FINAL

REMEDIAL INVESTIGATION

FOR

GENERAL INSTRUMENT CORPORATION

SHERBURNE, NEW YORK

Prepared for

GENERAL INSTRUMENT CORPORATION

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1.0 INTRODUCTION

This report presents the results of a remedial investigation at the General Instrument site in Sherburne, New York. The report is presented in seven chapters. Chapter 1 presents the site history and reviews previous work performed at the site. Chapter 2 discusses the preliminary conceptual model developed before the investigation began, and describes the tasks and methods which were implemented during the investigation. Chapter 3 describes the environmental setting (i.e, ecology, geology, hydrogeology) at the site. Chapter 4 presents the results of the field work and laboratory analysis. It is divided into two sections; the first part of Chapter 4 introduces the data, and the second part relates the data to the individual tasks described in the work plan. Chapter 5 identifies confirmed sources of contamination and discusses their transport and fate. Chapter 6 presents the results of the risk assessment, and Chapter 7 summarizes the results of the investigation.

1.1 Site History

In 1983, General Instrument Corporation implemented a plan to close their manufacturing and plating facility in Sherburne, New York. A closure plan consistent with RCRA regulations for decommissioning the plant was submitted to the New York State Department of Environmental Conservation (NYSDEC) in September 1984 and approved in October 1984. A copy of the "Engineering Report for Plant Closure" is found in Appendix M.

During plant closure, the presence of hazardous material on site required decontamination of the buildings and decommissioning of the manufacturing processes that used hazardous materials. On-site areas of possible environmental contamination were identified using the following criteria:

a. Discolored soil
b. Reported spill areas
c. Known waste storage areas
d Odor
e. Recorded areas of waste deposits

Following a screening process, possible sources of on-site contamination were concluded to be: (1) underground tanks: (2) contaminated soil along the west and south side of the property; and (3) contaminated soil in a section of a creek that runs through the property. Underground tanks were filled or removed, contaminated soils were excavated and disposed off site, and the creek was excavated and enclosed in a culvert.

A groundwater investigation was initiated in 1985 because of the detected contamination in the soil. A monthly sampling plan was implemented, during which monitoring wells were sampled between January 1985 and September 1986. The monthly groundwater sampling program revealed moderate but consistent concentrations of halogenated hydrocarbons and cyanide in the groundwater (Exhibit 9, Appendix K). As a result of the persistent groundwater problem, the General Instrument site was classified, in Consent Order #A701578810 (a copy of the consent order is found in Appendix J), an inactive hazardous waste site (Site #70901). In compliance with the consent order, Stearns & Wheler of Cazenovia, New York, was retained by General Instrument Corporation to prepare and execute a Remedial Investigation and Feasibility Study (RI/FS) at the site.

As part of the RI/FS, additional monitoring wells were installed, and soil and groundwater samples were collected. The objective of this Remedial Investigation was to evaluate the extent, source and fate of the remaining contamination in the soil and groundwater at the site, and to identify any populations potentially at risk.

1.2 Purpose of Report

The purpose of this report is to provide the results of the Remedial Investigation at the General Instrument site on TACO Street in Sherburne, New York. This report summarizes the results of the site characterization investigation and describes the geology and hydrogeology at the site. Because hazardous substances have been detected in the soil and groundwater on the site and have been found in monitoring wells off site, this report discusses the source, extent, transport and fate of these contaminants. Populations at risk are identified and a baseline risk assessment is also presented.

1.3 RI/FS Process

The basic components of the RI/FS process were formulated by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, generally known as Superfund. Superfund procedures were modified slightly in the Superfund Amendments and

Reauthorization Act (SARA) of 1986; however, the basic components of the RI/FS process remained the same. The purpose of the RI is to characterize the site and identify the source, extent, transport and fate of contamination. It is also through the RI that treatability screening is conducted and data are collected for the Feasibility Study. The FS is the mechanism for developing remedial technology and cleaning up the site. The guidelines for conducting the RI/FS (and used in this study) were those published in "Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA", EPA/540/G-89/004, OSWER Directive 9355.3-01, Interim Final, October 1988. The "Compendium of Superfund Field Operation Method", EPA/540/P-87/001, OSWER Directive 9355.0-14, December 1987, was also consulted for methodology.

These guidance documents emphasize that the RI/FS is an iterative process. Data collected during the RI is used to develop and screen remedial alternatives, which alternately may dictate additional data needs. This interactive feedback approach, called for in a phased RI/FS, facilitates scoping the investigation and encourages the identification of key data needs early in the process which ensures that later data collection is directed toward providing the information needed to select a remedial alternative.

Regarding the usability of existing data, the guidance documents state that "Regardless of the origin and quality of existing data, they typically are useful in constructing hypotheses concerning the nature and extent of contamination." (page 2-7, OSWER Directive 9355.3-01). In the spirit of the guidance document, Stearns & Wheler utilized data collected prior to the initiation of the RI/FS as an auxiliary source of data needed for temporal control. The quality of these earlier data was scrutinized and, where appropriate, these data were eliminated or only appropriate data were used.

At the TACO site, the combination of previously-collected data and the sampling conducted by Stearns & Wheler as part of the RI provides an understanding of the environmental impact and potential risk associated with contamination at the site.

1.4 Site Background

1.4.1 Site Description

The site is located on TACO Street in Sherburne, New York (Figure 1A). The Village of Sherburne is situated in the Town of Sherburne, Chenango County, approximately 28 miles south of Utica.

The 5.5-acre site is located approximately 250 feet west of Route 12 and 1,300 feet north of Route 80 (Figure 1B). The site borders agricultural fields on the west, residential and light commercial property on the east and south, and a bulk petroleum storage facility on the north. Property boundaries are delineated by a chain link fence around the main plant. There is a small parcel of property which borders Route 12 that is not fenced.

The facility consists of the following buildings: a 75,000 square foot main building previously used for manufacturing, warehousing and administration; a 4,900 square foot plating building used for applying metal plating material and for degreasing; a 1,600 square foot garage used as a maintenance shop; and a 2,800 square foot wooden shed used to store machinery and material (Figure 2; a surveyed map is included in Plate 1). The parking lot on the eastern side of the main building is paved with asphalt paving, and there is a small concrete pad south of the wooden shed. The remainder of the site (and the majority of ground surface) is open, grass-covered space. A two-acre field at the south side of the property (South Field) is currently grass covered; however, there are open patches in the grass where coarse gravel fill can be seen. Additionally, there are old concrete slabs and shallow foundations in the South Field, probably remnants of old sheds and outbuildings.

A stream, Potash Creek, roughly follows the route of the abandoned Chenango Canal, which runs from north to south across the eastern side of the property (Figure 3). Prior to plant closure, the portion of the creek which crossed the northern half of the property was enclosed in an underground culvert. During closure, the remaining portion of the creek was also enclosed in an underground culvert. The section of the creek enclosed during closure extends approximately from the south end of the main building, across the South Field, to a drainage ditch adjacent to the railroad tracks.

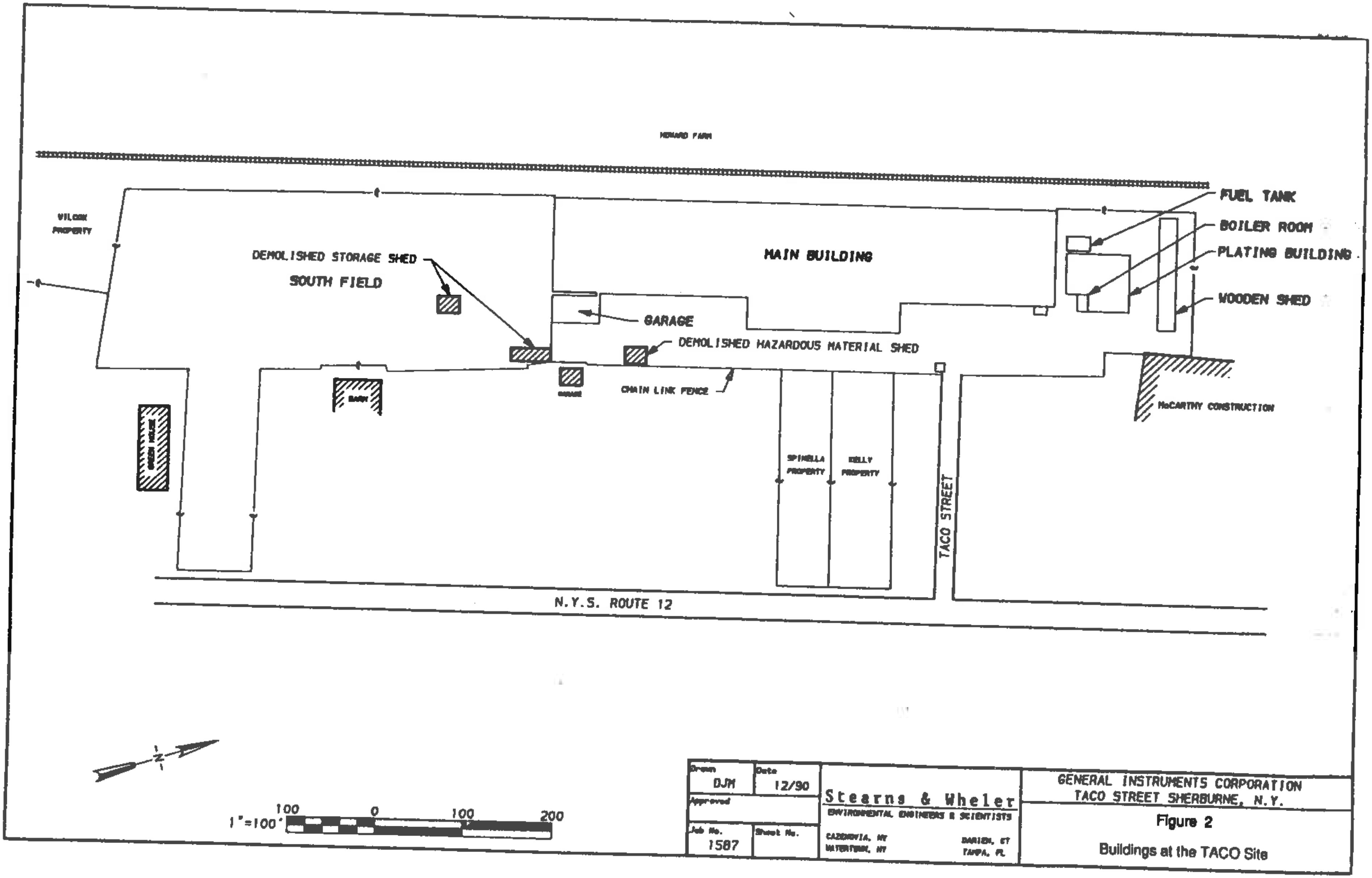

Figure 2

Buildings at the TACO Site

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1.4.2 Site Development

In 1947, the parcel of property was improved for manufacturing by the Technical Appliance Corporation of America (TACO). Initially, they manufactured kitchen equipment, but soon began to manufacture antennas. In 1962, Jerrold Electronic Corporation purchased the plant and renamed it R.F. Systems. General Instrument purchased the facility in 1968, and at first operated the site as R.F. Systems, a Division of General Instrument Corporation. Later, they operated the facility under the name "General Instrument".

From 1947 until plant operations ended in 1983, the plant was involved with developing, designing, manufacturing and testing aluminum antennas, remote control devices for televisions, and other types of electronic equipment. Production activities were supported by a fabrication shop, paint shop, degreasing apparatus, a metals plating facility (which included an analytical laboratory), and equipment for a treatment process that cleans antennas and other aluminum products and adds a protective gold coating to their surface; this trademarked process is called the Alodine™ process.

Other processes employed at the plant included metal etching with chromic acid and degreasing with halogenated solvents.

1.4.3 Facility Closure

In 1983, General Instrument Corporation implemented a plan to close the Sherburne facility. A closure plan for decommissioning the plant, consistent with RCRA guidelines, was submitted to the NYSDEC in September 1984 and approved in October 1984.

1.4.4 Consent Order

In 1989, a NYSDEC Consent Order #A701578810 (attached as Appendix J) classified the General Instrument TACO Street plant, a "Class 2" inactive hazardous waste site (#709010) and ordered General Instrument (the respondent) to conduct an RI/FS at the site. The consent order alleged that hazardous substances were discharged to soils and groundwater at the site. The hazardous substances are trans-1,2-dichloroethene, 1,1,1-trichloroethane, chloroform, trichloroethane, 1,1-dichloroethane, carbon tetrachloride, methylene chloride, chlorobenzene, toluene, benzene, 1,1,2-trichloroethene, tetrachloroethene, vinyl chloride, xylene, ethyl benzene, trichlorofluoromethane, and 1,1,2,2-tetrachloroethane. All the compounds listed above are volatile organic compounds (VOCs).

In addition, the consent order required that General Instrument: (1) identify on-site and off-site contamination; (2) determine the remedial program that is technologically feasible and practical that will mitigate and eliminate to the maximum extent possible any present or potential threat to the environment and to human health; (3) submit to the Department all data within its provision; (4) solicit public comment.

1.4.5 Previous Investigations

There is very little data available from the site prior to the implementation of the closure plan in 1984. It is known that OSHA collected samples relating to worker safety while the plant was still in operation. An engineering report on metal concentrations in the sanitary sewer effluent was conducted by an independent consultant, and the USEPA also conducted an investigation of metals in sewer effluent at the site. These previous reports deal with occupational safety and possible releases to the village sewer treatment system. The data they may contain do not affect the nature of this investigation; subsequently, they have not been reviewed as part of this report.

In November 1983, a sampling plan was compiled by Joseph Colletti, P.E., and William D. Carter, Ph.D., which outlined quality assurance and quality control, personnel protection, and the sampling locations for the investigation. Soil samples were collected from Potash Creek surface water and a well in the plant, and solid waste samples were collected from industrial equipment and storage areas.

In September 1984, Joseph Colletti submitted an "Engineering Report for Plant closure". The report outlined a plan for the decommissioning of the plant, the removal of industrial equipment, the decontamination of any affected surfaces, and testing for environmental releases in areas of suspected contamination. A full copy of the report is found in Appendix M.

Eight specific areas that required decontamination and cleaning were:

a. The plating room
b. The vapor degreasing room
c. A chemical laboratory
d. A 5,000-gallon underground settling tank
e. A paint shop
f. The Alodine™ booth
g. The hazardous material storage shed
h. The exterior faces of building walls.

The "Engineering Report for Plant Closure" compiled a list of potential contaminants on the site. The list is based on knowledge of the common components of the plating, painting, Alodine and degreasing processes. It includes, but is not limited to:

<u>Plating Process</u>

Ammonium chloride
Zinc chloride
Chromic acid
Phosphoric acid
Sulfuric acid
Hydrogen fluoride
Nitric acid
Caustic soda
Muriatic acid
Smut remover
1,1,1-trichloroethane (TCA)
Miscellaneous chlorinated hydrocarbons
Cyanide

Heavy metals:
Manganese
Iron
Silver
Titanium
Cadmium
Chromium
Copper
Lead
Mercury
Zinc
Aluminum

<u>Painting Shop</u>

Paint thinners
Toluene diisocyanate
Naptha
Xylol
Red lead
Lead chromate
Toluol
Methyl isobutyl ketone

Alkylamine
Formaldehyde
Lactol spirits
Ether ester
Aliphatic petroleum distillates
Acetyl acetone
Ethyl acetate
Methyl ethyl ketone

Alodine Process

Hydrofluoric acid
Potassium ferricyanide
Caustic potash
Alkali pyrophosphate
Sodium gluconate
Isopropanol
Glycol solvent
Organic dye
Bisulfite

Vapor Degreasing Process

1,1,1-trichloroethene (TCA)
Chlorinated solvents

In addition, eight areas were identified as suspected areas of contamination. The areas are:

Above ground

1. Waste drum storage area (northeast corner of property).
2. Surface soil adjacent Alodine booth (south end of building, west side).
3. Old Potash Creek bed (east side of South Field).
4. Surface soil adjacent paint shop (north end of building, west side).
5. Storage shed (east property boundary).
6. Hazardous material storage shed (east property boundary; see Exhibit 2a, Appendix K).

Below ground

1. 5,000-gallon buried settling tank (below boiler room)
2. Buried Alodine settling tank (east side of main building).

1.4.6 Results of Sampling Investigations During Closure

In March 1985, a "Report on Sampling Investigation" was prepared by Joseph Colletti, P.E., and William D. Carter, Ph.D. (attached as Appendix L). Upon reviewing these data, soil samples containing some degree of inorganic contamination were identified, including the following heavy metals: cadmium, chromium, mercury, silver and lead. Copper and zinc were also identified at levels above background, but were not considered a serious problem because of their low toxicity. In addition, some soils displayed contamination with volatile organic compounds, especially in the areas west of the loading dock at the north end of the main building.

Four water samples were analyzed for cyanide, metals and volatile organic solvents. Cyanide was found in surface water in Potash Creek, and groundwater analysis of existing water wells in the plant and one test pit that intercepted the water table revealed high concentrations of aluminum, iron, lead, and volatile organic compounds in excess of groundwater standards.

Although a groundwater monitoring program had not been part of the original closure plan, the soil and water contamination identified during the sampling investigation led General Instrument to initiate an investigation of groundwater quality at the site.

In March of 1985, a closure plan addendum was submitted to NYSDEC, describing monitoring wells that had been installed at each of the four corners of the property (Well Nos. 1 through 4). These wells were installed for the purposes of identifying site stratigraphy and determining groundwater flow direction and quality. Initial results from the first phase of the groundwater monitoring program are contained in a report submitted by Joseph Colletti, P.E., February 1985, entitled "Subsurface Investigation, General Instrument Corporation, TACO Road Plant". The full report is found in Appendix K.1. Volatile organic compounds and their detected concentrations are shown in Table 1.1.

TABLE 1.1

SUMMARY OF VOLATILE COMPOUNDS DETECTED
DURING INITIAL SUBSURFACE INVESTIGATION
March 1985
(µg/l)

Compound	MW-1	MW-2	MW-3	MW-4
Methylene chloride	1	1	1	<1
1,1-dichloroethane	<1	51	<1	6
1,2-dichloroethene	<1	33	2	37
1,1,1-trichloroethane	6	29	<1	12
Trichloroethene	1	9	6	44
1,1,2-trichloroethane	<1	2	<1	<1
Tetrachloroethene	5	1	<1	<1

The hydraulic gradient could not be accurately determined using the four wells, so in July of 1985, six piezometers were added, five in a field to the west and downgradient of the site and one to the east and upgradient. Mapping based on these ten points confirmed a generally westward groundwater flow. Later in 1985, five additional wells were added: No. 5 in April, and Nos. 6 through 9 in June. A monthly sampling and analysis program was implemented from January 1985 to September 1986. Data from the monthly groundwater sampling program are presented in Appendix K.

In February 1987, Joseph Colletti prepared the "Assessment Report for Plant Closure". The report summarized, assessed and referenced pertinent information regarding environmental contamination from all previous reports. Although the report acknowledged the presence of groundwater contamination, it suggested that both metal and volatile organic compound contamination were derived from an off-site/upgradient source. It asserted that the groundwater flow regime was being driven by a ponding phenomena on Potash Creek and traveled a preferred pathway along the old Chenango Canal.

Several conclusions were developed in the "Assessment Report for Plant Closure" (February 1987) that were based on data collected through 1986. The report was reviewed by NYSDEC, and in September 1987, the NYSDEC responded with recommendations for further study. Based on a review of the technical data, the February 1987 report, and NYSDEC comments by Stearns & Wheler, the following summary of site conditions was developed:

- Soil sampling and analysis along the west property boundary during closure activities revealed high levels of chromium, cyanide, lead and zinc. This soil was excavated and disposed of off site.

- High concentrations (including exceedances of groundwater guidance values or standards) of the volatile organic compounds tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (TCA) were found in Well Nos. 2, 4, 5, 6 and 8, all located along the downgradient boundary of the property. An exception to this general pattern is tetrachloroethylene (PCE), which was found in its greatest concentration in Well No. 1, an upgradient well.

- Metals, in particular lead and chromium, were found in some of the downgradient wells and in Well No. 7 near the center of the facility. In addition, elevated metal concentrations were detected in Monitoring Well No. 9 upgradient from the facility.

- Contaminants transported along Potash Creek and refuse dumped into the old Chenango Canal may provide a source of and conduit for off-site sources of contamination.

1.4.7 Existing Data QA/QC

Little information is available on the QA/QC practices and protocols used to acquire the data used in all reports up to and including the 1987 assessment report. Chain-of-custody forms are available, but in some cases these were improperly maintained. There is no information on preservation procedures and transportation protocol used in sample handling. There are no random duplicates of samples to test for precision and representativeness. And there are no quality assurance audit samples to test laboratory accuracy. There is, however, a reasonable approximation of representativeness acquired from trip blanks that were used during sample collection and an approximation of accuracy and matrix effects in reported matrix spike samples. There is also a test of accuracy simply in the temporal nature of sampling design. A review of groundwater results revealed consistency in both the compounds present and in their relative concentrations with time. Data comparability was reasonably maintained by the use of standard USEPA analytical laboratory protocol.

The NYSDEC noted that the laboratory QA/QC used in analysis conducted prior to 1987 was inadequate. Because of these inadequacies, all existing data were only used in hypothesis construction by Stearns & Wheler, as mandated in the RI/FS guidance documents OSWER 93550-01. The directive states that, "Regardless of the origin and quality of existing data, they typically are useful in constructing hypotheses concerning the nature and extent of contamination."

After our review of the existing data, we concluded that they were a reasonable approximation of groundwater contamination prior to 1987 and could be used to "construct hypotheses" regarding the nature and extent of contamination. We also concluded that the QA/QC protocol used in collecting these data prevented their usage in quantifying absolute contaminant concentrations, predicting contaminant fate, or designing a remedial system.

2.0 STUDY AREA INVESTIGATION

2.1 Conceptual Model

Based on existing data, previous reports, and site visits prior to the initiation of the Remedial Investigation, Stearns & Wheler compiled a preliminary conceptual model of the site. The conceptual model was presented by Stearns & Wheler in the RI/FS Work Plan. The Work Plan was approved by the NYSDEC in August 1989, and site work commenced in October 1989.

The conceptual model was used as a basis for the investigations, the principal components of which are presented below.

2.1.1 Site Hydrogeology

Previous workers had installed nine monitoring wells. Data collected from these wells established that: (1) the site is underlain by a sand and gravel aquifer with an average thickness of approximately 10 feet; (2) the aquifer is overlain by 2 to 8 feet of natural silty soil or fill material; (3) the aquifer is underlain by silt and clay up to 200 feet thick; and (4) groundwater level information suggested an east to west flow direction, probably indicating discharge to the Chenango River, approximately 1,500 feet west of the facility.

2.1.2 Metals Contamination

Stearns & Wheler compiled the following conceptual model regarding metal contamination at the site.

Metals may be found in high concentrations in both groundwater and soil samples on the site, suggesting that the site itself contains the source of the metals contamination. There was, however, conflicting evidence which suggested that the source may be from off site.

Zinc, lead, and chromium contamination levels were found in soil samples collected from along the west wall of the main building during plant closure, but the soil in this area had been remediated. The nature and proximity of the contamination suggested that on-site operations were the source of this contamination.

Monitoring Well No. 9, located off-site and upgradient, contained high levels of metals, suggesting an off-site upgradient source of metals contamination. Monitoring Well No. 5 contained cyanide above groundwater standards.

2.1.3 Volatile Organic Compound Contamination

Stearns & Wheler compiled the following conceptual model regarding volatile organic contamination at the site.

Low concentrations of volatile organic compound may be present in on-site monitoring wells and may be present in Potash Creek. VOC contamination may also be present in the soil west of the building, at the north end, in the soil around the plating building, and in the soil of the South Field. Given the fact that solvent use was widespread at the facility, on-site sources were believed to be a possibility. Analytical results from Well No. 1, however, did indicate the possibility of an off-site source. Therefore, our conceptual model was developed with the premise that there is sufficient evidence to suggest the plating facility and the north end of the main building is a source of organics contamination in soil and groundwater, but off-site possibilities should be investigated.

2.1.4 Possible Off-Site Contamination Sources

The conceptual model established that there are possible off-site sources of contamination that need to be considered:

- Potash Creek may have been used for disposal of waste liquids from an industrial facility upstream from the site. It had been speculated (in "Assessment Report for Plant Closure", Appendix K) that Potash Creek "ponds up", at both its entrance to and exit from the culvert that runs through the facility. It was suggested that this ponding may cause groundwater mounding and that contaminants may leave the stream bed and migrate toward the facility due to this mounding.

- A bulk storage facility located north of the site is a potential off-site source of petroleum products.

- The Old Chenango Canal may be a source of, and preferred pathway for contamination. It was suggested that refuse in the old canal bed may be generating a leachate which is entering on-site wells.

- The high metals concentrations in Well No. 9, which is off-site and upgradient, suggests an off- site source east of the site.

2.1.5 Migration and Exposure Pathways

The conceptual model identified three possible exposure pathways that could result in off-site health and environmental impact: (1) airborne transport; (2) surface runoff; and (3) groundwater flow in the shallow aquifer.

Contamination may be leaving the site by airborne transport in the form of metallic aerosol and organic vapors. In order to investigate the possible impact of contaminant transport by the air route, surface soils outside the perimeter of the site were sampled and analyzed. Of particular concern were the residential properties and gardens on the east side of the property.

Surface runoff has the potential to carry residual surface contamination into catch basins, which then run into Village sewers, onto residential property along the east boundary, or into the railroad right-of-way to the west. Given the known low concentrations of surface contamination and the probable dilution of surface water discharge, our conceptual model predicted limited impact by this route. Additionally, combined sewers should run through treatment systems, which would reduce any impact. Surface runoff onto residential property and the railroad right-of-way has the potential to impact vegetation. The surface soil samples collected to evaluate the potential for air transport were also used as an indicator of impact by surface runoff.

Groundwater is the most probable pathway for off-site migration. Two possible routes of groundwater migration were identified and investigated in the Remedial Investigation. The first route is the local groundwater flow to the west which is the most likely pathway for contaminant migration. The exact direction and rate of westward contaminant migration was investigated. A second pathway for groundwater migration was suggested in the old canal bed that runs through the site. Detailed groundwater elevation information was collected to confirm the relationship between site hydrogeology and the canal bed.

2.2 Site Investigation Plan

Sufficient data existed in previous reports to compile a preliminary conceptual model. However, to fully characterize the hydrogeology and source and fate of contaminants, additional information was needed. This section details the site investigation plan, the rationale, and methods of field investigation used to fully characterize the site.

2.2.1 Rationale

Previous investigations had confirmed a source of metal and volatile contaminants on the TACO site. Cleanup as part of the plant closure appeared to have removed and disposed of the source of the contamination, but the concentration of some contaminants persisted in the groundwater. Off-site sources of the groundwater contamination had been suggested but were never substantiated. The goals of this Remedial Investigation are:

- To identify sources of on-site contamination and to delineate between on-site and off-site sources.

- To define site hydrogeology in terms of flow directions and flow rates.

- To determine the lateral extent of on-site and off-site contamination by sampling and analyzing surface soils, installing additional borings and wells, and sampling and analyzing soils and groundwater both on and off site.

- To investigate the health and environmental impacts of site contamination.

- To propose remediation alternatives and determine data needs for future site work.

2.2.2 Site Investigation Tasks

Based on the conceptual model of the site, the following nine areas of concern were targeted as potential locations and sources of contamination at the site:

- Chromium and cyanide in the vicinity of Well No. 5.

- Tetrachloroethane, trichloroethylene and 1,1,1-trichloroethane near the west boundary of the property.

- 1,1,1-trichloroethane and trichloroethylene near Well No. 7.

- Potash Creek north of the site as a cause of groundwater mounding and a source of tetrachloroethylene and 1,1,1-trichlorethane in Well No. 1.

- Potash Creek as a source of organics contamination across the property.

- Leachate coming from the old canal bed, reportedly used for refuse disposal.

- Metals contamination in upgradient Well No. 9.

- The north end of the main building, including the removed fuel tank and the solvent disposal pit in the plating building.
- Potential off-site, upgradient source of hydrocarbon contamination.

The site investigation was divided into 12 tasks. Each task was designed to address a facet of an identified potential source of contamination. All samples were tested for all target compound-listed analytes. The full TCL list is presented in Table 2.1.

TABLE 2.1

SUPERFUND TARGET COMPOUND LIST (TCL) AND
CONTRACT-REQUIRED QUANTITATION LIMIT

INORGANICS

Parameter		Contract Required Quantitation Level* (ug/l)
1.	Aluminum	100
2.	Antimony	3
3.	Arsenic	10
4.	Barium	200
5.	Beryllium	3
6.	Cadmium	5
7.	Calcium	5000
8.	Chromium	10
9.	Cobalt	5
10.	Copper	25
11.	Iron	100
12.	Lead	5
13.	Magnesium	5000
14.	Manganese	15
15.	Mercury	0.2
16.	Nickel	40
17.	Potassium	5000
18.	Selenium	5
19.	Silver	10
20.	Sodium	5000
21.	Thallium	10
22.	Vanadium	50
23.	Zinc	20
24.	Cyanide	10

*Matrix: Groundwater. For soil matrix, multiply CRQL by 100.

TABLE 2.1 (continued)

ORGANICS

Volatiles*	Low Water ug/l	Low Soil/ Sediment (ug/kg)
1. Chloromethane	10	10
2. Bromomethane	10	10
3. Vinyl chloride	5	10
4. Chloroethane	10	10
5. Methylene chloride	5	5
6. Acetone	10	10
7. Carbon disulfide	5	5
8. 1,1-Dichloroethylene	0.13	5
9. 1,1-Dichloroethane	5	5
10. 1,2-Dichloroethylene (total)	5	5
11. Chloroform	5	5
12. 1,2-Dichloroethane	.32	5
13. 2-Butanone	10	10
14. 1,1,1-Trichloroethane	5	5
15. Carbon tetrachloride	5	5
16. Vinyl acetate	10	10
17. Bromodichloromethane	5	5
18. 1,1,2,2-Tetrachloroethane	.03	5
19. 1,2-Dichloropropane	5	5
20. cis-1,3-Dichloropropene	5	5
21. Trichloroethene	5	5
22. Dibromochloromethane	5	5
23. 1,1,2-Trichloroethane	.02	5
24. Benzene	0.2	5
25. trans-1,3-Dichloropropene	5	5
26. Bromoform	5	5
27. 2-Hexanone	10	10
28. 4-Methyl-2-pentanone	10	10
29. Tetrachloroethylene	.03	5
30. Toluene	5	5
31. Chlorobenzene	5	5
32. Ethyl Benzene	5	5
33. Styrene	5	5
34. Total Xylenes	5	5

*Using purge and trap (Method 5030).

SW004712

TABLE 2.1 (continued)

ORGANICS

Semi-Volatiles	Low Water µg/l	Low Soil/ Sediment (µg/kg)
35. Phenol	10	330
36. bis(2-Chloroethyl) ether	10	330
37. 2-Chlorophenol	10	330
38. 1,3-Dichlorobenzene	10	330
39. 1,4-Dichlorobenzene	10	330
40. Benzyl alcohol	10	330
41. 1,2-Dichlorobenzene	10	330
42. 2-Methylphenol	10	330
43. bis(2-Chloroisopropyl) ether	10	330
44. 4-Methylphenol	10	330
45. N=Nitroso-dipropylamine	10	330
46. Hexachloroethane	10	330
47. Nitrobenzene	10	330
48. Isophorone	10	330
49. 2-Nitrophenol	10	330
50. 2,4-Dimethylphenol	10	330
51. Benzoic acid	50	1600
52. bis(2-Chloroethoxy) methane	10	330
53. 2,3-Dichlorophenol	10	330
54. 1,2,4-Trichlorobenzene	10	330
55. Napthalene	10	330
56. 4-Chloroaniline	10	330
57. Hexachlorobutadiene	10	330
58. 4-Chloro-3-methylphenol (p-chloro-m-cresol)	10	330
59. 2-Methylnapthalene	10	330
60. Hexachlorocyclopentadiene	10	330
61. 2,4,6-Trichlorophenol	10	330
62. 2,4,5-Trichlorophenol	50	1600
63. 2-Chloronaphthalene	10	330
64. 2-Nitroaniline	50	1600
65. Demethyl phthalate	10	330
66. Acenaphthylene	10	330
67. 2,6-Dinitrotoluene	10	330
68. 3-Nitroaniline	50	1600
69. Acenaphthene	10	330
70. 2,4-Dinitrophenol	50	1600

TABLE 2.1 (continued)

ORGANICS

Semi-Volatiles	Low Water ug/l	Low Soil/ Sediment (ug/kg)
71. 4-Nitrophenol	50	1600
72. Dibenzofuran	10	330
73. Dinitrotoluene	10	330
74. Diethylphthalate	10	330
75. 4-Chlorophenyl phenyl ether	10	330
76. Fluorene	10	330
77. Nitroaniline	50	1600
78. 4,6-Dinitro-2-methylphenol	50	1600
79. N-nitrosodiphenylamine	10	330
80. 4-Bromophenyl phenyl ether	10	330
81. Hexachlorobenzene	10	330
82. Pentachlorophenol	50	1600
83. Phenanthrene	10	330
84. Anthracene	10	330
85. Di-n-butyl phthalate	10	330
86. Fluoranthene	10	330
87. Pyrene	10	330
88. Butyl benzyl phthalate	10	330
89. 3,3'-Dichlorobenzidine	20	660
90. Benz(a) anthracene	10	330
91. Chrysene	10	330
92. bis(2-ethylhexyl)phthalate	10	330
93. Di-n-octyl phthalate	10	330
94. Benzo(b)fluoranthene	10	330
95. Benzo(k)fluoranthene	10	330
96. Benzo(a)pyrene	10	330
97. Indeno(1,2,3-cd)pyrene	10	330
98. Dibenz(a,h)anthracene	10	330
99. Benzo(g,h,i)perylene	10	330

TABLE 2.1 (continued)

ORGANICS

Pesticides/PCBs	Low Water ug/l	Low Soil/ Sediment (ug/kg)
100. alpha-BHC	0.05	8.0
101. beta-BHC	0.05	8.0
102. delta-BHC	0.05	8.0
103. gamma-BHC (Lindane)	0.05	8.0
104. Heptachlor	0.05	8.0
105. Aldrin	0.05	8.0
106. Heptachlor epoxide	0.05	8.0
107. Endosulfan I	0.05	8.0
108. Dieldrin	0.10	16.
109. 4,4'-DDE	0.10	16.
110. Endrin	0.10	16.
111. Endosulfan II	0.10	16.
112. 4,4'-DDD	0.10	16.
113. Endosulfan sulfate	0.10	16.
114. 4,4'-DDT	0.10	16.
115. Endrin ketone	0.10	16.
116. Methoxychlor	0.5	80.
117. alpha-Chlordane	0.5	80.
118. gamma-Chlordane	0.5	80.
119. Toxaphene	1.0	160.
120. AROCLOR-1016	0.5	80.
121. AROCLOR-1221	0.5	80.
122. AROCLOR01232	0.5	80.
123. AROCLOR-1242	0.5	80.
124. AROCLOR-1248	0.5	80.
125. AROCLOR-1254	1.0	160.
126. AROCLOR-1260	1.0	160.

A. Task 1

Task 1 examined the soil in the vicinity of MW-5 for residual cyanide and chromium contamination. Earlier reports showed a persistent but diminishing concentration of cyanide in the groundwater near MW-5. By analyzing the soil and groundwater near MW-5, we determined the probable source and fate of these contaminants.

The native soil in the vicinity of MW-5 was excavated during plant closure, as the area was known to contain excess concentrations of cyanide and chromium. Task 1 was designed to evaluate the efficacy of the earlier remediation and determine if any residual contamination remained. As part of Task 1, soil samples were collected from off site; samples were tested for all Target Compound List (TCL) compounds.

B. Task 2

Volatile organic compounds and metals (particularly lead and chromium) have been detected in wells along the western boundary of the site. Task 2 addressed this perceived problem by sampling the western wells for TCL compounds and conducting a soil gas survey in the large field in the southern part of the site to determine whether there is an undetected source of VOCs in the subsurface.

C. Task 3

Trichloroethene and other volatile organic compounds (VOCs) have been detected in MW-7. To determine if there is a source of VOCs near MW-7, soil samples were collected from the shallow subsurface near MW-7, and a groundwater sample was collected from the well. All soil samples and groundwater samples were analyzed for TCL compounds.

D. Task 4

This task investigated the reported ponding of VOC-contaminated water in Potash Creek north of the property. Surveyed water elevations were collected in the vicinity of the pond, soil samples were collected from the stream bed, and groundwater samples were collected from monitoring wells on an adjacent property. Water level elevations were mapped and all samples were analyzed for TCL compounds.

E. Task 5

It had been suggested (in "Assessment Report for Plant Closure", Appendix K) that the enclosed portion of Potash Creek is a preferred pathway for contamination. To evaluate this hypothesis, five test pits were dug along the course of the old creek. The excavations were located to allow for sampling along the old stream bed and around the buried culvert to see whether it was leaking. Composite soil samples were collected from each excavation and analyzed for TCL compounds. Additionally, in an effort to investigate possible residual soil contamination derived from the creek, soil samples were collected from the downgradient side of the stream.

F. Task 6

Portions of the Old Chenango Canal were identified in test pits. To evaluate the possibility that the old canal is a source of contaminated leachate, soil samples representative of the soils infilling the old canal were collected and analyzed for TCL compounds.

G. Task 7

This task addressed the issue of an upgradient/off-site source of metal contamination in MW-9. Two additional monitoring wells were installed in upgradient off-site locations. These wells provided upgradient sample locations, as well as an additional groundwater elevation point, which helped determine site hydrogeology and flow direction.

H. Task 8

Volatile organic compounds were found in soil samples from the west side of the plating building, in water samples from Well Nos. 8 and 2, and qualitatively by odor and gas detectors in an excavation of the solvent pit inside the plating building. The presence of volatile organic compounds in the soil around the test pit was investigated further. Soil borings were collected from the ground immediately adjacent to the outside walls of the building and from the areas adjacent to the plating room. Test pits were excavated through the concrete floor of the plating building: one in the plating room (by expanding the excavation near the floor drain), and two in the degreasing area north of the plating room. Two test pits were also constructed in the loading dock area near MW-8. Multiple and composite soil samples were collected from each test pit and boring. All soil samples were analyzed for TCL compounds. Groundwater samples were collected from MW-8, MW-14, MW-2, MW-1 and MW-17, and analyzed for TCL compounds.

I. Task 9

Test pits excavated previously at the northern property boundary, in an area north of the woodshed but south of the adjacent property, revealed subsurface hydrocarbon contamination. Task 9 was designed to assess the nature, extent, source and fate of this known contamination. This task also addressed the possibility that this contamination was migrating to the south and contributing to on-site hydrocarbon contamination. A field reconnaissance of the site, an historical review of petrochemical activity at the TACO site and adjacent properties, and a qualitative survey with a photoionization detector of the test pit were conducted at the area of contamination. Soil and groundwater samples were collected and analyzed for TCL compounds.

J. Task 10

Four surface soil samples were collected from outside the perimeter of the site to investigate the possible impacts of air transport and surface water runoff means of off-site impact. The four soil samples were tested for TCL compounds.

K. Task 11

The confirmed presence of VOCs in groundwater on the site dictated that downgradient groundwater be explored for contamination. Three additional monitor wells were installed in an agricultural field west of the site, in the downgradient direction. Groundwater samples from each well were analyzed for TCL compounds.

L. Task 12

This task was designed to confirm the presence of contaminants in the original nine monitoring wells on the site. To do this, all existing wells were resampled for target compound list constituents. These data will help calibrate previously-collected samples and provide an approximation of the comparability of the two data sets.

2.3 Field Activity

All field activity was conducted within the framework and guidelines mandated by CERCLA and described in the site work plan. OSHA directive (29 CFR Part 1910) for personal protection at hazardous waste sites were observed during all field operations. The bulk of field work was conducted in Level D, the lowest level of personal protection. However, where required by the Site Health and Safety Plan (HSP), level of personal protection was upgraded to Level C.

Near the completion of the field sampling program, all sample locations, monitoring wells, buildings, utilities and property boundaries at the site were surveyed. The results of the site survey are presented in Plates 1 through 6.

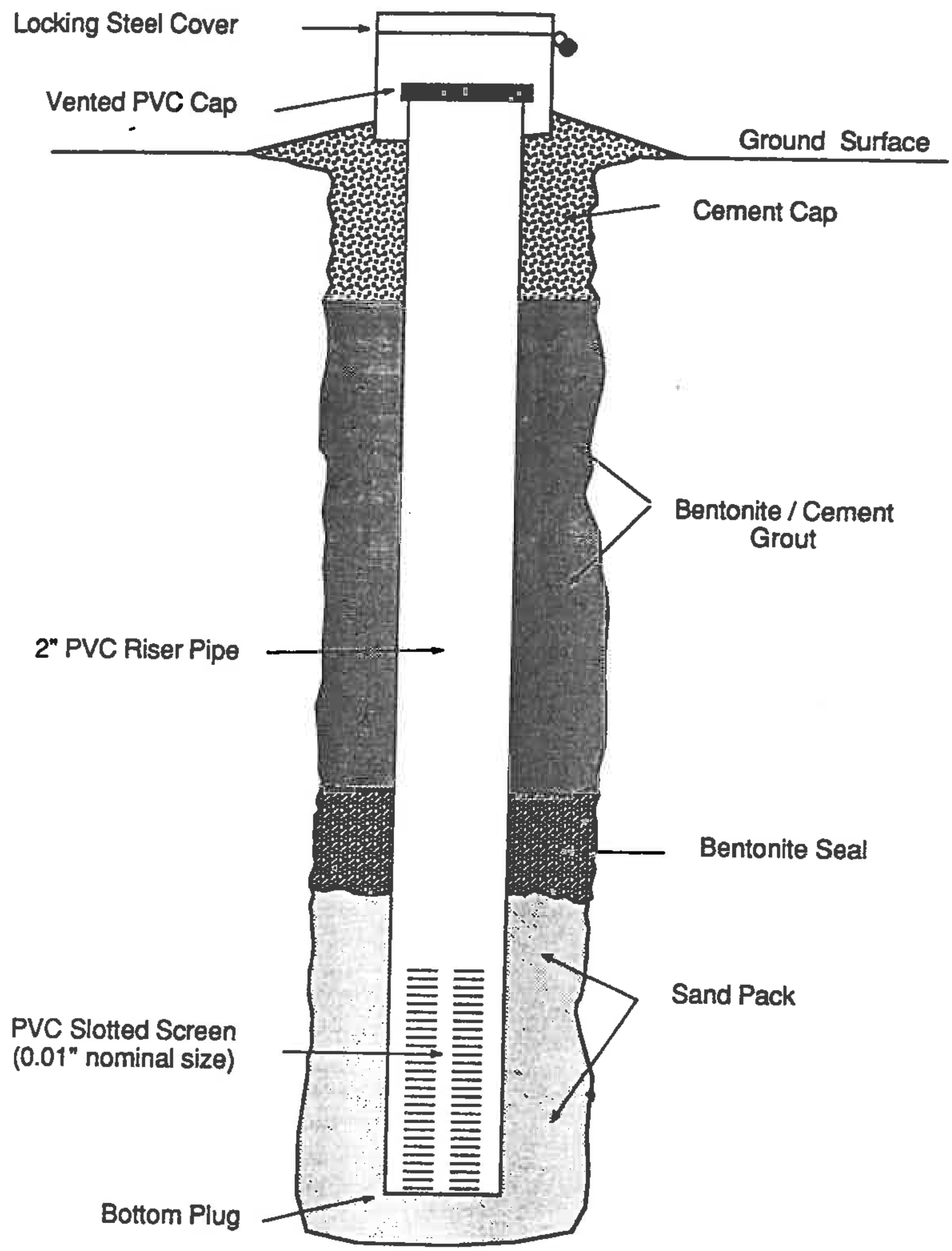
2.3.1 Borings and Wells

Monitoring wells were completed in aquifer material at upgradient, on-site, and downgradient locations. A 4-1/4-inch hollow stem auger-type drilling method was used to construct well borings. Soil samples were collected at the near surface and at 5-foot intervals throughout the entire boring with a 2-inch split spoon soil sampler (ASTM D-1586). A standard penetration test was conducted for each soil sample and a log of the number of blow counts required to penetrate 6 inches of soil was recorded. Soil collected in the split spoon was described using the Unified Soil Classification System (ASTM D-2487-83). In addition, each split spoon was examined for volatile organic compounds with a photoionization detector (PID). The PID used at this site was a Microtip™, manufactured by Photovac Corporation.

Monitoring well construction complied with the site-specific Field Sampling Plan contained within the site work plan. All monitoring wells were constructed with Schedule 40 PVC pipe set in No. 4, Q-rock, sealed with bentonite, and secured with a vented locking cap (Figure 4). After well completion, all wells were developed by the surge and pump method until the water ran clear. All equipment and drill rigs were decontaminated by steam cleaning between boring locations.

2.3.2 Test Pits

In October and November 1989, test pits were excavated in the open fields, parking lots, and building interior of the site. Exterior pits were dug with a conventional backhoe equipped with a 24-inch wide shovel. Interior pits were excavated by first breaking through the concrete floor with a compressed air jackhammer, then completing the pit by pick axe and hand shovel. Exterior pits were generally 5 to 7 feet deep and 8 to 12 feet long; interior pits were shallower.



Job Number:	Drawn by:	Stearns & Wheler Environmental Engineers and Scientists	General Instrument Corporation TACO Street, Sherburne, NY
Approved by:	Date:	Cazenovia, NY Darien, CT Watertown, NY Tampa, FL	Figure 4 Representative Well Construction

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During excavation, a field geologist described and recorded the soil encountered, as well as the depth to the water table. All pits were examined with a PID before entering. Strict decontamination procedures were followed for all equipment and personnel while excavating tests pits.

2.3.3 Soil Vapor Survey

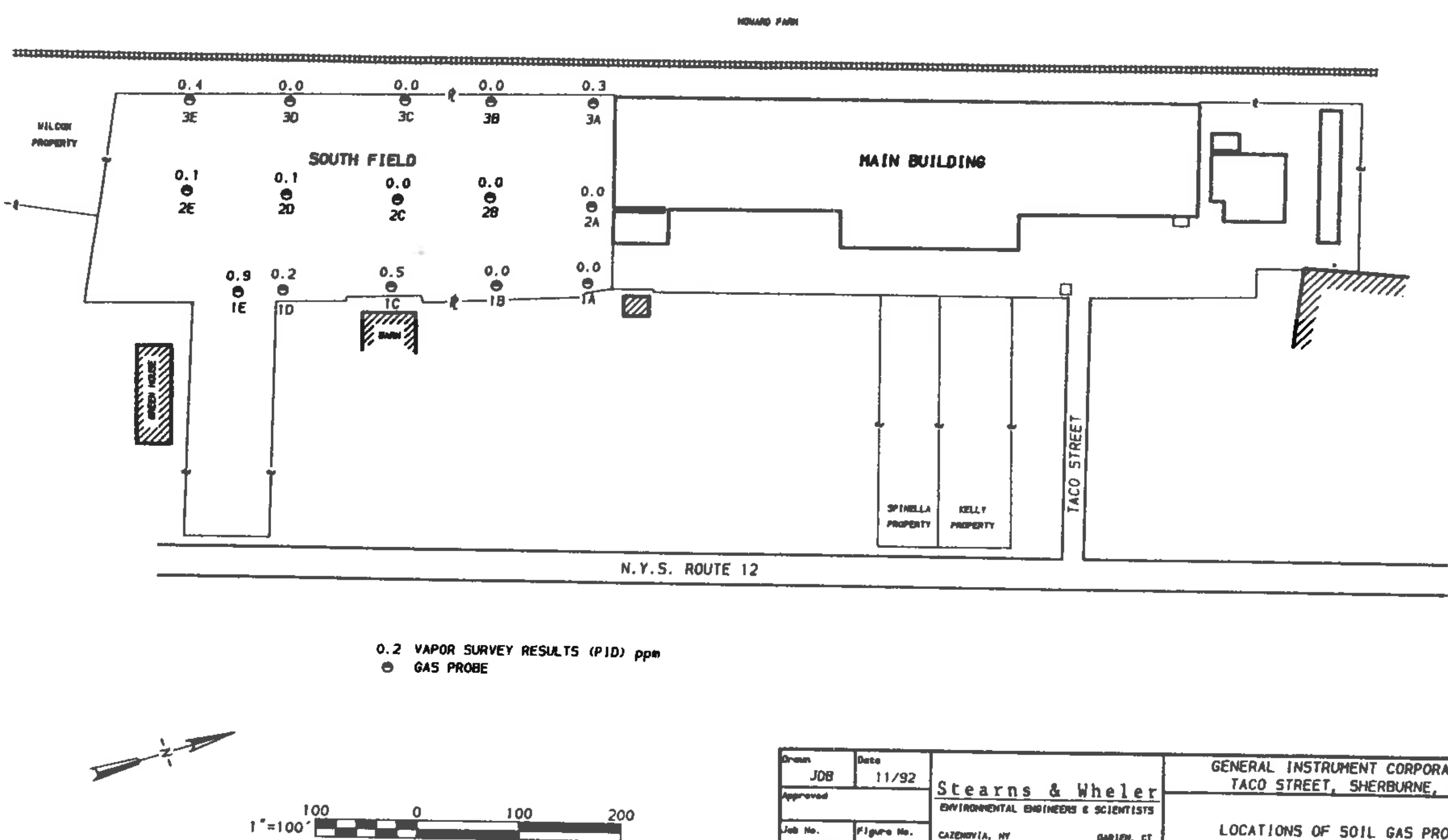
In November 1989, a soil vapor survey was conducted in the South Field at the site. The survey employed a field gas chromatographic manufactured by Photovac Corporation. Soil probes were installed in the vadose zone with a Hefty, K-V™ soil probe system. The location of the probes (illustrated in Figure 5; the surveyed locations of soil gas probes are presented in Plate 5) were placed at the nodes of a 100-foot sampling grid.

Soil vapor samples were collected via a "purge and trap" method which used a vacuum to extract soil pore vapors. The captured sample was analyzed in the field with the portable gas chromatograph.

2.3.4 Sampling

Groundwater and soil samples were collected in accordance with the work plan and standards adopted in USEPA Guidance Document (600/2-85/104), "Practical Guide for Groundwater Sampling." Wells to be sampled were purged of 3X to 5X the well volume. The sample was collected in an appropriate container (see Table 2.2 for list of sample containerization), chain-of-custody forms were completed, and samples were stored in chilled coolers until shipped to the laboratory.

Surface soil samples were collected by a field geologist with a stainless steel spoon. Composited samples were homogenized in commercially-available polymer plastic bags before being transferred into sample jars and shipped to the laboratory. Shallow subsurface and sediment samples were collected with a 4-inch soil auger. The auger and other sampling equipment was decontaminated with an Alconox™ wash, methanol, and a deionized water rinse. Chain-of-custody forms were completed for all



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Job No. 1587	Figure No. 5	CAZENOVIA, NY DARIEN, CT WATERTOWN, NY TAMPA, FL	LOCATIONS OF SOIL GAS PROBES

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TABLE 2.2

SAMPLE CONTAINERIZATION

Analysis	No.	Bottle Type	Preserva-tive(1)	Holding Time(2)
Water Samples				
GC/MS (extractable) and pesticide/PCBs	2	1-liter glass bottle	None	5 days (until extraction, 40 days extracted)
GC/MS (VOA)	2	40 ml, glass vial with septum cap	None	7 days
Metals(3)	1	1-liter, plastic bottle	Nitric acid to pH <2	6 months mercury; 26 days
COD		Plastic or glass	Sulfuric acid to pH <2	28 days
TDS		Plastic or glass	None	7 days
Chlorides		Plastic or glass	None	28 days
Ammonia		Plastic or glass	Sulfuric acid to pH <2	28 days
Alpha, Beta, Gamma		Plastic or glass	Nitric acid to pH <2	6 months
Dioxin		Glass with teflon-lined cap	None	7 days
pH		Plastic or glass	None	Analyze immediately
Soil, Sediment, Solid Waste				
TCL organics		Wide mouth, plastic or glass	None	7 days (until extraction, 40 days extracted)
TCL organics		Wide mouth, plastic or glass	None	6 months Cyanide: 12 days Mercury: 26 days

TABLE 2.2 (continued)

Analysis	No.	Bottle Type	Preservative(1)	Holding Time(2)
Radiological tests		Wide mouth, plastic or glass	None	6 months
pH		Plastic or glass	None	Analyze immediately

(1) All samples will be preserved with ice during collection and shipment.
(2) From verified time of sample receipt.
(3) Metals refers to the 24 metals in the Target Compound List (NYSDEC-CLP 11/87).

soil samples, and they were stored in chilled coolers before being shipped to the laboratory.

3.0 PHYSICAL CHARACTERISTICS

3.1 Surface Features

The Village of Sherburne and the General Instrument site are located on the eastern side of the Chenango Valley at a mean elevation of 1,047 feet. Steep valley sidewalls ascend to a maximum elevation of 1,800 feet on the east and west (Figure 6).

The site itself is relatively flat, with less than 5 feet of topographic relief between the paved surfaces along the east and north boundary of the site and the peripheral drainage ditch in the southwest corner. The highest point on the site is adjacent the plating room in the vicinity of MW-14 at 1,050 feet and the lowest is in the bottom of the drainage ditch south of MW-4 at 1,045 feet (see Plate 1).

3.2 Demography and Land Use

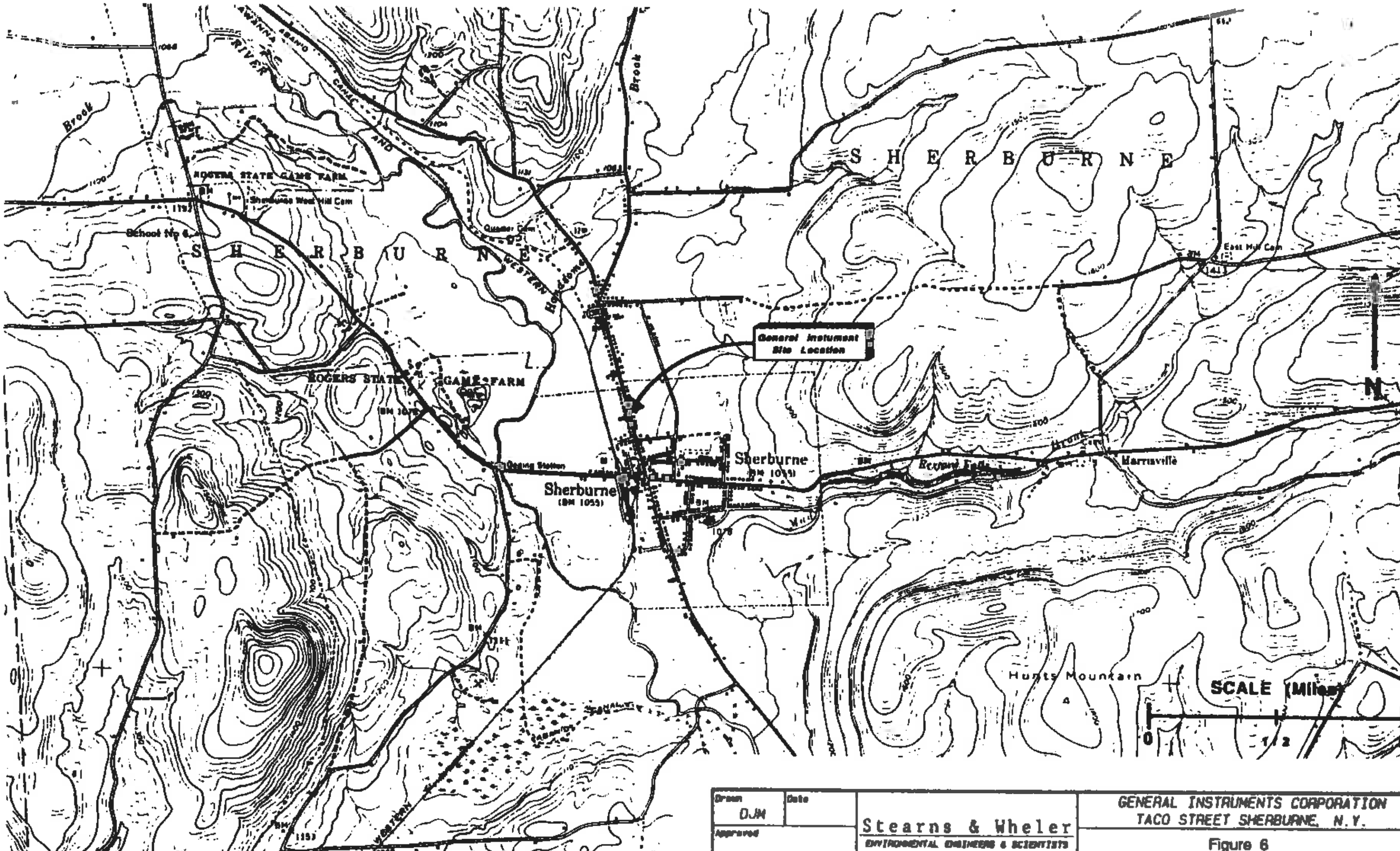
Chenango County has a population of approximately 42,000 persons. The Village of Sherburne has a population of 1,680 (1980 census) and covers an area of two square miles. The Village of Sherburne is mapped as commercial, industrial or residential land use areas in the County Land Use Map (Figure 7). The surrounding area is largely designated active or inactive agricultural fields or forestland.

3.3 Site Ecology

A habitat-based assessment of the site and surrounding area was conducted by ecologists and biologists at the LA Group of Saratoga Springs, New York. They described the wildlife habitat on site and in the field west of the property, which is summarized below. The full report is contained in Appendix B.

3.3.1 General Instrument Property

The General Instrument Corporation property contains little suitable wildlife habitat due to the lack of necessary food and cover resources. Since a large portion of the



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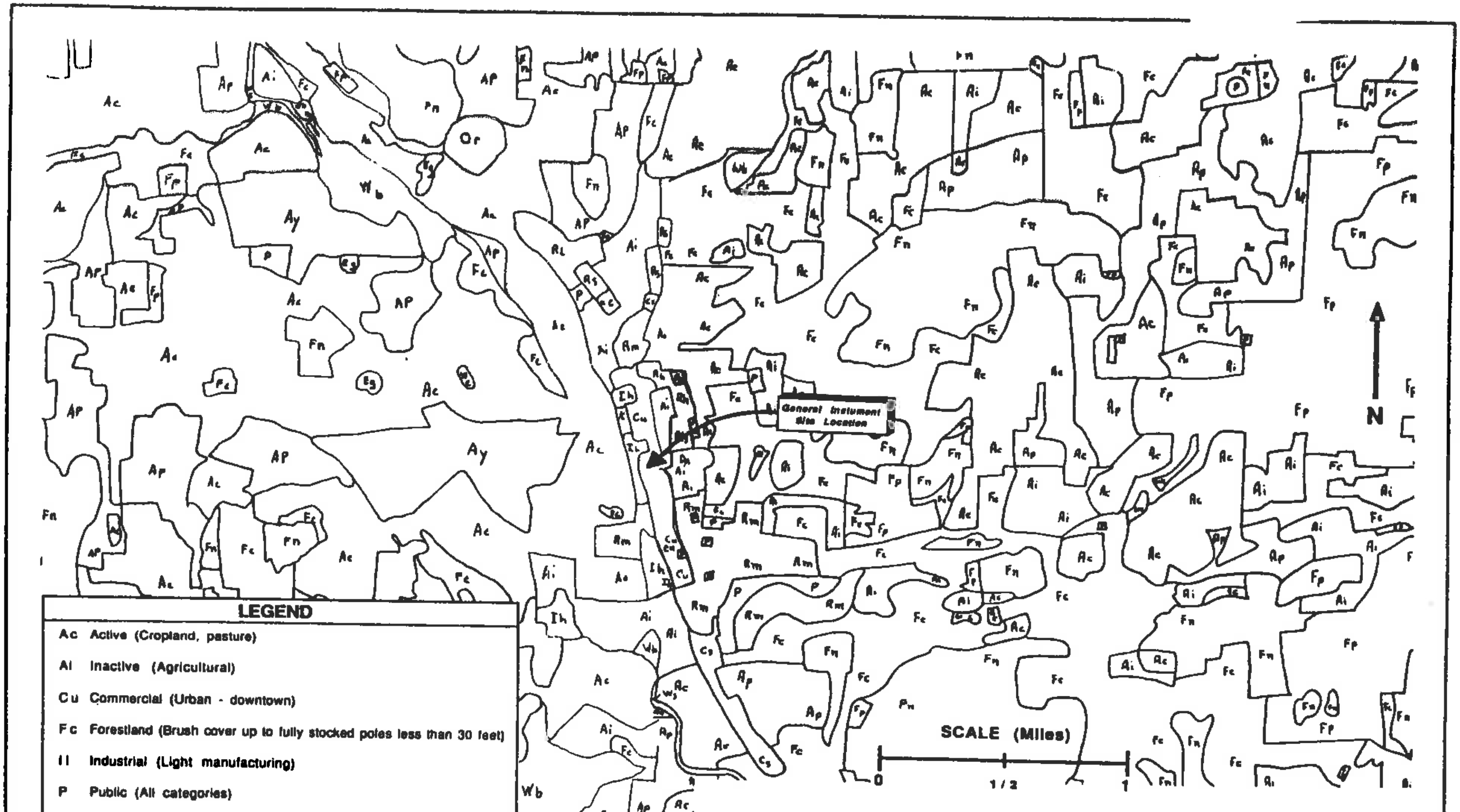
DJM		Stearns & Wheler	GENERAL INSTRUMENTS CORPORATION TACO STREET SHERBURNE, N.Y.
Approved		ENVIRONMENTAL ENGINEERS & SCIENTISTS	
Job No. 1587	Sheet No.	CAZENOVIA, NY WATERTOWN, NY DARIEN, CT TAMPA, FL	Figure 6 Topographic Map of the Chenango Valley near Sherburne



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Approved			Figure 7
Job No. 1587	Sheet No.		Land Use Map

property is occupied by existing structures and paved roadways, there is a limited amount of habitable area for wildlife. Additionally, the property is surrounded by a chain link fence, which excludes colonization of the property except for those mammalian and avian species which can move under, through or over the fence. No wildlife was observed on the site. However, fresh tracks indicated that eastern cottontails (Sylvilagus floridanus) utilize the site at least transiently. No other wildlife signs were observed on the site.

The absence of suitable trees for nesting and perching sites limits the property's ability to support a resident avifauna. The existing structures, especially the open-front storage buildings at the north end of the property, may provide nesting sites for species such as swallows (Hirundo spp.), eastern phoebe (Sayornis phoebe), house sparrow (Passer domesticus), house finch (Carpodacus mexicanus), European starling (Sturnus vulgaris), rock doves (Columbia livia), chimney swifts (Chaetura pelagica), house wren (Troglodytes aedon), American robin (Turdus migratorius), and dark-eyed junco (Junco hyemalis). The remaining open, grassy areas of the property could potentially be utilized by a number of other passerine bird species for seed and insect foraging. No surface waters exist on the General Instrument property.

3.3.2 Agricultural Property West of Site

Directly west of the site are actively-farmed fields of corn and alfalfa. Approximately 75 acres of corn and alfalfa are bordered by the Chenango River to the west, the Delaware Lackawanna and Western Railroad to the north and east, and New York Route 80 to the south. Eastern cottontails were abundant in the low scrubby vegetation along the railroad bed and the river, as well as in the hedgerow near the General Instrument Corporation property. Active burrows were also present in the hedgerow. Gray squirrels (Sciurus carolinensis) were observed in the hedgerow and in riverside trees. No smaller mammalian species (voles, mice, shrews) were observed; however, trails in the fresh snow were observed often along the fields' edges. No deer tracks were located in the fields or adjoining areas. The suitability of this particular area for deer may be precluded by the lack of suitable cover and the fields' isolated nature.

The cornfield serves as an important foraging area for a resident population of Canada geese (Branta canadensis). In the morning of the on-site investigation (December 14, 1989), numerous goose tracks were found in the corn and alfalfa fields. Later the same day, a flock of 35 to 40 geese was observed landing in the same fields, undoubtedly to forage on the plentiful waste corn. The occurrence of geese in the area is promoted by the proximity of preferred habitat provided by the Rogers State Game Farm located between the river and Route 80. In addition to the geese, American crow (Corvus brachyrynchos), blue jay (Cyanocitta crisata), and northern cardinal (Cardinalis cardinalis) were observed in the immediate area.

3.3.3 Potential Areas of Concern

The habitat-based survey found no evidence of significant habits or rare species at the site. The study did note that plants could take up contaminants found in the groundwater and pass them up the food ladder to domestic animals, and ultimately humans. The study also noted the risk to aquatic life if contamination reached the Chenango River.

3.4 Meteorology

Based on records kept by the National Weather Service, Sherburne receives 35.9 inches of precipitation yearly. The maximum average rainfall occurs in June (3.6 inches) and September (3.5 inches). The least amount of rainfall is recorded during February (2.1 inches on average).

The average daily temperature fluctuates seasonally from a low during February (average temperature 19°F) to a high during July (average temperature 66°F). Average monthly temperatures fall below freezing from December through March.

Based on 1989 data only, Sherburne receives approximately 45 inches of snowfall a year. Snow pack is accumulated during the months of November through March.

3.5 Surface Water Hydrology

Sherburne is located on the Chenango River at the northern extent of the Susquehanna River Basin. The Chenango River joins the Susquehanna River in Binghamton, New York, approximately 35 miles south of the site. The USGS gauge station on the Chenango, at Sherburne, has recorded discharge and river stage data since 1938. During that time, the average river stage has been 1,039.8 feet. Average discharge is 405 cubic feet/second (or about 20.9 inches/year) for the watershed, which is 263 square miles. Average rainfall on the watershed is approximately 36 inches/year; average discharge on the Chenango River at Sherburne is approximately 21 inches/year; the remaining 15 inches is accounted for by evapotranspiration, recharge of long-term groundwater storage, and use by municipalities and farmers for drinking and irrigation purposes.

Extreme discharge conditions during the period of record indicate a maximum flood stage of 1,047.7 feet and a minimum stage of 1,038.6. Maximum monthly discharge is associated with snowmelt and high precipitation events during April of each year. Minimum discharge occurs during the summer months.

Surface waters at the General Instrument site are drained by Potash Creek. Potash Creek flows south/southwest and joins the Chenango River approximately one mile south of the Village. Paved areas on the site drain into catch basins that lead to the underground culvert running through the old creek bed. Open grassy areas around the site and the South Field drain via runoff to the south/ southwest or by precolation into groundwater. The general lack of surface drainage features at the site can be explained by the highly permeable nature of the Howard loamy soil at the site, which the Soil Conservation Service describes as "extremely well drained" (Chenango Soil Survey, 1985). Residential yards to the east drain via percolation, as there is no apparent storm drainage system in place. Route 12 east of the site drains via catch basins and underground piping, which empty into the culvert in Potash Creek.

The Wescar property north of the site displays minor localized ponding in the tanker truck loading area; otherwise surface drainage is to the west into Potash Creek or the "dry" ravine along the railroad tracks.

The agricultural fields west of the site are moderately well drained. The soil in this field is of the Hamblin type, as classified by the SCS. Although the Hamblin type itself is moderately well drained, it is often associated with more silty soil types that are poorly drained. There are no known drainage tiles in the field; consequently, it was wet and saturated during the 1989 field season.

The General Instrument site is not located within a 100-year floodplain of the Chenango River. The area was mapped by the USGS (Figure 8), who designated 100-year floodplains west of the site. There is a mapped wetland (greater than 12.4 acres) located approximately 1-1/2 miles southwest of the site.

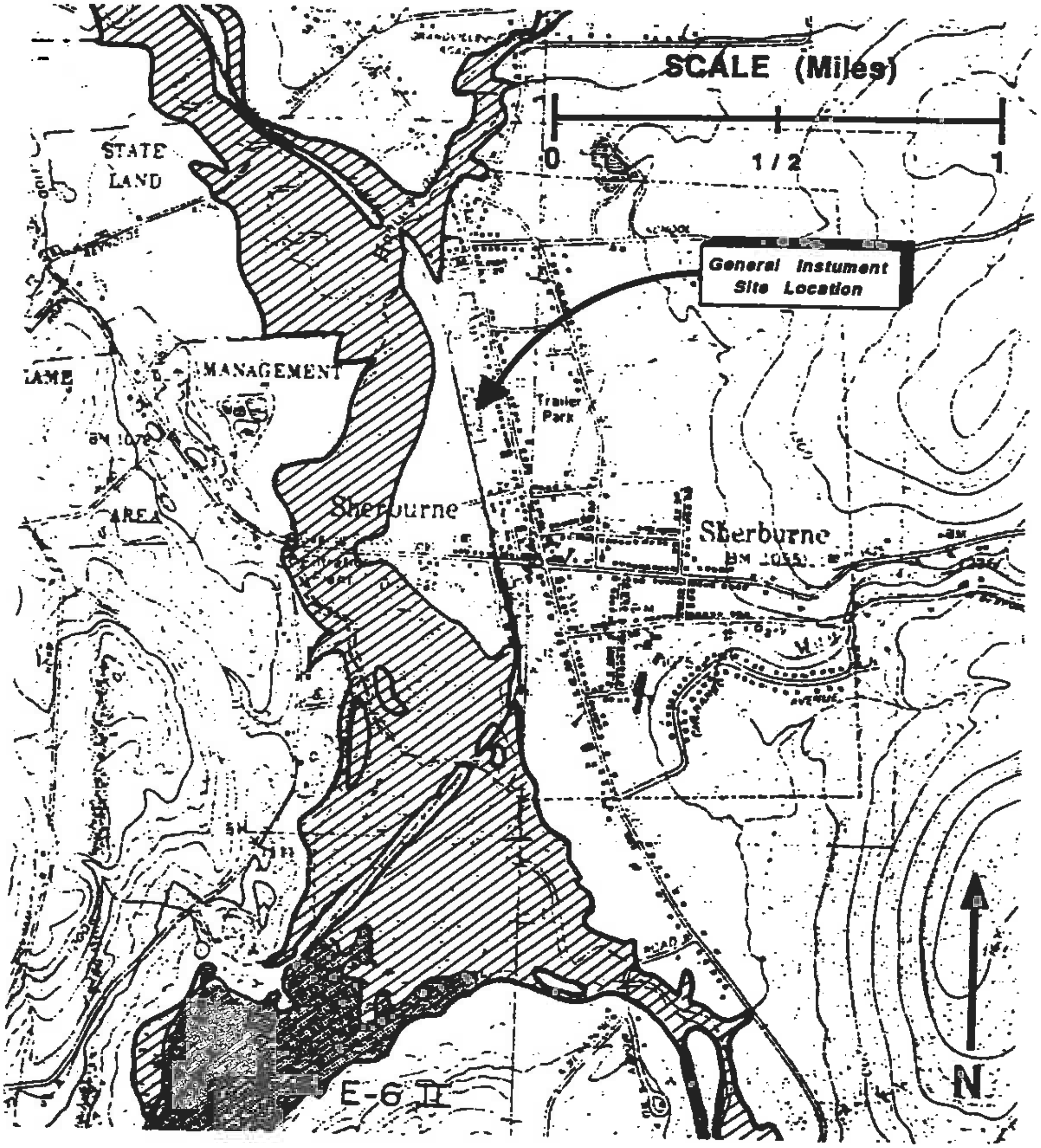
3.6 Geology

3.6.1 Bedrock Geology

Sherburne is located within the Appalachian Plateau geographic province of New York State. The plateau region is an area of glaciated Paleozoic sedimentary rocks that exhibit considerable relief, resulting from the erosion and scour associated with the advance and retreat of Pleistocene glaciers. Generally, bedrock outcrops or is found within 50 meters of the land surface on topographic highs, in contrast to the valley bottoms that may be filled with more than 500 feet of unconsolidated material.

The Village of Sherburne and the General Instrument site are underlain by the shales and sandstones of the middle Devonian Hamilton group. These rocks are approximately 380 million year old and were deposited in a closed or semi-closed tropical basin at sea level during a period of mountain building. Subsequent to deposition, uplift of the region raised the basin sediments to their current elevation of approximately 2,000 feet above sea level.

Bedrock at the site is generally flat lying with a <1° dip to the south/ southwest. There are subtle northeast-southwest trending folds in the bedrock, generally considered to be antithetic to tectonic forces active during the Permian period (approximately 250 million years ago), but not considered of any consequence for this



LEGEND

100 Year Flood Plain — Wetlands, 12.4 Acres or Greater

Job Number: 1587	Drawn by: EJH	Stearns & Wheler Environmental Engineers and Scientists	General Instrument Corporation TACO Street, Sherburne, NY
Approved by:	Date: 12/90	Cazenovia, NY Darien, CT Watertown, NY Tampa, FL	Figure 8 Wetlands and 100 Year floodplains

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study. Vertical fracture sets identified in the Hamilton group trend northwest-southeast across the area. These fractures are also believed to be a result of tectonic activity in the Permian period and are not active today, nor is there any evidence that they have been active in the recent past.

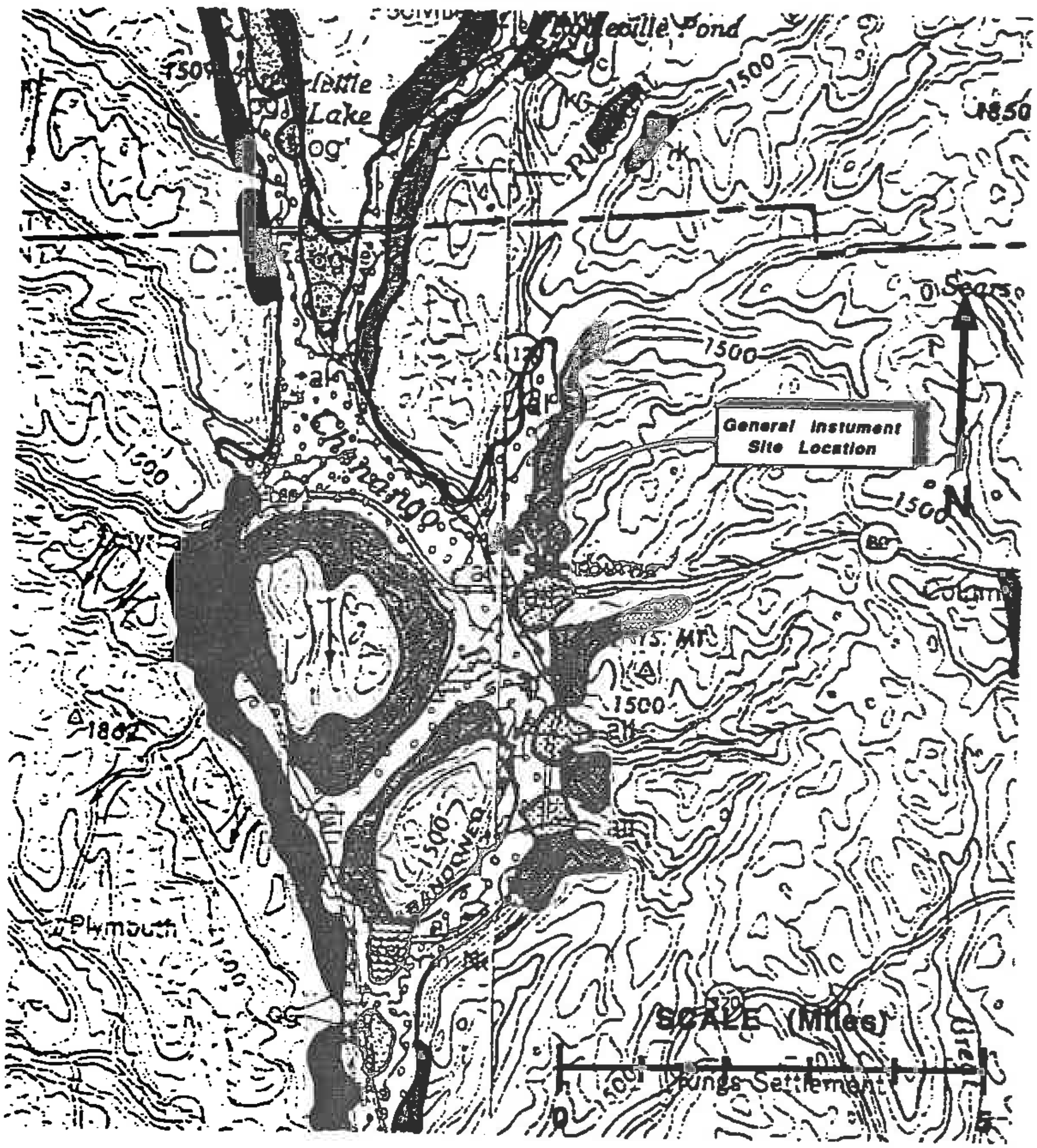
3.6.2 Surficial Geology

During the Pleistocene epoch (3.8 million years ago to 10,000 years ago), the region experienced extreme erosion by continental glaciation. The glaciers enlarged fluvial valleys and were largely responsible for carving the relief seen on the plateau today. The glaciers also deposited vast quantities of debris and sediment. Near Sherburne, the glaciers deposited a "till" on the uplands. Till is an unsorted mixture of clay, gravel and sand believed to have been deposited directly by glacial ice. In the valleys and along valley walls, sand and gravel kame deposits mark the edge of the ice sheet. Valley bottoms received the finest material (mostly silt and clay) deposited by the glaciers. The great accumulations of silt and clay were deposited in large lakes that formed in the valleys in front of the glaciers. The lakes drained as the ice retreated, so that today rivers and their associated alluvial deposits occupy the valley bottoms.

The surficial geology at the General Instrument site consists of the modern alluvial sand and gravel associated with the Chenango River and its smaller tributary streams (Figure 9). The alluvium varies in thickness from 5 to 15 feet across the site and is underlain by glacial lake clays, which are in turn underlain by glacial sand and gravel and bedrock.

3.7 Area Soils

The soil at the General Instrument site was mapped by the Soil Conservation Service in 1985 as the Howard soil type (Figure 10) (Chenango Soil Survey, 1985). Howard soil is deep, well drained, and in some cases, excessively drained gravelly loam soil. Typically, the surface layer is dark grayish-brown, while the subsoil lightens in color to a pale brown and coarser grain size. Water movement is moderate or moderately rapid in the surface soil and extremely rapid in the subsoil. High frost potential limits the use of the soil for road construction, and the



LEGEND

- Alluvial Fan
- Bedrock
- Kame Deposits
- Kame Moraine
- Lacustrine Sand
- Outwash Sand and Gravel
- Recent Deposits

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1587	[illegible]	Environmental Engineers and Scientists Cazenovia, NY Darien, CT Watertown, NY Tampa, FL	
Approved by:	Date: 12/90		Figure 9 Surficial Geology

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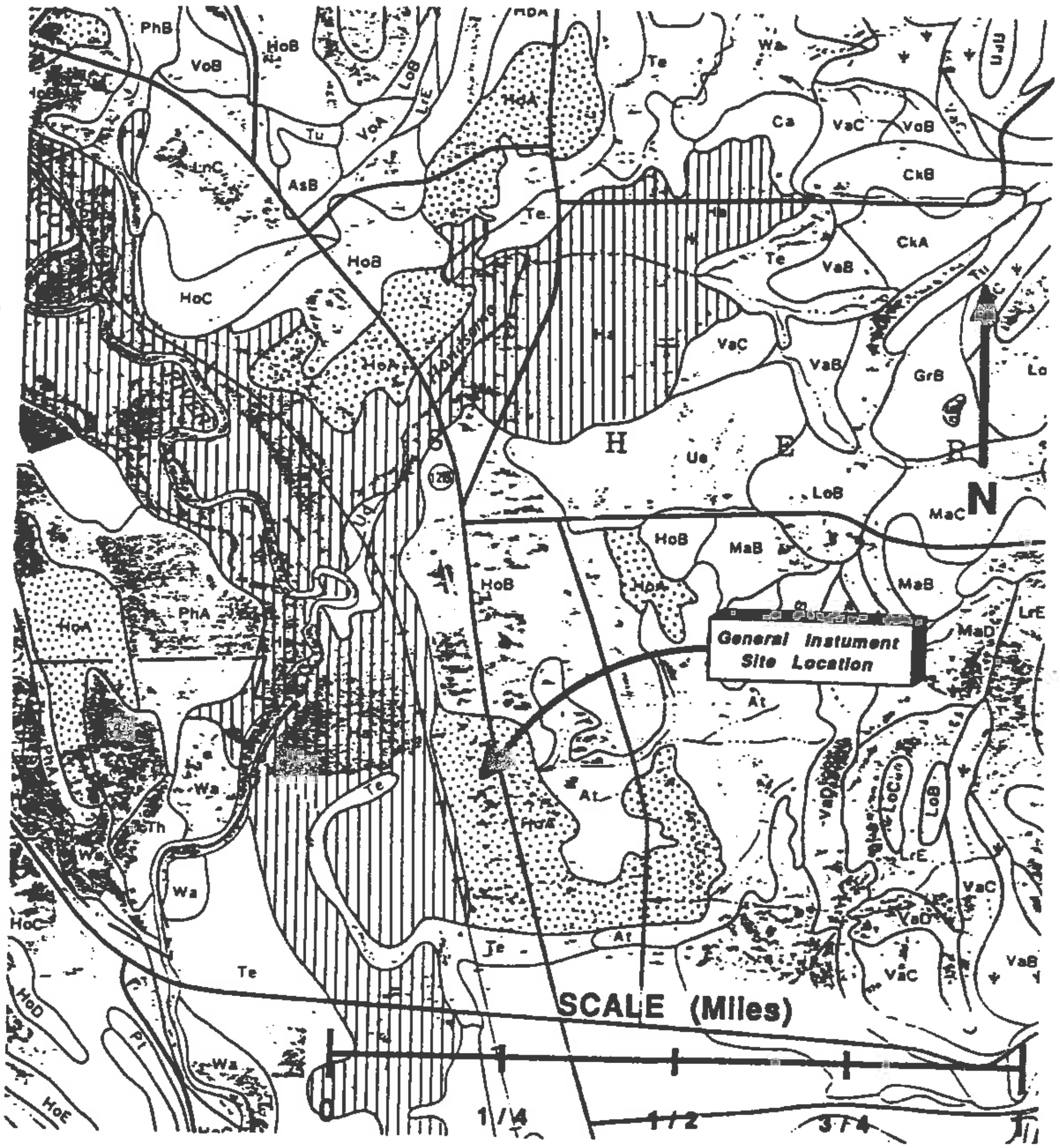


LEGEND

Hamlin silt loam, low bottom	Howard gravelly loam, 0 to 3 % slopes

Job Number: 1587	Drawn by:	Stearns & Wheler Environmental Engineers and Scientists	General Instrument Corporation TACO Street, Sherburne, NY
Approved by:	Date:	Cazenovia, NY · Waterlown, NY · Darien, CT · Tampa, FL	Figure 10 Soil Map

soil survey reports that the rapid water movement through the sub-stratum causes a hazard of groundwater contamination in areas used for septic leaching.

Today, the only observed areas of native soil development at the site were in the test pits and well borings. Extensive excavation, originally for canal construction and subsequently for railroad and plant construction, disturbed large areas of the site. Additionally, extensive excavation, disposal and backfill of contaminated soil were conducted as part of the plant closure. It is safe to say that the majority of the site has been impacted from construction and backfilling. Backfill used at the site consists of a sandy gravel (called No. 2 fill), mined from local gravel pits. Although the exact origin of the fill is not known, a reconnaissance of several active sand pits in the area revealed that the fill came from sand and gravel associated with kame deposition on the adjacent valley walls.

3.8 Subsurface Features

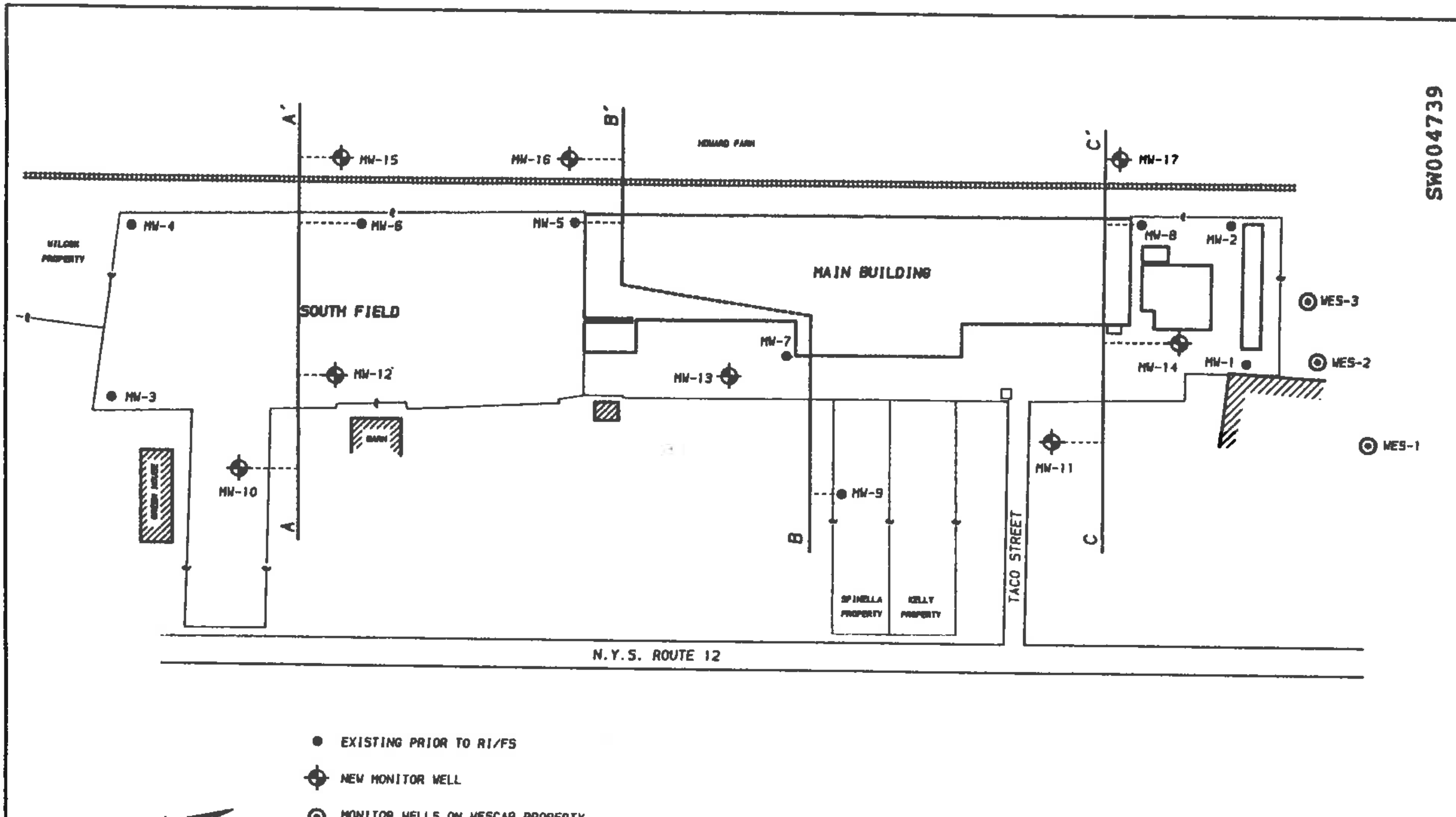
An understanding of the subsurface was developed by reviewing logs of existing wells and by completing new wells and test pits.

A total of 17 well borings have been drilled at the General Instrument site. Well Nos. 1 through 9 were constructed prior to this Remedial Investigation, whereas Nos. 10 through 17 were installed by Stearns & Wheler as part of this investigation. The drilling logs from all wells are included in Appendices D.1 and D.2.

Thirteen test pits were completed as part of this Remedial Investigation. Test pit logs are found in Appendix D.3. Data from observation trenches and excavation pits constructed during plant closure were not used in this report.

3.8.1 Well Borings

As directed by the work plan, eight monitoring wells were installed at the site in October 1989 (Figure 11; a map illustrating the surveyed well locations can be found in Plate 3). All well borings encountered a damp, brown sandy soil with some gravel near the ground surface. A thin, organic-rich topsoil was encountered at MW-3.



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Job No. 1587	Figure No.	

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Figure 11
Location of Monitoring Wells

MW-5, MW-6 on site and at MW-15, MW-16 and MW-17 off site. Fill was encountered near the ground surface at all other wells. Generally, the near-surface fill or topsoil is underlain by a brown-gray sandy silt horizon that grades into a wet sandy brown gravel. The wet gravelly material is underlain throughout the site by a blue-gray, clayey silt of suspected glacial origin.

Subsurface stratigraphy is fairly uniform throughout the site; a sandy-gravel fill or a loamy topsoil overlies a brown-gray sandy silt that grades into a coarse gravel (see Figures 12, 13 and 14 for cross sections). The entire sequence rests atop a clayey silt, probably of glaciolacustrine origin. Depth to the top of the glacial sediment varies from 13 feet to 26 feet in the subsurface.

3.8.2 Test Pits

Thirteen test pits were excavated throughout the site (Figure 15). Test Pit Nos. 1 through 5 were designed to locate and sample the soil in and around the old Chenango Canal and Potash Creek. Test Pit Nos. 6 through 8 broke through the concrete floor of the plating room to test the underlying soil for contamination. Test Pit Nos. 9 and 10 sampled soil in the shallow subsurface west of the plating room. These pits were dug because the soil in the vicinity of MW-8 and west of the plating room became suspect when routine examination with a photoionization detector found the presence of volatile compounds in the surface soil. Test Pit Nos. 11, 12 and 13 were excavated north of the woodshed at the boundary between the General Instrument property and the Wescar bulk storage facility. These pits were dug when a "fresh" release of petroleum product was discovered during weekly visual examination of the site. All test pits were examined with a PID. Records of PID logs are presented in Appendix C.

Test Pit No. 1 excavated through a brown sand and gravel to a depth of 48 inches, at which point flooding and sidewalk cave-in prevented deeper penetration. The brown sand and gravel appeared to be fill rather than native soil. The pit uncovered two 8-inch drainage tiles in the shallow subsurface and a 24-inch plastic culvert at approximately 3 feet in the subsurface. The 24-inch culvert is the underground enclosure and continuation of Potash Creek through the south end of the site.

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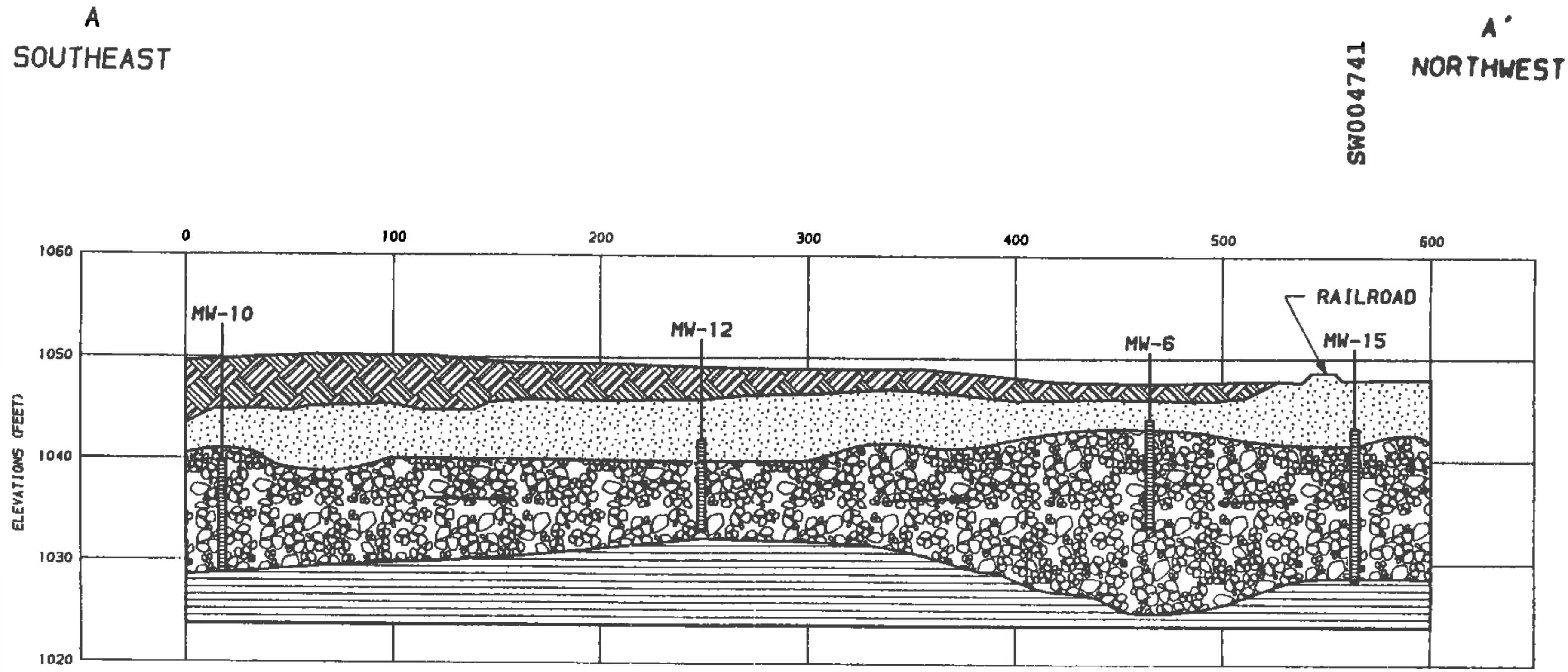

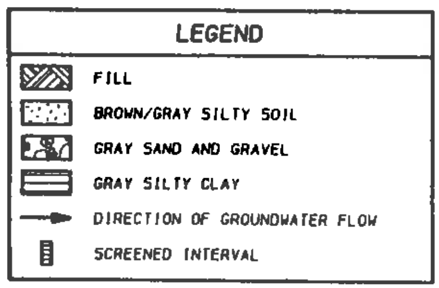

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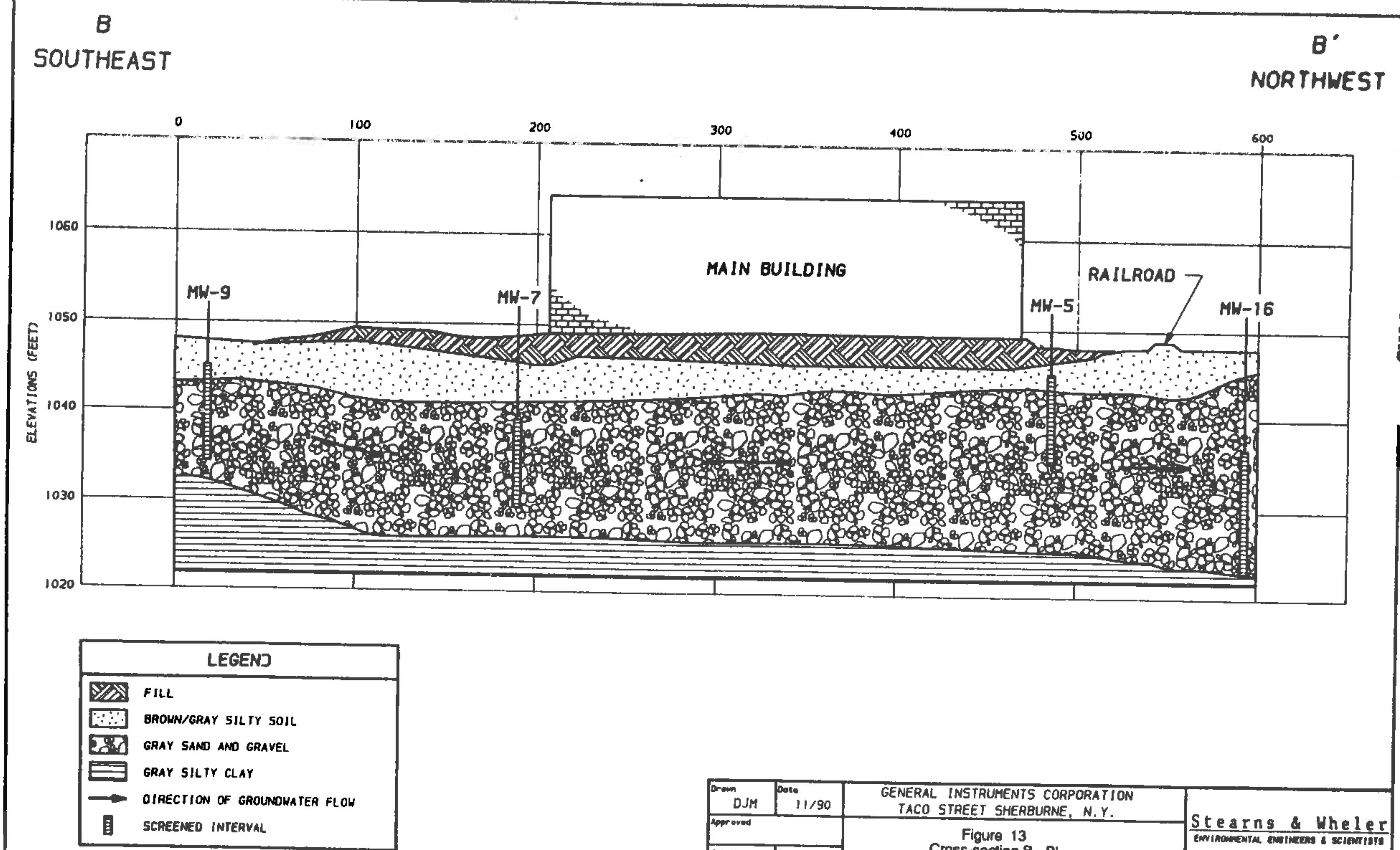
Approved		Figure 12 Cross-section A - A' (see figure 11 for location)	CAZENOVIA, NY DARIEN, CT WATERTOWN, NY TAMPA, FL
Job No. 1587	Sheet No.		



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Approved		Figure 13 Cross-section B - B' (see figure 11 for location)	
Job No. 1587	Sheet No.		

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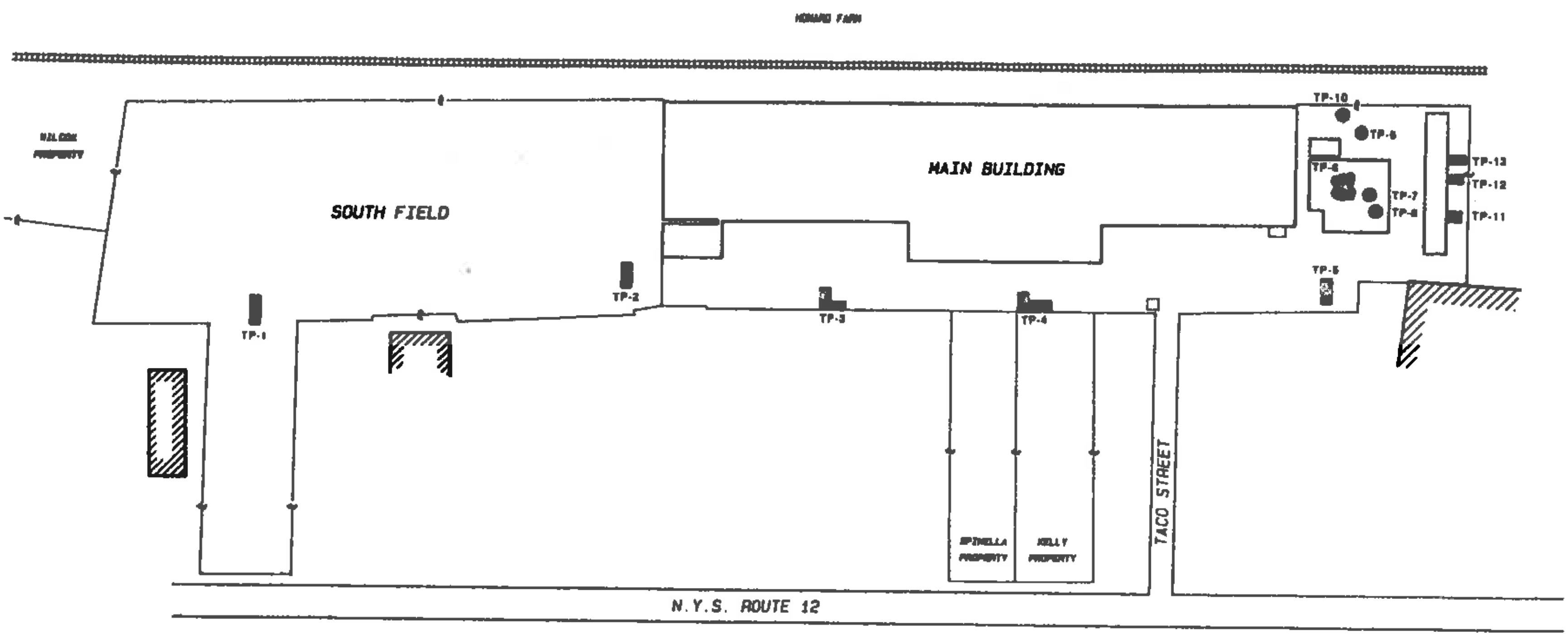

TEST PIT (APPROXIMATE SHAPE ILLUSTRATED)

1"=100'-0"   100   0   100   200

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Approved		ENVIRONMENTAL ENGINEERS & SCIENTISTS	Figure 15
Job No. 1587	Sheet No.	CAZENOVIA, NY / WATERTOWN, NY / DARIEN, CT / TAMPA, FL	Test Pit Locations

Test Pit No. 2 penetrated a reddish-brown sand and gravel, suspected to be fill, to a depth of 2 feet. The excavation encountered a tan (brownish) sandy soil extending downward from 2 feet in the subsurface to the bottom of the pit at 5 feet in the subsurface. The tan sandy soil is interpreted to be native soil classified as Howard loam by the Soil Conservation Service. Photoionization detector (PID) readings were "zero" (not greater than background) in the pit.

Test Pit No. 3 was an "L"-shaped pit constructed to provide three- dimensional control of the subsurface stratigraphy. The upper 2 feet of the subsurface soil was reddish-brown fill; at 2 feet, the hole uncovered refuse, bottles, metallic debris, and grayish-white clay streaks interpreted to be coal ash. The refuse and coal ash are interpreted to be debris which had been deposited in the Old Chenango Canal sometime after it was abandoned. The inferred age of the bottles and the presence of coal ash suggest that the refuse was placed in the canal in the late 19th Century or early 20th Century. The bottom of the excavations encountered a mottled gray clay interpreted to be the bottom of the canal.

Test Pit No. 4 encountered similar reddish-brown fill to a depth of 1.5 feet. Refuse interspersed with coal ash and orange oxidized horizons indicated the location of the old canal. Refuse extended from 1.5 feet in the subsurface to 5 feet. A gray clay with fossil molluscs and oxidized horizons was discovered from 4. 5 feet to 6 feet in the subsurface. The PID detected low concentrations of volatile compounds throughout the pit. Values ranged from a high of 7.7 ppm at 2 feet (the top of the refuse layer) to 1.5 ppm at the bottom of the pit.

Test Pit No. 5 penetrated the asphalt surface of the paved parking lot southeast of the plating room. Refuse was encountered at 1.5 feet in the subsurface, underlying a reddish-brown sandy gravel fill. At 4.5 feet, the pit uncovered a gray mottled clay. The excavation ended at 5.5 feet. The photoionization detected no volatile compounds.

Composite soil samples were collected from Test Pit Nos. 1 through 5 at 6-inch intervals from the pit sidewalls. In Test Pit No. 1 and Test Pit No. 5, excavation uncovered the 24-inch drainage culvert laid in the old course of Potash Creek. The condition of soil under and around the culvert was noted, and a sample of the soil was composited with the soil sample. At both locations, PID readings were "zero"; there was no evidence of leakage, discolored soil or breakage.

Test Pit No. 6 excavated an irregularly-shaped pit around the 24-inch vertical floor drain tile in the zinc plating room. Air-activated jackhammers were used to break through approximately 18 inches of concrete in the floor area and subfloor of the facility. A mini-backhoe was then brought in to enlarge the hole and remove soil. Beneath the concrete slab, sandy gravel fill 3 to 4 feet thick surrounded the floor drain pipe. Beneath the sandy gravel fill, a fine gray-brown clayey silt was encountered, which was interpreted to be native soil. An odor was sensed near the pit, and the presence of volatile compounds was confirmed with the PID. PID readings from just below the concrete floor and down to the bottom of the fill ranged from 1 to 3 ppm. PID values increased to 720 ppm at the contact with the native soil 4 feet below the concrete surface.

The high concentrations of volatile compounds encountered in Test Pit No. 6 (up to 720 ppm as measured with a PID) constituted a potential health threat. Concentrations above 100 ppm may be hazardous under any conditions, but since this work was being done indoors, extra precautions were required and the pit was sampled in Level C personal protection. Dragger™ tube samples (a compound specific method) were collected for benzene, vinyl chloride, and hydrozene. Benzene was the only analyte detected (0.8 ppm) which was below generally accepted safe concentration standards. A soil sample was collected from the native soil at the bottom of the pit for analysis.

Test Pit No. 7 enlarged a smaller hole that had already been excavated around a small floor drain in the vapor degreasing area of the plating building. The hole was dug by hand to a depth of about 18 inches, where native soil was encountered. PID readings in the shallow pit ranged from 5 to 15 ppm. A soil sample was collected from the native soil.

Test Pit No. 8 pierced the concrete slab in the vapor degreasing area north of the plating room. Jackhammers were used to break the concrete, and the hole was enlarged by hand shovel. Native sandy soil was encountered at a depth of 24 inches, and the excavation was terminated. PID readings ranged from 2 to 5 ppm. A soil sample was collected.

Test Pit Nos. 9 and 10 were excavated through the compacted sandy gravel fill in the open area west of the plating building. The sandy gravel fill at the surface was probably compacted by large trucks and equipment traversing the area to gain access to the loading dock entrance on the west side of the plating room and the north end of the main building. The holes were dug by pick and shovel to a depth of 12 to 24 inches. No native soil was encountered in the holes. PID readings ranged from 5 to 17 ppm in Pit No. 9 and 0 to 9.5 ppm in Pit No. 10. Upon close inspection with the PID, it was discovered that the sandy/silty component of the fill in No. 9 and No. 10 contained the highest concentrations of volatiles. Therefore, soil sampling procedures were modified to try to recover as much of the finer component of soil as possible.

Test Pit Nos. 11, 12 and 13 were dug in the open area north of the wooden shed at the north end of the building. The surface soil in the vicinity of these pits was discolored. PID readings at the ground surface exceeded 200 ppm, and there was a strong odor in the area. All three pits unearthed 1.5 to 3.0 feet of sandy gravel fill, on top of approximately 2.0 feet of a black sooty material that resembled charcoal in appearance. Native tan clayey-silt was exposed at 3.5 to 5.0 feet in the subsurface. Ambient PID readings in Pit Nos. 11 and 12 ranged from 3 to 9 ppm and up to 350 ppm at the contact between the sooty material and overlying gravel fill. PID readings in Test Pit No. 13 were "zero".

3.9 Hydrogeology

3.9.1 Principles of Groundwater Flow

Any accumulation of liquid water below ground level is called groundwater; when that accumulation is capable of yielding a significant amount of water to wells or springs, it is called an aquifer. There are two types of aquifers: confined and unconfined. An unconfined aquifer is called a water table aquifer because the water table, in equilibrium with atmospheric pressure, forms the upper boundary of the aquifer. A confined aquifer is "confined" by an aquitard (or impermeable unit), which forms the upper boundary of the aquifer. A confined aquifer is in hydrostatic equilibrium with the recharge area, resulting in an upward pressure on the overlying confining layer. In a confined aquifer, water level will rise above the aquitard in monitor and production wells. Wells in confined aquifers are sometimes called artesian; if flowing at land surface, they are called flowing artesian wells.

Water in an aquifer flows, and in some respects, groundwater flow is analagous to surface water flow. Groundwater flows from areas of higher head to areas of lower head, just as surface water flows from higher elevation to lower elevation. Head is defined as a measure of the potential energy at any point in a groundwater flow system expressed as the sum of elevation and pressure.

Surface water enters the groundwater in areas of groundwater recharge, where the net flow of water is downward. The net flow of groundwater is upward in areas of groundwater discharge. Groundwater flows from areas of recharge to areas of discharge. Recharge and discharge areas can be differentiated in several ways. In general, topographic highs are recharge areas and topographic lows are discharge areas. In recharge areas, a pair of wells completed at different depths will show higher water levels (head) in the shallower well, indicating downward flow. Conversely, in discharge areas, the deeper well will have a higher water level, indicating upward flow. Another method which is used to distinguish between discharge and recharge areas is to measure the concentration of dissolved solids. Generally, the dissolved solid content of groundwater will increase along a flow path. Groundwater in discharge areas will be more mineralized than groundwater in recharge areas because the water has been in contact with soil and rock for a much longer period of time.

A groundwater flow system is defined as a discrete area of flow that utilizes a common recharge and discharge zone. Flow systems occur on different scales and can have lengths of flow ranging from several hundred feet to several hundred miles. Flow systems are analagous to surface drainage systems in that regional flow systems encompass several intermediate flow systems and intermediate flow systems include several local flow systems.

Groundwater divides are boundaries between flow systems. At the divide, groundwater flow does not occur. Divides can be divergent, such as hilltops, where flow moves in opposite directions away from the topographic high. Divides can also be convergent; rivers, streams (and other discharge areas) are convergent boundaries. Groundwater moving towards rivers from either side cannot flow across because the convergent boundary (at the river surface) represents the area of lowest head in the flow system.

Recharge to a groundwater flow system can occur through infiltration of precipitation or through percolation from leaking stream and lake bottoms. Conditions which are favorable to high rates of infiltration from precipitation are:

- Permeable Soils: Allow higher rates of infiltration.
- Low Initial Soil Moisture Content: Capillary action will initially draw water in rapidly.
- Gentle Slopes: Slow the rate of runoff, allowing more time for infiltration.
- Vegetative Cover: Will also slow runoff.
- Rainfalls of Low Intensity and Long Duration: The rate of application will then not exceed the soil's ability to accept water.

Conditions opposite to those listed above (i.e. soils of low permeability; steep slopes; lack of vegetative cover; and short, high intensity rainfalls) will cause a larger percentage of precipitation to run off, decreasing recharge to the groundwater.

Discharge from the groundwater flow system can be through base flow to streams, through inflow to lakes and wetlands, springs and seeps, and through evapotranspiration. Groundwater discharge is responsible for most of the flow in streams and rivers, especially in the absence of recent rainfall. Streams and rivers have losing and gaining reaches or reaches of net recharge and net discharge with respect to groundwater. A losing reach is a length of stream channel where the net flow is downward into the aquifer. Losing reaches occur where upland streams enter major valleys and along the upper portions of alluvial fans. Usually, streams are "gaining" as discharge from groundwater contributes to stream flow. Springs and seeps occur on steep slopes where the water table intersects the surface and where low permeability layers direct flow laterally until it intersects the surface. Evapotranspiration refers to the use of groundwater by vegetation and is responsible for significant seasonal withdrawal. Direct evaporation can also occur where the water table is within a few feet of the ground surface.

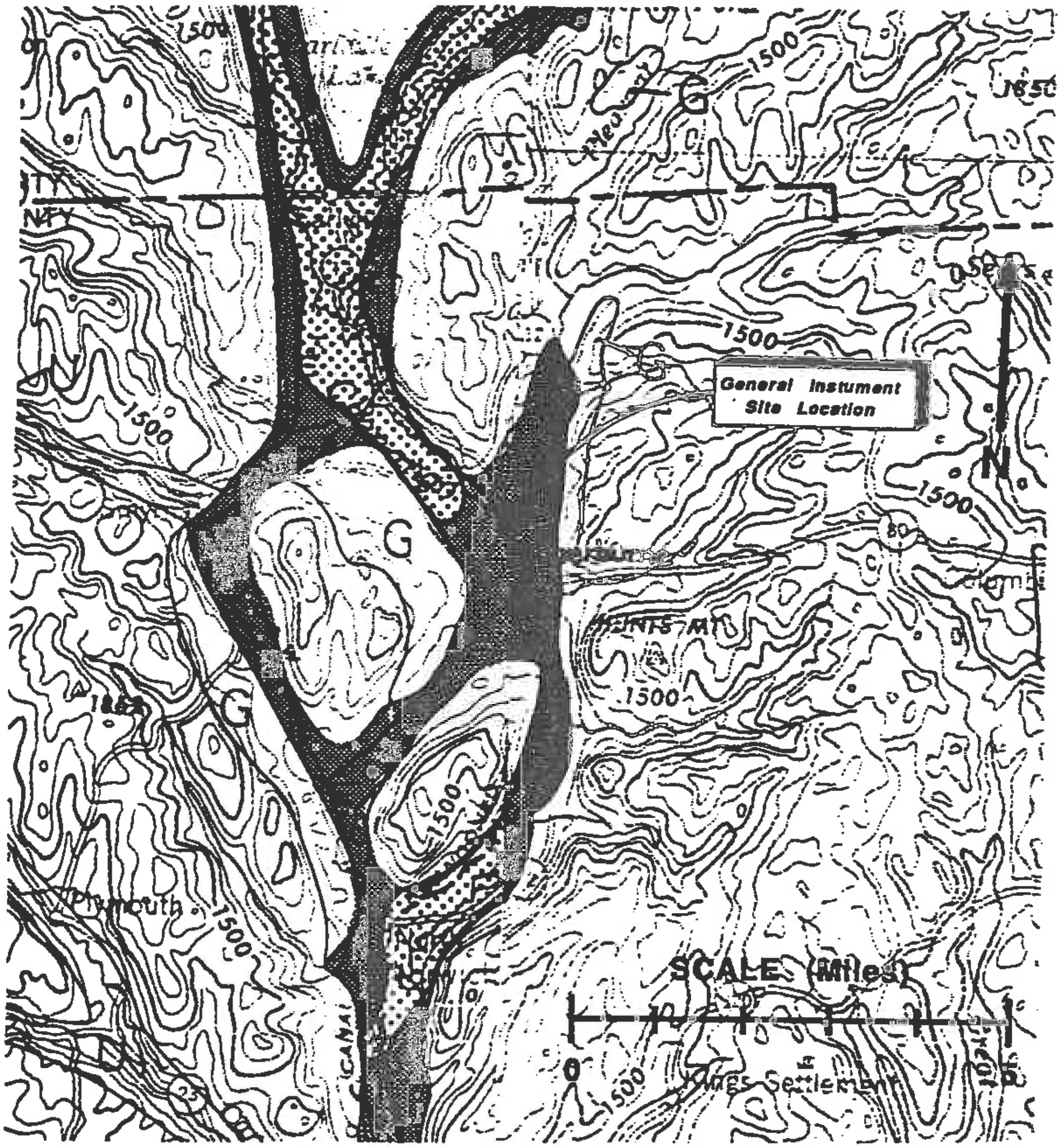
3.9.2 Regional Groundwater Flow

Regional groundwater flow is controlled by topography, overburden (soil) types and thickness, and bedrock lithology (i.e., the dip of bedding surfaces, and rock integrity).

Topography exerts a strong east/west component to groundwater flow in central New York because bedrock valleys generally trend in a north-south direction. Secondary porosity, fractures and dissolution pores and regional dip of bedding planes flow deep in bedrock. Since the Sherburne site is located on a thick accumulation of glacial sediment and alluvial fill, site hydrogeology is dominated by the local valley bottom flow system.

3.9.3 Local Groundwater Flow

Overburden aquifers of the Chenango Valley were mapped by McNish and Randall (1982). They identify both confined and unconfined aquifers in the Chenango Valley near Sherburne (Figure 16). The confined overburden aquifer is located in the axis of the valley north and south of Sherburne, while at Sherburne it extends across the entire valley bottom.



LEGEND

Confined acquifers — Unconfined acquifers

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1587	EJH	Environmental Engineers and Scientists	
Approved by:	Date: 12/90	Cazenovia, NY Watertown, NY Darien, CT Tampa, FL	Figure 18 Mapped Aquifers in Chenango Valley

SW004751

A conceptual model of subsurface stratigraphy was compiled by McNish and Randall, 1982 (Figure 17), from well logs in the Chenango Valley. The model suggests that two separate overburden aquifers exist in the valley: a quarternary sand and gravel aquifer (less than 15 feet thick) in the shallow subsurface, and a deeper quarternary sand and gravel aquifer. The two aquifers are separated by a thick layer (up to 300 feet) of impermeable glacial silts and clays.

There is no published information on the bedrock flow in the Chenango Valley. A reasonable first approximation suggests that flow follows topography, in which case, flow is parallel to slope, toward the axis of the valley.

3.9.4 Site Hydrogeology

Groundwater flow at the site was approximated by measuring water levels in monitoring wells. Water level readings provide the information needed to compile a map of the potentiometric surface of the aquifer. The potentiometric surface provides insight into direction of groundwater flow. Slug tests obtain an approximation of the hydraulic conductivity and transmissivity of an aquifer at the site. Slug tests were conducted at selected monitoring wells at the site. Borehole logs of site wells and area wells provide geologic information used to predict aquifer structure and probable areas of recharge.

All monitor wells on the site were completed in the upper sand and gravel aquifer. The thick glacial silt and clay deposit (approximately 150 feet thick) provides a lower aquiclude to the upper aquifer, preventing communication between the two aquifers.

Water level measurements were recorded in November 1989, January 1990, and July 1990 (Table 3.1). Maps of the potentiometric surface have been compiled in Figures 18, 19 and 20. These maps show that groundwater is found between the elevations of 1,047 feet and 1,044 feet beneath the site. Groundwater flow is predominantly east to west across the site. There is a southwesterly component to flow at the north end of the site, and localized mounding and depressions occur at MW-6 and

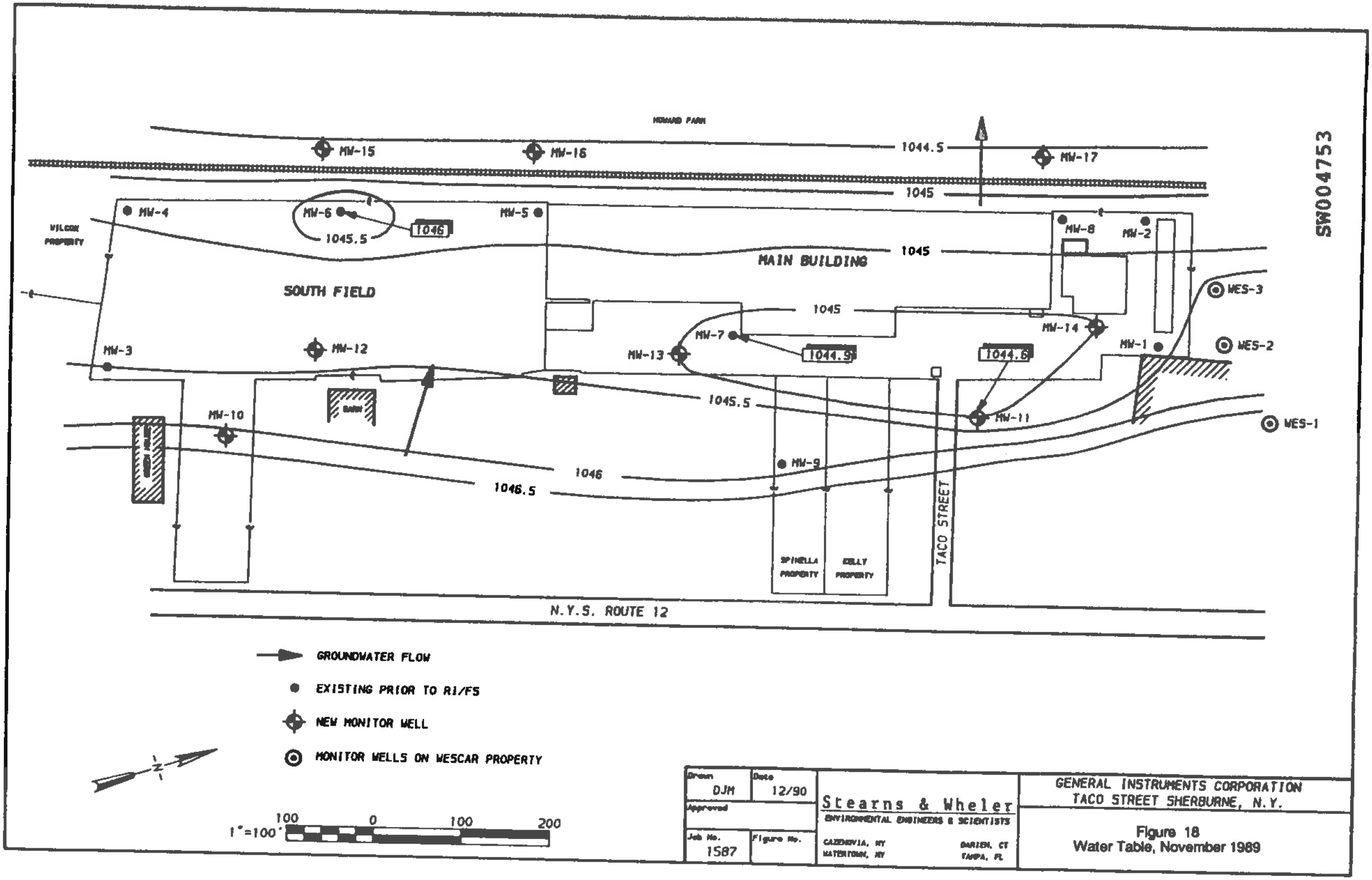
HOWARD FARM
MW-15
MW-16
MW-17
1044.5
1045
WILCOX PROPERTY
MW-4
MW-6
1045.5
1046
MW-5
MAIN BUILDING
MW-8
MW-2
WES-3
SOUTH FIELD
1045
MW-14
MW-1
WES-2
MW-3
MW-12
MW-7
MW-13
1044.9
1044.6
BARN
1045.5
MW-11
WES-1
MW-10
MW-9
1046
1046.5
TACO STREET
SPINELLA PROPERTY
KELLY PROPERTY
N.Y.S. ROUTE 12
GROUNDWATER FLOW
EXISTING PRIOR TO RI/FS
NEW MONITOR WELL
MONITOR WELLS ON WESCAR PROPERTY
N
1"=100'
100
0
100
200
Drawn DJM
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Figure 18
Water Table, November 1989

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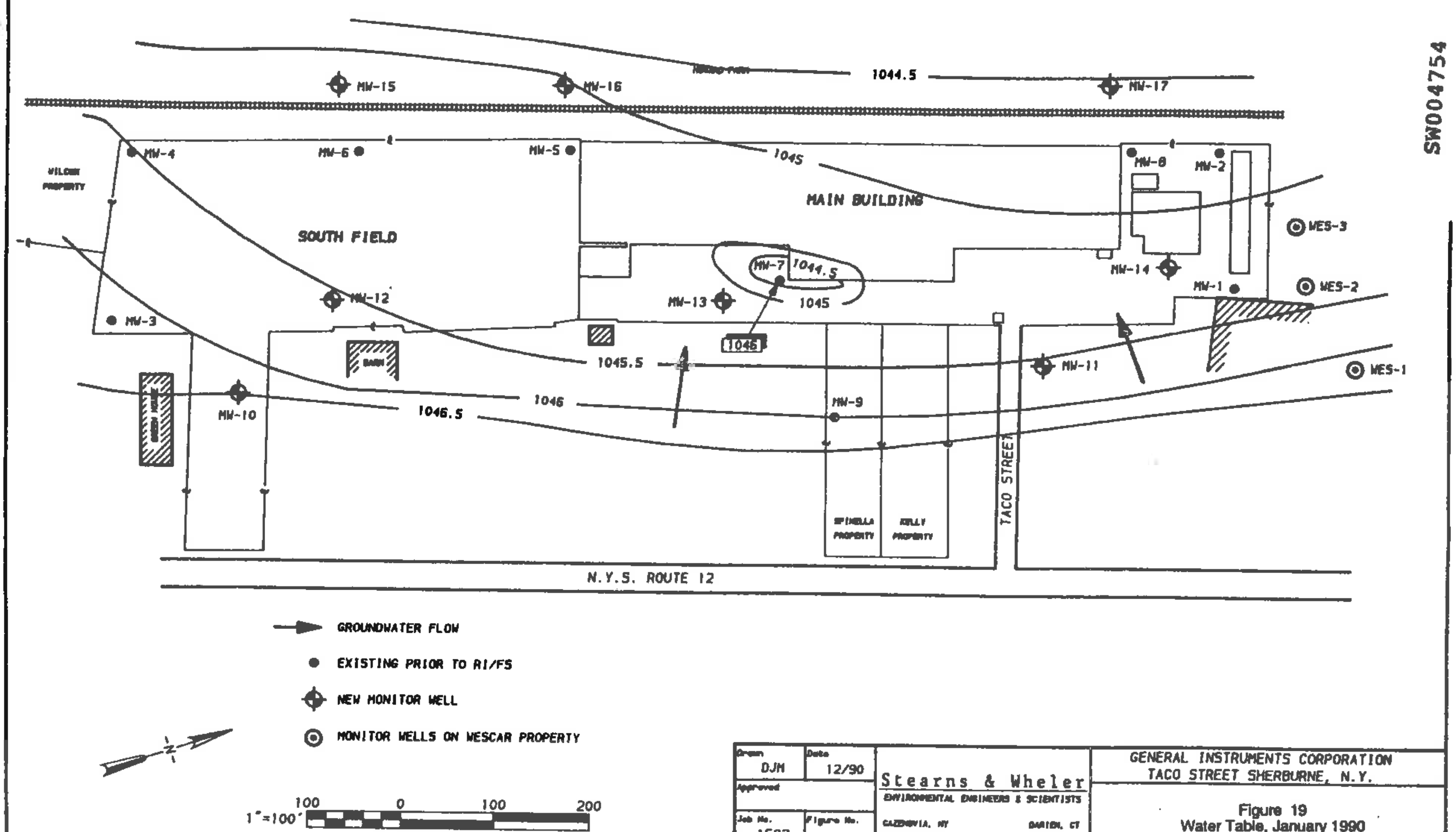

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Approved			Figure 19 Water Table, January 1990
Job No. 1587	Figure No.		

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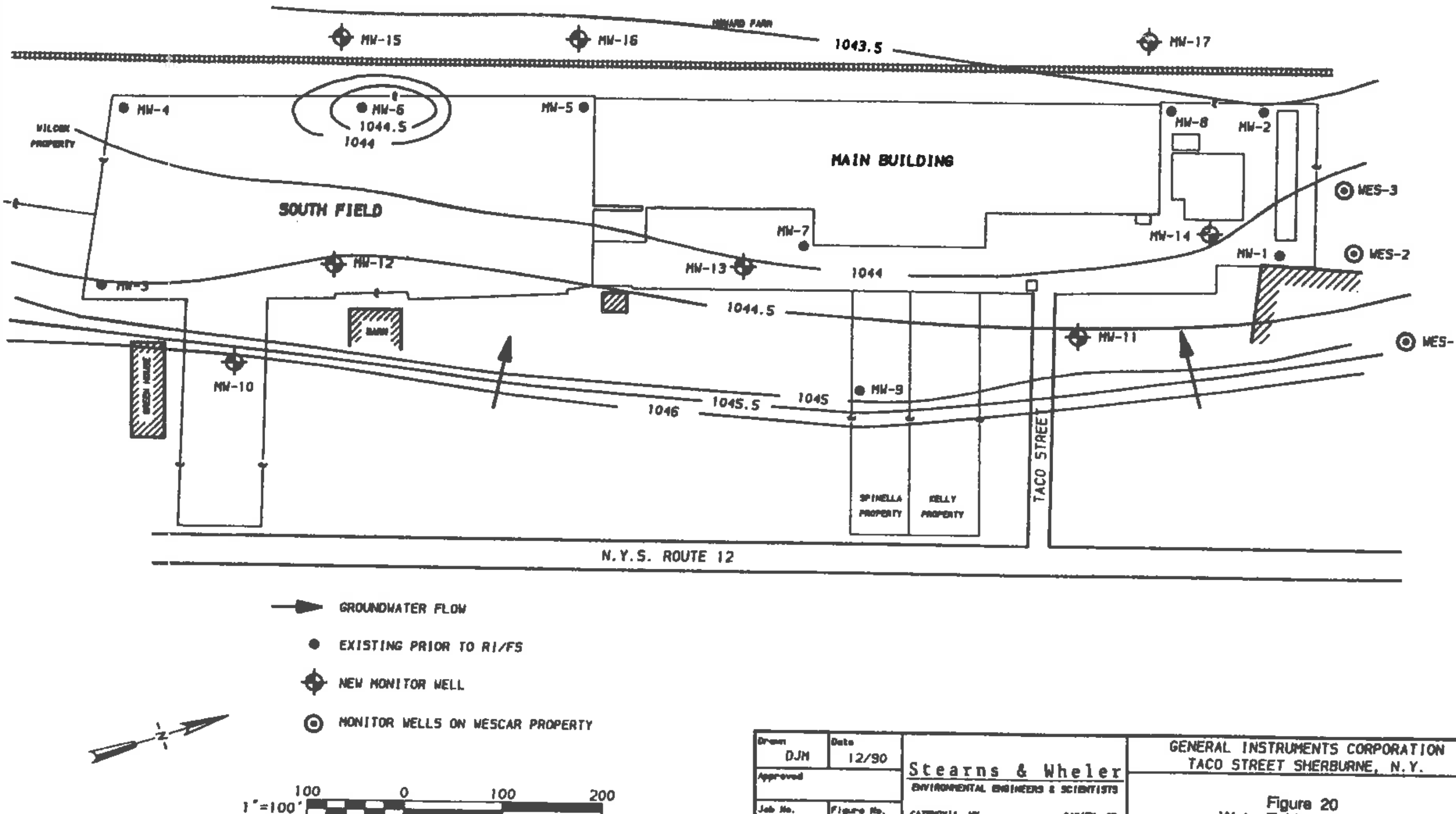

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Approved		CAZENOVIA, NY DARIEN, CT	Figure 20
Job No. 1587	Figure No.	WATERTOWN, NY TAMPA, FL	Water Table, July 1990

SW004755

Table 3.1
WATER LEVEL DATA

Monitor Wells Static Water Level Elevation (feet above mean Sea Level)						
Well Number	Measuring Point Elevation	Land Surface Elevation	2-Nov-89	8-Nov-89	5-Jan-90	26-Jul-90
MW-1	1052.80	1050.70	1045.10	1045.00	1045.10	na
MW-2	1050.60	1048.50	1044.70	1044.80	1044.70	1043.43
MW-3	1050.30	1048.10	1045.30	1045.30	1045.60	1044.52
MW-4	1048.90	1046.80	1044.70	1045.10	1045.50	1043.86
MW-5	1050.60	1048.30	1044.80	1045.20	1045.00	1043.70
MW-6	1050.30	1047.50	1045.60	1046.00	1045.90	1044.56
MW-7	1051.40	1049.50	1044.70	1044.90	1044.00	1043.43
MW-8	1051.00	1048.50	1041.70	1043.00	1043.10	1043.03
MW-9	1050.20	1048.30	1045.80	1045.80	1046.00	1044.75
MW-10	1050.40	1048.00	1046.40	1046.40	1046.50	1046.89
MW-11	1049.63	1049.80	1044.73	1044.63	1044.73	1044.58
MW-12	1050.30	1048.30	1045.50	1045.40	1045.50	1044.58
MW-13	1049.30	1049.30	1045.10	1045.00	1045.20	1044.02
MW-14	1050.01	1050.13	1045.11	1045.01	1045.11	1043.98
MW-15	1050.20	1048.00	1044.40	1044.80	1045.10	1043.76
MW-16	1051.00	1048.50	1044.80	1044.70	1045.00	na
MW-17	1051.20	1047.80	1044.60	1044.60	1044.60	na
*WES-1	1048.80	1049.20	na	1046.80	1046.60	1045.38
*WES-2	1049.70	1050.08	na	1045.60	1045.40	1044.14
*WES-3	1049.00	1049.43	na	1045.60	1045.40	1044.09

* Measuring point elevation approximated from survey and field measurements
MW-8 data was not used because of the confirmed presence of floating hydrocarbon product

SW004756

MW-7. The localized mounding is believed to be the result of short-lived events driven by small-scale variations in aquifer permeability or surface drainage and infiltration.

Groundwater data from MW-8 were not used when compiling the map of the potentiometric surface beneath the site because free phase petroleum product was discovered "floating" in the well. The presence of floating product has the effect of creating a false reading when the depth to the water table is measured with a conductive probe. The conductive probe has the ability to sense groundwater when the open circuit at the tip of the probe is closed by conductive ions in groundwater. In the event of floating free product in the well, the probe will not sense the "non-conducting" petroleum product, but will sense the underlying water. However, the underlying water at MW-8 has been depressed by the mass of the floating product, and will not reflect the true potentiometric surface at that point in the aquifer.

Before the problem at MW-8 was discovered, an incorrect map of the potentiometric surface suggested that groundwater flow was radially directed toward MW-8. However, this interpretation of groundwater flow is wrong, and when the data from MW-8 are removed and the map redrawn, it is clear to see that groundwater flow is westerly toward the Chenango River.

Because the site is located on a flat lying floodplain adjacent the Chenango River, the possibility of groundwater flow direction reversal occurring during flood stage on the Chenango River was investigated. The elevation of the river surface during average flow is approximately 1,040 feet; the average potentiometric surface beneath the site is approximately 1,045 feet. There is a 5-foot difference in elevation between the site and the river surface during normal river stage. The maximum flood stage ever recorded on the river was 1,048 feet, which is 3 feet above the potentiometric surface measured at the site. However, the potentiometric surface at the site would also be expected to rise during a flood due to infiltration of the permeable soil at the site. Therefore, it is unlikely that a flow reversal would occur under normal conditions.

Slug tests were used to approximate the hydraulic conductivity of the aquifer at the site. Hydraulic conductivity is a measure of the rate of water movement through

1 square foot of the aquifer at a known pressure and temperature. Hydraulic conductivity and permeability are similar in that they both apply to the rate of groundwater flow; however, hydraulic conductivity is a quantified measure of actual rate, whereas permeability is a qualitative measure of the aquifer matrix's ability to pass water. Seepage velocity, another measure of groundwater flow, is the linear rate of groundwater flow in a horizontal direction in the aquifer. It is calculated from the following equation:

$$\text{Seepage velocity } V = \frac{KI}{n}$$

where:

K = Hydraulic conductivity

I = Gradient

n = Porosity

(Freeze and Cherry, 1979)

Values for V were calculated and are presented in Table 3.2, where hydraulic conductivity was obtained from slug tests, gradient was obtained from measurements of the potentiometric surface, and porosity was estimated from the literature to be 25-40% (Freeze and Cherry, 1979). Seepage velocity was calculated for minimum conditions (25% porosity) and maximum conditions (50% porosity). Average seepage velocity for minimum conditions is 42 feet/year and 85 feet/year for maximum conditions. Based on these data, it would take at least 15.3 years to 30.9 years for groundwater from the General Instrument site to reach its natural discharge point, the Chenango River. However, because the gradient on the potentiometric surface will decrease as it approaches the river, if the linear velocity remained constant, it would actually take a much longer time to reach the river.

3.9.5 Area Groundwater Quality

There are no water quality data available from the shallow aquifer other than the data generated in this report because the Village uses water from the deep aquifer.

Table 3.2
Seepage Velocity as calculated from Slug Test data

Well Location	Hydraulic Gradient	Hydraulic Conductivity K (cm/sec)	Seepage Velocity *Vmin (ft/day)	Seepage Velocity *Vmin (ft/yr)	Seepage Velocity **Vmax (ft/day)	Seepage Velocity **Vmax (ft/yr)
MW-3	0.0032	8.07E-02	0.183	66.805	0.366	133.610
MW-4	0.0032	6.73E-02	0.153	55.712	0.305	111.425
MW-9	0.0091	5.94E-02	0.383	139.834	0.766	279.669
MW-10	0.0032	2.91E-02	0.066	24.090	0.132	48.179
MW-11	0.00032	1.29E-02	0.003	1.068	0.006	2.136
MW-12	0.0018	4.60E-02	0.059	21.420	0.117	42.840
MW-15	0.0018	5.55E-03	0.007	2.584	0.014	5.169
MW-16	0.0091	3.10E-02	0.200	72.978	0.400	145.955
MW-17	0.00032	3.58E-02	0.008	2.964	0.016	5.927

* Based on a porosity of 25%

** Based on a porosity of 50%

SW004759

Water quality data from the deeper aquifer were provided by the Sherburne Water Department. Results from a recent analysis of the city wells found no detectable levels of organic compounds (J. Guter, Personal Communication, 1990). The most recent inorganic analysis was conducted in 1984 when the last well was completed. Results indicate a neutral pH, low TDS, and metal concentrations are all below MCLs. Results are presented in Table 3.3.

TABLE 3.3

ANALYSIS FROM VILLAGE WELLS

TDS	258 mg/l
TSS	264 mg/l
Alkalinity ($CaCO_2$)	160 mg/l
pH	7.6
Turbidity	3 Ntu
Coliform	<1
Total bacteria	18
Hardness	179
Chloride	31 mg/l
Sulfate	18.7 mg/l
Nitrate	0.094 mg/l
Calcium	27 mg/kg
Sodium	28 mg/kg

Note: All other metals were less than detection limits.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 Potential Sources of Contamination

The plant closure report identified several potential sources of contamination associated with metal plating operations at General Instrument. To the credit of General Instrument Corporation, these sources were largely remediated during plant closure. Hazardous material contained in drums and tanks was disposed of off site, building walls were decontaminated, and contaminated soil was excavated. Despite the extensive cleanup and remediation effort, contamination of groundwater with volatile organic compounds and cyanide persisted, and the issue of metal contamination was never fully resolved.

To resolve the question of whether any sources of contamination remained on the site, Stearns & Wheler devised a work plan to evaluate potential sources. The rationale of the work plan was to fully characterize the four following areas:

1. Precisely identify the source of on-site contamination and delineate between on-site and off-site sources.

2. Further define the site hydrogeology in terms of flow directions and flow rates.

3. Determine the lateral extent of soil contamination.

4. Determine what populations (if any) are at risk from contamination found on the site.

A sampling strategy was developed and groundwater and soil were sampled for all TCL compounds (volatile organic compounds, semi-volatile organic compounds, pesticides, PCBs, metals and cyanide).

Twelve (12) tasks (previously described) were implemented to evaluate specific potential sources of contamination. Each task is briefly described below, and the samples are identified that relate to each particular task.

Task 1	Purpose:	Examine residual soil contamination in the vicinity of Well No. 5.
	Compounds of Interest:	Chromium, cyanide and TCL compounds.
	Sample Identification:	SS-1 (soil); SS-2 (soil); SS-3 (soil); background soil samples, GW-5 (groundwater).
Task 2	Purpose:	Examine soils and groundwater to determine source of volatile organic compound contamination and metals in groundwater on west end of South Field.
	Compounds of Interest:	Volatile organic compounds and metals.
	Sample Identification:	MW-4, MW-5, MW-6, MW-9, MW-15, MW-16 and MW-17 (groundwater); soil gas survey in South Field; SS-1, SS-2, SS-3, SS-10 and SS-12 (background soil samples).
Task 3	Purpose:	Determine source of volatile organic compounds in MW-7.
	Compound of Interest:	Trichloroethene
	Sample Identification:	MW-13, MW-7, MW-9 (groundwater); SS-7, SS-8, SS-9, SS-11, SS-12, SS-13 (soil).
Task 4	Purpose:	Evaluate the possibility that Potash Creek north of the site is a source of volatile organic compounds from off-site contamination.
	Compounds of Interest:	Volatile organic compounds.
	Sample Identification:	SED-1, SED-2 (sediment); GW-18, GW-19, GW-20, MW-1, MW-2.
Task 5	Purpose:	Evaluate the possibility that old Potash Creek (now contained in an underground culvert) is a source of and "preferred pathway" for contamination.
	Target Compounds:	Volatile organic compounds, metals.
	Sample Identification:	Test Pits 1, 2, 3, 4 and 5; SS-10, SS-11, SS-12, SS-13, SS-25, SS-25A; background soil samples.

<u>Task 6</u>	Purpose:	Determine whether refuse deposited in the Old Canal could be a source of leachate contamination.
	Compounds of Interest:	Metals
	Sample Identification:	Test Pits, 1, 2, 3, 4 and 5; SS-10, SS-11, SS-12, SS-13, SS-25 and SS-25A.
<u>Task 7</u>	Purpose:	Search for upgradient source of metal contamination in groundwater.
	Compounds of Interest:	Metals
	Sample Identification:	MW-9, MW-10, MW-11.
<u>Task 8</u>	Purpose:	Determine the source of volatile organic compounds in soil and groundwater in the vicinity of the plating room.
	Compounds of Interest:	Volatile organic compounds, metals.
	Sample Identification:	MW-14, MW-2, MW-8, MW-17 (groundwater); SS-14, SS-15, SS-16, SS-17, SS-18, SS-26, SS-27, SB-3, SB-4, SB-5, SB-6, SB-7, SB-8, SB-9 (soil).
<u>Task 9</u>	Purpose:	Determine source of petroleum hydrocarbon contamination in subsurface at north end of site.
	Compounds of Interest:	Ethylbenzene, toluene, xylene and other volatile organic compounds.
	Sample Identification:	GW-18 (WES-1), GW-19 (WES-2), GW-20 (WES-3), GW-1, GW-2, GW-8, GW-17 (groundwater); SS-26, SS-27, SB-3, SB-4, SB-5, SB-6, SB-7, SB-8 (soil).
<u>Task 10</u>	Purpose:	Determine whether off-site transport has occurred via air transport.
	Compounds of Interest:	Target compound list (TCL).
	Sample Identification:	SS-4, SS-5, SS-6, SS-22, SS-23 and SS-24.

Task 11	Purpose:	Determine whether off-site migration of contaminated groundwater has occurred.
	Compounds of Interest:	Volatile organic compounds, metals and cyanide.
	Sample Identification:	MW-15, MW-16 and MW-17.
Task 12	Purpose:	Re-analyze existing monitor wells (No. 1 to No. 9) to calibrate previously collected data.
	Compounds of Interest:	Volatile organic compounds, metals and cyanide.
	Sample Identification:	MW-1 through MW-9.

4.1.1 Note on Data Reports

Data are presented in tabular form throughout the report. They are generally grouped by task, geographic location, and/or relevance to the investigation.

Detection limits will vary between samples because of the dilution factor used to prepare the sample. Generally, samples that are contaminated or contain a high concentration of an analyte also have a high a high detection limit.

Some results are qualified as "biased high" or "biased low". This comment is assigned by the validators when they determine that procedures or laboratory techniques and equipment created an anomalous quantification. Biased data can also be caused by matrix interference, which resulted in poor "spike compound" recovery. It usually occurs in samples that are highly contaminated. These "biased" data are valid in a quantitative sense (i.e., presence or absence of an analyte); however, the absolute value may be inaccurate.

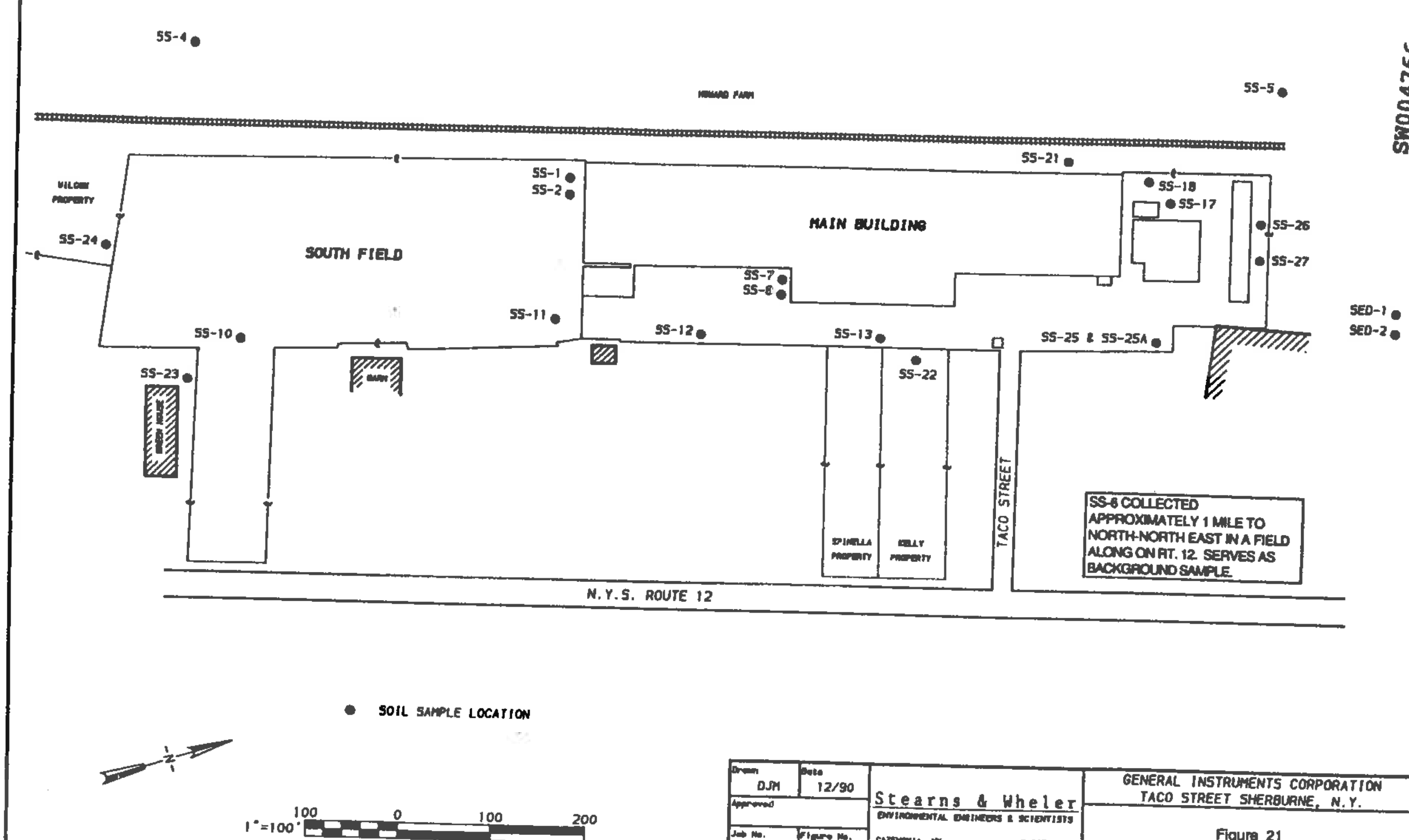
4.2 Volatile Organic Compound (VOCs)

Soil and groundwater samples were analyzed for volatile organic compounds (VOCs). VOCs are a class of compounds that readily vaporize at atmospheric temperature and pressure. Generally, VOCs are divided into two broad categories: halogenated hydrocarbons and aromatic hydrocarbons. Halogenated hydrocarbons (mostly chlorinated) are found in cleaning solvents, degreasing agents and paint thinners. Sample halogenated compounds are trichloroethene (TCE), 1,2-dichloroethene (DCE), 1,1,1-trichloroethane (TCA), and tetrachloroethane (PCE). TCE and PCE are widely used as dry cleaning solvents, paint thinners, and for drying metal parts. DCE is used as a solvent in resin coatings, whereas TCA is used predominantly for cleaning metal parts. The volatile aromatic hydrocarbons are benzene, toluene, ethylbenzene and xylene, commonly referred to as the BTEX compounds. In chemical terms, benzene is the simplest aromatic, consisting of one 6-carbon ring; toluene, ethylbenzene and xylene are variations of the benzene compound. Typically, BTEX compounds are associated with petroleum product contamination. Benzene is a large component of gasoline, as is ethylbenzene. Toluene is an additive in high octane gasoline and used as a solvent in paints and coatings. Xylene is used in motor fuels of various grades and as a solvent for lacquers, enamels and rubber cements.

In general, the suite of volatile organic compounds identified in the groundwater at the site is similar to the suite of volatile compounds identified in the soil. The chlorinated solvents, DCE, TCA, TCE, chloroform (CF), and PCE were found in both the soil and groundwater. The aromatic volatiles toluene and xylene are also common to both the soil and groundwater at the site. Vinyl chloride (VC) and 1,3-dichloropropene were detected in groundwater, but not the soil, whereas 2-butanone, benzene, 2-hexanone and ethylbenzene were detected in the soil, but not the groundwater.

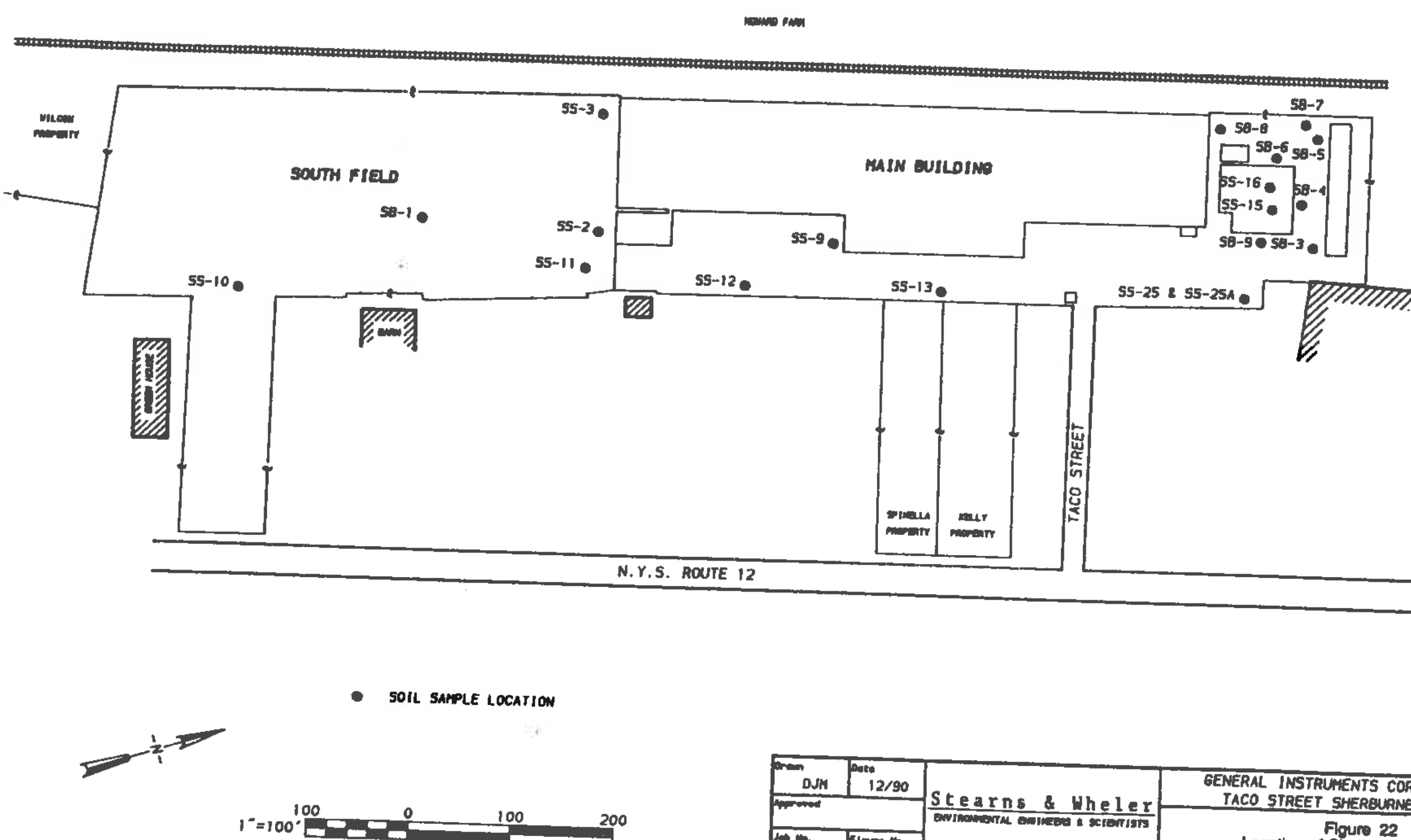
Groundwater samples were collected from all 17 monitoring wells at the General Instrument site and three monitoring wells on the Wescar property (previously presented in Figure 11). Soil samples were collected from test pits and the stream bottom of Potash Creek at varying depths, ranging from the near surface (Figure 21), 2 feet (Figure 22), and 4 feet (Figure 23) in the subsurface.

VOCs were detected in varying degrees in the groundwater and soil on the site; however, the greatest concentrations were found in the vicinity of the plating room, which is located at the north end of the site.



SW004766

Drawn DJM	Date 12/90	Stearns & Wheler ENVIRONMENTAL ENGINEERS & SCIENTISTS CAZENOVIA, NY · WATERTOWN, NY · DARIEN, CT · TAMPA, FL	GENERAL INSTRUMENTS CORPORATION TACO STREET SHERBURNE, N.Y.
Approved			
Job No. 1587	Figure No.		Figure 21 Location of Surface Soil Samples



Drawn	Date	Stearns & Wheler	GENERAL INSTRUMENTS CORPORATION TACO STREET SHERBURNE, N.Y.
DJM	12/90	ENVIRONMENTAL ENGINEERS & SCIENTISTS	
Approved		CAZENOVIA, NY WATERTOWN, NY	DARIEN, CT TAMPA, FL
Job No. 1587	Figure No.		Figure 22 Location of Shallow Sub-surface (2'-4') Soil Samples

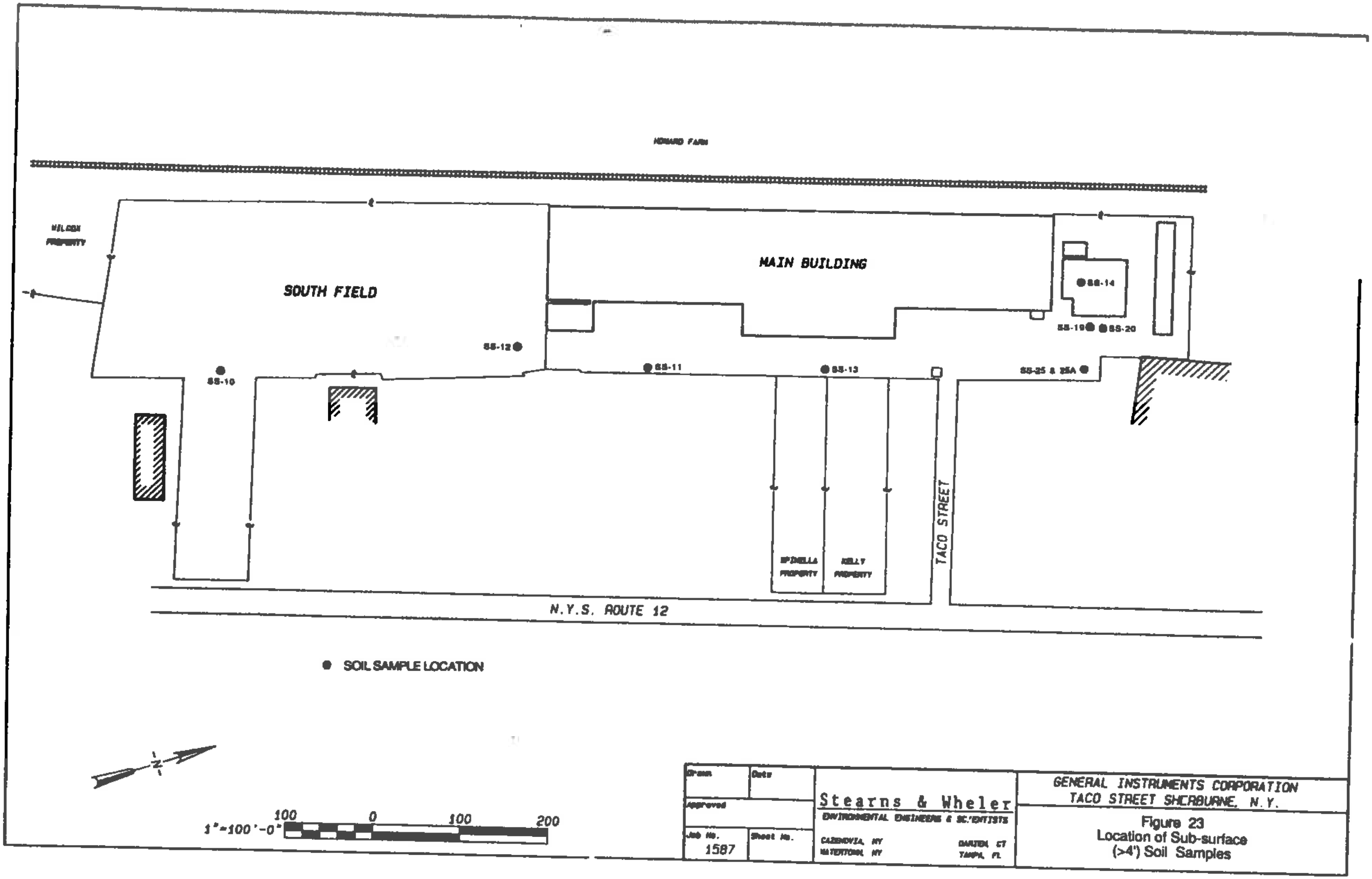


Figure 23
Location of Sub-surface
(>4') Soil Samples

SW004768

4.2.1 Groundwater

Table 4.1 presents the list of volatile organic compounds identified and quantified in the groundwater (see Appendix H for complete results). 1,2-dichloroethene (1,2-DCE) and trichloroethene (TCE) are the most common halogenated contaminants present. 1,2-dichloroethene was found in nine of the 20 wells sampled in concentrations of up to 7,700 µg/l; trichloroethene was discovered in eight of the wells in concentrations ranging from 3-130 µg/l. Other halogenated compounds identified were vinyl chloride (VC); 1,1 dichloroethene (1,1-DCE); 1,1 dichloroethane (1,1-DCA); 1,1,1 trichloroethane (1,1,1-TCA); cis-1,3 dichloropropene; and tetrachloroethene (PCE). BTEX compounds (benzene, toluene, ethylene and xylene), the aromatic volatiles, were also detected in groundwater at the site. Of these, toluene and xylene were found in MW-8 at 110 µg/l and 51 µg/l, respectively. Toluene and xylene were identified, but concentrations only estimated in MW-4, MW-12, WES-2 and WES-3.

No volatiles were detected in MW-6, MW-9 MW-11, MW-14 and WES-1. VOCs were identified, but concentrations only estimated (because values were less than detection limit) in MW-3, MW-12 and WES-2.

The distribution of total halogenated VOCs in groundwater shows the greatest concentration near the plating room. Figure 24 illustrates the approximate lateral extent of contamination and the greatest concentration in MW-8 at the northwest end of the main building. The total concentration of VOCs in MW-8 is 8251 µg/l, of which 7,700 µg/l (93%) is 1,2 dichloroethene (1,2-DCE). The approximate location of the greatest concentration is indicated in Figure 24 by the shaded area. The shaded area represents a zone where concentrations are greater than 100 µg/l. Further downgradient and off site, MW-17 has 309 µg/l total halogenated VOCs (Table 4.1). Upgradient and cross-gradient from these wells, MW-2, WES-3, MW-1 and MW-14 show non-detectable concentrations or concentrations of less than 19 µg/l. The low concentrations upgradient (MW-2, WES-2, MW-1 and MW-14) and high concentrations at MW-8 and downgradient at MW-17 strongly implicate the plating room as the source of halogenated VOCs found in the groundwater. Additionally, there

TABLE 4.1
VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER

Sample Number	GW-01	GW-02	GW-03	GW-04	GW-05	GW-07	GW-08	GW-10	GW-12	GW-13	GW-15	GW-16	GW-17	GW-19	GW-20
Location	MW-1	MW-2	MW-3	MW-4	MW-5	MW-7	*biased low* MW-8	MW-10	MW-12	MW-13	MW-15	MW-16	MW-17	WES-2	WES-3
Compound															
Vinyl Chloride							280 E			2 E			6 E		
1,1-Dichloroethene															
1,1-Dichloroethane		7											7		6
1,2-Dichloroethene (total)		5	3 E	30	8	25	7700			36		11	76		2 E
Chloroform							63 E								
1,1,1-Trichloroethane	10	2E		4 E									96		5
Trichloroethene	3 E	6	3 E	9	9		110 E	6	2E		8	65	130		3 E
Tetrachloroethene	4 E														
Toluene				2 E			110 E	(shaded)	2E		(shaded)			2 E	2 E
Xylene (total)							51 E								
SUMMARY															
TOTAL HALOCARBONS	17.0	20.0	6.0	43.0	17.0	25.0	8153.0	6.0	2.0	38.0	8.0	76.0	315.0	0.0	16.0
% OF VOC'S PRESENT	100.0	100.0	100.0	95.6	100.0	100.0	98.1	88.2	50.0	100.0	89.9	100.0	100.0	0.0	88.9
TOTAL BTEX COMPOUNDS	0.0	0.0	0.0	2.0	0.0	0.0	161.0	0.8	2.0	0.0	0.9	0.0	0.0	2.0	2.0
% OF VOC'S PRESENT	0.0	0.0	0.0	4.4	0.0	0.0	1.9	11.8	50.0	0.0	10.1	0.0	0.0	100.0	11.1
TOTAL VOLATILES	17.0	20.0	6.0	45.0	17.0	25.0	8314.0	6.8	4.0	38.0	8.9	76.0	315.0	2.0	18.0

All concentrations reported in µg/l.
"E" denotes estimated value below detection limit
No Volatile compounds were detected in GW-6, GW-9, GW-11, GW-14 and GW-18
Shaded area indicates data was rejected during data validation.

SW004770

4.2.1 Groundwater

Table 4.1 presents the list of volatile organic compounds identified and quantified in the groundwater (see Appendix H for complete results). 1,2-dichloroethene (1,2-DCE) and trichloroethene (TCE) are the most common halogenated contaminants present. 1,2-dichloroethene was found in nine of the 20 wells sampled in concentrations of up to 7,700 µg/l; trichloroethene was discovered in eight of the wells in concentrations ranging from 3-130 µg/l. Other halogenated compounds identified were vinyl chloride (VC); 1,1 dichloroethene (1,1-DCE); 1,1 dichloroethane (1,1-DCA); 1,1,1 trichloroethane (1,1,1-TCA); cis-1,3 dichloropropene; and tetrachloroethene (PCE). BTEX compounds (benzene, toluene, ethylene and xylene), the aromatic volatiles, were also detected in groundwater at the site. Of these, toluene and xylene were found in MW-8 at 110 µg/l and 51 µg/l, respectively. Toluene and xylene were identified, but concentrations only estimated in MW-4, MW-12, WES-2 and WES-3.

No volatiles were detected in MW-6, MW-9 MW-11, MW-14 and WES-1. VOCs were identified, but concentrations only estimated (because values were less than detection limit) in MW-3, MW-12 and WES-2.

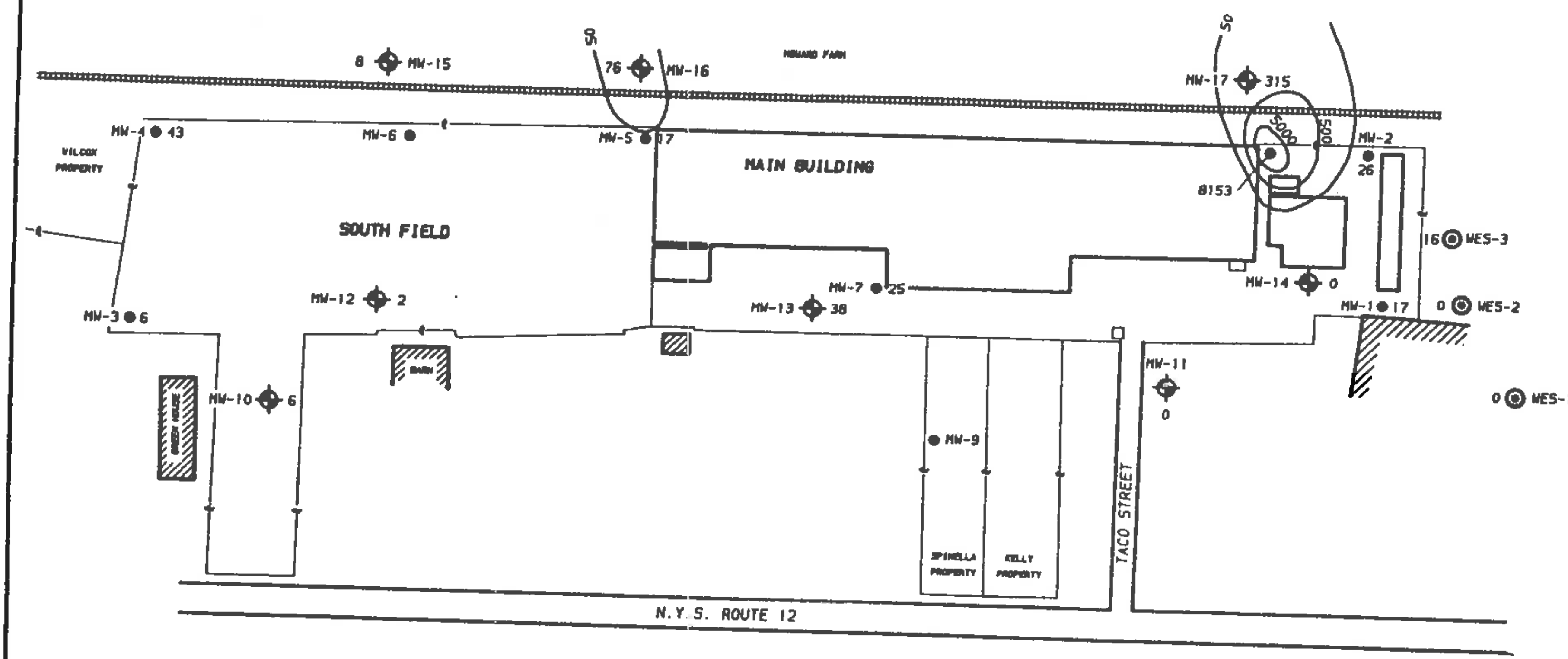
The distribution of total halogenated VOCs in groundwater shows the greatest concentration near the plating room. Figure 24 illustrates the approximate lateral extent of contamination and the greatest concentration in MW-8 at the northwest end of the main building. The total concentration of VOCs in MW-8 is 8251 µg/l, of which 7,700 µg/l (93%) is 1,2 dichloroethene (1,2-DCE). The approximate location of the greatest concentration is indicated in Figure 24 by the shaded area. The shaded area represents a zone where concentrations are greater than 100 µg/l. Further downgradient and off site, MW-17 has 309 µg/l total halogenated VOCs (Table 4.1). Upgradient and cross-gradient from these wells, MW-2, WES-3, MW-1 and MW-14 show non-detectable concentrations or concentrations of less than 19 µg/l. The low concentrations upgradient (MW-2, WES-2, MW-1 and MW-14) and high concentrations at MW-8 and downgradient at MW-17 strongly implicate the plating room as the source of halogenated VOCs found in the groundwater. Additionally, there

TABLE 4.1
VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER

Sample Number	GW-01	GW-02	GW-03	GW-04	GW-05	GW-07	GW-08	GW-10	GW-12	GW-13	GW-15	GW-16	GW-17	GW-19	GW-20
Location	MW-1	MW-2	MW-3	MW-4	MW-5	MW-7	*biased low* MW-8	MW-10	MW-12	MW-13	MW-15	MW-16	MW-17	WES-2	WES-3
Compound															
Vinyl Chloride							280 E			2 E			6 E		
1,1-Dichloroethene															
1,1-Dichloroethane		7											7		6
1,2-Dichloroethene (total)		5	3 E	30	8	25	7700			36		11	76		2 E
Chloroform							63 E								
1,1,1-Trichloroethane	10	2E		4 E									96		5
Trichloroethene	3 E	6	3 E	9	9		110 E	6	2E		8	65	130		3 E
Tetrachloroethene	4 E														
Toluene				2 E			110 E		2E					2 E	2 E
Xylene (total)							51 E								
SUMMARY															
TOTAL HALOCARBONS	17.0	20.0	6.0	43.0	17.0	25.0	8153.0	6.0	2.0	38.0	8.0	76.0	315.0	0.0	16.0
% OF VOC'S PRESENT	100.0	100.0	100.0	95.6	100.0	100.0	98.1	88.2	50.0	100.0	89.9	100.0	100.0	0.0	88.9
TOTAL BTEX COMPOUNDS	0.0	0.0	0.0	2.0	0.0	0.0	161.0	0.8	2.0	0.0	0.9	0.0	0.0	2.0	2.0
% OF VOC'S PRESENT	0.0	0.0	0.0	4.4	0.0	0.0	1.9	11.8	50.0	0.0	10.1	0.0	0.0	100.0	11.1
TOTAL VOLATILES	17.0	20.0	6.0	45.0	17.0	25.0	8314.0	6.8	4.0	38.0	8.9	76.0	315.0	2.0	18.0

All concentrations reported in µg/l.
"E" denotes estimated value below detection limit
No Volatile compounds were detected in GW-6, GW-9, GW-11, GW-14 and GW-18
Shaded area indicates data was rejected during data validation.

SW004772



SW004773

● EXISTING PRIOR TO RI/FS

NEW MONITOR WELL

MONITOR WELLS ON WESCAR WESCOR PROPER

—500— CONTOUR INTERVALS = ORDER OF MAGNITUDE ug/L

1"=100' 100 0 100 200

Drawn	Date	Stearns & Wheler ENVIRONMENTAL ENGINEERS & SCIENTISTS	GENERAL INSTRUMENT CORPORATION TACO STREET, SHERBURNE, NY
JDB	11/92		
Approved		CAZENOVIA, NY WATERTOWN, NY DARIEN, CT TAMPA, FL	LATERAL DISTRIBUTION OF CHLORINATED VOC's IN GROUNDWATER
Job No. 1587	Figure No. 24		

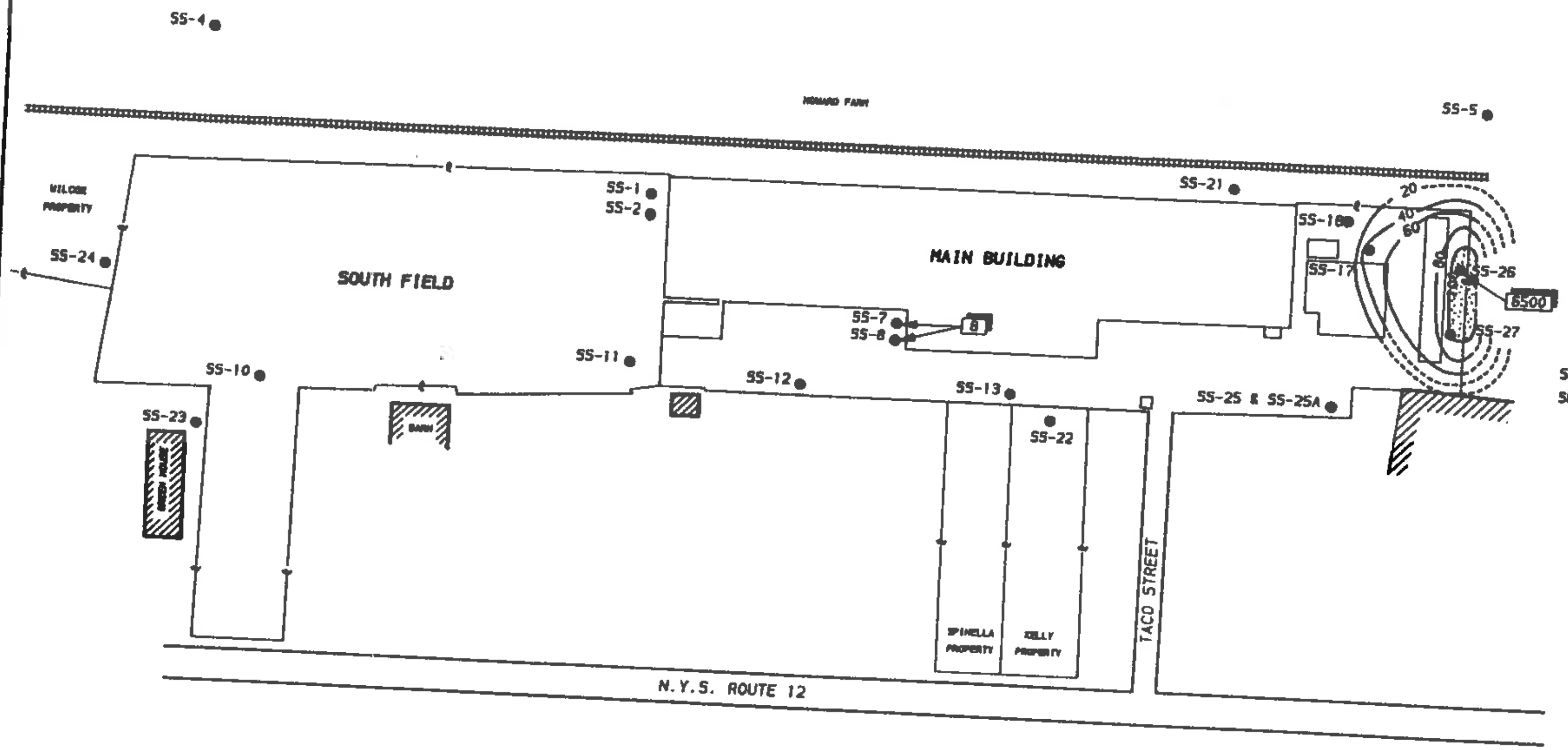
appears to be a plume of VOCs migrating west and southwest roughly parallel to the direction of groundwater flow.

Halogenated VOCs were identified and quantified in other monitor wells on and off the site. Generally, the concentration in these wells is very small (<25 µg/l); however, concentrations of 36 µg/l, 76 µg/l, and 43 µg/l were found in MW-13, MW-16 and MW-4, respectively. Based on approximated groundwater flow direction, these wells are in a cross-gradient and slightly downgradient direction from the contamination at the north end of the site. MW-13 is located close to an area once used to store paint, paint thinner, and other "solvent-like" compounds (R-1 and W-1 in Figure 1b of Appendix M). MW-16 is downgradient from a part of the plant once used to plate metal antennae (specifically, the Alodine™ process). The occurrence of VOCs in MW-4 is anomalous because there is no record of solvents being used in this part of the site; however, Potash Creek flowed through this area and may have transported organics from the north end of the site.

4.2.2 Soil

Aromatic (BTEX) and halogenated compounds were found in the surface (0 to 2 feet), shallow subsurface (2 to 4 feet), and subsurface (>4 feet) at the site (see Table 4.2 for summary). The greatest concentrations were found in the shallow subsurface (2 to 4 feet) in the soil around MW-8 and in the soil north of the wooden shed. Both areas are located at the north end of the site near the plating room. With notable exception, surface samples were relatively uncontaminated except in the area adjacent to the Wescar property and west of the plating building. Subsurface samples (>4 feet) contained no VOCs except for Test Pit No. 6 in the plating room.

Aromatic VOCs were found in the surface soil at SS-17 (75 µg/l), SS-26 (6500 µg/kg), and SS-27 (297 µg/kg) (Figure 25). SS-17 is located near the loading docks west of the plating room; SS-26 and SS-27 are located north of the woodshed near the boundary of the Wescar property. BTEX compounds were found in the shallow subsurface in concentrations of up to 15,600 µg/kg (Figure 26). Concentrations were greatest at the north end of the site where they appear to be



SW004775

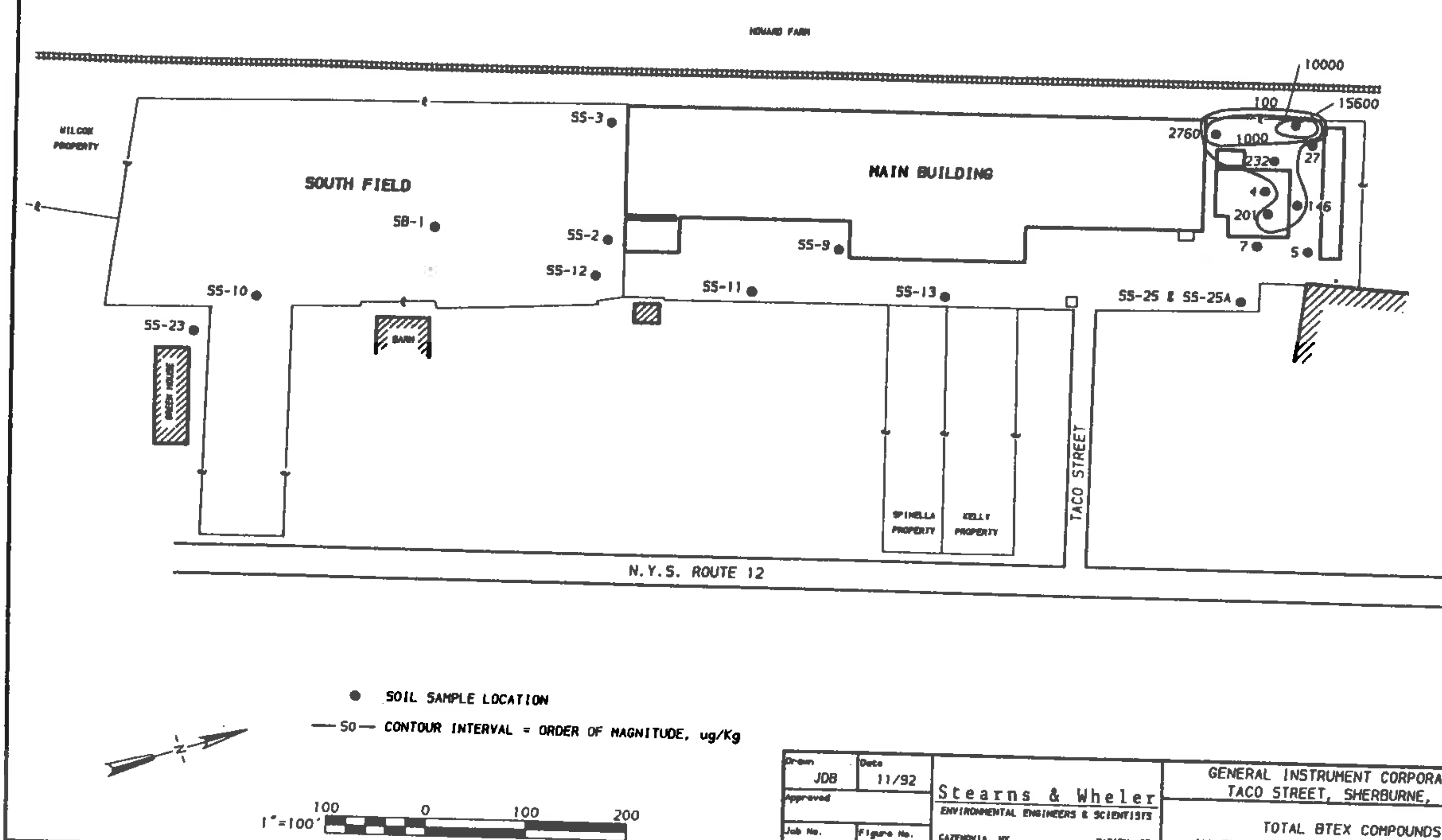
AREA SUSPECTED TO BE GREATER THAN 100 ug/L

SOIL SAMPLE LOCATION

—60— CONTOUR INTERVAL 20 ug/Kg

1"=100' 100 0 100 200

Drawn DJM	Date 12/90	Stearns & Wheler ENVIRONMENTAL ENGINEERS & SCIENTISTS	GENERAL INSTRUMENTS CORPORATION TACO STREET SHERBURNE, N.Y.
Approved		CAZENOVIA, NY WATERTOWN, NY DARIEN, CT TAMPA, FL	Figure 25 Lateral Distribution of Aromatic VOC's in Surface soil
Job No. 1587	Figure No.		



Drawn	Date	Stearns & Wheler	GENERAL INSTRUMENT CORPORATION TACO STREET, SHERBURNE, NY
JDB	11/92	ENVIRONMENTAL ENGINEERS & SCIENTISTS	
Approved		CAZENOVIA, NY / WATERTOWN, NY — DARIEN, CT / TAMPA, FL	TOTAL BTEX COMPOUNDS IN SHALLOW SUB-SURFACE SOIL SAMPLES
Job No. 1587	Figure No. 26		

SW004776

4.3.2 Soils

The soil on and off the General Instrument site contains a variety of SVOCs, but the majority of compounds identified are PNAs. Table 4.4 presents the total list of SVOCs identified at the site.

Sample No. 22 contained the greatest concentration of SVOCs on or off site. It was collected from the surface soil of the Kelly property, located just east of the site, and contained 90 ppm total SVOCs, of which 99.2% were PNAs and the remaining 0.8% was dibenzofuran. The highest concentrations on site were in the surface and shallow subsurface soil around MW-7 (Samples SS-7, SS-8, SS-9) and associated with the petroleum-contaminated soil in the spill area north of the wooden shed (SS-26 and SS-27). The soil around MW-7 contained an average of 14 ppm total SVOCs, of which 96% is one or more PNA compound. The soil from the spill area north of the woodshed contained up to 14 ppm SVOCs, of which 99% are PNAs. The complete list of PNAs identified in the soil samples is presented in Table 4.5.

The PNA concentration found at SS-22 (on the Kelly property) is directly correlated to, and believed to be derived from, coal ashes deposited in the old Chenango Canal by residents bordering the canal. Mr. Sean Kelly, adjacent property owner, described "piles of ash" in his backyard "that must have filled in a low spot" (personal communication, 1990). His house used to be heated with coal, as were many of the houses along Route 12 adjacent to the site. Also, during the test excavation at the site, we encountered several gray clay lenses in the old canal which we determined were coal ash. Other soil samples that may have been affected by dumping of coal ash into Potash Creek are SS-12, SS-13 (the second greatest concentration at the site), SS-25 and SS-25A.

Other PNA compounds found at the site are probably related to atmospheric deposition from internal combustion engines: SS-1, SS-2, SS-3, SS-4 (background); SS-5 (background); SS-6 (background); SS-7, SS-8, SS-9, SS-21, SS-23, SS-24, SED-1 and SED-2 (see Table 4.6 for background concentrations). Sample SS-6 was collected about one-half mile from the site from a field along Route 12. This location

Table 4.4
SEMI VOLATILE ORGANIC COMPOUNDS IN SOIL

Sample Number		SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-9	SS12	SS13	SS25	SS25A	SS14	SS15	SS16	SS17	SS18	SS19	SS20
Location		Well #5	Well #5	Well #5	Farmer's Field	Farmer's Field	Off Site Field	Well #7	Well #7	Well #7	T.P. #3	T.P. #4	T.P. #5	T.P. #5	T.P. #6	T.P. #7	T.P. #8	T.P. #9	T.P. #10	MW-14	Mw-14
Depth		0' - 2'	0' - 2'	2' - 4'	0' - 2'	0' - 2'	0' - 2'	0' - 2'	0' - 2'	2' - 4'	0' - 4'	0' - 4'	0' - 4'	0' - 4'	> 4'	2' - 4'	2' - 4'	0' - 2'	0' - 2'	10'	20'
Compound	**Type**																				
Benzoic acid	MISC							310 E		190 E											
bis(2-Chloroethoxy)methane	MISC																				
Naphthalene	PNA	200 E							130 E								39	830			
2-Methylnaphthalene	PNA	270 E							73 E						3300	61	49	2500	63 E		
Acenaphthylene	PNA	41 E					120 E	61 E	180 E	73 E		610		40							
Acenaphthene	PNA	820						93 E	300 E	82 E	92										
Dibenzofuran	MISC	520						50 E	220 E	32 E	72	100			670			160			
Diethylphthalate	PHTH																				
Fluorene	PNA	660					46 E	86 E	340 E	78 E	120	220									
4-Nitroaniline	MISC													370							
N-Nitrosodiphenylamine (1)	MISC																				
Phenanthrene	PNA	5100	190 E	38 E			510	1100	3500	1100	670	3700	160	220	2300 E	110	81	880	89 E		
Anthracene	PNA	1200					96 E	160 E	630	190 E	170	820	57	58							
Di-n-butylphthalate	PHTH	37 E			63 E		41 E	41 E	23 E	23 E	110		53	60		50	26			70	29 E
Fluoranthene	PNA	5900	390 E	67 E	46 E	45 E	720	2100	6700	1900	770	8400	320	320		140	95	350	44 E		
Pyrene	PNA	3300	200 E	45 E	43 E	30 E	680	960	2000	1000	450 E	4600	160 E	210 E	220	99	53 E	160 E	61 E		
Butylbenzylphthalate	PHTH										65										
Benzo(a)anthracene	PNA	2200	140 E	34 E			260 E	780	1900	820	380	2800	180	160		65		200 E			
Chrysene	PNA	2100	150 E				450	770	2200	820	390	2500	170	180	78	63		210			
bis(2-Ethylhexyl)phthalate	PHTH																				
Di-n-octylphthalate	PHTH							32 E			120 E				7						
Benzo(b)fluoranthene	PNA	1200	130 E				230 E	1200	1200	1100	420 E	1200 E	130					240			
Benzo(k)fluoranthene	PNA	1400					46 E	770	2100	770	410 E		72					27			
Benzo(a)pyrene	PNA	2000	120 E				330 E	820	1900	880	660 E	2400	140					180			
Indeno(1,2,3-cd)pyrene	PNA	320 E					56 E	180 E	820	120 E	240 E	630						140			
Dibenzo(a,h)anthracene	PNA								94 E												
Benzo(g,h,i)perylene	PNA	260 E					82 E		360 E	220 E	260 E	480						130			
Summary																					
TOTAL PNA's		26971	1310	184	91	73	3548	9102	23927	9153	4952	26360	1359	1186	5898	518	317	5667	257	0	0
% OF SVOL PRESENT		98.0	100.0	100.0	58.3	100.0	98.9	95.5	99.0	97.4	95.4	99.6	96.2	73.4	89.7	91.2	92.4	97.3	100.0	0.0	0.0
TOTAL PHTHALATES		37	0	0	65	0	41	73	23	23	185	0	53	60	7	50	26	0	0	70	29
% OF SVOL PRESENT		0.1	0.0	0.0	41.7	0.0	1.1	0.8	0.1	0.2	3.2	0.0	3.8	3.7	0.1	8.8	7.6	0.0	0.0	100.0	100.0
TOTAL PHENOLICS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% OF SVOL PRESENT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MISC. SEMI-VOLATILES		520	0	0	0	0	0	360	220	222	72	100	0	370	670	0	0	160	0	0	0
% OF SVOL PRESENT		1.9	0.0	0.0	0.0	0.0	0.0	3.8	0.9	2.4	1.4	0.4	0.0	22.9	10.2	0.0	0.0	2.7	0.0	0.0	0.0
TOTAL SEMI-VOLATILES		27529	1310	184	156	75	3589	9535	24170	9398	5186	26460	1412	1616	6575	568	343	5827	257	70	29

SS-9, SS-10, and SS-11 contained no semi-volatile compounds
SS-4 was rejected for poor surrogate recovery.
All concentrations reported as µg/kg.
"E" denotes estimated value below detection limit.
Shaded area indicates analyte found in blank.

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Table 4.4 (continued)
SEMI-VOLATILE COMPOUNDS IN SOIL

Sample Number	SS-21	SS-22	SS-23	SS-24	SS25	SS25A	SS-26	SS-27	SS-28	SB-1	SB-2	SB-3	SB-4	SB-5	SB-6	SB-7	SB-8 DL	SED-1	SED-2
Location	Adjacent R/R Track	Kelly Property	Southeast Property	Wilcox Property	T.P. #5	T.P. #5	Spill Area	Spill Area	Dirt In Shed	S. Field Middle	Garage S. Wall	East W. Shed	N. Wall Plat. Bldg.	Shed West	Plat. Rm. W. Door	N/W Boundary	MW-8	Creek (-18")	Creek Surf. Sed
Depth	0' - 2'	0' - 2'	0' - 2'	0' - 2'	0' - 4'	0' - 4'	0'-2'	2'	N/A	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'
Compound																			
Benzoic acid				35 E							82E	8E				130 E		1100 E	
bis(2-Chloroethoxy)methane																			
Naphthalene	84 E	270 E					590	220 E								180	2300		
2-Methylnaphthalene	140 E						4100	1100							1600	450	8600		
Acenaphthylene	710	1400 E		41 E		40		270 E							140				
Acenaphthene	140 E	440 E						84 E								96 E			
Dibenzofuran	120 E	690 E						46 E											
Diethylphthalate										120 E						23 E			
Fluorene	300 E	1400 E					1100	180 E							360 E	160 E	1400		
4-Nitroaniline						370													
N-Nitrosodiphenylamine (1)																52 E			
Phenanthrene	2300	14000	71 E	77 E	160	220	2100	1200	40 E						840	1200	2000	54 E	170 E
Anthracene	800	2200			57	58	270 E	280 E							160 E	150 E			
Di-n-butylphthalate	66 E			25 E	53	60													72 E
Fluoranthene	4100	18000	110 E	160 E	320	320	820	2800	64 E					470 E	970	1600		92 E	260 E
Pyrene	2800	13000	79 E	93 E	160 E	210 E	590	2300	36 E					380 E	670	1100		49 E	320 E
Butylbenzylphthalate	48 E																		
Benzo(a)anthracene	1500	7700	51 E	65 E	150	160	300 E	1600						270 E	420	520		45 E	180 E
Chrysene	1900	8600	59 E	96 E	170	180	340 E	1700	37 E					350 E	460	550		52 E	200 E
bis(2-Ethylhexyl)phthalate	1100														4300	2500			
Di-n-octylphthalate															77 E	18 E			
Benzo(b)fluoranthene	1600	8200	63 E	85 E	130		270 E	1600						420 E	470	440 E		72 E	210 E
Benzo(k)fluoranthene	1200	4200			72		160 E	1600						96 E	110 E	76 E			150 E
Benzo(a)pyrene	1200	6800			140		270 E	1600						320 E	380 E	420 E			150 E
Indeno(1,2,3-cd)pyrene	350 E	1900 E					100 E	660						440 E	360 E	380 E			
Dibenzo(a,h)anthracene														160 E	59 E	48 E			
Benzo(g,h,i)perylene	160 E	1300 E					63 E	320 E						380 E	380 E	280 E			
Summary																			
TOTAL PNA's	19294	89410	433	617	1359	1188	11073	17514	177	0	0	0		3286	7379	7650	14300	364	1640
% OF SVOL PRESENT	98.8	99.2	100.0	91.1	96.2	73.4	100.0	99.7	100.0	0.0	0.0	0.0		100.0	99.0	97.1	100.0	24.9	95.8
TOTAL PHTHALATES	114	0	0	25	53	60	0	0	0	120	0	0		0	77	44	0	0	72
% OF SVOL PRESENT	0.6	0.0	0.0	3.7	3.8	3.7	0.0	0.0	0.0	100.0	0.0	0.0		0.0	1.0	0.6	0.0	0.0	4.2
TOTAL PHENOLICS	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
% OF SVOL PRESENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
MISC. SEMI-VOLATILES	120	690	0	35	0	370	0	46	0	0	82	8		0	0	182	0	1100	0
% OF SVOL PRESENT	0.6	0.8	0.0	5.2	0.0	22.9	0.0	0.3	0.0	0.0	100.0	100.0		0.0	0.0	2.3	0.0	75.1	0.0
TOTAL SEMI-VOLATILES	19528	90100	433	677	1412	1618	11073	17560	177	120	82	8		3286	7456	7876	14300	1464	1712

SB-9, SS-10, and SS-11 contained no semi-volatile compounds
SB-4 was rejected for poor surrogate recovery.
All concentrations reported as µg/kg.
"E" denotes estimated value below detection limit.
Shaded area indicates analyte found in blank.

TABLE 4.5: POLYNUCLEAR AROMATIC COMPOUNDS IN SOIL

Sample Number		SS17	SS18	SS-21	SS-22	SS-23	SS-24	SS-26	SS-27	SS-28	SB-5	SB-6	SB-7	SB-8 DL	SED-1	SED-2
Location		T.P. #9	T.P. #10	Adjacent R/R Tracks	Kelly Property	Southeast Property	Wilcox Property	North of Wood shed	North of Wood shed	Dirt in Shed	Shed West	Pk Room W. Door	N/W Boundary	MW-8	Creek (-18")	Creek Surf. Sed
Depth		0'-2'	0'-2'	0'-2'	0'-2'	0'-2'	0'-2'	0'-2'	2'	N/A	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'
Compound	Type															
Naphthalene	PNA	830		94 E	270 E			590	220 E				180 E	2300		
2-Methylnaphthalene	PNA	2500	63 E	140 E				4100	1100			1600	450	6600		
Acenaphthylene	PNA			710	1400 E		41 E		270 E			140 E				
Acenaphthene	PNA			140 E	440 E				84 E				96 E			
Fluorene	PNA			300 E	1400 E			1100	180 E			360 E	180 E	1400		
Phenanthrene	PNA	680	89 E	2300	14000	71 E	77 E	2100	1200	40 E		840	1200	2000	54 E	170 E
Anthracene	PNA			800	2200			270 E	280 E			160 E	150 E			
Fluoranthene	PNA	350	44 E	4100	18000	110 E	180 E	820	2800	64 E	470 E	970	1600		92 E	260 E
Pyrene	PNA	180 E	61 E	2800	13000	79 E	93 E	590	2300	36 E	380 E	670	1100		49 E	320 E
Benzo(a)anthracene	PNA	200 E		1500	7700	51 E	65 E	300 E	1800		270 E	420	520		45 E	180 E
Chrysene	PNA	210 E		1900	8600	59 E	96 E	340 E	1700	37 E	350 E	460	550		52 E	200 E
Benzo(b)fluoranthene	PNA	240 E		1800	8200	63 E	85 E	270 E	1600		420 E	470	440 E		72 E	210 E
Benzo(k)fluoranthene	PNA	27 E		1200	4200			180 E	1600		96 E	110 E	76 E			150 E
Benzo(a)pyrene	PNA	180 E		1200	6800			270 E	1600		320 E	380 E	420 E			150 E
Indeno(1,2,3-cd)pyrene	PNA	140 E		350 E	1900 E			100 E	660		440 E	360 E	380 E			
Dibenzo(a,h)anthracene	PNA										160 E	59 E	48 E			
Benzo(g,h,i)perylene	PNA	130 E		160 E	1300 E			63 E	320 E		380 E	380 E	280 E			
TOTAL PNA's		5667	257	19294	89410	433	617	11073	17514	177	3286	7379	7650	14300	364	1640
% OF SVOL PRESENT		97.3	100.0	98.8	13206.8	100.0	91.1	100.0	99.7	100.0	100.0	99.0	97.1	100.0	24.9	95.8
TOTAL SEMI-VOLATILES		5827	257	19528	677	433	677	11073	17560	177	3286	7456	7876	14300	1464	1712

All concentrations reported as µg/l.
"E" denotes estimated value below detection limit.
Shaded area indicates analyte found in blank.

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TABLE 4.2
VOLATILE ORGANIC COMPOUNDS IN SOIL

Sample Number	SB-1	SB-2	SB-3	SB-4	SB-5	SB-6	SB-7	SB-8	SB-9	SS-14	SS-15	SS-16	SS-17	SS-21	SS-26	SS-27
Location	S. Field Middle	S. Wall of Garage	South of Plating Bg.	N. Wall of Plating Bg.	Shed West	Pit Room W. Door	N/W Boundary	MW - 8	Pit Room E. Door	biased high T.P. #6	biased high T.P. #7	T.P. #8	T.P. #9	by R/R Tracks	Spill Surface	Spill (-20')
Depth	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	2'-4'	>4'	2'-4'	2'-4'	0'-2'	0'-2'	0'-2'	0'-2'
Compound																
Methylene Chloride						460 E	580 E	320 E							150 E	
1,1-Dichloroethene																
1,1-Dichloroethane					46					40	18	8	12			
1,2-Dichloroethene (total)	8				18			1900	28		51	22	15			
Chloroform											7 E	1 E	.7 E			
2-Butanone		.6 E			65 E					[illegible]		[illegible]	[illegible]			
1,1,1-Trichloroethane						7400 E	[illegible]	[illegible]		270	390		10			
Carbon Tetrachloride						940										
Trichloroethene	8				6 E	700 E		1800	12		170		11	6 E		
Benzene						82 E										5 E
2-Hexanone				140												
Tetrachloroethene						130 E		530 E			4 E					
Toluene	3 E			13 E	8	150 E	1500	230 E	3 E		18 E		3 E		100 E	32 E
Chlorobenzene						130E										
Ethylbenzene				13 E	3 E		1100	430 E		12 E	23 E		15			
Xylene (total)	17	6 E	6	120	16		13000	2100	4 E	140	160	4 E	57		6400	260
SUMMARY																
TOTAL BTEX	20.0	5.0	6.0	146.0	27.0	232.0	15600.0	2760.0	7.0	152.0	201.0	4.0	75.0	0.0	6500.0	297.0
% OF VOC'S PRESENT	55.6	89.3	100.0	51.0	16.7	2.4	96.4	38.8	15.6	32.9	23.9	10.5	59.7	0.0	97.7	100.0
TOTAL HALOCARBONS	16.0	0.6	0.0	140.0	135.0	9630.0	580.0	4350.0	38.0	310.0	640.0	34.0	50.7	5.0	150.0	0.0
% OF VOC'S PRESENT	44.4	10.7	0.0	49.0	83.3	97.6	3.6	61.2	84.4	67.1	76.1	89.5	40.3	100.0	2.3	0.0
TOTAL VOLATILES	36.0	5.6	6.0	286.0	162.0	9862.0	16180.0	7110.0	45.0	462.0	841.0	38.0	125.7	5.0	6650.0	297.0

All concentrations reported in µg/kg.
"E" denotes estimated value below detection limit
Shaded area indicates analyte was found in blank or sample was rejected for QA/QC.

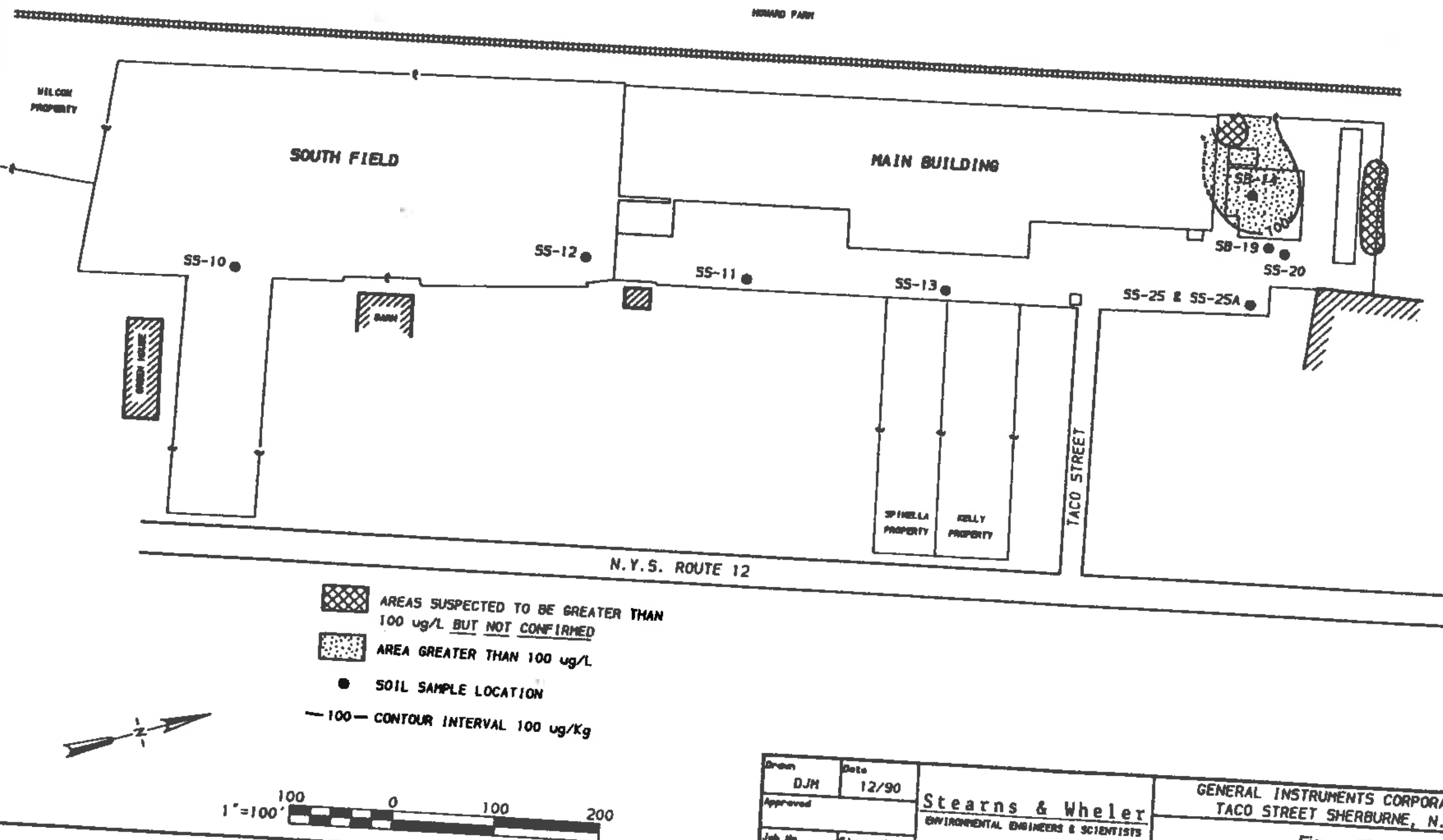
associated with the soil adjacent to MW-8, soil north of the wooden shed, and the soil in the loading dock area of the main building and plating room. In the subsurface, BTEX compounds were found in Test Pit No. 6 (SS-14), which was dug around the tile pipe in the center of the plating room (Figure 27). The compounds identified were ethylbenzene (12 µg/kg) and xylene (140 µg/l).

Halogenated compounds were also found in the soil on the site. Surface Sample SS-17 contained 50 µg/kg total halogenated VOCs; SS-21 contained an estimated 5 µg/kg TCE; and SB-2 contained an estimated 0.6 µg/kg of 2-butanone (MEK). Halogenated volatile compounds were not encountered at any other surface soil samples. However, relatively high concentrations were encountered in the shallow subsurface near the north end of the site at the plating room (see Figure 28 for distribution). SB-8 and SB-6 contained 4,350 µg/l and 9,630 µg/l, respectively. The major components of both of these samples are 1,2 dichloroethene (1,2-DCE); 1,1,1 trichloroethane (1,1,1-TCA); and trichloroethene, (TCE), which are the same compounds found in the groundwater at the site (Table 4.1). The highest concentrations of chlorinated hydrocarbons were found west of the plating room; however, they were also detected in the (one) shallow subsurface sample from the South Field (Sample SB-1, Figure 26). Soil Sample SS-14 from Test Pit No. 6 (in the plating room) was the only subsurface sample to contain VOCs. It contained chlorinated hydrocarbons 1,1-DCE (40 µg/kg) and 1,1,1-TCA (270 µg/kg) (Figure 29).

4.3 Semi-volatile Organic Compounds

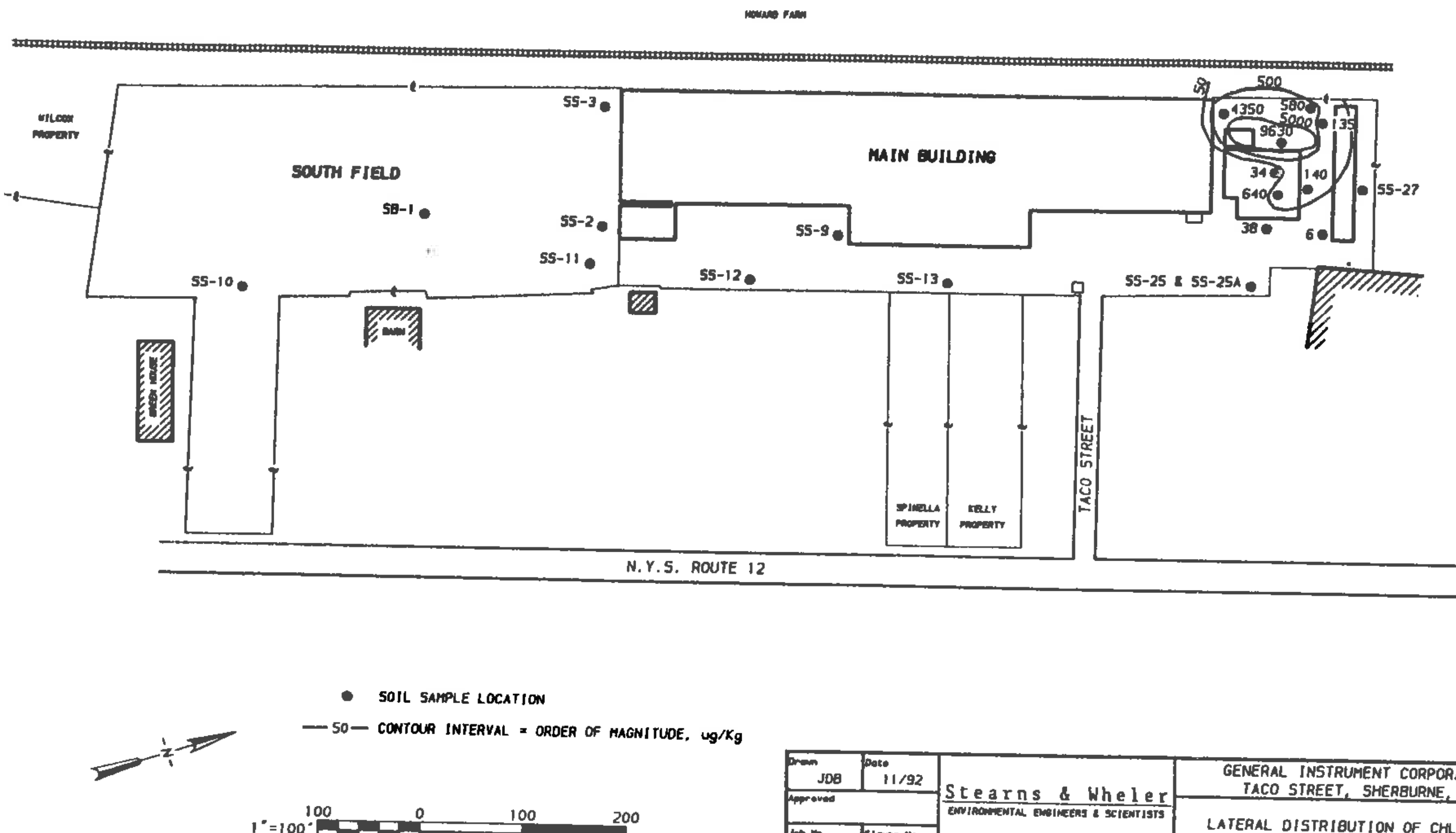
Semi-volatile organic compounds (SVOCs) are a group of compounds that do not readily volatilize at atmospheric pressure and temperature. The semi-volatiles can be divided into four categories based on chemical structure and environmental source: (1) the polynuclear aromatic hydrocarbons; (2) phthalates; (3) phenolics; and (4) miscellaneous semi-volatiles. To facilitate the organization and utilization of semi-volatile data, the results are grouped into these four categories.

Polynuclear aromatic compounds (PNAs) form during the incomplete combustion of hydrocarbons (fossil fuels) and are encountered in ash, soot and oil spills (Sittig, 1985). This



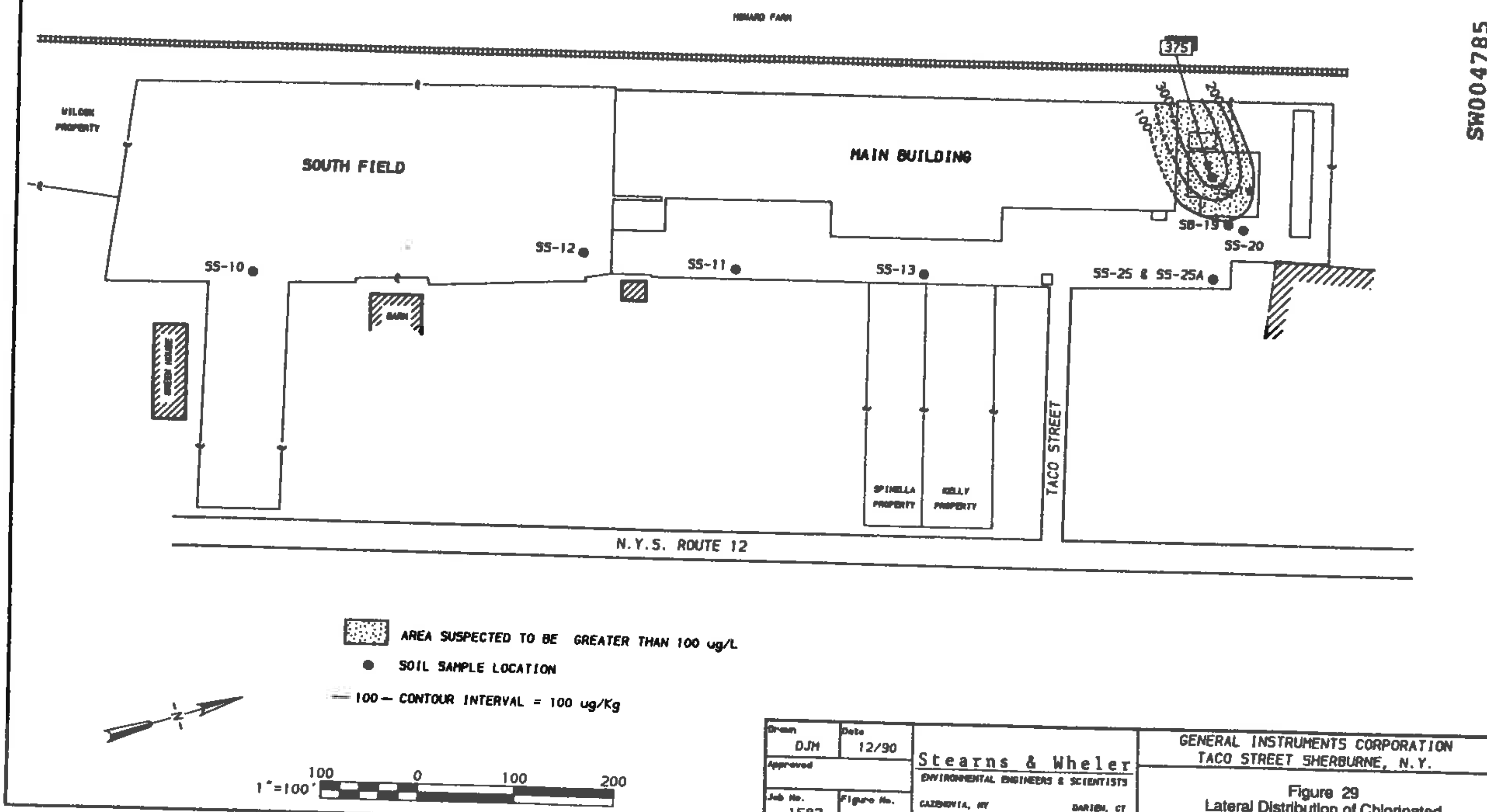
Drawn	Date		
DJM	12/90	Stearns & Wheler ENVIRONMENTAL ENGINEERS & SCIENTISTS CAZENOVIA, NY DARIEN, CT WATERTOWN, NY TAMPA, FL	GENERAL INSTRUMENTS CORPORATION TACO STREET SHERBURNE, N.Y.
Approved			
Job No. 1587	Figure No.		Figure 27 Lateral Distribution of Aromatic VOC's in Sub-surface soil

SW004783



Drawn	Date	Stearns & Wheler	GENERAL INSTRUMENT CORPORATION TACO STREET, SHERBURNE, NY
JDB	11/92	ENVIRONMENTAL ENGINEERS & SCIENTISTS	
Approved		CAZENOVIA, NY DARIEN, CT WATERTOWN, NY TAMPA, FL	LATERAL DISTRIBUTION OF CHLORINATED VOC's IN SHALLOW SUB-SURFACE SOIL
Job No. 1587	Figure No. 28		

SW004784



Drawn	Date
DJM	12/90
Approved	
Job No. 1587	Figure No.

Stearns & Wheler
ENVIRONMENTAL ENGINEERS & SCIENTISTS
CAZENOVIA, NY · WATERTOWN, NY · DARIEN, CT · TAMPA, FL

GENERAL INSTRUMENTS CORPORATION
TACO STREET SHERBURNE, N.Y.

Figure 29
Lateral Distribution of Chlorinated VOC's in Sub-surface soil

SW004785

group includes fused ring benzene compounds such as napthalene, anthracene, chrysene, etc. The second group is the phthalates; phthalates are derivatives of phthalic acid and are commonly used as plasticizers and solvents in the plastics industry. The third group of SVOCs is the phenolics; phenolic compounds were not identified at the site and will not be discussed as part of this report. The fourth group is a miscellaneous group of halogenated and nitrogen-containing aromatics. Included in this group are benzoic acid and dibenzofuran. Benzoic acid forms in the oxidation reaction of PNAs, whereas dibenzofuran (or diphenylene oxide) forms during the combustion of coal (Montgomery and Welkom, 1989).

SVOCs were identified in both soil and groundwater at the site, but the greatest concentrations are associated with the soils, both on and off site. Groundwater in the vicinity of MW-8 contained low levels of some semi-volatiles, but the remaining groundwater was free of semi-volatiles.

4.3.1 Groundwater

With the exception of PNAs and dibenzofuran found in MW-8, there were no confirmed SVOCs in the groundwater at the TACO site. The PNA, napthalene (510 µg/l), 2 methylnapthalene (510 µg/l), fluorene (120 µg/l) and phenanthrene (270 µg/l), were identified in MW-8, as well as dibenzofuran (88 µg/l). A complete list is found in Table 4.3. The presence of PNAs in MW-8 is probably associated with the observed free-phase petroleum product in the well. These petroleum products are probably derived from the petroleum spills that occurred at the loading dock in 1987 and from spills that occurred north of the woodshed at the boundary with the Wescar property.

Very low concentrations of phthalates were reported in most groundwater samples (see data in Appendix H). However, the presence of these same phthalates in the method blank questioned their validity. We believe all reported phthalate values are due to ambient background concentrations and not associated with site-specific contamination.

Table 4.3

SEMI-VOLATILE COMPOUNDS IN GROUNDWATER

Sample Number		GW-8	GW-10	GW-14	GW-20
Location		*biased high* MW-8	MW-10	MW-14	WES-3
Compound	**Type**				
Naphthalene	PNA	510			
2-Methylnaphthalene	PNA	510			
Dibenzofuran	MISC	88			0.2 E
Diethylphthalate	PHTH				
Fluorene	PNA	120			
Phenanthrene	PNA	220			
Di-n-butylphthalate	PHTH				0.9 E
Fluoranthene	PNA	12 E			
Pyrene	PNA	25 E		0.8 E	
Benzo (a) Anthracene			0.3 E		
Butylbenzylphthalate	PHTH	3 E			
Chrysene	PNA	4 E			
bis(2-Ethylhexyl)phthalate	PHTH				
Di-n-octylphthalate	PHTH				
Summary					
TOTAL PNA's		1401	0	0.8	
% OF SVOL'S PRESENT		92.9	0	100	0
TOTAL PHTHALATES		19	0	0	
% OF SVOL'S PRESENT		1.26	0	0	0
Misc. Semi-Voaltiles		88	0	0	
% OF SVOL'S PRESENT		5.836	0	0	0
TOTAL SEMI-VOLS		1508	0	0.8	0

All Concentrations are in µg/l.
Shaded areas indicate analyte was found in blank.
"E" denotes estimated value below detection limit.

TABLE 4.5: POLYNUCLEAR AROMATIC COMPOUNDS IN SOIL

Sample Number		SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-9	SS12	SS13	SS26	SS25A	SS14	SS15	SS16
Location		Well #5	Well #6	Well #5	Farmer's Field	Farmer's Field	Off Site Field	Well #7	Well #7	Well #7	T.P. #3	T.P. #4	T.P. #5	T.P. #5	T.P. #6	T.P. #7	T.P. #8
Depth		0'-2'	0'-2'	2'-4'	0'-2'	0'-2'	0'-2'	0'-2'	0'-2'	2'-4'	0' - >4'	0' - >4'	0' - >4'	0' - >4'	>4'	2'-4'	2'-4'
Compound	Type																
Naphthalene	PNA	200 E							130 E								39 E
2-Methylnaphthalene	PNA	270 E							73 E						3300	61 E	49 E
Acenaphthylene	PNA	41 E					120 E	61 E	180 E	73 E		610 E		40			
Acenaphthene	PNA	820						93 E	300 E	82 E	92 E						
Fluorene	PNA	660					46 E	88 E	340 E	78 E	120 E	220 E					
Phenanthrene	PNA	5100	190 E	38 E			510	1100	3500	1100	570 E	3700	160 E	220 E	2300	110 E	81 E
Anthracene	PNA	1200					96 E	180 E	630	190 E	170 E	820	57 E	58 E			
Fluoranthene	PNA	6900	380 E	67 E	48 E	45 E	720	2100	5700	1900	770	6400	320 E	320 E		140 E	95 E
Pyrene	PNA	3300	200 E	45 E	43 E	30 E	580	960	2900	1000	450	4600	160 E	210 E	220 E	99 E	53 E
Benzo(a)anthracene	PNA	2200	140 E	34 E			280 E	780	1900	820	380 E	2800	150 E	160 E		56 E	
Chrysene	PNA	2100	150 E				450	770	2200	820	390 E	2500	170 E	160 E	78 E	63	
Benzo(b)fluoranthene	PNA	1200	130 E				250 E	1200	1200	1100	420	1300	130 E				
Benzo(k)fluoranthene	PNA	1400					46 E	770	2100	770	410		72 E				
Benzo(a)pyrene	PNA	2000	120 E				330 E	820	1800	880	660	2400	140 E				
Indeno(1,2,3-cd)pyrene	PNA	320 E					58 E	180 E	520	120 E	240 E	530 E					
Dibenzo(a,h)anthracene	PNA								94 E								
Benzo(g,h,i)perylene	PNA	260 E					62 E		360 E	220 E	280 E	480 E					
TOTAL PNA's		26971	1310	184	91	76	3548	9102	23927	9153	4952	26360	1359	1188	5898	518	317
% OF SVOL PRESENT		98.0	100.0	100.0	58.3	100.0	98.9	97.3	99.0	97.4	95.4	99.6	96.2	73.4	89.7	91.2	92.4
TOTAL SEMI-VOLATILES		27526	1310	184	166	76	3589	9353	24170	9398	5189	26480	1412	1616	6575	568	343

All concentrations reported as µg/l.
"E" denotes estimated value below detection limit.
Shaded area indicates analyte found in blank.

SW004788

TABLE 4.6
BACKGROUND CONCENTRATION OF SEMI-VOLATILES

Sample Number		SS-4	SS-5	SS-6
Location		Farmer's Field	Farmer's Field	Off Site Field
Depth		0'-2'	0'-2'	0'-2'
Compound	Type			
Benzoic acid	MISC			
bis(2-Chloroethoxy)methane	MISC			
Naphthalene	PNA			
2-Methylnaphthalene	PNA			
Acenaphthylene	PNA			120 E
Acenaphthene	PNA			
Dibenzofuran	MISC			
Diethylphthalate	PHTH			
Fluorene	PNA			46 E
4-Nitroaniline	MISC			
N-Nitrosodiphenylamine (1)	MISC			
Phenanthrene	PNA			510
Anthracene	PNA			96 E
Di-n-butylphthalate	PHTH	65 E		41 E
Fluoranthene	PNA	48 E	45 E	720
Pyrene	PNA	43 E	30 E	580
Butylbenzylphthalate	PHTH			
Benzo(a)anthracene	PNA			280 E
Chrysene	PNA			450
bis(2-Ethylhexyl)phthalate	PHTH			
Di-n-octylphthalate	PHTH			
Benzo(b)fluoranthene	PNA			250 E
Benzo(k)fluoranthene	PNA			46 E
Benzo(a)pyrene	PNA			330 E
Indeno(1,2,3-cd)pyrene	PNA			58 E
Dibenzo(a,h)anthracene	PNA			
Benzo(g,h,i)perylene	PNA			62 E
Summary				
TOTAL PNA's		91	75	3548
% OF SVOL PRESENT		58.3	100.0	98.9
TOTAL PHTHALATES		65	0	41
% OF SVOL PRESENT		41.7	0.0	1.1
TOTAL PHENOLICS		0	0	0
% OF SVOL PRESENT		0.0	0.0	0.0
MISC. SEMI-VOLATILES		0	0	0
% OF SVOL PRESENT		0.0	0.0	0.0
TOTAL SEMI-VOLATILES		156	75	3589

All concentrations reported as μg/kg
"E" denotes estimated value below detection limit
Shaded area indicates analyte found in blank

SW004789

was selected because SCS mapping indicated a similar soil type to that found on the GI property.

Soil Samples SS-14, SS-15, SS-16, SS-17; and Soil Boring Samples SB-5, SB-6, SB-7 and SB-8 (all derived from around the plating building) were contaminated with SVOCs. The SVOCs found in these samples may be related to the source of the VOC, that is, releases associated with activity in the plating room.

The remaining SVOCs (non-PNAs) found during this investigation were phthalates (Table 4.7) and miscellaneous SVOCs (Table 4.8). The phthalate, bis(2-ethylexyl)phthalate, was found in large enough quantities in Samples SB-6 and SB-7 to be considered present in the environment. It is found in concentrations of up to 4377 µg/kg and represents 36% of the SVOCs in this sample. The source of this phthalate, at these locations, is problematic because there were no reported uses for phthalates at the site. Bis(2-ethylexyl)phthalate is used as a plasticizer in polymeric products and as a lubricant in vacuum pumps. However, these uses are incompatible with activity at the General Instrument plant, and the source of the phthalate is unknown.

Dibenzofuran (diphenylene oxide) was positively identified in soil samples collected at the site and adjacent properties. It is reported to be a by-product of coal gasification (Montgomery and Welkom, 1990). Its presence in soil samples at the General Instrument site is probably related to fossil fuel releases (fuel oil near the loading dock and north of the woodshed) and coal ash in the old Chenango Canal. There are no indications that General Instrument directly or indirectly released dibenzofuran, except what may have been contained in fuel oil near the loading dock.

The remaining miscellaneous compounds benzoic acid, bis(2-chloroethoxy) methane, 4-nitroaniline , and 4-nitrosodiphenylamine were identified in samples on site, but at concentrations below quantification limits. Their presence is considered part of the background concentrations associated with urban and industrial environments and not a result of activity at the General Instrument site.

Table 4.7
PHTHALATES IN SOIL

Sample Number		SS-1	SS-4	SS-6	SS-7	SS-9	SS12	SS15	SS16	SS19	SS20	SS-21	SS-24	SS25	SS25A	SB-1	SB-6	SB-7	SED-2
Location		Well #8	Farmer's Field	Off Site Field	Well #7	Well #7	T.P. #3	T.P. #7	T.P. #8	MW-14	Mw-14	Adjacent R/R Tracks	Wilcox Property	T.P. #5	T.P. #5	S. Field Middle	Pit Room W. Door	NW Boundary	Creek Surf. Sed
Depth		0'-2'	0'-2'	0'-3'	0'-2'	2'-4'	0' - >4'	2'-4'	2'-4'	-10	20'	0'-2'	0'-2'	0' - >4'	0' - >4'	2'-4'	2'-4'	2'-4'	2'-4'
Compound	**Type**																		
Diethylphthalate	PHTH																		
Di-n-butylphthalate	PHTH	37 E	65 E	41 E	41 E	23 E	110 E	50 E	26 E	70 E	26 E	66 E	25 E	53 E	60 E	120 E		28 E	
Butylbenzylphthalate	PHTH						85 E					40 E							72 E
bis(2-Ethylhexyl)phthalate	PHTH																4300	2500	
Di-n-octylphthalate	PHTH				32		120 E										77 E	16 E	
Summary																			
TOTAL PHTHALATES		37	65	41	73	23	315	50	26	70	26	116	25	53	60	120	4377	2544	72
% OF SVOL PRESENT		0.1	21.2	1.1	0.8	0.2	5.7	7.1	6.4	57.4	37.8	0.6	3.3	3.6	3.5	36.4	37.1	24.4	3.4
TOTAL SEMI-VOLATILES		27708	306	3715	9685	9478	5489	709	404	122	74	20628	750	1476	1716	330	11790	10444	2142

All concentrations reported as µg/kg.
"E" denotes estimated value below detection limit.
Shaded area indicates analyte found in blank.

Table 4.8
MISCELLANEOUS SEMI-VOLATILES IN SOIL

Sample Number		SS-1	SS-7	SS-8	SS-9	SS12	SS13	SS14	SS17	SS-21	SS-22	SS-24	SS25A	SS-27	SB-2	SB-3	SB-7	SED-1
Location		Well #5	Well #7	Well #7	Well #7	T.P. #3	T.P. #4	T.P. #6	T.P. #9	Adjacent R/R Tracks	Kelly Property	Wilcox Property	T.P. #5	North of Wood shed	Garage S. Wall	East W. Shed	N/W Boundary	Creek (-18")
Depth		0'-2'	0'-2'	0'-2'	2'-4'	0' - >4'	0' - >4'	>4'	0'-2'	0'-2'	0'-2'	0'-2'	0' - >4'	2'	2'-4'	2'-4'	2'-4'	2'-4'
Compound	**Type**																	
Benzoic acid	MISC		310 E		180 E							35 E					130 E	1100 E
bis(2-Chloroethoxy)methane	MISC														82 E	8 E		
Dibenzofuran	MISC	826	50 E	220 E	32 E	72 E	100 E	670	160	120 E	690 E			46 E				
4-Nitroaniline	MISC												370 E					
N-Nitrosodiphenylamine (1)	MISC																52 E	
Summary																		
MISC. SEMI-VOLATILES		520	360	220	222	72	100	670	160	120	690	35	370	46	82	8	182	1100
TOTAL SEMI-VOLATILES		27708	9665	24300	9478	5489	26460	8685	5997	20628	90100	750	1716	17730	186	178	10444	1834

All concentrations reported as pg/kg.
"E" denotes estimated value below detection limit.
Shaded area indicates analyte found in blank.

SW004792

4.4 Pesticides and PCBs

Pesticides were identified in soil samples on and off site. PCBs were identified and quantified in soil samples on site. No pesticides or PCBs were identified in groundwater samples at the site.

4.4.1 Soils

The pesticides 4,4' DDE, Dieldrin, 4,4' DDD, gamma chlordane, and endosulfan were identified in samples collected from property adjacent to the General Instrument site and from the background samples collected approximately one-half mile from the site (Table 4.9). Dieldrin and gamma chlordane were identified (at concentrations below quantifiable detection limits) in Samples SS-12, SS-21 and SS-13 on site.

The presence of pesticides on and off site at low concentrations is probably a result of pesticide use by local homeowners and farmers in this agricultural area. Today, pesticides are used routinely to control ant, roach, fly and bee populations in residential properties. Farmers use them to control crop-damaging worms, larvae and flying insects. There is no indication that pesticide concentrations in the soil at the General Instrument site exceed ambient concentrations in soil of the region, and therefore will not be discussed further in this report.

Arochlor 1254, a PCB, was found in concentrations of up to 1900 µg/kg in the soil around MW-5. It is believed to be a confirmed hit, as it showed up in three other samples collected from the same area. Arochlor 1254 was also identified but not quantified in SB-7 at the northwest corner of the property. The surface soil in both areas, MW-5 and SB-7, is composed of a gravelly fill; the material is not native to the site and was probably trucked there as part of site construction or remediation. The apparent lack of a source of PCBs associated with site activity suggests that the PCBs may actually have been transported to the site in contaminated fill. In any event, the concentration is less than the generally-accepted RCRA (50 mg/kg) guidance value requiring soil cleanup.

4.5 Metals Plus Cyanide

The following section details the distribution of total and dissolved metals plus cyanide in groundwater, and total metals plus cyanide in the soil at the site. Metals in groundwater will be discussed first, followed by a discussion of metals in the soil. Generally, only metals of concern or metals that exceed NYSDEC standards as established under 6 NYCRR 703 and presented in TOGS 1.1.1 will be discussed.

A full scan for metals detailed on the Target Compound List by Superfund (SARA, 1986) and cyanide was run on groundwater and soil samples collected from on and off site as part of this investigation.

In groundwater, concentrations of total cadmium, iron, lead and magnesium exceeded NYSDEC groundwater standards; and concentrations of total antimony and magnesium exceeded established guidance values. In most cases, upgradient concentrations of metals were less than on-site or downgradient concentrations.

There are no established standards for metal concentrations in soil because of the variation which occurs naturally in soil. To make a reasonable determination of on-site contamination, on-site concentrations were compared with off-site ("background") concentrations and USGS published data for average soil in the eastern United States (Shackletter and Boerngen, 1984). In this comparison, very little difference was seen between on-site and off-site concentrations.

4.5.1 Groundwater

The NYSDEC standard or guidance value was exceeded in one or more wells for the following nine metals: antimony, cadmium, chromium, iron, lead, magnesium, manganese, sodium, and zinc. Each metal will be discussed separately, followed by a discussion of metal distribution on and off site.

a. Antimony

The concentration of antimony was below detection limits for all except the six wells described below.

CONCENTRATION OF ANTIMONY
IN WELLS THAT EXCEED THE STANDARD

Well No.	Concentration (µg/l)
MW-12	25.0
MW-14	24.0
MW-15	16.1
MW-16	15.4
MW-17	52.4
WES-3	15.0

The standard for antimony is 3 µg/l in groundwater, which is exceeded at one well off-site (WES-3); the three off-site downgradient wells (MW-15, MW-16 and MW-17); MW-14 east of the plating room; and MW-12 from near the Potash Creek debouchment in the South Field.

b. Cadmium

The concentration of total cadmium exceeded the MCL in MW-14 (16.1 µg/l). The standard is 10 µg/l. MW-14 is located east of the plating room.

c. Chromium

The chromium standard is 50 µg/l. Five monitoring wells sampled had total chromium concentrations in excess of that standard (see below).

CONCENTRATION OF TOTAL CHROMIUM
IN MONITORING WELLS THAT EXCEEDED THE STANDARD

Well No.	Concentration (µg/l)
MW-5	56.2
MW-12	69.8
MW-14	90.7
MW-16	57.8
MW-17	59.3

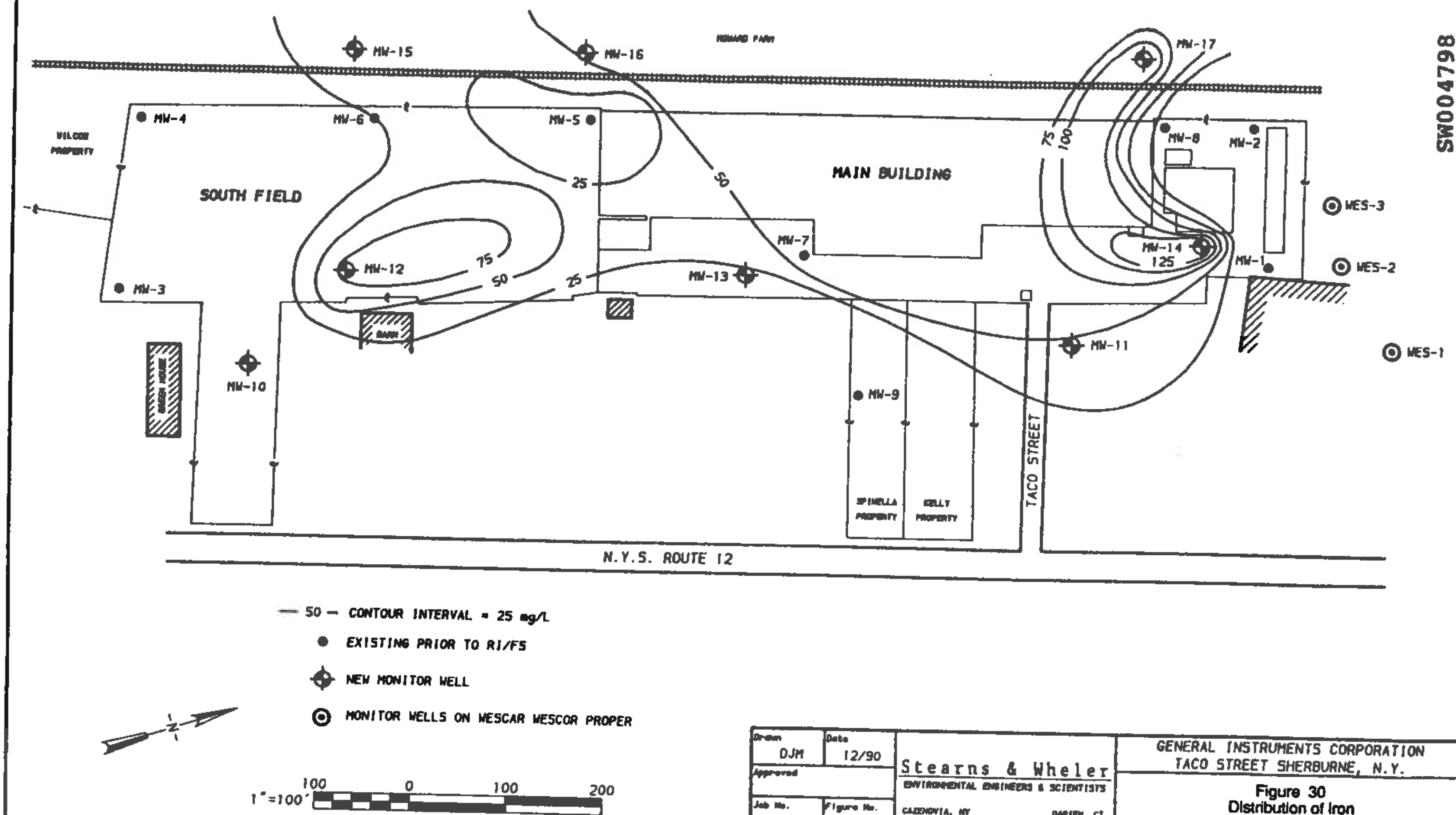
Monitoring Wells MW-12, MW-14 and MW-17 had the greatest concentration of total chromium. These are the same three wells that have the greatest concentration of other metals of interest.

d. Iron

The concentration of total iron exceeded the standard in all wells on site and off site. The standard for iron is 300 µg/l; concentrations ranged from 907 µg/l to 141,000 µg/l for monitoring wells on site, and from 2,360 µg/l to 107,000 µg/l for monitoring wells off site.

The distribution of total iron is presented in Figure 30. It is apparent from Figure 30 that MW-14 has the greatest concentrations of iron (141,000 µg/l), and MW-17 (hydrogeologically downgradient) has the second highest concentration at 107,000 µg/l. Concentrations are also elevated in MW-12, located in the South Field.

The distribution of iron is fairly typical of the distribution for all metals tested. That is, MW-14, MW-17 and MW-12 have elevated concentrations of metals relative to the other monitoring wells sampled. MW-14 and MW-17 are in close proximity to the plating room (adjacent to the east wall and downgradient, respectively), whereas MW-12 is located at the "old" debouchment of Potash Creek.



Drawn	Date
DJM	12/90
Approved	
Job No. 1587	Figure No. 30

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ENVIRONMENTAL ENGINEERS & SCIENTISTS
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GENERAL INSTRUMENTS CORPORATION
TACO STREET SHERBURNE, N.Y.

Figure 30
Distribution of Iron
in Groundwater

SW004798

The concentration of dissolved metals was determined for all groundwater samples collected, including iron. The concentration of dissolved iron was generally less than total iron in all monitoring wells. This is probably a result of the loss of iron in soil minerals that were removed during filtration. It is evident in Figure 31 that even after filtering, some on-site wells exceed the standard for iron, specifically MW-4, MW-7, MW-8 and MW-13. Off-site upgradient wells (MW-9, MW-10 and MW-11) were below the standard, as were downgradient wells (MW-15, MW-16 and MW-17).

e. Lead

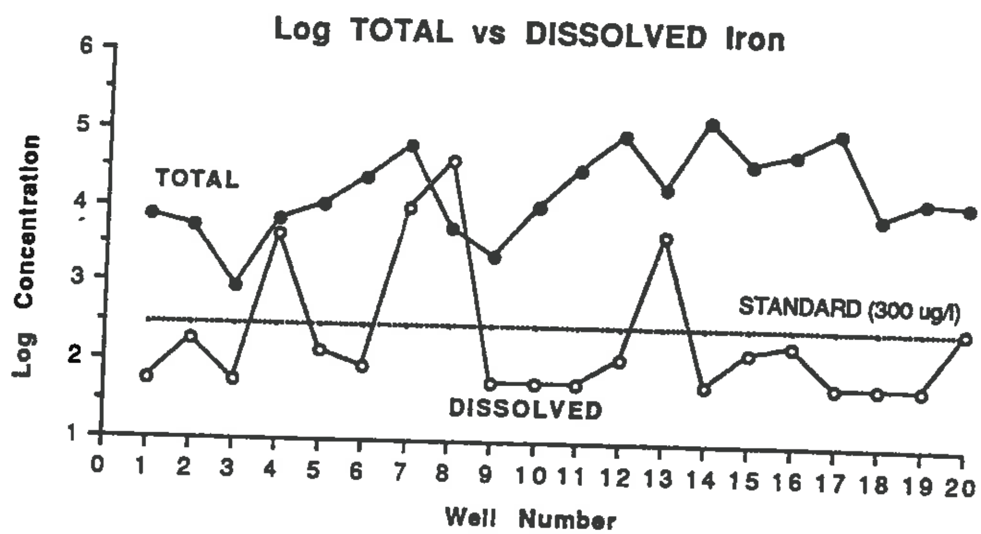
The concentration of total lead exceeded the standard in five monitoring wells on site and off site (see below). The standard for lead is 25 µg/l.

CONCENTRATION OF TOTAL LEAD
IN WELLS THAT EXCEED THE STANDARD

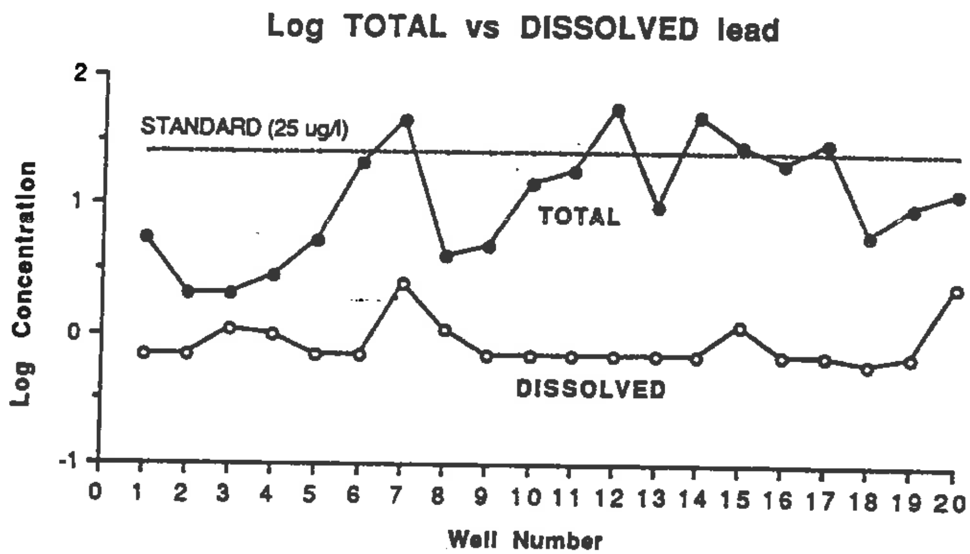
Well No.	Concentration (µg/l)
MW-7	45.4
MW-12	55.3
MW-14	49.8
MW-15	28.7
MW-17	29.9

The greatest concentration of lead is found in MW-12; however, MW-14 and MW-17 also have elevated concentrations. The distribution of lead is similar to the distribution of iron.

A comparison of total lead to dissolved lead (Figure 32) shows that nearly all lead is removed during filtration. This strongly suggests that the lead is adsorbed to organic or clay particles in the water, and is effectively removed during field filtration. The concentration of dissolved lead does not exceed the standard for any wells on site or off site.



Job Number: 1587	Drawn by: EJH	Stearns & Wheler Environmental Engineers and Scientists Cazenovia, NY Watertown, NY Darien, CT Tampa, FL	General Instrument Corporation TACO Street, Sherburne, NY
Approved by:	Date: 12/90		Figure 31 Total versus Dissolved Iron



Job Number: 1587	Drawn by: EJH	Stearns & Wheler Environmental Engineers and Scientists Cazenovia, NY Waterlown, NY Darien, CT Tampa, FL	General Instrument Corporation TACO Street, Sherburne, NY
Approved by:	Date: 12/90		Figure 32 Total versus Dissolved Lead

SW004801

f. <u>Magnesium</u>

A guidance value of 35,000 µg/l has been established for magnesium by the NYSDEC. Concentrations of total magnesium in groundwater exceeded the guidance value in seven wells on site and off site (see below).

CONCENTRATION OF TOTAL MAGNESIUM IN WELLS THAT EXCEED THE GUIDANCE VALUE

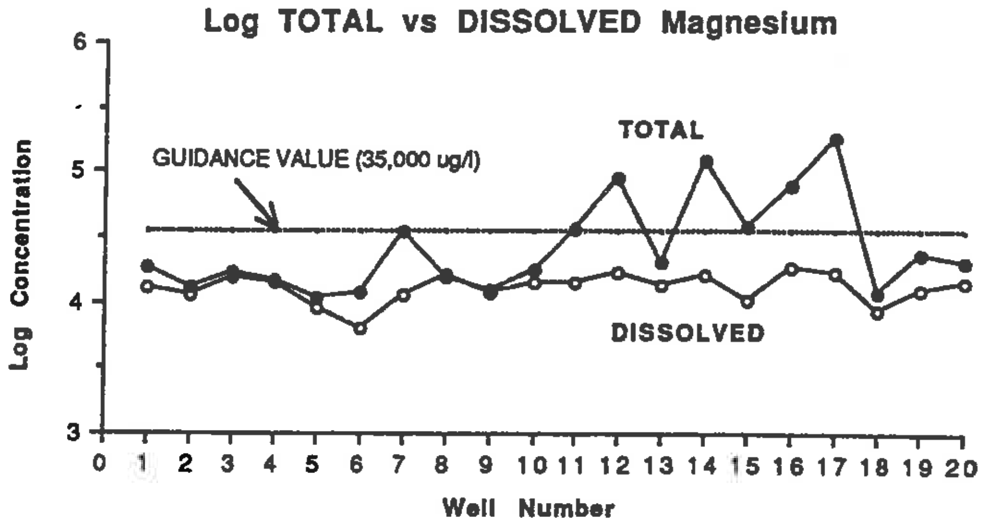
Well No.	Concentration (µg/l)
MW-11	36,000
MW-12	87,500
MW-14	124,000
MW-15	37,600
MW-16	77,500
MW-17	178,000

A comparison of total versus dissolved magnesium (Figure 33) reveals a dramatic reduction in magnesium in filtered samples. In fact, no dissolved concentrations approached the guidance values. Magnesium is found naturally in the minerals within limestones, clays, and feldspathic sands.

The difference between total magnesium and dissolved magnesium concentrations probably reflects a high concentration of suspended mineral particles rich in magnesium, that were subsequently removed during field filtration.

g. <u>Manganese</u>

The standard for manganese is 300 µg/l. All monitoring wells tested (including on-site and off-site wells) exceeded the standard for manganese, except Wells MW-5 and MW-6, located in the South Field. Concentrations ranged from 215 µg/l (below standard) to 12,100 µg/l for monitoring wells on site. Off site, concentrations ranged from 305 µg/l to 11,400 µg/l.



Job Number:	Drawn by:	Stearns & Wheler	General Instrument Corporation TACO Street, Sherburne, NY
1587	EJH	Environmental Engineers and Scientists	
Approved by:	Date: 12/90	Cazenovia, NY Watertown, NY Darien, CT Tampa, FL	Figure 33 Total versus Dissolved Magnesium

Dissolved concentrations of manganese did not differ appreciably from total concentrations. A comparison of total versus dissolved (Figure 34) illustrates that in a general sense, the dissolved component constitutes most of manganese in the sample.

Manganese is used in the iron and steel industries as an alloy; it is also used as an alloy in zinc and aluminum products. It also has many uses in the fertilizer industry, in paints, varnishes and inks. There is not an appreciable increase in manganese concentration from upgradient to downgradient, and manganese frequently exceeds groundwater standards naturally. The manganese detected in on-site wells may be derived in part from site operations as well as from natural occurrence.

h. Sodium

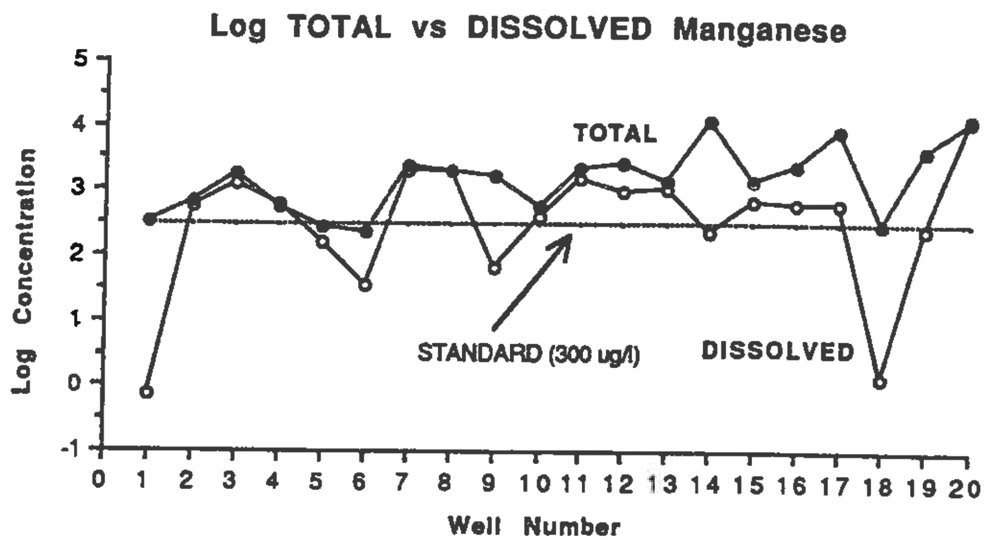
The groundwater standard is 20,000 µg/l. This was exceeded in 12 of the 18 wells tested. Concentrations exceeding the standard ranged from 21,000 to 346,000 µg/l. The highest values were at the north end of the site (MW-14 and MW-17), suggesting a possible connection to plating room activities. The standard was exceeded in two of the three upgradient wells, suggesting high background levels.

i. Zinc

The zinc standard of 300 µg/l was exceeded in three wells, and only minimally. Concentrations of 306, 381, and 381 µg/l were detected Wells MW-12, MW-14, and MW-17, respectively.

j. Cyanide

Cyanide was discovered in the groundwater at MW-5, MW-6 and MW-16. MW-5 and MW-6 exceeded the standard of 100 µg/l, with concentrations of 206 µg/l and 118 µg/l, respectively. The source of this cyanide is probably



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Approved by:	Date: 12/90		Figure 34 Total versus Dissolved Manganese

related to soil contamination previously discovered during plant closure. The contaminated soil has subsequently been excavated, and analysis of soil samples from the remediated area (SS-1, SS-2 and SS-3) revealed low levels of cyanide, but dramatically less than concentrations before remediation.

In summary, nine of 23 metals tested exceeded standards in one or more wells. This data was compared to historical, unvalidated data from 1985 and 1986. Of the metals tested in those sampling events, four exceeded standards. These included chromium, iron, manganese, and zinc. Chromium was consistently at or above standards in all wells in 1985 and 1986. In our study, only five wells had chromium exceedances.

The most consistent exceedances are at the north end of the site and may be related to plating room activities.

4.5.2 Soils

As with many soil analyses, there are no established limits or standards for metal concentrations in soils. To determine whether metal concentrations at the site were excessive, on-site concentrations were compared to background for the Town of Sherburne, and to USGS published data of mean concentrations in the eastern United States (Shackletter and Boerngan, 1984). Background and USGS values are reported in Table 4.10. Background samples from Sherburne exceeded USGS values for cobalt, lead, nickel and zinc; therefore, in the comparison, the background sample will supersede the USGS values.

The concentration in metals in on-site soil samples was greater than background and USGS reports for the following metals: arsenic, copper, lead and zinc (Tables 4.11, 4.12, 4.13 and 4.14). Beryllium, cadmium and chromium concentrations in sediment samples from Potash Creek (off-site and cross-gradient) exceeded background and USGS values, but are associated with the fine grain organic-rich stream (pond) sediments where one would expect to find higher concentrations of metals.

Table 4.10
BACKGROUND METAL CONCENTRATION IN SOIL

Sample Number	SS-04	SS-05	SS-06				
	BACKGROUND						
Location	Farmer Field	Farmer Field	Farmer Field	AVERAGE		COMPARISONS	
Metal	Conc. mg/kg	Conc. mg/kg	Conc. mg/kg	Conc. mg/kg	STD. DEV	MAXIMUM BCKGRND*	USGS +
Aluminum	21000	18200	13600	17600.0	3736.3	21336.3	N/A
Antimony			3.4 E	3.4	0.0	3.4	2.9
Arsenic	5.9	5.5	4.5	5.3	0.7	6.0	7.4
Barium	125	99.1	64.3	96.1	30.5	126.6	292.2
Beryllium	1	0.95	0.47	0.8	0.3	1.1	3.1
Cadmium	0.83	0.85	0.86	0.8	0.0	0.9	N/A
Calcium	2480	2970	6030	3826.7	1923.8	5750.5	N/A
Chromium	27.5	24.8	15.8	22.7	6.1	28.8	35.6
Cobalt	13.3	13.1	5.7	10.7	4.3	15.0	8.5
Copper	13.7	12	15.5	13.7	1.8	15.5	15.8
Iron	29200	26500	21800	25833.3	3744.8	29578.1	N/A
Lead	30.7	18.1	23	23.9	6.4	30.3	15.9
Magnesium	4570	4140	2370	3693.3	1166.0	4859.4	N/A
Manganese	633	516	379	509.3	127.1	636.5	263.8
Mercury	0.11	0.07	0.06	0.1	0.0	0.1	2.6
Nickel	30.2	28.8	12.9	24.0	9.6	33.6	13.6
Potassium	1760	1550	973	1427.7	407.5	1835.2	N/A
Selenium	0.38	0.41	0.42	0.4	0.0	0.4	2.7
Silver	0.44	0.45	0.46	0.5	0.0	0.5	N/A
Sodium	186	102	162	150.0	43.3	193.3	N/A
Thallium	0.29	0.3	0.3	0.3	0.0	0.3	9.3
Vanadium	28.1	25.4	22.6	25.4	2.8	28.1	N/A
Zinc	108	93.5	69	90.2	19.7	109.9	42.11
Cyanide				N/A	N/A	N/A	N/A

All values reported as mg/kg of dry soil.
Shaded areas considered non-detect based on field or method blank contamination.
Smaller type denotes levels below ICP Analytical detection limit.
" E " denotes estimated value.
* Calculated from the average offsite samples plus one standard deviation.
+ Source: Shacklette, H.T. and Boerngen, (1984)

Table 4.11
OFFSITE METAL CONCENTRATION IN SOIL

Sample Number	SS-21			SS-22			SS-23			SS-24			SED-1			SED-2		
Location	OFFSITE			OFFSITE			OFFSITE			OFFSITE			OFFSITE			OFFSITE		
Metal	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*
Aluminum	8260			14400			15700			19600			18700			19200		
Antimony	2.9			2.8			2.8			3.2	X		[illegible]			[illegible]		
Arsenic	12.4	X	X	9	X	X	8.8	X	X	7.6	X	X	3.7			6.9		X
Barium	121			128		X	117			113			1200	X	X	317	X	X
Beryllium	0.73			0.81			0.56			1.1		X	1.0 E	X	X	2.8 E	X	X
Cadmium	8.6		X	0.79			0.82			0.92		X	12.1		X	24.8		X
Calcium	10200		X	20600		X	4670			2800			2660			3450		
Chromium	82	X	X	23.9			24.3			25.3			42.9	X	X	256	X	X
Cobalt	7.7			11.9	X		9.6	X		12.8	X		10.1	X		9	X	
Copper	86.2	X	X	52.2	X	X	20.5	X	X	14.9			70.4	X	X	426	X	X
Iron	19700			25400			23900			27200			25000			27700		
Lead	81.8	X	X	178	X	X	130	X	X	34.9	X	X	73.3	X	X	238	X	X
Magnesium	3480			3930			3630			3850			3910			3600		
Manganese	337	X		516	X		453	X		612	X		238			205		
Mercury	0.08			0.41		X	0.12		X	0.12		X	0.28		X	0.64		X
Nickel	21.7	X		23.3	X		20.8	X		26.8	X		29.2	X		29.3	X	
Potassium	1010			1350			1460			1250			1630			1750		
Selenium	0.87		X	0.58		X	0.31			0.57		X	0.81		X	2.1		X
Silver	7.7		X	0.42			0.43			0.48		X	1.4		X	22.5		X
Sodium	105			170			106			109			323		X	394		X
Thallium	0.28			0.28			0.29			0.3			0.37		X	0.52		X
Vanadium	15.2			21			25.3			29.2		X	25.3			35.1		X
Zinc	222	X	X	259	X	X	181	X	X	95.1	X		335	X	X	513	X	X
Cyanide	1.9			0.64			0.65			0.7			[illegible]			[illegible]		

All values reported as mg/kg of dry soil.
Shaded areas considered non-detect based on field or method blank contamination.
Smaller type denotes levels below ICP analytical detection limit.
" E " denotes estimated value.
* Compared to the average offsite samples plus one standard deviation.
+ Compare the USGS value, Shacklette, H.T. and Boerngen, (1984)
"X" indicates exceedance of either the background or USGS value

Table 4.12
METAL CONCENTRATIONS IN SOIL FROM TEST PITS

Sample Number	SS-10			SS-11			SS-12			SS-13			SS-14			SS-15			SS-16			SS-17			SS-18			SS-25			SS-25A		
Location	ONSITE			ONSITE			ONSITE			ONSITE			ONSITE			ONSITE			ONSITE			ONSITE			ONSITE			ONSITE			ONSITE		
Metal	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*
Aluminum	9980			15700			12800			14600			22200		X	22200		X	20800			12200			13000			11200			12400		
Antimony	2.8			2.6			2.8			3.1	X		2.8			3.1	X		3	X		2.5			2.5			2.9			3.3	X	
Arsenic	5.5			6.3		X	8.3	X	X	8	X	X	4.2			4.7			4.7			4.8			6			4.4			5.1		
Barium	35.6			65.8			77.7			95.5			141		X	125			118			57.3			46.7			65.8			92.5		
Beryllium	0.22			0.51			0.64			0.62			0.94			1.2		X	1.1		X	0.82			0.51			0.38			0.45		
Cadmium			X										0.82			2.1		X	0.85			15.9		X	0.95		X						
Calcium	71000		X	6380		X	12700		X	31100		X																40200		X	33800		X
Chromium													29.8		X	34.7		X	27.4			26.7			21								
Cobalt	5			10.8	X		6.8			7.4			12.8	X		13.8	X		12.6	X		8.9	X		11.7	X		6.8			5.8		
Copper	28.9	X	X	20.3	X	X	26.5	X	X	51	X	X	18	X	X	34	X	X	19.2	X	X	37.4	X	X	20.1	X	X	64	X	X	64	X	X
Iron	20400			29200			22200			21600			30500		X	30000		X	30400		X	21400			27100			19700			17600		
Lead	11.7			11.3			37.1	X	X	55.2	X	X	11.6			21.4	X		14.4			23.9	X		15.3			67.1	X	X	45.2	X	X
Magnesium													4840			4880		X	5110		X	6370		X	6240		X						
Manganese	484	X		641	X	X	238			344	X		502	X		448	X		611	X		550	X		462	X		493	X		376	X	
Mercury	0.04			0.06			0.05			0.09			0.06			0.09			0.25		X	0.06			0.04			0.22		X	0.43		X
Nickel	18.8	X		26.8	X		20.1	X		22.9	X		30.3	X		41.7	X	X	31.7	X		22.7	X		26.5	X		17.9	X		16.7	X	
Potassium	1060			1320			1130			1350			1540			1600			1460			1420			1110			986			937		
Selenium	0.28			0.32			0.42			0.35			0.24			0.26			0.25			0.21			0.22			0.33			0.68		X
Silver	0.37			0.39			0.42			0.46		X	0.57		X	1.2		X	0.45			19.8		X	0.52		X	7.1		X	5.4		X
Sodium	54.9			58			63			69			229		X	260		X	244		X	224		X	168			149			877		X
Thallium	0.28			0.32		X	0.35		X	0.35		X	0.34		X	0.37		X	0.35		X	0.3			0.31		X	0.33		X	0.38		X
Vanadium	13.2			21.3			19			22.4			30.6		X	29		X	27.9			18.6			17			16.7			15.8		
Zinc	62.8	X		68.8	X		175	X	X	276	X	X	79.5	X		133	X	X	91.5	X		88.5	X		78.5	X		208	X	X	428	X	X
Cyanide	0.54			0.6			2.2			0.67			0.63			0.68			0.63			4.1			0.59			6.9			4.4		

All values reported as mg/kg of dry soil.
Shaded areas considered non-detect based on field or method blank contamination.
Smaller type denotes levels below ICP analytical detection limit.
" E " denotes estimated value.
* Compared to the average offsite samples plus one standard deviation.
+ Compared the USGS value, Shacklette, H.T. and Boerngen, (1984)
"X" indicates exceedance of either the background or USGS value

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Table 4.13
METAL CONCENTRATION IN SOILS FROM SPILL AREA

Sample Number	SS-26			SS-27			S-28		
Location	ONSITE			ONSITE			ONSITE		
Metal	Conc. mg/kg	+	*	Conc. mg/kg	+	*	Conc. mg/kg	+	*
Aluminum	14400			13100			4410		
Antimony	2.8			2.9			2.3		
Arsenic	6.5		X	7.3		X	3.1		
Barium	91.3			85.6			30		
Beryllium	0.93			0.67			0.32		
Cadmium	0.81			0.84			0.66		
Calcium	9340		X	16000		X	213000		X
Chromium	22.3			19.9			7.2		
Cobalt	11.5	X		9.9	X		4.9		
Copper	18.6	X	X	18.6	X	X	10.3		
Iron	25800			22800			8780		
Lead	31.3	X	X	65.2	X	X	8		
Magnesium	5140		X	5060		X	10800		X
Manganese	577	X		624	X		356	X	
Mercury	0.05			0.13		X	0.05		
Nickel	25.7	X		22	X		10.8		
Potassium	1130			1210			743		
Selenium	0.41			0.3			0.26		
Silver	0.42			0.44			0.35		
Sodium	83.6			470		X	143		
Thallium	0.28			0.28			0.25		
Vanadium	19.2			20.5			8.7		
Zinc	94.1	X		121	X	X	39.2		
Cyanide	0.63			0.65			0.53		

All values reported as mg/kg of dry soil.
Shaded areas considered non-detect based on field or method blank contamination.
Smaller type denotes levels below ICP analytical detection limit.
" E " denotes estimated value.
* Compared to the average offsite samples plus one standard deviation.
\+ Compared the USGS value, Shacklette, H.T. and Boerngen, (1984)
"X" indicates exceedance of either the background or USGS value

4.6 Contaminant Source Investigation

As part of the work plan, 13 tasks were proposed to address NYSDEC concerns at the site. The first part of this chapter introduced the data and identified compounds of concern and areas where data exceeded established standards. For the remainder of this chapter, we will address the results of specific tasks, describing the presence or absence of contamination and suggesting the probable sources of contamination in greater detail.

4.6.1 Task 1

The purpose of this task was to determine whether a source of inorganic contamination persists in the vicinity of MW-5; the two primary inorganics of concern are chromium and cyanide. Concentrations of all inorganics in the soil around MW-5 and MW-7 are reported in Table 4.15.

At the time of sampling, chromium concentration in the soil around MW-5 ranged from 22 mg/kg to 51 mg/kg. Background samples from Sherburne averaged 22±6 mg/kg; the maximum expected background concentration is 28 mg/kg. Prior to plant closure, the soil in the vicinity of MW-5 contained greater than 1000 ppm. The soil concentrations of chromium in the vicinity of MW-5, although slightly higher than background, are considerably less than pre-closure concentrations and are not a source of contamination.

Cyanide in MW-5 was perceived to be a problem and is specifically addressed in the work plan. Groundwater sampled from MW-5 contained cyanide in excess of the State groundwater standard. The standard is 200 µg/l for cyanide; MW-5 contained 206 µg/l. MW-16 (immediately downgradient) and MW-6 (cross-gradient) contained 26 µg/l and 118 µg/l, respectively, of cyanide. These were the only monitor wells to have detectable levels of cyanide.

We found that concentrations of cyanide in MW-5 showed a gradual decrease with time. Between 1985 and 1986, MW-5 was tested for cyanide on a monthly basis. During that time, the average concentration was 360 µg/l. The concentration we measured was 206 µg/l. This is less than the historical concentration and shows a decline over time.

4.6.2 Task 2

The purpose of this task is to determine the source and extent of contamination in the soil and groundwater along the western boundary of the property and the South Field. Monitor Wells MW-4, MW-5, MW-6, MW-8 and MW-2 are located along the western boundary of the site. Soil Samples SS-1, SS-2, SS-3, SS-21, SB-8 and SB-7 were collected from the western boundary of the site.

Contamination of soil and groundwater along the western border of the property can be divided into a southerly and northerly component. The southerly component is characterized by low concentrations of chlorinated VOCs in the groundwater and moderate chromium and cyanide concentrations in MW-5. The northerly component is a complex combination of volatile and semi-volatile organic compound contamination of soil and groundwater. It is characterized by high concentrations of aromatic and chlorinated hydrocarbons in MW-8 and in soil around the plating room. Contamination along the western boundary at the north end of the site will be addressed in Task 8, Task 9, and Task 13.

In the South Field, low levels of VOCs, in particular 1,2 dichloroethene (1,2-DCE) and trichloroethene (TCE), persist in MW-4, MW-5 and MW-6. Sample SB-1 from the center of the South Field also contained 8 µg/l of 1,2-DCE and TCE. The soil gas survey encountered low levels of unidentified volatile compounds at two locations: in the center of the field near SB-1, and west of SB-1 towards MW-6. The locations of soil gas probes and test results are shown on Figure 5 (page 2-11).

No direct source of VOC contamination was encountered during monitor well installation, test pit excavation, or the soil gas survey. It is possible that the source is low level residual contamination in the soil around the Potash Creek debouchment or in the deeper unremediated soil in the areas of previous remediation. During the operation of the plant, drums of material were stored in the South Field, paints and thinners were stored in temporary sheds which have subsequently been removed.

Examination of soil samples from the west boundary indicates slightly elevated concentrations of chromium. Soil Sample SS-21 (west of the main building) contained 82 mg/kg of chromium (Table 4.11). During plant closure, the same area contained greater than 4000 mg/kg chromium. While the most recent measurement is greater than background (28.8 µg/kg) and USGS reports (35.6 µg/kg), it is still far below maximum ambient concentrations as reported by the USGS (≥1,000 µg/kg) and pre-closure concentrations. Soils from behind the building were removed by excavation during the RCRA closure and the area was backfilled with clean fill.

The source of chromium near MW-5 was discussed in Task 1, where it was determined that soil concentrations in the vicinity of MW-5 had been significantly reduced. The groundwater standard for chromium is 50 µg/l. The groundwater standard for cyanide is 100 µg/l. Chromium concentration in MW-5 is 56.2 µg/l; cyanide concentration is 206 µg/l. The surface soil near the west boundary is not believed to be a source of inorganic contamination at the site. The occurrence of cyanide and chromium in MW-5 is believed to be the result of low level residual concentrations in the soil at depth, in the aquifer, or in soil under the main building.

4.6.3 Task 3

The purpose of this task was to determine the source of volatile organic compounds in MW-7. Historically, TCE, 1,1,1-TCA, 1,2-DCE and methylene chloride (DCM) had been intermittently discovered in MW-7. During our survey, only 25 µg/l of 1,2-DCE was encountered, considerably less than historical records.

To determine whether the soil at the well was the source of VOCs, soil samples were collected in the vicinity of the well (SS-7, SS-8 and SS-9) and along the Old Chenango Canal (SS-11, SS-12 and SS-13); all soil sampled tested negative for VOCs. Therefore, we determined that the source of volatiles in MW-7 is not the immediate soil around the well or the old canal bed immediately upgradient.

To determine whether an upgradient, off-site source existed, MW-9 was tested for VOCs and contained no VOCs. However, MW-13, an upgradient/cross-gradient, on-site sampling point, contained low levels of 1,2-DCE. The presence of 1,2-DCE in MW-7 and MW-13 suggests either a localized (and yet undiscovered) source along the eastern property boundary, or residual concentrations in the soil and aquifer.

During plant operation, General Instrument stored hazardous waste material in a shed located due east of the garage (Figure 12). The shed is now demolished, but during plant closure, contamination was discovered in the soil around this shed. The soil was excavated as part of the plant closure. The low levels of 1,2-dichloroethene identified in MW-13 and MW-7 may be related to low levels of residual concentrations in the deep soil and aquifer in the vicinity of the now-demolished storage shed. There is reason to believe that the source is diminishing, as concentrations and the number of compounds present have decreased with time.

4.6.4 Task 4

The purpose of this task was to evaluate the possibility that ponding on Potash Creek is an off-site source of VOCs. Soil samples collected from the bottom of Potash Creek did not contain any volatile compounds; therefore, it is unlikely that Potash Creek is a source of VOCs.

Monitor wells north of the site (WES-2 and WES-3) contained VOCs at low levels, and Monitoring Well MW-1, north of the plating room but on site, also contained low concentrations of VOCs. The concentration in all wells north of the plating room and site boundary are low when compared to values downgradient and on site; Potash Creek or the soil and groundwater north of the site are not considered a primary source of VOCs in the soil and groundwater on site, but may contribute to the overall concentration found on site.

4.6.5 Task 5

The purpose of this task was to determine whether the "old" course of Potash Creek through the site was a preferred pathway of contaminant migration.

Analysis of soil samples collected in test pits along the eastern boundary indicate that no volatile compounds are present along the buried culvert, south of the plating room. In Test Pit No. 5 (SS-25A), 2-butanone and chloroform were detected at concentrations below method detection limits. The presence of these volatiles is attributed to percolation of the plating room floor drainage system. Prior to 1973, the floor drain in the plating room percolated into a gravel bed located under the parking lot and plating room (T. Favalaro, Personal Communication). In 1973, the floor drain was connected to the village sewer system. The exact location of the gravel percolation bed beneath the parking lot has not been identified, but VOCs were encountered in SS-19 and SS-20 (samples collected from the well boring for MW-14), also located in the parking lot east of the plating room.

Monitor Well MW-12 is located in the South Field close to the south end of the buried portion of Potash Creek across the site where the underground pipe historically emerged (debouchment). MW-12 contained volatile compounds in concentrations below method detection limits, suggesting that Potash Creek was not a preferred pathway of VOCs, and the VOCs encountered east of the plating room did not migrate along a preferred route. However, high concentrations of inorganics were discovered in MW-12. Antimony, chromium, iron, lead, manganese and magnesium exceeded state standards or guidance values.

4.6.6 Task 6

The purpose of this task was to determine whether refuse deposited in the Old Chenango Canal could be the source of metals in the groundwater. Five test pits were dug along the course of the old canal. At depth, the test pits uncovered a black, silty soil that contained some refuse. The refuse consisted of broken jars, small scraps of rusted metal, and discontinuous lenses of a white clay interpreted to be coal ash. We did not uncover large piles of refuse to which we could attribute the high metals concentrations in groundwater.

Additionally, soil samples collected from the test pits (SS-10, SS-11, SS-12, SS-13, SS-25 and SS-25A) did not contain high concentrations of metals. All test pits showed elevated concentrations of copper relative to background and USGS published data for ambient concentrations. The greatest copper concentration (64 µg/kg) is still well below the observed range, as published by the USGS (700 µg/kg).

Lead and zinc concentrations in TP-3, TP-4 and TP-5 exceeded background and USGS published means, but were below the USGS observed range of 300 µg/kg and 2900 µg/kg, respectively.

4.6.7 Task 7

The purpose of this task was to determine whether an upgradient source of metal contamination is moving onto the site. It was determined that the concentration of metals in upgradient wells is not greater than on-site wells. The average concentration of metals in on-site and downgradient wells is 356 ppm; the average concentration of metals upgradient/off-site is 192 ppm. There does not appear to be an upgradient/off-site source of metals in the groundwater.

4.6.8 Task 8

The purpose of this task was to characterize the nature and extent of volatile organic compounds previously identified in, and adjacent to, the plating room.

Test pits were excavated through the concrete floor of the plating building. All test pits encountered volatile compounds, as indicated by high PID readings in the field (see Appendix C), and later confirmed by laboratory analysis. Test Pit No. 6, in the center of the plating room, enlarged a smaller test pit originally excavated by others during earlier investigations (not a part of the RI/FS). The pit exposed a 24-inch clay tile floor drain pipe that extended vertically from the floor of the room to an undetermined depth in the subsurface. Strong odors were encountered during excavation, and PID readings exceeded 200 ppm at the bottom of the pit. A soil sample (SS-14) collected from the pit contained 1,1,1-TCA (270 µg/kg;) 1-1-DCA (40 µg/kg); and xylene (140 µg/kg), and a confirmed presence of (but below quantifiable levels) ethylbenzene.

Other test pits through the floor of the plating building (Test Pit Nos. 7 and 8) also contained volatile organic compounds. SS-15 from Test Pit No. 7 contained 1,1-DCA (18 µg/kg); 1,2-DCE (51 µg/kg); 1,1,1-TCA (390 µg/kg); TCE (170 µg/kg), and xylene (160 µg/kg); and confirmed presence of ethylbenzene, toluene, PCE, chloroform and methylene chloride. SS-16 from Test Pit No. 8 contained 1,1-DCA (9 µg/kg); 1,2-DCE (22 µg/kg); and an estimated quantity of xylene, chloroform, and methylene chloride. The results from these three test pits confirm the presence of volatile organic compounds in the soil beneath the plating building. The VOCs were probably derived from the plating degreasing and rinsing operations conducted in the plating building.

To determine the extent of soil contamination adjacent to the plating room, additional test pits and soil borings were collected from the surface and near-surface soil. Test Pit No. 9 and Test Pit No. 10, excavated west of the plating building through the gravel fill of the parking area, contained volatile organic contaminants as indicated by PID readings of 11 ppm and 9.5 ppm, respectively. However, laboratory analysis revealed VOCs in Test Pit No. 9 (SS-17) only. The suite of compounds present is similar to that found in the test pits inside the plating building (1,1-DCA; 1,2-DCE; 1,1,1-TCA; TCE; ethylbenzene; and xylene). Toluene and chloroform were present but quantities only estimated.

Soil borings from the near-surface around the plating room (SB-2 through SB-9) also contained a suite of VOCs similar to those found beneath the plating building, indicating that either the soil was affected before plant closure or the VOCs are migrating through the soil from beneath the building to the perimeter of the building. We suggest (and will discuss in greater detail in Chapter 5) that volatilization of organic compounds in the soil and groundwater beneath the plating building is migrating by dispersive processes into the adjacent soils.

Groundwater in MW-8 downgradient of the plating room is contaminated by chlorinated hydrocarbons (up to 8,153 µg/l) and BTEX organic compounds (up to 9 inches of free-phase floating product), probably derived from operations at the plating room, the oil spill near the loading dock in General Instrument property, and the oil spill at the northern property boundary adjacent to the Wescar bulk storage facility. MW-8 is directly downgradient of the plating room, and it contained six of the seven VOCs identified in the soil of the plating room. MW-17, further downgradient of both MW-8 and the plating room, contained a similar suite of compounds, but in lower concentrations. It appears that volatile organic compounds originally released to the soil beneath the plating building have impacted groundwater. The scenario is complicated by the presence of petroleum hydrocarbons released by accidental spills. Monitor Well MW-14, directly upgradient of the plating room, does not contain any VOCs.

4.6.9 Task 9

The purpose of this task was to determine the source of petroleum hydrocarbons at the north end of the site. Volatile indicators of petroleum hydrocarbons are the aromatics (benzene, toluene, ethylbenzene and xylene). Since xylene was discovered in and is associated with activity in and around the plating building, the most accurate VOC indicator of petroleum is considered to be benzene, toluene and ethylbenzene. Napthalene and methylnapthalene, both semi-volatile compounds, are reliable indicators of fuel oil contamination.

Free phase product was identified in MW-8, and contaminated soil was identified at the northern property boundary during the field investigation. We believe the free product in MW-8 is at least partially due to the spill near the loading dock. The release was reported to NYSDEC in September 1986 (Spill No. 8604201). There was another spill that occurred at the loading dock in 1987 (Spill No. 8702865), and additional release at the north end of the property in 1989. A spill was reported to the NYSDEC in October 1989 (Spill No. 8907369). This release was probably the result of intentional or inadvertent release by persons (other than General Instrument personnel) who gained access to the site from the north. At the time of the release, there was no fence at this portion of the property. Soil samples collected from the spill area indicate the presence of benzene, toluene and xylene, napthalene and methylnapthalene. As part of the NYSDEC spill report, and independent of the RI/FS, soil from the spill area was analyzed for total petroleum hydrocarbons. Results indicate the presence of kerosene and fuel oil (see Appendix E).

Surface soil samples from the area of the plating room and petroleum spills (SB-3 through SB-9) contained various amounts of petroleum hydrocarbons. SB-7, from the furthest northwest corner of the property adjacent MW-2, contained very high concentrations of BTEX compounds (15,600 µg/kg). SB-8, from the area adjacent MW-8 (in the vicinity of the 1986 and 1987 release), contained high concentrations of petroleum hydrocarbons (2,760 µg/kg).

Groundwater samples collected from WES-2 and WES-3 (upgradient and cross-gradient of both spills) contained small amounts of toluene, no benzene, ethylbenzene, or semi-volatile compounds. MW-8, on the other hand, contained 9 to 24 inches of floating free-phase product (suspected to be fuel oil), 110 µg/l toluene, 51 µg/l xylene, and napthalene and 2-napthalene at 510 µg/l each. Clearly this well has been impacted by petroleum hydrocarbons, most probably fuel oil released during the 1986, 1987 and 1989 spills.

Petroleum hydrocarbons at the north end of the site appear to be localized in the surface and near-an soils (see Figures 25 and 26). Petroleum-derived hydrocarbons have had an impact on groundwater. The source of the petroleum hydrocarbons in the groundwater is from spills by General Instrument in the vicinity of the loading dock, and by unknown persons who gained access to the site from the north.

4.6.10 Task 10

The purpose of this task was to determine whether off-site transport had occurred via air transport.

Six soil samples were collected: two from off-site/upwind north and west of the site (SS-4 and SS-5), three from off-site/downwind south and east of the site (SS-22, SS-23 and SS-24). Additionally, one sample from a farmer's vacant field approximately one mile from the site was used as a background data point. All soil samples contained no volatile organic compounds, PCBs or pesticides of concern.

Downwind samples contained marginally-elevated concentrations of arsenic, copper, lead and zinc relative to upwind and background concentrations. In all cases, however, the elevated concentrations are less than the observed range as published by the USGS, and only marginally greater than background for the site and for Sherburne in general. There is no evidence of off-site migration via atmospheric deposition of metals at the site.

Soil Sample SS-22 downwind/off-site contained high concentrations of polynuclear aromatic compounds (the product of incomplete fossil fuel combustion). The soil at SS-22 contained 89 ppm PNAs and a small amount of dibenzofuran which, although it is not classified a PNA, is related to fossil fuel combustion. The concentration of PNAs at SS-22 is higher than any sample, on- or off-site. We believe the elevated PNAs are the result of the coal ash deposition by adjacent homeowners into the abandoned Chenango Canal. Mr. Sean Kelly reported large quantities of ash in his backyard, "that must have filled in a low spot" (Personal Communication). He excavated these ashes while doing landscape construction on his property.

From the soil samples collected, there is no evidence of off-site migration via atmospheric deposition of contaminants generated at the TACO site.

4.6.11 Task 11

The purpose of this task was to determine whether off-site migration has occurred via groundwater transport.

Three monitor wells were installed off-site/downgradient from the site; all three contained elevated concentrations of VOCs. MW-15 contained 8 µg/l of TCE;

MW-16 contained 1,2-DCE (11 μg/l) and TCE (65 μg/l); and MW-17 contained 1,1-DCE (7 μg/l), 1,2-DCE (76 μg/l), 1,1,1-TCA (96 μg/l), and TCE (130 μg/l), and an estimated quantity of vinyl chloride.

In addition, MW-16 contained 28 μg/l of cyanide, which is below the MCL but elevated relative to other off-site wells. It indicates a moderate off-site migration from the vicinity of MW-5, which had 206 μg/l of cyanide.

There was no evidence of off-site migration via groundwater of any contaminants except chlorinated hydrocarbons and cyanide.

4.6.12 Task 12

The purpose of this task was to: (1) re-evaluate data from existing wells to gain a historical perspective of contamination at the site; and (2) resample existing wells for calibration purposes.

An evaluation of existing data revealed that concentrations of VOCs in MW-1 through MW-9 were lower in samples collected as part of the RI/FS field investigation (sample collected in October 1989) than historical concentrations. Previous investigations collected monthly or bi-monthly data from February 1985 through September 1986. These data revealed a wide range of concentrations that varied over time; however, the suite of compounds remained relatively constant. Earlier investigations detected TCE, 1,1,1-TCA, 1,2-DCE, 1,1-DCA, carbon tetrachloride, chloroform, methylene chloride, vinyl chloride, benzene, toluene, 1,1,2-TCA, and tetrachloroethene. During the RI/FS, all the above compounds except carbon tetrachloride, benzene, and 1,1,2 trichloroethane were discovered. A quality control note: The previous investigator had no quality control plan. A look at the data (Exhibit 9, Appendix K) reveals that the benzene and carbon tetrachloride were detected on isolated days which, in the absence of rigorous quality control, renders the data suspect. If these two compounds are eliminated, the compound list from both investigations is nearly identical. This substantiates, to some extent, the validity of earlier data and confirms the presence of an existing low level source of these compounds in the groundwater.

4.7 Identified Areas of Concern

Three sources of contaminants and areas of concern are identified: (1) the soil beneath and adjacent to the plating building is a source of chlorinated hydrocarbons and xylene; (2) the soil adjacent to MW-8 at the north end of the main building is a source of volatile organic compounds and semi-volatile organic compounds; and (3) the soil north of the wooden shed at the property boundary with Wescar bulk storage facility is a source of volatile and semi-volatile hydrocarbons.

A low level source of volatile organics is recognized in the South Field. However, the origin of VOCs in wells of the South Field is problematic, as no direct source was discovered. The source is probably low level residual concentrations in the deep soil and aquifer associated with the demolished storage sheds and drums that were once stored in the South Field.

Low levels of cyanide persist in MW-5 and MW-15, but no apparent source was identified. The low levels (at or below the standard, 100 µg/l) are attributed to residual concentrations in the soil.

There is no evidence of serious metal contamination (including aluminum or chromium) in the soil or groundwater of the site. There are slightly elevated concentrations in the groundwater at MW-12, MW-14, MW-8 and MW-17, but we found little evidence to attribute this to site activity.

Polychlorinated biphenyls (PBCs) were found in the soil around MW-5, but in concentrations below levels of concern. Additionally, there is reason to believe the soil around MW-5 was imported fill as part of site construction and remediation; therefore, the PCBs may have been derived from off-site.

Polynuclear aromatics were present, both on site and off site. The PNAs are attributed to background fossil fuel combustion and not a product of site activity.

Low levels of pesticides were identified in soil samples on site and off site. Their presence is associated with, and consistent with the agricultural land use practices of the area and not a product of site activity.

Although test excavation discovered fill (including metaliferous and coal ash waste) in the Old Chenango Canal, there is no evidence that the canal is a source of metallic or volatile compound contamination. Additionally, there is no evidence that the buried portion of Potash Creek is a selected pathway of off-site-derived contamination.

5.0 CONTAMINANT MIGRATION AND FATE

5.1 Identified Sources and Routes of Migration

As described in the previous chapter, three areas of concern have been identified at the site: (1) volatile and semi-volatile compounds in the soil beneath the plating building; (2) volatile and semi-volatile compounds in the groundwater and soil at MW-8; and (3) petroleum-related hydrocarbons in the soil at the north property boundary.

The site characterization also identified two areas of potential concern: (1) low levels of chlorinated hydrocarbons in monitoring wells at the south end of the site; and (2) cyanide in excess of the MCL in MW-5. However, it was noted that the levels of these contaminants has shown a decrease with time and may actually be residual contamination from earlier remediations.

This chapter of the report will detail the source, probable migration, and in a theoretical sense, the fate of contaminants from the three areas of concern and areas where residual contamination is suspected. A discussion of each specific source will be followed by a discussion of individual compounds and specific matrices, migration and fate.

5.1.1 Source of Organics Beneath the Plating Building

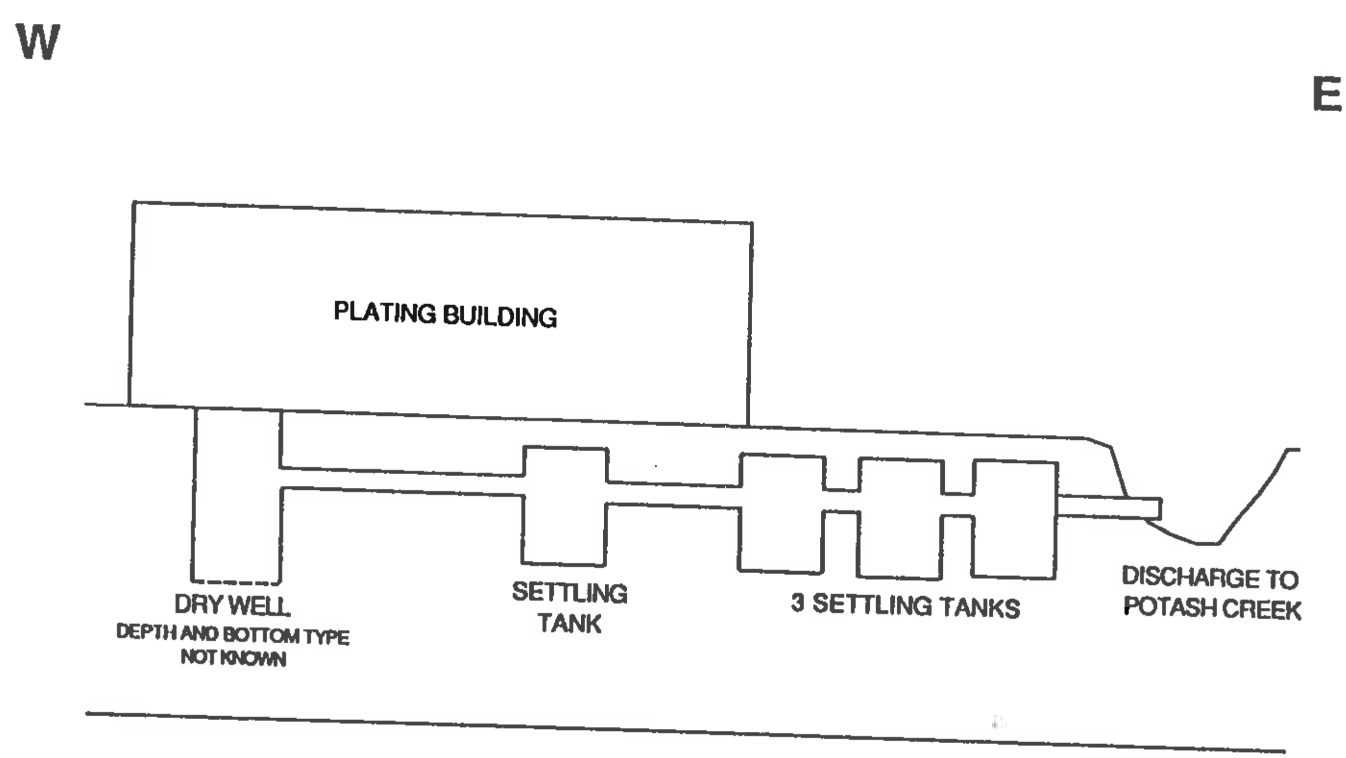
The source of volatile organic compounds (including chlorinated solvents and xylene) beneath and adjacent the plating building, is probably the result of activity in the plating building during plant operation. The compounds probably entered the soil via the building's floor drain system. The large room (the plating room), that contains the 24-inch clay-tile vertical floor drain, was used to plate aluminum antennae and associated parts. The plating operation required extensive cleaning of the parts to be plated. Solvents, including but not limited to, chlorinated compounds, were used to clean the parts. The cleaned parts were then rinsed with large quantities of water. The rinse water was collected in the floor drain. We believe that organic compounds found beneath the plating room were released to the environment through the floor drain as part of the rinsing process.

The plating room was constructed with heavy metal grating on the floor to keep the workers' feet dry while washover from process tanks flowed freely across the floor to the 24-inch floor drain. Figure 35 is a schematic representation of a cross-section through the plating room, illustrating the floor drain system.

Prior to 1973, the rinse water was reported to have flowed into the vertical clay tile pipe, which was probably open at the bottom. Near the top of the 24-inch vertical tile, just below the building floor, there is an 8-inch horizontal pipe that carried rinse water to a settling tank under the boiler room. After the rinse water left the settling tank under the building, it reportedly passed into three more settling tanks under the parking lot in front of the building. The settling tanks discharged into Potash Creek.

In 1973, effluent from the settling tanks was diverted to the recently-installed village sanitary sewer line. Effluent to the village sewer contained volatile compounds, for which General Instrument was charged a monthly fee by the village (T. Favalaro, Personal Communication). The settling tank under the boiler room also received influent from a floor drain located in a room north of the plating room. This floor drain served the area around the vapor degreasing bath and sludge concentrator. Our analysis showed that the soil around this floor drain is also contaminated with volatile compounds.

Chlorinated hydrocarbons, including 1,1,1-TCA, and aromatics such as toluene and xylene, were used in the plating, cleaning and rinsing processes. Our analysis revealed 1,1,1-TCA, TCE, 1,1-DCE, 1,1-DCA, PCE, methylene chloride and chloroform in the soil under the plating room. These compounds may be derived from other chlorinated solvents used in the building as part of the plating process, or from the research and testing laboratory, also located in the building. It is known that many solvents and reagents were used and stored in this laboratory. It is not known where waste chemicals from the laboratory were disposed, but appears probable that the laboratory used the same disposal system employed in the plating room (i.e., the floor drain). The volatile and semi-volatile contamination found beneath the plating room is a source to the groundwater, air and soil around the building.



Drawn DJM	Date 12/90	Stearns & Wheler ENVIRONMENTAL ENGINEERS & SCIENTISTS CAZENOVIA, NY DARIEN, CT WATERTOWN, NY TAMPA, FL	GENERAL INSTRUMENTS CORPORATION TACO STREET SHERBURNE, N.Y.
Approved			
Job No. 1587	Figure No. 35		Figure 35 Schematic Cross-section Through Plating Room

5.1.2 Source of Organics at MW-8

The source of volatile and semi-volatile compounds in the soil and groundwater at MW-8 may be from four different sources. First, there was a reported release of petroleum product adjacent and under the loading dock and building in the proximity of MW-8. This release is probably responsible for the free-phase hydrocarbon product found floating on the water table in the well. Second, the groundwater at MW-8 has elevated concentrations of polynuclear aromatic (PNAs) compounds usually associated with fossil fuels. These PNAs may be derived from the two possible locations: the loading dock release of petroleum products and/or the release that occurred at the property boundary with the bulk storage facility to the north. Third, the groundwater has elevated concentrations of chlorinated compounds (predominantly 1,2-DCE) which is probably derived from downgradient migration of contamination released beneath the plating room. However, very little 1,2-DCE was encountered in the soil beneath the plating room, and very high concentrations were discovered in the soil around MW-8. This suggests a fourth, "localized" (and undiscovered) source in the vicinity of MW-8.

In summary, the exact source of the three types of contamination, free-phase petroleum product, PNAs, and chlorinated solvents (mostly 1,2-DCE) is the result of many potential sources. Those sources have been identified as: (1) petroleum spills near MW-8; (2) petroleum spill near the north property boundary; (3) soil beneath the plating building; and (4) a possible unidentified source at the northwest corner of the main building.

5.1.3 Source of Organic Compounds North of Wooden Shed

There is soil contaminated with petroleum hydrocarbons located north of the wooden shed. This contamination is derived, in part, from a petroleum release that occurred in 1989. The volume of soil affected is too large to be the result of just the 1989 release. Other releases must have occurred to account for extent and depth of contamination.

This soil is a source of volatile and semi-volatile contamination to the air and groundwater.

5.1.4 Residual Contamination

Chlorinated hydrocarbons persist in wells located in the South Field. The concentrations are very low, but do exceed the MCL in MW-4, MW-5 and MW-7. The greatest concentration is found in MW-7 (22 µg/l, 1,2-DCE), whereas MW-4 and MW-5 have low levels of 1,2-DCE and TCE. These compounds (1,2-DCE and TCE) were also found in the soil of the South Field.

Monitoring Well MW-5 exceeded the standard for cyanide, but no additional source was discovered. The relatively low level of cyanide and no identified sources minimizes cyanide contamination as a source to groundwater at the site.

5.2 Contaminant Distribution

Organic compounds in the soil have been identified as the major concern at the site. This section of the report details the distribution of organics in the surface soils, shallow subsurface soils, and subsurface soils.

5.2.1 Distribution in Surface Soil

The greatest concentrations of chlorinated VOCs occur adjacent and under the plating room; the distribution of aromatic compounds in the surface soils (Figure 25) is influenced by high concentrations north of the wooden shed.

5.2.2 Distribution of Shallow Subsurface Soil

Concentrations of chlorinated VOCs in the shallow subsurface soils (Figure 28) are greatest under the plating building and the yard area west of the plating room. Aromatic compounds are widely distributed in the shallow subsurface (Figure 26). The greatest concentration may occur in the yard area west of the plating room, but there appears to be three discrete zones of high concentration: (1) the yard west of the plating room where concentrations exceed 15,660 µg/kg; (2) the area north of the wooden shed where concentrations are found up to 287 µg/kg; and (3) under the plating room in concentrations up to 201 µg/kg.

5.2.3 Distribution in Subsurface Soils

Chlorinated VOCs contamination was found in the subsurface soil beneath the plating room (Figure 29) in concentrations up to 375 µg/kg, and aromatic contamination was found in concentrations up to 152 µg/kg (Figure 27).

5.3 Contaminant Migration

Our results indicate that the soil and groundwater at the north end of the site has been impacted with organic compounds. For the most part, the contaminants are contained within the soil at the surface, in the shallow subsurface, and under the plating building.

In light of the fact that soil contains a large portion of the contaminants, we have identified three routes of migration of contaminants: (1) groundwater advection and dispersion; (2) vapor dispersion in the vadose zone; and (3) atmospheric volatilization and transport.

5.3.1 Migration in Groundwater

The groundwater gradient, as measured in monitoring wells, is to the west. Movement is through the sand and gravel aquifer toward the Chenango River, approximately 1,500 feet away. Seepage velocity in the aquifer was approximated in slug tests to range from 43 feet/year to 86 feet/year. It is unlikely that the original concentration could be conserved along this distance because dispersive and mixing processes will dilute the contaminant plume. Organic compounds in the aquifer will tend to move along the direction of flow until concentrations are diminished by dilution, or until they degrade by inorganic or biologically-mediated processes.

Contaminants have been found in all three off-site downgradient wells, indicating a plume of contaminants is migrating downgradient. The furthest extent of this plume has not been identified.

5.3.2 Migration in the Vadose Zone

Organic compounds trapped in the vadose zone can migrate vertically under the force of gravity into the groundwater, or laterally into adjacent soil by dispersive processes; but the largest fraction of the contaminant will remain adsorbed to the soil matrix. This is called the residual concentration (Olsen and Davis, 1990). The ability of a soil to adsorb organic compounds and retard contaminant migration is a function of grain size, porosity, charge distribution, and organic content of the soil. With time, the contaminant will be desorbed by pore water and transported to groundwater in a solution phase. Additionally, a fraction of the residual concentration will vaporize into the pore spaces. This vapor phase is then capable of migrating vertically (upward) or laterally, depending on soil pore pressure and temperature gradients.

The vadose zone in the vicinity of the plating room contains high concentrations of organic compounds released during plating operations and subsequent petroleum spills. The high concentrations of organics in MW-8 indicate that infiltration (vertical migration to the water table) has occurred.

From soil and groundwater data, we have created a conceptual model of vadose zone contamination and contaminant migration based on the premise that a large component of organic compounds released are being held (adsorbed) in the unexcavated soil beneath and around the plating building and the two spill areas. The organic compounds held in the soil are probably migrating laterally into "fresh" soil adjacent the plating room via vapor migration and vertically (downward) into the groundwater via infiltration. Once in the groundwater, organic compounds are migrating downgradient by advective processes.

There is evidence for lateral migration of volatile organic compounds in the soil samples collected from Test Pit No. 7 (SS-15). The soil from this pit contained

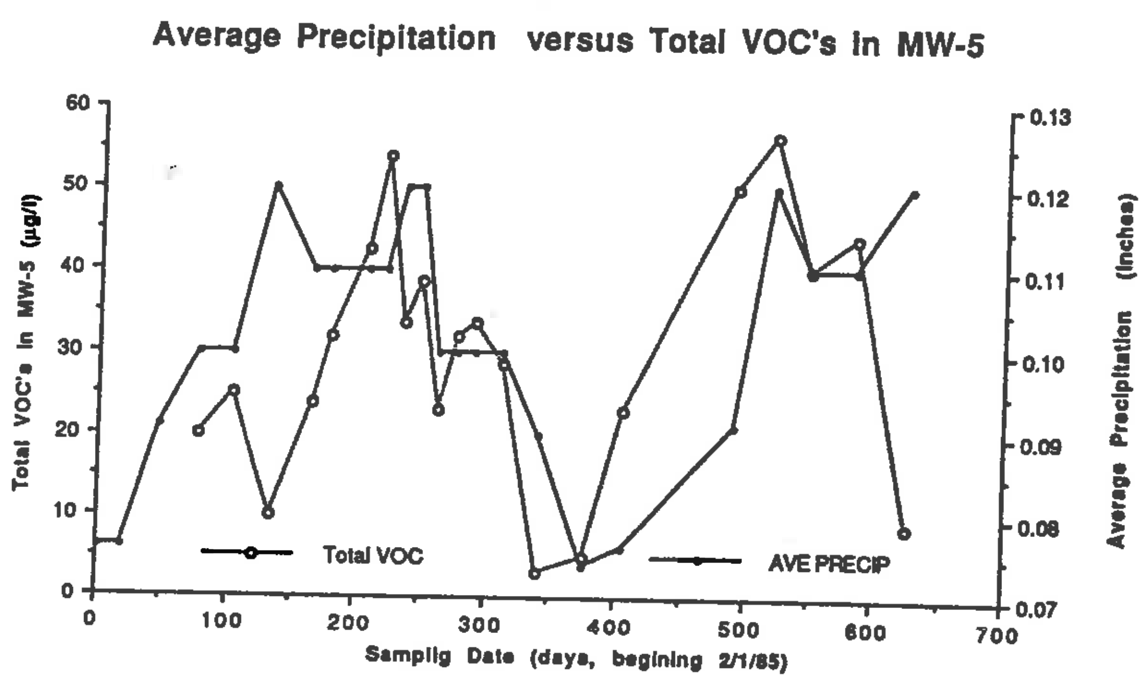
640 µg/kg of chlorinated solvents, including 1,1,1-TCA and TCE. This pit was excavated through the concrete floor of the plating building approximately 25 feet away from any hole or floor drain through the slab. The only way solvents could have migrated to this location is by migration of the vapor component. This example illustrates two points: (1) lateral migration is occurring beneath the building; and (2) the concentration is substantial if the vapor phase exceeds 600 µg/kg a reasonable distance from the source.

Upward vertical migration from deeper soils and the water table is demonstrated in Test Pit No. 9 (SS-17). This soil sample was collected from an area that was previously excavated as part of the oil spill remediation. The soil was presumably "fresh" (clean and uncontaminated) when brought onto the site. Subsequently, it has become contaminated with petroleum hydrocarbons and chlorinated VOCs (75 µg/kg and 56 µg/kg, respectively). The source of the petroleum hydrocarbons could be random displacement of petroleum-contaminated soils during or after the cleanup, but the presence of chlorinated solvents is harder to explain because the soil was emplaced after plating operations had ceased and the site was decontaminated. We suggest that vapor phase VOCs are migrating vertically upward into the fresh fill from a source in the subsurface (probably the groundwater).

There is further evidence of vertical and/or lateral migration of chlorinated solvents in the vadose zone at SS-21. SS-21 was collected west of the north end of the main building, between the building and the railroad tracks. The soil in this area was excavated as part of the original plant closure; therefore, should contain "fresh" soil. The sample collected from the surface of these fresh soils tested positive for TCE. The occurrence of TCE in these soils indicates migration in the soil.

5.4 Role of Precipitation

A review of historical precipitation records during the week prior to sampling events reveals a correlation between magnitude of precipitation and concentration of VOCs in the aquifer. This suggests that VOCs held in the vadose zone migrate downward with the wetting face of infiltration events. As the wetting face passes through the contaminated soil, a fraction of the residual contamination is dissolved and transported in an aqueous phase to the water table.



Job Number:	Drawn by:	Stearns & Wheler	General Instrument Corporation TACO Street, Sherburne, NY
1587	EJH	Environmental Engineers and Scientists	
Approved by:	Date:	Cazenovia, NY Watertown, NY / Darien, CT Tampa, FL	Figure 36
	12/90		Precipitation versus VOC's in MW-5

Figure 36 compares the historical VOC data collected at MW-5 for the period from 1985 through 1986 (including the RI/FS data point in October 1989), with the weekly average amount of precipitation at the site for the week preceding the sampling event. It is evident that a correlation exists between average precipitation and concentration of total VOCs in the groundwater. This relationship is consistent with other wells on the site.

We have compiled a conceptual model to explain the relationship between precipitation (infiltration event) and concentration of VOCs in the groundwater. The model calls for contaminated soil above the water table. The soil holds the VOCs in the pore spaces until percolation by rainwater absorbs a percentage of the contaminant and transports it to the water table in a solution phase (Figure 37).

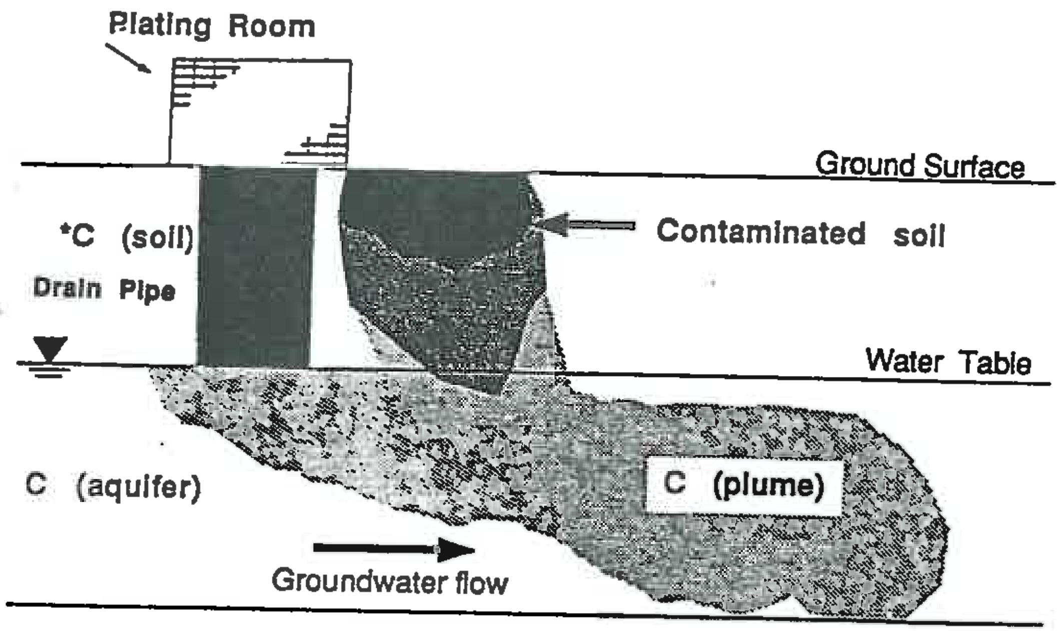
5.5 Contaminant Persistence

The organic contamination in the soil and groundwater is a complex mixture of chlorinated solvents and volatile and semi-volatile petroleum-derived hydrocarbons. With time, the organic compounds will undergo transformations and degradation by abiotic and biotic processes. The abiotic reactions are oxidation, hydrolysis and dehydrohalogenation. In oxidation, O_2 (or RO_2) is reduced and the compound of interest is oxidized to CO_2 and water (in complete oxidation). In hydrolysis, the compound of interest reacts with water to introduce an hydroxyl group (OH^-) releasing the halogen. If the reaction were occurring with a halogenated solvent (such as TCE), the reaction is a substitution reaction, whereby the hydroxyl group replaces the halogen on the hydrocarbon molecule. Dehydrohalogenation is a reaction that involves the removal of a halogen from a saturated hydrocarbon, resulting in the formation of an alkene.

Biodegradation is the oxidation, hydrolysis or dehydrohalogenation of compounds of interest by biological processes or mediated by biologic processes. Microorganisms facilitate these reactions by producing enzymes that reduce the reaction energy and drive reactions to completion.

The degradation of 1,1,1-TCA to DCE is one reaction that may be occurring at the site. The original plant closure plan documents the use of 1,1,1-TCA (along with other unspecified

CONCEPTUAL MODEL



C (soil) >> C (aquifer)

Natural condition of the aquifer:
C (aquifer) = 0 µg/l

After Rainfall and Infiltration event:
C (plume) = C (aquifer) + [C (soil) X K]

where, K is a function of migration

With no rainfall:
C (plume) —approaches→ C (aquifer)

*C = Concentration of Contaminant

Drawn by: EJH	Stearns & Wheler Environmental Engineers and Scientists	General Instrument Corporation TACO Street, Sherburne, NY
December 1990	Cazenovia, NY Watertown, NY Darien, CT Tampa, FL	Figure 37 Conceptual Model of Vadose Zone Contamination

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chlorinated solvents) in the plating process. 1,1,1-TCA undergoes degradation, forming 1,1-DCE or 1,2-DCE. Dehydrohalogenation may be occurring in the soil and groundwater at the north end of the site. It has been documented in the plant closure documents that 1,1,1-TCA was used extensively in the plating building. The soil beneath the plating room contains 1,1,1-TCA (270 µg/l), but no DCE. Immediately downgradient, MW-8 contains 7,700 µg/l of 1,2-DCE, but no 1,1,1-TCA. The presence of 1,2-DCE downgradient may indicate the degradation of 1,1,1-TCA, which has been shown to occur very rapidly in natural conditions (Vogel and McCarty, 1987; Cline, et al., 1988). At this point of the investigation, based on our sampling, it is hard to tell whether the 1,2-DCE (in MW-8) is a primary contaminant or a daughter product of 1,1,1-TCA degradation.

5.6 Groundwater Contaminant Migration

Organic compounds entering the unconfirmed aquifer beneath the plating room, around MW-8, and north of the woodshed are migrating along the direction of the groundwater gradient by advective processes towards the Chenango River. The hydraulic conductivity in the aquifer is high (10^{-2} cm/s) and there is sufficient gradient on the piezometric surface (up to 2.5 feet) to transport contaminants in a downgradient direction once they reach the water table.

At the present time, chlorinated volatile organic compounds have migrated downgradient and off-site. (Figure 24 illustrates the distribution of chlorinated volatiles in groundwater.) The greatest concentration is in the vicinity of the plating room, with an apparent plume that decreases in concentration to the west. The shaded area of Figure 24 approximates the lateral extent of the plume. The direction of plume migration is oblique to the measured direction of groundwater movement. This may be caused by: (1) an artifact of how the data were contoured (objective interpolation); (2) contaminants from an unidentified source under the main building; or (3) the subsurface geology exerting directional effects on migration. The ultimate receptor of this plume is the groundwater divide and discharge point on the Chenango River.

During transport in the aquifer, organic chemicals can experience the same degradation and transformation reactions previously discussed. So that, the original suite of contaminants released may transform along the migration route, and the receptor will receive both the primary contaminant and daughter products.

Dehydrohalogenation is a mechanism of elimination that removes a halogen from a saturated compound resulting in the creation of an ethene. As already discussed, dehydrohalogenation is a major pathway for the creation of 1,1-Dichloroethene and 1,2-dichloroethene from 1,1,1-trichloroethane (Vogel and McCarty, 1987). The half life of this reaction in biotic conditions is approximately 230 days in-situ (Roberts, et al., 1982) and 16 days in laboratory conditions (Wood, et al., 1985). 1,1,1-TCA and tetrachloroethane have been identified at the site; if dehydrohalogenation is occurring, the breakdown products (DCE and VC) should be expected in the groundwater at the site and downgradient. Detailed quantitative laboratory analysis of the contaminated soil would be required to determine the concentration of daughter products that could be expected in the aquifer.

5.7 Summary of Contamination at North End of Site

The high concentrations of organics in the soil and groundwater in the three areas of concern at the north end of the site may require remediation. The free phase product in MW-8 will need to be removed. The contaminated soil under and around the plating room will have to be remediated, as well as the petroleum-contaminated soil north of the woodshed. Additional data for soil characterization, lateral extent of plume, and proximal aquifer characteristics will be required for remediation.

5.8 Source Organic Compounds in the South Field

The source of organic compounds in the soil (SB-1) and groundwater of the South Field is probably derived from the residual concentration adsorbed to native soil. Our sampling program detected low levels of chlorinated organic compounds in one soil sample and in MW-3, MW-4, MW-5, MW-12 and MW-15. The greatest concentration did not exceed 45 µg/l. Upgradient well MW-10 contained no VOCs; and MW-6, an on-site downgradient well, also contained no VOCs.

The scattered low level "hits" have been persistent since 1985, but they have not dramatically increased or decreased in concentration. The original source of these volatile compounds was probably the result of accidental release from the paint and thinner storage shed, and the storage of drums on the ground surface in the South Field during plant operation.

Solvent sources (stored materials) and soil that may have been contaminated were removed during plant closure. Surficial soils were removed and replaced with clean fill, but low level residual concentrations in deep soil and the aquifer may persist.

The migration of the chlorinated organic compounds held as residual product in the pore spaces of the South Field is similar to that of the organics at the north end of the site. In the groundwater, the compounds will migrate westward toward the Chenango River. Concentrations in the South Field are very low, at or slightly above the MCL, and will not require remediation. At these low levels, the natural attenuation capability of the aquifer will degrade and dilute the contaminant before it could reach a vector of human exposure.

6.0 BASELINE RISK ASSESSMENT

6.1 Introduction

Risk assessments are conducted as an integral part of the Remedial Investigation/Feasibility Study process. The baseline risk assessment characterizes and quantifies the risk to human health posed by on-site conditions. The analysis of risk at the site helps determine the need for and extent of remedial actions.

Methodologies presented in United States Environmental Protection Agency (USEPA) 1988, 1989, 1990, and 1991 guidance documents were used in preparing the risk assessment. The format for this chapter is consistent with USEPA 1989 interim final publication: Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A).

As defined by USEPA guidance, the baseline risk assessment has four activities: data collection and evaluation, exposure assessment, toxicity assessment, and risk characterization.

Data collection and evaluation defines the spatial distribution of site contaminants and identifies potential contaminants of concern. Data are screened for technical defensibility and the existence of quantifiable toxicity information.

Exposure assessment considers the pathways by which humans or other populations might be exposed to site contaminants. This activity also quantifies, to the extent possible, the concentrations of chemicals to which receptors could be exposed. It is important to note that exposure can only occur when a mechanism for contaminant transport and a receptor exist along with the contaminant source.

After exposure from site-related chemicals is calculated, it is compared to levels leading to adverse health effects. This activity, toxicity assessment, evaluates the available toxicological database compiled for each site-related chemical of concern.

Risk characterization integrates the existing site conditions, exposure pathways and receptors, and chemical toxicity data. This final step characterizes the potential for adverse effects on human health of existing site conditions. Both carcinogenic and non-carcinogenic human health impacts are detailed. The uncertainty in risk characterization is detailed.

6.2 Site Background/Environmental Setting

The environmental character and surrounding land uses of a site will, to a large degree, determine the amount of risk posed to human health by site-related contaminants. The General Instrument site is located in rural Chenango County. The manufacturing and plating facility was located on TACO Street, off of Route 12, the main corridor through Sherburne. Adjacent to the site is low density residential property (north and east) and agricultural land (south and west). Sherburne is not experiencing significant growth pressure.

As described in earlier sections of the report, portions of site soils and groundwater are contaminated with site-related chemicals. The property is fenced, with the exception of a small parcel bordering Route 12, but access is not restricted by locked gates.

A shallow aquifer underlies the General Instrument site and discharges to the Chenango River, approximately 0.5 km to the west. Site soils are highly permeable Howard loam. Overland flow occurs in association with impervious surfaces, such as paved areas and buildings. Former paved parking areas have been converted to lawn. At present, paved area covers approximately one-quarter of the site.

The General Instrument facility has been sold and is now operated as a print shop. Approximately 90 people are employed by the printing business. There is no retail operation.

The environmental setting, including current and future land use, is used to frame the possible pathways of exposure to site-related contaminants. For example, USEPA guidance suggests that redevelopment of this industrial property into future residences is not an appropriate scenario in a rural area such as Sherburne. If the site were in an urban or rapidly developing suburban area, residential redevelopment would be a reasonable future land use, and thus would be evaluated. However, future residential development along the Chenango River adjacent to the site is plausible. This future land use is considered in the baseline risk assessment.

6.3 Summary of Site Contamination

The sampling plan carried out for the General Instrument, Sherburne, site has been described in Section 2. Groundwater, sediment, soil, and air samples were collected in the fall of 1989 to address each of the 12 tasks and to further characterize the site.

Samples were analyzed by a New York State-certified laboratory in the Contract Laboratory Protocol (CLP) program. Each analytical result was subjected to rigorous data validation; that is, examined for compliance with the technical criteria specified by NYSDEC and USEPA for defensible data. A Data Usability Summary (Appendix I) details the basis for accepting, rejecting, or flagging each analytical result, based on these technical criteria. Only data deemed acceptable were used to characterize the Sherburne site.

Technically acceptable data underwent additional screening before inclusion in the calculations of site-related risk. Screening was based on comparison to background (off-site) concentrations, comparison to applicable standards, and presence of quantifiable toxicological information. The basis for inclusion/exclusion of each analyte detected on site is detailed below.

6.3.1 Matrix: Shallow Soils

No state or federal criteria or standards have been promulgated that regulate allowable concentrations of contaminants in soils. Remedial decisions are determined by the risk posed by site conditions and by comparison to cleanup goals published as a Technical Assistance Guidance Memorandum (TAGM) by NYSDEC. During site characterization, an objective is to identify hot spots of soil contamination on site and to calculate reasonable maximum concentrations of potentially harmful chemicals.

Inorganic chemicals are found in soils under natural conditions. Quantitative risk assessment from exposure to inorganic soil contaminants was conducted when concentrations on site were significantly elevated compared to off site, and quantitative toxicological data existed.

A non-parametric statistical test was used to identify inorganic chemicals elevated on site. Only two compounds, silver and sodium, exhibited statistically elevated concentrations on site. Quantitative toxicological information (reference dose-non-carcinogenic effects and slope factors-carcinogenic effects) is not available for silver and sodium.

Organic compounds were evaluated for inclusion in the quantitative risk assessment regardless of the relative on-site and off-site concentrations. Data were screened for the possibility of laboratory contamination (common laboratory contaminants such as acetone and methylene chloride were present in samples and blanks).

The upper 95 percent confidence interval around the logarithmic mean was used as a reasonable maximum estimate of chemical concentrations in site soils. Shallow soils adjacent to the plating shed exhibited highest concentrations of contamination. A total of 15 organic compounds were detected and verified through the data screening. Eight of the 15 were volatile organics; seven were semi-volatile. Those with quantitative toxicity data were carried through risk calculations. Across the entire site, 24 organic compounds (15 volatile, nine semi-volatile) were detected.

6.3.2 Matrix: Groundwater

Groundwater quality data can be interpreted by comparison to state standards for the appropriate use (drinking water supply, industrial, irrigation, etc.). Earlier sections of the report detail the chemicals found in monitoring wells on site. Again, inorganics were screened by comparing on-site to off-site using non-parametric statistics. Organic compounds were carried through quantitative risk assessment if exposure was possible, and quantitative toxicity data existed. The upper 95 percent confidence interval around the mean of the site data was used to characterize concentrations.

6.4 Discussion of Pathways

Figure 38 illustrates the potential pathways of human exposure to site-related contaminants. In this section, the rationale for including or eliminating each pathway from quantitative risk assessment is detailed. As discussed above, human exposure from site-related contamination is only possible when there is a pathway of contaminant migration and a human receptor. When the source, transport mechanism, and receptor are all present, the exposure pathway is termed "complete".

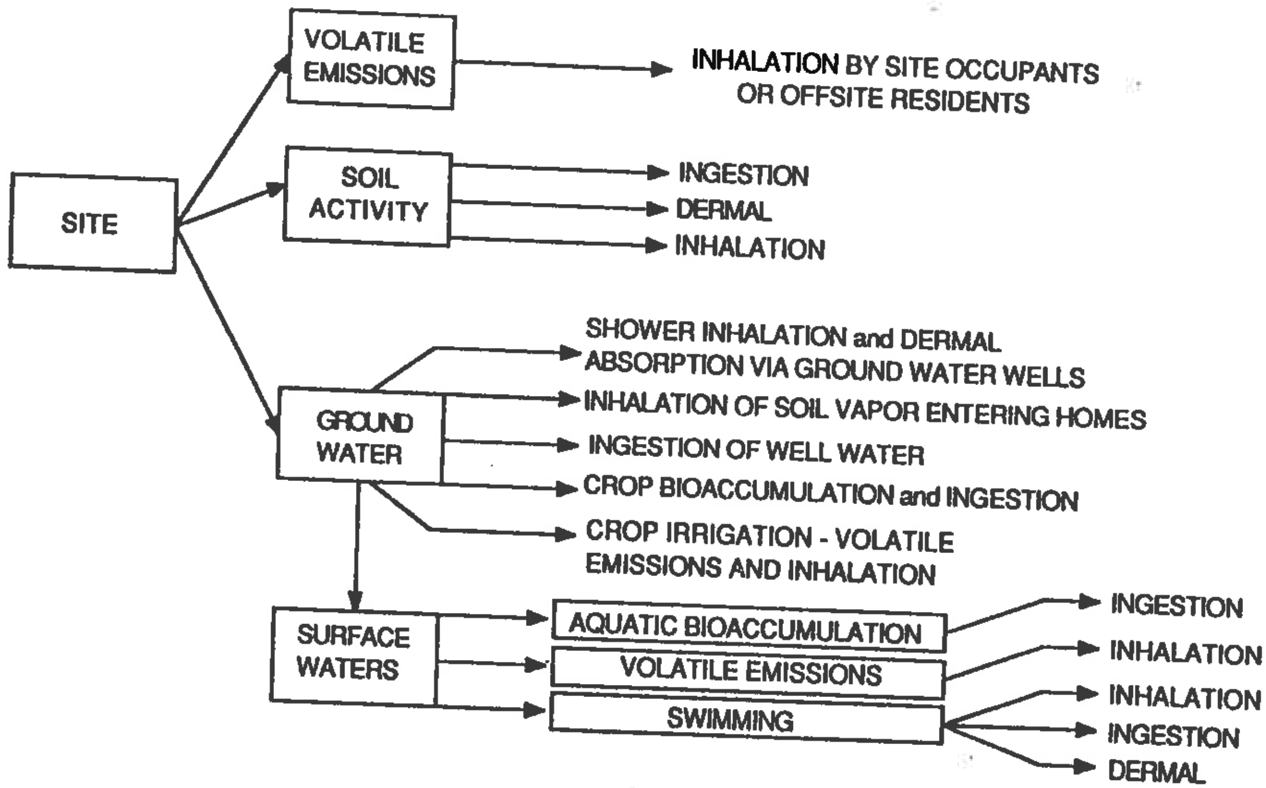
Any contractors on site to implement remedial actions will be trained per requirements of OSHA 29 CFR 1910.120. Contractors would have personal protective equipment and medical surveillance in addition to the required education and training. Consequently, exposure to remedial contractors was not included in this baseline risk assessment.

Inhalation of volatile organic contaminants of the surface soils is a complete exposure pathway and has been carried through quantitative risk assessment. Site occupants, as well as the neighboring residential population, could be receptors of chemicals volatilized into the atmosphere from on-site contamination.

Ingestion of contaminated soils is a second complete pathway arising from surficial soil contamination at the General Instrument, Sherburne site. Accidental ingestion of contaminated soils by the on-site employees of the printing business is a possibility. As site access is not fully restricted, accidental ingestion by trespassers is also possible.

Terrestrial bioaccumulation of site-related chemicals is a possible pathway of human exposure. The nature of the chemical release of this facility produced localized areas of elevated chemical concentrations in soil; large regions of soil and vegetation were not affected. Consequently, this pathway was not carried through quantitative risk assessment. Any remedial measures deemed necessary to protect against direct ingestion of chemicals will also protect against potential bioaccumulation through the terrestrial food web.

Groundwater underlying the facility is contaminated to a significant degree by petroleum hydrocarbons and chlorinated organics. There is currently no downgradient use of the



POTENTIAL HUMAN EXPOSURE PATHWAYS FROM CONTAMINANT RELEASES

Job Number: 1587	Drawn by: DH	Stearns & Wheler Environmental Engineers and Scientists Cazenovia, NY Watertown, NY Darien, CT Tampa, FL	General Instrument Corporation TACO Street, Sherburne, NY
Approved by:	Date: 12/90		Figure 38 Potential Human Exposure Pathways

groundwater resource. Land between the facility and the river is within boundaries of the Village of Sherburne. Any future residential development will be required to pay Village water connection fees. However, there is apparently no local law prohibiting installation of a private well for water supply within the Village limits. Future downgradient water use was therefore considered possible, and a quantitative risk was calculated for ingestion of contaminants in groundwater.

With possible future residential development occurring between the site and the river, contaminants in groundwater could migrate upward in soil vapor and enter residences. Residents would then be exposed by inhalation. This pathway was calculated as well.

A final pathway for complete exposure is human use of the Chenango River, the discharge point of contaminated groundwater. Calculations of concentrations in the aquifer at the river boundary and dilution with river water are included in the exposure assessment.

Surface water concentrations are compared to ambient water quality standards, to evaluate the potential for accumulation through the aquatic food web, and to evaluate the potential for adverse impacts on aquatic organisms.

Table 6-1 summarizes the exposure pathways carried through quantitative risk assessment calculations. The next section, Exposure Assessment, presents calculations of the amount of contaminants to which receptors could be exposed by these pathways.

6.5 Exposure Assessment

6.5.1 Exposure From Inhalation of Volatile Organic Contaminants, Surface Soils

Volatilization of compounds from contaminated surface soils is a potential pathway of concern on this site. Three surface (0 to 2 feet) soil samples were obtained as part of this investigation. Two of these exhibited only traces of contamination by volatile organic compounds (see Table 4.2). SS-17, a sample from Test Pit 9, was contaminated with both halocarbon and petroleum-associated volatile organic compounds.

TABLE 6-1

EXPOSURE PATHWAYS CONSIDERED LIKELY FOR
GENERAL INSTRUMENT CORPORATION SITE
SHERBURNE, NY

Source	Pathway	Receptor
Surface soils with elevated concentrations of volatile organics	Volatilization to air, transport to receptors	On-site industrial Off-site residential
Surface soils with elevated concentrations of target compounds	Incidental ingestion	Off-site residential trespassers On-site industrial
Groundwater with elevated concentrations of target compounds	Transport downgradient	Future residential users with private wells
Groundwater with elevated concentrations of volatile organics	Volatilization into soil vapor	Downgradient future residents
Groundwater with elevated concentrations of target compounds	Transport in groundwater to Chenango River	Chenango River users

Table 6-2 details relevant chemical properties of volatile organic compounds detected in Test Pit 9, adjacent to the plating building. The vapor pressure of each substance is high, resulting in high potential volatilization into the atmosphere over this source. The presence of sorptive surfaces in the soils may act to reduce the loss of volatile chemicals to the atmosphere. Photoxidation of toluene, xylene, and ethylbenzene in air is fast; of 1,2-dichloroethene is moderate; and of the remainder of volatile organics detected in Test Pit 9 is slow.

In order to calculate exposure to receptors (on site and off site) of volatile emissions, three calculations are necessary. First, the rate at which each chemical volatilizes from the soil into the atmosphere must be calculated. Next, the atmospheric fate (dilution and transport) of each chemical volatilized into the atmosphere must be considered. Finally, the amount of each chemical actually inhaled by the receptor must be calculated.

a. Rate of Chemical Volatilization from Soil to the Atmosphere

Volatile organic contaminants associated with Test Pit 9 originated from spillage to the soil surface. The appropriate model to estimate rate of chemical volatilization from the soil to the atmosphere under these conditions is presented in the Superfund Exposure Assessment Manual (USEPA 1988).

The rate of volatilization is calculated for each chemical using the following model:

$$\bar{E}_i = \frac{2DC_sA}{(d + (2DC_st/C_B) + d^2)^{1/2}} \qquad \text{(Equation 6-1)}$$

where:

$\bar{E}_i$ = Average emission rate of component i over time t (g/sec)

D = Phase transfer coefficient (cm^2/sec)

C_s = The liquid-phase concentration of contaminant i in the soil (g/cm^3)

C_B = Bulk contaminant concentration in soil (g/cm^3)

TABLE 6-2

PROPERTIES OF VOLATILE ORGANIC COMPOUNDS IN TEST PIT 9

Volatile Organic	Concentration (ug/kg)	Vapor Pressure (mm)		Photoxidation Half-Life (Day)	Photoxidation Rate
1,1-dichloroethane	12	234	(25°)	10-103	Slow
1,2-dichloroethene	15	200	(25°)	1-11	Moderate
Chloroform	7J	100	(14°)	26-260	Slow
1,1,1-trichloroethane	10	100	(20°)	225-2247	Resistant
Trichloroethene	11	100	(32°)	Unknown, estimated 10^3-10^4	Resistant
Toluene	3J	36.7	(30°)	0.4-4.3	Fast
Ethylbenzene	15	10	(25.9°)	0.3-3.6	Fast
Xylene	57	6.72	(21°)	0.1-1.8	Fast

J = Estimated concentration present at less than contract required quantitation limit.

A = Contaminated surface area (cm^2)

d = Depth of dry zone at sampling time (cm)

t = Time measured from sampling time (seconds)

D (cm^2/sec) is related to the amount of contaminant i that goes from liquid to gas phase, and then from gas phase to diffusion in air. It can be estimated as follows:

$$D = D_i (P_t^{4/3}) H_i' \qquad \text{(Equation 6-2)}$$

where:

D = Phase transfer coefficient (cm^2/sec)

D_i = Diffusion coefficient of component i in air (cm^2/sec)

P_t = Total porosity (dimensionless)

H_i' = Henry's Law constant in concentration form (dimensionless)

H_i', the Henry's Law constant in concentration form (ratio of the boundary layer concentration of contaminant in air to the boundary layer concentration of contaminant in "wet" soil), can be determined as follows:

$$H_i' = \frac{H_i}{RT} \qquad \text{(Equation 6-3)}$$

where:

H_i = Henry's Law constant of contaminant i (atm-m^3/mol)

R = Gas constant (8.2×10^{-5} atm-m^3/mol-°K)

T = Absolute temperature (°K)

Summer maximum temperatures were used to estimate short-term release, and annual average temperatures were used to estimate long-term release rate.

The following assumptions were made in order to assign values to these coefficients that would be applicable to the Sherburne site.

D_l phase transfer coefficient was assigned for 30°C and 10°C to represent short-term (summer) and long-term (average annual) conditions. Values for the volatile organic compounds detected in Test Pit 9 were assigned from a table in the Superfund Exposure Assessment Manual (USEPA, 1988, page 18). The table presents D_l, which was then corrected for a soil porosity of 0.4.

The bulk contaminant concentration of each chemical in soil (C_B) is equivalent to the analytical results (concentration in µg/kg dry weight). The bulk density of the Howard loam soils on site was estimated at 1.3 g per cubic centimeter (Brady, 1974, page 55). We further assumed that the liquid phase concentration of each contaminant in soil was one-half of the total contamination.

Contaminated surface area was (conservatively) estimated at 100 square meters ($10^6 cm^2$). Actual size of the "hot spot" of volatile organic contamination associated with the plating activities is likely to be less.

The diffusion model assumes that chemicals volatilize from a wet (contaminated) zone, yielding a progressively deeper dry (non-contaminated zone). Depth of the dry zone at sampling time was estimated at 2 cm, representing close to worst case conditions.

The coefficient t (time) in the equation was assigned at four months (maximum summer conditions) and 12 months (annual average).

Table 6-3 summarizes the calculation of $\bar{E}_l$, the average emission rate of each chemical of concern over time. Both summer volatilization rate (worst case) and annual average conditions are presented. Note that xylene volatilization proceeds at the greatest rate; this is a function of the concentration detected.

TABLE 6-3. VOLATILE EMISSIONS FROM TEST PIT NINE

EXPOSURE ASSESSMENT: GENERAL INSTRUMENT CORP., SHERBURNE NY
Rate of volatilization of chemicals from surface soils

Chemical	Di (10)	Di (30)	Hi' (10)	Hi'(30)	D (10)	D(30)	conc, ug/kg	conc, g/cm3	numerator 10 °C	numerator 30° C	denom 10° C	denom 30 30° C	E (10)	E (30)
1,1-dichloroethane	0.08557	0.09643	0.251	0.237	0.0086	0.0091	12	1.56E-08	1.33E-04	1.42E-04	4.00	4.00	3.33E-05	3.54E-05
1,2-dichloroethane	0.08557	0.09643	0.042	0.039	0.0014	0.0016	15	1.95E-08	2.78E-05	2.91E-05	4.00	4.00	6.96E-06	7.28E-06
chloroform	0.08346	0.09404	0.189	0.175	0.0062	0.0065	7	9.1E-09	5.61E-05	5.95E-05	4.00	4.00	1.40E-05	1.49E-05
1,1,1-TCA	0.07638	0.08606	0.342	0.323	0.0104	0.0110	10	1.3E-08	1.35E-04	1.43E-04	4.00	4.00	3.37E-05	3.58E-05
TCE	0.07638	0.08606	0.44	0.416	0.0133	0.0142	11	1.43E-08	1.91E-04	2.03E-04	4.00	4.00	4.77E-05	5.07E-05
toluene	0.07367	0.08301	0.264	0.24	0.0074	0.0079	3	3.9E-09	2.90E-05	3.08E-05	4.00	4.00	7.24E-06	7.71E-06
ethylbenzene	0.06274	0.0707	0.214	0.202	0.0063	0.0067	15	1.95E-08	1.04E-04	1.11E-04	4.00	4.00	2.60E-05	2.78E-05
xylene	0.06742	0.07579	0.283	0.267	0.0076	0.0080	57	7.41E-08	5.61E-04	5.95E-04	4.00	4.00	1.40E-04	1.49E-04

KEY

Di is the diffusion coefficent of chemical i in air (cm2/sec)
Data are presented at 10 and 30 degrees (average and worst case)

Hi' is Henry's Law constant

D is the phase transfer coefficent of chemical i in air (cm2/sec)

Numerator refers to the nuemerator of equation 1 (2DCsA)

Denominator refers to the denominator of equation 1 (d+SQRT[(2DCst/Cb)+d*d])

Ei is the emission rate of chemical i at temperature

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b. <u>Transport of Volatilized Chemicals From Soil Surface to Downwind Receptors</u>

Organic chemicals volatilized from Test Pit 9 will be transported downwind of the source toward potential residential and commercial receptors. A second model presented in the Superfund Exposure Assessment Manual (USEPA 1988, pages 42-46) can be utilized to estimate downwind concentrations of chemical contaminants.

Concentrations at distances from the source are calculated as follows:

$$C(x) = \frac{G}{\pi \sigma_y \sigma_x \mu} \qquad \text{(Equation 6-4)}$$

where:

G = Release rate (mass/time)

σ_y and σ_x are dispersion coefficients in the x and y directions (meters)

μ = Mean wind speed (distance/time)

Wind speed was estimated at 3 m/sec, which is the default value mandated by USEPA without site-specific data. Sherburne has no official National Weather Service wind speed measurements. Average annual wind speed in Syracuse, New York, northwest of Sherburne, is 4.25 m/sec.

Dispersion coefficients in the x and y directions were obtained from nomographs in the Superfund Exposure Assessment Manual (USEPA 1988, pages 43-44). Stability Class D, also a default value, was chosen to represent atmospheric conditions in the Sherburne area.

The concentration of each volatile organic compound detected in Test Pit 9 at distances of 0.1, 0.2, 0.5, 1.0 and 2.0 Km under 10°C (annual average) and 30°C (summer maximum) conditions is presented in Table 6-4. Note that concentrations are slightly higher during summer conditions, consistent with the faster rate of volatilization from the soil to the atmosphere.

The results tabulated in Table 6-4 are the concentrations of volatile organic compounds at the ground surface. As the model does not calculate vertical attenuation by dispersion and dilution, the concentrations should be considered as worst-case estimates of exposure.

c. Human Exposure From Inhalation of Volatile Organic Compounds

Human exposure from the volatile organic compounds would result from inhalation of contaminants by on-site employees and off-site residents.

Chemical exposure by inhalation is a function of the concentration of the chemical in the breathing zone, the volume of air inhaled each day, the time period of exposure (all day for residents and eight hours/day for employees of the print shop), and the duration of the exposure. Biological effects depend on body weight of the receptor. Standard default values for each of these variables have been developed and are provided in USEPA guidance documents. For carcinogenic chemicals, biological effects are averaged over a lifetime (assumed 70 years). For non-carcinogenic chemicals, effects are averaged only over the exposure time (30 years residential, 25 years for employees).

Exposure to the volatile chemicals through inhalation is calculated using the following model (USEPA, 1989, page 6-44).

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT} \qquad \text{(Equation 6-5)}$$

where:

CA = Concentration of contaminant in air (mg/m^3)
IR = Inhalation rate (m^3/hr) (default $20 m^3/day$)
ET = Exposure time (hrs/day)
EF = Exposure frequency (days/yr) default: 250 days/yr commercial; 350 days/yr residential
ED = Exposure duration, years
BW = Body weight (default = 70 kg)

TABLE 6-4. TRANSPORT OF VOLATILE ORGANICS WITH DISTANCE

EXPOSURE ASSESSMENT: GENERAL INSTRUMENT CORP., SHERBURNE NY
Downwind transport and dilution of volatile compounds

Chemical	EMMISSIONS 10° C (GRAMS PER SECOND)	30° C	CONC., 0.1 KM 10° C (GRAMS PER CUBIC METER)	30° C	CONC., 0.2 KM 10° C (GRAMS PER CUBIC METER)	30° C	CONC., 0.5 KM 10° C (GRAMS PER CUBIC METER)	30° C	CONC., 1 KM 10° C (GRAMS PER CUBIC METER)	30° C	CONC., 2KM 10° C (GRAMS PER CUBIC METER)	30° C
1,1-dichloroethane	3E-05	4E-05	9E-08	1E-07	3E-08	3E-08	5E-09	5E-09	2E-09	2E-09	5E-10	5E-10
1,2-dichloroethane	7E-06	7E-06	2E-08	2E-08	5E-09	6E-09	1E-09	1E-09	3E-10	3E-10	1E-10	1E-10
chloroform	1E-05	1E-05	4E-08	4E-08	1E-08	1E-08	2E-09	2E-09	7E-10	7E-10	2E-10	2E-10
1,1,1-TCA	3E-05	4E-05	9E-08	1E-07	3E-08	3E-08	5E-09	6E-09	2E-09	2E-09	5E-10	5E-10
TCE	5E-05	5E-05	1E-07	1E-07	4E-08	4E-08	7E-09	8E-09	2E-09	2E-09	7E-10	7E-10
toluene	7E-06	8E-06	2E-08	2E-08	6E-09	6E-09	1E-09	1E-09	3E-10	4E-10	1E-10	1E-10
ethylbenzene	3E-05	3E-05	7E-08	8E-08	2E-08	2E-08	4E-09	4E-09	1E-09	1E-09	4E-10	4E-10
xylene	1E-04	1E-04	4E-07	4E-07	1E-07	1E-07	2E-08	2E-08	7E-09	7E-09	2E-09	2E-09

AT = Averaging time (period over which exposure is averaged, days) Default: carcinogens, 70 yrs; non-carcinogens, 30 yrs residential, 25 yrs commercial

Note that for non-carcinogenic effects, exposure duration and averaging time will cancel. For carcinogenic effects, the two factors do not cancel.

Table 6-5 presents these calculations for inhalation of chemicals related to the Sherburne site. Residential exposure is estimated to occur at 0.5 km from the source; commercial exposure occurs at 0.1 km from the source.

6.5.2 Exposure From Ingestion of Contaminated Soils

Surficial soils on the site of the General Instrument Corporation, Sherburne facility, exhibited elevated concentrations of some target compounds. As the site is currently occupied and likely to be occupied in the future, incidental ingestion of contaminated soils appears to be a complete pathway of exposure.

As discussed earlier, contaminants of concern were screened from the validated analytical results based on criteria of concentration and differences from background results. For organic compounds, concentrations greater than the contract required analytical limit of detection (that is, statistically different from zero) were selected. For inorganic compounds, only those statistically greater than off-site were selected. The test statistic used was the non-parameter Mann-Whitney test for equal location parameters, at $\alpha = 0.05$. The upper 95 percent confidence interval around the population mean was used to estimate concentration of contaminants on site, per USEPA guidance. The underlying distribution of concentration was assumed to be log normal.

Exposure to the on-site employees from accidental ingestion of contaminated soils was estimated using the following model:

TABLE 6-5. EXPOSURE FROM INHALATION OF SITE-RELATED VOLATILE ORGANIC COMPOUNDS

EXPOSURE ASSESSMENT: GENERAL INSTRUMENT CORP., SHERBURNE NY
Inhalation of volatile organic compounds

revised 11/92

CHEMICAL	CONCENTRATION AT 0.1 KM 10° C	CONCENTRATION AT 0.1 KM 30° C	EXPOSURE AT 0.1 KM (EMPLOYEES) CHRONIC	EXPOSURE AT 0.1 KM (EMPLOYEES) CARCINOGENIC	CONCENTRATION AT 0.5 KM 10° C	CONCENTRATION AT 0.5 KM 30° C	EXPOSURE AT 0.5 KM (RESIDENTIAL) CHRONIC	EXPOSURE AT 0.5 KM (RESIDENTIAL) CARCINOGENIC
	units: grams per cubic meter		units: mg per kg body weight per day		units: grams per cubic meter		units: mg per kg body weight per day	
1,1-dichloroethane	9E-08	9.8E-08	3E-5	7E-6	5E-9	5E-9	2E-6	6E-7
1,2-dichloroethene	1.9E-08	2.0E-08	5E-6	1E-6	1E-9	1E-9	3E-7	1E-7
chloroform	3.9E-08	4.1E-08	1E-5	3E-6	2E-9	2E-9	5E-7	2E-7
1,1,1-TCA	9.3E-08	9.9E-08	3E-5	7E-6	5E-9	6E-9	2E-6	6E-7
TCE	1.3E-07	1.4E-07	4E-5	1E-5	7E-9	8E-9	2E-6	8E-7
toluene	2.0E-08	2.1E-08	6E-6	1E-6	1E-9	1E-9	3E-7	1E-7
ethylbenzene	7.2E-08	7.6E-08	2E-5	5E-6	4E-9	4E-9	1E-6	5E-7
xylene	3.9E-07	4.1E-07	1E-4	3E-5	2E-8	2E-8	7E-6	3E-6

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$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT} \quad \text{(Equation 6-6)}$$

where:

CS = Chemical concentration in soil (mg/kg)

IR = Ingestion rate (mg soil/day) In this case, 50 mg soil/day per USEPA guidance (1991)

CF = Conversion faction (10^{-6} kg/mg)

FI = Fraction ingested from contaminated source; assume 0.5 industrial (half of daily exposure in workplace)

EF = Exposure factor, 250 days/yr industrial

ED = Exposure duration, 25 yrs industrial

BW = Body weight (assume 70 kg)

AT = Averaging time (days) Carcinogenic effects, 70 yrs; non-carcinogen (chronic) 25 yrs, 250 days/yr industrial

Results of these calculations are summarized in Table 6-6.

As access to the site is not completely restricted, a second receptor population may be trespassers. Calculations of potential exposure to adolescents have therefore been made. The same model (Equation 6-6) is used to estimate exposure to adolescent site trespassers. Parameter values change to reflect different body weights and amount of accidental soil ingestion each day. In this case, the parameter values are assigned as follows:

CS = Chemical concentration in soil (mg/kg)

IR = Ingestion rate (mg soil/day) In this case, 200 mg/event

CF = Conversion faction (10^{-6} kg/mg)

FI = Fraction ingested from contaminated source (100%, conservative)

EF = Exposure factor (number of trespasses on this site per year; assume 10)

BW = Body weight (15 kg)

TABLE 6-6. EXPOSURE ASSESSMENT, INGESTION OF CONTAMINATED SOILS

EXPOSURE ASSESSMENT: GENERAL INSTRUMENT CORP., SHERBURNE NY
Ingestion of on site soils by employees of print shop and child trespassers

CHEMICAL	UPPER 95% CI LOG-NORMAL CONCENTRATION (mg/kg)	COMMERCIAL EXPOSURE (mg/kg-day) (Lifetime AT) CA	(25 Yr. AT) CHRONIC	CHILD EXPOSURE (mg/kg-day)
VOLATILE ORGANICS				
methylene chloride	0.065	7E-09	2E-08	5E-09
1,1-dichloroethane	0.008	8E-10	3E-09	6E-10
1,2-dichloroethene	0.038	4E-09	1E-08	3E-09
chloroform	0.006	6E-10	2E-09	5E-10
2-butanone	0.012	1E-09	4E-09	9E-10
1,1,1-trichloroethane	0.086	9E-09	3E-08	7E-09
carbon tetrachloride	0.014	1E-09	5E-09	1E-09
trichloroethene	0.059	6E-09	2E-08	5E-09
benzene	0.007	7E-10	3E-09	5E-10
t 1,3-dichloropropene	0.005	5E-10	2E-09	4E-10
2-hexanone	0.025	3E-09	9E-09	2E-09
tetrachloroethene	0.008	8E-10	3E-09	6E-10
toluene	0.064	7E-09	2E-08	5E-09
ethylbenzene	0.041	4E-09	1E-08	3E-09
xylene	1.689	2E-07	6E-07	1E-07
SEMIVOLATILE ORGANICS				
Butlybenzyphthalate	0.371	4E-08	1E-07	3E-08
benzo(a)anthracene	1.135	1E-07	4E-07	9E-08
bis(2-ethylhexyl)phthalate	0.433	5E-08	2E-07	3E-08
chrysene	0.972	1E-07	3E-07	8E-08
benzo(b)fluoranthene	0.768	8E-08	3E-07	6E-08
benzo(k)fluoranthene	0.802	8E-08	3E-07	6E-08
bezo(a)pyrene	0.958	1E-07	3E-07	7E-08
indeno(1,2,3-cd)pyrene	0.363	4E-08	1E-07	3E-08
dibenzo(a,h)anthracene	0.355	4E-08	1E-07	3E-08
INORGANICS				
Silver	3.95	4E-07	1E-06	3E-07
Sodium	263.3	3E-05	9E-05	2E-05

Note: ED and AT are not used in this calculation, as they will cancel. Child intakes are used to calculate reasonable worst-case scenario for non-carcinogenic risk estimates. Conversion in denominator, 365 days per year, is required to standardize units.

The results of these calculations are presented in Table 6-6.

6.5.3 Exposure to Receptors From Contaminated Groundwater: Inhalation and Ingestion

Land between the TACO site and the Chenango River is currently in agricultural use. As discussed previously, Sherburne and neighboring rural communities are not experiencing growth pressure. It is consequently unlikely that the area between the river and the site (a significant portion of which is in the 100-year floodplain; refer to Figure 8) will undergo residential development. However, for the purpose of this baseline risk assessment, it is assumed that residential development of this land might occur in the future.

The impacted groundwater could expose future residents to chemicals by two pathways: ingestion and inhalation. Ingestion would be possible if private water supply wells utilized the impacted shallow aquifer downgradient of the chemical release detected at MW-8. However, future residences would be required to pay for connection to the Village water system. It is therefore unlikely that residents would choose to install a private well in addition, particularly with the elevation in inorganics that render the water unpalatable. Since there is no ordinance prohibiting residential wells within the Village limits, this pathway was carried through quantitative risk assessment.

In an earlier draft of this report, concentrations of organic compounds were estimated using a simple first-order decay model. The estimation technique was conservative, as dispersion and retardation on soil particulate were not calculated. The additional field monitoring performed in mid-1992 provided actual concentrations of organic compounds downgradient of the site. The measured concentrations were used to calculate potential exposure to future residents from impacted groundwater.

A later section of the report (8.3.1 and Table 8-1) discusses the findings of the additional field program in detail. Results of chemical analysis of groundwater collected from temporary boreholes are used to delineate the extent of the plume of impacted groundwater downgradient of MW-8. Results from A-2, a boring several hundred feet from the property boundary and not within the floodplain, were used to calculate potential exposure (Table 6-7). Figure 41 depicts the locations of 2A and the other additional sampling points.

To calculate exposure to future residents from residual contamination in their water supply, default model parameters (USEPA, 1991) have been assigned as follows:

$$\text{Intake (mg/kg-day)} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

where:

C = Estimated groundwater concentration of chemical at 250 m downgradient

IR = Ingestion rate, 2 l/day

EF = Exposure frequency, 350 days/yr

ED = Exposure duration, 30 yr

BW = Body weight, 70 kg

AT = Averaging time (days), 30-yr chronic, 70-yr carcinogenic

Results of these calculations are presented in Table 6-8. The potential health impacts resulting from exposure to this dose are discussed in Section 6.6, Toxicity Assessment.

Future site residents could be exposed to volatile organic compounds through inhalation as well as ingestion. Inhalation of volatile compounds in soil vapor could impact future residents. In addition, inhalation of volatile organic released during bathing and showering would create additional exposure if the aquifer were used as a water supply.

Soil vapor results are presented in Section 8.3.3 and Table 8-2. Note that the maximum concentration of total VOCs measured approximate 76 ppm (mg/kg). At this

TABLE 6-7

VOLATILE ORGANIC COMPOUNDS
MEASURED IN TEMPORARY BORING A-2

Analyte	Concentration (µg/l)	Part V NYSDOH Standard (µg/l)
Chlorobenzene	ND(1)	20
Chloroethane	102	5 (POC)(2)
1,1-dichloroethane	132	5
1,2-dichloroethane	ND	5
1,2-dichloroethene	132	5
1,1,2,2-tetrachloroethane	ND	5
1,1,1-trichloroethane	97	5
Trichloroethene	56	5
Vinyl chloride	220(3)	2

(1) ND = Not detected.
(2) POC refers to principal organic contaminant. Maximum concentration level is 5 µg/l.
(3) Estimated concentration (above calibration).

TABLE 6-8. EXPOSURE OF FUTURE RESIDENTS TO INGESTION OF CONTAMINATED GROUNDWATER

EXPOSURE ASSESSMENT: GENERAL INSTRUMENT CORP., SHERBURNE NY
Ingestion of contaminated groundwater in future residence

revised 1/13/93

CHEMICAL	MEASURED CONCENTRATION IN A-2 (UG/L)	CARCINOGENIC EXPOSURE (MG/KG/DAY)	CHRONIC EXPOSURE (MG/KG/DAY)
Vinyl chloride	2E+02	6E-03	1E-02
1,2-dichloroethene	1E+02	4E-03	8E-03
chloroethane	1E+02	3E-03	7E-03
trichloroethene	6E+01	2E-03	4E-03
1,1,1-trichloroethane	1E+02	3E-03	6E-03
1,1-dichloroethane	1E+02	4E-03	8E-03

concentration in soil, soil vapor concentrations infiltrating residential basements are likely to be low.

Volatilization from private water supply and inhalation during bathing and showering can be a significant source of exposure. Recent research indicates that exposure via inhalation of volatile organics can be of greater health impact than exposure via ingestion.

Exposure via this pathway is estimated using the following model:

$$\text{Daily exposure} = \frac{\underset{(1)}{\text{Volume of air inhaled during shower } (m^3)} = \underset{(2)}{\text{Mass of chemical transferred water to air (mg)}} \times \underset{(3)}{\text{Number of of showers per day}}}{\underset{(4)}{\text{Volume of air in shower } (m^3)} \times \underset{(5)}{\text{Body weight (kg)}}}$$

Parameters are estimated as follows:

(1) Volume of air inhaled during shower: 20 m^3/24 hours (standard). Assume shower is 10 minutes = 0.14 m^3

(2) Mass of chemical transferred.
(Volume x concentration = mass)
Assume shower delivers 50l water in 10 minutes. Assume that with heat and pressure, all volatile organics are transferred from water to air.

(3) Assume one shower per day.

(4) Assume shower shall = 1m x 2m x 3m = 6m^3. No air exchange.

(5) Assume body weight 70 Kg (standard adult)

Results of these calculations for the TACO site are presented in Table 6-9.

TABLE 6-9. EXPOSURE ASSESSMENT, INHALATION

EXPOSURE ASSESSMENT: GENERAL INSTRUMENT CORP., SHERBURNE NY
Inhalation of organic vapors in shower, future residence

revised 1/13/93

CHEMICAL	MEASURED CONCENTRATION IN A-2 (UG/L)	EXPOSURE (MG/KG/DAY)
Vinyl chloride	2E+02	4E-03
1,2-dichloroethene	1E+02	2E-03
chloroethane	1E+02	2E-03
trichloroethene	6E+01	9E-04
1,1,1-trichloroethane	1E+02	2E-03
1,1-dichloroethane	1E+02	2E-03

6.5.4 Exposure to Users of the Chenango River From Transport of Contaminants Via Groundwater Discharge

The transport of chemicals from the General Instrument site to the Chenango River is a fourth potential pathway for human exposure to site contaminants. The shallow aquifer underlying the industrial site discharges to the Chenango River about 500 m to the west. Potential receptors in the Chenango River include bathers and anglers, as well as aquatic organisms.

In the preceding section, potential decay in organic compounds was discussed. Additional dilution would be provided when the plume of contaminated groundwater intercepts the river basin. Dilution with overlying river water was calculated under low flow conditions.

The MA_7CD_{10} (mean average seven-day low flow with a recurrence interval of ten years) was selected to estimate low flow and consequent least dilution conditions. Using the MA_7CD_{10} is consistent with waste load allocation models for predicting the impact of point sources of pollution on receiving water quality.

The dilution of the groundwater plume with Chenango River water was estimated at one-thousand-fold under MA_7CD_{10} conditions. The following estimation technique was utilized:

$$\text{Dilution factor} = \frac{\text{Plume velocity x cross-sectional area}}{\text{River discharge}}$$

$$\text{Low flow dilution factor} = \frac{6 \times 10^{-4}\ m^3/sec}{0.62\ m^3/sec} = 10^{-3}$$

The concentration of each chemical of concern projected at the leading edge of the plume at 500 m was then diluted by the factor of 10^3. Resulting concentrations were compared to NYSDEC surface water standards to evaluate whether additional toxicity assessment was warranted.

Table 6-10 presents the results of calculations of possible concentrations in the Chenango River resulting from migration of site contaminants via groundwater. No chemicals are projected to be present in detectable concentrations, even at low flow. No further analysis of this pathway was consequently performed.

6.5.5 Summary of Exposure Assessment

In Section 6.4, six pathways for human exposure were considered possible based on the character of site contamination and surrounding land use. The six pathways included inhalation of volatile soil contaminants, ingestion of contaminated soils, inhalation of contaminated soil vapor, ingestion of contaminated groundwater, inhalation of contaminated groundwater, and uses of the Chenango River. The calculations generated in the exposure assessment have reduced the original six pathways to four: inhalation of volatiles from contaminated surface soils, ingestion of site soils, and inhalation and ingestion of groundwater downgradient of the site. Potential exposure from the other two pathways was minimal. Uncertainty in exposure assessment calculations are detailed in Table 6-11.

6.6 Toxicity Assessment

Toxicity data for site-related chemicals have been compiled from the Integrated Risk Information System (IRIS), an on-line database maintained by USEPA. Each chemical has been evaluated to determine whether exposure presents a risk and to quantify the risk to the extent possible. Chemicals can exert adverse impacts on human health by one of two mechanisms: carcinogenesis (cancer causing) or noncarcinogenesis (non-cancer causing, or chronic effects). The mechanisms by which the two impact human health are fundamentally different. The hypothesized mechanism for carcinogenesis is "non-threshold," meaning that there is no level of exposure to a chemical that does not pose a risk of changes in cellular metabolism that may lead eventually to cancer.

Non-carcinogenic effects, in contrast, are modeled as threshold effects. Levels of daily exposure are believed to exist for which no adverse health impacts will be felt. The human

TABLE 6-10. Dilution of contaminants from site with Chenango River flow

EXPOSURE ASSESSMENT, GENERAL INSTRUMENT CORP., SHERBURNE NY
Dilution of groundwater contaminants with Chenango River water

CHEMICAL	PROJECTED CONCENTRATION PLUME AT RIVER INFLOW (ug/l)	DILUTION WITH RIVER WATER mean flow (ug/l)	Low flow (ug/l)	NYSDEC CLASS A SURFACE WATER STANDARD (ug/l)
Vinyl chloride	6.9E-02	6.9E-06	6.9E-05	0.3(guidance)
1,2-dichloroethene	1.9E+00	1.9E-04	1.9E-03	0.07(guidance)
chloroform	2.1E-03	2.1E-07	2.1E-06	7
trichloroethene	2.1E-03	2.1E-07	2.1E-06	3 (guidance)
toluene	2.3E-154	2.3E-158	2.3E-157	5 (guidance)
xylene	4.5E-13	4.5E-17	4.5E-16	5 (guidance)
SEMIVOLATILES				
napthalene	8.5E-17	8.5E-21	8.5E-20	10
2-methylnapthalene	8.5E-17	8.5E-21	8.5E-20	NA
dibenzofuran	9.9E-124	9.9E-128	9.9E-127	NA
fluorene	1.4E-36	1.4E-40	1.4E-39	50 (guidance)
phenanthrene	3.4E-11	3.4E-15	3.4E-14	50 (guidance)
fluoranthene	1.2E-06	1.2E-10	1.2E-09	50 (guidance)
pyrene	1.4E-02	1.4E-06	1.4E-05	50 (guidance)
butylbenzylphthalate	3.0E-26	3.0E-30	3.0E-29	50 (guidance)
chrysene	2.2E-04	2.2E-08	2.2E-07	.002 (guidance)

TABLE 6-11

EFFECTS OF UNCERTAINTY IN ASSUMPTIONS, EXPOSURE ASSESSMENT

Assumption	Effect on Exposure: Potential Magnitude of Over-estimation of Exposure	Potential Magnitude of Under-estimation of Exposure	Potential Magnitude Over or Under Estimation of Exposure
Environmental Sampling and Analysis:			
- Systematic bias in analytical results			Low
- Small number of samples used to characterize site			Moderate
Fate and Transport Modeling:			
- Model of volatilization from soil to air			Moderate
- Air transport from hot spot to receptors			Moderate
- Groundwater velocity measurements			Low
- Volatile exposure calculated at ground surface, not in breathing zone	High		
Exposure Parameter Estimation:			
- Standard assumptions	Moderate		
- Use of upper 95 percent confidence interval on means of soils data	Moderate		

organism has protective measures that must be overwhelmed before an adverse impact is expressed.

The exposure concentrations presented in Section 6.5 are evaluated for their potential impact on human health. Note that the action levels for the two effects (carcinogenic and non-carcinogenic) differ. Chronic toxicity indices are the ratio between exposure from site contamination and reference dose, a measure of allowable exposure. Therefore, as the individual and summary indices exceed unity, potential for unacceptable exposure exists. Carcinogenic effects, on the other hand, are calculated by multiplying exposure amounts (mg/kg-day) times a "slope factor" (unit risk per mg/kg-day). The product is thus the unit risk of developing carcinogenic effects. The typical acceptable standard is a risk of 1xE-06, one in one million. Levels of concern, therefore, are greater than unity (chronic toxicity) and greater than 1xE-06 (carcinogenicity). The two models for health impacts (threshold and non-threshold) provide the theoretical basis for the different calculation methods.

For several of the contaminants of concern on this site, quantitative assessment of toxicity effects is not possible. Reference dose and slope factor data are occasionally withdrawn under review, or do not yet exist. Only qualitative assessment of toxicity is possible.

For the inhalation of contaminants from soil pathway, quantitative data are available for several contaminants of concern to human health (Table 6-12). The sum of chronic toxicity and carcinogenicity indices is well below action levels. Chronic toxicity index is 10^{-4} (residential) and 10^{-5} (commercial), significantly below unity. The calculated carcinogenic index is in the order of 10^{-8}, well below action levels of 10^{-6}. Even if these indices are doubled, the orders of magnitude below action levels will remain. Therefore, the additional contribution from chemicals without quantified toxicity effects is unlikely to change the general conclusions relating to this site.

Similar calculations have been made detailing possible health impacts from ingestion of contaminated soils (Table 6-13). Again, the indices are far below action levels. Inclusion of additional chemicals was therefore considered unlikely to alter the general conclusions of the toxicity assessment.

TABLE 6-12. Inhalation pathway: toxicity assessment

TOXICITY ASSESSMENT, GENERAL INSTRUMENT CORP., SHERBURNE NY

Toxicity and carcinogenic effects, inhalation pathway
Surface soil contamination

Chemical	CHRONIC TOXICITY RfD (mg/kg-day)	CARCINOGENIC EFFECTS Carcinogen?	Slope factor (mg/kg-day)-1	Weight of Evidence	ESTIMATED EXPOSURE (Commercial)	ESTIMATED EXPOSURE (Residential)	CHRONIC INDEX (Commercial)	CHRONIC INDEX (Residential)	CARCINOGENIC INDEX (Commercial)	CARCINOGENIC INDEX (Residential)
1,1-dichloroethane	1.0E-01	possibly	nd	C	4E-07	6E-07	4E-06	4E-05	nd	nd
1,2-dichloroethene	nd	no	nd		8E-08	1E-07	nd	nd	nd	nd
chloroform	nd	probably	8.10E-02	B2	2E-07	3E-07	nd	nd	1E-08	2E-08
1,1,1-TCA	3.0E-01	unknown	nd		1E-06	2E-06	4E-06	1E-05	nd	nd
TCE	nd	probably	1.70E-02	B2	5E-07	9E-07	nd	nd	9E-09	2E-08
toluene	7.0E-01	unknown	nd	D	2E-07	3E-07	3E-07	5E-07	nd	nd
ethylbenzene	nd	unknown	nd	D	8E-07	1E-06	nd	nd	nd	nd
xylene	1.0E-01	unknown	nd	D	5E-06	6E-06	5E-05	5E-04	nd	nd
						SUM	5E-05	5E-04	2E-08	4E-08

nd = not determined

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TABLE 6-13. Ingestion pathway: toxicity assessment

Toxicity assessment for ingestion, continued

Chemical	CHRONIC INDEX (Commercial)	CHRONIC INDEX (Residential)	CARCINOGENIC INDEX (Commercial)	CARCINOGENIC INDEX (Residential)
Butylbenzyphthalate	7E-07	1E-06	nd	nd
Benz(a)anthracene	nd	nd	nd	nd
bis(2-ethylhexly)phthalate	8E-06	1E-05	6E-10	2E-09
chrysene	nd	nd	nd	nd
benzo(b)fluoranthene	nd	nd	nd	nd
benzo(k)fluoranthene	nd	nd	nd	nd
benzo(a)pyrene	nd	nd	nd	nd
indeno(1,2,3-cd)pyrene	nd	nd	nd	nd
dibenzo(a,h)anthracene	nd	nd	nd	nd
Methylene chloride	4E-07	7E-07	5E-11	1E-10
1,1-dichloroethane	3E-06	5E-06	nd	nd
1,2-dichloroethene	1E-06	3E-06	nd	nd
chloroform	2E-07	4E-07	4E-12	1E-11
1,1,1-trichloroethane	3E-07	7E-07	nd	nd
carbon tetrachloride	7E-06	1E-05	2E-10	5E-10
trichloroethene	nd	nd	7E-11	2E-10
benzene	nd	nd	2E-11	6E-11
t-1,3-dichloropropene	6E-06	1E-05	9E-11	3E-10
2-hexanone	nd	nd	nd	nd
tetrachloroethene	3E-07	5E-07	4E-11	1E-10
toluene	1E-07	2E-07	nd	nd
ethylbenzene	1E-07	3E-07	nd	nd
xylene	3E-07	6E-07	nd	nd
silver	nd	nd	nd	nd
sodium	nd	nd	nd	nd
SUM	2E-05	5E-05	1E-09	3E-09

nd=not determined

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Ingestion of contaminated groundwater downgradient of the site was the third pathway evaluated for toxicity effects (Table 6-14). Note that an overall carcinogenic risk factor of 4E-02 is calculated by summing quantitative risks for individual contaminants in groundwater. Ingestion of contaminated groundwater would lead to an excess risk of developing cancer.

Inhalation of organic compounds through residential use of impacted groundwater is the final complete pathway for this site. Table 6-15 summarizes the toxicity assessment for this pathway. Note that a carcinogenic risk factor of 3E-01 is calculated. This risk is greater than risk from ingestion.

6.7 Risk Characterization

This section represents the final step in the baseline risk assessment. Exposure and toxicity data are integrated into a final description of risk to human health posed by the site.

Based on the distribution of contaminants on site and the environmental setting of Sherburne, New York, feasible pathways of exposure were identified and quantified. Inhalation of volatile contaminants of surface soils, ingestion of soil, and potential future residential use of contaminated groundwater were quantitatively evaluated. One pathway, future residential use of the shallow aquifer downgradient of the General Instrument site, resulted in elevated risk of carcinogenic effects. Land downgradient of the site is within the Village of Sherburne, and any Village residents are required to pay for utility connection fees. Private wells are therefore unlikely. However, there is no ordinance prohibiting installation of a private residential well.

Overall, the risk to human health posed by the General Instrument Corporation site in Sherburne, New York appears to be minimal. The one potential pathway for elevated health risks, future downgradient water supply wells, is unlikely.

Responses to NYSDEC comments made on the original draft of the risk assessment have been integrated into the text of Chapter 6 and are also included in Appendix R.

TABLE 6-14. Groundwater ingestion pathway: toxicity assessment

TOXICITY ASSESSMENT, GENERAL INSTRUMENT CORP., SHERBURNE N.Y.

Chronic toxity and carcinogenic response, ingestion pathway
Groundwater contamination
Future residential development

Chemical	Measured conc. at A-2 (downgradient) (ug/l)	CHRONIC TOXICITY RfD (mg/kg-day)	CARCINOGENIC EFFECTS Carcinogen?	Slope factor (mg/kg-day)-1	Weight of Evidence	EXPOSURE (mg/kg-day) (Lifetime AT)	(30 Yr. AT)	CHRONIC INDEX	CARCINOGENIC INDEX
Vinyl chloride	220	ND	yes	2E+00	A	8E-03	1E-02	ND	1E-02
1,2-dichloroethene	132	1E-02	probable	ND	B2	4E-03	8E-03	4E-01	ND
chloroethane	102	ND	unknown	ND	ND	3E-03	7E-03	ND	ND
trichloroethene	56	ND	probable	1E-02	B2	2E-03	4E-03	ND	2E-05
1,1,1-Trichloroethane	97	9E-01	unknown	ND	ND	3E-03	6E-03	3E-03	ND
1,1-Dichloroethane	132	1E+00	probably not	ND	C	4E-03	8E-03	4E-03	ND
	Potential conc. downgradient (modeled,not measured)								
napthalene	4E-8	4E-03	unknown	ND	D	1E-12	2E-12	2E-10	ND
2-methylnapthalene	4E-8	ND	unknown	ND	D	1E-12	2E-12	ND	ND
dibenzofuran	5E-62	inadequate data	unknown	ND	D	1E-66	3E-66	ND	ND
fluorene	2E-18	4E-02	unknown	ND	D	6E-23	1E-22	1E-21	ND
phenanthrene	1E-5	inadequate data	unknown	ND	D	4E-10	9E-10	ND	ND
fluoranthene	6E-4	4E-02	probable	ND	B2	2E-08	4E-08	4E-07	ND
pyrene	1E-1	3E-02	unknown	ND	D	3E-06	7E-06	9E-05	ND
butylbenzylphthalate	5E-14	2E-01	possible	ND	C	1E-18	3E-18	7E-18	ND
chrysene	5E-3	ND	probable	ND	B2	1E-07	3E-07	ND	ND
SUM								4E-01	1E-02

ND = NOT DETERMINED
<LOD= Less than limit of detection

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TABLE 6-15. Inhalation pathway (residential groundwater) toxicity assessment

TOXICITY ASSESSMENT, GENERAL INSTRUMENT CORP., SHERBURNE NY

Toxicity and carcinogenic effects, inhalation pathway
Residential inhalation of affected groundwater

Chemical	CHRONIC TOXICITY RfD (mg/kg-day)	CARCINOGENIC EFFECTS Carcinogen?	Slope factor (mg/kg-day)-1	Weight of Evidence	ESTIMATED EXPOSURE (Residential) (mg/kg/day)	CHRONIC INDEX	CARCINOGENIC INDEX
Vinyl chloride	ND	YES	2.95E-01	A	4E-03	ND	3E-01
1,2-dichloroethene	ND	PROBABLE	ND	B2	2E-03	ND	ND
chloroethane	ND	UNKNOWN	ND	ND	2E-03	ND	ND
trichoroethene	ND	PROBABLE	1.70E-02	B2	9E-04	ND	2E-02
1,1,1-trichloroethane	3.0E-01	UNKNOWN	ND	ND	2E-03	7E-03	ND
1,1-dichloroethane	1.0E-01	PROBABLY NOT	ND	C	2E-03	2E-02	ND
SUM						3E-02	3E-01

nd = not determined

SW004873

7.0 SUMMARY AND CONCLUSIONS

7.1 Summary of Site Characterization

Based on historical data and data from our site characterization sampling, we have identified three sources that contribute to soil and groundwater contamination at the north end of the site. The three sources are: (1) contaminated soil in the vicinity of MW-8; (2) the soil beneath and adjacent to the plating building; and (3) the soil north of the woodshed, near the property boundary with the Wescar bulk storage facility. Volatile organic compounds from these three sources are impacting groundwater and migrating off site.

Volatile organic compounds encountered in the soil have migrated vertically downward during infiltration events where they have impacted the groundwater. There is evidence that suggests VOCs have migrated laterally and vertically upwards in the unsaturated zone as well. Westward-flowing groundwater and soils in the vicinity of the plating building and behind the shed represent the most contaminated media at the site, and most likely point of human exposure. We project that the westward-flowing groundwater ultimately discharges into the Chenango River where VOCs, if present in groundwater, would become available for human contact. However, the dilution which is likely to occur before and upon discharge would eliminate risk. The volatiles in the soil may be released to the atmosphere if the soil is disturbed. Soil disruption may occur during site remediation. These activities would be conducted by OSHA trained individuals under a NYSDEC-approved health and safety plan. Access to the area by Kenyon employees or other uninvolved individuals would be restricted.

Metals concentrations exceeded standards in several wells, upgradient as well as on site. Every well tested exceeded standards for at least two metals. The discussion of metals results was based on concentration of unfiltered (total) metals concentrations. This is done to comply with NYSDEC guidance that requires metals concentrations to be based on unfiltered samples. High concentrations of total metals are frequently the result of a significant suspended sediment load and are often as indicative of the aquifer matrix chemistry as they are of contamination. This explains high concentrations of metals in upgradient wells, as well as a contributing factor in downgradient wells.

independent of that discussion, metals concentrations are notably higher in the vicinity of the plating building and may represent impacts by activity in that area.

The low level contamination found in monitoring wells in the South Field presents a moderate concern. We found no direct sources of contaminants to the groundwater in the South Field, and believe that low level residual contamination is a remnant of earlier remediation efforts which excavated contaminated sediment and soil from the South Field.

The site characterization work plan performed 12 tasks that were designed to address specific contaminant source and migration issues. The results of these 12 tasks are summarized below.

<u>Task 1</u>

The purpose of this task was to determine the extent of inorganic contamination near MW-5. Cyanide concentrations in MW-5 were elevated (206 µg/l), exceeding the standard of 100 µg/l. Chromium concentrations were also slightly elevated, exceeding the standard by 12% (6 µg/l). There was no evidence that soil near MW-5 is a source of inorganic contamination. The soil in the vicinity of MW-5 was excavated during an earlier remediation, and there is no evidence of new contamination.

<u>Task 2</u>

The purpose of the task was to characterize volatile contamination found along the western boundary of the South Field. We determined that low levels of volatiles persist in the groundwater near the South Field. The volatiles are found in very low concentrations (<45 µg/l), and changes in groundwater concentrations correlate with precipitation events. The increase in VOC concentration of groundwater is a result of vertical downward migration with the wetting front during infiltration. No direct source of volatile compounds was found; however, soil gas analysis indicated low levels persist in the soil of the South Field.

<u>Task 3</u>

The purpose of this task was to determine the source of volatile organic compounds in MW-7. Our analysis of groundwater from MW-7 revealed the presence of 1,2-DCE at 25 µg/l. The soil in the vicinity of the well did not contain volatiles. A direct source for these volatiles was not found. It was determined that the source may be residual concentrations in the soil near the site of the now demolished hazardous waste shed. The shed was located in an upgradient location, along the eastern border of the property.

Task 4

The purpose of this task was to determine whether volatile compounds are derived from Potash Creek, located cross-gradient and off site. Ponding on the creek had been suggested as a potential mechanism of transport. We found no volatiles in the sediment around Potash Creek, and we found no evidence of ponding in groundwater measurements. It is unlikely that Potash Creek, north of the site, is a source of volatile organic compounds to the site.

Task 5

The purpose of this task was to determine whether the "old" course of Potash Creek, which is now contained in an underground culvert, is a preferred pathway of contaminant migration across the site. Examination of the culvert and soil around the culvert revealed a concrete and plastic pipe in good repair, with no contaminants in the soil around the pipe. We found no evidence for preferred movement of groundwater along the "old" pathway of Potash Creek.

Task 6

The purpose of this task was to determine whether refuse in the old Chenango Canal could be a source of contaminants on the site. Although some refuse and coal ash was discovered in the old canal, quantities were not large enough to warrant suspicion. With the exception of PNAs in Test Pit #4 and Test Pit #3, soil samples from test pits excavated into or adjacent to the old canal did not reveal elevated concentrations of TCL compounds.

Task 7

The purpose of this task was to determine whether an off-site, upgradient source of metal contamination existed. Although the three upgradient off-site wells contained iron, manganese, and magnesium at levels that exceed NYSDEC standards, such exceedances are natural in groundwater in this area. There is no evidence of an off-site upgradient source of inorganics.

Task 8

The purpose of this task was to characterize volatile contamination associated with the plating facility. We determined that the soil beneath and adjacent the plating room is heavily contaminated with chlorinated and aromatic solvents. The source of these organic compounds was probably the floor drain system, which allowed contaminated metal plating rinse water to enter the soil and aquifer. The contamination appears to be migrating through the vadose zone by dispersive processes and in the groundwater by advective transport.

Task 9

The purpose of this task was to determine the origin of petroleum contamination at the north end of the site. Two distinct locations of petroleum release were identified: (1) adjacent MW-8; and (2) north of the woodshed. The release near MW-8 (MW-8 is located next to the northwest corner of the main building) is responsible for up to 9 inches of free floating product in MW-8. The release north of the woodshed is responsible for extensive soil contamination and impact on the groundwater with semi-volatile organic compounds.

Task 10

The purpose of this task was to determine whether there had been airborne transport of particulate contamination off site. Surface soil samples from downwind locations did not contain elevated concentrations of any site-derived compounds.

Task 11

The purpose of this task was to determine whether groundwater contamination was moving off site. We determined that off-site migration appears to be occurring. Samples from all three off-site downgradient monitoring wells have been found to contain chlorinated and aromatic volatile organic compounds. The extent of the migration has not been accurately determined because the "zero point", or furthest extent of the plume, has not been found.

Task 12

This task resampled the existing monitoring wells and determined that historical records are reasonable approximations of contaminant concentrations in the nine existing monitoring wells.

7.2 Conclusions of Risk Assessment

Based on the risk assessment conducted at the site (and described in Chapter 6), the following conclusions can be made:

- All wells sampled upgradient, on-site and downgradient exceed Part 703 (NYSDEC Groundwater Standards) for organic and/or inorganic constituents and are not potable. The upgradient groundwater exceeds groundwater inorganic standards and is not related to site activities.

- Off-site and on-site well water exceeded standards or guidance values for aluminum, iron, manganese, magnesium and sodium.

- Certain man-made volatile substances that exceed drinking water standards in on-site monitoring wells appear to be site related. These would pose a hazard if ingested in drinking water.

- In a worst case scenario, vinyl chloride identified in GW-8 is associated with an upper bound excess cancer risk of 1.82×10^{-2}. The acceptable level of risk is 10^{-6}. Based on a worst case scenario, the excess cancer risk for a lifetime of ingestion and inhalation of impacted groundwater downgradient from the site is 3×10^{-1}. The acceptable level of risk is 10^{-6}. However, the water in MW-8 is not potable, and human exposure is considered unlikely.

- The risks of incidental ingestion of volatile soil contaminants by site occupants is not excessive.

The quantified risks stated above represent worst case scenarios, that being the direct ingestion of contaminated water and inhalation of organic vapors from groundwater. The methodology of risk assessment requires that risks be stated in that manner (USEPA, 1989). True risks associated with the site, however, are minimal as groundwater on site or downgradient is not currently utilized or recovered for use. Actual exposure therefore is unlikely to occur.

7.3 Data Limitation and Future Work

The data set for this phase of the RI/FS is nearly complete. A comprehensive analysis of soil and groundwater determined sources of contamination, the general areas of impact, and resolved many questions regarding transport and fate of contamination.

At this point in the project, more data are needed to refine the site characterization and to direct the feasibility study. A scope of work for additional investigation was agreed to by General Instrument and NYSDEC. That additional work is described in Chapter 8.

7.4 Interim Remediation Measures (IRMs)

Interim remedial measures (IRMs) are part of the RI/FS process. An IRM is implemented to clean up or halt the spread of gross contamination when its presence is easily identified, and the danger to the environment and human health is evident.

Based on the data collected during the RI sampling event and earlier investigations, organic hydrocarbon contamination has been identified in Monitoring Well MW-8. Up to 24 inches of free product was discovered in a well bailer, and 9 inches of product was recently measured in the well via an "interface probe". Recovery of the free product by General Instrument Corporation should begin as soon as possible to expedite timeliness of the cleanup and prevent further contaminant migration.

A free product recovery system was installed in November 1992. It was agreed between General Instrument and NYSDEC that a skimming device that does not depend on groundwater depression was the best method at this time.

8.0 PHASE II FIELD INVESTIGATION

8.1 Additional Data Requirements

In March 1992, NYSDEC completed their review of Chapters 1 through 7 of this report. The findings of the investigation identified areas where additional data were needed to characterize the site to a degree that would allow completion of the feasibility study. In a meeting held on May 1, 1992, General Instrument, Stearns & Wheler, and NYSDEC agreed that the following unknowns warranted additional investigation, and a scope of work was developed.

8.1.1 Downgradient Extent of Impacted Groundwater

MW-17 is the most downgradient well in the area of the most significant groundwater impact and indicated 315 ppb total volatile organics. It was determined that the downgradient extent of impact needed to be further investigated.

8.1.2 Integrity of Lower Confining Layer

Existing monitoring wells encountered, but did not penetrate, the lower confining layer at the site. Its thickness and character had therefore not been determined. Assurance was needed that the lower confining unit was thick enough and of low enough permeability to prevent downward migration of contamination.

8.1.3 Areal Extent of Soil Contamination

Although impact to soil was clearly identified under and around the plating building, additional work would be needed to determine areal extent precisely enough to design remediation phase.

8.1.4 Presence of Free Phase Product (DNAPL)

None of the existing wells were completed with the screen intersecting the base of the aquifer of concern. After the source and area of primary impact were identified in the first part of this investigation, it was determined that testing the base of the aquifer for free product was warranted.

8.1.5 Confirmation of First Round Water Quality Data

All on-site monitoring wells would be sampled a second time for volatile organics and metals. Semi-volatile compounds would be analyzed in samples from MW-8 and MW-18.

8.2 Scope of Investigation

To obtain the additional data identified above, the following tasks were proposed to and approved by NYSDEC.

8.2.1 Downgradient Extent

In order to delineate the downgradient extent of groundwater without installing numerous monitoring wells, the installation of temporary sampling probes was proposed. This investigation was conducted in two phases of nine sampling points each. The locations of the second nine probes were determined, with input from NYSDEC, after the results of the first nine were reviewed. Probe locations are shown on Figure 39. The first nine probes were driven in lines extending northwest, west, and southwest from MW-17 at 100-foot intervals.

One-inch steel probes were driven into the soil using an electric percussion hammer. The probe was advanced until groundwater was penetrated from 1 to 2 feet and was then extracted. A tube was lowered into the open hole, and a groundwater sample was collected in purge vials and stored on ice.

The data from sampling points 1A through 3C, shown on Figure 39, were reviewed by Stearns & Wheler and NYSDEC. Based on the results, nine additional sampling points were selected. Findings and conclusions are discussed in Section 8.3.

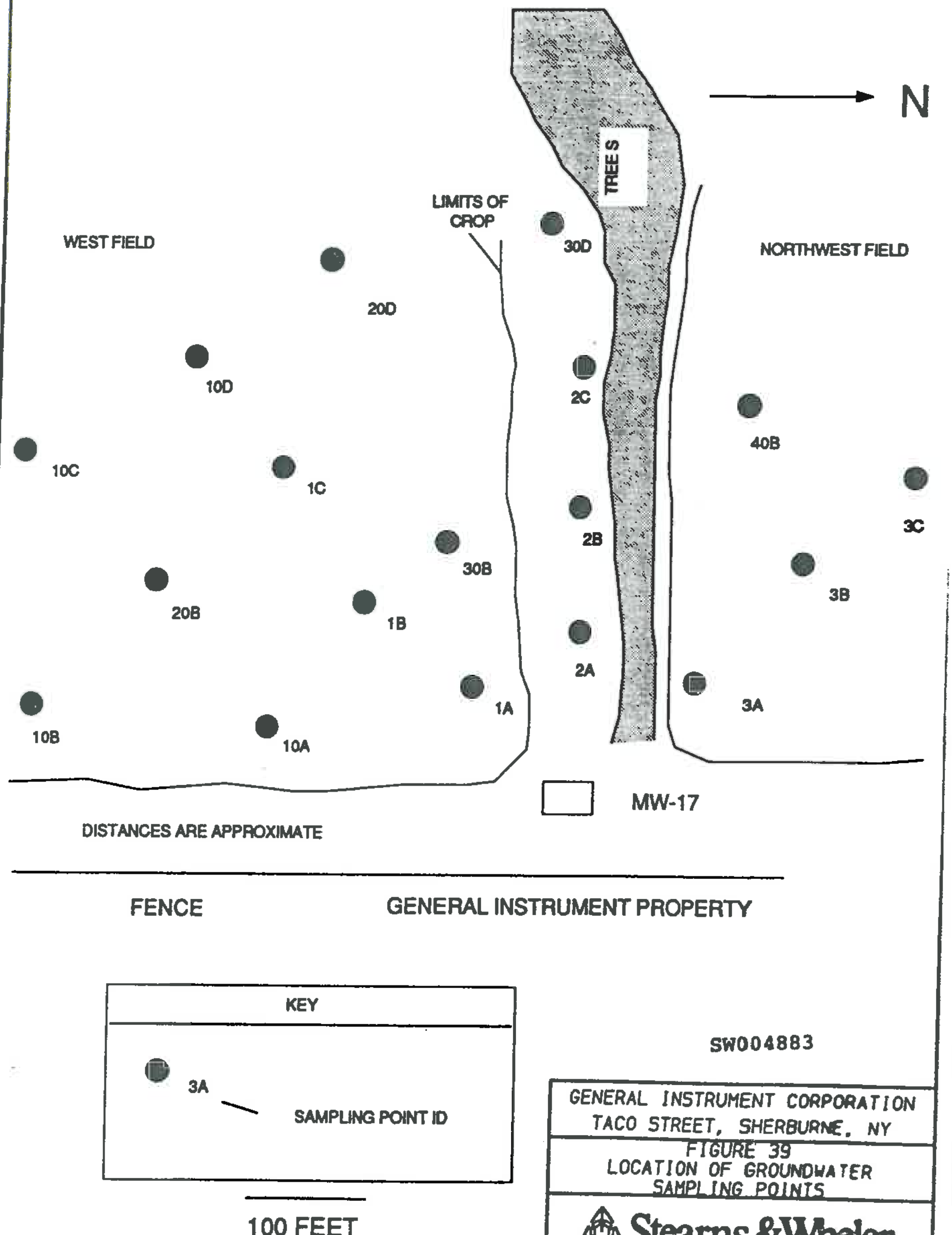

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FIGURE 39
LOCATION OF GROUNDWATER SAMPLING POINTS

Stearns & Wheler
ENVIRONMENTAL ENGINEERS & SCIENTISTS

8.2.2 Integrity of Lower Confining Layer

To determine if the lower confining layer was thick enough and of low enough permeability to be confident of no significant downward migration, an additional soil boring was installed. The boring was installed at the northeast corner of the plating building. It was agreed to in advance that the boring would extend 10 feet into the underlying silt/clay unit. If it was not readily apparent that the lower unit was of low enough permeability, lab permeability would be determined on a Shelby tube sample or a well would be installed and an in-situ hydraulic conductivity test would be performed.

The boring was completed on July 10, 1992 under the supervision of a Stearns & Wheler geologist and a representative of NYSDEC. The boring was advanced to 27 feet, encountering the lower confining layer at 15 feet. A boring log is included in Appendix N. A Shelby tube sample was collected from 25 to 27 feet. It was agreed to by all present that the lower confining layer was of adequate thickness and character and that no further testing was necessary.

8.2.3 Areal Extent of Soil Contamination

To better define the areal extent of soil contamination, a soil vapor survey, in conjunction with a soil boring/sampling program, was proposed. Sampling locations were selected in and around the plating building. Soil vapor probes were to be driven at each location and soil vapor readings were to be made at 2 feet and 4 feet using a photoionization detector. At four of the locations, a soil boring would be advanced with truck-mounted drilling equipment. Two samples would be collected from depths corresponding to the soil vapor survey from each boring, and each sample would be analyzed in a lab for VOC concentrations. The purpose of this was to compare the soil vapor survey concentrations to the lab results, allowing a correlation and extrapolation of the soil vapor results to actual soil concentrations.

The soil vapor survey could not be completed as proposed. The fill material that was emplaced around the plating building was too cobbly to allow probes to be advanced, and refusal occurred within a foot of the surface in numerous attempts. The four soil borings were completed as proposed.

It was determined that additional soil borings would be completed and soil samples collected at the locations outside of the building where probes could not be driven. Sampling locations are shown on Figure 40. The soil vapor probes would still be used inside the building. Soil borings were completed, and one soil sample was collected from 5 to 7 feet from each boring. Soil vapor probes were advanced to refusal inside the building. Results are discussed in Section 8.3.

8.2.4 Presence of Free Product

An additional monitoring well was installed 15 feet east of MW-8. The new well, MW-18, was installed for two reasons; the primary reason was to determine if there was free phase sinking product in the vicinity of the source. The second reason was to have a well constructed in such a way that it would be useful for groundwater recovery, in anticipation of future groundwater remediation. To accommodate a recovery system, the well was constructed of 4-inch stainless steel and was advanced 6 feet into the lower confining layer with a 2-foot blind riser at the bottom to accommodate a submersible pump. A boring log and completion diagram are included in Appendix N.

8.2.5 Confirmation of First Round Water Quality Data

On July 20-21, 1992, a second round of monitoring well sampling was completed. MW-10 was covered when a new driveway was constructed and MW-16 was damaged by vandals or by farming operations, so these wells were not accessible, and Wescar wells were not proposed to be sampled. All other on-site and off-site wells related to this investigation were resampled. Based on the results of the first round, PCBs, pesticides, and semi-volatiles were excluded from the analytical program, except for MW-8 and MW-18, where semi-volatiles were repeated. Analytical results are summarized in Section 8.3.

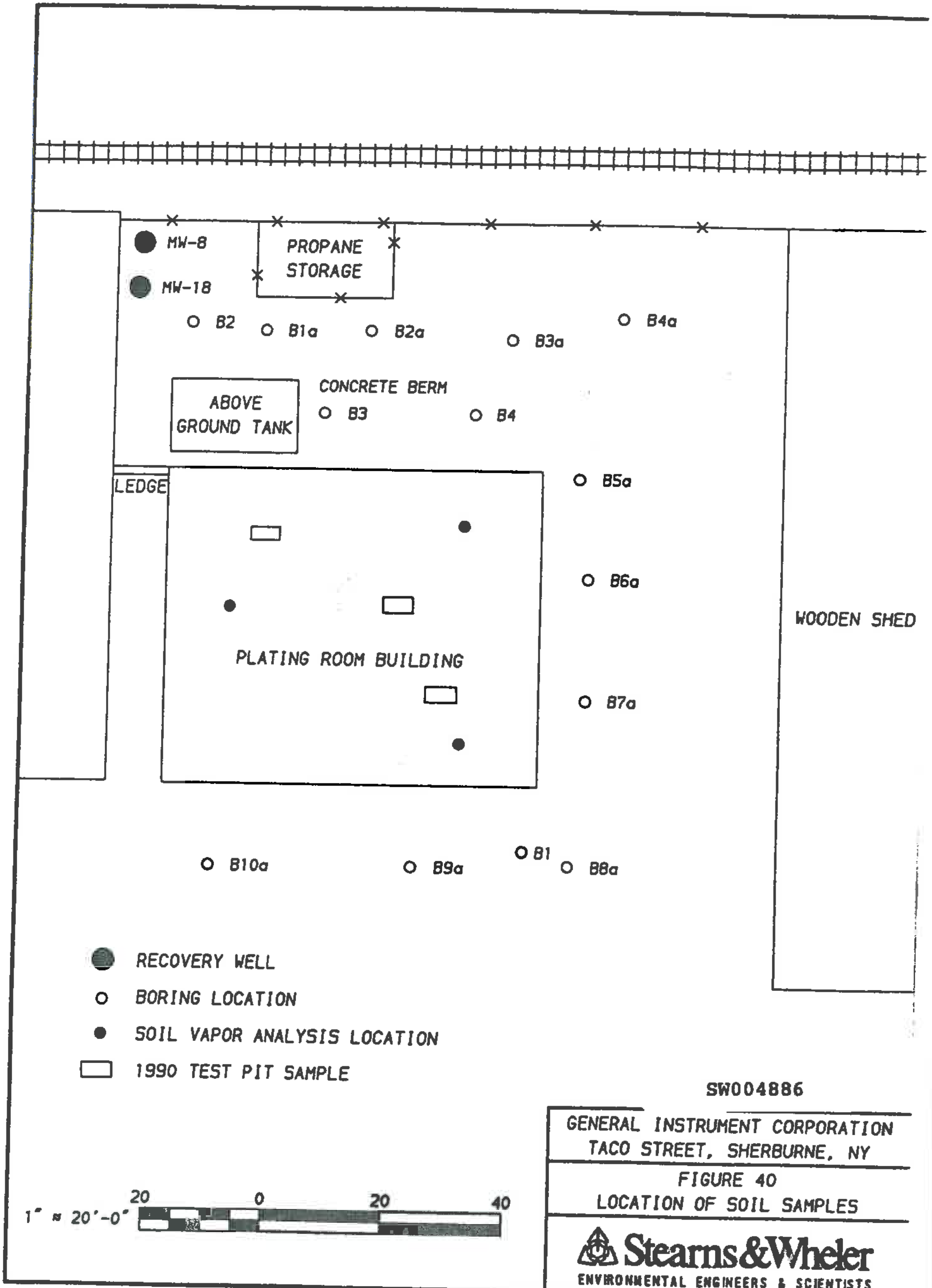

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FIGURE 40
LOCATION OF SOIL SAMPLES

Stearns&Wheler
ENVIRONMENTAL ENGINEERS & SCIENTISTS

8.3 Findings

8.3.1 Downgradient Extent of Impacted Groundwater

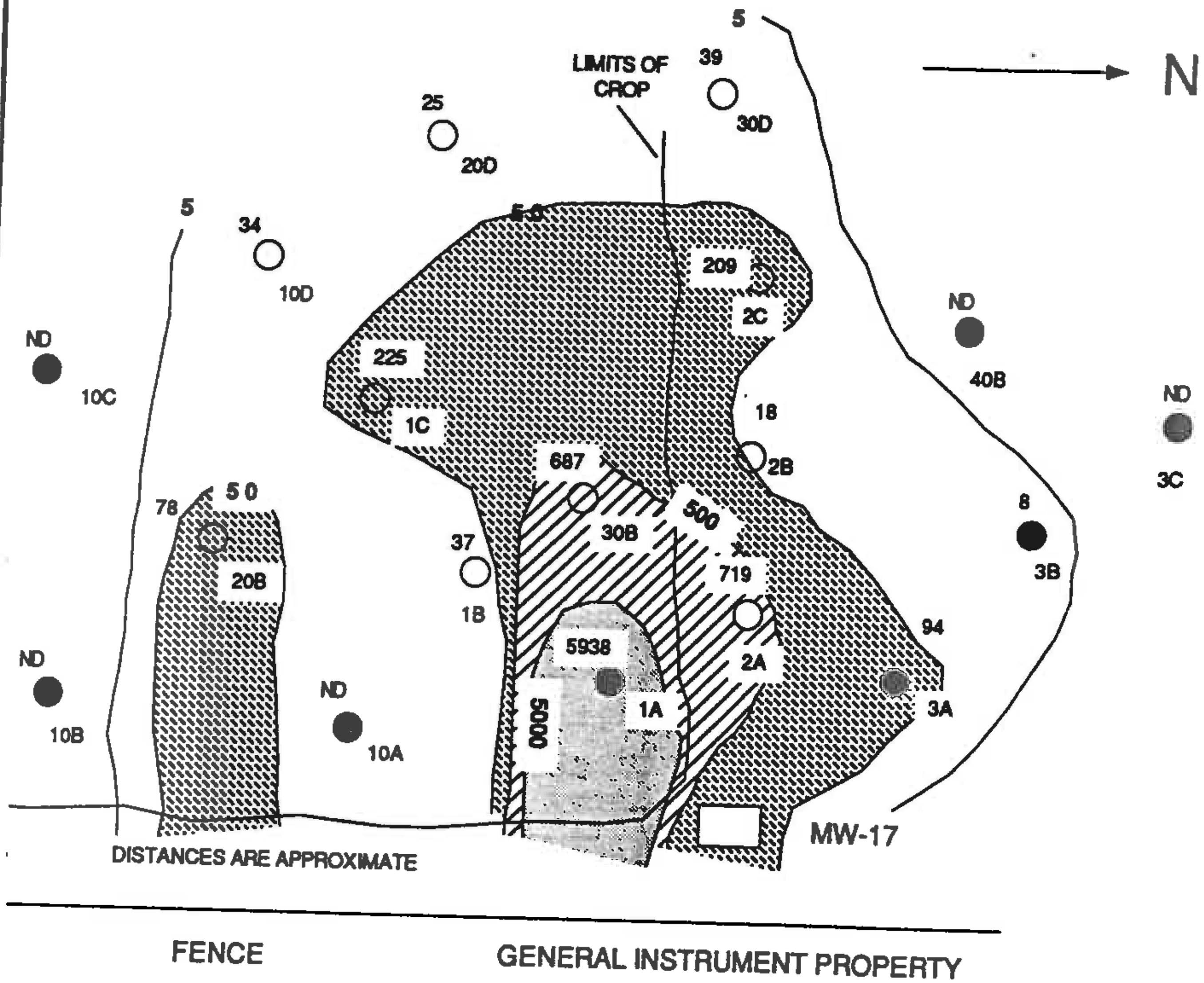
Analytical results of the 18 probe sampling points are plotted on Figure 41 and are summarized on Table 8.1. Analytical results are attached as Appendix O. Sampling Points 3A and 3B contained 94 and 8 ppb total VOCs, indicating some migration to the northwest. However, other more distant points to the northwest had non-detectable levels. It can be assumed that the area of concern can be considered, for the most part, to be south of the tree line that extends west from MW-17. Probes 10B and 10C were located approximately 400 feet south and 500 feet south-southwest of MW-17. Results of non-detect at those two sampling points indicate the southern extent of impact to groundwater. The three westernmost probes, 10D, 20D, and 30D, indicate minimal impact (25-39 ppb) at a distance of approximately 400 feet from MW-17.

8.3.2 Integrity of Lower Confining Layer

Based on observation of samples collected from the boring installed to investigate the lower confining layer, Stearns & Wheler and NYSDEC geologists agreed that the unit prevented significant downward migration of contamination.

8.3.3 Areal Extent of Soil Contamination

VOC concentrations in the soil samples are plotted on Figures 42, 43, and 44. Analytical results are summarized on Table 8.2 and presented in Appendix P. Figures 42 through 44 show the location of the 14 borings installed outside of the plating building. Borings B-1 to B-4 are the original four borings that were correlated to soil vapor survey points. Borings B1A to B10A are the borings that were installed after it was determined that probes could not be driven into the ground. The map also shows three locations inside of the building where soil samples were collected and analyzed in 1990, and three soil vapor collection points inside the building. Figure 42 shows total VOC results. Results from the 5- to 7-foot samples are contoured and results from 1- to 3-foot samples are indicated at the sampling point. The data



ND — TOTAL VOC IN PPB

3A — SAMPLING POINT ID

CONTOUR INTERVAL = ORDER OF MAGNITUDE PPB

100 FEET

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FIGURE 41
ANALYTICAL RESULTS
WEST FIELD GROUNDWATER

Stearns & Wheler
ENVIRONMENTAL ENGINEERS & SCIENTISTS

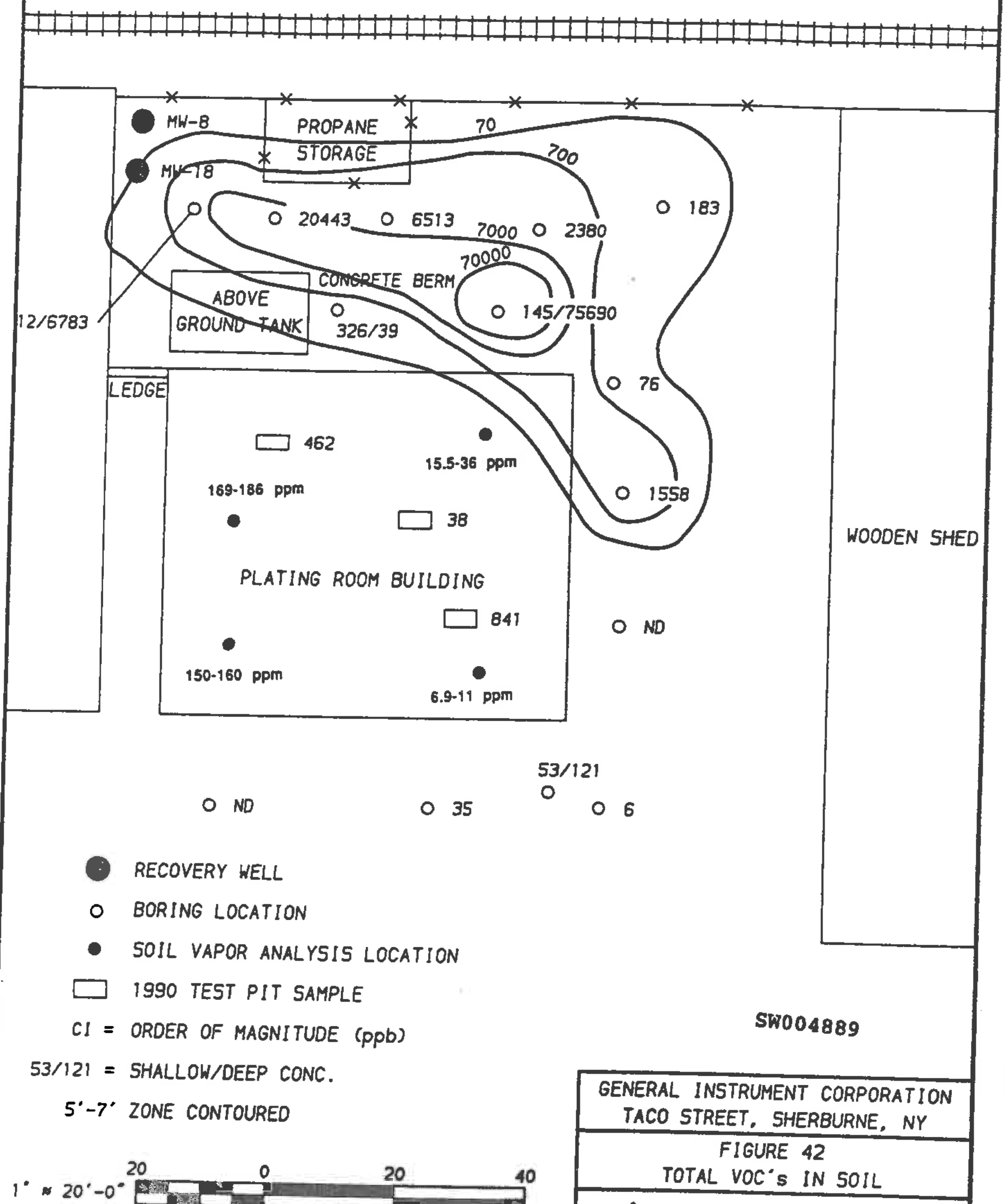

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FIGURE 42
TOTAL VOC's IN SOIL

Stearns&Wheler
ENVIRONMENTAL ENGINEERS & SCIENTISTS

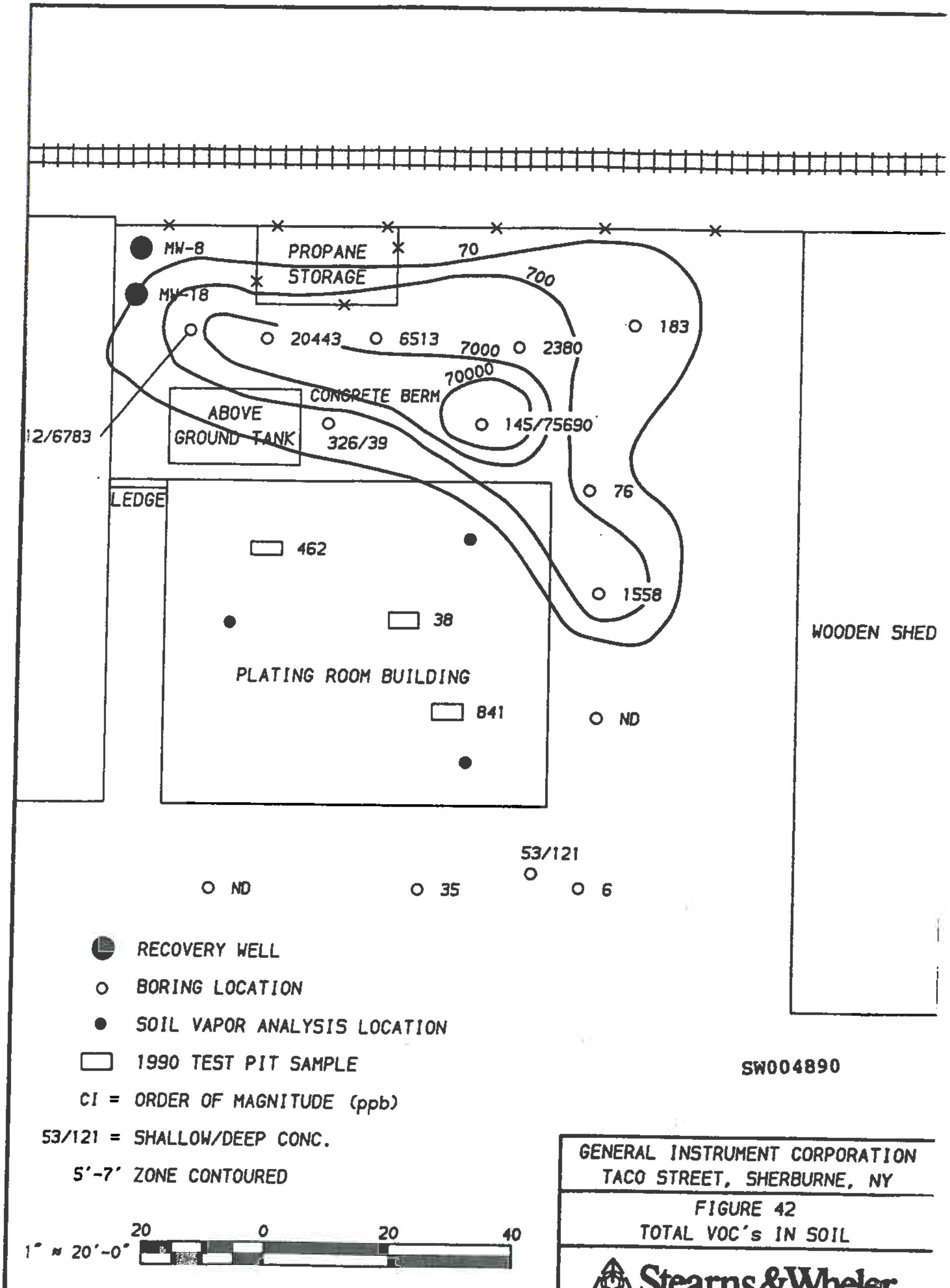

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FIGURE 42
TOTAL VOC's IN SOIL

Stearns&Wheler
ENVIRONMENTAL ENGINEERS & SCIENTISTS

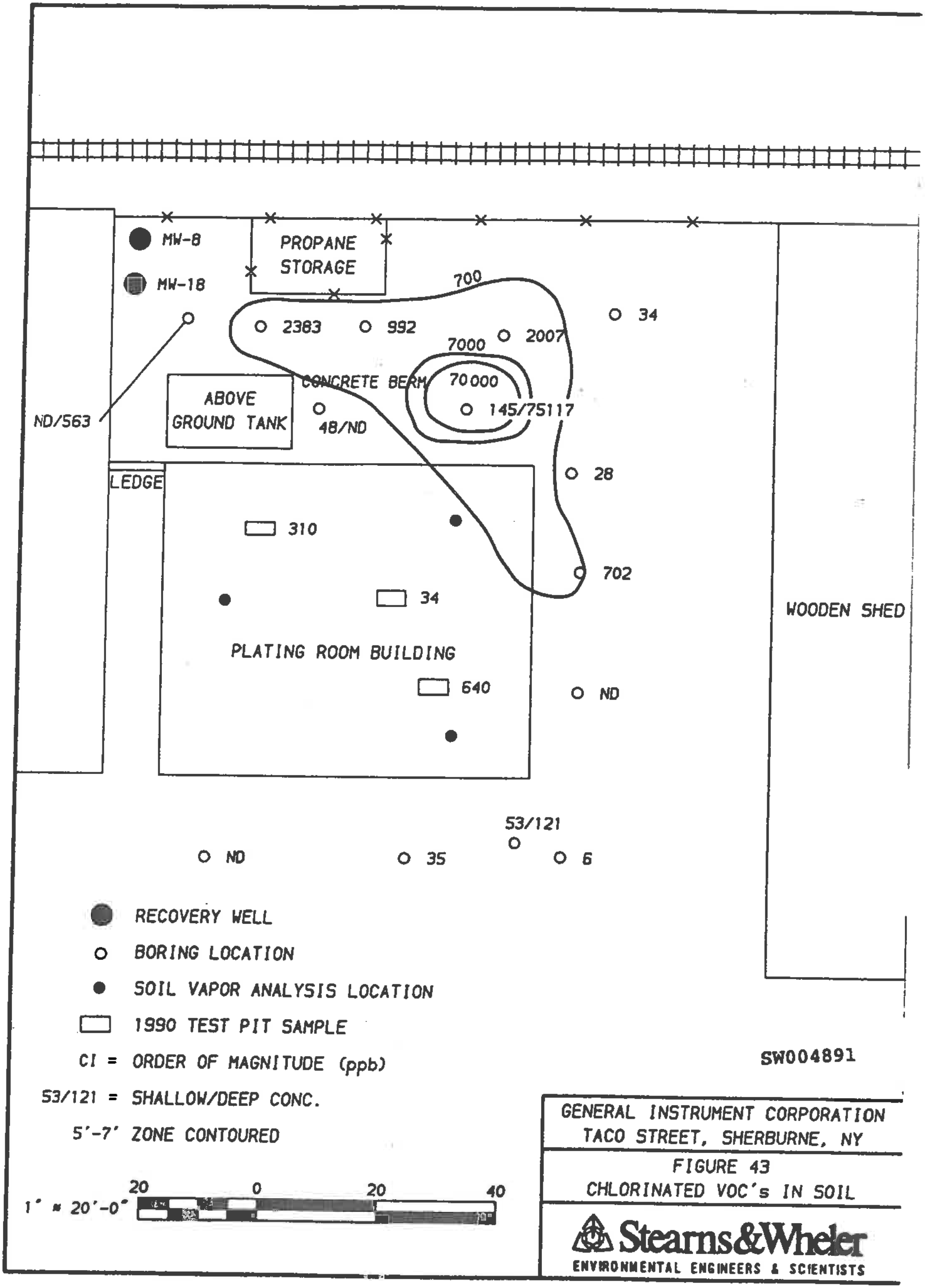
MW-8
MW-18
PROPANE STORAGE
700
7000
70000
2383
992
2007
34
ND/563
ABOVE GROUND TANK
CONCRETE BERM
48/ND
145/75117
LEDGE
28
310
702
34
WOODEN SHED
PLATING ROOM BUILDING
640
ND
53/121
ND
35
6
RECOVERY WELL
BORING LOCATION
SOIL VAPOR ANALYSIS LOCATION
1990 TEST PIT SAMPLE
CI = ORDER OF MAGNITUDE (ppb)
53/121 = SHALLOW/DEEP CONC.
5'-7' ZONE CONTOURED
1" = 20'-0"
20 0 20 40
SW004891
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FIGURE 43
CHLORINATED VOC's IN SOIL
Stearns&Wheler
ENVIRONMENTAL ENGINEERS & SCIENTISTS

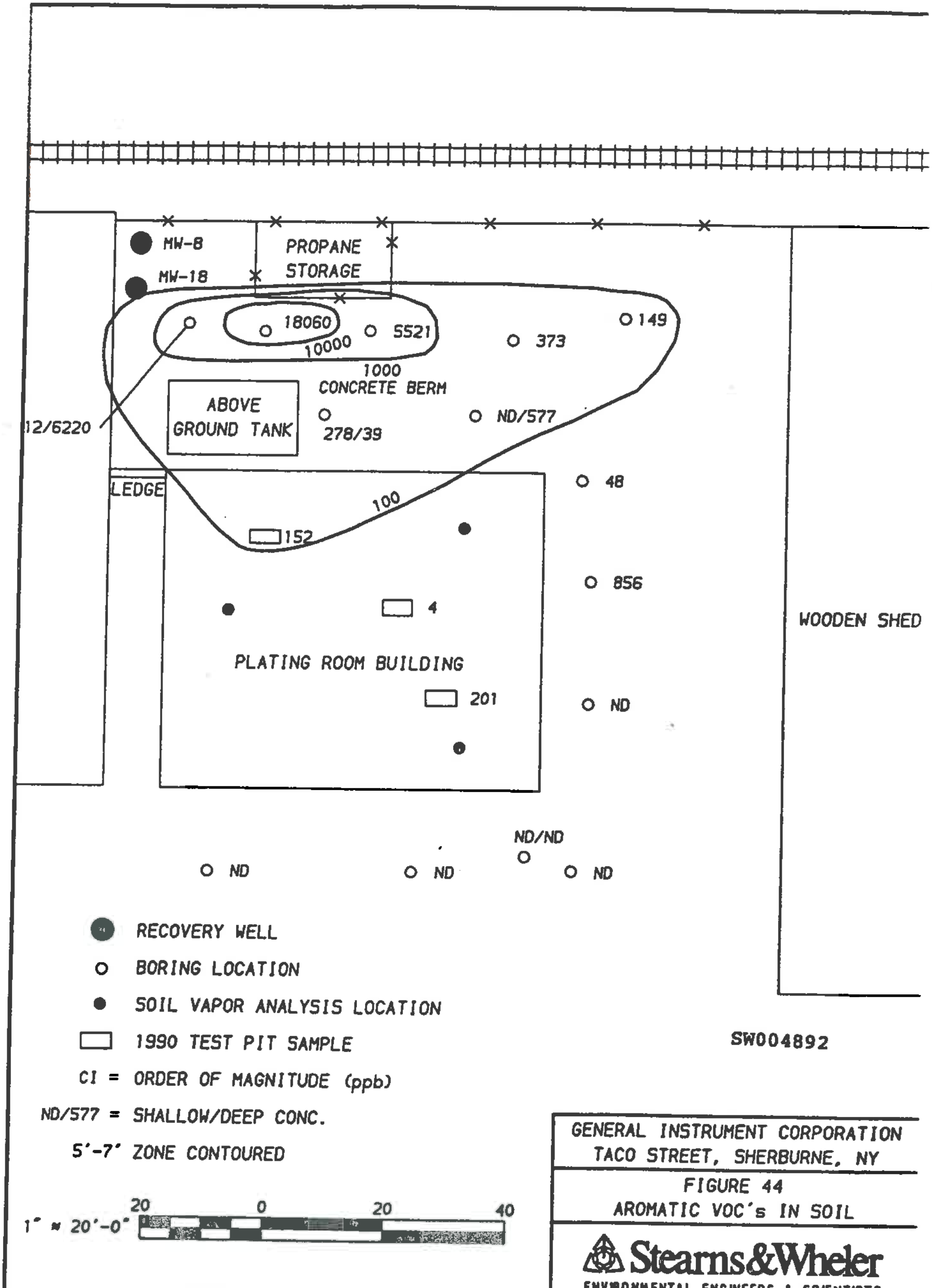

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FIGURE 44
AROMATIC VOC's IN SOIL

Stearns&Wheler
ENVIRONMENTAL ENGINEERS & SCIENTISTS

TABLE 8-2: VOLATILE ORGANIC COMPOUNDS IN SOIL

CONCENTRATION (ug/kg)

SAMPLING POINT	B-1	B-1	B-2	B-2	B-3	B-3	B-4	B-4	B1A	B2A	B3A	B4A	B5A	B6A	B7A	B8A	B9A	B10A
DEPTH	1-3	5-7	1-3	5-7	1-3	5-7	1-3	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7
CARBON DISULFIDE										66	38	34						
CHLOROBENZENE					48				843	61				702				
CHLOROETHANE										142	1880							
CHLOROFORM										55								
1,1 DICHLOROETHANE							24	2880		648	16		28					
1,2 DICHLOROETHANE								16700										
1,2 DICHLOROETHENE							22	2640										
METHYLENE CHLORIDE									1540	20	73					6	35	
1,1,2,2 TETRACHLOROETHANE								1700										
1,1,2 TRICHLOROETHANE								97										
1,1,1 TRICHLOROETHANE		121		368			20	51100										
TRICHLOROETHENE	53			53			79											
VINYL CHLORIDE				142														
TOTAL CHLORINATED VOCs	53	121	0	563	48	0	145	75117	2383	992	2007	34	28	702	0	6	35	0

BENZENE										320	32							
TOLUENE				3870				244	1370	37								
ETHYLBENZENE					125			70	3990	1224	212		11					
XYLENE			12	2350	153	39		263	12700	3940	129	149	37	856				
TOTAL AROMATIC VOCs	0	0	12	6220	278	39	0	577	18060	5521	373	149	48	856	0	0	0	0
TOTAL VOCs	53	121	12	6783	326	39	145	75694	20443	6513	2380	183	76	1558	0	6	35	0

SW004893

TABLE 8-1: TOTAL VOCs IN WEST FIELD GROUNDWATER

ANALYTE	CONCENTRATION (ug/L)												
	A-1	A-2	A-3	B-1	B-2	B-3	C-1	C-2	10-D	20-B	20-D	30-B	30-D
CHLOROBENZENE				37**									
CHLOROETHANE		102											
1,1 DICHLOROETHANE		132	26		6			48					8.9
1,2 DICHLOROETHANE								10					
1,2 DICHLOROETHENE	5650	132	42			8	83	40		32		478*	
1,1,2,2 TETRACHLOROETHANE							7						
1,1,1 TRICHLOROETHANE		97	6					53				6	14
TRICHLOROETHENE	288**	56	20		12		135	58	34	46	25	203	16
VINYL CHLORIDE		220***											
TOTALS	5938	719	94	37	18	8	225	209	34	78	25	687	39

NON DETECT 10A,10B,10C,3C,4OB

* ESTIMATED CONCENTRATION - ABOVE, BUT WITHIN 20% OF CALIBRATION
** PRESENT, BUT BELOW DETECTION LIMIT
*** ESTIMATED CONCENTRATION - ABOVE CALIBRATION

indicates that the greatest concentration of organic compounds in the soil is between the plating building and the west boundary. The rectangle bounded by the fence, the main building, and the plating building defines the area of greatest concern.

Figure 43 shows concentrations of chlorinated compounds only. The greatest concentration is at the northwest corner of the building and extends towards the south and west, decreasing from 75,117 mg/kg to 2007 mg/kg in a distance of approximately 20 feet to the north and to 563 mg/kg 50 feet to the west.

Figure 44 shows levels of aromatic compounds. Separate plots were made of aromatic and chlorinated compounds because it is possible, although not certain, that the aromatics are derived from fuel releases and the chlorinated compounds more likely result from process activities. Different focuses of concentrations further support this idea.

8.3.4 Presence of Free Product

No sinking free phase product was encountered in MW-18 during drilling or subsequent sampling. As expected, free phase petroleum product was encountered in the well, as has been consistently recorded in MW-8.

8.3.5 Round Two Analytical Results

Analytical results from the second round of samples are summarized on Table 8.3 to 8.6. Validation reports are presented in Appendix A. Table 8.3 presents results for volatiles in groundwater. For ease of comparison, 1990 analytical results are summarized at the bottom of the table. The 1992 results are generally consistent with the 1990 results and indicate that the area with significant impact to groundwater quality exists around Wells MW-8, MW-17, and MW-18. In accordance with an agreement with NYSDEC, MW-8 and MW-18 were sampled for semi-volatile organic compounds. Results are presented on Table 8.4.

TABLE 6-3: VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER

Location / Compound	G.W. Std.	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-11	MW-12	MW-13	MW-14	MW-15	MW-17	MW-18
Vinyl Chloride	2	10 U	1 J	10 U	10 U	10 U	10 U	10 U	630 J	10 U	10 U	10 U	10 U	10 U	10 U	8 J	65
Methylene Chloride	5	10 J	10 U	10 U	10 U	2 J	2 J	10 U	2504	13 U	10 U	10 U	10 U	10 U	10 U	10 U	3 J
Acetone	*	1 J	10 U	10 U	10 U	10 U	10 U	10 U	UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon Disulfide	*	10 U	10 U	10 U	10 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2 J
1,1-Dichloroethene	5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	5	10 U	9 J	10 U	1 J	10 U	10 U	10 U	44 J	10 U	10 U	10 U	10 U	10 U	10 U	5 J	6 J
1,2-Dichloroethene (total)	*	10 U	3 J	2 J	36	9 J	10 U	20	9700 R	10 U	10 U	4 J	26	10 U	10 U	92	210
Chloroform	100	10 U	10 U	10 U	10 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	5	10 U	10 U	10 U	1 J	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	42	30
cis-1,3-Dichloropropene	5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	5	4 J	3 J	3 J	6 J	6 J	2 J	10 U	250 U	10 U	4 J	10 U	10 U	10 U	5 J	90	22
Tetrachloroethene	5	5 J	10 U	10 U	10 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzene	*	10 U	1 J	10 U	10 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1 J
Toluene	5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	100 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	13
Ethylbenzene	5	10 U	1 J	10 U	10 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Xylene (total)	5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	100 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	8 J
TOTAL VOLATILES		20.0	18.0	5.0	44.0	17.0	4.0	20.0	13076	0.0	14.0	4.0	26.0	0.0	5.0	207.0	360.0
1990 RESULTS		17.0	20.0	6.0	45.0	17.0	ND	25.0	8314	ND	ND	4.0	38.0	ND	8.9	315.0	NI

All concentrations reported in µg/l.

U = Not detected substantially above the level reported in laboratory or field blanks.

J = Analyte present. Reported value may not be accurate or precise.

R = Unreliable result. Analyte may or may not be preent. Supporting data necessary.

NI = Well MW-18 had not been installed in 1990

MW-10 and MW-16 were damaged between 1990 and 1992 and could not be accessed. 1990 results: MW-10 = 6.8 ug/l., MW-16 = 76 ug/l.

SW004896

TABLE 8-4: SEMI-VOLATILE ORGANIC COMPOUNDS IN MW-8 AND MW-18

	CONCENTRATION ug/L	
	MW-8	MW-18
COMPOUND		
Naphthalene	860 E	
2- Methylnaphthalene	3000 E	25
2,6-Dinitrotoluene		6 J
Acenaphthene	160	4 J
2,4-Dinitrophenol	64	
Dibenzofuran	130	
Fluorene	300	6 J
N-Nitrosodiphenylamine	660	
Phenanthrene	1600 J	8 J
Anthracene	280	2 J
Fluoranthene	66 J	
Pyrene	43 J	1 J
Chrysene	23 J	
bis(2-Ethylhexyl)phthalate		2 BJ

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected substantially above the level reported in laboratory or field blanks.

TABLE 8-5: TOTAL METALS IN GROUNDWATER

LOCATION / ANALYTE	G.W.Std	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-11	MW-12	MW-13	MW-14	MW-15	MW-17	MW-18
Aluminum	none	9100	462	1700	1940	1930	7660	4870	263	407	1170	31900	14500	30700	5300	9510	6120
Antimony	3G	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U
Arsenic	25	5.0 U	5.0 U	5.0 U	7.0	25.3	5.0 U	15.1	5.0 U	5.0 U	5.0 U	5.0 U	6.3	5.0 U	5.0 U	5.0 U	5.0 U
Barium	1000	118	78.7	133	119	224	86.8	144	69.2	82.8	78.7	384	132	349	74.6	129	114
Berryllium	3G	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	10	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U
Calcium	none	97100	94200	112000	87600	82100	82700	77600	91900	93100	93700	209000	109000	184000	88300	127000	106000
Chromium	50	16.2	6.5 U	6.5 U	6.5 U	219.0	31.8	13.9	6.5 U	6.5 U	6.5 U	59.0	25.3	59.7	14.6	13.3	6.5 U
Cobalt	5	8.4	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	10.1	7.3 U	7.3 U	7.3 U	38.8	16.9	80.0	7.6	7.3 U	7.3 U
Copper	200	26.3 J	9.1 J	43.5 J	6.4 U	6.4 U	21.7 J	23.6 J	12.7 J	10.9 J	8.2 J	114.0	31.7 J	57.1 J	26.3 J	21.7 J	6.4 U
Iron	300	16300	2380	2640	10400	34500	14200	28600	1410	562	2090	73900	39700	82200	12000	20200	8890
Lead	25	8.6	3.0 U	3.0 U	4.2	3.6	9.9	9.4	3.0 U	3.0 U	3.0 U	38.9	3.0	30.7	8.2	3.0 U	6.6
Magnesium	35G	20300	10900	17400	13400	10900	15700	14400	13000	12600	15000	58800	27000	50900	13700	29900	18300
Manganese	300	639	1010	2130	627	424	258	1470	1450	281	3000	2130	1120	6950	316	1700	703
Mercury	2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	none	44.4	16.8 U	16.8 U	16.8 U	23.8	16.8 U	23.8	16.8 U	16.8 U	16.8 U	87.2	47.6	61.2	29.2	22.2	16.8 U
Potassium	none	5740	4050	2380	1610	39490	2760	7530	2070	6070	3340	7410	6600	8390	3460	3620	2910
Selenium	10	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ
Silver	50	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.8 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ
Sodium	20000	29500	19600	17000	13200	27000	10400	13300	45700	21100	35400	19800	15000	91300	8440	49900	47600
Thallium	4G	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Vanadium	none	18.8	6.0 U	6.3	6.0 U	10.9	12.3	15.6	6.0 U	6.0 U	7.4	56.3	28.4	54.6	15.8	16.1	6.3
Zinc	300	99.8 J	128 J	144 J	101 J	62.4 J	294 J	378 J	204 J	28.5 J	26.6 J	267 J	959 J	232 J	71.2 J	96.1 J	39.5 J

All concentrations reported in ug/L.

U = Not detected substantially above the level reported in laboratory or field blanks.

J = Analyte present. Reported value may not be accurate or precise.

UJ = The reported quantitation limits are qualified estimated.

G - Indicates a NYSDEC guidance value where a standard has not been established.

Shaded column indicates groundwater standards or guidelines.

Shaded rows indicate exceedance of standards or guidelines.

SW004898

TABLE 8-6: DISSOLVED METALS IN GROUNDWATER

LOCATION / ANALYTE	G.W.Std.	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-11	MW-12	MW-13	MW-14	MW-15	MW-17	MW-18
Aluminum	none	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ	32.6 UJ
Antimony	3G	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U	55.2 U
Arsenic	25	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Barium	1000	64.8	73.3	124	109	38.0	38.6	107	71.9	80.3	63.4	193	77.5	56.4	46.5	62	76.1
Berryllium	3	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	10	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U
Calcium	none	99000	101000	132000	102000	88000	97000	71100	103000	101000	104000	120000	723000	104000	88200	102000	101000
Chromium	50	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U
Cobalt	5	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U	7.3 U
Copper	200	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ
Iron	300	10.8 UJ	393	10.8 UJ	10.8 UJ	39.8 U	17.1 U	41.7 U	10.8 UJ	10.8 UJ	10.8 UJ	128 J	3220 J	10.8 UJ	10.8 UJ	10.8 UJ	15.4 U
Lead	25	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Magnesium	35G	14400	11400	19200	15000	11500	15200	9860	14700	13300	15900	19000	14000	14100	9780	15800	15700
Manganese	300	1.2 U	967	1450	658	176	36.7	1450	1590	47.6	113	1150	779	151	90.9	380	486
Mercury	2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	none	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U	16.8 U
Potassium	none	3520	3870	2570	1880	3310	3070	6170	2130	6290	2510	2720	5650	1950	1610	3500	2790
Selenium	10	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ
Silver	[illegible]	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ	9.3 UJ
Sodium	20000	33200	20300	19000	14300	29800	11300	13900	50000	22000	38000	21100	16000	101000	8980	53600	53300
Thallium	4G	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Vanadium	none	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U
Zinc	300	5.0 U	7.0 J	6.6 J	7.3 J	9.5 J	7.6 J	7.5 J	4.3 UJ	9.8 J	5.3 J	7.0 J	4.3 UJ	4.3 UJ	12.0 J	4.3 UJ	7.5 J

All concentrations reported in ug/L.

U = Not detected substantially above the level reported in laboratory or field blanks.

J = Analyte present. Reported value may not be accurate or precise.

UJ = The reported quantitation limits are qualified estimated.

G - Indicates a NYSDEC guidance value where a standard has not been established.

Shaded column indicates groundwater standards or guidelines.

Shaded rows indicate exceedance of standards or guidelines.

Total and dissolved metals were also analyzed in this round of sampling. This discussion focuses on total metal concentrations because they are the basis of NYSDEC standards. The significance of the dissolved results will be discussed below. In the first round of sampling, standards or guidance values were exceeded for antimony, cadmium, chromium, iron, lead, magnesium, manganese, sodium, and zinc. In this round of sampling, antimony and cadmium did not exceed standards or guidelines, but cobalt did. Otherwise, results are generally consistent and do not show any significant trends in terms of groundwater impact, source areas, or laterally extensive plumes of impact.

8.4 Conclusions

It was the objective of the Phase II field investigation to clarify and better define conditions discovered or further investigated in the initial phase of Remedial Investigation field work. Specifically, those objectives included:

- Better definition of downgradient extent of groundwater impact.
- Confirmation of integrity of lower confining layer.
- Further definition of areal extent of impacted soil around plating building.
- Confirmation of no free phase DNAPL.
- Confirmation of first round analytical results.

Conclusions for each of those objectives will be briefly restated and then the general significance will be discussed.

8.4.1 Individual Conclusions

1. Based on water samples collected from temporary probe holes, it has been determined that impacted groundwater extends at least 400 feet west of the site. Northern and southern extent has been defined and suggests that plume of impacted groundwater is approximately 600 feet wide. Concentrations at the most westerly points tested ranged from 25 to 39 μg/l.

2. The thickness and integrity of the lower confining layer were confirmed.

3. Impacted soil in the vicinity of the plating room appears to be concentrated in the open area between the plating room and the western boundary. Concentrations are generally greater at depth (5 to 7 feet) than near the surface (1 to 3 feet). Shallow soils in this area had been removed and replaced as a remedial effort during the plant closure. It is reasonable that there are less significant (38 to 841 mg/kg) levels directly under the building, because the old sump provided a barrier between the disposed solvents and the unsaturated soils underlying the building. Concentrations in soil beyond the perimeter of the building can be attributed to vapor phase migration or spills or releases in that area.

4. Based on the findings gathered from the installation and sampling of MW-18, there is no indication of free phase solvent at the base of the aquifer in that immediate area.

5. Groundwater analytical results were consistent with results of the 1990 sampling event. Significant findings restated include:

   a. Significant concentrations of volatile organic compounds (237 µg/l to 10,648 µg/l) exist in MW-8, MW-18, and MW-17.

   b. Significant levels of semi-volatile compounds (7186 µg/l) are present in MW-8.

   c. Elevated levels of metals, not attributable to background conditions, exist in Wells MW-5, MW-7, MW-12, MW-13, and MW-14. Although levels exceed standards and may be attributable to site activities, there is no indication of significant sources, concentrations, or off-site migration.

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