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# Semiannual Monitoring Report

## June 2000

## Carroll and Dubies Superfund Site
## Town of Deerpark, Orange County, New York

*Prepared for:*

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Project No. 698-0110

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# 1.0 Introduction

This *Semiannual Monitoring Report* has been prepared for the Carroll and Dubies (C&D) Superfund Site, on behalf of the Carroll and Dubies Superfund Site Potentially Responsible Parties (PRP) Group, by Shield Environmental Associates, Inc. (Shield).

This report documents field activities, presents analytical data, and analyzes the data from field work completed between June 5 and June 9, 2000.

The documents used as guidance for the field activities were:

- *Field Sampling and Analysis Plan Addendum* (Shield, 1998)
- *Final Remedial Design Work Plan Addendum* (Shield, 1998a)
- *Quality Assurance Project Plan Addendum* (Shield, 1998b)
- *Remedial Action Work Plan, Appendix B, Health and Safety Plan* (Shield, 1998c)

Historical data from the *Addendum to Supplemental Hydrogeologic Remedial Investigation* (Remediation Technologies Inc. [RETEC], 1995) and *Preliminary Remedial Investigation Results* (Blasland, Bouck, & Lee, Inc. [BB&L], 1992) have been incorporated into this report as well as data collected during previous Shield sampling events.

The remedial activities for this site are separated into two operable units. Operable Unit 1 (OU-1) addressed source control through the remediation of the lagoons, which was completed in 1999. This report covers the OU-2 activities only, which addresses groundwater impacts and remediation.

A Record of Decision (ROD) for OU-2 was signed by the U.S. Environmental Protection Agency (U.S. EPA) in September 1996. The major components of the selected remedy in the ROD included:

- Documenting monitored natural attenuation of organic contaminants in the groundwater

- Implementing institutional controls
- Monitoring of the groundwater to evaluate groundwater quality and ensure effectiveness of the remedy
- Sampling of water and sediment in Gold Creek

## 1.1 Site Location and History

The C&D Superfund Site is located in the Town of Deerpark in Orange County, New York (Figure 1). The three-acre site is approximately 3,000 feet northeast of the City of Port Jervis, New York. In 1970, the site began operating as a disposal facility. Liquid industrial wastes were received from approximately 1971 to 1979. The facility also accepted septic waste and municipal solid waste until 1989, which were the majority of wastes disposed of at the site. Figure 2 presents the details of the site. The wastes disposed at the site were removed during remediation activities conducted in 1999. Site restoration continued through the first week of January 2000. These activities are documented in the OU-1 Remedial Action Report (Shield, 2000).

The site is situated in the Neversink Valley. Gold Creek lies approximately 1,500 feet to the east, and the Neversink River is located approximately 2,000 feet beyond Gold Creek. The immediate surrounding area includes undeveloped woodlands to the north; undeveloped woodlands, a sand and gravel quarry pit, and the closed City of Port Jervis landfill to the east; the City of Port Jervis shooting range to the south; and a sparsely vegetated, shale bedrock, hillside to the west.

## 1.2 Site Hydrogeology

Subsurface investigations at the site (BB&L, 1992) have delineated three hydro-stratigraphic units. The uppermost units have been identified as Pleistocene Age glacial outwash underlain by glacial till (RETEC, 1995). The underlying bedrock is the Middle Devonian age Mahantango Formation, the uppermost unit of the Hamilton Group. The outwash unit is generally described as a medium brown, fine- to coarse-grained sand with inclusions of gravel and some cobbles. Color variations include reddish-brown and brownish gray. Very few logs indicate the presence of silt. Where silt is mentioned, it is usually as a trace amount. The till unit is generally described as dark gray, orangish brown, or dark brown silt and sand. Trace amounts of gravel and small sand lenses are reported. The bedrock is generally described as gray, dark gray, or black competent shale with horizontal fractures.

Groundwater flow across the site is to the southeast toward Gold Creek (Figure 3). Gold Greek serves as the base level for local groundwater flow.

## 1.3 Summary of Baseline Groundwater Quality

Groundwater at the site has been impacted by organic compounds at concentrations that exceed the Federal Maximum Contaminant Level (MCL) or New York State Department of Environmental Conservation (NYSDEC) water quality standards and guidance values (SGV) for groundwater, or both. Appendices A and B contain summaries of volatile and semivolatile organic analytes, respectively, that have been historically detected in groundwater.

Based on the findings of the remedial investigation/feasibility study (RI/FS) and the selected remedy, inorganic constituents are not part of the ongoing monitoring program and will not be discussed in this report.

The groundwater sample results during the sampling periods before source removal (prior to January 2000) were used as the baseline for comparing groundwater sampling results subsequent to source removal activities. The concentrations of historically detected constituents are presented in Appendices A and B.

Historically, the groundwater downgradient of former Lagoons 1 and 2 has been impacted at levels greater than MCLs or SGVs by benzene, 1,2-dichloroethene (1,2-DCE), trichloroethene (TCE), and tetrachloroethene (PCE) in the outwash or outwash/ till. With the exception of OW-13, the groundwater immediately downgradient of former Lagoons 3 and 4 has not been impacted above MCLs or SGVs. OW-13 has contained concentrations of benzene, vinyl chloride, methylene chloride, toluene, phenol, and 1,2-DCE that exceed standards. The major area of impact to groundwater within the outwash/till interval lies downgradient of former Lagoons 6, 7, and 8. Contaminants that have exceeded standards in this area include the volatile organic compounds (VOCs) acetone, benzene, chlorobenzene, chloroethane, 1,2-DCE, ethylbenzene, methylene chloride, toluene, vinyl chloride, and xylenes and the semivolatile organic compounds (SVOCs) isophorone, naphthalene, and phenol.

Within the till and bedrock there were no organic compounds reported above the MCLs or SGVs.

## 1.4 Work Plan Variations

During this round of field activities, the minor variations from the work plans are listed below, followed by a brief explanation:

- Ferrous iron was analyzed in the laboratory rather than in the field. The laboratory method for analysis of ferrous iron uses the same reagent chemistry as the Hach® field kit, and the appropriate holding times were met.

- Hydrochloric acid (HCl) was added to the volatile organic analysis (VOA) vials by the laboratory before shipment, rather than by the field team. The use of pre-preserved VOA vials did not compromise the data as all samples were at a pH of ≤2 as tested at the laboratory upon arrival. Placement of acid in the VOA bottles by the laboratory before shipment to the field, rather than sample acidification in the field, is the more common practice today.

# 2.0 Semiannual Monitoring Activities

This section outlines the procedures used for field sampling and monitoring activities, including measurement of groundwater elevations, collection of groundwater samples, measurement of field parameters in groundwater, surface water sampling, and sediment sampling. The results and interpretation of the semiannual monitoring program are provided in Section 4.0.

## 2.1 Groundwater Elevations

Groundwater elevations were determined based on measured depths to water from the reference point elevations before sampling began. The depth to groundwater was measured using a Solinst® electronic water-level meter and recorded in the field logbook to the 1/100th of a foot.

In addition to gauging groundwater levels, three surface water elevations were also measured. Three permanent gauge staffs were installed, two along Gold Creek and one adjacent to the quarry pond east of monitoring well OW-8. The elevations and locations of the gauge staffs were surveyed by a State of New York registered surveyor. These locations are shown in Figure 3 and are identified as SW-1, SW-2, and quarry pond.

## 2.2 Monitoring Well Sample Collection

Dedicated low-flow purging and sampling pumps are utilized to sample the monitoring wells. After stabilization procedures were completed for each monitoring well, groundwater samples were taken directly from the Tygon® tubing dedicated to each respective well pump.

All monitoring wells maintained less than 0.3 foot of drawdown during purging and stabilization.

During purging of each monitoring well, temperature, dissolved oxygen (DO), redox potential, specific conductance, pH, and turbidity were monitored and recorded on field forms (Appendix C) in average intervals of 5 minutes. The wells were pumped for periods ranging from 45 to 85 minutes. The goal was for three consecutive readings of field parameters within the following ranges:

- ±0.1 for pH
- ±3% for specific conductance (conductivity)
- ±10 millivolts (mV) for redox potential (redox)
- ±10% for DO
- ±10% for turbidity

A range was not established for temperature; however, consistent temperature readings were also utilized as an indication that a monitoring well had reached stabilization.

Groundwater purged from the majority of monitoring wells in preparation for sampling was relatively clear and contained little to no detectable sediment or suspended particles. All groundwater samples were collected at a flow rate of between 200 and 500 milliliters per minute (mL/min). The low-flow sampling pumps allowed all samples to be collected with minimal turbulence.

## 2.3 Groundwater Field Parameters

Groundwater field parameters were measured with a YSI Model 6820 flow-through cell that was calibrated daily prior to sampling activities. Field parameters measured and recorded included:

- Temperature (°Celsius [C])
- DO (milligrams per liter [mg/L])
- Redox potential (mV)
- pH (standard units)
- Specific conductance (umhos/cm)
- Turbidity (nephelometric turbidity units [NTUs])

The final stabilized field parameter values are presented in Tables 1 and 2.

### Temperature

Although a range for temperature fluctuations was not established in the *Field Sampling and Analysis Plan Addendum* (Shield, 1998), fluctuations were less than one degree (1°) Centigrade for a minimum of three consecutive readings prior to sampling all of the monitoring wells. Groundwater temperatures ranged from 10.18° to 12.56°Centigrade.

### Dissolved Oxygen

DO concentrations stabilized for a minimum of three consecutive measurements within the recommended ±10% range in all but two monitoring wells. DO is an important parameter in the interpretation of natural attenuation trends. DO readings across the site ranged from -1.83 to 1.72 mg/L.

### Redox

Redox stabilized within the recommended ±10 mV range for three consecutive measurements in all monitoring wells except MW-1. Redox is also an important parameter in the interpretation of natural attenuation trends. A wide range of redox readings were found in the wells, varying from -42.6 to 303.3 mV.

### pH

A minimum of three consecutive readings for pH within the recommended ±0.1 range was achieved for all monitoring wells prior to sampling. Groundwater samples were within the pH range of 5.75 to 6.70.

### Specific Conductance

A minimum of three consecutive readings for specific conductance was achieved within the recommended ±3% range for all monitoring wells prior to sampling. Specific conductance varied from 140 to 1,449 umhos/cm across the site.

### Turbidity

A minimum of three consecutive readings for turbidity was achieved within the recommended ±10% range for all monitoring wells prior to sampling except MW-4, OW-16, and OW-18. Turbidity readings varied from 0.8 to 626 NTUs across the site.

## 2.4 Surface Water Sampling

Two surface water samples were collected from Gold Creek and are identified as SW-1, the downstream sample, and SW-2, the upstream sample. These locations were permanently monumented with gauge staffs by the licensed surveyor.

Samples were collected in accordance with the *Field Sampling and Analysis Plan* for VOCs and SVOCs. The SVOCs container was used to collect the samples at each location. Water was then transferred to the VOC sample vial from the SVOC container. The SVOC bottle was placed back into the water, and the bottle was refilled. The sample bottles were labeled appropriately and placed in a cooler with ice.

## 2.5 Sediment Sampling

Two sediment samples were collected from Gold Creek. These samples, identified as Sed 1 and Sed 2, are identified in Figure 2. They coincide with surface water sample locations SW-1 and SW-2. The samples were collected at the sediment/water interface.

The sediment samples were collected with a stainless steel spoon and a stainless steel pan. The VOC sample jar was filled directly from the spoon as the sediment was collected to minimize the potential release of VOCs due to disturbing the sample. Sediment for the SVOC sample was then placed in the pan, homogenized, and placed in the sample jars. The spoon and pan were decontaminated prior to and after use in accordance with the procedures outlined in the *Field Sampling and Analysis Plan Addendum.* Upon completion of sediment sampling and decontamination, an equipment blank was collected for laboratory analysis.

# 3.0 Sampling Results

## 3.1 Groundwater Elevations

The groundwater elevations for this sampling round are presented in Table 3. The groundwater elevation data were collected prior to any well sampling. Figure 2 shows site monitoring wells, and Figure 3 shows the groundwater elevation contours.

The elevations of adjacent surface water bodies have been included in the groundwater contours map shown in Figure 3. The gauge staffs for measuring surface water elevations were installed and measurements taken on the last day of sample collection. While surface water data were included on the map, it was not used for the interpretation of groundwater elevations due to the three-day interval between collection of surface water and well data. In addition, a significant rain event (more than 1 inch) occurred between the data collection events.

The groundwater flow direction on site is toward the southeast in the direction of Gold Creek. The groundwater gradient across the site is approximately 0.15. The gradient transitions to a lesser slope at about the location of the towpath. From the towpath to Gold Creek, the gradient is very shallow, approximately 0.008. The steeper gradient on the western side of the site is due to the depth to bedrock along the valley wall. It is known from previous borings that the bedrock elevation in the vicinity of OW-15 is higher than across the rest of the site (RETEC, 1995). The bedrock elevation at OW-15 is approximately 433 feet, which is at or above the groundwater elevation of most of the wells. As the depth to bedrock increases towards the valley floor, the alluvial fill increases and the groundwater gradient flattens.

## 3.2 Groundwater Quality

The groundwater analytical results from the June 2000 sampling event indicate that groundwater at the site is impacted by organic compound concentrations that exceed either MCLs or SGVs, or both. Summaries of detected VOC and

SVOC analytes from the June 2000 sampling event are presented in Tables 4 and 5, respectively, and in Figures 4 and 5. Historical data of detected organic compounds have been combined with the most recent data and are presented in Appendices A (VOCs) and B (SVOCs). Appendix D contains the analytical reporting pages from the data packages. The table at the beginning of Appendix D indicates changes to laboratory-reported concentrations as a result of data validation. The validated concentrations are used throughout this report. The complete laboratory analytical reports for this sampling episode have been submitted separately as electronic files on disk, along with the data validation report.

VOCs are the primary contaminants of concern in groundwater at this site. The concentrations of VOCs in site monitoring wells for this semiannual monitoring event have been reviewed in comparison to results from previous sampling events. Although variations in concentrations are seen from well to well for individual constituents, the results for this monitoring event show that concentrations have decreased or remained relatively constant when pre-source removal concentrations are compared with post-source removal concentrations (Appendix A).

SVOCs are of lesser concern in groundwater than VOCs due to lower concentrations and limited areal extent. The SVOC concentrations in samples collected in June 2000 generally declined, compared to the SVOC concentrations in samples collected during previous sampling episodes (Appendix B).

### 3.2.1 Volatile Organic Compounds

Eleven VOCs were detected in various wells during this sampling event, of which seven exceeded regulatory limits (Table 4). The VOCs that exceeded regulatory limits are benzene, chlorobenzene, 1,2-DCE (total), ethylbenzene, PCE, TCE, and vinyl chloride. The detected compounds and concentrations are shown by well in Figure 4. Monitoring wells MW-1 and OW-15 did not contain VOCs at concentrations greater than MCLs or SGVs. Monitoring wells OW-8 and OW-16 did not contain detectable VOCs. The other 10 wells within the network had concentrations that exceeded MCLs or SGVs for one or more VOCs. The principal nonchlorinated VOC was benzene, and the principal chlorinated VOCs were 1,2-DCE and PCE.

Figure 6 shows a comparison of benzene concentrations in monitoring network wells in February 1999, January 2000, and June 2000. Benzene concentrations in June 2000 were 11 ug/L or less in all monitoring wells, except for OW-10R and OW-13.

In all wells except OW-21, concentrations were lower in June 2000 compared to January 2000. In monitoring wells OW-10R and OW-13, both close to the former lagoons, the benzene concentrations in June 2000 were approximately one-third the concentrations measured in January 2000.

The change in concentrations of benzene in OW-10 and OW-10R should be noted. The sampling results from OW-10 indicated that, during pre-source removal sampling, the concentrations for benzene was declining slightly and averaged approximately 1,410 ug/L. During the source removal activities, OW-10 was destroyed and re-located. Results of groundwater sampling of the replacement well, OW-10R has indicated that the concentrations are less that those indicated from the original OW-10 well. OW-10R is located further downgradient of OW-10 and would be expected to result in slightly lower concentrations of benzene. We will continue to evaluate the concentrations of chemical constituents in this replacement well.

In addition, the concentrations of benzene at OW-13 have varied substantially during both the pre- and post-source removal sampling episodes. A clear, overall concentration pattern has not become evident; however, the concentration of benzene during this sampling episode decreased by as much as 30%.

Figure 7 illustrates a similar comparison for chlorinated aliphatic VOCs, represented by total concentrations for 1,2-DCE, TCE, PCE. It is reasonable to sum the concentrations of these compounds for comparison purposes because PCE can degrade in groundwater to TCE, and TCE can degrade to 1,2-DCE. There were variations in concentrations from well to well. In all wells where concentrations most recently exceeded regulatory levels, total concentrations decreased by 21% to 82% from January 2000 to June 2000.

The results for all the wells viewed together for benzene and chlorinated aliphatic compounds indicate, in most wells, a significant decrease in concentrations.

Concentrations of organic constituents are expected to continue to decrease as a result of natural attenuation.

### 3.2.2 Semivolatile Organic Compounds

Seven different SVOCs were detected in five monitoring wells: OW-2, OW-10R, OW-13, OW-18, and OW-22, in relatively low concentrations (Table 5). The detected compounds and concentrations are shown by well in Figure 5. SVOCs exceeded SGVs for phenol in OW-10R, OW-13, and OW-22, and for bis(2-ethylhexyl)phthalate in OW-2. In comparison, in February 1999, SVOCs were reported in six wells, OW-2, OW-5, OW-10, OW-13, OW-21, and OW-22, and in four wells in January 2000, OW-10R, OW-13, OW-18, and OW-22. Figure 8 compares results for OW-10 (February 1999) and OW-10R (January and June 2000), where the highest concentrations and largest number of SVOCs have been found. Concentrations decreased for the last two monitoring events (post-source removal), except for phenol, which increased slightly.

### 3.2.3 Monitored Natural Attenuation Parameters

Field measurements and laboratory analyses were performed on groundwater samples collected during this semiannual monitoring program. This information was collected to monitor evidence that natural attenuation processes, through biodegradation and other physical and chemical processes, are occurring and reducing contaminant concentrations in groundwater over time. Both aerobic and anaerobic biodegradation can occur, depending on site conditions.

The chemical and physical parameters measured as part of this monitoring program show that natural attenuation is occurring at the site. Since wastes and contaminated soils that acted as source material have been removed, concentrations of organic constituents in groundwater will continue to decrease over time due to natural attenuation.

Table 2 summarizes the natural attenuation parameter results, including:

- DO
- Alkalinity
- Chloride
- Ferrous iron

- Nitrate
- Sulfate
- Sulfide
- Total organic carbon (TOC)
- Ethane/ethene
- Methane
- Redox

The field parameters (Appendix C; Appendix E) were measured during monitoring well sample collection using a multi-parameter instrument. Natural attenuation analytical parameters for samples collected since February 1999 are provided in Appendix F.

### General Observations

U.S. EPA has provided final guidance on tracking and interpreting natural attenuation trends in groundwater (U.S. EPA, 1999). Table 6 is an adaptation of a table presented at a U.S. EPA symposium (Weidermeier, 1996) that is useful in data interpretation. The contaminant plume at the C&D site is relatively complex, in that it shows impacts from chlorinated VOCs, nonchlorinated VOCs, and organic carbon as lagoon leachate. The general observations regarding natural attenuation data are:

- Several parameters indicate that reductive dechlorination of chlorinated VOCs may be occurring (presence of chlorinated daughter products, presence of ethane/ethene and methane within the plume, elevated chloride concentrations downgradient of the lagoons, redox readings less than 50 mV within the plume). Reductive dechlorination occurs under anaerobic conditions.

- Indicators of reductive dechlorination are most consistently found in association with the former Lagoon 8 portion of the contaminant plume, which contains both benzene and chlorinated VOCs. The former Lagoon 2 portion of the plume contains mainly chlorinated VOCs.

- All monitoring wells, except for OW-6 and OW-16, were found to have DO readings less than 1 mg/L. DO concentrations in most wells were less than 0.5 mg/L, which is indicative of anaerobic conditions, under which reductive dechlorination will occur.

A good example of a well that shows strong indicators of natural attenuation processes is OW-13. Groundwater from this well in January 2000 contained benzene, low concentrations of TCE, and higher concentrations of the degradation products 1,2-DCE (total) and vinyl chloride. It had a DO concentration of less than 0.5 mg/L, and a negative redox value, conditions under which reductive dechlorination can occur. It had an alkalinity value greater than two times the background concentration, indicating that oxidation of vinyl chloride may be occurring. The chloride concentration was greater than twice the background concentration, indicative of the degradation of chlorinated aliphatic compounds. Groundwater from OW-13 also had significant concentrations of ethene and ethane, daughter products of vinyl chloride.

Results from the June 2000 sampling of OW-13 show a lower concentration of benzene, TCE is no longer detectable, and the daughter products 1,2-DCE and vinyl chloride have reduced concentrations. The DO concentration is slightly above 0.5 mg/L but still less than 1 mg/L, and the redox value is less than 50 mV, both indicators of reductive dechlorination. The alkalinity value is still more than two times the background concentration, an indicator of possible oxidation of vinyl chloride. The chloride concentration is again more than twice the background concentration, indicative of the degradation of chlorinated aliphatic hydrocarbons. Ethane and ethene, daughter products of the degradation of vinyl chloride, are also still at detectable concentrations. In this well the decrease in contaminant concentrations in the six months since source removal was complete demonstrates natural attenuation processes are working.

In summary, natural attenuation data sets will continue to be evaluated to develop an understanding of trends and conditions. In the following paragraphs, the results for the individual natural attenuation parameters are summarized.

### Dissolved Oxygen

DO readings were less than 0.5 mg/L in most wells, indicative of low oxygen conditions that would favor anaerobic degradation pathways, and less than 1.0 mg/L in all monitoring wells, except for OW-6 and OW-16. These wells, OW-6 and OW-16, had DO concentrations of 1.05 and 1.72 mg/L, respectively. Figure 9 shows site-wide DO concentrations and highlights those wells where DO is less than 0.5 mg/L.

### Redox

Redox readings below approximately +750 mV indicate that anaerobic processes can occur. A reductive dechlorination pathway is possible when redox readings are +50 mV or less. Redox values for most of the wells located near and downgradient of the former lagoons exhibited redox readings less than +50 mV, indicative of conditions conducive to dechlorination. Background well MW-1 and downgradient wells OW-2, OW-5, OW-6, and OW-16, located further from the source areas, indicated redox values of greater than +50 mV. Figure 10 shows site-wide redox concentrations and highlights those wells where redox is less than +50 mV.

### Alkalinity

Alkalinity greater than two times the background concentration may be indicative of the ultimate oxidation of vinyl chloride to $CO_2$. Vinyl chloride is a degradation product of other chlorinated VOCs. For this evaluation, the alkalinity value of 100 mg/L for MW-1 was considered background. Alkalinity greater than or equal to 200 mg/L was found in MW-4, OW-10R, OW-13, OW-18, OW-21, and OW-22. Vinyl chloride was detected above MCLs during this sampling round in OW-10R and OW-13. The presence of vinyl chloride and elevated alkalinity concentrations in these wells indicates that more highly chlorinated VOCs are being degraded to vinyl chloride and, ultimately, to $CO_2$.

### Chloride

Elevated chloride concentrations (equal to or greater than two times the background concentration of 48 mg/L in MW-1), indicative of reductive dechlorination, were found in MW-4, OW-5, OW-8, OW-10R, OW-13, OW-15, OW-18, OW-19, OW-21, and OW-22, all wells where chlorinated VOCs and degradation products have been detected (Figure 11).

### Ferrous Iron

Ferrous iron is generated when ferric iron is used as an electron acceptor under anaerobic conditions. Ferrous iron concentrations greater than 1 mg/L may be indicative of reductive dechlorination (Figure 12). Ferrous iron concentrations greater than 1 mg/L were measured in all monitoring wells except MW-1, OW-2, OW-6, and OW-16. The elevated ferrous iron concentrations were generally found downgradient of former Lagoons 6, 7, and 8.

### Nitrate

Low nitrate concentrations (less than 1 mg/L) potentially indicate the occurrence of anaerobic degradation processes and reductive dechlorination. Nitrate concentrations of 1 mg/L or less were found in all wells except MW-1, the background well, and OW-2 and OW-5, downgradient of the Lagoon 2 contaminant plume, and OW-16, a downgradient well that has always been clean. The relatively high nitrate concentrations in OW-2 and OW-5 are probably a result of sewage and septage wastes from former Lagoons 1 and 2.

### Sulfate/Sulfide

Sulfate is an electron acceptor under anaerobic, strongly reducing conditions; sulfide is produced under these conditions. Relatively low sulfate (less than 20 mg/L), combined with detectable sulfide (greater than 1 mg/L) may be indicative of this reductive dechlorination pathway. Although sulfate concentrations less than 20 mg/L were measured in several wells, sulfide was only detected in OW-5, which also had the highest sulfate concentration at 68 mg/L, indicating that sulfate is probably not being used as an electron acceptor.

### TOC

Organic carbon, as measured by TOC, provides a carbon and energy source for biodegradation, and can drive dechlorination. Although TOC was not measured in any well at the "rule of thumb" concentration of 20 mg/L or greater, concentrations significantly greater than the background concentration of 1 mg/L (MW-1) were found in OW-10R, OW-13, OW-18, and OW-22, all downgradient of former Lagoon 8.

### Ethane/Ethene

These compounds are daughter products of vinyl chloride. Detectable concentrations are indicative of degradation of vinyl chloride and more highly chlorinated compounds. Detectable concentrations were found in OW-13, OW-19, OW-21, and OW-22.

**Methane**

Methane is an ultimate reductive dechlorination daughter product, and concentrations greater than 0.1 mg/L may indicate this process. However, its presence at this site in relatively high concentrations, greater than 1 mg/L, is more likely an indicator of impacts from septic waste disposal. It was measured at concentrations greater than 1 mg/L (1,000 micrograms per liter [ug/L]) in OW-10R, OW-13, OW-15, OW-19, OW-21, and OW-22.

## 3.3 Surface Water Quality

Two surface water samples were collected during this sampling event. No detectable VOCs or SVOCs were reported in either the downstream sample SW-1 or the upstream sample SW-2. Historically detected VOCs are shown in Table 7.

## 3.4 Sediment Quality

Two sediment samples were collected during this sampling event. Analytical results for detected constituents are provided in Table 8. The VOCs 2-butanone and acetone were detected in the downstream sample, Sed 1. Acetone, 2-butanone, and toluene were detected in the upstream sample, Sed 2. All of the detections were J- and/or B-qualified, indicating the analyte was detected below method reporting limits (J) or the analyte was detected in a reportable quantity in the associated method blank (B). Historically, acetone has been detected in both the upstream and downstream sediment samples. The acetone concentrations in the sediment samples may be due to decontamination procedure residuals since acetone was also detected in the equipment blank. The detection of toluene is a first-time occurrence. The result is estimated and the duplicate of the sample indicates toluene to be nondetectable.

The SVOCs bis(2-ethylhexyl)phthalate and 4-methylphenol were detected for the first time in sediments during this sampling event. The reported concentrations for both of these SVOCs are "J"-qualified.

# 4.0 Summary and Conclusions

The 14 monitoring network wells were sampled between June 6 and June 8, 2000 for analysis of VOCs, SVOCs, and natural attenuation parameters. Two surface water samples and two sediment samples were collected and analyzed for VOCs and SVOCs. All laboratory analytical samples were analyzed by Quanterra Environmental Services, North Canton, Ohio.

In addition to the standard sampling activities, a one-time activity occurred. This was the installation of staff gauges adjacent to Gold Creek and the quarry pond.

Generally, the concentrations of VOCs in groundwater collected from the two post-source removal sampling episodes either declined or were similar to the concentrations from the pre-source removal sampling episodes (Appendix A). Some chemical constituents that increased during the post-source removal sampling, were degradation products of PCE (1,2-DCE and vinyl chloride). The concentrations of SVOCs during the post-source removal sampling generally decreased as compared to the concentrations during the pre-source removal sampling (Appendix B).

A comparison of Figure 4 from the January 2000 sampling event and Figure 4 from the June 2000 sampling event highlights the improvements in groundwater quality that have occurred following the removal of the source. A comparison of key wells with concentrations above standards shows:

- OW-2 - A 21% decrease in chlorinated compounds (1,2-DCE, TCE, PCE); vinyl chloride was not detected in June
- OW-6 - A decrease in PCE (33%) and 1,2-DCE (67%); 1,2-DCE was below the standard in June
- OW-5 - A decrease in PCE (87%), TCE (72%), and 1,2-DCE (81%); PCE and TCE decreased to below the standards
- MW-4 - A 30% decrease in benzene
- OW-13 - A decrease (600 to 200 ug/L) in benzene (67%)

- OW-21 - An increase in benzene (42%) and a decrease in the total compounds detected

- OW-22 - A decrease in benzene (70%) and the total compounds detected

- OW10R - A decrease in benzene (400 to 130 ug/L) (68%)

- OW-15 - Benzene decreased (9%) to below the standard

- OW-18 - A decrease in benzene (14%)

- OW-19 - A decrease in benzene (38%)

Although the observations above are based on the first two rounds of sampling data only, these decreases are encouraging, and consistent with the predicted response to the source removal and ongoing natural attenuation. As indicated by OW-21, some variation in the trends can be expected, but over time, the concentrations will continue to decrease to below regulatory standards.

The groundwater chemical analyses and other parameters provide evidence that natural attenuation is occurring within the groundwater plume.

The evidence of ongoing natural attenuation processes, includes:

- The reduction of VOC and SVOC concentrations.

- The presence of 1,2-DCE, chloroethane, and vinyl chloride, degradation products of tetrachloroethene and trichloroethene

- The presence of ethene/ethane and methane, which are the ultimate degradation products of chlorinated VOCs

- Elevated chloride concentrations in and downgradient of impacted zones, evidence of the release of chloride associated with the degradation of chlorinated VOCs

- DO and redox values that indicate reductive dechlorination can occur

Specifically, in addition to an overall decrease in VOCs and SVOCs in most wells, there are several lines of evidence that natural attenuation is occurring. First, the continued presence of natural attenuation degradation products during this sampling episode, specifically 1,2-DCE and vinyl chloride, indicating that the

PCE is degrading into it's daughter products. Second, the presence of ethane and ethene, which are the degradation products of vinyl chloride, were detected in wells with relatively higher concentrations of vinyl chloride. Third, elevated chloride concentrations are indicative of reductive chlorination, during which chlorides are released. The areas of relatively high chloride concentrations (relative to background) were measured downgradient of each of the lagoon areas.

Before source removal, natural attenuation of waste constituents dissolved in groundwater helped to retard or contain the contaminant plume. However, chemicals continued to dissolve from the waste materials, and the contaminant plume did not shrink. Now that source materials have been removed, chemical concentrations in groundwater will continue to decrease as a result of natural attenuation.

Low concentrations of the VOC methylene chloride were detected in surface water samples collected from Gold Creek. These concentrations are qualified "J," as an estimated concentration below the reporting limit.

Low concentrations of VOCs were detected in sediment samples from Gold Creek, including 2-butanone, acetone, toluene, and methylene chloride. Acetone and 2-butanone are common laboratory contaminants and acetone was found in the sediment sampling equipment blank. This is the first occurrence of toluene and methylene chloride in sediment samples. The concentrations are all "J"-qualified, designating an estimated concentration below the method reporting limit, or "B"-qualified, indicating possible laboratory contamination. The SVOCs bis(2-ethylhexyl)phthalate and 4-methylphenol were detected in the sediment samples from this sampling event. The SVOC concentrations are all "J"-qualified.

# 5.0 Recommendations

It is recommended that the groundwater, surface water, and sediment sampling program continue on a semiannual basis, as outlined in the approved work plan. The next sampling event is scheduled for March 2001.

Evaluation of analytical data will continue to determine the effect of source removal on groundwater and document the effectiveness of natural attenuation.

# 6.0 References

Blasland, Bouck, and Lee, Inc., 1992, *Preliminary Remedial Investigation Results, Carroll & Dubies Site*, Port Jervis, New York.

Remediation Technologies, Inc., 1995, *Addendum to Supplemental Hydrogeologic Remedial Investigation: Results of Field Investigation at the Carroll and Dubies Site During April, 1995.*

Shield Environmental Associates Inc., 1998, *Field Sampling and Analysis Plan Addendum, Carroll & Dubies Superfund Site*, Town of Deerpark, Orange County, New York.

Shield Environmental Associates Inc., 1998a, *Final Remedial Design Work Plan Addendum, Carroll & Dubies Superfund Site*, Town of Deerpark, Orange County, New York.

Shield Environmental Associates Inc., 1998b, *Quality Assurance Project Plan Addendum, Carroll & Dubies Superfund Site*, Town of Deerpark, Orange County, New York.

Shield Environmental Associates Inc., 1998c, *Remedial Action Work Plan, Carroll & Dubies Superfund Site*, Town of Deerpark, Orange County, New York.

Shield Environmental Associates, Inc., 1999, *Semiannual Monitoring Report, February 1999, Carroll and Dubies Superfund Site*, Town of Deerpark, Orange County, New York.

Shield Environmental Associates, Inc., 2000, *Remedial Action Report, Carroll & Dubies Superfund Site,* Town of Deerpark, Orange County, New York.

Shield Environmental Associates, Inc., 2000a, *Semiannual Monitoring Report, January 2000, Carroll & Dubies Superfund Site,* Town of Deerpark, Orange County, New York.

U.S. Environmental Protection Agency, 1999, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, OSWER Directive No. 92004-17P.

Weidermeirer, Todd H., J.T. Wilson, and D.H. Kampbell, 1996, *Natural Attenuation of Chlorinated Aliphatic Hydrocarbons at Plattsburgh Air Force Base, New York*, presented at the 1996 Symposium on Natural Attenuation of Chlorinated Organics in Groundwater, EPA/540/R-96/509.

# Tables

# Table 1
## Groundwater Field Parameters
## June 2000
## Carroll and Dubies Superfund Site
## Town of Deerpark, Orange County, New York

| Well ID | Date | Temperature (oC) | pH (standard units) | Specific Conductance (umhos/cm) | Turbidity (nephelometric turbidity units) |
|---|---|---|---|---|---|
| MW-1 | 06/06/00 | 10.79 | 6.31 | 333 | 135.7 |
| MW-4 | 06/06/00 | 11.52 | 6.54 | 1,449 | 3.2 |
| OW-2 | 06/06/00 | 11.80 | 5.75 | 232 | 0.8 |
| OW-5 | 06/07/00 | 11.68 | 6.03 | 708 | 626 |
| OW-6 | 06/07/00 | 12.17 | 6.09 | 140 | 1.2 |
| OW-8 | 06/07/00 | 10.52 | 6.70 | 195 | 4.7 |
| OW-10R | 06/06/00 | 10.81 | 6.62 | 776 | 6.1 |
| OW-13 | 06/07/00 | 11.68 | 6.44 | 654 | 1.0 |
| OW-15 | 06/06/00 | 11.71 | 6.36 | 374 | 5.1 |
| OW-16 | 06/07/00 | 10.18 | 5.87 | 257 | 2.7 |
| OW-18 | 06/08/00 | 12.56 | 6.45 | 831 | 7.1 |
| OW-19 | 06/08/00 | 12.23 | 6.45 | 497 | 11.1 |
| OW-21 | 06/07/00 | 12.04 | 6.47 | 668 | 0.9 |
| OW-22 | 06/07/00 | 12.14 | 6.42 | 725 | 0.9 |

# Table 2
## Natural Attenuation Parameters
## June 2000
## Carroll and Dubies Superfund Site
## Town of Deerpark, Orange County, New York

| Well ID | Date | Alkalinity (mg/L) | Chloride (mg/L) | Dissolved Oxygen (mg/L) | Ferrous Iron (mg/L) | Nitrate (mg/L) | Redox (mV) | Sulfate (mg/L) | Sulfide (mg/L) | TOC (mg/L) | Ethane (ug/L) | Ethene (ug/L) | Methane (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-1 | 06/06/00 | 100 | 48 | -1.83 | <0.050 | 4.1 | 171.6 | 15 | <1.0 | 2 | <0.50 | <0.50 | 76 D,B |
| MW-4 | 06/06/00 | 200 | 250 | 0.02 | 8.9 | 0.3 | 19.5 | 40 | <0.50 | 4 | <0.50 | <0.50 | 1,100 D,B |
| OW-2 | 06/06/00 | 46 | 12 | 0.26 | <0.050 | 4.4 | 303.3 | 33 | <1.0 | 1 | <0.50 | <0.50 | 0.51 B |
| OW-5 | 06/07/00 | 96 | 170 | 0.32 | 3.8 | 1.6 | 118.2 | 68 | 5.9 | 1 | <0.50 | <0.50 | 17 |
| OW-6 | 06/07/00 | 46 | 43 | 1.05 | <0.050 | 0.2 | 222.9 | 20 | <0.50 | <1 | <0.50 | <0.50 | 1.5 |
| OW-8 | 06/07/00 | 63 | 120 | 0.04 | 12.1 | <0.1 | -21.5 | 13 | <0.50 | <1 | <0.50 | <0.50 | 3.1 |
| OW-10R | 06/06/00 | 320 | 230 | -0.08 | 43.6 | <0.1 | -42.6 | 48 | <0.50 | 6 | 0.97 | 0.81 | 1,700 D |
| OW-13 | 06/07/00 | 280 | 270 | 0.59 | 12.7 | <0.1 | 2.5 | 26 | <1.0 | 6 | 1.5 | 7.1 | 1,200 D |
| OW-15 | 06/06/00 | 120 | 110 | -0.09 | 59.2 | <0.1 | -16.0 | 16 | <0.50 | 4 | 1.0 | <0.50 | 3,200 D |
| OW-16 | 06/07/00 | 72 | 5 | 1.72 | <0.050 | 2.6 | 232.6 | 28 | <1.0 | <1 | <0.50 | <0.50 | 8.7 |
| OW-18 | 06/08/00 | 320 | 120 | 0.35 | 34.3 | <0.1 | -36.8 | 5 | <0.50 | 11 | <0.50 | <0.50 | 1,100 D |
| OW-19 | 06/08/00 | 180 | 120 | 0.27 | 30.1 | <0.1 | -22.7 | 13 | <0.50 | 5 | 0.17 J | 0.15 J | 720 D |
| OW-21 | 06/07/00 | 200 | 310 | 0.47 | 25.3 | <0.1 | 4.7 | 49 | <1.0 | 3 | 0.32 J | 0.24 J | 200 |
| OW-22 | 06/07/00 | 300 | 150 | 0.50 | 69.5 | <0.1 | -34.8 | 6 | <0.50 | 8 | 3.2 | 0.32 J | 1,900 D |

**Notes:**

D = Result was obtained from the analysis of a dilution
TOC = Total organic carbon
< = Analyte not detected at method reporting limit
B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.
J = Estimated result; result is less than the reporting limit
NFD = No field duplicate

## Table 3
## Groundwater and Surface Water Elevation Data - June 5, 2000
## Carroll and Dubies Superfund Site
## Town of Deerpark, Orange County, New York

| Well No. | Top of Casing Elevation or Gauge Staff | Screened Interval | Depth to Groundwater or Surface Water | Groundwater or Surface Water Elevation |
|---|---|---|---|---|
| MW-1 | 469.39 | 28.5 - 43.5 | 32.94 | 436.45 |
| MW-4 | 470.13 | 35.3 - 50.3 | 38.41 | 431.72 |
| OW-2 | 472.33 | 30.0 - 47.0 | 40.72 | 431.61 |
| OW-3 | 472.70 | 30.0 - 46.5 | 41.46 | 431.24 |
| OW-4 | 473.33 | 26.5 - 27.5 | 35.37 | 437.96 |
| OW-5 | 459.85 | 25.5 - 45.5 | 28.35 | 431.50 |
| 0W-6 | 464.40 | 31.4 - 51.4 | 32.85 | 431.55 |
| OW-7 | 459.31 | 24.5 - 34.5 | 27.99 | 431.32 |
| OW-8 | 464.63 | 34.6 - 54.6 | 32.98 | 431.65 |
| OW-9 | 472.91 | 25.3 - 35.3 | 30.01 | 442.90 |
| OW-10R | 469.27 | 29.0 - 39.0 | 30.09 | 439.18 |
| OW-13 | 458.00 | 24.8 - 34.8 | 26.70 | 431.30 |
| OW-15 | 472.05 | 22.0 - 32.0 | 12.29 | 459.76 |
| OW-16 | 453.90 | 18.0 - 28.0 | 22.85 | 431.05 |
| OW-17 | 447.18 | 11.0 - 21.0 | 16.11 | 431.07 |
| OW-18 | 444.57 | 11.0 - 21.0 | 13.68 | 430.89 |
| OW-19 | 438.69 | 5.0 - 15.0 | 8.14 | 430.55 |
| OW-21 | 467.46 | 37.1 - 47.1 | 36.50 | 430.96 |
| OW-22 | 467.10 | 38.0 - 48.0 | 36.16 | 430.94 |
| OW-23 | 444.73 | 29.0 - 39.0 | 13.83 | 430.90 |
| SW-1 | 432.06 | - | 1.33 | 430.73 |
| SW-2 | 432.03 | - | 1.25 | 430.78 |
| SW-3 | 440.10 | - | 3.00 | 437.10 |

**Notes:**

Top of casing and gauge staff elevations surveyed by Maser Consulting P.A.

Data reported in feet; elevations relative - mean sea level; 1988 National Geodetic Vertical Datum

## Table 4
## Summary of Detected TCL Volatile Organic Compounds in Groundwater (ug/L)
## Carroll and Dubies Superfund Site
## Town of Deerpark, Orange County, New York

| Compound | NYSDEC SGV (ug/L) | U.S. EPA MCL (ug/L) | MW-1 06/06/00 | MW-4 06/06/00 | MW-4D 06/06/00 | OW-2 06/06/00 | OW-5 06/07/00 | OW-6 06/07/00 | OW-8 06/07/00 | OW-10R 06/06/00 | OW-13 06/07/00 | OW-15 06/06/00 | OW-16 06/07/00 | OW-18 06/08/00 | OW-19 06/08/00 | OW-21 06/07/00 | OW-22 06/07/00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Benzene | 1 (S) | 5 | 0.57 J | 4.8 | 5.7 | <3.3 | 0.91 J | <1.0 | <1.0 | 130 J | 200 | 0.91 J | <1.0 | 4.8 | 2.3 | 5.4 | 11 |
| Chlorobenzene | 5 (S)* | 100 | 0.30 J | 0.20 J | 0.22 J | <3.3 | 0.19 J | <1.0 | <1.0 | 3.0 J | 0.84 J | 0.60 J | <1.0 | 4.6 | 5.2 | <1.0 | 5.8 |
| Chloroethane | 5 (S)* | NA | <2.0 | <2.0 | <2.0 | <6.7 | <2.0 | <2.0 | <2.0 | <10 | <17 | <2.0 | <2.0 | 1.3 J | 1.9 J | <2.0 | <2.0 |
| 1,1-Dichloroethane | 5 (S)* | NA | <1.0 | 0.11 J | 0.10 J | <3.3 | <1.0 | <1.0 | <1.0 | <5.0 | <8.3 | 0.28 J | <1.0 | 0.24 J | <1.0 | <1.0 | <1.0 |
| 1,2-Dichloroethene (total) | 5 (S)* | 70 | <1.0 | 3.8 | 4.3 | 99 | 7.3 | 2.2 | <1.0 | <5.0 | 15 | <1.0 | <1.0 | <1.0 | 1.0 | <1.0 | <1.0 |
| Ethylbenzene | 5 (S)* | 700 | <1.0 | <1.0 | <1.0 | <3.3 | <1.0 | <1.0 | <1.0 | 2.2 J | 5.5 J | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| Tetrachloroethene | 5 (S)* | 5 | <1.0 | 0.30 J | 0.35 J | 80 | 2.4 | 14 | <1.0 | <5.0 | <8.3 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| Toluene | 5 (S)* | 1,000 | <1.0 | <1.0 | <1.0 | <3.3 | <1.0 | <1.0 | <1.0 | 0.52 J | <8.3 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| Trichloroethene | 5 (S)* | 5 | <1.0 | <1.0 | <1.0 | 19 | 1.7 | 2.6 | <1.0 | <5.0 | <8.3 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| Vinyl Chloride | 2 (S) | 2 | <2.0 | 0.18 J | 0.21 J | <6.7 | <2.0 | <2.0 | <2.0 | 2.2 J | 17 | 1.0 J | <2.0 | <2.0 | <2.0 | 0.54 J | <1.0 |
| Xylenes (Total) | 5 (S)* | 10,000 | <1.0 | <1.0 | <1.0 | <3.3 | <1.0 | <1.0 | <1.0 | <5.0 | <8.3 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | 1.4 |

**Notes:**

TCL = Target Compound List

NYSDEC SGV = New York State Department of Environmental Conservation Standards (S) and Guidance (G) Values for groundwater

U.S. EPA MCL = United States Environmental Protection Agency Maximum Concentration Limit for drinking/groundwater

NA = Not applicable; no criteria specified

< = Analyte not detected at reporting limit

J = Estimated result; result is less than reporting limit

B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.

* = The principal organic contaminant (POC) standard for groundwater of 5 ug/L applies to this substance.

Red = Concentrations detected at or above regulatory limit

Blue = Analyte detected at less than regulatory limit, or analyte detected but no regulatory criteria specified.

# Table 5
## Summary of Detected TCL Semivolatile Organic Compounds in Groundwater
## Carroll and Dubies Superfund Site
## Town of Deerpark, Orange County, New York

| Compound | | Phenol | 1,2-Dichlorobenzene | 1,4-Dichlorobenzene | Naphthalene | 2-Methylnaphthalene | Diethyl phthalate | bis(2-Ethylhexyl)phthalate |
|---|---|---|---|---|---|---|---|---|
| **NYSDEC SGV (ug/L)** | | **1 (S)** | **5 (S) (a)** | **5 (S) (a)** | **10 (G)** | **NA** | **50 (G)** | **5 (S)** |
| **U.S. EPA MCL (ug/L)** | | **NA** | **600** | **75** | **NA** | **NA** | **NA** | **NA** |
| **Well ID** | **Sample Date** | **Compound Concentrations in ug/L** | | | | | | |
| MW-1 | 06/06/00 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| MW-4 | 06/06/00 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| MW-4D | 06/06/00 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| OW-2 | 06/06/00 | <10 | <10 | <10 | <10 | <10 | <10 | 5.7 J,B |
| OW-5 | 06/07/00 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| OW-6 | 06/07/00 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| OW-8 | 06/07/00 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| OW-10R | 06/06/00 | 3.6 J,B | 1.7 J | <10 | 6.6 J | 12 | 2.0 J | <10 |
| OW-13 | 06/07/00 | 1.2 J,B | <10 | <10 | 2.0 J | 1.9 J | 2.0 J | <10 |
| OW-15 | 06/06/00 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| OW-16 | 06/07/00 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| OW-18 | 06/08/00 | <10 | <10 | 1.2 J | <10 | <10 | <10 | <10 |
| OW-19 | 06/08/00 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| OW-21 | 06/07/00 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| OW-22 | 06/07/00 | 1.3 J,B | <10 | <10 | <10 | <10 | <10 | <10 |

**Notes:**

TCL = Target Compound List

NYSDEC SGV = New York State Department of Environmental Conservation Standards (S) and Guidance (G) Values for groundwater

U.S. EPA MCL = United States Environmental Protection Agency Maximum Concentration Limit for drinking/groundwater

S (a) = Sum of dichlorobenzenes 5 ug/L

NA = Not applicable; no criteria specified

< = Analyte not detected at method reporting limit

J = Analyte detected at less than the method reporting limit

B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.

Red = Concentration detected at or above regulatory limit

Blue = Concentration detected below regulatory limit or analyte detected but no regulatory criteria specified

## Table 6
## Parameters for Preliminary Monitored Natural Attenuation Screening

| Analyte | Concentration in Most Contaminated Zone | Interpretation |
|---|---|---|
| Oxygen | <0.5 mg/L | Tolerated; suppresses reductive dechlorination at higher concentrations |
| Oxygen | >1 mg/L | Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur |
| Nitrate | <1 mg/L | May compete with reductive pathway at higher concentrations |
| Iron (II) | >1 mg/L | Reductive pathway possible |
| Sulfate | <20 mg/L | May compete with reductive pathway at higher concentrations |
| Sulfide | >1 mg/L | Reductive pathway possible |
| Methane | >0.1 mg/L | Ultimate reductive daughter product |
| | >1 mg/L | Vinyl chloride accumulates |
| | <1 mg/L | Vinyl chloride oxidizes |
| Oxidation reduction potential | <50 mV against Ag/AgCl | Reductive pathway possible |
| pH | 5 < pH <9 | Tolerated range for reductive pathway |
| DOC | >20 mg/L | Carbon and energy source; drives dechlorination; can be natural or anthropogenic |
| Temperature | >20 degrees C | At T >20 degrees C, biochemical process is accelerated |
| Carbon dioxide | >2x background | Ultimate oxidative daughter product |
| Alkalinity | >2x background | Results from interaction of carbon dioxide with aquifer minerals |
| Chloride | >2x background | Daughter product of organic chlorine; compare chloride in plume to background conditions |
| Hydrogen | >1 nM | Reductive pathway possible; vinyl chloride may accumulate |
| Hydrogen | <1 nM | Vinyl chloride oxidized |
| Volatile fatty acids | >0.1 mg/L | Intermediates resulting from biodegradation of aromatic compounds; carbon and energy source |
| BTEX | >0.1 mg/L | Carbon and energy source; drives dechlorination |
| Perchloroethene | | Material released |
| Trichloroethene | | Material released or daughter product of perchloroethene |
| Dichloroethene | | Material released or daughter product of trichloroethene; if amount of cis-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene |
| Vinyl chloride | | Material released or daughter product of dichloroethenes |
| Ethene/Ethane | <0.1 mg/L | Daughter product of vinyl chloride/ethene |
| Chloroethane | | Daughter product of vinyl chloride under reducing conditions |
| 1,1,1-trichloroethane | | Material released |
| 1,1-dichloroethene | | Degradation product of 1,1,1-trichloroethane |

*Source: Weidermeier, et al., 1996*

# Table 7
# Detected TCL Volatile Organic Compounds in Surface Water (ug/L)
# Carroll and Dubies Superfund Site
# Town of Deerpark, Orange County, New York

| Analyte | | Benzene | Chloroethane | Methylene Chloride | Vinyl Chloride |
|---|---|---|---|---|---|
| NYSDEC SGV | | 1 (S) | 5 (S) | 5 (S) | 2 (S) |
| U.S. EPA MCL | | 5 | NA | NA | 2 |
| Sample ID | Date | | | | |
| SW-1 | 02/18/99 | <1.0 | <2.0 | <1.0 | <2.0 |
| | 01/04/00 | 0.19 J,B | 0.85 J | 0.15 J,B | 0.99 J |
| | 06/08/00 | <1.0 | <2.0 | <1.0 | <2.0 |
| SW-2 | 02/18/99 | <1.0 | <2.0 | <1.0 | <2.0 |
| | 01/04/00 | <1.0 | <2.0 | <1.0 | <2.0 |
| | 06/08/00 | <1.0 | <2.0 | <1.0 | <2.0 |

**Notes:**

TCL = Target Compound List

NYSDEC SGV = New York State Department of Environmental Conservation Standards (S) and Guidance (G) values for groundwater

U.S. EPA MCL = United States Environmental Protection Agency Maximum Concentration Limit for drinking/groundwater

NA = Not applicable; no criteria specified

< = Analyte not detected at reporting limit

J = Estimated result; result is less than reporting limit

B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.

Blue = Analyte detected at less than regulatory limit, or analyte detected but no regulatory criteria specified.

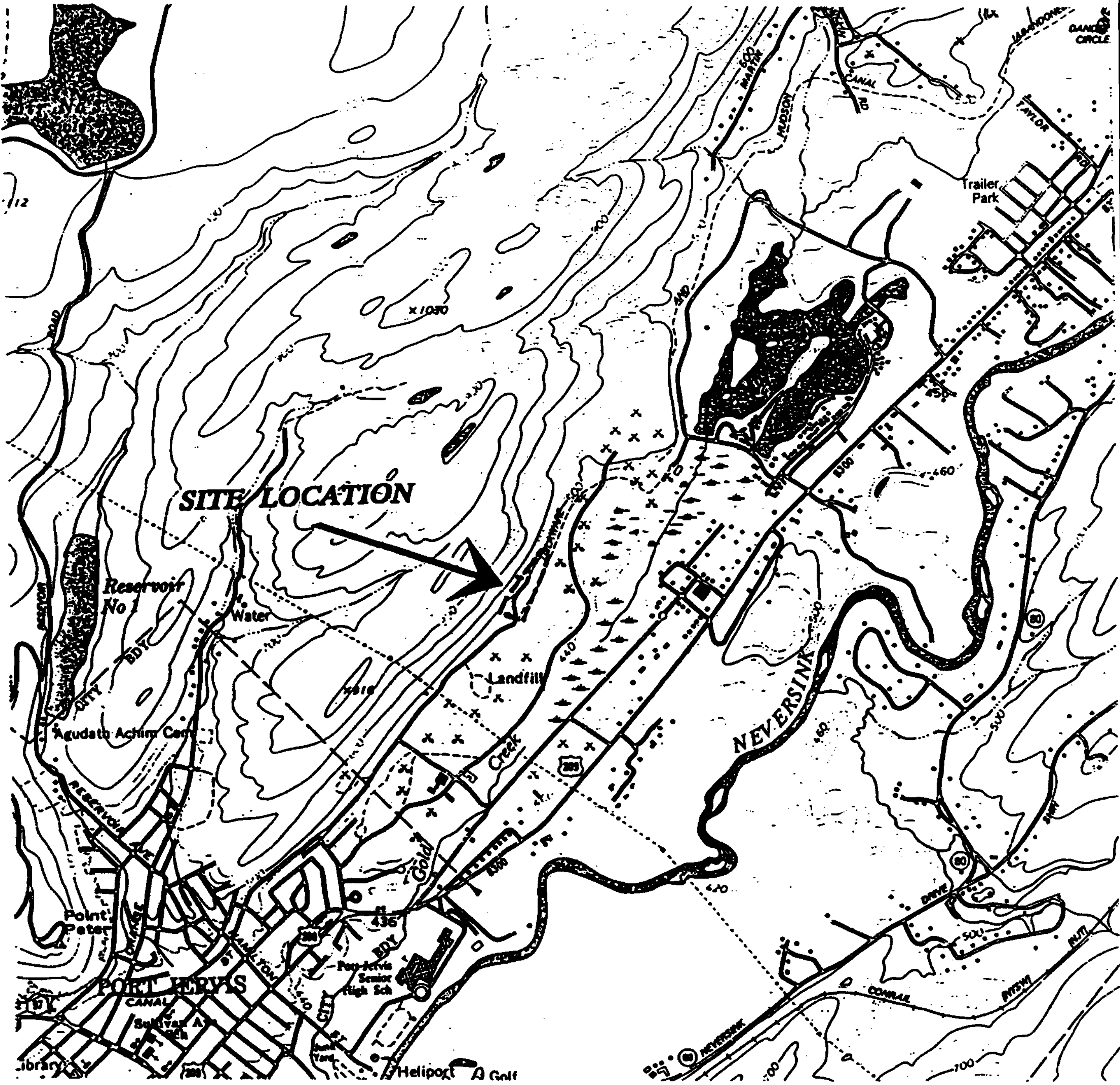
## Table 8

## Detected TCL Volatile and Semivolatile Organic Compounds in Sediment
## Carroll and Dubies Superfund Site
## Town of Deerpark, Orange County, New York

| Compound (Concentrations in ug/kg) | SED 1 09/27/94 | SED 1 02/18/99 | SED 1 01/04/00 | SED 1 06/08/00 | SED 2 09/27/97 | SED 2 02/18/99 | SED 2 01/04/00 | SED 2 / 2 DUP 06/08/00 |
|---|---|---|---|---|---|---|---|---|
| ***VOLATILE COMPOUNDS*** | | | | | | | | |
| 2-Butanone | <20 | <28 | 82 J | 17 J | <23 | 50 J | <220 | 49 J / <160 |
| Acetone | 58 | <28 | 370 | 60 J,B | 76 | 140 J | 180 J | 150 J / <160 |
| Vinyl Chloride | <20 | <14 | 6.9 J | <27 | <23 | <88 | <110 | <91 / <81 |
| Toluene | ND(1) | ND(1) | ND(1) | <13 | ND(1) | ND(1) | ND(1) | 13 J / <41 |
| ***SEMIVOLATILE COMPOUNDS*** | | | | | | | | |
| Di-n-butyl phthalate | 190 J,B | 77 J | <2,000 | <880 | 220 J,B | 370 J | <3,600 | <3,000 / <2,700 |
| bis(2-Ethylhexyl)phthalate | ND(1) | ND(1) | ND(1) | 590 J | ND(1) | ND(1) | ND(1) | 2,900 J / 1,500 J |
| 4-Methylphenol | ND(1) | ND(1) | ND(1) | <880 | ND(1) | ND(1) | ND(1) | 480 J,# / <2,700 |

**Notes:**
TCL = Target Compound List
< = Not detected at the method detection limit.
J = Estimated result; result is less than method reporting limit
B = Method blank contamination. The associated method blank contains the analyte at a reportable level.
ND(1) = Not detected prior to 06/08/00.
# = This value represents a probable combination of 3-methylphenol (m-cresol) and 6-methylphenol (p-cresol).

# Figures



– – – – Approximate Site Boundary

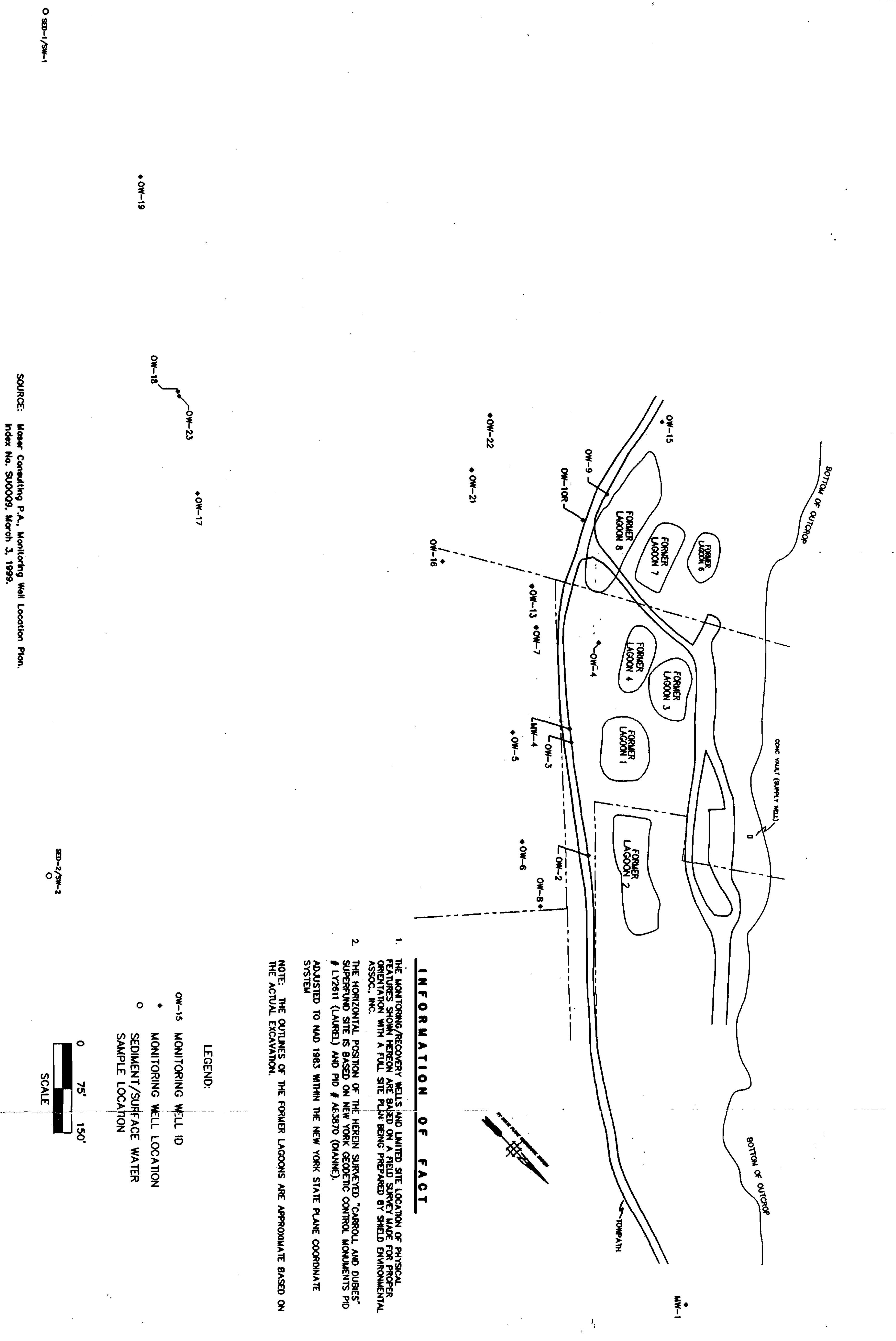
SOURCE: USGS Topographic Quadrangle Map
Port Jervis North Quadrangle - 1991

-N-

0 1,000' 2,000'
SCALE

| | |
|---|---|
| **DATE: 3/25/99** | FIGURE 1 |
| **DRAWN BY: P.D.H.** | SITE LOCATION MAP<br>CARROLL AND DUBIES SUPERFUND SITE<br>TOWN OF DEERPARK<br>ORANGE COUNTY, NEW YORK |
| **APPROVED BY: C.L.P.** | |
| **CLIENT NO.: 698-0110** | |

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA



SOURCE: Maser Consulting P.A., Monitoring Well Location Plan. Index No. SU0009, March 3, 1999.

**INFORMATION OF FACT**

1. THE MONITORING/RECOVERY WELLS AND LIMITED SITE LOCATION OF PHYSICAL FEATURES SHOWN HEREON ARE BASED ON A FIELD SURVEY MADE FOR PROPER ORIENTATION WITH A FULL SITE PLAN BEING PREPARED BY SHIELD ENVIRONMENTAL ASSOC., INC.
2. THE HORIZONTAL POSITION OF THE HEREIN SURVEYED "CARROLL AND DUBIES" SUPERFUND SITE IS BASED ON NEW YORK GEODETIC CONTROL MONUMENTS PID # LY2611 (LAUREL) AND PID # AE3870 (DIANNE). ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

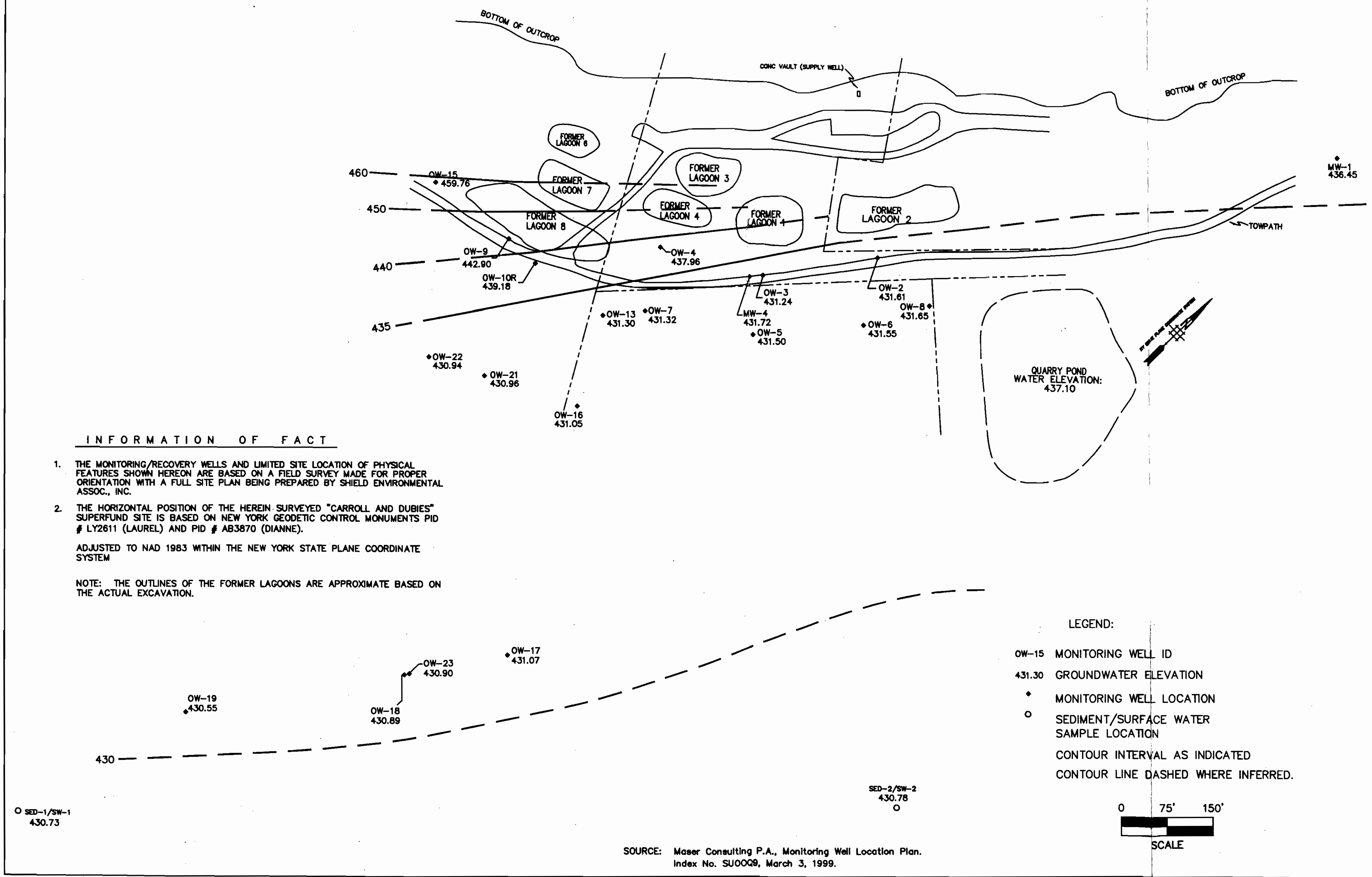
NOTE: THE OUTLINES OF THE FORMER LAGOONS ARE APPROXIMATE BASED ON THE ACTUAL EXCAVATION.

LEGEND:

OW-15 MONITORING WELL ID
◆ MONITORING WELL LOCATION
○ SEDIMENT/SURFACE WATER SAMPLE LOCATION

| | | |
|---|---|---|
| DATE: 04/05/00 | FIGURE 2<br>SITE PLAN/MONITORING WELL LOCATIONS<br>CARROLL AND DUBIES SUPERFUND SITE<br>TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK | *SHIELD*<br>ENVIRONMENTAL ASSOCIATES, INC.<br>PITTSBURGH, PENNSYLVANIA |
| DRAWN BY: P.D.H. | | |
| APPROVED BY: C.L.P. | | |
| CLIENT NO.: 698-0110 | | |

80110-10



## INFORMATION OF FACT

1. THE MONITORING/RECOVERY WELLS AND LIMITED SITE LOCATION OF PHYSICAL FEATURES SHOWN HEREON ARE BASED ON A FIELD SURVEY MADE FOR PROPER ORIENTATION WITH A FULL SITE PLAN BEING PREPARED BY SHIELD ENVIRONMENTAL ASSOC., INC.
2. THE HORIZONTAL POSITION OF THE HEREIN SURVEYED "CARROLL AND DUBIES" SUPERFUND SITE IS BASED ON NEW YORK GEODETIC CONTROL MONUMENTS PID # LY2611 (LAUREL) AND PID # AB3870 (DIANNE).

   ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

NOTE: THE OUTLINES OF THE FORMER LAGOONS ARE APPROXIMATE BASED ON THE ACTUAL EXCAVATION.

LEGEND:

| | |
|---|---|
| OW-15 | MONITORING WELL ID |
| 431.30 | GROUNDWATER ELEVATION |
| ◆ | MONITORING WELL LOCATION |
| ○ | SEDIMENT/SURFACE WATER SAMPLE LOCATION |
| | CONTOUR INTERVAL AS INDICATED |
| | CONTOUR LINE DASHED WHERE INFERRED. |

SOURCE: Maser Consulting P.A., Monitoring Well Location Plan. Index No. SU0009, March 3, 1999.

FIGURE 3

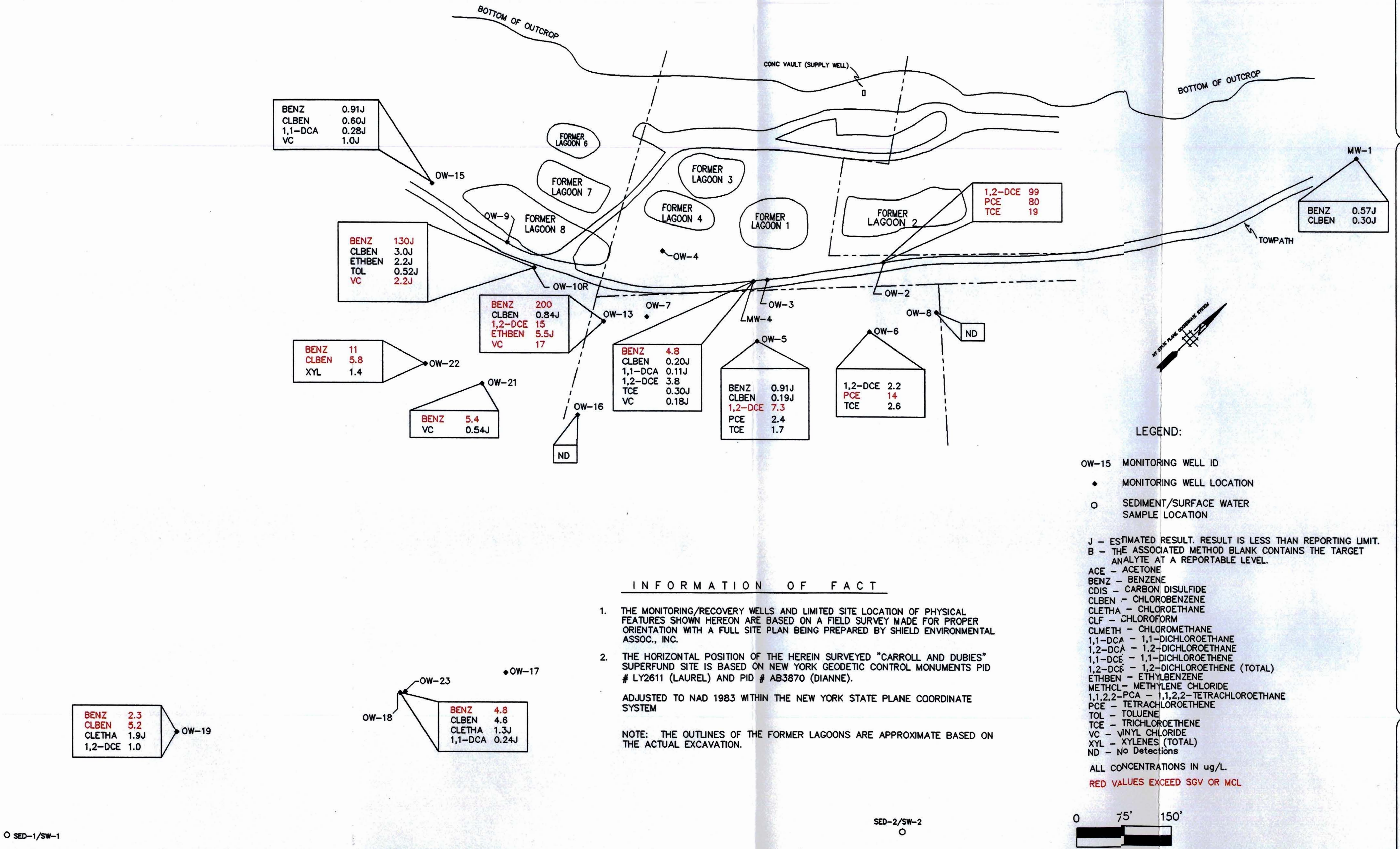
GROUNDWATER CONTOUR MAP – JUNE 5, 2000

CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK

*SHIELD*
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA

DATE: 07/26/00
DRAWN BY: P.D.H.
APPROVED BY: C.L.P.
CLIENT NO.: 698–0110

80110-10



LEGEND:

OW-15 MONITORING WELL ID

◆ MONITORING WELL LOCATION

○ SEDIMENT/SURFACE WATER SAMPLE LOCATION

J - ESTIMATED RESULT. RESULT IS LESS THAN REPORTING LIMIT.
B - THE ASSOCIATED METHOD BLANK CONTAINS THE TARGET ANALYTE AT A REPORTABLE LEVEL.
ACE - ACETONE
BENZ - BENZENE
CDIS - CARBON DISULFIDE
CLBEN - CHLOROBENZENE
CLETHA - CHLOROETHANE
CLF - CHLOROFORM
CLMETH - CHLOROMETHANE
1,1-DCA - 1,1-DICHLOROETHANE
1,2-DCA - 1,2-DICHLOROETHANE
1,1-DCE - 1,1-DICHLOROETHENE
1,2-DCE - 1,2-DICHLOROETHENE (TOTAL)
ETHBEN - ETHYLBENZENE
METHCL - METHYLENE CHLORIDE
1,1,2,2-PCA - 1,1,2,2-TETRACHLOROETHANE
PCE - TETRACHLOROETHENE
TOL - TOLUENE
TCE - TRICHLOROETHENE
VC - VINYL CHLORIDE
XYL - XYLENES (TOTAL)
ND - No Detections

ALL CONCENTRATIONS IN ug/L.

RED VALUES EXCEED SGV OR MCL

## INFORMATION OF FACT

1. THE MONITORING/RECOVERY WELLS AND LIMITED SITE LOCATION OF PHYSICAL FEATURES SHOWN HEREON ARE BASED ON A FIELD SURVEY MADE FOR PROPER ORIENTATION WITH A FULL SITE PLAN BEING PREPARED BY SHIELD ENVIRONMENTAL ASSOC., INC.
2. THE HORIZONTAL POSITION OF THE HEREIN SURVEYED "CARROLL AND DUBIES" SUPERFUND SITE IS BASED ON NEW YORK GEODETIC CONTROL MONUMENTS PID # LY2611 (LAUREL) AND PID # AB3870 (DIANNE).

ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

NOTE: THE OUTLINES OF THE FORMER LAGOONS ARE APPROXIMATE BASED ON THE ACTUAL EXCAVATION.

SOURCE: Maser Consulting P.A., Monitoring Well Location Plan
Index No. SUOOQ9, March 3, 1999.

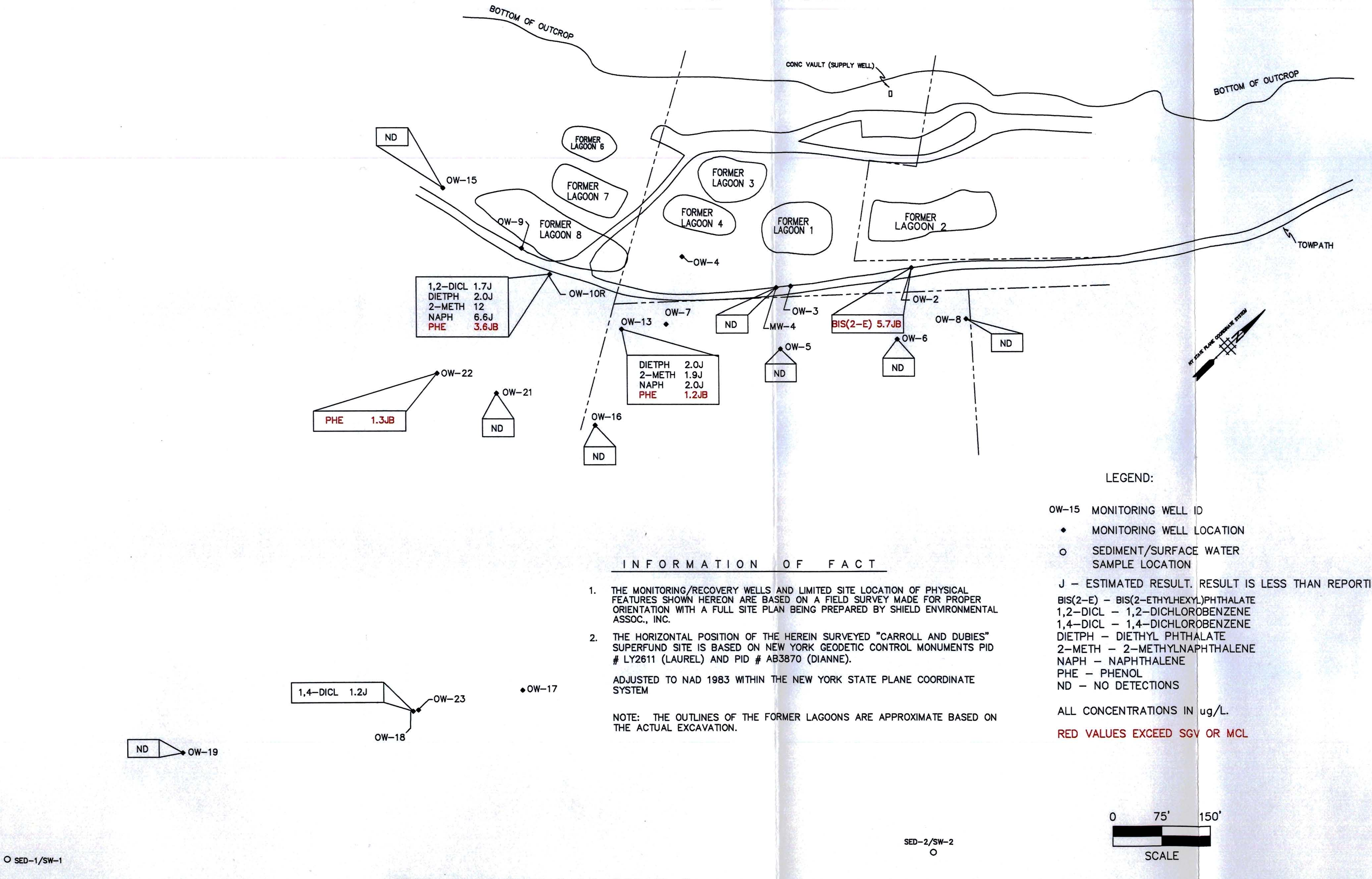
SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA

FIGURE 4
DETECTED VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER
JUNE 2000

CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK

DATE: 08/17/00
DRAWN BY: P.D.H.
APPROVED BY: C.P.
CLIENT NO.: 698-0110

80110-10



LEGEND:

OW-15 MONITORING WELL ID
◆ MONITORING WELL LOCATION
○ SEDIMENT/SURFACE WATER SAMPLE LOCATION

J – ESTIMATED RESULT. RESULT IS LESS THAN REPORTING LIMIT.
BIS(2-E) – BIS(2-ETHYLHEXYL)PHTHALATE
1,2-DICL – 1,2-DICHLOROBENZENE
1,4-DICL – 1,4-DICHLOROBENZENE
DIETPH – DIETHYL PHTHALATE
2-METH – 2-METHYLNAPHTHALENE
NAPH – NAPHTHALENE
PHE – PHENOL
ND – NO DETECTIONS

ALL CONCENTRATIONS IN ug/L.

RED VALUES EXCEED SGV OR MCL

## INFORMATION OF FACT

1. THE MONITORING/RECOVERY WELLS AND LIMITED SITE LOCATION OF PHYSICAL FEATURES SHOWN HEREON ARE BASED ON A FIELD SURVEY MADE FOR PROPER ORIENTATION WITH A FULL SITE PLAN BEING PREPARED BY SHIELD ENVIRONMENTAL ASSOC., INC.
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ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

NOTE: THE OUTLINES OF THE FORMER LAGOONS ARE APPROXIMATE BASED ON THE ACTUAL EXCAVATION.

SOURCE: Maser Consulting P.A., Monitoring Well Location Plan.
Index No. SUOOQ9, March 3, 1999.

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA

FIGURE 5

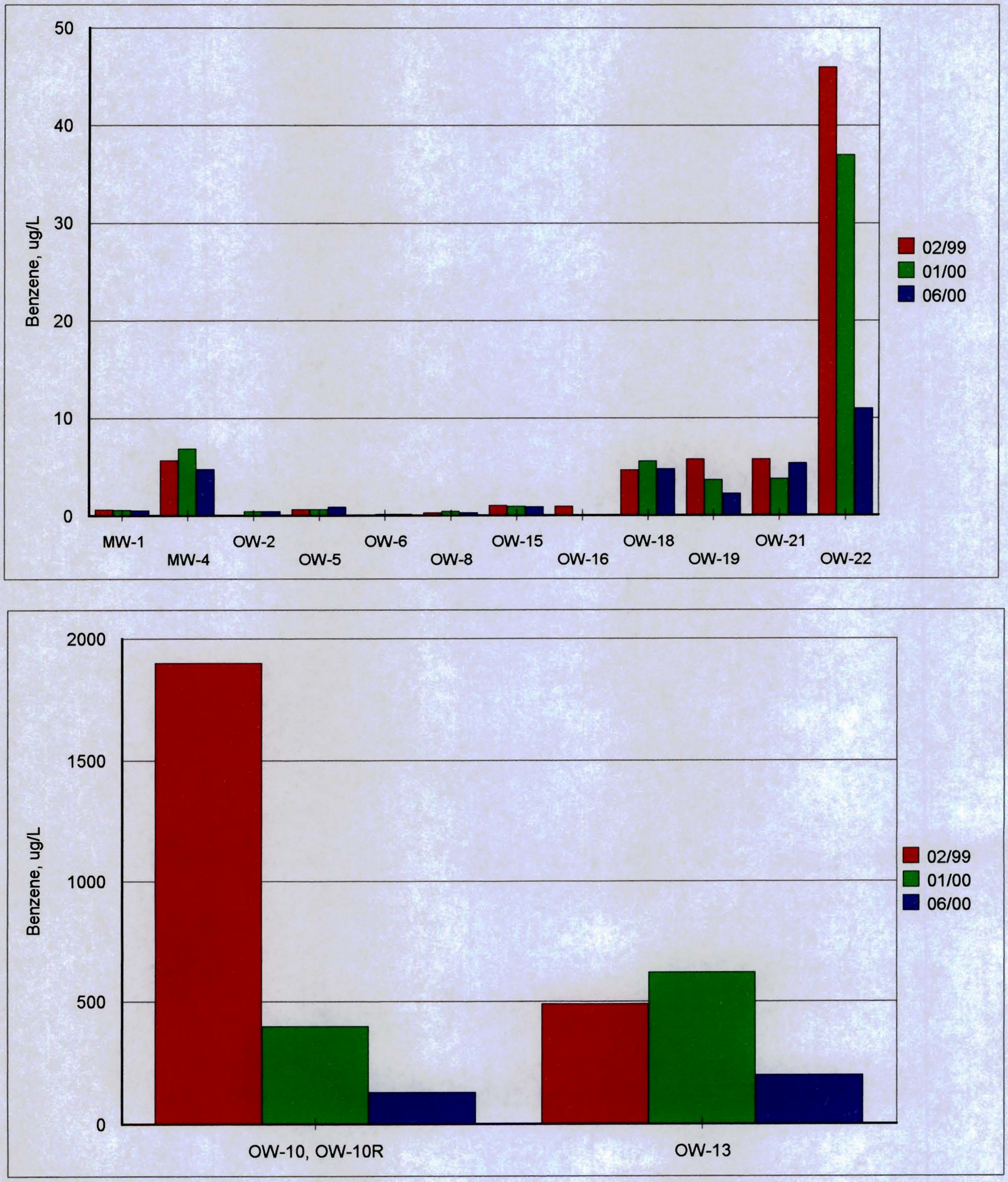
DETECTED SEMIVOLATILE ORGANIC COMPOUNDS IN GROUNDWATER
JUNE 2000

CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK

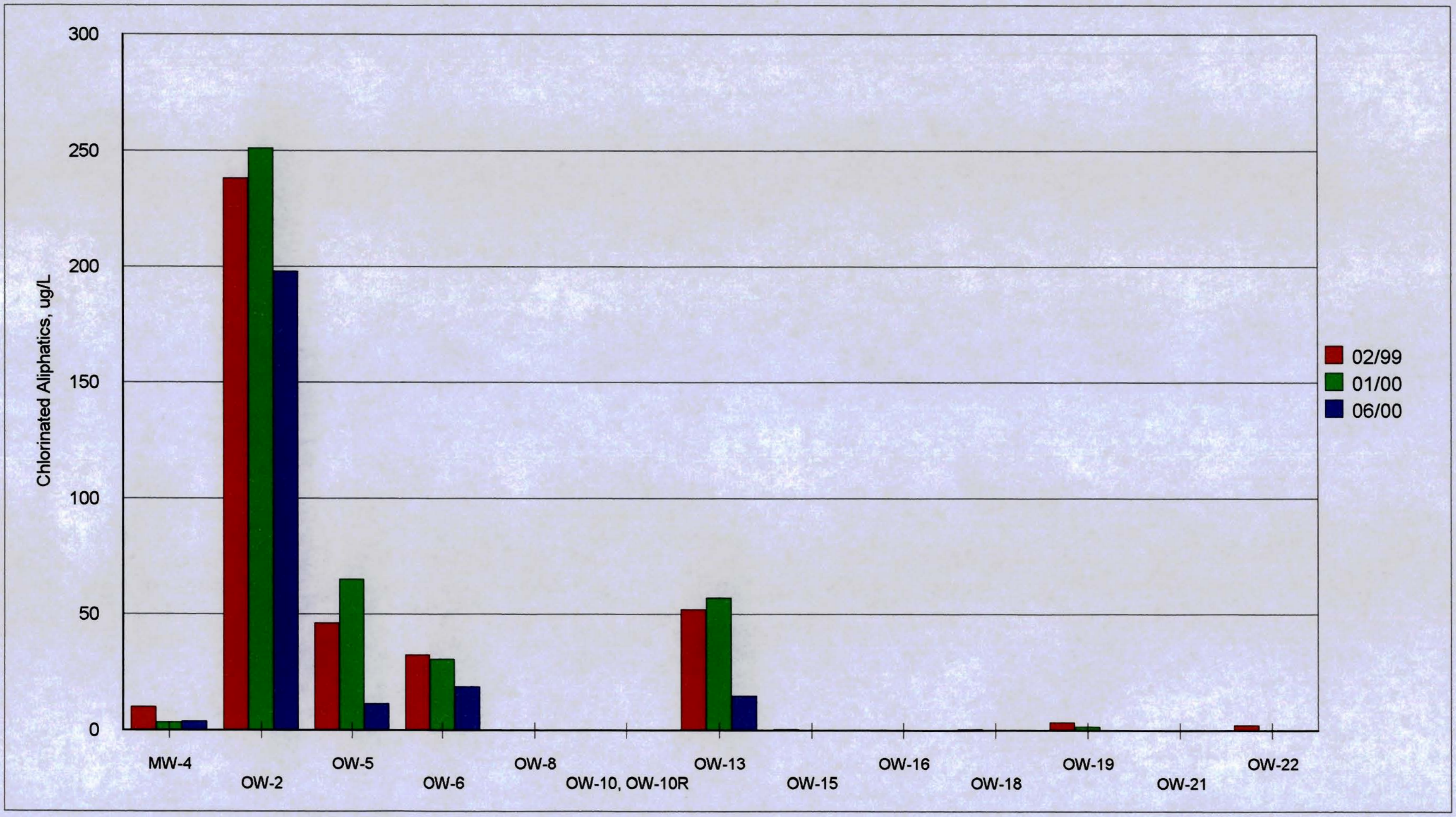
DATE: 07/26/00
DRAWN BY: P.D.H.
APPROVED BY: C.P.
CLIENT NO.: 698-0110

80110-10

# Figure 6
# A Comparison of Benzene Concentrations in Monitoring Network Wells, 1999 and 2000
# OW-10R, OW-13

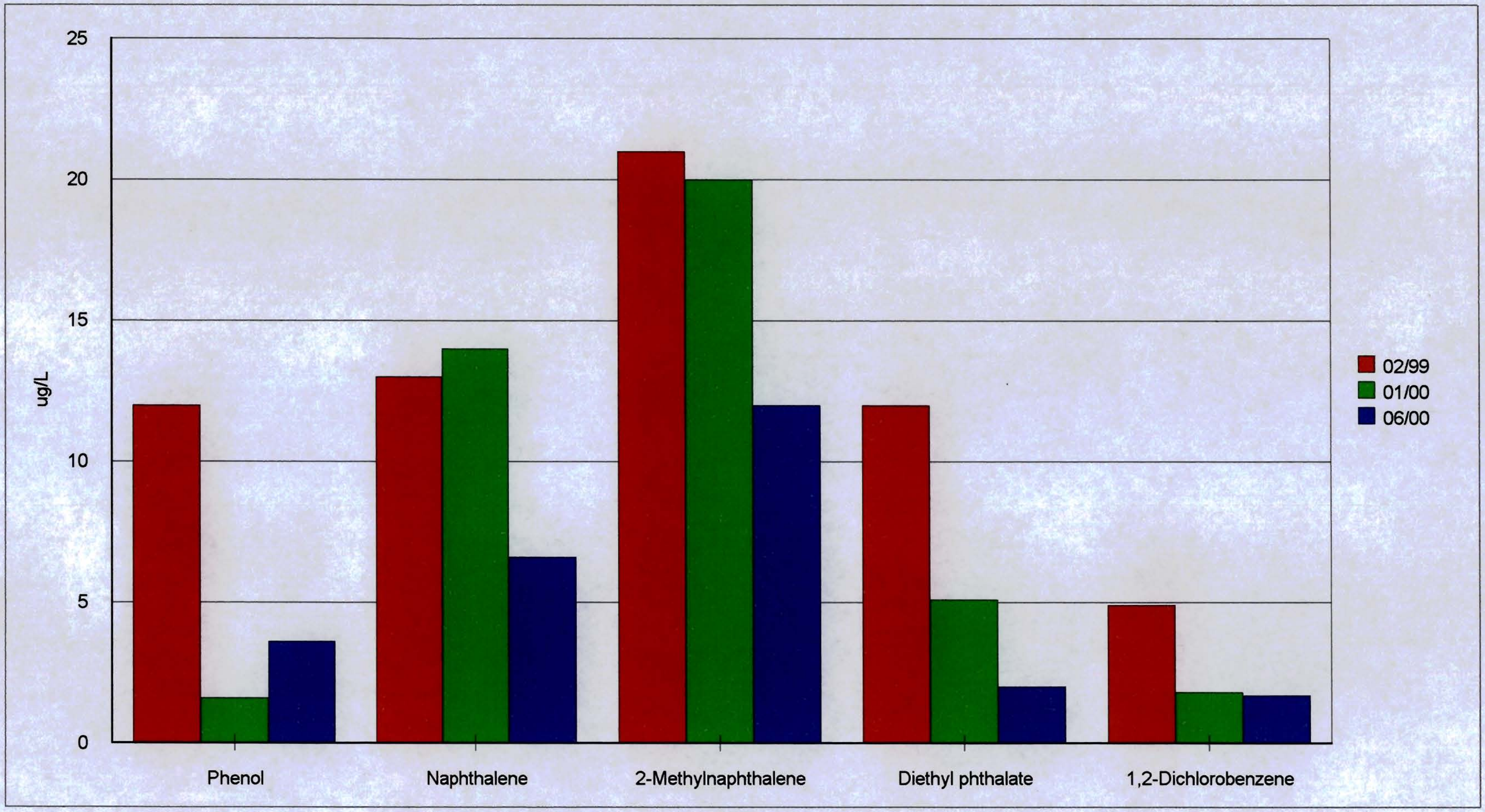


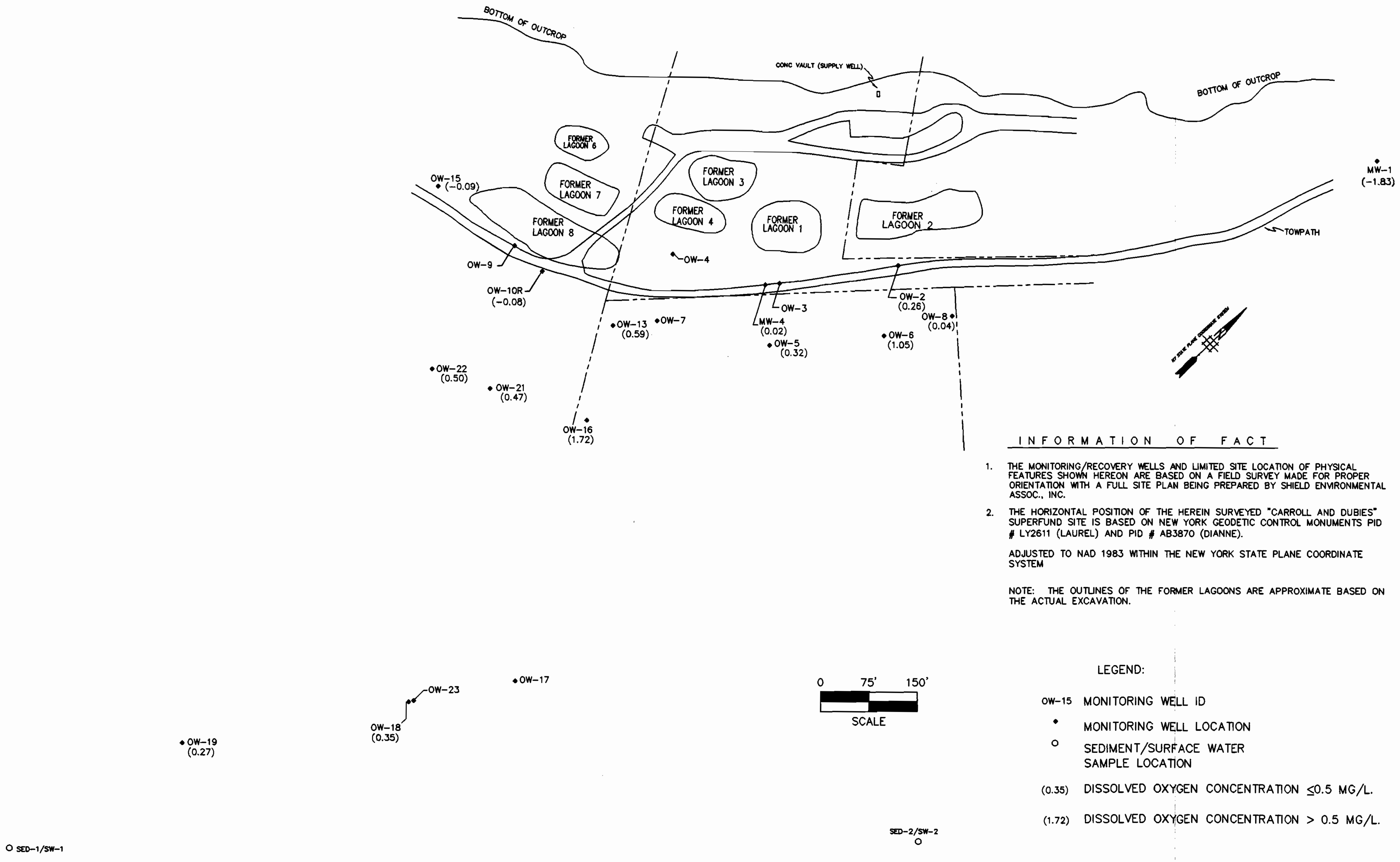
# Figure 7
# A Comparison of Representative(1) Chlorinated Aliphatic Concentrations in Monitoring Network Wells, 1999 and 2000



(1)Summation of detected 1,2-dichloroethene, trichloroethene, and tetrachloroethene

# Figure 8
# A Comparison of SVOC Concentrations in OW-10 and OW-10R, 1999 and 2000





## INFORMATION OF FACT

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ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

NOTE: THE OUTLINES OF THE FORMER LAGOONS ARE APPROXIMATE BASED ON THE ACTUAL EXCAVATION.

LEGEND:

| | |
|---|---|
| OW-15 | MONITORING WELL ID |
| ◆ | MONITORING WELL LOCATION |
| ○ | SEDIMENT/SURFACE WATER SAMPLE LOCATION |
| (0.35) | DISSOLVED OXYGEN CONCENTRATION ≤0.5 MG/L. |
| (1.72) | DISSOLVED OXYGEN CONCENTRATION > 0.5 MG/L. |

SOURCE: Maser Consulting P.A., Monitoring Well Location Plan.
Index No. SUOOQ9, March 3, 1999.

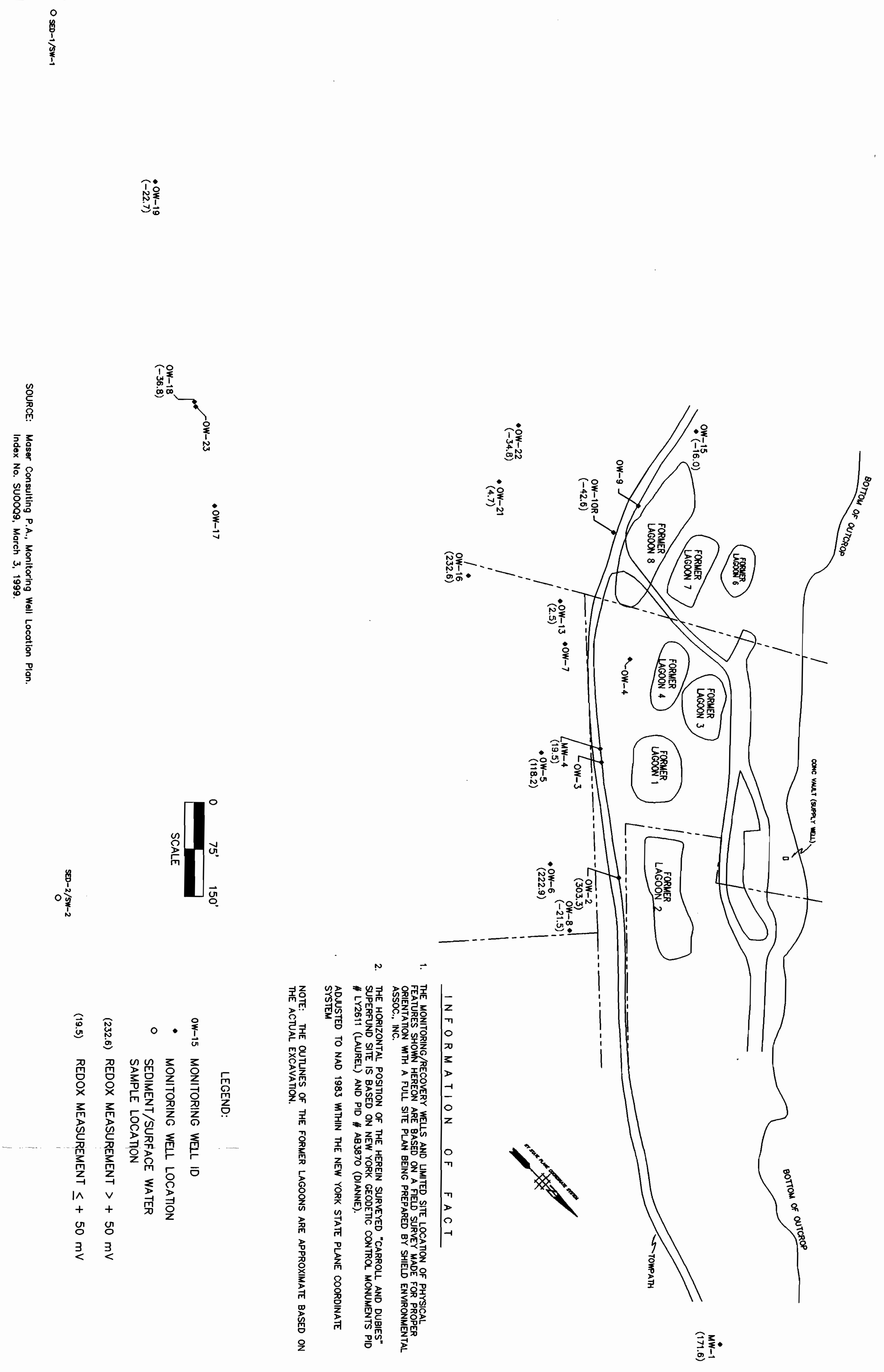
DATE: 07/27/00
DRAWN BY: P.D.H.
APPROVED BY: C.P.
CLIENT NO.: 698-0110

FIGURE 9

DISSOLVED OXYGEN MEASUREMENTS, JUNE 2000

CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA



SOURCE: Maser Consulting P.A., Monitoring Well Location Plan. Index No. SUOOO9, March 3, 1999.

### INFORMATION OF FACT

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ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

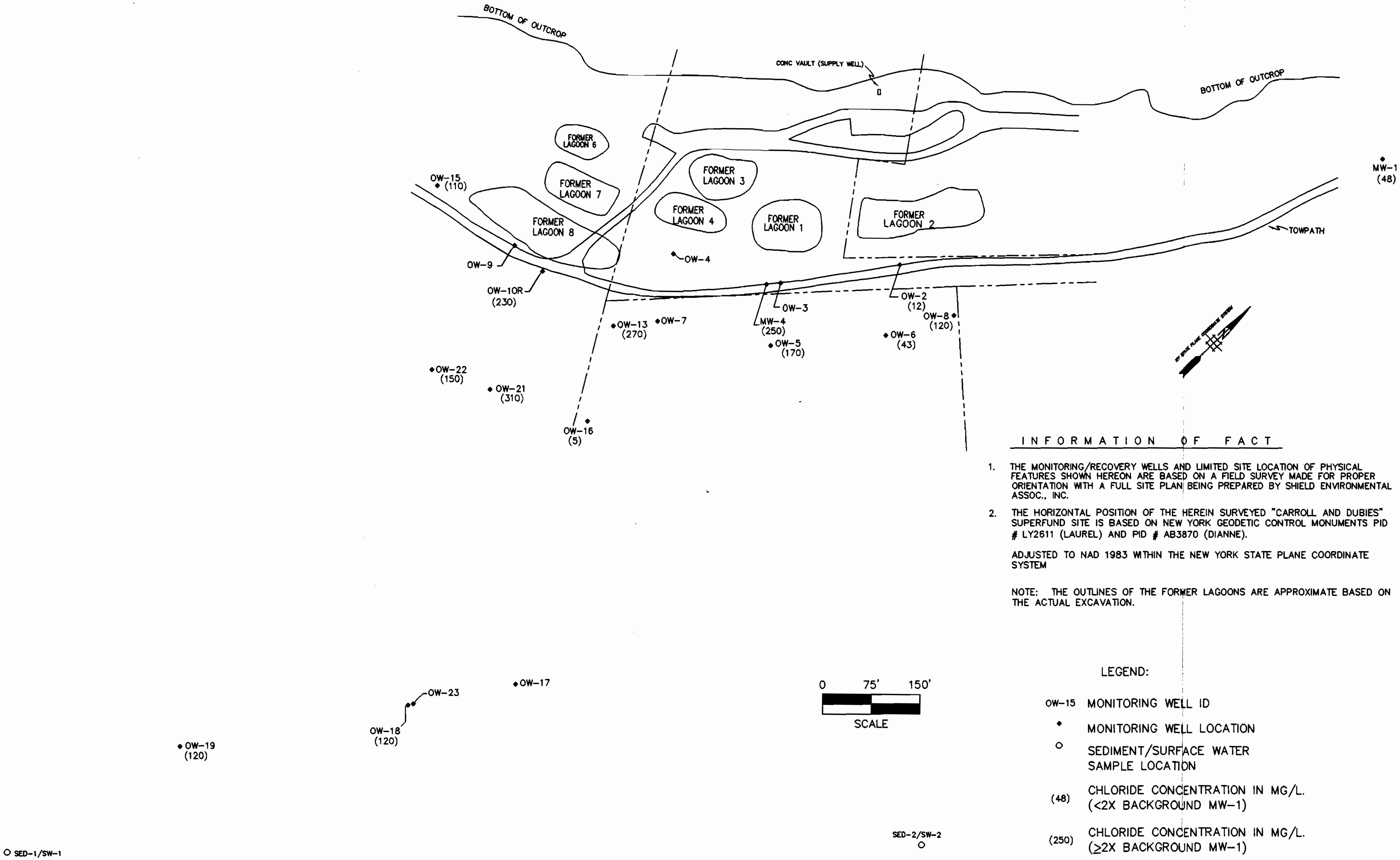
NOTE: THE OUTLINES OF THE FORMER LAGOONS ARE APPROXIMATE BASED ON THE ACTUAL EXCAVATION.

LEGEND:

OW-15 MONITORING WELL ID
◆ MONITORING WELL LOCATION
○ SEDIMENT/SURFACE WATER SAMPLE LOCATION
(232.6) REDOX MEASUREMENT > + 50 mV
(19.5) REDOX MEASUREMENT ≤ + 50 mV

| | | |
|---|---|---|
| DATE: 07/27/00 | FIGURE 10 | SHIELD |
| DRAWN BY: P.D.H. | REDOX MEASUREMENTS, JUNE 2000 | ENVIRONMENTAL ASSOCIATES, INC. |
| APPROVED BY: C.P. | CARROLL AND DUBIES SUPERFUND SITE | PITTSBURGH, PENNSYLVANIA |
| CLIENT NO.: 698-0110 | TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK | |

80110-11



SOURCE: Maser Consulting P.A., Monitoring Well Location Plan. Index No. SUOOQ9, March 3, 1999.

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   ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

NOTE: THE OUTLINES OF THE FORMER LAGOONS ARE APPROXIMATE BASED ON THE ACTUAL EXCAVATION.

LEGEND:

| | |
|---|---|
| OW-15 | MONITORING WELL ID |
| ◆ | MONITORING WELL LOCATION |
| ○ | SEDIMENT/SURFACE WATER SAMPLE LOCATION |
| (48) | CHLORIDE CONCENTRATION IN MG/L. (<2X BACKGROUND MW-1) |
| (250) | CHLORIDE CONCENTRATION IN MG/L. (≥2X BACKGROUND MW-1) |

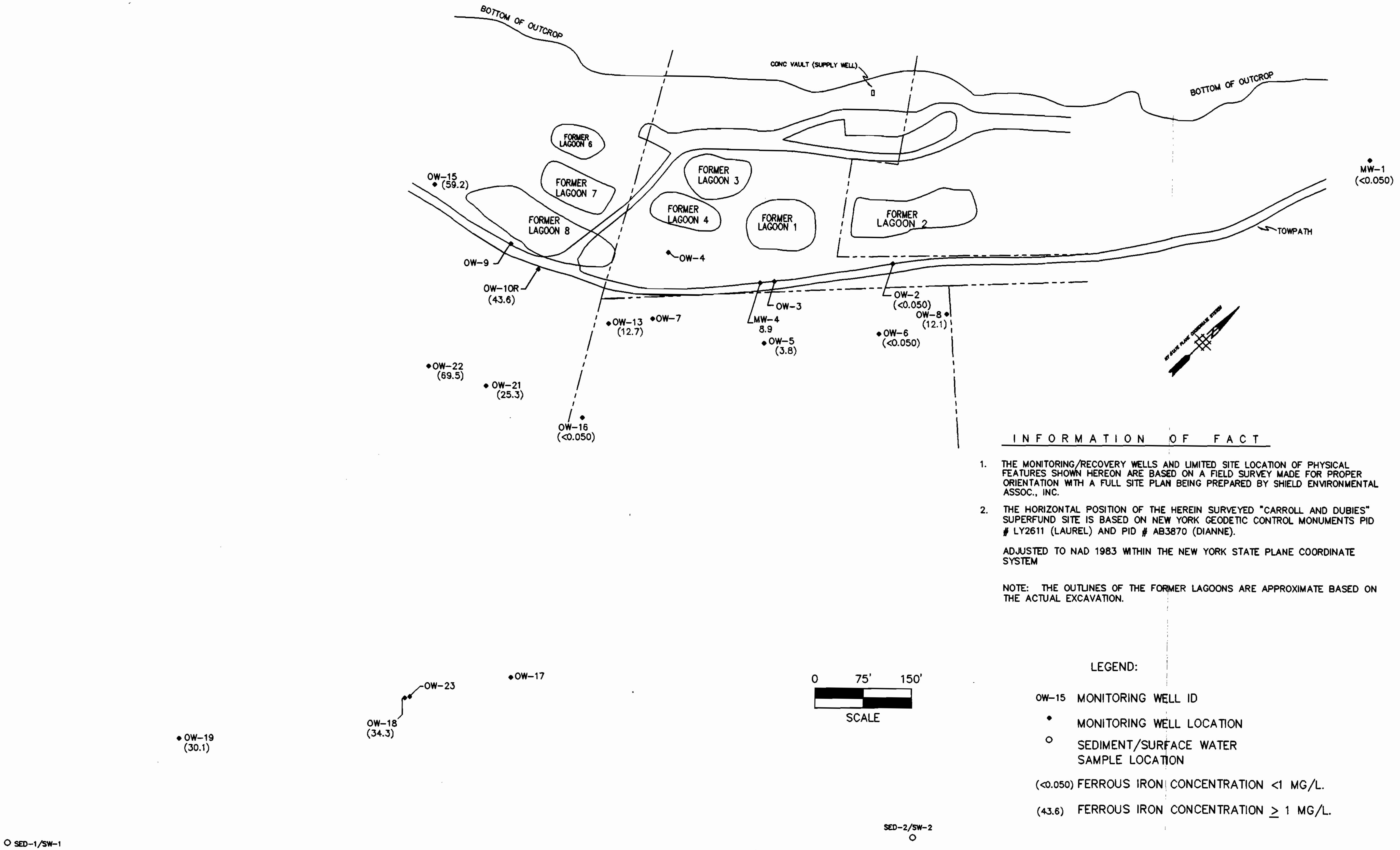
DATE: 07/27/00
DRAWN BY: P.D.H.
APPROVED BY: C.P.
CLIENT NO.: 698-0110

FIGURE 11

CHLORIDE MEASUREMENTS, JUNE 2000

CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK

*SHIELD*
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA



INFORMATION OF FACT

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ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

NOTE: THE OUTLINES OF THE FORMER LAGOONS ARE APPROXIMATE BASED ON THE ACTUAL EXCAVATION.

LEGEND:

| | |
|---|---|
| OW-15 | MONITORING WELL ID |
| ◆ | MONITORING WELL LOCATION |
| ○ | SEDIMENT/SURFACE WATER SAMPLE LOCATION |
| (<0.050) | FERROUS IRON CONCENTRATION <1 MG/L. |
| (43.6) | FERROUS IRON CONCENTRATION ≥ 1 MG/L. |

SOURCE: Maser Consulting P.A., Monitoring Well Location Plan. Index No. SU00Q9, March 3, 1999.

FIGURE 12

FERROUS IRON MEASUREMENTS, JUNE 2000

CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA

DATE: 07/27/00
DRAWN BY: P.D.H.
APPROVED BY: C.P.
CLIENT NO.: 698-0110

80110-11