upward flow of groundwater due to recharge from the steep hill to the east. MW-1S and surrounding soils receive groundwater discharge from the deep flow system.

Bedrock groundwater flow in the region is also generally to the southwest as shown in Figure 3-3. During non-business hours such as weekends or early mornings, groundwater flow at the site is to the west (see Figure 3-3). Groundwater flow direction reversals are periodically induced by pumping of the LaRussell's Cleaners well. Water level data indicate that during pumping of the LaRussell's Cleaners well (during business hours), groundwater flow reverses and groundwater from MW-3 flows east, toward the LaRussell supply well (see Figure 3-4).



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LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

WATER TABLE SURFACE
MARCH 26,1997 – 7:00 A.M.

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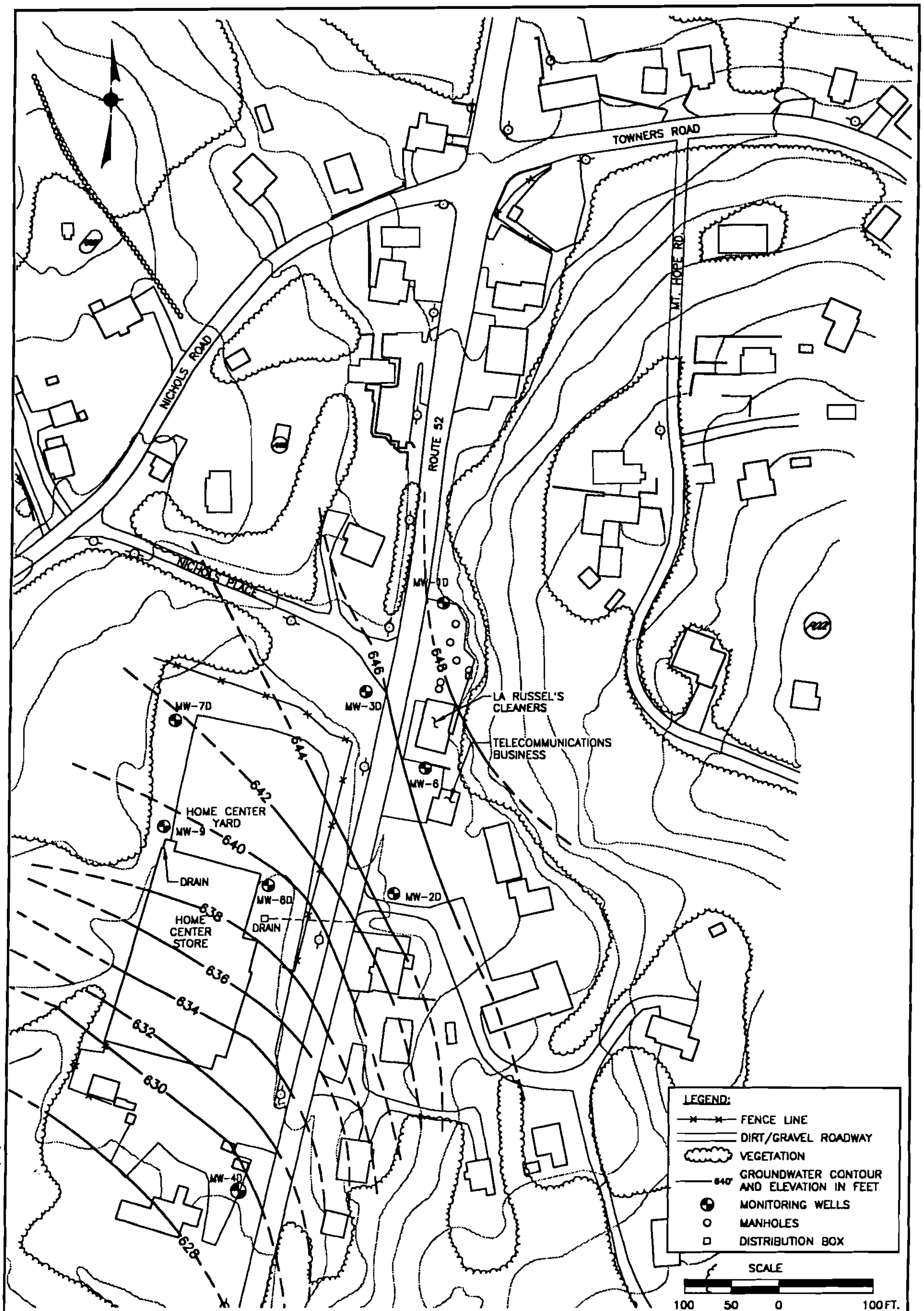
FIGURE 3-2



LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

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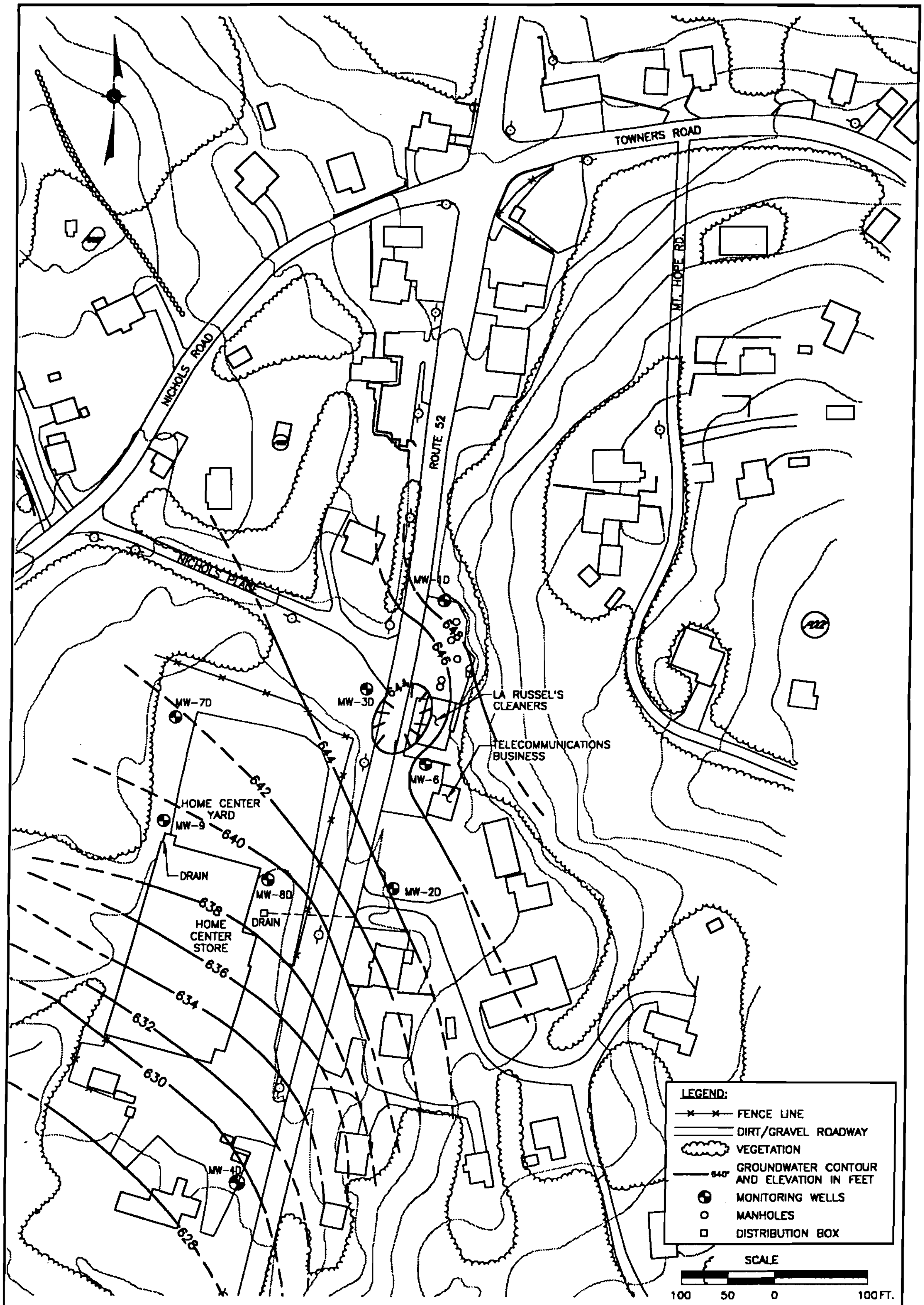
POTENTIOMETRIC SURFACE BEDROCK WELLS
MARCH 26,1997 – 7:00 A.M.

FIGURE 3-3



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LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

POTENTIOMETRIC SURFACE MAP DEEP WELLS
MARCH 26,1997 – 2:00 P.M.

Dvirka and Bartilucci
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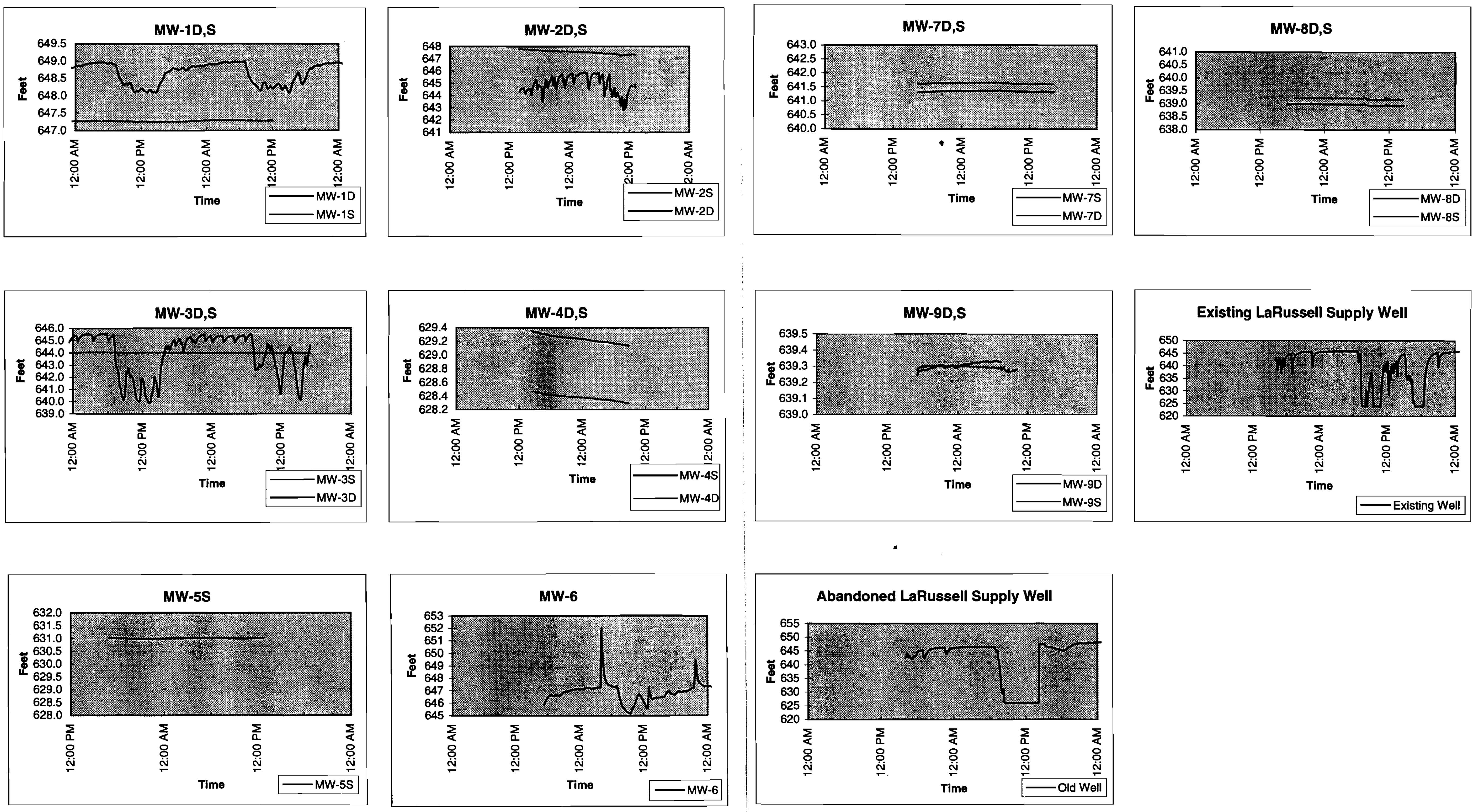
FIGURE 3-4

In general, aquifer permeability in the shallow flow system is relatively low. Shallow wells were slow to recover when developing and sampling. Shallow water elevations responded more readily to weather patterns and the presence of delivery vehicles driving nearby (see MW-8 in Figure 3-5). Deep wells have variable permeability based upon fractures encountered. Some wells produced water at a rate of as high as 2 gpm as in MW- 6, while others were much lower, and pumped or bailed dry at less than 1 gpm as at MW-3S. A local driller (Boyd, 1996) indicates that there are localized fault and fracture zones that can yield upwards of several 10's of gpm if the zone is penetrated. The old LaRussell's Cleaners well, which is deeper and larger diameter than the monitoring wells, was pumped at 3 gpm for 12 hours.

Since groundwater flow in bedrock is dominated by fractures, it is difficult to predict definitive flow directions and patterns. However, data collected during the Remedial Investigation do allow for a determination of the general direction of groundwater flow. The general trend of groundwater flow, based upon several rounds of groundwater elevation measurements and the analysis of groundwater chemistry from 16 monitoring wells and 15 domestic wellss, is to the southwest.

Water levels in the monitoring wells were all monitored for at least 24 continuous hours at various times during the investigation using an electronic data logger and pressure transducers. Examination of the water levels over time has revealed that many wells have a significant range of water elevations that varies in quick response to changes in aquifer conditions (see Figure 3-5). This verifies the strong interconnection of fractures between some wells. Conversely, some wells did not react to large changes in water level brought on by pumping. The lack of water level response in some wells may be due to the distance of those wells from a pumping well, a lack of fractures in the well, or intersected fractures that are not part of the primary fracture system that controls groundwater flow. The most important factors that influence groundwater flow are the proximity of a well to a pumping well and interconnectedness of fractures.



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LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

GROUNDWATER ELEVATION GRAPHS

FIGURE 3-5

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Groundwater recharge is through infiltration of precipitation from upland areas. Groundwater discharge is to wetland areas and lakes south of the site. Water supplies for homes in the area are obtained from private wells. Generally these wells are over 100 feet deep and are completed in granitic gneiss. Water supplies are reportedly reliable.

Wells MW-1D, MW-3D and MW-6 are all influenced by pumping from the LaRussell's Cleaners well. Water levels in these wells fluctuate on a daily cycle that closely correlates with business hours and activities at the cleaners (see Figure 3-5). This relationship suggests that during business hours, groundwater in the vicinity of the site is drawn toward the LaRussell's Cleaners well. This water is run through the cleaners and re-enters the aquifer through the septic system. The system during the day is essentially a closed system. During off-hours of business, including nights and weekends, groundwater flow is to the southwest.

MW-2D also exhibits cyclic water level changes, but these changes do not coincide with the usage cycles in the cleaners. MW-2D is probably influenced by wells serving the apartments on Adams Lane or the business on the corner of Route 52 and Adams Lane. Monitoring wells located on the home center property do not exhibit a direct influence from the LaRussell's Cleaners well as determined by logging of water levels in both unstressed and stressed conditions.

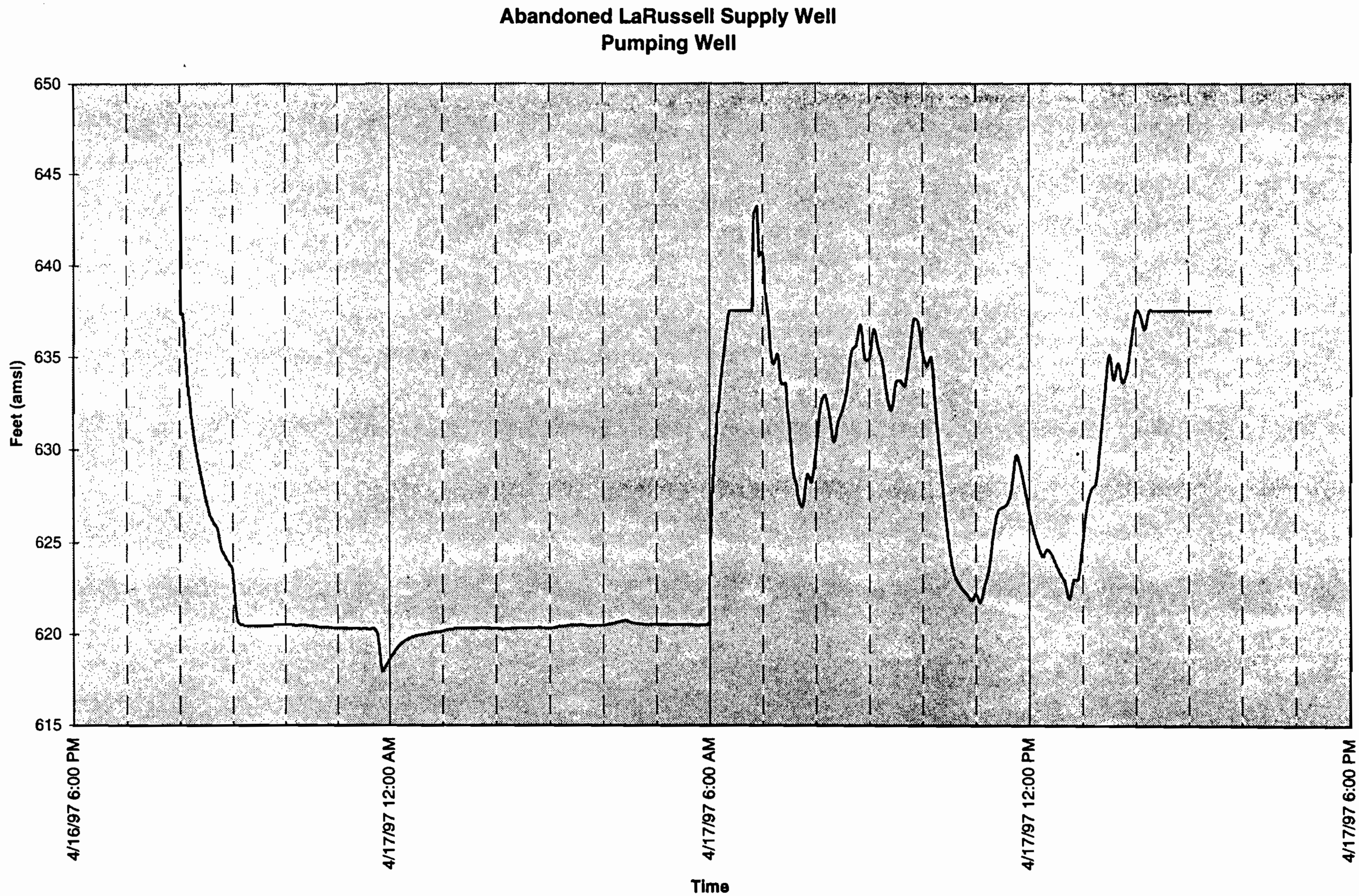
3.4 Pumping Test Results

On April 16 and 17, 1997, a pumping test was conducted on the Abandoned LaRussell Water Supply Well. The well was pumped at a rate of 3 gallons per minute for a period of 10 hours. The pump was then shut off and groundwater recovery was monitored for 10 hours. Watér levels were monitored in select monitoring wells for the duration of the test. Water levels in the monitoring wells were recorded using electronic data loggers. Logged wells included MW-2D, MW-3S, MW-3D, MW- 6, MW-7S, MW-7D, MW-8S, MW-8D, MW-9S, MW-9D and the existing LaRussell Water Supply Well. The pump intake was set at a depth of approximately

45 feet below ground surface. The extent and condition of casing of the well is unknown, however the well was determined to be 62 feet deep and cased to at least 25 feet with 5 inch diameter iron pipe inside of 6 inch diameter iron pipe.

Equilibrium draw down was achieved approximately one hour after pumping began. The equilibrium depth was approximately 25 feet below the static pre-test water level. The maximum drawdown occurred at about 5 hours into the test. The maximum drawdown was 27.6 feet below the static pre-test water level and was a result of constructive interference caused by pumping of the existing LaRussell water supply well coincidentally with the pumping well. The well was probably actuated by tenants in the apartment above the cleaners. The water level in the pumping well recovered to its previous equilibrium level in less than one hour. This was the only significant variation in the equilibrium water level during the pumping portion of the test. The pump was shut off at 6:00 a.m., one hour before LaRussell's Cleaners opened for business on April 17th. Water in the pumping well recovered within two feet of the pre-test level in one hour. Shortly before 7:00 a.m. water usage in the cleaners began, and the water levels measured in the abandoned water supply well began to cycle up and down, based upon water demand in the cleaners. During peak usage at 11:00 a.m. and again at 12:45 p.m. water levels dropped in the abandoned water supply well to within two feet of the pumping test maximum draw down. Figure 3-6 shows the water level elevations in the pumping well during the pumping test.

During the pumping test, water levels in the existing water supply well responded closely to observed changes in the pumping well. The equilibrium drawdown in the existing well was approximately 15 feet below static water level. The maximum drawdown occurred at 11:45 p.m. and was coincident with the maximum drawdown observed in the pumping well. As described above, the increase in drawdown was the result of water usage in the apartment above the cleaners. The existing water supply well recovered to its pre-test water level within one hour of the end of pumping. Usage of water from the existing well caused drawdown within the well to surpass the pumping test drawdown by greater than 10 feet (approximately 25 feet below pre-test static water level. The total drawdown exceeded the measurement depth capability of the water level recording device. The water level was presumed to be close to the existing water supply



LA RUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

PUMPING TEST GROUNDWATER ELEVATIONS
ABANDONED LARUSSELL'S CLEANERS SUPPLY WELL

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FIGURE 3-6

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well pump intake, based upon sounds observed at the well head suggesting cavitation or air entering into the pump. The top of the pump was measured at approximately 50 feet below top of casing and approximately 25 feet below pre-test static water level.

Water levels in nearby monitoring wells were influenced by the pumping of the abandoned LaRussell water supply well. The greatest influence caused by pumping was observed in MW-6. Recorded water levels fluctuated up to 3 feet. These fluctuations, however may not reflect the maximum changes in water level experienced in the well. Data recorded at this location was averaged over a five minute interval and may not reflect short term extremes. MW-3D also exhibited influence from the pumping well. The water level in MW-3D achieved a pumping test equilibrium of approximately four feet below the pre-test static level. The water level in MW-3D recovered to its pre-test level within one hour after pumping was stopped. Water levels in the well then closely mirrored water usage in the cleaners during the day. The maximum drawdown in MW-3D occurred during the recovery portion of the pumping test. The water elevation in MW-3D decreased due to pumping of the existing LaRussell water supply well. The maximum drawdown was one foot greater than that observed during the pumping test.

Monitoring of wells MW- 2D, MW-7S, MW-7D, MW-8S, MW-8D, MW-9S and MW-9D indicated no observable influence from pumping the abandoned LaRussell water supply well for 10 hours. Water level fluctuations in each of these wells were less than one foot and could not be discerned from typical fluctuations due to precipitation, barometric pressure variations or typical diurnal variations.

The area of influence of the pumping test extended a maximum distance of approximately 175 feet away from the pumping well. This distance is the distance to MW-1D, for which data was lost, but drawdown was noted during the test. Water level changes at MW-1D have also been observed during prior monitoring periods and are attributable to usage of the existing water supply well.

4.0 NATURE AND EXTENT OF CONTAMINATION

The purpose of this section is to provide a discussion of the results of the field investigation and environmental sample analytical results, and the nature and extent of contamination found at and in the vicinity of the LaRussell's Cleaners Site during the remedial investigation.

4.1 Identification of Standards, Criteria and Guidelines

This section provides a presentation of the standards, criteria and guidelines which were used to determine the significance of the analytical results and the potential threat to human health and the environment.

4.1.1 Surface and Subsurface Soil

A group of compounds has been identified as contaminants of concern for the LaRussell's Cleaners Site. The contaminants of concern (based on toxicity characteristics and elevated concentrations found at the site) are volatile organic compounds (VOCs) including tetrachloroethene (PCE), trichloroethene (TCE) and 1,2 - dichloroethene (DCE).

Screening levels for the contaminants of concern have been identified based upon review of applicable standards, criteria and guidelines (SCGs). The New York State Department of Environmental Conservation (NYSDEC) Technical and Administrative Guidance Memorandum (TAGM) for Determination of Soil Cleanup Objectives and Cleanup Levels (January, 1994) has been determined to be most applicable for surface and subsurface soils for this investigation.

Off-site surface soil samples were collected and analyzed as part of this investigation to compare to on-site samples and to assist in selection of background contaminant concentrations. Exceedances of the Soil Cleanup Objectives, background concentrations and screening levels will be used as the basis for the Exposure Assessment. This assessment identifies specific exposure pathways and receptors that may be subject to unacceptable risk. The results of the Exposure Assessment may further define the screening levels utilized in this document and will allow for the selection of remediation guidelines and measures, if required. It should be noted that exceedances of the screening levels do not mean that remediation is necessary, but rather, that the contaminant concentrations are sufficiently elevated to warrant concern and further evaluation. The purpose of establishing screening levels is to provide a basis with which to identify areas and matrices of concern that may require some form of remediation, including limited or restricted access and use.

Table 4-1 lists the composition of the group of contaminants of concern applicable to the site. The screening levels utilized for evaluation of the soil analytical results obtained during this investigation are presented on this table.

4.1.2 Sediment

Screening levels for surface water sediment analytical results at the LaRussell's Cleaners Site were developed based upon the NYSDEC Soil Cleanup Objectives, rather than NYSDEC Division of Fish and Wildlife Technical Guidance for Screening Contaminated Sediment. This is because the sediment samples collected were from areas that are not typical wetland habitats frequented by fish and wildlife. The sediment samples were obtained from a roadside catch basin, an outfall from an intermittently flowing drain pipe, and a 5 feet by 5 feet ponded groundwater seep. At each of these locations the most likely health risk from sediment is direct contact by humans. Therefore, the Soil Cleanup Objectives were selected because they are protective of exposure due to ingestion and possible migration to groundwater.

Table 4-1

LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

PRELIMINARY STANDARDS, CRITERIA AND GUIDELINES (SCGs)

Surface and Subsurface Soils

Compound	Screening Value (µg/kg)
Tetrachloroethene	1,400
Trichloroethene	700
1,2 Dichloroethene	300

Sediment

Compound	Screening Value (µg/kg)
Tetrachloroethene	1,400
Trichloroethene	700
1,2 Dichloroethene	300

Groundwater

Compound	Screening Value (µg/l)
Tetrachloroethene	5
Trichloroethene	5
1,2 Dichloroethene	5

4.1.3 Groundwater

The screening levels for groundwater analytical results at the LaRussell's Cleaners Site were obtained from the NYSDEC Technical and Operational Guidance Series (TOGS) - Ambient Water Quality Standards and Guidance Values dated October 1993. Analytical results obtained for groundwater samples are compared to Class GA groundwater standards.

4.2 Results of Site Characterization

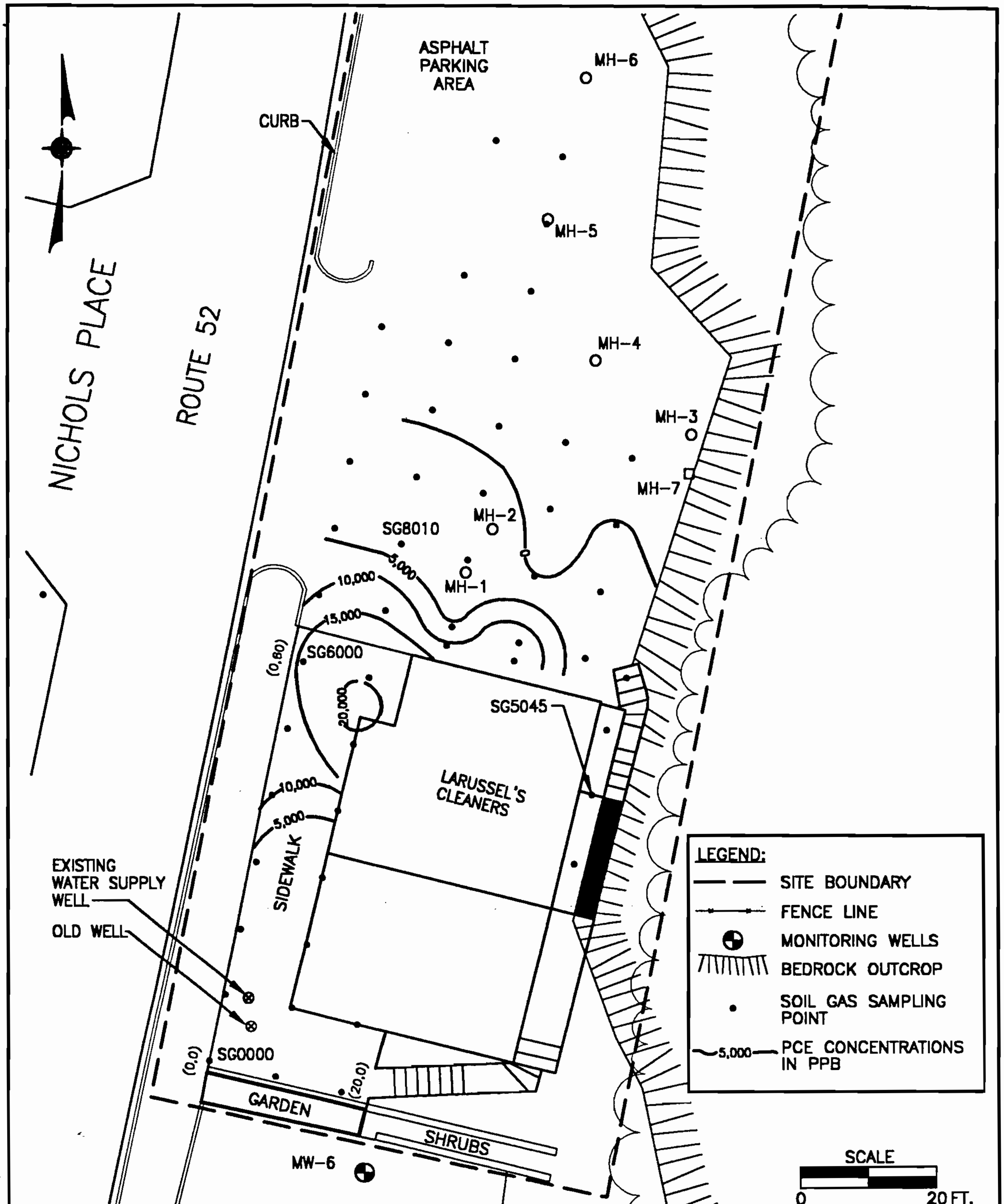
The results of the laboratory analyses of environmental samples collected at the LaRussell's Cleaners Site are presented below. The results are grouped by environmental media sampled. Analytical results are compared to the SCGs discussed in Section 4.1.

4.2.1 Soil Gas Survey

Soil gas was screened on site using a photoionization detector and a portable gas chromatograph (GC). A total of 51 soil gas samples from 51 borings penetrating the parking lot and adjacent areas were screened. The portable GC was calibrated for PCE, TCE and DCE. For the purpose of site screening, the soil gas technique provided qualitative information relative to the potential for VOCs in the subsurface. Chromatograph data for all samples were evaluated. The peaks on each individual sample chromatogram were analyzed and judged to correspond to one or more of the calibrated VOCs in the subsurface.

VOCs were identified in 47 of the 51 soil gas samples screened on-site. The concentrations of PCE ranged from non-detectable to 36,990 parts per billion (ppb) and are presented on Figure 4-1. The concentrations of TCE ranged from non-detectable to 243 ppb and concentrations of DCE ranged from non-detect to 172 ppb. The results of portable GC analyses for the soil gas samples are presented in Appendix G.

A total of four soil gas samples were collected for laboratory analyses to establish a relationship between portable GC field screening concentrations and laboratory results. The soil



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LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

PCE CONCENTRATIONS
IN SOIL GAS

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Consulting Engineers
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FIGURE 4-1

gas samples for laboratory analyses were collected based upon portable GC screening results. Soil gas samples analyzed in the laboratory are designated with the prefix SG and are presented on Figure 4-1. Results of the laboratory soil a gas analysis for PCE were 100ppb at SG0000, non-detect at SG5045, 200 ppb at SG6000 and 800 ppb at SG8010. No other VOCs were identified. The soil gas concentrations reported in laboratory analyses were in all instances less than those measured on the portable GC in the field. The differences between field measurements lab analyses is probably due to the sensitivity of the portable GC to environmental factors such as temperature, moisture and ambient air composition. Lab analyses confirmed that relatively high concentrations of PCE in soil gas occur near the northeast corner of the building near the septic tanks and lower concentrations occur southeast and west of the building. The results of the laboratory analyses of soil gas are presented in Appendix H, Table 1.

4.2.2 Sanitary System

Two samples were collected from the sediment on the bottom of the septic tanks in the existing sanitary system. The samples were analyzed for TCL + 10 VOCs. Sample SD-1 was obtained from the bottom of the septic tank under manhole MH-1. The sample was denser than the liquid in the tank and had the appearance of white to light gray lint or tissue paper. Laboratory analysis of the sample indicates that the solids content of the sample was 7%. DCE was detected at 198,000 μg/kg . A liquid sample was not obtained from this tank.

Sediment sample SD-2 was collected from the septic system dissipater beneath MH-4, and contained sand and silt sized sediment. No VOCs were detected above contract required detection limits (CRDL). Results of the analyses of septic system sediments are presented in Appendix H, Table 2.

4.2.3 Surface Soils

Two surface soil samples were collected from a small unpaved area beneath the fire escape staircase located on the east side of the building near the service entrance. The samples were analyzed for TCL + 10 VOCs. There were no VOCs detected at concentrations above SCGs. Results of sample analyses are presented in Appendix H.

4.2.4 Subsurface Soil

Subsurface soil samples were collected from borings installed on the site through the parking lot and floor of the LaRussell's Cleaners building. A total of 24 subsurface soil samples were analyzed. Eleven samples were collected beneath the parking lot north of the building and eight samples were collected from soil beneath the concrete floor of the cleaners building. Subsurface soil samples were also analyzed from one off-site boring adjacent to monitoring well MW-3S. This location was chosen as a result of contaminated groundwater detected in MW-3S in a previous sampling round. Four samples were collected at various depths from boring B-15 located across Route 52 from the entrance to the cleaners and adjacent to MW-3S.

Only one of the 24 soil samples collected exhibited contaminant concentrations above NYSDEC Soil Cleanup Objectives. This sample, SB-5, was obtained from a portion of the parking lot approximately 10 feet west of the front of the building. Tetrachloroethene was detected at a depth of 2 to 4 feet below ground surface at a concentration of 3,100 μg/kg. The soil cleanup objective for PCE is 1,400 μg/kg.

In addition to analyses for volatile organic compounds, eleven subsurface soil samples from beneath the parking lot area were analyzed for total organic carbon (TOC). TOC analyses will be used for designing a groundwater treatment system, if necessary. TOC concentrations range from 502 mg/kg in SB-6 (4-6') to 46,000 mg/kg at SB-3 (2-4').

4.2.5 Groundwater

Groundwater samples were obtained and analyzed using two different methods of sample collection. The first method involved use of direct push sampling technology resulting in a discreet groundwater sample from a temporary sampling point. This method was employed in an attempt to located locally high concentrations of groundwater contaminants that may indicate a source of contamination on the site. The second method involved two rounds of groundwater sampling from monitoring wells installed on and near the site. Round one of groundwater sampling occurred in November 1996 and round two was conducted in March 1997.

4.2.5.1 Direct Push Groundwater Sample Results

A total of five groundwater samples were collected from five soil borings on the site. The groundwater samples were collected from the same borings as subsurface soil samples. The groundwater samples were analyzed for TCL + 10 volatile organic compounds. Three compounds were detected in four of the samples and included PCE, TCE and DCE. PCE exceeded groundwater standards in samples SB-2-GW, SB-3-GW, SB-4-GW and SB-5-GW, and ranged in concentration from 60 to 160 µg/l. TCE exceeded groundwater standards in two of the five samples including SB-4-GW and SB-5-GW. TCE concentrations in these samples range from 10 to 13 µg/l. DCE was identified at concentrations above groundwater standards in four of the five direct push samples. Concentrations of DCE range from 10 to 60 µg/l in samples SB-2-GW, SB-3-GW, SB-4-GW and SB-5-GW. Complete results of the groundwater analyses are presented in Appendix H.

4.2.5.2 Monitoring Well Sampling Results

The first round of groundwater sampling from monitoring wells included a total of 10 groundwater samples. Groundwater was sampled from six monitoring well clusters, including a total of 10 wells. These wells include MW-1D and S, MW-2D and S, MW-3D and S, MW-4D and S, MW-5 and MW-6. The groundwater samples obtained in round 1 were analyzed for TCL + 10 volatile organic compounds, as well as iron and manganese. Iron and manganese results will be used to design a groundwater remediation system, if necessary.

Four volatile organic compounds were detected at concentrations above NYSDEC groundwater standards in five wells. The four compounds detected were PCE, TCE, DCE and vinyl chloride. PCE was detected above groundwater standards in MW-1S (12 µg/l), MW-3S (300 µg/l), MW-3D (12 µg/l) and MW-6 (500 µg/l). TCE was detected above standards in MW-3S (52 µg/l) and MW-6 (44 µg/l). DCE was detected above standards in MW-1S (97 µg/l), MW-1D (86 µg/l), MW-3S (360 µg/l), MW-3D (45 µg/l) and MW-6 (97 µg/l) and vinyl chloride was detected above standards in MW-1S and MW-1D at a concentration of 6 µg/l.

Concentrations of iron and manganese exceeded groundwater standards in most wells. The relatively high concentrations are likely attributable to turbid samples containing soil particles that are typically not transported in groundwater, but cause metals concentrations to be high. Turbidity was high in these samples due to the fine grained soils in the overburden and sample collection with a bailer.

Results from the second round of groundwater sampling were similar to those of the first round. The second round of sampling included three monitoring well clusters that were not installed in the first round. The three new clusters are located on the home center property. Of the new wells, only MW-8D exhibited contaminants in concentrations above groundwater standards. These contaminants are PCE and DCE at concentrations of 61µg/l and 11 µg/l respectively. Figure 4-1 shows the results of groundwater sampling and Figure 4-2 depicts the groundwater contaminant plume.

Metals results of round two sampling show no particular trend compared to round one sampling. In some instances metals concentrations are higher and in others they are lower. These inconsistencies can likely be attributed to turbid samples as discussed above. Results of metals analyses for round two groundwater sampling are presented in Appendix H.

4.2.6 Storm Water System Sediment Sampling Results

During the second round of groundwater sampling, one surface water and three surface sediment samples were collected from the drainage system near the site. Surface water collected from an area of ponded water (SW-1) below a seep contained no detectable concentrations of volatile organic compounds. Similarly, sediment samples collected at three locations downgradient of the site contained no VOCs at concentrations above SCGs.

4.2.7 Water Supply Well Sampling Results

Private water wells were sampled by the NYSDOH during the remedial investigation at LaRussell's Cleaners. A total of 15 wells were sampled. In each well sampled there were no detectable concentrations of PCE, TCE or DEC. The locations of the homes at which the samples were collected and the results of analyses are presented in Figure 4-1 and in Table 4-2.

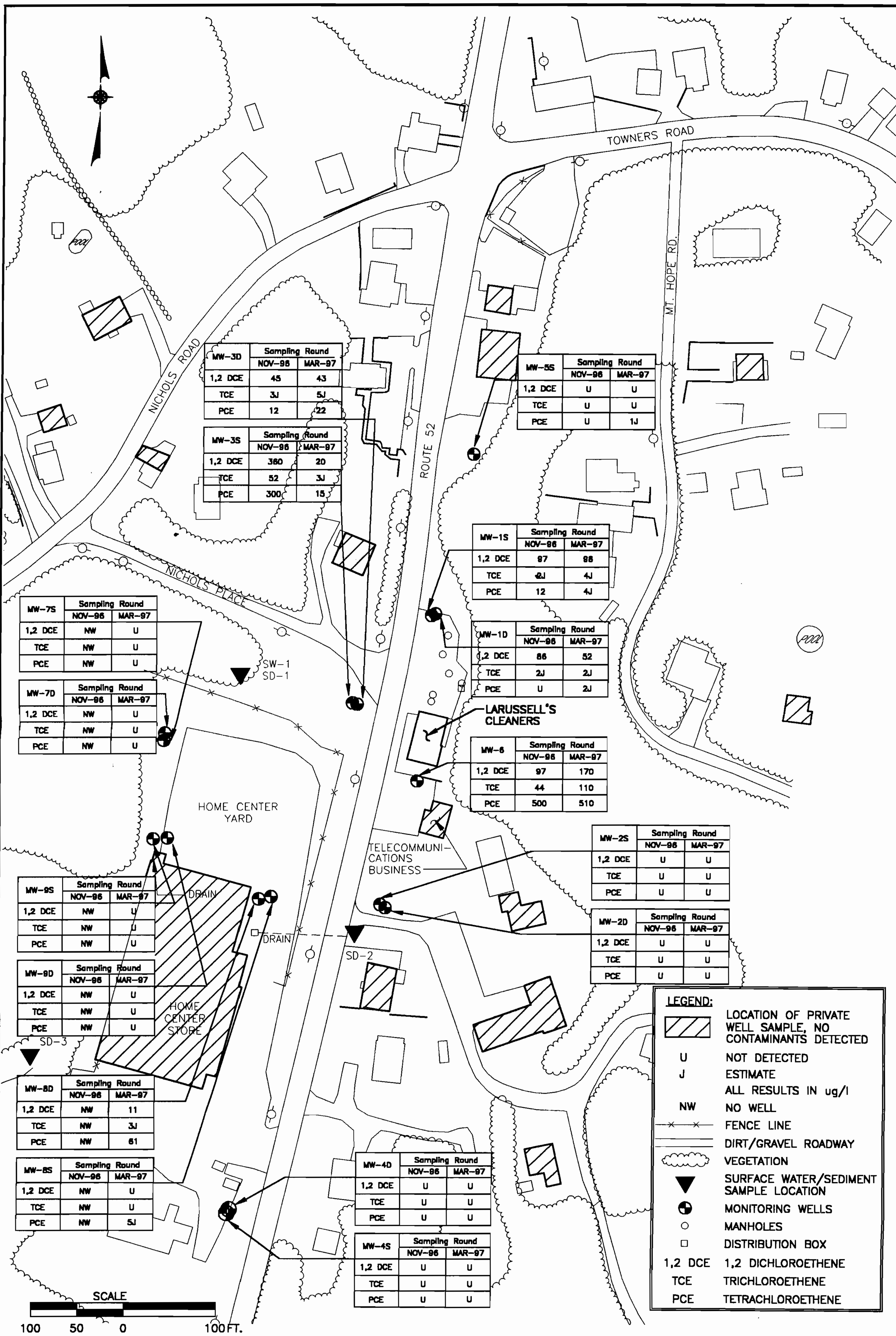
Prior to the remedial investigation, several water samples were collected from the LaRussell's Cleaners supply well. Samples were also collected from the telecommunications business adjacent to the cleaners and several other locations surrounding the cleaners. Results of these analyses indicate groundwater contamination in the LaRussell's Cleaners and telecommunications business water supply wells.

During the period between July 1981 and March 1996, the LaRussell's Cleaners water supply has been sampled 19 times. PCE concentrations have ranged from non detect to 1,000 parts per billion (ppb) over this period, with an average concentration of 281 ppb. During the same period, the telecommunications business water supply well has been sampled 16 times with a high concentration of PCE of 6,000 ppb and an average of 2,027 ppb.

PCE concentrations were relatively low from 1981 through 1991. However in 1992, PCE concentrations at the telecommunications business were 6,000 ppb. Levels above 5,000 ppb were recorded through 1995. Since then, PCE concentrations have generally decreased. Sampling was also conducted at an apartment house on Route 52 north of LaRussell's Cleaners. PCE concentrations at the apartment house ranged from non detect to 9 ppb. All three of the above mentioned water supply wells are equipped with a carbon filtration water treatment systems that were installed in 1992 and have been maintained by NYSDEC since.

Data Validation/Usability

All of the samples collected during the remedial field investigation at the LaRussell's Cleaners Site were analyzed for the New York State Department of Environmental Conservation (NYSDEC) Target Compound List (TCL) volatile organic compounds (VOCs) +10 as listed in the 12/91 NYSDEC Analytical Services Protocol (ASP) in accordance with Method 91-1. Groundwater samples collected from monitoring wells were also analyzed for iron and



MW-3D	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	45	43
TCE	3J	5J
PCE	12	22

MW-3S	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	360	20
TCE	52	3J
PCE	300	15

MW-5S	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	U	U
TCE	U	U
PCE	U	1J

MW-1S	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	97	98
TCE	2J	4J
PCE	12	4J

MW-1D	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	86	52
TCE	2J	2J
PCE	U	2J

MW-7S	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	NW	U
TCE	NW	U
PCE	NW	U

MW-7D	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	NW	U
TCE	NW	U
PCE	NW	U

MW-6	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	97	170
TCE	44	110
PCE	500	510

MW-2S	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	U	U
TCE	U	U
PCE	U	U

MW-2D	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	U	U
TCE	U	U
PCE	U	U

MW-9S	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	NW	U
TCE	NW	U
PCE	NW	U

MW-9D	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	NW	U
TCE	NW	U
PCE	NW	U

MW-8D	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	NW	11
TCE	NW	3J
PCE	NW	61

MW-8S	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	NW	U
TCE	NW	U
PCE	NW	5J

MW-4D	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	U	U
TCE	U	U
PCE	U	U

MW-4S	Sampling Round	
	NOV-96	MAR-97
1,2 DCE	U	U
TCE	U	U
PCE	U	U

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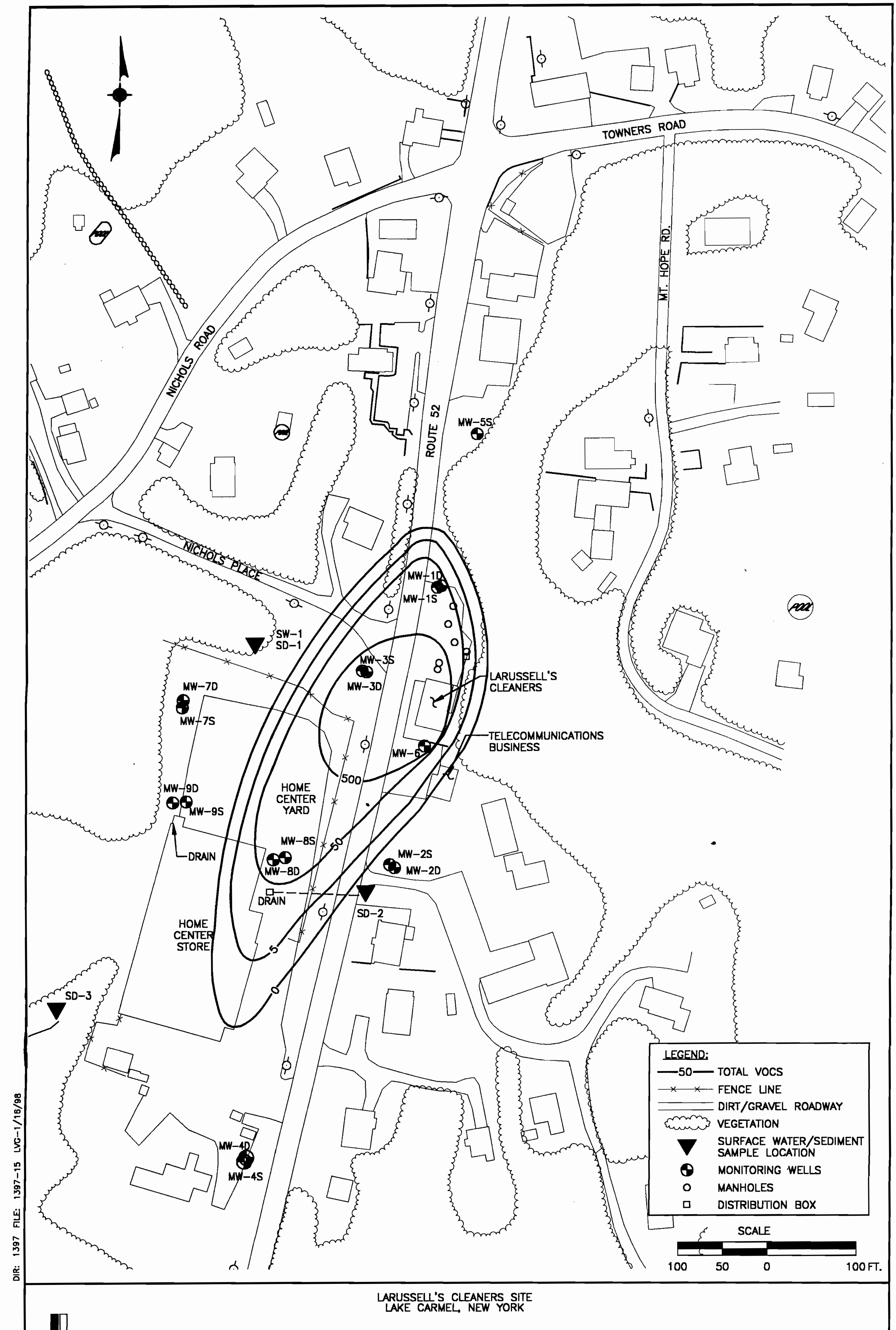
LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

GROUNDWATER SAMPLING RESULTS

FIGURE 4-2



LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

GROUNDWATER CONTAMINANT PLUME

FIGURE 4–3

Table 4-2
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

PRIVATE WELL SAMPLING RESULTS

No.	Location*	PCE (ug/l)	TCE (ug/l)	DCE (ug/l)
1	6 Adams Lane	ND	ND	ND
2	8 Adams Court	ND	ND	ND
3	15 Adams Court	ND	ND	ND
4	Route 52	ND	ND	ND
5	10 Mt. Hope Road	ND	ND	ND
6	386 Nichols Street	ND	ND	ND
7	78 A Smadbeck Avenue	ND	ND	ND
8	377 Nichols Avenue	ND	ND	ND
9	80 Smadbeck Avenue	ND	ND	ND
10	417 Smadbeck Avenue	ND	ND	ND
11	28 Mt. Hope Road	ND	ND	ND
12	2126 Route 52	ND	ND	ND
13	383 Nichols Street	ND	ND	ND
14	Nichols Place	ND	ND	ND
15	Route 52	ND	ND	ND

* All street addresses are in Lake Carmel, NY

ND - not detected

manganese in accordance with NYSDEC 12/91 ASP Superfund inorganic compound requirements.

All data packages were validated in accordance with NYSDEC 12/91 ASP and USEPA 3/90 Scope of Work (SOW) requirements at 100% by Enviroscience, Inc., a subcontractor to Dvirka and Bartilucci Consulting Engineers. Table 4-3 summarizes the findings of the data validation and the qualifiers that were applied to each sample.

In general, all analyses were contractually compliant with the ASP. Field blanks were not required to be collected during this field investigation since dedicated disposable equipment was utilized for sample collection. The findings of the validation process are summarized below.

Several compounds, primarily methylene chloride and acetone, have been qualified as non-detected due to laboratory contamination. That is, the sample concentration for that particular compound was less than five times the blank concentration. Refer to Table 4-2 for the samples which have been qualified.

The tetrachloroethene (PCE) result from sample SB-8 (0-2 ft) exceeded the instrument calibration range. As per the 12/91 NYSDEC ASP, the sample should have been reanalyzed at a secondary dilution. In the case narrative, the laboratory reported that reanalysis was not performed due to an oversight. However, the result is deemed usable, but has been qualified as estimated, possibly biased low.

Sample SB-4 (2-4 ft) was reanalyzed at a 1:5 dilution due to the concentration of PCE exceeding the instrument calibration range, however, the reanalysis, SB-4 (2-4 ft) DL, was run 20 minutes outside the 12-hour tune (BFB) clock. Therefore, both PCE results have been qualified as estimated with the best result being from the diluted analysis.

Four groundwater samples, SB-2-GW, SB-3-GW, SB-4-GW and SB-6-GW, were analyzed one day outside of the 7-day from Validated Time of Sample Receipt (VTSR) holding time, therefore, the analysis was not contractually compliant. The results are deemed usable since the analysis was performed within the USEPA holding time of ten (10) days from collection.

Four soil samples, SB-3 (2-4 ft), SB-4 (2-4 ft), SB-4 (4-6 ft) and SB-5 (2-4 ft), had internal standard area counts outside of QC limits. Three of the samples were rerun at secondary dilutions and one was utilized as the MS/MSD (SB-4 [4-6 ft]), therefore, no further action was required and all results are deemed valid and usable.

The analysis for surface soil sample SS-2 was not contractually compliant since one internal standard area count was outside QC limits and the sample was not reanalyzed, however, the data is deemed usable, but qualified as estimated.

The results for sample SD-1 collected on 9/19/96 have been qualified as estimated since the percent solids was 7%, with 93% being liquid. If the sample was considered a liquid the 1,2 dichloroethene (total) result would be 13,300 µg/l instead of 190,000 µg/kg.

All other data is deemed valid and usable for environmental assessment.

Table 4-3

LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

CONTRACTUAL COMPLIANCE SUMMARY
(12/91 NYSDEC ASP)

Sample ID	Matrix	VOA	Metals (Fe, Mn)
Groundwater Sampling Round 1, November 21, 1996			
MW-1S	Groundwater	OK	OK
MW-1D	Groundwater	OK	OK
MW-2S	Groundwater	OK	OK
MW-2D	Groundwater	OK[1,2,4]	OK
MW-3S	Groundwater	OK	OK
MW-3D	Groundwater	OK[1,2,4]	OK
MW-4S	Groundwater	OK[1,2,4]	OK
MW-4D	Groundwater	OK[1]	OK
MW-5S	Groundwater	OK[1,2,3]	OK
MW-6	Groundwater	OK[1,2,4,5]	OK
Groundwater Sampling Round 2, March 25, 1997			
MW-1S	Groundwater	OK	OK
MW-1D	Groundwater	OK	OK
MW-2S	Groundwater	OK	OK
MW-2D	Groundwater	OK	OK
MW-3S	Groundwater	OK	OK
MW-3D	Groundwater	OK	OK
MW-4S	Groundwater	OK	OK
MW-4D	Groundwater	OK	OK
MW-5S	Groundwater	OK	OK
MW-6	Groundwater	OK[5]	OK
MW-7D	Groundwater	OK	OK
MW-7S	Groundwater	OK	OK
MW-8D	Groundwater	OK	OK
MW-8S	Groundwater	OK	OK
MW-9D	Groundwater	OK	OK
MW-9S	Groundwater	OK	OK
SD-1	Sediment	OK[1]	NA
SD-2	Sediment	OK[1]	NA
SD-3	Sediment	OK[1]	NA
SW-1	Surface Water	OK	NA

Table 4-3 (continued)
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

CONTRACTUAL COMPLIANCE SUMMARY
(12/91 NYSDEC ASP)

Sample ID	Matrix	VOA	Metals (Fe, Mn)
SB-2-GW	Groundwater	No[1,7]	NA
SB-3-GW	Groundwater	No[1,7]	NA
SB-4-GW	Groundwater	No[1,7]	NA
SB-5-GW	Groundwater	OK	NA
SB-6-GW	Groundwater	No[1,7]	NA
SD-1	Sediment	OK[13]	NA
SD-2	Sediment	OK[1,2]	NA
SB-1A (4-6 ft.)	Subsurface Soil	OK[4]	NA
SB-2 (0-2 ft.)	Subsurface Soil	OK	NA
SB-2 (2-4 ft.)	Subsurface Soil	OK	NA
SB-2 (4-6 ft.)	Subsurface Soil	OK	NA
SB-3 (2-4 ft.)	Subsurface Soil	OK[5]	NA
SB-3 (6-8 ft.)	Subsurface Soil	OK	NA
SB-4 (2-4 ft.)	Subsurface Soil	OK[5, 11]	NA
SB-4 (4-6 ft.)	Subsurface Soil	OK	NA
SB-4 (6-8ft.)	Subsurface Soil	OK	NA
SB-5 (2-4 ft.)	Subsurface Soil	OK	NA
SB-6 (4-6 ft.)	Subsurface Soil	OK	NA
SB-7 (0-2 ft.)	Subsurface Soil	OK	NA
SB-8 (0-2 ft.)	Subsurface Soil	OK[6, 1]	NA
SB-8A (0-2 ft.)	Subsurface Soil	OK[5]	NA
SB-9 (0-2 ft.)	Subsurface Soil	OK[2]	NA
SB-10 (0-2 ft.)	Subsurface Soil	OK[2]	NA
SB-11 (0-2 ft.)	Subsurface Soil	OK[2]	NA
SB-12 (2-4 ft.)	Subsurface Soil	OK[2]	NA
SB-13 (4-6 ft.)	Subsurface Soil	OK	NA
SB-14 (4-6 ft.)	Subsurface Soil	OK[8]	NA
SB-15 (0-2 ft.)	Subsurface Soil	OK[9]	NA
SB-15 (2-4 ft.)	Subsurface Soil	OK	NA
SB-15 (4-6 ft.)	Subsurface Soil	OK[10]	NA
SB-15 (8-10 ft.)	Subsurface Soil	OK[10]	NA
SS-1	Surface Soil	OK	NA
SS-2	Surface Soil	No[1,8]	NA

Table 4-3 (continued)
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

CONTRACTUAL COMPLIANCE SUMMARY
(12/91 NYSDEC ASP) (continued)

Sample ID	Matrix	VOA	Metals (Fe, Mn)
SG000	Soil Gas	OK	NA
SG5045	Soil Gas	OK	NA
SG6000	Soil Gas	OK	NA
SG8010	Soil Gas	OK	NA

Key:
OK - Data is 100% contractually compliant, no qualifiers required.
OK# - Data is contractually compliant, but qualified (see # below for further explanation).
No# - Data is not 100% contractually compliant; data is qualified (see # below for explanation of usability).
NA - Not Analyzed.

Comments:

1 Methylene chloride has been qualified as non-detect due to method blank (laboratory) contamination. The sample concentration was less than five times the concentration found in the method blank.

2 Acetone has been qualified as non-detect due to method blank (laboratory) contamination. The sample concentration was less than five times the concentration found in the method blank.

3 Chloroform has been qualified as non-detect due to method blank (laboratory) contamination. The sample concentration was less than five times the concentration found in the method blank.

4 2-Butanone has been qualified as estimated due to the continuing calibration having a % RSD >30%.

5 The sample was reanalyzed at a secondary dilution due to the concentration of tetrachloroethene exceeding the instrument calibration range in the initial undiluted run. The tetrachloroethene result from the diluted run suffix "-DL" should be utilized for environmental assessment with all other results being taken from the initial analysis.

6 Tetrachloroethene has been qualified as estimated since the concentration exceeded the instrument calibration range.

7 Sample was analyzed 1 day outside of the NYSDEC 12/91 ASP 7-day from VTSR holding time, data qualified as estimated.

8 Results qualified as estimated due to one internal standard area count being outside QC limits. The sample was not reanalyzed as per 12/91 NYSDEC ASP requirements.

9 The sample was reanalyzed due to one internal standard area count being outside of QC limits. The reanalysis yielded similar results with the data from the initial run being deemed the best set of data.

10 The sample was reanalyzed at a dilution due to the concentration of acetone exceeding the instrument calibration range in the initial undiluted run. The acetone result should be taken from the diluted analysis, suffix "-DL-" with all other results being taken from the undiluted run.

Table 4-3 (continued)
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

CONTRACTUAL COMPLIANCE SUMMARY
(12/91 NYSDEC ASP)

[11] Trichloroethene has been qualified as estimated based on the associated internal standard area count being outside QC limits.

[12] Tetrachloroethene has been qualified as estimated due to the associated surrogate's recovery being outside QC limits.

[13] The 1,2 dichloroethene (total) result has been qualified as estimated due to the percent solids for this sample being less than 50%.

5.0 CONCLUSIONS

This section presents the conclusions of the remedial investigation. The conclusions are presented for each area of investigation on, or in the vicinity of, the site.

5.1 Sanitary System

Sediment sampling of the sanitary sewer system indicates that the system is functioning properly with respect to the transport of sediment. Sediment in the septic tank was found to contain DCE, however, DCE was not found in a sample of sediment collected from the dissipater tank. These results suggest that sediment is settling out in the septic tank, as it is designed to do. At the time the remedial investigation was conducted, contaminated sediment apparently was not migrating to the dissipater tanks.

Liquid samples were not obtained from the septic tanks, however sediment sample SD-1, with only 7% solids, contained a high concentration of DCE at 190,000 µg/kg. This condition of low solids suggests that liquid waste in the system has the potential to be contaminated with DCE. Additionally, on numerous occasions the leaching tanks overflowed through manhole covers and raw liquid waste flowed over the ground surface. It is unknown if the raw liquid waste contained elevated concentrations of the contaminants of concern. Groundwater samples collected from soil borings B-2 and B-3, near the septic tank, had significantly lower concentrations of DCE at 60 µg/l and 10 µg/l, respectively. Subsurface soil samples collected near the septic tank from borings B-2 and B-3 had no detectable concentrations of DCE. A subsurface soil sample collected from a location near the dissipater tank, B-1A, also did not contain DCE.

DCE is a breakdown component of PCE. Distillation by heating PCE and biodegradation can both cause the formation of DCE. The absence of PCE and TCE in the septic tank sediments indicates the breakdown to DCE before entering the septic tank, or that the residence of PCE-TCE-DCE has been of such a length of time that PCE and TCE have completely broken down to DCE. The final breakdown product of PCE is vinyl chloride. Vinyl chloride has not been found in significant concentrations in the septic tank.

In order to determine the source of DCE and prevent possible migration of DCE to soils and groundwater, as well as surface overflows, a thorough cleaning of the septic system is recommended. Both septic tanks should be pumped and residual sediment removed. This cleaning will eliminate the existing contaminants. After cleaning, periodic sampling of the tank should be conducted to determine if DCE is continuing to enter the system, or if the DCE found was the result of earlier discharges. In the past, the septic tanks have been pumped, however, it is unknown if both tanks were pumped and to what extent sediments may have remained after pumping.

5.2 Surface Soil

Surface soils that potentially could be contaminated make up a very small percentage of the site. Most surface soils on the site occur on steep hills that are at higher elevation than the floor of the building, and therefore, are unlikely to have contacted contaminants from the dry cleaners. The ground surface at and below the building floor elevation is paved with the exception of a small area near the east edge of the building near a bedrock outcrop and beneath the fire escape stair case. Surface soil sample results from this location indicate no surface soil contamination, therefore, surface soil contamination at the site is not a concern.

5.3 Subsurface Soil

Subsurface soils at the site also appear to be relatively free of contamination. However, despite widespread coverage of the site by soil borings, there is still a potential that contaminated soils are present. The shallow depth to bedrock and undulating, fractured bedrock surface may cause isolated areas of contaminated soil to have gone undetected. The potential for migration of soil contaminants is low due to the pavement cap on the site and relatively low hydraulic conductivity of the soils. Subsurface soil contamination is not of concern.

5.4 Groundwater

Groundwater contamination is greatest near the LaRussell's Cleaners Site water supply well as depicted in Figure 4-2. Contamination is also relatively high near the telecommunications business well, MW-6, and monitoring wells MW-3S and MW-3D across

Route 52 from the site. The water supply well pumping at the site influences groundwater in the vicinity of the site. When it is pumping, the LaRussell's Cleaners water supply well captures the groundwater contaminant plume in a cone of influence that extends at least 175 feet away from the well. Groundwater pumped into the LaRussell Well is then treated by the existing on-site carbon treatment system prior to use in the facility. During business hours, contaminated groundwater is likely pumped into the well and through the water treatment system in the building. To minimize possible exposure to groundwater contaminants, NYSDEC has issued a contract to maintain this and other carbon filtration systems. These systems are sampled twice a year to ensure that they are functioning properly. Carbon canisters are replaced on an as-needed basis so that contaminant breakthrough does not occur.

Wastewater from the dry cleaning operation is piped to the septic system. (It should be noted that, under the operating conditions observed during the remedial investigation, dry cleaning wastes, including PCE, were properly handled and disposed of, and did not enter the septic system.) As a result, contaminants detected in the septic system sediments are assumed to be residual left from activities of prior years. Waste water in the septic system either infiltrates the groundwater flow system or is discharged to the surface during frequent septic system overflows. Waste water that infiltrates the groundwater system either flows off-site through bedrock fractures or is pumped back into the water supply well via bedrock fractures and is effectively re-circulated.

During non-business hours, groundwater flow is generally toward the southeast. Groundwater contamination found in MW-8D at the home center, confirms southeastward migration of contaminants. MW-4S and MW-4D exhibit clean groundwater, thus suggesting that contaminants have not migrated further south. The likely discharge zone for groundwater flowing from the site is Palmer Lake, located approximately one half mile south of the site. Based upon observed groundwater chemistry in MW-4S and D (non detect), it is unlikely that groundwater contaminants originating at the LaRussell's Cleaners Site have migrated as far as Palmer Lake.

Groundwater contamination is restricted to a relatively small area on and surrounding the LaRussell's Cleaners Site. Analyses of groundwater from several private residential water supply wells near the site have indicated no groundwater contaminants. Similarly, groundwater analyses of off-site monitoring wells (with the exclusion of MW-3S,D and MW-6S,D which are located adjacent to the site) have indicated no contaminants. Based upon these results, groundwater contamination, in off-site residential water supply wells, is not a concern.

The groundwater plume onsite and offsite has been defined. Offsite groundwater monitoring will be incorporated in the long-term monitoring plan to continue to identify the extent of the contaminant plume and to minimize the potential for human health and environmental risk. The goal of monitoring is to maintain a clean water supply for groundwater users near the site.

5.5 Site Drainage System

Results of storm water drainage system sediment samples collected from locations near the site indicate that there are no exceedances of SCGs. This suggests that if waste water leaving the site as surface water run-off due to septic system overflows contains contaminants of concern, theses contaminants are not being received or retained in catch basins or pipe outfalls downgradient of the site. Contaminant transport in the site drainage system is not a concern.

5.6 Surface Water

Surface water sampled from an area adjacent to a groundwater seep was found to contain no contaminants of concern. The location of the seep is approximately 100 feet west of wells MW-3D and MW-3S which exhibited contaminated groundwater. The absence of contamination from the seep suggests that the seep may not be in hydraulic connection with the screened zones of the wells, or that groundwater conditions at the time of sampling prevented contaminated water from discharging (i.e. pumping of the LaRussell's Cleaners well during business hours). Surface water contamination is therefore, not a concern.

6.0 EXPOSURE ASSESSEMENT

The results of the remedial investigation indicate that dry cleaning contaminants are present at the LaRussell's Cleaners Site. In order to determine the need for and extent of remediation, an assessment of possible human exposure to site contamination is necessary. The results of this assessment will be incorporated into the selection and evaluation of remedial alternatives in the feasibility study, if required.

The contaminants of concern at the LaRussell's Cleaners Site are tetrachloroethene (PCE), trichloroethene (TCE) and 1,2 dichloroethene (DCE). These contaminants have been identified in soil, groundwater and septic system sediment at the site. In general, contaminant concentrations are low (below applicable regulatory standards, criteria and guidelines) and confined to areas on or near the site. Some exceedances do exist, particularly for groundwater found beneath, and in the immediate vicinity of, the site (see Section 4.0 for a discussion of investigation results). This assessment addresses possible exposures resulting from ingestion, inhalation, and dermal contact and absorption.

6.1 Ingestion

Exposures to contaminants at the LaRussell's Cleaners Site may occur through various media. The media that have been tested at the site and found to contain the contaminants of concern are soil, groundwater and septic system sediment. Septic system liquid overflows have also been frequently observed and, although not tested during the investigation, pose a potential health concern due to contact with contaminated septic system sediment. The following describes possible exposures from each of these media.

6.1.1 Soil

Soil sampling at the site included the analyses of two surface soil samples and 24 subsurface soil samples. Of these analyses, no surface soil samples and only one subsurface soil sample exhibited contaminants of concern above screening levels (NYSDEC Soil Cleanup Objectives). The one subsurface soil sample containing contaminants of concern slightly above screening levels, contained PCE at a concentration (3,100 μg/kg). The NYSDEC recommended soil cleanup objective for PCE is 1,400 μg/kg.

Possible exposure to contaminants in surface soil and subsurface soil is limited on the site. Almost all portions of the site are either paved or covered by the building. There is a small area of approximately 50 square feet below an outdoor stair case at the rear of the building that is not paved and where surface soil is exposed. Samples collected and analyzed from this location did not contain contaminants above screening levels. Access to this location is restricted by a door on the service entrance of the building and the low clearance of the staircase. The ground in this area is used as storage for trash cans, various scrap lumber and debris. Access to soils on the site can only be made by breaking through the parking lot pavement, crawling under the stairs, or entering by passing through a locked door. The most probable means of exposure to soil would occur from construction personnel working on the parking lot or septic system, and it is unlikely these individuals would ingest soil.

The possibility of exposure to contaminated soil via ingestion is remote. Exposure to contaminated soils is minimized due to isolation of the soils beneath pavement, relatively low concentrations of contaminants in soil, and the likelihood that only adults would contact the soils.

6.1.2 Groundwater

Groundwater is the principle source of drinking, cooking and bathing in Lake Carmel, New York where LaRussell's Cleaners is located. Groundwater from wells on, and immediately adjacent to (the OSCOM building), the site has been determined to contain PCE, TCE and DCE at levels above drinking water standards. Analyses of groundwater from the wells of 15 selected homes in the vicinity of the site have no contamination above drinking water standards. Water samples from several wells have exhibited trace amounts of contamination in the past.

Contaminants have been detected above groundwater standards in an off-site monitoring well in the parking lot of Dill's Lumber Company, located approximately 600 feet southwest of the site. Groundwater flow has been determined to be to the southwest.

Ingestion of untreated groundwater in the LaRussell's Cleaners building and OSCOM building presents a high risk for exposure to PCE, TCE and DCE. The Dill's Lumber store, downgradient of the site, is also at potential risk from contamination from the LaRussell's Cleaners Site. The Dill's Lumber water supply well was found free from detectable levels of contamination during the remedial investigation, however, a monitoring well located between Dill's Lumber water supply well and LaRussell's Cleaners was determined to be contaminated. Since groundwater is flowing to the southwest, there is a possibility that groundwater contaminants may reach the Dill's Lumber water supply well and pose an exposure risk through ingestion. There are no other groundwater users, and therefore no receptors, downgradient (southwest) of the site for 1000 feet. Users further away than 1000 feet are likely in a different groundwater flow system, and therefore not within the groundwater flow path from the LaRussell's Cleaners Site.

LaRussell's Cleaners, OSCOM, Sofair Apartments and Dill's Lumber all reportedly have carbon filtration water treatment systems on their water supply wells. The maintenance and effectiveness of these systems is unknown. The potential risk for ingestion of contaminated ground water on, and in the areas immediately adjacent to, and to a lesser extent, down gradient of, LaRussell's Cleaners is high for groundwater ingestion.

Bedrock fractures documented during drilling, and stressed during a pumping test, may provide conduits for contaminant migration. Fractures may allow contaminated groundwater to travel long distances in a relatively short period of time, thus allowing high concentrations of contaminants to migrate outside of the monitoring area around the site in a short period of time. Groundwater flowing through fractures may not be detectable using the existing monitoring well system. Fractures that do not directly connect to the monitoring wells may convey groundwater to locations beyond the wells. Although there is no evidence to indicate water supply contamination beyond and immediately adjacent to the site based on existing data, the presence of connected fractures poses a risk to groundwater users.

6.1.3 Septic System Liquids

The onsite septic system has been observed to frequently overflow. Liquid from the overflows travels across the parking lot and into the drainage ditch on the east side of Route 52. Although no liquid samples of septic system water were analyzed, septic system sediment sample analyses did reveal high concentrations of DCE (198,000 µg/kg). It is possible that DCE is, or potentially could be, present in septic system overflows. Likewise, DCE could accumulate in storm water sediment captured in catch basins and storm drains off-site.

Human ingestion of septic system overflows is unlikely. The over flows exhibit a septic odor and are cloudy gray in color and sometimes have a blue sheen. It is unlikely that an individual, adult or child, could collect this water since it is flowing in sheets across the ground. It is possible, however, that children may play in the water and get splashed on the hands or face. Such contact may lead to ingestion of small quantities of water. Additionally, animals may contact and ingest septic system water as it flows across the ground surface.

6.2 Inhalation

The most likely exposure to inhalation hazards at the site are inside the dry cleaning facility where PCE is regularly used or immediately outside the building near the exhaust fans. Exposures at these locations are to dry cleaning employees, customers and apartment tenants. It is assumed that these possible exposures are minimized by engineering controls, including solvent recovery systems and ventilation. Proper use and maintenance of this equipment minimizes human exposure. A recent compliance inspection conducted by the NYSDEC at the LaRussell's Cleaners Site (Battista, 1996) indicated that there were no odors outside of the facility and that the facility was in compliance with applicable regulations.

Although contaminants have not been detected in private residential water supply wells, another possible inhalation exposure to contaminants may occur via contaminated groundwater. Groundwater entering a home or business via a water well can cause inhalation exposure through the vaporization of contaminants during bathing, especially showers, and cooking.

Inhalation exposure from soil is unlikely because the soil is isolated beneath pavement and the site building and subsurface soil sampling analyses did not detect contaminants at levels above screening levels. Similarly, possible inhalation exposure to septic system overflows is minimal. Liquid overflowing from the system occurs outdoors and flows along the pavement. The liquid, and any associated vapors that may cause an inhalation hazard, is exposed to ambient weather conditions and is subject to immediate dispersion and dilution. No odors related to dry cleaning fluid were observed near the overflows during the remedial investigation.

6.3 Dermal Contact and Absorption

Dermal contact involves exposure of contaminants to the skin or eyes. Absorption exposures may occur as a result of skin or mucous membrane contact with contaminants. Exposure from soils by absorption or contact is remote at the LaRussell's Cleaners Site. The soils are for the most part isolated by pavement and the site building. The exception to this would be workers involved with replacement of the asphalt or demolition of the building. (However, as noted previously, no soil samples collected beneath the LaRussell's Cleaners building exceeded screening levels.).

Groundwater contact exposure is high at, and in the immediate vicinity of, the site. Contaminated groundwater has been identified in wells on, and near, the site. Tap water that is used for washing hands, bathing, irrigation and recreational purposes may contain contaminants and may result in exposure to contaminants by dermal contact and absorption.

Septic system overflows have a relatively high potential for contact. During the remedial investigation, LaRussell's Cleaners customers and employees, and pedestrians on Route 52, were often observed walking through water from the septic system overflows. Children were also observed walking through the flowing water and getting footwear wet and splashing water on hands with stray drops possibly getting in the face and eyes.

6.4 Conclusions

Exposure to contaminants originating from the LaRussell's Cleaners Site can come from any one of three media. The media include soil, groundwater and septic system overflow water. Based upon the remedial investigation results, none of the sources is an immediate acute health hazard, assuming that the treatment systems on the LaRussell's Cleaners and OSCOM building water supply wells are effective. However, source control and remediation are recommended for groundwater and septic system overflows to prevent possible chronic exposures and contaminant migration away from the site.

7.0 FOCUSED FEASIBILITY STUDY

The following focused feasibility study has been prepared as the result of the identification of environmental contaminants at the LaRussell's Cleaners Site during the remedial investigation. This feasibility study was conducted in accordance with the Generic Work Plan for Dry Cleaner Sites (D&B, 1996) to evaluate possible interim remedial measures and presumptive remedies that will minimize the potential risks of exposure to contaminated waste water, subsurface soils and groundwater. The Generic Work Plan calls for the implementation of presumptive remedies in accordance with United States Environmental Protection Agency (USEPA) guidance (USEPA, 1993a, 1993b, 1996). The objective of this focused feasibility study is to determine cost-effective remedial actions that are protective of human health and the environment.

A feasibility study is a process to identify and screen potentially acceptable remedial technologies, combine technologies into alternatives and evaluate appropriate alternatives in detail. The remainder of this section identifies the objectives of the remedial action, general responses and goals of the remediation. Remedial technologies are then identified and screened for technical suitability regarding the contaminants and media of concern. Remedial technologies that are retained after screening are combined as appropriate, into remedial alternatives consisting of one or more acceptable technologies. The alternatives are then evaluated on a preliminary basis for effectiveness and implementability at the site. Alternatives that are retained after this preliminary evaluation are then evaluated in detail with respect to overall ability to achieve the objectives of remedial actions and maintain human and environmental protection while being cost effective. The following sections detail the remedy selection process for the LaRussell's Cleaners Site.

7.1 Background

Results of the remedial investigation (see Section 4.0) indicate that tetrachloroethene (PCE), trichloroethene (TCE) and 1,2 dichloroethene (DCE) were found in groundwater at concentrations above applicable standards, criteria and guidelines (SCGs) established for the site. A subsequent exposure assessment (see Section 6.0) determined that the greatest human and environmental health risks exist at the site as a result of contaminated groundwater. Lesser risks occur at the site due to contaminated waste water disposal system sediment and low levels of contamination in subsurface soils. Based upon the identification of these risks, remedial action is required at the site.

7.2 Remedial Action Objectives

The objectives of the remedial action for the LaRussell's Cleaners Site are to:

- Prevent exposure to contaminated groundwater,
- Prevent or minimize further migration of the contaminant plume,
- Prevent or minimize further migration of contaminants from source materials to the ground surface and groundwater, and,
- Return groundwater to its expected beneficial use wherever practicable.

7.3 General Response Actions and Goals

Three contaminant areas have been identified at the LaRussell's Cleaners Site. These areas include sediment in the on-site waste water disposal system, on-site subsurface soils, and on- and off-site groundwater contamination. The following describes general response actions for each area.

7.3.1 Waste Water Disposal System Sediment

The general response to waste water disposal system sediment contamination will be removal of contaminants from the system. The goal for remediation of the waste water disposal system is to prevent migration of contaminants from the system to the surrounding subsurface soils and groundwater, and to prevent contact with contaminants during septic system overflows.

7.3.2 On-Site Subsurface Soils

The general response to subsurface soils will be no action because no significant source of contaminants has been identified in subsurface soils on-site. Subsurface soil contaminants were identified slightly above SCGs (3.1 mg/kg for PCE as compared to the NYSDEC soil cleanup objective of 1.4 mg/kg) in only one of 24 subsurface soil samples collected during the remedial investigation. The contaminated soil is located 2 to 4 feet beneath the paved parking lot adjacent to Route 52 and is effectively capped by asphalt. The quantity of contaminated subsurface soil is considered to be too small to act as a source of contaminants to groundwater. As a result, there is no contaminant level goal associated with the remedial response in this area.

7.3.3 On and Off-Site Groundwater

Contaminated groundwater has been identified on and off the site. The most highly contaminated groundwater has been found within a 160 foot radius of the LaRussell's Cleaners building (see Figure 4-2). The general response to groundwater contamination will be to reduce groundwater contaminant levels. Groundwater remediation will target the zone in which groundwater contaminants have exceeded 100 μg/l of total volatile organic compounds (VOCs). This zone is based upon the shape and size of the contaminant plume, thorough review of groundwater sampling data and discussion with NYSDEC. Groundwater extraction and treatment will be the general response to groundwater contamination. Based on a pumping test conducted during the remedial investigation, it has been determined that an on-site extraction well will capture contaminated groundwater within the target zone. The goal for groundwater remediation within the treatment zone is the NYS Class GA groundwater standards for PCE, TCE and DCE of 5 μg/l each, however, groundwater treatment may not continue until this level is attained. Groundwater treatment will be discontinued when reduction in contaminant levels is no longer cost effective. If groundwater treatment is terminated prior to attaining the groundwater standards, then groundwater monitoring will continue until such time as contaminant concentrations are no longer a health risk.

An interim measure for groundwater has previously been implemented at and adjacent to the site. Individual water supply systems were protected with carbon treatment systems provided by NYSDEC in 1992. The carbon systems were installed at the LaRussell's Cleaners Site, the telecommunications business south of the site and the apartment building north of the site. Drinking water samples collected from these three water supply systems have indicated that the carbon systems are effective and that no contaminants are present in drinking water at these locations. Untreated drinking water supply samples collected during the remedial investigation (1996-1997) from 15 homes in the vicinity of the site also did not indicate the presence of contaminants. The carbon systems will continue to be maintained by NYSDEC until such time as groundwater remediation is complete and it has been determined that drinking water supplies are no longer at risk. Additionally, water supplies in the vicinity of the site will be periodically tested throughout the remediation period to ensure that contaminant levels remain below drinking water standards. The goal for contaminant levels in water supplies is less than the drinking water standards.

7.4 Identification and Screening of Remedial Technologies

The remedial technologies evaluated in this section include presumptive remedies. A presumptive remedy is a technology that has been proven effective under various conditions for similar sites. Presumptive remedies for dry cleaners sites have been previously identified in the Generic Work Plan for Dry Cleaners (D&B, 1996). These remedies have also been identified by the USEPA and NYSDEC as appropriate presumptive remedies for sites contaminated with volatile organic compounds (VOCs), such as dry cleaner sites. Descriptions of these remedies are contained in "Presumptive Remedies: Site Characterization and technology selection for CERCLA sites with volatile organic compounds in soils", USEPA (1993b). As part of this directive, USEPA indicated that when evaluating presumptive remedies at VOC-contaminated sites, site-specific identification of alternatives is not necessary. This directive will be included as part of all Records of Decision prepared for sites that utilize a presumptive remedy.

The presumptive remedial technologies presented in the Generic Work Plan and this section have been identified through proven effectiveness at dry cleaner sites and sites with similar types of contamination and contaminated media. The technologies described below consist of two groups including source control technologies and groundwater treatment technologies. Section 7.4.3 provides an evaluation and screening of the technologies described and lists those technologies that will be retained for the development of remedial alternatives.

7.4.1 Source Control Technologies

Source control technologies remove or isolate continuing sources of contamination. Effective source control prevents further migration of contaminants from source materials, such as contaminated soil or waste water disposal systems to groundwater. Five presumptive remedies for source control are identified in the Generic Work Plan for Dry Cleaners Sites. These remedies include:

- Waste water disposal system clean out,
- Excavation and off-site disposal,
- Soil vapor extraction,
- Low temperature thermal desorption,
- Containment and isolation, and,
- No action.

Sections 7.4.1 and 7.4.2 below provide a discussion of each of the presumptive remedy technologies that are applicable to this site. Section 7.4.3 describes the screening of these technologies as they pertain to the LaRussell's Cleaners site.

7.4.1.1 Waste Water Disposal System Clean Out

Waste water systems may contain contaminated sediment or liquid that are a source of surface or groundwater contamination. In order to prevent possible migration of sediment or liquid to other portions of the system, the surface or the subsurface, the contaminated sediment and liquid should be removed from the system. Removal can be performed by pumping out the septic tanks and dissipater system using a vacuum truck. Sediment can be removed at the same time as the liquid. During the removal of liquid, the system should be closed from influent liquid sources. The tank interior can then be inspected for signs of leakage and cleaned further or repaired if necessary. Follow up sampling should occur after the waste water disposal system is returned to use to verify that the system is functioning properly and contaminated sediment and liquid are not entering the system.

7.4.1.2 No Action

The no-action alternative can be utilized in situations where residual contamination is not a significant threat to human health or the environment. Inclusion of the no-action alternative is a regulatory requirement to identify and evaluate potential problems posed by a site if no remedial actions are implemented. This alternative may also be applicable to sites where there is no remaining contaminant source or where no significant groundwater contamination exists and natural attenuation would be expected to occur.

7.4.2 Groundwater Remediation Technologies

Groundwater contamination is present beneath and downgradient of the LaRussell's Cleaners Site. The plume of groundwater contamination migrating from the site has impacted shallow private water supply wells located immediately downgradient of the site, and may be a threat to private water supply wells located further downgradient of the site. The following presents an evaluation of presumptive remedies and developing technologies to mitigate groundwater contamination on and off the site.

As identified in the Generic Work Plan for Dry Cleaner Sites, the following presumptive remedies are identified to address groundwater contamination at dry cleaner sites:

- Extraction and treatment
- Air sparging
- Treatment of existing individual water supplies
- No action
- Long-term monitoring

In addition to these presumptive remedies, in-well air stripping is also included in the evaluation of remediation technologies due to the potential applicability of this developing technology to remediation of VOC contaminated groundwater. Natural attenuation of groundwater contamination is also evaluated.

7.4.2.1 Extraction and Treatment

There are several different extraction and treatment system combinations that can be utilized to address groundwater contaminated by PCE, TCE and DCE. Typical extraction methods include the use of extraction wells or a trench-drainline system. Once contaminated groundwater has been removed from the subsurface, there are three options for treatment as indicated in the Generic Work Plan for Dry Cleaners Sites (D&B, 1996). The three technologies are air stripping, granular activated carbon (GAC) adsorption and chemical/ultraviolet (UV) oxidation.

Air Stripping

Air stripping involves the mass transfer of volatile contaminants from water to air. This process is typically conducted in a packed tower or an aeration tank. The generic packed tower air stripper includes a spray nozzle at the top of the tower to distribute contaminated water over the packing in the column, a fan to force air counter current to the water flow, and a sump at the bottom of the tower to collect decontaminated water. Auxiliary equipment that can be added to the basic air stripper includes a feed water heater (normally not incorporated within an operational facility because of the high cost) and an air heater to improve removal efficiencies; automated control systems with sump level switches and safety features such as differential pressure monitors; high sump level switches and explosion proof components; and discharge air treatment systems such as activated carbon units, catalytic oxidizers or thermal oxidizers. Packed tower air strippers are installed either as permanent installations on concrete pads, or as temporary installations on skids, or on trailers.

Air stripping performance can be affected by high concentrations of dissolved iron and hardness in groundwater which requires pre-treatment of groundwater prior to introduction to the air stripper. In some instances, groundwater must be pre-heated before introduction into the packed tower, which requires additional system components. Off-gases produced by air stripping may require treatment. The energy costs for operating air strippers are also generally high.

Carbon Adsorption

Liquid phase carbon adsorption is a full-scale technology in which groundwater is pumped through a series of vessels containing activated carbon to which dissolved contaminants adsorb. When the concentration of contaminants in the effluent from the bed exceeds a certain level; the carbon can be regenerated in place, removed and regenerated at an off-site facility, or removed and disposed of. Adsorption by activated carbon has a long history of use in treating municipal, industrial and hazardous wastes.

Liquid phase carbon adsorption is less effective if multiple contaminants are present in groundwater. Similarly, high concentrations of contaminants require more carbon and increase system maintenance and costs. The selection of the proper carbon to match the contaminants is important in this system. Spent carbon must be regenerated or disposed, thus require additional handling and cost.

UV Oxidation

UV oxidation is a destruction process that oxidizes organic and explosive constituents in waste waters by the addition of strong oxidizers and irradiation with UV light. Typically, easily oxidized organic compounds, such as those with double bonds (e.g., TCE, PCE and vinyl chloride), as well as simple aromatic compounds (e.g., toluene, benzene, xylene and phenol), are rapidly destroyed in UV oxidation processes. The oxidation reactions are achieved through the synergistic action of UV light in combination with ozone (O_3) and/or hydrogen peroxide (H_2O_2). If complete mineralization is achieved, the final products of oxidation are carbon dioxide, water and salts. The main advantage of UV oxidation is that it is a destruction process, as opposed to air stripping or carbon adsorption, for which contaminants are extracted and concentrated in a separate phase. UV oxidation processes can be configured in batch or continuous flow modes, depending on the throughput under consideration.

UV oxidation is not effective if groundwater turbidity is high or if water contains grease or oils. Filtration may be required to maximize the effectiveness of UV oxidation. UV oxidation has higher energy costs than other treatment methods and also requires extra safety precautions for storage and handling of oxidizers.

These three treatment technologies may be used individually or in combination to remediate contaminated groundwater to acceptable concentrations. Pretreatment of groundwater by metals precipitation and filter systems may be required for removal of iron and manganese prior to treatment for VOC removal in order to prevent fouling and ensure effective operation of the remediation system. The sludges from these metals removal systems require off-site disposal.

Disposal of treated groundwater is an important component of groundwater extraction technologies. The ability to handle treated water on site requires storage capacity and a disposal method capable of handling the appropriate flow of effluent water. Potential options include discharge to sanitary or storm water sewer systems, a recharge basin, injection wells or leaching pools.

7.4.2.2 Air Sparging

Air sparging involves the injection of compressed clean air into the contaminated aquifer. The air percolates up through the contaminated region of the zone of saturation and strips VOCs from the aqueous phase into the vapor phase. Air sparging systems are typically installed in conjunction with soil vapor extraction (SVE) systems which are designed to capture the injected air and volatilized contaminants (off-gases) released into the overlying vadose zone. Increasing the air flow rate of the sparging system can increase in the dissolution of non-aqueous phase liquid (NAPL) residual trapped below the water table.

Air sparging is subject to the same limitations as SVE. These limitations include poor performance in low permeability and heterogeneous soils. Air sparging is also inefficient in soils with high moisture content and a water table that changes elevation significantly over time. Air sparging is not appropriate for use in bedrock because air flow is channeled through fractures and may not come in contact with contaminants.

7.4.2.3 In-Well Air Stripping

In-well air stripping is a developing technology that treats groundwater without the need for temporary on-site storage or ex-situ treatment. As its name implies, contaminant vapors are removed form the groundwater inside the well. Typically, a well is installed with two screens, one below the water table and one at or just above the water table for shallow contamination, or one below the zone of contamination and one above the zone of contamination for deeper contamination. Groundwater is drawn in through the bottom well screen and discharged after treatment through the top screen. Air is bubbled through the water column and volatile organic compounds are transferred from the aqueous to the vapor phase. The vapor phase is removed from the well and treated aboveground with carbon adsorption.

This technology is not appropriate in bedrock aquifers since vertical movement of groundwater between the two well screens occurs through fractures and prevents proper functioning of the system. This technology also has limited application in shallow aquifers due to the lack of vertical separation between well screens necessary to provide proper treatment. In general aquifer hydraulic conductivity must be greater than 1×10^{-5} cm/sec to be effective. Water table fluctuations may cause the flow paths of injected water to vary and compromise the system.

Some other potential concerns with this technology include limitations in contaminant reduction (levels of 50 to 99% reduction have been reported) resulting in continued horizontal migration of contamination greater than groundwater cleanup standards, well screen and aquifer clogging due to iron oxidation and bacteria, and vertical migration of contamination as a result of mixing within the recirculation zone.

7.4.2.4 Treatment Of Existing Individual Water Supplies

This technology involves providing individual well users with water treatment. A water treatment system can be installed at the kitchen or other suitable tap, or at the well head to treat all water entering a home or business establishment. Individual treatment systems might include carbon filtration, reverse osmosis or other suitable systems. These individual treatment systems are generally inexpensive when compared to larger scale groundwater extraction and treatment systems.

Disadvantages of individual water supply treatment include the need to potentially service many wells thus requiring access to many homes or businesses. Coordination and cooperation for service with owners may be difficult. Maintenance of these systems is also difficult. Users would have to be educated to recognize malfunctions and the need to replenish expendable supplies.

7.4.2.5 No Action

The no-action alternative is used in situations where source control activities are effective and residual groundwater contamination and does not pose a significant threat to human health or the environment. The no-action alternative is not applicable to sites where there is a source of contamination, where there is the potential for exposure to contamination or where natural attenuation is not expected to occur. The no-action alternative must be considered in any feasibility study in order to serve as a baseline against which to compare the effectiveness of action alternatives.

Natural attenuation can occur under the no action scenario. Natural attenuation involves natural subsurface processes, such as dilution, dispersion, volatilization, biodegradation, adsorption and chemical reactions with subsurface materials. These processes reduce contaminant concentrations, and over time may reach acceptable levels. Consideration of this option often requires groundwater modeling and evaluation of contaminant degradation rates to determine feasibility, and special regulatory approvals may be needed. In addition, long-term, comprehensive groundwater sampling and analysis must be conducted throughout the attenuation process to confirm that attenuation is proceeding at rates predicted and consistent with meeting groundwater cleanup objectives, and that any potential receptors will not be impacted. Several disadvantages of natural attenuation include: intermediate degradation products may be more mobile and toxic than the original contaminant; it should be used only in low-risk situations; it should be used only where there are no potential impacts on receptors; contaminants may migrate and cause adverse impacts before they are degraded; and regulatory agency and community acceptability is poor.

7.4.2.6 Long Term Monitoring

Long term monitoring is applicable to many remediation technologies and sites. Long term monitoring is particularly appropriate at sites where source remediation has been conducted, natural attenuation is effective and no action is appropriate. Long term monitoring is important at sites where potential receptors are downgradient of an identified contaminant plume. Analyses of groundwater sampled form a long term monitoring network may be limited to contaminants of concern rather than a full Target Compound List (TCL) + 30 analysis. For dry cleaners sites, the analyses may be limited to specific volatile organic compounds (PCE, TCE, DCE and vinyl chloride). The sampling and analyses frequency is determined based upon site-specific conditions. A typical long term monitoring program may require sampling on a quarterly basis for the first 5 years, semiannually for the 6- to 10-year period and annually for the next 20 years. The monitoring locations would be selected on a site-specific basis.

7.4.3 Screening of Remedial Technologies

Remedial technologies previously discussed are screened below in consideration of their applicability to the LaRussell's Cleaners Site. Remedial technologies that likely result in the satisfaction of the remedial objectives listed in Section 7.0 are retained. The technologies that are deemed ineffective due to general site constraints will be rejected and no longer considered. Technologies that are retained will be used to develop remedial alternatives consisting of one or more of the retained technologies (see Section 7.4). Table 7-1 summarizes the screening of Source Control Technologies described in Section 7.4.3.2. Table 7-2 summarizes the screening of groundwater remediation technologies described in Section 7.4.3.3.

7.4.3.1 Source Control Technologies

Six source control technologies are described in Section 7.4.1. Of those six technologies, two will be retained for further evaluation. The two retained technologies include waste water disposal system clean out and no action. Excavation and off-site disposal, soil vapor extraction,

Table 7-1
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
SOURCE CONTROL TECHNOLOGIES SCREENING SUMMARY

Presumptive Remedy Technology	Description	Site Specific Comments	Retained for Further Evaluation
1. Waste Water Disposal System Clean Out	• Cleaning of active systems can be achieved by vacuum pumping liquid and sediment using conventional equipment. • System integrity can be checked visually after pumping. • Follow-up sampling of waste water and sediment is required for active systems.	• Waste water system tank openings are easily accessible. • Minimal disturbance of parking lot required.	Yes
2. No Action	• No short-term impacts to the environment. • Not effective in reducing high levels of contamination when natural attenuation is unlikely to occur or when there are potential receptors. • Does not provide source control.	• *The no-action alternative is required to be considered to provide a baseline for comparison to all other alternatives.*	Yes

Table 7-2
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
GROUNDWATER REMEDIATION TECHNOLOGIES SCREENING SUMMARY

Presumptive Remedy	Description	Site Specific Comments	Retained for Further Evaluation
1. Extraction and Treatment	• Controls contaminant plume and mitigates migration to downgradient receptors. • Will not effectively treat residual NAPL. • Authorization, access and significant space required for treatment and discharge systems. • Poor performance in low hydraulic conductivity material (less than 10^{-7} cm/sec). • Disposal of treated water is often critical issue to implementation.	• Limited space available on-site for construction of extraction and treatment system. • Treated water discharge options are limited. • Possible interference with existing water supply wells at and adjacent to site.	Yes
2. Air Sparging	• Shorter remediation time than extraction and treatment. • In situ remediation, therefore no discharge of treated groundwater required. • Air must contact all contaminated water, vapors must be controlled by SVE. • Applicable only to shallow groundwater contamination. • Does not provide hydraulic control of plume.	• Soils conditions not appropriate for SVE and therefore not appropriate for air sparging. • Fractured bedrock prevents uniform air flow and air contact with all contaminated groundwater.	No
3. In-well Air Stripping	• In situ remediation, therefore no discharge of treated groundwater. • Ineffective in bedrock aquifers. • Critical placement of well screens not suitable to widely fluctuating water table.	• Contaminated groundwater is in fractured bedrock. • Wide ranging water level fluctuations on site will require special consideration for well screen locations and control of flow rates	No
4. Individual Water Supply Well Treatment	• Provide carbon filtration or other suitable treatment system to impacted or potentially impacted wells.	• Carbon filtration systems are already in use on water supply wells at and near the site.	Yes
5. No Action.	• Applicable to sites which do not have very significant levels of contamination and there are no potential receptors. • Only applicable to sites where there is source control and natural attenuation is expected to occur. • Requires private water supply well monitoring or restrictions downgradient of plume. • Degradation compounds may be more mobile and toxic than original contaminants. • Contaminants may migrate and create unacceptable risk before they are degraded.	• On-site source of groundwater contamination must be remediated to eliminate a continuing source of contamination. • *The no-action alternative is required to be considered to provide a baseline for all other alternatives.*	Yes
6. Long Term Monitoring	• Monitors the effectiveness of remedial controls and/or no action/natural attenuation to determine if additional controls are required for health protection. • Is not a remedial measure in and of itself. • Applicable to sites where there is source control and natural attenuation is expected to occur.	• On-site source of groundwater contamination must be remediated to eliminate a continuing significant source of contamination. Appropriate and effective monitoring system must be in place to determine effectiveness of long term remediation selection.	Yes

low temperature thermal desorption and containment/isolation have all been eliminated because no significant source of contaminants has been identified in subsurface soils on-site.

7.4.3.2 Groundwater Remediation Technologies

Eight groundwater remediation technologies were considered in Section 7.4.2. Four of these technologies are retained for further evaluation as remedial alternatives. The retained technologies include extraction and treatment, treatment of individual water supply wells, long term monitoring and no action. The remaining four groundwater technologies were eliminated. Rationale for the elimination of the technologies follows.

Air sparging has been eliminated due to subsurface conditions. Low permeability, heterogeneous soils and underlying fractured bedrock prevent adequate contact of injected air with contaminated groundwater. Channeled air flow through bedrock fractures can not be reliably recovered since its destination may be unknown.

In-well air stripping has also been eliminated. In-well air stripping has not been proven effective in bedrock aquifers. Bedrock fractures may cause channeling or short circuiting of groundwater in the system and prevent thorough treatment. In the overburden zone, variable water table surface elevations over time prohibit the effective location of the two well screens required for in-well air stripping.

7.5 Development of Remedial Alternatives

Remedial alternatives are developed using the applicable technologies described in Section 7.4. These alternatives can be stand-alone remedial technologies or a combination of technologies. Provided below is a description of the selected alternatives for the LaRussell's Cleaners Site. Three remedial alternatives have been developed for the LaRussell's Cleaners Site. These alternatives include:

Alternative 1: No Action;

Alternative 2: Waste water disposal system clean out and groundwater extraction and treatment; and

Alternative 3: Waste water disposal system clean out and treatment of individual water supplies at point of entry.

Each of the alternatives is described below. Detailed evaluations of the alternatives are presented in Section 7.6.

7.5.1 Alternative 1: No Action

The no-action alternative must be considered in order to serve as a baseline against which to compare the effectiveness of other alternatives. Under this alternative, no remediation system will be implemented. Similarly, no additional monitoring wells will be installed. Fourteen (14) existing monitoring wells will be sampled on a quarterly basis and analyzed for exceedances of drinking water standards for PCE, TCE and DCE. Groundwater monitoring will continue for a period of 30 years.

If monitoring well sampling results indicate that the contaminant plume is moving toward private water supply wells, sampling of the potentially affected wells will be initiated. Existing individual treatment systems will be maintained and groundwater usage downgradient of the site will be restricted if the contaminant plume migrates to water supply wells.

This alternative will be retained for detailed evaluation. The detailed evaluation is presented in Section 7.6.

7.5.2 Alternative 2: Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

This alternative involves the continued operation of existing carbon filtration systems previously installed in response to contaminated groundwater originating from the site. The carbon systems at LaRussell's Cleaners, the telecommunications business and the apartment north of the site will continue to be maintained until such time as groundwater remediation has resulted in contaminant concentrations of dry cleaning related VOCs including PCE, TCE and DCE, to be below drinking water standards

This alternative also involves removal and disposal of liquid and sediment from the on-site waste water disposal system. The system has an estimated capacity of 4,000 gallons. The liquid and sediment will be disposed of off-site at a permitted facility. Following evacuation of the system, an inspection of the integrity and general condition of the septic tanks will occur. The tanks may be further cleaned by steam cleaning or other suitable method if it is determined that contaminant residues are still present. Following cleaning, usage of the system will resume. Once the system has returned to equilibrium liquid volumes (several weeks later), samples of liquid and sediment will be obtained periodically for one year and analyzed to verify proper functioning of the system and the absence of contaminants.

A groundwater extraction well will also be installed on-site. The extraction well will be operated in a manner that causes groundwater drawdown at the site 24 hours per day. Water extracted by the well will be treated with one of two methods including carbon filtration or air stripping (UV/oxidation will not be considered as a treatment option due to relatively high energy costs and the increased safety concerns with on-site handling and storage of oxidizers). The treatment system will be located on-site. Treated water will be discharged to the storm water catch basin near the corner of Route 52 and Adams Lane via piping to be installed at the time of treatment system installation. Treatment will be to groundwater standards.

Monitoring of groundwater quality and treatment system effluent will also be conducted for this alternative. Six (6) existing monitoring wells will be sampled and analyzed quarterly during remediation to monitor the effectiveness of remediation on the contaminant plume. The sampling frequency may be reduced to semi-annual after a year of operation when the groundwater flow system has equilibrated to groundwater extraction. Analyses will be limited to VOCs. The groundwater treatment system effluent will be sampled and analyzed at monthly intervals. Analyses of effluent will be used to evaluate the effectiveness of groundwater treatment and to ensure that the discharge requirements are being met.

The groundwater extraction system will be operated until groundwater standards are met or until such time as the continued reduction of contaminants is determined negligible, whichever occurs first. The anticipated duration of extraction and treatment is ten years. Post remediation sampling of groundwater monitoring wells will continue semi-annually for an additional five years.

This alternative will be retained for detailed evaluation. The detailed evaluation is presented in Section 7.6.

7.5.3 Alternative 3: Waste Water Disposal System Clean Out and Treatment of Individual Water Supplies at Point of Entry

This alternative involves pumping liquid and sediment from the on-site waste water treatment system as described in Alternative 2.

In addition, this alternative involves continued treatment of individual water supplies using point of entry or "whole house" water treatment systems. Activated carbon filtration systems will be maintained at businesses or residences with contaminated water. The systems are installed at the point of entry of water into the building and provide treatment for all water used in the building. The systems consist of lead and lag carbon filters that will require regular maintenance and replenishment.

Monitoring of groundwater quality and drinking water at homes and businesses with individual carbon treatment systems will also be conducted for this alternative. Six existing monitoring wells and two private water supply wells will be sampled and analyzed quarterly to monitor the contaminant plume for a period of 30 years. Analyses will be limited to VOCs. Tap water from water systems that have carbon treatment will also be sampled and analyzed semi-annually. Tap water analyses will be used to evaluate the effectiveness of individual carbon treatment systems and to ensure that water used at the households and businesses meets drinking water standards.

This alternative will be retained for detailed evaluation. The detailed evaluation is presented in Section 7.6.

7.6 Detailed Evaluation of Alternatives

Provided below is a comparative evaluation of Alternatives 1, 2 and 3. All three alternatives have been retained for evaluation because each is implementible and effective. Based on this detailed evaluation, a remedial plan will be selected for the site. In accordance with CERCLA and the NYSDEC Guidance for Selection of Remedial Actions at Superfund Sites, the following feasibility study criteria will be evaluated:

- Compliance with New York State Standards, Criteria and Guidelines (SCGs);
- Protection of human health and the environment;
- Short-term effectiveness;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, and volume through treatment;
- Implementability;
- Cost;
- Regulatory acceptance; and
- Community acceptance.

A detailed analysis of the remedial alternatives to each criterion is provided below. Summaries of the detailed analysis for each alternative are presented in Tables 7-3a, 7-3b and 7-3c.

7.6.1 Compliance With SCGs

Alternative 1 - No Action

On-site groundwater currently exceeds groundwater and drinking water standards for PCE. The no action alternative will not reduce the concentration of PCE or other groundwater contaminants as quickly as groundwater extraction methods. Therefore, compliance with groundwater quality SCGs is unlikely to occur if this alternative is implemented.

Alternative 2 - Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

Waste water disposal system liquid and sediment will be removed and disposed off site. Therefore, the waste water disposal system will be in compliance with SCGs as long as dry cleaning equipment and operational practices continue to follow regulatory and industry standards for chemical collection and disposal.

Groundwater will be extracted from an on-site well under this alternative. The extracted groundwater will be treated to lower the concentrations of PCE, TCE and DCE. The clean up goal for treated groundwater is to achieve the Class GA standard and drinking water maximum concentration limit (MCL) of 5 µg/l for PCE, TCE and DCE. Groundwater treatment will result in meeting groundwater and drinking water standards, and therefore, compliance with SCGs will be achieved. Groundwater treatment may not continue until this level is attained. Groundwater treatment may be discontinued when reduction in contaminant levels is no longer cost effective. If groundwater treatment is terminated prior to attaining the groundwater standards, then groundwater monitoring will continue until such time as contaminant concentrations are no longer a health risk.

Table 7-3a
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

ALTERNATIVE 1 - DETAILED EVALUATION

No Action and Long Term Monitoring

Evaluation Criteria	Comments
Alternative 1 - No Action with long term groundwater monitoring	• No remediation attempted. • Use existing groundwater monitoring network. • Restrict groundwater usage in vicinity of site. • Maintain existing individual carbon filtration systems.
1. Compliance with SCGs	• On-site groundwater currently exceeds SCG for PCE.
2. Protection of human health and the environment	• Possible ingestion of contaminated groundwater by well users not currently using treatment systems.
3. Short term effectiveness	• Can be fully implemented immediately. • Causes no change in current contaminant levels.
4. Long term effectiveness and permanence	• Contaminant concentrations may decrease over time due to natural attenuation however, contaminant levels may remain above SCGs and a health risk.
5. Reduction of toxicity, mobility, and volume through treatment	• No reduction.
6. Implementability	• Easily implemented.
7. Cost	• $275,000
8. Regulatory agency acceptance	• Unlikely due to SCG exceedances.
9. Community acceptance	• Unlikely due to health and environmental exposure risks.

Table 7-3b
LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

ALTERNATIVE 2 - DETAILED EVALUATION

Waste Water Disposal System Clean-out and Groundwater Extraction and Treatment

Evaluation Criteria	Comments
Alternative 2 - Waste Water Disposal System Clean-out and Groundwater Extraction and Treatment	• Contaminated liquid and sediment will be pumped from septic tanks. • Contaminated groundwater from on- and off-site will be extracted from an on-site well and treated. • Downgradient monitoring and water supply wells will be monitored . • Treated water will be discharged to storm water system. • Maintain existing individual carbon filtration systems.
1. Compliance with New York State SCGs	• Groundwater treatment will result in meeting Class GA standards.
2. Protection of human health and the environment	• Minimizes or prevents plume migration to receptors. • Reduces contaminant concentrations and possible exposure risks to downgradient groundwater users.
3. Short term effectiveness	• Waste water system clean-out will eliminate source of DCE. • Groundwater extraction system will control migration of groundwater contaminants upon start-up and begin contaminant reduction. • Construction impacts are small
4. Long term effectiveness and permanence	• Prevents migration of contaminant plume. • May not fully remediate DNAPL that may be present in isolated areas of soil or bedrock. • Should cause significant reductions in contaminants.
5. Reduction of toxicity, mobility, and volume through treatment	• Will permanently reduce contaminant mass thereby permanently reducing toxicity, mobility and volume.
6. Implementability	• Techniques are proven to work in similar settings. • Equipment and technology is commercially available. • Preliminary pumping tests indicate site is suitable for pump and treat.
7. Cost	• $289,000
8. Regulatory agency acceptance	• Likely to be accepted.
9. Community acceptance	• Likely to be accepted.

Table 7-3c

LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

ALTERNATIVE 3 - DETAILED EVALUATION

Waste Water Disposal System Clean-out and Individual Water Supply Treatment Systems

Evaluation Criteria	Comments
Alternative 3 - Waste Water Disposal System Clean-out and Individual Water Supply Treatment Systems	• Contaminated liquid and sediment will be pumped from septic tanks. • Granular activated carbon systems will be maintained at LaRussell's Cleaners and the telecommunications business. A third system will be installed on the home center system, downgradient of the contaminant plume. • Downgradient monitoring and water supply wells will be monitored . • Treated water will be discharged to individual septic systems.
1. Compliance with New York State SCGs	• Groundwater extracted by individual water supply systems within the contaminant plume will be treated and meet SCGs. • Remaining groundwater will not meet SCGs.
2. Protection of human health and the environment	• Protective for groundwater users within the contaminant plume. • Low risk to environment and other users, due to small plume extent.
3. Short term effectiveness	• Immediately effective for treated water supply users.
4. Long term effectiveness and permanence	• Only for users of maintained individual water supply treatment systems.
5. Reduction of toxicity, mobility, and volume through treatment	• Toxicity will be reduced. • Mobility will not be effected. • Volume will be minimally effected.
6. Implementability	• Techniques are proven to work in similar settings. • Equipment and technology is commercially available. • Requires cooperation from business owners for installation and maintenance.
7. Cost	• $240,000
8. Regulatory agency acceptance	• Possible
9. Community acceptance	• Possible.

Alternative 3 - Waste Water Disposal System Clean Out and Treatment of Individual Water Supplies at Point of Entry

Waste water disposal system liquid and sediment will be removed and disposed off site. Therefore, the waste water disposal system will be in compliance with SCGs as long as dry cleaning equipment and operational practices continue to follow regulatory and industry standards for chemical collection and disposal.

Groundwater extracted from wells with individual whole house systems will be treated to meet drinking water standards. The use of these systems will not, however, result in the containment of contaminated groundwater in the bedrock aquifer, and therefore, will result in continued exceedance of SCGs in groundwater that is not withdrawn from the aquifer.

7.6.2 Protection of Human Health and the Environment

Alternative 1 - No Action

The no action alternative may not be protective of human health. Although all groundwater users whose wells have been impacted by contamination currently have installed carbon filtration systems, the possibility for contaminant migration to other users or environmental receptors still exists. There is a remote possibility for ingestion of contaminated groundwater by well users not currently using treatment systems. In addition, exposure to contaminated waste water may occur resulting from septic system overflows.

Alternative 2 - Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

Waste water disposal system liquid and sediment will be removed and disposed off site. Therefore, the waste water disposal system clean-out will be protective of human health and the environment as long as dry cleaning equipment and operational practices continue to follow regulatory and industry standards for chemical collection and disposal.

The groundwater extraction and treatment portion of Alternative 2 minimizes or prevents plume migration to possible receptors. This alternative will reduce contaminant concentrations in groundwater and possible exposure risks to downgradient groundwater users. This alternative is protective of human health and the environment.

Alternative 3 - Waste Water Disposal System Clean Out and Treatment of Individual Water Supplies at Point of Entry

Waste water disposal system liquid and sediment will be removed and disposed off site. Therefore, the waste water disposal system clean-out will be protective of human health and the environment as long as dry cleaning equipment and operational practices continue to follow regulatory and industry standards for chemical collection and disposal.

This alternative will be protective of human health for those users who have individual whole house treatment systems. Downgradient groundwater users will be protected by long term monitoring of existing monitoring wells. Should groundwater contaminants be found in downgradient monitoring wells, appropriate measures, such as supplying and maintaining treatment systems on private water supply wells, will be taken to protect downgradient users.

7.6.3 Short Term Effectiveness

Alternative 1 - No Action

The no action alternative requires no on-site response, and therefore, can be fully implemented immediately. The no action alternative however, causes no change in current contaminant levels and is not effective in the short term.

Alternative 2 - Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

The waste water disposal system clean-out portion of this alternative will mitigate contamination in the septic system as soon as it is performed. The groundwater extraction system will control migration of groundwater contaminants upon start-up and begin contaminant reduction in the short term. Alternative 2 provides short term effectiveness by controlling contaminant migration and reducing contaminant concentrations.

A construction health and safety plan will be implemented to minimize the potential for adverse impacts to human health and the environment resulting from installation of the remediation system and will result in very low potential short term impacts. There will be no significant disruption of the general community, and any contaminated soil or groundwater water generated during construction will be properly and safely handled and disposed of off-site.

Alternative 3 - Waste Water Disposal System Clean Out and Treatment of Individual Water Supplies at Point of Entry

The waste water disposal system clean-out portion of this alternative will mitigate contamination in the septic system as soon as it is performed. The individual water supply treatment provides short term effectiveness by reducing contaminant levels and preventing the ingestion of contaminated groundwater by users whose water supply has a whole house treatment system. This alternative does not effect contaminated groundwater remaining in the bedrock aquifer.

A construction health and safety plan will be implemented to minimize the potential for adverse impacts to human health and the environment resulting from installation of the remediation system and will result in very low potential short term impacts. There will be no significant disruption of the general community, and any contaminated soil or groundwater water generated during construction will be properly and safely handled and disposed of off-site.

7.6.4 Long Term Effectiveness and Permanence

Alternative 1 - No Action

Using the no action alternative, contaminant concentrations may decrease over the long term due to natural attenuation. However, the contaminant plume will continue to migrate and may impact potential receptors. Despite the reduction of contaminants due to natural attenuation, contaminant concentrations may remain above SCGs and remain a health risk. The long term effectiveness and permanence of this alternative are inadequate.

Alternative 2 - Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

Waste water disposal system liquid and sediment will be removed and disposed off site. Therefore, the waste water disposal system clean-out will permanent as long as dry cleaning equipment and operational practices continue to follow regulatory and industry standards for chemical collection and disposal.

Groundwater extraction and treatment would be an effective technology over the long-term through mitigating the spread of contaminants and reducing contaminants in the groundwater to acceptable levels. While DNAPL could not be identified at the site, if present in the soil or bedrock, it could act as a continuing source for groundwater contamination on or near the site. DNAPL would also be addressed through this groundwater technology.

Alternative 3 - Waste Water Disposal System Clean Out and Treatment of Individual Water Supplies at Point of Entry

Waste water disposal system liquid and sediment will be removed and disposed off site. Therefore, the waste water disposal system clean-out will permanent as long as dry cleaning equipment and operational practices continue to follow regulatory and industry standards for chemical collection and disposal.

Individual whole house treatment systems will continue to protect groundwater users as long as regular maintenance is performed. The systems will provide little or no long term benefit for the reduction of contaminants in groundwater that is not withdrawn from the bedrock aquifer.

7.6.5 Reduction of Toxicity, Mobility and Volume Through Treatment

Alternative 1 - No Action

The no action alternative offers no effective reduction in toxicity, mobility or volume.

Alternative 2 - Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

Waste water disposal system liquid and sediment will be removed and disposed off site. Therefore, the waste water disposal system clean-out will reduce toxicity, mobility and volume of contaminants as long as dry cleaning equipment and operational practices continue to follow regulatory and industry standards for chemical collection and disposal.

Groundwater extraction and treatment will control the migration of contaminants and permanently reduce contaminant mass, thereby permanently reducing toxicity, mobility and volume.

Alternative 3 - Waste Water Disposal System Clean Out and Treatment of Individual Water Supplies at Point of Entry

Waste water disposal system liquid and sediment will be removed and disposed off site. Therefore, the waste water disposal system clean-out will reduce toxicity, mobility and volume of contaminants as long as dry cleaning equipment and operational practices continue to follow regulatory and industry standards for chemical collection and disposal.

Individual whole house treatment systems will cause a small reduction in the mass and volume of contaminated groundwater. Toxicity will decrease to safe levels at the point of water use. These systems will not cause any change in toxicity of groundwater that remains in the bedrock aquifer nor will they be effective regarding the control of contaminant migration.

7.6.6 Implementability

Alternative 1 - No Action

Because no action is required, this alternative is easily implemented.

Alternative 2 - Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

The remedial technologies in this alternative have been proven to work in similar settings. The equipment and technology necessary for implementation are readily available through commercial means. Preliminary groundwater pumping tests conducted during the remedial investigation indicate that the site is suitable for extraction and treatment.

Alternative 3 - Waste Water Disposal System Clean Out and Treatment of Individual Water Supplies at Point of Entry

The remedial technologies for waste water disposal system clean-out have been proven to work in similar settings. The equipment and technology necessary for implementation are readily available through commercial means. Implementation of whole house treatment systems is feasible, however, implementation requires cooperation and coordination with home and business owners.

7.6.7 Cost

Alternative 1 - No Action

Total Cost for 30 years operation -	$275,000
Capital Cost	0
Operation and Maintenance	46,000
Long Term Monitoring	229,000

A detailed cost breakdown for the No Action alternative is presented in Appendix I-1.

Alternative 2 - Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

	Carbon Filtration	Shallow Tray Air Stripper
Total Cost for 10 years operation -	$289,000	$489,000
Capital Cost	37,000	89,000
Operation and Maintenance	66,000	214,000
Operation Monitoring (10 years)	161,000	161,000
Post Operation Monitoring (5 years)	25,000	25,000

A detailed cost breakdown for carbon filtration as the treatment for this alternative is presented in Appendix I-2a and a detailed cost breakdown for the shallow tray air stripper treatment for this alternative is presented in Appendix I-2b.

Alternative 3 - Waste Water Disposal System Clean Out and Treatment of Individual Water Supplies at Point of Entry

Total Cost for 30 years operation -	$240,000
Capital Cost	20,000
Operation and Maintenance	46,000
Long Term Monitoring	174,000

A detailed cost breakdown for the this alternative is presented in Appendix I-3.

7.6.8 Regulatory Acceptance

Alternative 1 - No Action

Regulatory acceptance for this alternative is unlikely due to the fact that exceedances of SCGs have been documented and that there are potential health risks due to the exceedances.

Alternative 2 - Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

The technologies comprising this alternative are proven effective under similar conditions. The result will be reduction in contaminants and decrease in risk to human health and the environment. Therefore, this alternative is likely to be accepted by the regulatory agencies.

Alternative 3 - Waste Water Disposal System Clean Out and Treatment of Individual Water Supplies at Point of Entry

This alternative is likely to be acceptable for protection of human health, however it may not be acceptable for the environment, since it leaves untreated groundwater that may continue to migrate toward other groundwater users or environmental receptors. Therefore, this alternative may not be acceptable to the regulatory agencies.

7.6.9 <u>Community Acceptance</u>

Alternative 1 - No Action

Community acceptance is unlikely due to health and environmental exposure risks.

Alternative 2 - Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

The technologies in this technique are proven effective under similar conditions. The result will be reduction in contaminants and decrease in risk to human health and the environment. Therefore, this alternative is likely to be accepted by the public.

Alternative 3 - Waste Water Disposal System Clean Out and Treatment of Individual Water Supplies at Point of Entry

This alternative is likely to be acceptable for protection of human health, however it may not be acceptable for the environment since it leaves untreated groundwater that may continue to migrate toward other groundwater users or environmental receptors. Therefore, this alternative may not be acceptable to the public.

7.7 Comparative Analysis of Alternatives

Three remedial alternatives have been evaluated in detail in the previous section. The following compares each of the alternatives on the basis of the criteria described in the detailed evaluation. Tables 7-4 and 7-5 summarize the comparison. Each criteria is ranked using a three point system. When an alternative meets or exceeds the evaluation criteria, it is assigned a plus (+). If a remedial alternative fails to meet the criteria it is assigned a minus (-). A remedial alternative is assigned a zero (0) if can not be clearly demonstrated that it fully meets the criteria while at the same time having some value in partially fulfilling the criteria.

Based upon the comparison in Table 7-4, Alternative 2 is more favorable than Alternatives 1 and 3. The preferred remedial action based upon these criteria is Alternative 2 - waste water disposal system clean out and extraction and treatment of groundwater with continued operation and maintenance of individual carbon treatment systems.

7.8 Remedial Plan Recommendation: Alternative No. 2 - Waste Water Disposal System Clean Out and Groundwater Extraction and Treatment

Alternative No. 2, waste water disposal system clean out, groundwater extraction and treatment and continued operation and maintenance of the two existing individual water supply treatment systems, is the recommended remedial plan for the LaRussell's Cleaners Site. The system can be implemented in a cost-effective, efficient manner and is described below.

The waste water disposal system clean out can be performed by a local permitted environmental contractor. Once liquid has been removed, the tanks and dissipaters will be steam cleaned using a high pressure steam cleaner. Any remaining sediment will be removed, drummed and disposed of at a permitted off-site facility. The resulting wash water will also be removed by the vacuum truck.

Table 7-4

LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
COMPARATIVE ANALYSIS SUMMARY

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Waste Water Disposal System Clean-out and Groundwater Extraction and Treatment	Alternative 3 Waste Water Disposal System Clean-out and Individual Water Supply Treatment Systems
1. Compliance with SCGs	-	+	0
2. Protection of human health and the environment	-	+	0
3. Short term effectiveness	-	+	0
4. Long term effectiveness and permanence	-	+	0
5. Reduction of toxicity, mobility, and volume through treatment	-	+	0
6. Implementability	+	+	+
7. Cost	$275,000	$289,000	$240,000
8. Regulatory agency acceptance	-	+	0
9. Community acceptance	-	+	0

+ Fully Meets Criteria

0 May or Partially Meets Criteria

- Does Not Meet Criteria

Table 7-5

LARUSSELL'S CLEANERS SITE
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

REMEDIAL ALTERNATIVE COST SUMMARY

Alternatives	Capital	Operation and Maintenance (O&M)	Long Term Monitoring	Totals
1. No Action*	$0	$46,000	$229,000	$275,000
2. Groundwater extraction and treatment**	$37,000	$66,000	$186,000	$289,000
3. Individual Water Supply Treatment Systems***	$20,000	$46,000	$174,000	$240,000

* Detailed cost analyses for this alternative are provided in Appendix I - 1.
** Detailed cost analyses for this alternative are provided in Appendix I - 2.
*** Detailed cost analyses for this alternative are provided in Appendix I - 3.

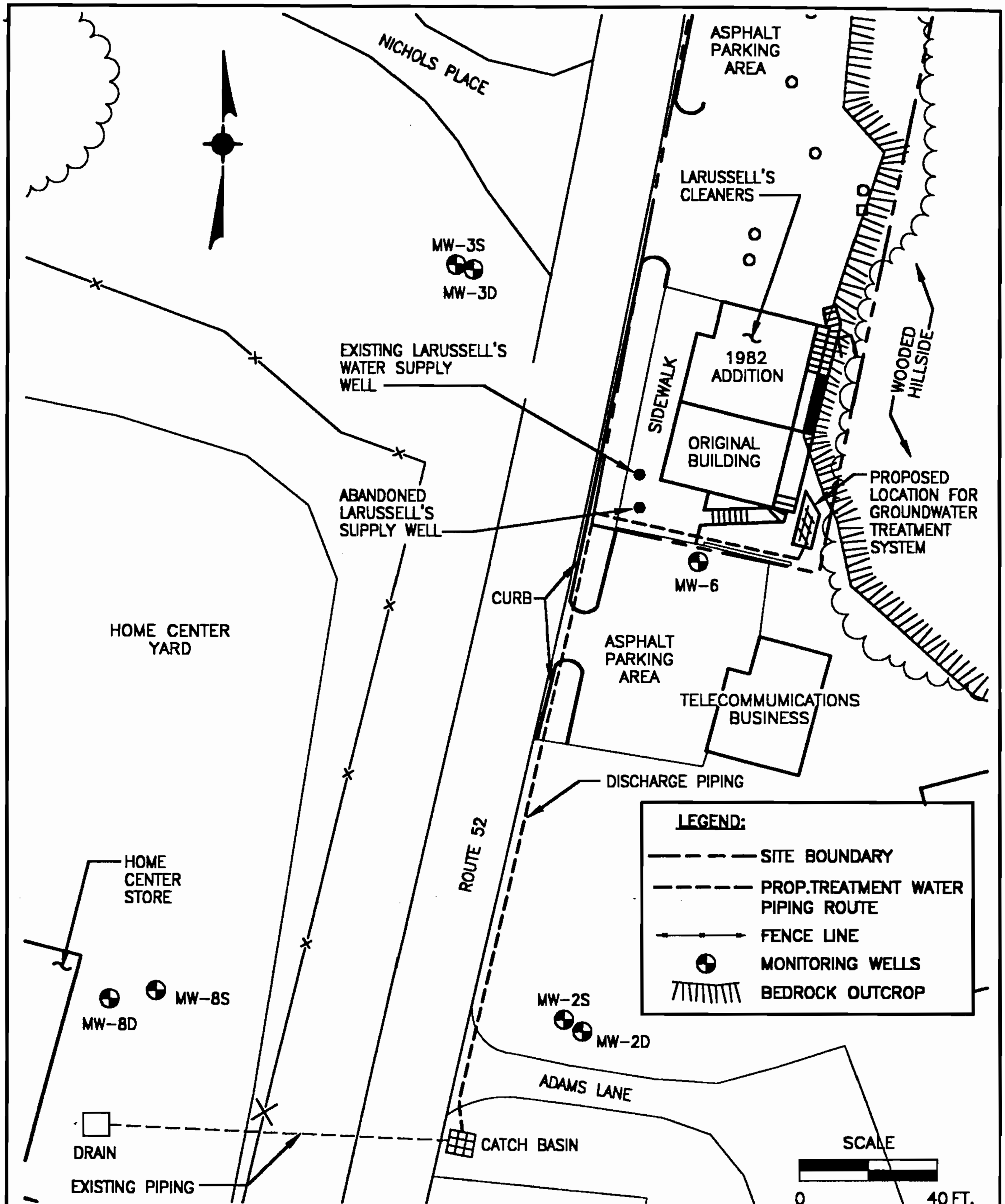
The extraction and treatment system for groundwater remediation will be installed on-site (see Figure 7-1). The extraction well will be installed on the southwest corner of the LaRussell's Cleaners property. The well will extract groundwater 24 hours per day. Extracted water will be treated and discharged off-site to a storm water catch basin via buried piping.

Extracted groundwater will be pumped through a treatment system located in the on-site yard area southeast of the building. The treatment system will be housed in a small wood frame shed or other suitable structure that will be located on LaRussell's Cleaners property, southeast of the LaRussell's Cleaners building. Electricity will be obtained from the cleaners and the shed will be heated to prevent freezing in winter months. Electric heat tape will be attached to above ground piping between the abandoned water supply well and the wood frame enclosure.

Contaminated groundwater will be treated using a carbon filtration system or a shallow tray air stripper. The specific system will be selected during the remedial design phase of the project.

Discharge water from the treatment vessels will be piped below ground to the catch basin at the intersection of Route 52 and Adams Lane. Water entering this catch basin is piped to an outfall in an unnamed stream that flows into Palmer Lake, approximately one half mile south of the site.

Discharge water will be sampled on a monthly basis to confirm that discharges of contaminants are below the groundwater standards, since water in the stream has the potential to recharge groundwater. Groundwater monitoring wells will be sampled quarterly to evaluate the progress of aquifer clean-up and provide early detection of groundwater plume migration if it occurs.



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LARUSSELL'S CLEANERS SITE
LAKE CARMEL, NEW YORK

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

REMEDIATION SYSTEM LOCATION

FIGURE 7-1

8.0 REFERENCES

Boyd, D., 1996. Personal Communication on October 27, 1996.

Cashin Associates, 1982. Sewage Disposal System Repair for Eugene F. LaRussell,, Plan Drawing 1"=20', 1 sheet.

Dvirka & Bartilucci, 1996a. Remedial Investigation and Feasibility Study, GENERIC WORK PLAN, Dry Cleaners Sites, February, 1996.

Dvirka & Bartilucci, 1996b. Remedial Investigation and Feasibility Study, WORK PLAN, LaRussell's Cleaners Site, Lake Carmel, Putnam County, NY, Site Registry No. 3-40-020, May, 1996.

EPA,1993a. Presumptive Remedies: Policy and Procedures. OSWER EPA 540-F-93-047, 8p.

EPA,1993b. Presumptive Remedies: Site Characterization and technology selection for CERCLA sites with volatile organic compounds in soils. EPA 540-F-93-048, 25p.

EPA,1996. Presumptive response strategy and ex-situ treatment technologies for contaminated ground water at CERCLA sites - Final Guidance. OSWEREPA 540/R-96/023, PB96-963508, 31 p. + 4 appendices.

Fisher, D.W., Isachsen, Y.W., and Rickard, L.V., 1970, Geologic Map of New York, Lower Hudson Sheet, New York State Museum and Science Service, p. map.

Grossman, I.G., 1957, The groundwater resources of Putnam County, New York, State of New York Department of Conservation Water Power and Control Commission, p. 78.

Muller, E.H., 1965, Bibliography of New York Quaternary Geology, The University of the State of New York, p. 116 p.

PCDOH, 1987. Well Completion report for Eugene LaRussell, Route 52 Lake Carmel, 1p.

Pfizer-Jahnig, 1993. Preliminary Site Report, LaRussell's Laundry and Dry Cleaning, Inc., 5p.

Prucha, J.J., Scotford, D.M., and Sneider, R.M., 1968, Bedrock geology of parts of Putnam and Westchester Counties, New York, and Fairfield County, Connecticut: Albany, New York State Museum and Science Service, p. 26 p. + 1 !:24,000 map of 3 quads.

USDA SCS, 1994, Soil Survey of Putnam and Westchester Counties, New York, Soil Conservation Service, p. 205p. + 189 maps.