Report
Volume One
Main Report
Tables
Figures

RECEIVED
JUN 30 1989
DIV. ENVIRONMENTAL ENFORCEMENT
BUFFALO FIELD UNIT

Remedial Investigation
Cherry Farm Site
Tonawanda, New York

NIAGARA MOHAWK

Niagara Mohawk Power Corporation
Syracuse, New York

June 1989

O'BRIEN & GERE

1118.057

REPORT

REMEDIAL INVESTIGATION

CHERRY FARM SITE
TONAWANDA, NEW YORK

NIAGARA MOHAWK POWER CORPORATION
SYRACUSE, NEW YORK

JUNE, 1989

O'BRIEN & GERE ENGINEERS, INC.
1304 BUCKLEY ROAD
SYRACUSE, NEW YORK 13221

TABLE OF CONTENTS

Page

SECTION 1 - INTRODUCTION

SECTION 2 - STUDY AREA INVESTIGATION

SECTION 3 - PHYSICAL CHARACTERISTICS OF STUDY AREA

SECTION 4 - ANALYTICAL RESULTS

SECTION 6 - RISK ASSESSMENT

TABLE OF CONTENTS
(Continued)

Page

SECTION 6 - RISK ASSESSMENT (Continued)

TABLES

TABLE OF CONTENTS
(Continued)

TABLES (Continued)

FIGURES

APPENDICES

SECTION 1 - INTRODUCTION

1.01 Purpose of Investigation

Between 1978 and 1980, the Interagency Task Force on Hazardous Wastes, comprised of representatives from the New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH) and Region II of the United States Environmental Protection Agency (USEPA), identified 215 hazardous waste disposal sites in Erie and Niagara counties, New York. Information obtained by the Task Force indicated these sites potentially contained hazardous materials which could be released to the environment, and therefore, further investigations were deemed to be necessary. The Cherry Farm Site, located in Tonawanda, New York and currently owned by the Niagara Mohawk Power Corporation (NMPC) was included as one of these sites based on activities which allegedly occurred on the property.

As a result of the inclusion of the Cherry Farm site on the list of inactive hazardous waste sites, a series of investigations was completed. The investigation began with a NYSDEC review of the available background data and progressed to sampling and analysis of shallow soils and surface water on the property by the United States Geological Survey (USGS). Subsequent investigations were completed by NMPC in cooperation with NYSDEC, beginning with a Phase II Investigation in 1985 and culminating with the completion of a Remedial Investigation (RI) by NMPC to assess fully the physical and chemical characteristics of the site as they relate to potential effects on human health and the environment.

The scope of the RI, developed in conjunction with and subsequently approved by NYSDEC and NYSDOH, is detailed in a Remedial Investigation/Feasibility Study (RI/FS) Work Plan dated March 1988 (Appendix A.) To guide the schedule by which the RI/FS was to be completed, NYSDEC entered into an Administrative Order on Consent with NMPC in May 1988. The RI Work Plan was attached to this order.

This Remedial Investigation Report represents the findings of all investigations completed on the Cherry Farm Site to date. These findings will provide the basis for the evaluation of remedial options to be completed in the Feasibility Study.

1.02 Report Organization

This report is divided into six sections and includes tables, figures, and appendices. A brief overview of these sections follows:

Section 1 provides information on property use and previous studies conducted. In addition, this section includes a description of study objectives and structure of Remedial Investigation Report.

Section 2 presents a detailed description of the data collection efforts completed during the RI. Field techniques used to collect the data including a summary of the methods used to complete the test borings and ground water monitoring wells, are discussed. Additionally, specific details of sampling techniques, handling, and analysis are described.

Section 3 provides a discussion of the regional and site characteristics. More specifically, descriptions of the area, meteorology, land use, surface features, soils and fill, surface water, geology, and hydrogeology are provided.

Section 4 presents the results of the chemical analyses completed during the RI. A description of the site waste material chemistry is provided. The chemistry of on-site soil, ground water, sediment and surface water as it relates to site waste residuals is also discussed.

Section 5 presents a qualitative and quantitative risk assessment. This includes an evaluation of compounds present on the site, the related exposure pathways and the endangerment to human health and the environment associated with each complete exposure pathway.

The report is structured to reflect the format outlined in "Guidance on Remedial Investigations under CERCLA" (USEPA, March 1988). The following table can be used to cross-reference the Tasks identified in the Work Plan with the report sections.

Work Plan		RI/Report
Task 2 - Hydrogeologic Investigation		
2.01	Background Review	Section 1.02
2.03	Soil Borings	Section 2.05
2.04	Monitoring Wells	Section 2.06
Task 3 - Sampling and Analyses		
3.01	Soil/Fill	Section 2.03
3.02	Sediment	Section 2.04
3.03	Surface Water	Section 2.04
3.04	Ground Water	Section 2.06
3.05	Air	Section 2.02
3.06	Sample Analysis	Sections 2.03, 2.04, 2.06
Task 4 - Risk Assessment		
4.01	Qualitative Exposure Assessment	Sections 6.01 - 6.04
4.02	Quantitative Exposure Assessment	Section 6.05
4.03	Site Specific Considerations	Section 6.05

Tables and figures have been prepared to summarize the data and to present interpretations. The appendices contain the raw data, calculations, and other materials which support the interpretations presented in the report. Additionally, the validation of analytical procedures and chemical data are presented under separate cover as Appendix F. A single copy of the CLP QA/QC packages will be provided to the NYSDEC and NMPC.

1.03 Site Background

1.03.1 Site Description and Site History

The Cherry Farm Site is located between River Road and the Niagara River in the Town of Tonawanda , New York (Figure 1). The land use of the area surrounding the site can be characterized as industrial. Nearby industries include Tonawanda Coke, FMC, NMPC C.F. Huntley Power Station, Dunlop Chemical, Browning Ferris Landfill, NMPC C.F. Huntley Fly Ash Landfill, INS Scrapyard, Wickwire Steel, Clarence Material Corporation, and several petroleum storage and refining facilities. The site is bounded on the south by property reported by NYSDEC to be owned by INS Equipment and on the north by Pilot Trucking.

The site encompasses approximately 55 acres, 80 percent of which (44 acres) is covered by fill material. The fill material, consisting primarily of foundry sand, slag, and cinders, is approximately 10 to 20 feet above the original land surface (Figure 2). The present topography of the filled area is essentially flat but several low lying areas temporarily collect surface water after precipitation. The sides of the filled area are generally steep (approximately 70 percent slope).

The fill area is surrounded by surface water. A wetland designated as BW-6 by the NYSDEC is present on the eastern portion of the site. This wetland drains into two drainage ditches which flow along the southern and northern boundaries of the property and ultimately discharge to the Niagara River which forms the western side of the site (Figure 1). The adjacent Tonawanda Channel of the Niagara River is approximately 20 feet deep and flows northward with an average volume of 57 billion gallons per day (approximately 88,000 CFS) (The Niagara River Toxics Committee, 1984.)

A 1965 United States Geological Survey (USGS) topographic map of the area showed that historical site features included a small stream which cut diagonally across the site from the southeast corner to approximately the center of the west side of the property. In addition, two settling ponds were also present in the southwest corner of the property (Figure 2). The streams and settling ponds are now covered with fill material.

The City of Tonawanda water supply is obtained from the Niagara River. The intake is located approximately 3 miles downstream from the site. Ground water is not used for municipal supplies in the vicinity of the site. Clarence Materials Corporation, however, located on the property just south of the site uses a supply well solely for truck cleaning (Hazard Ranking- Cherry Farm Site, OBG, 1986). No additional municipal or private ground water supply wells are known to be present in the vicinity of the site.

Information provided to the NYSDEC by Colorado Fuel & Iron Steel Corporation (CF&I), in a letter dated October 10, 1985, revealed that between 1945 and 1970 the Cherry Farm site was owned by CF&I. Dust and slag from the CF&I blast and open-hearth furnace operations were discarded at the site until 1963. CF&I then entered into an agreement with INS Equipment Company (INS), which allowed INS to dispose of foundry sand and sandcasts from a nearby Chevrolet plant on the property.

The site, together with some additional acreage, was purchased by NMPC in 1970 from CF&I. At the time of the purchase, foundry sand was exposed at the surface of the fill area. To prevent wind erosion and reduce human exposure, the surface of the fill was capped by NMPC with approximately six inches of clay and seeded with rye grass. Fill remains exposed on the sides of the fill area.

Presently, the site is used for recreational purposes by NMPC. Two softball fields have been constructed on top of the clay cap in the center of the fill area. The access road to the site is regulated by a locked gate.

1.03.2 Previous Investigations

Several site investigations have been conducted since 1978. The first studies were completed by the Interagency Task Force between 1978 and 1980 as part of a statewide program. These investigations were completed as a result of a misunderstanding of the site history which indicated that Dow Chemical and Hooker-Durez disposed chemical wastes at the site. Disposal of waste material by these companies has not been substantiated by site investigations.

The NYSDEC prepared a Hazardous Waste Disposal Site Report for the site in April 1980. As a result of this report the site was listed in NYSDEC's Inactive Hazardous Waste Disposal Sites in New York State - First Annual Report in June of 1980 (Site No. 915063) as an A classification. This classification indicated that further field inspection and additional hydrogeological and chemical information were needed.

A USEPA Site Inspection and Background Report was completed by Fred C. Hart Associates in March 1981. This report was based on a site inspection completed with an NYSDEC representative. The report concluded the "...site should be rated as a low priority site. No evidence of phenol tars or other hazardous substances was observed..." (Hart, March 1981). In June 1981, RCRA Research completed analyses on soils, sediment, and surface water in conjunction with NYSDEC's In-Place Toxics study.

The RCRA report concluded that total phenol concentrations in the surface water on the property ranged from 0.01 ppm to 1.0 ppm and chlorobenzenes in the soil ranged between 0.02 ppm to 4.5 ppm.

In July 1982 the USGS sampled soil and surface water at the site. The analytical results indicated the presence of iron, lead, nickel, cadmium, and arsenic in both the soil and surface water. Based upon these analyses, the USGS sampled soils and surface water for organic compounds. The analyses identified polychlorinated biphenyls (PCBs) (2.5 ppm to 199 ppm), toluene (0.013 ppm to 0.052 ppm), phenol (0.13 ppm to 35 ppm), naphthalene (1.5 ppm to 5.6 ppm), and benzene (0.013 ppm to 0.018 ppm) to be present in the fill material. Other, non-priority, pollutants identified in the fill were 2-methylphenol and 4-methylphenol. In the surface water, napthalene was observed in one sample at 0.29 ppm and PCBs were detected at levels ranging from 0.32 ppm to 1.1 ppm. No formal reports were published by the USGS; only analytical data were summarized.

Based on the USGS findings, the NYSDEC employed Engineering Science and Dames & Moore to complete a Phase I Investigation in 1983. The disposal allegations and previous analytical data referred to in this investigation suggested that waste materials might contain tars and resins.

The Phase I investigation included a preliminary Hazard Ranking System (HRS) scoring of the site. (It was concluded that there were insufficient data to complete a final HRS score.) The total score for the site, S (m), was 28.95. This score exceeded the USEPA value of 28.5 which meant that a more detailed Phase II Investigation was warranted.

In 1984, the Niagara River Toxics Committee issued a report that summarized discharges of hazardous substances to the Niagara River. The Cherry Farm site was included in this report as a non-point source based on data collected during preliminary investigations completed by NYSDEC.

This report included a list of 261 substances identified in the water, sediments, and biota of the Niagara River. These substances were organized in nine groups (I, II A through G, and III) based on levels of concern ranging from Group I, which includes substances posing a potential threat to human health or the environment, to Group III which contains chemicals of little concern. A number of the substances included in Group I had previously been identified at the Cherry Farm Site by USGS and NYSDEC including arsenic, cadmium, chromium, lead, mercury, nickel, methylene chloride, heptachlor epoxide, phenol, fluoranthene, bis(2-ethylhexyl)phthalate, benzene and PCB aroclor 1260.

In cooperation with NYSDEC, NMPC agreed to complete a Phase II Investigation of the site in 1985. NMPC retained O'Brien & Gere Engineers, Inc. (OBG) to prepare a Work Plan which was subsequently approved by NYSDEC. The scope of work included completion of geophysical surveys, installation of seven ground water monitoring wells, completion of five soil borings, and the analysis of soil, ground water, surface water, and sediment samples.

Results of the Phase II Investigation (O'Brien & Gere, 1986) revealed that the fill material is comprised of 10 to 20 feet of foundry sand, sand casts, slag, and black sandy material. The fill was found to be underlain by silt and sand which grades to fine to coarse sand with increasing depth. Ground water elevation data revealed that ground water flows to the north-northwest towards the adjacent Niagara River and approximately 5 feet of the fill material was saturated.

Analysis of the fill material completed during the Phase II indicated the presence of phenolic compounds, polynuclear aromatic hydrocarbons (PAHs), and phthalates at part per billion (ppb) concentrations. PCBs (Arochlor 1248) were identified at parts per million (ppm) concentrations. Sediment and surface water samples also contained detectable concentrations of phenols and PAHs with highest concentrations observed at upstream locations.

Analyses of ground water samples collected as part of the Phase II Investigation detected mercury, nickel, zinc, and arsenic. Ground water samples also contained the following organic compounds: benzoic acid, PAHs, and phthalates. PCBs were not detected in any of the monitoring well samples.

Based on the findings of the Phase II investigation, an HRS score was completed for the site with the following individual route scores: ground water, S(gw) at 6.12; surface water, S(sw), at 21.82; direct contact, S(dc) at 25, and air, S(a) at 0. The fire and explosion score S(fe) was not completed as available data indicated that this hazard did not exist at the site. The composite score, S(m), was 13.1.

As a result of the Phase II Investigation, the NYSDEC required that a Remedial Investigation/Feasibility Study (RI/FS) be completed. A Work Plan detailing the investigation tasks to be completed at the Cherry Farm Site was prepared by OBG. This Work Plan included a Quality Assurance Project Plan (QAPP) and a Health and Safety Plan (HASP) as required by NYSDEC. The Work Plan (Appendix A) was reviewed and approved by NYSDEC in April 1988. The approved Work Plan was then incorporated in the Administrative Order on Consent signed by NYSDEC and NMPC in May 1988.

SECTION 2 - STUDY AREA INVESTIGATION

Work conducted by OBG and its subcontractors was completed in accordance with the procedures outlined in the Health and Safety Plan (Appendix A). This included wearing disposable coveralls, rubber boots, gloves and hard hats when appropriate. Additionally, the work was completed according to the NYSDEC approved QAPP with any NYSDEC approved deviations noted later in this report (Appendix A). A NYSDEC representative was onsite during completion of all work efforts. No deviations from the Work Plan were made without approval of the onsite NYSDEC representative.

2.01 Topographic Survey

A topographic map was made of the Cherry Farm site using aerial photographs taken on February 25, 1987 by Lockwood Support Services. The topographic map was prepared at a scale of 1 inch = 100 ft with 2-ft contour intervals. This map was reduced to a scale of 1 inch = 200 ft for this report. In addition, all ground water monitoring wells, test borings, and soil sample locations installed during the Phase II Investigation and the RI were surveyed for location and elevation by NMPC personnel using conventional instrument survey techniques. Well casing elevations were determined to the nearest 0.01 ft.

2.02 Ambient Air Quality Survey

The results of the Phase II investigation concluded that the site had no effect on ambient air quality and that air emissions from other nearby industries likely mask trace concentrations of volatile organics, if any, that may be emitted from the site. Therefore, an extensive air quality survey was not included as a task in the NYSDEC approved Work Plan.

In accordance with Task 3.05 of the Work Plan and the Health and Safety Plan (HSP), an ambient air survey was conducted around the perimeter of the site on May 4, 1988 to confirm the results of the Phase II air survey. This survey was completed using a photoionization analyzer (HNU model PI-101) calibrated to benzene. HNU readings were collected during a walk around the perimeter of the fill material. In addition, the HNU was used to periodically monitor the ambient air during the drilling of monitoring wells and borings for health and safety purposes. Throughout the survey and drilling program, no readings above background were observed.

2.03 Surface Soil Sampling

Surface soil samples were collected from the softball fields and along the sloping sides of the fill (fill face) to evaluate the potential exposure to the human population and the environment. In addition, foundry sand casts, exposed on the face of the fill were also collected to evaluate their chemical composition. The surface soil and sand cast samples were collected between June 20, 1988 and June 22, 1988.

Per the Work Plan, each surface soil sample to be analyzed was comprised of three to four sub-samples collected from an area approximately 2 feet in diameter. These samples were composited into a single sample for chemical analysis.

At each softball field, two composite samples were collected; one sample was a composite of sub-samples collected from home plate and the pitchers mound, the second composite sample was collected from 1st, 2nd, and 3rd bases as specified in Task 3.01 of the Work Plan (Appendix A). At each of these locations, sub-samples were collected randomly near the area. The sub-samples were collected at a depth of zero to six inches below the surface using a trowel. Lexan tubing was specified in the Work Plan for sample collection, however, due to the dense soil encountered its use was not feasible. This change in methods was agreed to in the field by the on-site NYSDEC representative. The trowel was decontaminated between sub-samples using a hexane rinse followed by a clean water rinse. The sub-samples were placed into a new aluminum tray, composited and placed into appropriate jars.

A total of eight fill samples were collected along the face of the fill, two samples per side as illustrated on Figure 2. The samples were collected using 3/4 inch O.D. Lexan tubing in accordance with the procedures outlined in the Work Plan (Appendix A). A new length of Lexan tubing was used for each sub-sample.

Each sample consisted of material collected at a depth of 0 to 6 inches below the ground surface from three sampling locations. At each sampling location, four sub-samples were collected, generally starting at the top of the fill and proceeding to the bottom of the exposed fill material along the face of the landfill. These sub-samples were placed in aluminum trays, composited, and placed into the appropriate containers.

A sand cast composite sample was collected from along the river bank near MW-4. The composite sample was made up of three casts that were pulverized using a hammer and then homogenized to constitute one sample. The sample was placed in appropriate containers and stored in a cooler with ice for transport to the laboratory for analysis.

It was necessary to re-sample surface soil at locations SS-6, SS-7, SS-8, and the sand cast due to poor surrogate recoveries during the laboratory analyses. These samples were re-collected on July 19, 1988 using the same methods.

All samples were placed on ice and packaged in a cooler for transport to OBG Laboratories, Inc. immediately after their respective collection. All samples were accompanied by chain-of-custody forms which are presented in the CLP laboratory data package. The collected samples were analyzed for the Target Compound List (TCL) parameters (formerly Hazardous Substance List or HSL parameters) using Contract Laboratory Program (CLP) protocols. Additional non-TCL parameters were also analyzed, consisting of monochlorobenzene, orthochlorotoluene, 1,2,3-trichlorobenzene, ortho-chlorophenol, and para-chlorophenol. These additional parameters are considered by NYSDEC to be indicators for Hooker-Durez waste materials. As per the NYSDEC's the CLP Quality Assurance/Quality Control requirements (QA/QC), a matrix spike and matrix spike duplicate were also collected and analyzed.

2.04 Subsurface Soil Sampling

Seven soil borings were advanced through the fill material to characterize its physical and chemical composition per Tasks 2.03 and 3.01 of the Work Plan (Appendix A). These samples were collected between May 17, 1988 and May 19, 1988. The boring locations are shown on Figure 2 and selected based on the following:

Borings A & B - Areas where EM and magnetometer anomalies were observed during the Phase II Investigation.

Borings C & D - The settling pond area observed on the 1965 USGS topographic map.

Borings E & F - The former stream channel observed on the 1965 USGS topographic map.

Boring G - An area identified as having PCB concentrations in the soils of 199 ppm (USGS, 1983).

The exact locations were selected in the field and agreed upon by the on-site NYSDEC representative. The boring logs are included in Appendix B.

The soil borings were completed using 3¼ inch I.D. hollow stem augers. Split spoon samples were collected continuously through the fill material in accordance with ASTM method D-1586-84. Each sample was screened for volatile organics using an HNU Model PI-101 photoionization analyzer. The work was completed per the detailed procedures for the completion of the borings and sample collection, as presented in the Work Plan (Appendix A). All soils generated during completion of the borings were placed in 55-gallon drums for later disposal.

Samples were selected for analyses based upon HNU readings, visual appearances and depth. The following lists those samples submitted for analysis as agreed to by the on-site NYSDEC Representative.

Boring A: 10 to 12 feet
Boring B: 4 to 6 feet
Boring C: 2 to 4 feet
Boring D: 14 to 16 feet

Boring E: 8 to 10 feet

Boring F: 6 to 8 feet

Boring G: 14 to 16 feet

Samples were placed in appropriate containers and stored on ice for transport to the OBG Laboratories, Inc. for analysis. Chain-of-custody documents were initiated in the field and maintained throughout transport of the samples to the laboratory for analysis. The samples were analyzed for TCL parameters using CLP procedures. In addition, the Hooker-Durez indicator parameters listed in Section 2.03 of this report were analyzed. A matrix spike sample was also collected from Boring C for laboratory QA/QC.

All split spoons were decontaminated between each sample using a clean water rinse, followed by an acetone wash and a final clean water rinse. Additionally, the hollow stem augers, drilling rods and other associated tools were steam cleaned between each boring. Steam-cleaning was completed at a single, on-site location. All water generated during steam cleaning was contained in drums for later disposal.

2.05 Surface Water and Sediment Sampling

Surface water and sediment samples were collected as part of this investigation to evaluate whether substances found in the fill material are migrating off the property via the drainage ditches which surround the site. As outlined in Task 3.03 of the Work Plan, two sets of surface water samples were collected. One set of sediment samples was collected per Task 3.02 of the Work Plan (Appendix A). The locations of the samples are shown on Figure 2.

The first set of surface water samples was collected on July 18, 1988 during low surface water flow conditions. The second set was collected on December 12, 1988 during a period considered to represent high water conditions. These dates were agreed upon by the NYSDEC on-site representative. The sediment samples were also collected during the high water period on December 12,1988. Because of cold weather, one area of the ditch was frozen which prevented collection of a surface water and sediment sample. These samples, SW-3 and SED-3, were subsequently collected on March 3, 1989, as agreed to by NYSDEC.

Matrix spike and matrix spike duplicate samples were collected for CLP QA/QC on both occasions for the surface water and once for sediment sampling. Additionally, a matrix spike was collected at SW-3 and SED-3 on March 3, 1988, as agreed to by the NYSDEC.

The surface water samples were collected by submerging the sample jars and allowing them to fill. Care was taken not to disturb the sediment near the surface water sample location. The sampling procedures are detailed in the approved Work Plan (Appendix A). Temperature and pH measurements were recorded at the time of collection. These measurements are presented in Appendix D. Samples were then placed in a cooler with ice for transport to the laboratory for analysis.

Sediment samples were collected at approximately the same locations as the surface water. Due to the noncohesive nature of the sediment, it was not possible to collect the sample using Lexan tubing as described in the Work Plan. Therefore, a decontaminated trowel was used to collect the samples. This collection method was approved by the on-site NYSDEC representative.

As per the Work Plan, four sub-samples were collected at each sample location to a depth of approximately 6 inches. The sub-samples were then composited, placed in appropriate containers, and stored on ice for transport to the laboratory for analysis.

Chain-of-custody documents were initiated in the field and maintained throughout transport of the samples to the laboratory for analysis. Surface water and sediment samples were analyzed for full CLP-TCL parameters, in addition to the Hooker-Durez indicator parameters described in section 2.02.

2.06 Ground Water Investigations

To monitor the ground water quality beneath the site and evaluate the ground water flow characteristics, twenty one ground water monitoring wells were installed on the site to supplement the seven monitoring wells installed during the Phase II investigation. The wells were installed to screen three distinct zones within the subsurface.

Ten "shallow" wells, designated on Figure 2 with an S, were installed in the fill material to assess the shallow ground water flow direction and the ground water quality within the fill. Four "intermediate" wells, designated on Figure 2 with an I, were installed to screen the native materials underlying the fill. These wells were used in conjunction with six of the wells installed during the Phase II investigation to evaluate the ground water in the native unconsolidated material. Five "deep" wells, designated with a D on Figure 2, were installed at the overburden/bedrock interface. These wells were used in conjunction with the shallow and intermediate wells to evaluate the vertical ground water flow potential in addition to assessing vertical changes in the ground water chemistry. Two additional shallow wells were installed on the southern side of the drainage ditch located on the south side of the site. These wells were placed adjacent to the INS property to monitor the ground water quality on the south side of the drainage ditch.

The wells were installed between May 9, 1988 and May 21, 1988 and between July 5, 1988 and July 6, 1988 by Northstar Drilling, Inc. of Cortland, New York. An OBG hydrogeologist and NYSDEC representative was on-site to supervise the well installations. The wells were completed in accordance with Task 2.04 of the Work Plan (Appendix A). The borings associated with the monitoring well installations were completed using hollow stem auger drilling methods and employed 4 1/4 inch I.D. augers. Split spoon samples were collected continuously through the fill material and at 5-ft intervals beneath the fill, according to ASTM method D-1586-84 for fill and soil characterization. Soil samples were screened for volatile organics, using a HNU. The results of the field screening are presented on the boring logs included in Appendix B.

Split spoons were decontaminated between each sampling using a potable water rinse, followed by an acetone wash and a final potable water rinse. The drilling equipment was decontaminated between each location using a steam cleaner. Soils generated during the drilling and water generated during decontamination were placed in 55-gallon drums and stored in a secure area on-site for later disposal.

Monitoring wells were constructed using 10 feet of 2 inch I.D., schedule 40, 0.010-inch slot, PVC well screen with flush joint couplings attached to an appropriate length of 2-inch I.D. PVC riser casing.

Well MW-5S was constructed using only 8 feet of well screen due to its shallow depth (Appendix B). A washed silica sand pack (4Q) was installed around the well screen and extended at least 2 feet above the top of the well screen.

Per the approved Work Plan, 2 feet of bentonite pellets were used to seal the shallow monitoring wells. A cement/bentonite grout was then tremmied from the top of the bentonite seal to the ground surface. A field decision was made to tremmie a bentonite slurry to seal the intermediate and deep ground water monitoring wells instead of using bentonite pellets specified in the approved Work Plan. This change was agreed upon by the on-site NYSDEC representative. The bentonite slurry was used because bentonite pellets often swell and become stuck inside of the hollow stem augers when passed through a column of water. A locking, steel, protective casing was then cemented into place over all wells. Monitoring well construction data are summarized on Table 2 and detailed on the attached boring logs (Appendix B).

The newly installed monitoring wells were developed to remove any fine grained material that may have settled around the well screen during installation and to increase the hydraulic connection of the well with the aquifer. This was accomplished by using a centrifugal pump and hose. The hose used for well development was decontaminated using a methyl alcohol rinse followed by a potable water rinse between each well. The wells were developed until relatively sediment-free water was obtained. Development water was placed into 55-gallon drums and placed in a secure area on-site for later disposal.

In-situ tests were conducted on all newly installed wells to estimate the hydraulic conductivity of the screened material for the purpose of estimating ground water flow rates. These tests were completed on the deep wells and the newly installed intermediate wells on July 1, 1988. Tests on the shallow wells were completed between April 27, 1989 and April 28, 1989.

The tests were performed using a slug method, as detailed in Appendix B of the Work Plan. In general, the tests were completed by inserting a Teflon rod into a well to increase the water level. The water level was then monitored as it returned to the static level. The data was analyzed using Hvorslev's Method. These data are included in Appendix C. An Enviro Labs Model DL-120-MCP pressure transducer data acquisition system was used to monitor and record the water level data. Equipment which was placed down the wells was decontaminated by wiping with hexane and water solution.

Ground water elevations, summarized on Table 2, were measured at all monitoring wells on five occasions. These data were used to assess ground water flow direction, hydraulic gradient, and vertical flow potential in the site area.

2.07 Ground Water Sampling

Ground water sampling was conducted on two occasions. The first set of samples was collected during the last week of June 1988 and coincided with low ground water conditions. The second set of samples was collected during the first week of December 1988 and was considered to represent high ground water conditions (NYSDEC letter, Appendix D).

All ground water samples were analyzed for TCL parameters and the Hooker-Durez indicator parameters described in Section 2.03. The

Work Plan specified that a reduced list of parameters would be selected for the second round of samples. This assumed the first set of samples would be collected during a period of high ground water conditions. Due to drought conditions, the low water condition samples were collected first, however, it was agreed upon by NYSDEC and NMPC representatives that the second set of samples would be analyzed for all of the TCL parameters and the additional five Hooker-Durez indicators using CLP protocols. Both filtered and unfiltered samples were collected for metals analysis. The samples collected in July 1988 were analyzed by OBG Laboratories Inc. Samples collected in December 1988 were analyzed by Versar, Inc.

Ground water samples were collected in accordance with the procedures detailed in section 3.04 and Appendix B of the Work Plan using a decontaminated bottom-loading, stainless steel bailer attached to a new length of polypropylene rope (Appendix A). The bailer was decontaminated between wells with a methyl alcohol rinse followed by a potable water rinse. Ground water sampling field logs which summarize the amount of water removed prior to sample collection are in Appendix D. NYSDEC representatives were on-site periodically and split samples on each sampling occasion. The following seven monitoring well samples were split with NYSDEC during the first sampling event: MW-4S, MW-5S, MW-7S, MW-8S, MW-10S, MW-12 and MW-13. During the second round of sampling, NYSDEC collected six split samples as follows: MW-3S, MW-5I, MW-6I, MW-10I, MW-11I and MW-13.

Prior to sample collection, three well volumes of water were removed. If the well went dry before three volumes of water were removed, the well was allowed to recover and the sample was collected.

Water generated during decontamination or removed from the well prior to collection of the sample was placed in 55-gallon drums and stored in a secure area on-site for later disposal.

The collected samples were placed in appropriate containers and stored in a cooler with ice for transport to the laboratory for analysis. Chain of custody forms were initiated in the field and maintained throughout transport to the laboratory. Two matrix spike and two matrix spike duplicate samples were collected during each sampling round as required by CLP procedures. A trip blank was also included with each cooler of VOC samples.

SECTION 3 - PHYSICAL CHARACTERISTICS OF STUDY AREA

3.01 Meteorology

The site is located in Erie County, New York State which has a humid continental climate (NOAA, 1986). Annual precipitation averages 37.52 inches (NOAA, 1986). Mean temperatures range from 23.5 degrees Fahrenheit in January to 70.7 degrees in July (NOAA, 1986). Winds monitored at the Buffalo Airport, located 15 miles southeast of the site are primarily from the southwest, with an average velocity of 12 miles/hour.

3.02 Land Use and Surface Features

The Cherry Farm site is located between River Road and the Niagara River and about 1/4 mile south of the Grand Island Bridge in the Town of Tonawanda, New York (Figure 1). The site is bounded by property reportedly owned by INS Equipment on the south and Pilot Trucking on the north. A strip of land approximately 30 feet wide borders the east side of the site. This land is owned by New York State and was once the Erie Canal.

The site encompasses approximately 55 acres, 80 percent (approximately 44 acres) of which is covered by fill material. The elevation of the fill materials ranges from about 10 to 20 feet above the original land surface. The estimated volume of fill material at the site is approximately 1 X 10^6 cubic yards (Hazard Ranking Score - Cherry Farm Site, 1986). The surface of the fill was graded and capped with clay. As a result of grading, the surface of the top of the fill material is relatively flat, with an average elevation of about 580 feet above mean sea level (msl). The sides of the landfill slope downward at approximately 70 degrees to an elevation of approximately 560 to 570 feet.

The vegetation on top of the fill is mainly comprised of tall grasses with sporadic occurrences of sumac and other low ground shrubs. Vegetation in the form of bushes and scrub grass is present on some of the fill face slopes. Surrounding the fill area are areas of marsh vegetation as well as tall trees which are indicative of areas not disturbed by the former filling activities at the site.

A NYSDEC designated wetland, BW-6, is located on the east side of the site. This wetland is divided into two separate areas by the entrance road to the site. Drainage ditches extend from this wetland around the south and north sides of the site. These drainage ways discharge to the Niagara River, which borders the west side of the site.

Currently, access to the property is restricted by a locked gate across the only access road to the property. Two softball fields are located in the center of the fill area. These fields are used and maintained on a regular basis by NMPC personnel. Unrestricted access is, however, available by recreational boaters along the Niagara River.

3.03 Geology

3.03.1 Regional Geology

The site is located within the Erie - Ontario Lowlands of the Central Lowland Physiographic Province. The region is underlain by a series of sedimentary rocks that were deposited in ancient seas during the Devonian and Silurian Periods (425-350 million years ago)(Ground Water Resources - Erie-Niagara Basin, 1968).

The major rock types in the area are shale, dolostone and limestone. The regional dip of the bedrock units is to the south at an average of 30 to 40 feet per mile (Ground Water Resources - Erie-Niagara Basin, 1968).

The site is underlain by the Camillus Shale Formation (Ground Water Resources - Erie-Niagara Basin, 1968). This formation is predominantly a gray shale with interbedded limestone and dolomite.

The unconsolidated material in the region are predominantly glacial deposits formed during the Pleistocene Epoch. (Ground Water Resources - Erie-Niagara Basin, 1968). These sediments consist of glacial till and lacustrine and outwash deposits. Thickness of the unconsolidated material varies but is generally less than 50 feet thick in the northern part of the Erie County. Other unconsolidated deposits found in the area are alluvium which is deposited near recent streams and rivers and also marsh deposits (Ground Water Resources - Erie-Niagara Basin, 1968).

3.03.2 Site Geology

The subsurface materials on the Cherry Farm Site are comprised of 10 to 20 feet of fill underlain by alluvium. A thin mantle of glacial till separates the alluvium from the Camillus Formation shale bedrock. The subsurface stratigraphy is illustrated on the cross-sections A-A' and B-B' (Figures 3 and 4). The locations of these cross-sections are presented on Figure 2.

As stated previously, the fill material was deposited from approximately 1945 to 1970. Information obtained from the soil and monitoring well borings completed on the property indicates that the fill is comprised of foundry sand, cinders and pieces of slag.

Figure 5 presents the fill thickness contours. As illustrated here the fill is generally between 15 and 20 feet thick. Data from the southwest corner of the site, however, indicate the presence of the former settling ponds identified on the 1965 USGS topographic map. The thickness of the fill near boring D suggests that the alluvium material was excavated near boring D, likely for constructing the settling ponds. It is believed that the excavated material was placed along the eastern edge of settling ponds as evidenced by the limited thickness of the fill at the MW-9 location.

The logs of the monitoring wells and soil borings completed in the fill area suggest that the fill is inhomogeneous. Distinct layers were not apparent and, therefore, no correlation regarding fill stabilization can be made across the site.

A summary of general and specific observations made in the field during the drilling program are, however, presented below:

- Greater amounts of gray porous slag exists at the southern end of the site as compared to the rest of the site.
- Sand casts are exposed along the landfill face predominantly in the vicinity of well nests MW-4 and MW-10 (western and southwestern faces, respectively).
- A metal tag was discovered during the drilling of MW-8 which contained part numbers and lot numbers from pieces manufactured at Bethlehem Steel.
- Borings A and B, located in the vicinity of previously observed magnetic and EM anomalies observed during the Phase

II Investigation, encountered numerous slag fragments which may account for the geophysical anomalies. Barrels or other metal fragments were not observed.

- Borings C and D were located in the vicinity of the former settling ponds. Boring C encountered a black sludge between 15 and 19 feet below grade. Boring D encountered a reddish pink and black sludge material at a depth of 14 to 25 feet below the ground surface. This likely represents the base of the settling ponds. The base of these layers appears to extend approximately 10 feet into the underlying marsh mat suggesting that some previous excavation occurred. In addition, the elevation of the top of the alluvium encountered in MW-9I was approximately 10 feet higher than that encountered in the surrounding wells and borings (Figure 4). Well MW-9I is located about 75 feet away from the approximate location of the settling ponds. The higher elevation of the fill material may represent the location of the alluvium material which was excavated to construct the former settling ponds.
- The location of borings E and F were selected to intersect the former stream depicted in the 1965 topographic map. The log of Boring F indicates the top of the alluvium deposits are approximately 5 feet below that encountered in nearby borings and wells. This suggests that the stream channel may have been in this area. Figure 6 which illustrates the top of the alluvium, however, suggests that this depression may be connected with that of the former settling ponds.

- Boring G was completed in an area where USEPA reported 199 ppm of PCB in a till sample. The samples collected from this boring did not physically appear to be different from the composition of the fill material encountered in the other borings. A discussion of the analytical results is presented in Section 4.

The fill material is underlain by alluvial deposits comprised of fine to medium grained sand, and silt. The upper foot of this material contains organic material such as twigs, root hairs, and other plant matter which suggests that it was once exposed at the surface. The alluvium varies in thickness and ranges from approximately 25 feet (MW-1) on the eastern side of the property to less than 10 feet on the west side of the site (MW-6) (Figure 4).

MW-11 is located along the eastern edge of the property and outside the limits of the fill. This boring encountered a red silt and clay layer which extended from the surface to about 11 feet. Below 11 feet an odorous black silt and sand layer was encountered. These deposits may represent the sediments of the former Erie Canal which was once located in this area.

Figure 6 illustrates the elevation of the surface of the alluvial deposits. The alluvium surface is generally flat with the exception of a depression and mound in the southwest quarter of the property. In this area it is evident that the alluvium was excavated to construct the settling ponds and resulted in a depression in the alluvium surface. The excavated material appears to have been placed along the eastern edge of the settling pond as evidenced by the higher alluvium surface elevations observed in this area.

The fine grained alluvium coarsens downward to coarse sand with increasing depth. Varying amounts of silt were observed to be present in all of the alluvium deposits. A sand and gravel deposit was also encountered at the base of the alluvium at the MW-1 location.

Glacial till occurs beneath the alluvium and overlies the bedrock. This deposit is approximately 4 feet thick and is comprised of unsorted clay, silt, sand, and gravel.

The bedrock beneath the site is identified as the Camillus Shale of the Salina Group (Geology of Erie County, 1963). This formation is approximately 400-feet thick in the area and is characterized as thin-bedded shale to massive mudstone with large amounts of limestone, dolostone, and gypsum seams.

3.04 Surface Water Hydrology

The fill is bounded on all sides by surface water (Figure 2). From the east, surface water is transported to the site by four drainage ditches which collect runoff from industrial sites located on the east side of River Road. These drainage ditches discharge into the designated wetland located along the eastern edge of the site. The wetland is divided into two separate areas by the entrance road to the site.

Two outlet drainage ditches originate from the wetland and form the site boundary along the southern and northern portions of the site. These drainage ditches discharge to the Niagara River which borders the western side of the site. Observations during the site investigations indicate that these streams are intermittent with flow rates dependent upon runoff. During a heavy rainfall, levels in the drainage ditches were observed to rise over a 2-hour period. The southern drainage ditch has recently been dredged by the New York State Department of Transportation (NYSDEC, 1988) which has resulted in a more constant flow. The dredged materials were presumably placed on the banks of the ditches. The wetland area is wet perennially, based on observations made during the Phase II and Remedial Investigations.

The Tonawanda Channel of the Niagara River is located along the western edge of the landfill. The river discharges an average of 57 billion gallons per day (88,198 cfs) in the vicinity of the site (Niagara River Toxics Committee, 1984). The Niagara River ultimately discharges to Lake Ontario (approximately 31 miles downriver of the site). The Niagara River has a watershed which encompasses approximately 263,700 square miles (Water Resources Data Vol 3. Western New York 1987.)

3.05 Hydrogeology

3.05.1 Regional Hydrogeology

With the exception of areas adjacent to rivers, the majority of the unconsolidated deposits in the region are low permeability lacustrine silts and clay or glacial till. The yields of these materials are generally not sufficient for water supply. Therefore, the major water bearing zone in the area is the Camillus Shale (Ground Water Resources - Erie-Niagara Basin, 1968).

The Camillus Shale contains large amounts of limestone, dolostone, and gypsum seams. Due to the chemical nature of the carbonates and gypsum, it is possible for ground water to dissolve the rock and enlarge fractures to allow transmission of large volumes of water. The dissolution of the rock, however, results in highly mineralized ground water. The water from the Camillus Shale often contains dissolved solids at concentrations between 800 ppm and 5,000 ppm (Ground Water Resources - Erie-Niagara Basin, 1968). Additionally, calcium, magnesium, sodium bi-carbonate, sulfate and chloride are present in significant concentrations (Ground Water Resources - Erie-Niagara Basin, 1968). As a result of these constituents, water from the Camillus Shale can be used for industrial purposes, however, treatment would be necessary to use this aquifer for municipal supplies.

Ground water wells completed in the Camillus Formation in the Buffalo and Tonawanda areas yield between 300 and 1,200 gallons per minute (Ground Water Resources - Erie-Niagara Basin, 1968). Logs of a number of wells completed in the Camillus Shale indicate transmissivity values ranging from 7,000 gallons per day per foot (gpd/ft) to 70,000 gpd/ft. (Ground Water Resources - Erie-Niagara Basin, 1968).

3.05.2 Site Hydrogeology

The ground water investigation of the Cherry Farm Site evaluated three separate zones; shallow, intermediate, and deep. As discussed in section 2.1.5, the shallow zone is comprised of fill: the intermediate zone is the alluvium underlying the fill; and, the deep zone is the alluvium at the overburden/bedrock interface. Ground water elevations were measured on five occasions and are summarized on Table 2.

Ground water flow maps were constructed for each zone using data collected from the sampling events on July 19, 1988 and December 2, 1988. These maps are included as Figures 7 through 12. Review of the available ground water elevation data indicates that the July 19 and December 2, 1989 ground water elevations represent typical ground water flow conditions for the site.

The volume of ground water flowing through each of the ground water flow zones was calculated using Darcy's Law:

$$Q = KIA$$

where: Q = discharge volume in gallons per day (gpd)

K = hydraulic conductivity in gallons per day/foot^2 (gpd/ft^2)

I = hydraulic gradient in feet per foot (ft/ft)

A = cross sectional area of the saturated zone perpendicular to ground water flow in feet squared (ft^2)

Ground water flow velocity in each zone was also calculated using:

$$V = KI/7.5n$$

where: V = ground water flow velocity in feet per day (ft/day)

K = hydraulic conductivity (gpd/ft^2)

I = hydraulic gradient (ft/ft)

n = porosity of the saturated medium.

The highest, lowest, and median values of hydraulic conductivity were used in the ground water discharge volume and velocity calculations for each flow zone. The median value of hydraulic conductivity was used in the calculations because it is representative of the actual conditions given the differences in hydraulic conductivity observed across the site which may influence the calculation of a mean hydraulic conductivity value.

SHALLOW GROUND WATER FLOW: Twelve shallow ground water monitoring wells have been installed at the site. Ten of these wells were installed into the fill material during the Remedial Investigation of the site. The two additional wells were installed adjacent to the INS property located on the southern side of the property.

Figures 7 & 8 illustrate the shallow ground water flow pattern for the July and December dates, respectively. These flow maps indicate that the shallow ground water flows to the west towards the Niagara River under an average hydraulic gradient of approximately 0.006 ft/ft. The hydraulic gradient across the site, varied slightly on both dates due likely to seasonal differences in ground water recharge rates.

Shallow ground water appears to converge in the vicinity of MW-5S. This convergence is likely due to the influence of a former stream channel which passed through the site near this location and represents a preferred ground water flow path. The former settling ponds likely also have a role in influencing this flow pattern.

As discussed previously, MW-12 and MW-13 are shallow wells installed adjacent to the INS property and located on the southern side of the drainage ditch which borders the south side of the site. According to the Phase II report of the INS property, MW-13 is located downgradient of the INS property (Dames and Moore, 1986). Given that the screened intervals of MW-12 and MW-13 are above the base of the drainage ditch (approximately 565 feet elevation) ground water in the shallow material in which these wells are installed is not likely to be in direct hydraulic connection with the shallow fill aquifer on the Cherry Farm Site.

The ground water flow maps do not indicate the presence of a ground water mound which is typical in areas where fill material is saturated. The lack of a mound suggests that the previously installed clay cap is reducing the infiltration of precipitation and/or the permeability of the fill material allows for relatively rapid dissipation of ground water recharge.

The calculated discharge ranged from 130 gallons per day to 79,200 gallons per day with a median value of 10,200 gallons per day (Table G-1). Using the range of hydraulic conductivities listed above, the velocity was calculated to range from 2.1 feet/year (5.7×10^{-3} feet/day) to 1,291 feet/year (3.5 feet/day) with a median value of 163 feet year (0.45 feet/day) (Table G-2).

INTERMEDIATE GROUND WATER FLOW: Eleven intermediate ground water monitoring wells were installed at the site. Seven of the wells were installed as part of the Phase II Investigation, and four wells were installed during the RI.

The wells installed during the Phase II Investigation were installed with the top of the screened interval approximately five feet below the bottom of the fill material. Wells which were installed as part of the RI were constructed with screens about 10 feet below the bottom of the fill material. The purpose of installing the RI wells deeper was to further evaluate the vertical flow conditions. The difference in screened intervals of the two sets of intermediate wells will likely have no affect on the horizontal ground water flow interpretation as the vertical separation is minimal.

Figures 9 and 10 illustrate the ground water flow pattern for the intermediate zone. As indicated on these figures, the intermediate ground water flows to the west toward the Niagara River under an average hydraulic gradient of 0.0016 ft/ft.

An increased hydraulic gradient of 0.007 feet/feet was measured along the eastern portion of the site on December 2, 1988. Review of the ground water elevation data suggests that this increase in hydraulic gradient was the result of increased ground water elevation of 1.6 feet between July 1988 and December 1988 at MW-1I. Other intermediate wells had ground water elevation changes of approximately 0.2 feet to 0.3 feet (Table 2) during this time period. The change in ground water elevation is likely due to the increased precipitation during the fall of 1988. The greater increase observed in MW-1I is a result of the increase in precipitation combined with the lower permeability of the materials at MW-1I, located on the east side of the site, which dissipates the infiltration of rainfall at a slower rate than the wells located closer to the river on the west side of the site. Flow convergence suggesting a preferential flow pathway was not observed in the vicinity of MW-5 as it was in the shallow zone. This indicates that the preferential flow pathway is unique to the shallow zone, likely a result of filling within the former stream channel or settling ponds.

The volume of ground water moving through the intermediate zone was calculated to range from 20 gallons/day to 7,488 gallons/day with a median value 2,189 of gallons/day (Table G-1). The ground water flow velocity was calculated to range from 0.06 feet/year (2.0×10^{-4} feet/day) to 22 feet/year (6.1×10^{-2} feet/day) with a median value of 6.6 feet/year (1.8×10^{-2} feet/day) (Table G-2).

DEEP GROUND WATER FLOW: Five deep ground water monitoring wells were installed at the site as part of the RI. These wells were installed in the unconsolidated deposits at the bedrock interface to evaluate deep ground water chemistry as well as horizontal and vertical ground water flow conditions.

Figures 11 and 12 represent the ground water flow conditions in the deep zone. As indicated by these figures, the deep ground water moves to the west, toward the Niagara River under an average hydraulic gradient of 0.0003 ft/ft. This hydraulic gradient is an order of magnitude less than the intermediate or shallow wells.

The volume of ground water moving through the deep zone was estimated to range from 32 gallons/day to 1,400 gallons/day with a median value of 430 gallons/day (Table G-1). The ground water flow velocity was calculated to range from 0.12 feet/year (3.0×10^{-4} feet/day) to 5.4 feet/year (1.5×10^{-2} feet/day) with an median value of 1.6 feet/year (4.6×10^{-3} feet/day) (Table G-2).

By comparing the ground water elevations of deeper wells with that of shallow and/or intermediate wells at the same location, it is possible to evaluate the vertical hydraulic flow potential between the different horizontal ground water flow zones. At the site, there appears to be a downward flow potential between the shallow and intermediate wells. This indicates that the shallow ground water has the hydraulic potential to move downward into the alluvium. A slight upward hydraulic potential exists between the intermediate and deeper wells which indicates the deeper ground water has the potential to flow upward into the intermediate zone and discharge to the Niagara River.

The ground water elevation data indicate that the shallow monitoring wells have ground water elevations ranging from 569 feet to 567 feet which are 2 to 3 feet greater than intermediate and/or deep wells. However, at well nests MW-6, MW-9, and MW-5, the shallow wells have ground water elevations similar to the intermediate wells. The ground water elevation at MW-9S is likely influenced by the fact that the well is screened in alluvium which was likely excavated from the settling pond area. The similarity of the ground water elevations may be due to the similarity of the screened material. The downward flow potential observed at well nests MW-5 and MW-6 may be due to the fact that this area represents the preferred shallow ground water flow pathway

(Figures 7 and 8). The presence of the former settling ponds could have an effect on the ground water elevations observed in this area.

The hydraulic potential between the deep and intermediate wells is downward on the east side of the site but reverses with decreasing distance from the shore of the Niagara River. At well nest MW-1, which is located about 1000 feet from the Niagara River, a downward flow potential of approximately 3 feet exists between wells MW-1 and MW-1D. At the well nest MW-7 location, approximately 200 feet from shore, a downward flow potential of 0.3 feet exists between the shallow and deep well. At well nests MW-5 and MW-6 which are located 100 feet and 110 feet from the Niagara River respectively, no vertical flow potentials exist. However at well nest MW-4, which is located only 30 feet from shore, an upward flow potential of 0.3 feet exists. This indicates that discharge of the site ground water is to the Niagara River.

SECTION 4 - ANALYTICAL RESULTS

As stated in section 2.1.2, the ground water, surface soil, soil boring, surface water, and sediment samples were analyzed for Target Compound List (TCL) parameters in accordance with CLP procedures. In addition, the following Hooker-Durez waste indicator parameters were also analyzed for: monochlorobenzene, ortho-chlorotoluene, 1,2,3 trichlorobenzene, ortho-chlorophenol, and para-chlorophenol. The results of the analyses are summarized in separate tables based on sample media: Tables 3 and 4 for surface soil analyses, Tables 5 and 6 for subsurface soil analyses, Tables 7 and 8 for surface water analyses, Tables 9 and 10 for sediment analyses and Tables 11 through 14 for ground water analyses. Only those parameters which were detected in at least one sample of a given matrix are included on the tables. A summary of the laboratory data, including its validation, is included in Appendix E and the laboratory QA/QC packages (under separate cover).

In addition to the data summarized on the Tables, Figure 13 illustrates the location of the samples of each matrix sampled which contain the highest concentrations of substances detected by the analyses. For the purpose of illustration as well as the following discussions, the substances identified at the site have been separated into five groups. These groups are as follows: volatile organics, (chlorinated, aromatic or both), phenols, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), phthalates, and inorganics (includes metals and cyanide).

The CLP's QA/QC procedures are such that the reportable detection limits for a number of compounds determined to be accurate are higher than the detection limit of the analytical instruments. For this reason, although discernible peaks are observed on the chromatographs, the quantification cannot be considered precise. The values obtained from these peaks are, therefore, qualified using a _J_ after the value on the report form. This _J_ means that the substance is present at levels below the reportable detection limit and, therefore, the reported value represents an estimated concentration. These estimated values are included in the following discussions and are indicated as estimated values.

4.01 Data Validation

To assess the validity and useability of the analytical results, a data validation was completed on all analytical data. As the analyses were completed in accordance with CLP procedures, a CLP checklist developed by USEPA Region II was used to validate analytical data. Analytical data quality was assessed in a two-step process. First, data were checked against USEPA guidelines and the quality control criteria stated in the CLP checklist, the USEPA Statement of Work for Laboratory Analyses, and the respective methodologies. Upon completion of the check list, the quality of the data was evaluated in light of its applicability toward the study objectives.

A detailed discussion of the data validation findings is presented in Appendix F together with the laboratory summary forms for all of the samples. All analytical data reported by the laboratories were deemed acceptable for use in assessing site chemistry.

4.02 Surface Soil Analyses

Organic Analyses

Seven surface soil samples were collected at the locations designated as SS in Figure 1. The analytical results are summarized on Tables 3 and 4 and reported in micrograms per kilogram (ug/kg) based on the dry weight of the sample. The volatile organic scan revealed the presence of methylene chloride, acetone and trichloroethane. Methylene chloride was detected in samples obtained from Field #1 (1st, 2nd, and 3rd bases), Field #2 (home plate), and SS-1, SS-2, SS-3, SS-4, SS-5, SS-6 and SS-7. Concentrations ranged from 3 ug/kg (estimated value) in Field #2 to 33 ug/kg in SS-2. Acetone was detected at concentrations ranging from 28 ug/kg (estimated) in SS-4 to 173 ug/kg in SS-6. Trichloroethene was detected only at SS-4 at a concentration of 8 ug/kg (estimated).

The pesticide/PCB scan detected PCBs, predominantly Aroclors 1248 and 1254, in the composite sand cast sample and surface soils SS-2, SS-3, SS-4, SS-5, SS-6 and SS-7. Aroclor-1254 was detected in SS-1 and SS-8. SS-3 had the highest total PCB concentration of 44,000 ug/kg (44 milligrams per kilograms (mg/kg)), SS-7 was the lowest at 160 ug/kg (0.16 mg/kg).

The base neutral/acid extractable scan revealed the presence of 20 compounds in at least one soil sample. Phenols were detected at Field #1 (1st, 2nd, and 3rd bases), SS-2, and SS-3. Totals of all phenolic compounds in a given sample were used to compare the phenol content in the samples and indicate total phenol concentrations ranging from 43 ug/kg (estimated) in Field #1 to 604 ug/kg total phenols in SS-3.

Phthalates detected include di-n-butylphthalate, bis (2-ethylhexyl) phthalate and di-n-octylphthalate. Di-n-butylphthalate was detected at Field #1 (1st, 2nd, 3rd bases) at 37 ug/kg (estimated). Bis(2-ethylhexyl)phthalate was detected in all samples except SS-7, at concentrations ranging from 42 ug/kg (estimated) in the sand cast to 1,900 ug/kg in SS-2. Di-n-octylphthalate was detected in the composite sand cast sample at a concentration of 23 ug/kg (estimated).

Twelve PAHs were detected in the surface soil samples. These compounds included naphthalene, 2-Methylnaphthalene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a) anthracene, chrysene, benzo(b)fluoranthene, benzo(k) fluoranthene, benzo(a)pyrene and benzo(g,h,i)perylene. PAH concentrations were generally highest in SS-8 followed by SS-2 and SS-3. The lowest PAH concentrations were observed in the sand cast sample, with a concentration of 42 ug/kg.

Other organic compounds detected include dibenzofuran (non-chlorinated) at concentrations ranging from 54 ug/l (estimated) to 280 ug/kg (estimated); isophorone in SS-8 at a concentration of 420 ug/kg; and hexachlorobenzene in SS-1 and SS-3 at concentrations of 57 ug/l (estimated) and 49 ug/l (estimated) respectively.

Inorganic Analyses

Inorganic surface soil sample results are summarized on Table 4. Seven samples revealed the presence of most inorganic parameters with the exception of antimony, cobalt, selenium, and thallium. Sample SS-2, located on the northeast corner of the fill, generally contained the highest metal concentrations. SS-3, SS-5 and SS-8 also contained higher concentrations of metals than identified at other locations. The sand cast contained the lowest concentrations for all inorganic parameters analyzed. Metal concentrations in samples from Field #1 and Field #2 were generally lower than the eight surface soil samples, with the exception of aluminum and vanadium.

Surface Soil Sample Summary

Of the volatile organic compounds detected in the samples, acetone was observed in a number of samples with the highest concentrations observed in samples SS-5, SS-6, and SS-7. These samples are all located on the southern end of the site (Figure 13). Methylene chloride was also detected in a number of samples, although no pattern of occurrence was observed.

In general, PCBs, phenolic compounds, phthalates, and PAHs were detected in all of the surface soils collected at the site. Overall, samples SS-2 and SS-3 contained the highest concentrations of these compounds (Figure 13). Both of these samples are located on the north face of the fill.

Samples obtained from the two softball fields showed the presence of some phenolic compounds in the sample from Field #1 (1st, 2nd, 3rd bases). PAHs were detected from the samples from Field #1 (1st, 2nd, 3rd bases) and Field #2 (1st, 2nd, 3rd bases). In addition, (1st, 2nd, 3rd bases) and Field #2 (home plate). Acetone was detected in three of the four softball field samples.

Bis(2-ethylhexyl) phthalate was detected in all four samples. Concentrations of these parameters were generally highest in the samples from Field #1 (1st, 2nd, 3rd bases) and Field #2 (1st, 2nd, 3rd bases), although no specific pattern of occurrence was evident.

Sample SS-2, on the north fill face, also contained the highest concentrations of metals (Figure 13) followed by samples SS-5 located on the southwest side of the site near the settling ponds and SS-8 located on the eastern side of the site. Metal concentrations were generally lowest in the softball field samples. Overall, no specific pattern of surface soil contaminant occurrence was apparent.

The five Hooker-Durez indicator compounds were not detected in any of the samples.

4.03 Subsurface Soils

Seven soil borings were completed in the fill. A sample from each of these borings was selected for analysis based on visual inspection and volatile screening results. A summary of these analyses is included in Tables 5 and 6.

Organic Analyses

As summarized on Table 5, the purgeable priority pollutant scan reveals the presence of acetone in all samples. It ranges in concentration from 93 ug/kg in Boring B to 11,000 ug/kg in Boring F. Acetone was also detected in the sample blank for all analyses, suggesting it was probably introduced during sample collection. Acetone was used for decontamination of the split spoon samplers. 2-Butanone was detected in Boring A, Boring B, Boring C, and Boring G at concentrations ranging from 45 ug/kg in Boring B to 79 ug/kg in Boring C. 2-Butanone was also detected in the sample blank, suggesting that it was introduced in the field or laboratory and is not likely present in the samples.

Carbon disulfide was found in Boring D at 26 ug/kg. Chloroform was observed in Boring C at a concentration of 15 ug/kg. Benzene was detected in samples from Boring B and Boring D at 4 ug/kg (estimated) and 200 ug/kg, respectively. Toluene was also found in the Boring B and Boring D samples at concentrations of 18 ug/kg (estimated) and 82 ug/kg, respectively. In addition, ethylbenzene and xylene were found in Boring D at concentrations of 40 ug/kg and 190 ug/kg, respectively.

The pesticide/PCB scan detected primarily Aroclor-1248 in all boring samples except that from Boring B. Concentrations range from 280 ug/kg (0.28 mg/kg) in Boring E to 89,000 ug/kg (89 mg/kg) in Boring F. Boring A revealed the second highest concentration of PCBs at 70,000 ug/kg (70 mg/kg).

The base neutral/acid extractable scan detected several compounds in the soil boring samples. These compounds include phenols, phthalates and PAHs. Phenols were detected in samples from borings A, B, E, F and G. Highest concentrations of total phenolic compounds were observed in Boring B (8,730 ug/kg) and Boring G (2,070 ug/kg). The sample from Boring A contained the lowest levels of total phenols detected (990 ug/kg).

PAHs were detected in samples from all seven borings. Specific compounds identified can be seen in Table 5. Highest concentrations were observed in the sample from Boring C. Boring B and Boring G also showed high PAH concentrations. Lowest concentrations were observed in Boring E.

Of the phthalates, di-n-butylphthalate was detected in Boring E at a concentration of 46 ug/kg (estimated). Bis-2(ethylhexyl) phthalate was detected in all borings except Boring C, at concentrations ranging from 400 ug/kg (estimated) in Boring E to 1,600 ug/kg in Boring G.

Other compounds detected include dibenzofuran (non-chlorinated), at concentrations ranging from 70 ug/kg (estimated) in Boring F to 2,900 ug/kg (estimated) Boring C, and 3,3-dichlorobenzidine in Boring G, at a concentration of 1,500 ug/kg.

Inorganic Analyses

The inorganic analyses reveal the presence of almost all analyzed parameters in each of the seven samples except antimony, cobalt, potassium, selenium, sodium and thallium (Table 6). The highest metal concentrations were found in the sample obtained from Boring C (2 to 4 ft). Samples collected from borings A, D, F and G show metal concentrations rather similar to each other. Metal concentrations are lowest in samples from Boring B and Boring E.

Subsurface Soil Sample Summary

Acetone was observed in all subsurface soil samples. Acetone was, however, also detected in the sample blank for all analyses. It was probably introduced during sample collection, as it was used for decontamination of the split spoon samplers. 2-butanone was also found in a number of samples and the blank which suggests that it was either introduced in the field or the laboratory and not likely present in the samples.

In general, Boring C showed high concentrations of inorganics, volatiles and semivolatiles, although no phenols were detected (Figure 13). Boring C is located in the vicinity of boring B-5, which previously showed the highest metal concentrations (Phase II Site Investigation, 1986). Both of these borings are located in or near what was once a settling pond at the site, although the sample from Boring C was collected from 2 to 4 feet below the surface and would not be expected to represent the contents of the pond. The substances observed in these borings probably represent a localized deposit. Similar concentrations were observed in both borings.

The highest concentrations of volatile organics, primarily aromatic hydrocarbons, were observed in Boring D (Figure 13). Ethylbenzene and xylene were found in Boring D at concentrations of 40 ug/kg and 190 ug/kg, respectively. The sample from Boring D was a sludge material collected from a depth of 14 to 16 feet below the surface and is considered to represent the bottom deposits of one of the former settling ponds.

Borings B and E showed the lowest concentrations of most parameters tested excluding the phenols where Boring B showed the highest concentrations (Figure 13). Boring E is located in the southeast corner of the site near the point where the old stream crossed the site. Boring B is located in the northwest corner where similarly high concentrations of semi-volatile compounds were observed in the surface soil samples.

The pesticide/PCB scan primarily detected Aroclor 1248 in all boring samples except that obtained from Boring B. Concentrations range from 280 ug/kg (0.28 mg/kg) in Boring E to 89,000 ug/kg (89 mg/kg) in Boring F. Boring F is located in the area of a former settling pond (Figure 13). Boring A, located in the northeast corner of the site, revealed the second highest concentration of PCBs, 70,000 ug/kg (70 mg/kg). Boring G was located in the vicinity of the sample collected by USGS (1983) which contained 199 mg/kg PCBs. The PCB concentration observed in the sample collected from this boring reveals 39,000 ug/kg (39 mg/kg). This suggests that the PCB levels within the fill are not evenly distributed, and no specific pattern of contamination is apparent.

The five Hooker-Durez indicator compounds were not detected in any samples.

4.04 Surface Water

Seven surface water samples were collected on two occasions. Samples SW-1, SW-2, SW-6, and SW-7 were located in the drainage ditch upstream of the site. Sample SW-5 was located in the middle of the southern drainage ditch adjacent to the INS property. Samples SW-3 and SW-4 were located in the ditches downstream of the site.

Organic Analyses

The volatile organic scan revealed the presence of several compounds in the surface water samples as summarized on Table 7.

Methylene chloride was detected in SW-1 in December 1988 at a concentration of 8.5 ug/l. This is below the NYS Class A Surface Water Guidance Value of 50 ug/l. Acetone was detected in upstream samples SW-1, SW-2, and SW-7, and downstream sample SW-4. Concentrations ranged from 4 ug/l (estimated) in SW-1 to 7 ug/l (estimated) in SW-4. These values are below the reportable detection limit of 10 ug/l. 1,2-dichloroethene was detected in SW-2 in December 1988 at a concentration of 15 ug/l. Chloroform was detected in upstream samples SW-1 and SW-6 at concentrations ranging from 2 ug/l (estimated) to 9.8 ug/l which is above the NYS Class A Surface Water Standard of 0.2 ug/l. Finally, bromodichloromethane was detected in SW-1 at concentrations of 1 ug/l (estimated) and 3.3 ug/l (estimated), which are below the reportable detection limit of 5 ug/l as well as below the guidance value of 50 ug/l.

The pesticide/PCB scan revealed the presence of predominantly, Aroclor 1242 in upstream sample SW-6 in December 1988 at a concentration of 18 ug/l. No other pesticides or PCBs were detected in the surface water samples.

The semi-volatile analyses of surface water samples reveal the presence of benzyl alcohol, phenols and phthalates. Benzyl alcohol was detected in SW-2 at a concentration of 7 ug/l (estimated). Diethylphthalate was detected in SW-3 at a concentration of 1 ug/l (estimated). Bis(2-ethylhexyl)phthalate was detected in SW-2 and SW-3 at concentrations of 27 ug/l and 24 ug/l, respectively. Phenols were detected in SW-7 at concentrations of 6 ug/l (estimated) in June 1988 and 12,333 ug/l in December 1988.

Inorganic Analyses

The inorganic parameter analyses for surface water samples reveal the presence of most analytes with the exception of antimony, beryllium, cadmium, mercury, selenium, silver, thallium and cyanide. Aluminum was detected at all locations at concentrations ranging from 63 ug/l in SW-6 to 33,800 ug/l in SW-3. SW-6 is an upgradient location at the south end of the site, while SW-3 is a downgradient location on the north side of the site. Arsenic was detected in SW-2, SW-3 and SW-7, although all values are below the NYS Water Quality Standard of 50 ug/l. Barium was detected at concentrations ranging from 36 ug/l (SW-2) to 288 ug/l (SW-6), although none of the values exceed the water quality standard of 1,000 ug/l. Chromium was detected at all locations on at least one occasion ranging from 5.9 ug/l to 45 ug/l, both observed in SW-3. Copper was detected at all locations at concentrations ranging from 5.3 ug/l to 79 ug/l, both in SW-2 which are below the 200 ug/l surface water quality standard. Iron concentrations ranged from 236 in SW-4 to 40,700 ug/l in SW-3, and exceeded the standard of 300 ug/l in all locations on at least one occasion.

Lead concentrations range from 8.3 ug/l in SW-6 to 124 ug/l in SW-3. Only samples obtained from SW-2 and SW-3 exceed the water quality standard of 50 ug/l for lead. Manganese was detected in all samples on both sampling dates, at concentrations ranging from 152 ug/l to 2,200 ug/l. Samples obtained from SW-2, SW-3, SW-6 and SW-7 were above the 300 ug/l standard. Nickel was detected in samples from SW-2 and SW-3, at concentrations ranging from 16 ug/l to 97 ug/l. Silver was only detected in SW-3 in July 1988 at a concentration of 10 ug/l, which is below the surface water standard of 50 ug/l. Vanadium was detected in all surface waters on at least one occasion at concentrations ranging from 5.7 ug/l to 67 ug/l. Zinc was detected in all surface waters on at least one occasion at concentrations ranging from 13 ug/l to 184 ug/l. All zinc values were below the standard of 300 ug/l.

Surface Water Sample Summary

Upstream sample SW-7 contained elevated levels of inorganics as well as the highest concentrations of semi-volatile compounds, predominantly phenolics (Figure 13). This sampling location is upstream of the site which suggests an upstream source is present. The large increase in total phenolics concentration between the June 1988 and December 1988 sampling events suggests that the source is intermittent. SW-1, collected from the north central upstream location, contained the lowest inorganic and highest volatile concentrations which also suggests an upstream source of volatile organics is present (Figure 13).

Sample SW-2 contained the highest concentrations of inorganics. SW-2 is located upstream of the site on the northern side of the property (Figure 13). SW-7, located upstream of the site on the southern side of the site, contained the second highest concentrations of inorganics.

The five Hooker-Durez indicator compounds were not detected in any of the samples.

In general, the data indicate that the chemistry of the surface water is not affected by the site as upstream concentrations of most parameters are greater than the concentrations observed downstream. Upgradient sources of several compounds, particularly volatiles and semi-volatiles, appear to be present.

4.05 Sediment

Seven sediment samples were collected in approximately the same locations as the surface water samples. Sediment sample locations can be seen in Figure 2. Similarly, samples SED-1, SED-2, SED-6, and SED-7 are located upstream of the site. Sample SED-5 is located in the middle of the southern drainage ditch adjacent to the INS property. Samples SED-3 and SED-4 are located downstream of the site.

Organic Analyses

Table 9 summarizes the organic analysis results for the sediment samples collected. The volatile scan for the sediment samples detected methylene chloride in SED-1 at a concentration of 6 ug/kg (estimated) and acetone in SED-4 at a concentration of 9 ug/kg (estimated). These values are below the reportable detection limit for the analyses.

The semi-volatile scan revealed the presence of di-n-butylphthalate and bis(2-ethylhexyl)phthalate in SED-3 at concentrations of 170 ug/kg (estimated) and 150 ug/kg (estimated) respectively. These concentrations are also below the reportable detection limit of the analysis. No other semivolatiles were detected.

The pesticide/PCB scan revealed Aroclor 1254 and Aroclor 1260 in SED-5 at concentrations of 1000 ug/kg and 150 ug/kg (estimated). No pesticides and no other PCBs were detected in any of the samples.

Inorganic Analyses

The inorganic parameter analyses for the seven sediment samples revealed the presence of all parameters with the exception of mercury, selenium, silver, thallium, and cyanide. SED-7, an upstream sample, generally contains the highest concentrations of the parameters analyzed. SED-1, also an upstream sample, shows the next highest concentration. Lowest concentrations were generally found in SED-2 obtained from an upstream location at the north side of the site. All other samples showed overall similar concentrations.

Sediment Sample Summary

As with the surface water samples, the upstream sediment samples SED-1 and SED-7 contained higher concentrations of organic and inorganic compounds (Figure 13). This suggests upstream sources are present.

The PCBs detected in SED-5, located in the drainage ditch in the center of the southern side of the site, are likely a result of erosion of exposed fill on the site or the adjacent property as PCBs were observed in surface soils collected on this side of the site as well as the ground water at MW-13 (Figure 13). The phthalate compounds found in the downstream sample SED-3 are also likely the result of erosion of the fill face.

The five Hooker-Durez indicator compounds were not detected in any of the samples.

4.06 Ground Water

Ground water samples were collected on two occasions: July 1988 and December 1988. The results are summarized on Tables 11, 12, 13, and 14. New York State Class GA ground water standards are included on these tables for comparison, where applicable.

Organic Analyses

Analyses of ground water samples for volatile compounds revealed the presence of several compounds (Table 11). Vinyl chloride exceeded the water quality standard of 5 ug/l in MW-5S and MW-9S. Concentrations of 1,2-dichloroethene exceeded the New York State water quality guidance value of 0.07 ug/l in shallow wells MW-5S, MW-7S, MW-8S, and MW-9S and intermediate wells MW-5I and MW-8I. 1,2-dichloroethene was previously detected in intermediate well MW-5I at a concentration of 4 ug/l (Phase II Site Investigation, 1986). Trichloroethene was detected in shallow wells MW-5S and MW-8S although only the samples from MW-5S were above the NYS Water Quality Standard of 10 ug/l. Tetrachloroethene was detected in shallow wells MW-5S, MW-8S and MW-10S at concentrations of 1 ug/l (estimated) which is below the reportable detection limit of the analysis of 5 ug/l.

Aromatic compounds including benzene, toluene, ethylbenzene and xylene were also detected in some of the wells. Benzene was detected in ten shallow and two intermediate wells. Concentrations in the shallow wells ranged from 1 ug/l (estimated) to 3 ug/l (estimated), all of which are below the reportable detection limit of 5 ug/l. In the intermediate wells, MW-3I contained 1 ug/l (estimated) and MW-6I was found to contain 260 ug/l and 350 ug/l.

The NYS Class GA Ground Water Quality Standard for benzene is not detectable; however, the USEPA Maximum Contaminant Level (MCL) is 5 ug/l.

Toluene was detected in nine shallow and three deep wells. Shallow wells MW-6S, MW-8S and MW-13 were the only wells with levels above the reportable detection limit of the analysis (5 ug/l) and all values were below the NYS Ground Water Guidance Value of 50 ug/l except those samples collected from MW-6I, where concentrations were 110 ug/l and 140 ug/l.

Ethylbenzene was detected in samples from five shallow and two intermediate wells, although only samples from shallow well MW-8S and intermediate well MW-6I contained levels above the reportable detection limit of the analysis. Of these two wells, only the samples collected from MW-6I (63 ug/l and 76 ug/l) exceeded the NYS Ground Water Guidance Value of 50 ug/l.

Xylene was detected in seven shallow and two intermediate wells. Concentrations observed in the shallow wells ranged from 1 ug/l (estimated) in MW-5S to 130 ug/l in MW-8S. The highest concentrations in the intermediate well were observed in MW-6I (120 ug/l and 170 ug/l). The level of xylene observed in MW-8I was 4 ug/l (estimated) which was below the reportable detection limit of the analysis. All samples were below the NYS Ground Water Guidance Value for xylene of 50 ug/l except samples collected from MW-8S (100 ug/l and 130 ug/l) and MW-6I (120 ug/l and 170 ug/l). These aromatic compounds were previously detected in MW-6I (Phase II Site Investigation, April 1986) at similar concentrations.

Other compounds that were detected in the volatile scan either do not have established guidance values or did not exceed standards and include chloromethane, methylene chloride, acetone, carbon disulfide, 1,1-dichloroethane, 2-butanone, 4-methyl-2-pentanone and styrene.

The semi-volatile scan detected phenols, phthalates and PAHs in several of the monitoring wells. These compounds were also identified during the Phase II investigation (Table 12).

Phenol concentrations exceeded the NYS Water Quality Standard of 1 ug/l in shallow wells MW-2S, MW-3S, MW-4S, MW-5S, MW-6S, MW-7S, MW-8S, MW-9S, MW-10S, MW-11S, MW-12 and MW-13 and intermediate wells MW-6I and MW-8I. The highest concentration was observed in shallow well MW-13 in the June 1988 sampling event where total phenols were 3,010 ug/l. MW-8S also showed high concentrations of total phenols, 1,740 ug/l in June 1988 and 2,480 ug/l in December 1988. MW-4S contained concentrations of 889 ug/l and 2,789 ug/l on the June 1988 and December 1988 sampling dates, respectively. Of the intermediate wells, total phenols were 17 ug/l in well MW-6I and 5 ug/l (estimated) in MW-8I. Phenol previously exceeded the water quality standard in intermediate wells MW-3I through MW-7I, at concentrations ranging from 2 ug/l to 88 ug/l. (Phase II Site Investigation, April 1986).

The phthalates detected include diethylphthalate, di-n-butyl-phthalate, and bis(2-ethylhexyl)phthalate (Table 12). Diethylphthalate was observed in MW-1I and MW-1D at 1 ug/l (estimated). These are upgradient wells. Di-n-butyl-phthalate was detected in five wells at low concentrations (1 ug/l to 3 ug/l).

Bis(2-ethylhexyl)phthalate was detected in 25 wells at concentrations ranging from 4 ug/l to 120 ug/l. This compound was also observed in a majority of the blanks, suggesting that it was introduced in the field or laboratory, and is not likely present in the samples.

Eleven PAH compounds were detected in at least one of the ground water samples with the exception of the upgradient wells MW-1I and MW-1D (Table 12). Phenanthrene was detected in eight shallow wells at concentrations ranging from 1 ug/l (estimated) in MW-2S to 58 ug/l in MW-6S. Only one sample, that collected from MW-6S in December 1988, exceeded the NYS Ground Water Quality Guidance Value of 50 ug/l. Phenanthrene was not observed in the intermediate or deep wells. Naphthalene concentrations ranged from 1 ug/l (estimated) to 41 ug/l. Naphthalene exceeded the NYS Guidance Value of 10 ug/l in shallow wells MW-6S, MW-8S, MW-9S and MW-13 in addition to intermediate well MW-6I. Concentrations of 2-methylnapthalene ranged from 1 ug/l (estimated) to 24 ug/l (estimated). All are below the reportable detection limit of the analytical method. Concentrations were highest in MW-13 and MW-9S.

The following PAH compounds were only detected in shallow wells: phenanthrene, fluoranthene, anthracene, pyrene, chrysene, fluorene, acenaphthene, benzo(b)fluoranthene, benzo(k) fluoranthene, benzo(a)pyrene, and benzo(a)anthracene. Anthracene was detected in shallow wells MW-2S and MW-6S at concentrations of 2 ug/l (estimated) and 25 ug/l, respectively. Fluoranthene was detected in four shallow wells at concentrations ranging from 4 ug/l (estimated) to 21 ug/l. Pyrene was detected at 2 ug/l (estimated) in MW-3S and MW-5S. Chrysene was detected in MW-5I and MW-6S at concentrations of 16 ug/l and 72 ug/l respectively. Acenaphthene was detected in MW-6S and MW-9S at concentrations of 19 ug/l and 17 ug/l, respectively. Benzo(b) fluoranthene was detected in MW-5S and MW-6S in December 1988 at concentrations of 20 ug/l and 84 ug/l, respectively. Benzo(k)-fluoranthene was also detected in these two samples at concentrations ranging from 22 ug/l to 90 ug/l. These values exceed the guidance value of 0.002 ug/l for these compounds. Benzo(a)anthracene and benzo(a)pyrene were also detected in only these two wells.

Dibenzofuran (non-chlorinated) was detected in four shallow monitoring wells, MW-5S, MW-6S, MW-9S and MW-11S, at concentrations ranging from 1 ug/l (estimated) to 4 ug/l (estimated). 4-chloroaniline was detected in MW-6I at a concentration of 120 ug/l.

The pesticide/PCB scan for ground water samples revealed the presence of PCBs, predominantly Aroclor 1248, in MW-2S, MW-2I, MW-3S, MW-3I, MW-4S, MW-4D, MW-5S, MW-6S, MW-6D, MW-7I, MW-8S, MW-8I, MW-9S, MW-9I, MW-10S, MW-11S, MW-11I and MW-13 in the June 1988 sampling event (Table 13). Detectable concentrations ranged from 0.5 ug/l in MW-7I to 180 ug/l in MW-13. During the November 1988 sampling event, Aroclor 1242 was detected in MW-2S, MW-3S, MW-3I, MW-5S, MW-8S, MW-9S, MW-11S, MW-11I and MW-13. Aroclor 1260 was also detected in MW-13 in December 1988 at a concentration of 0.20 ug/l. It should be noted that it is difficult to differentiate between Aroclors 1248 and 1242 in environmental samples. Therefore, it is possible that the same Aroclors were detected in both sampling events. Of the samples in which PCBs were only detected during the first sampling event, the low concentrations observed (0.1 to 24 ug/l) and the absence of PCBs in the second sample suggests that PCBs were not present in the ground water from these wells but may have been adsorbed to the soils suspended in the sample which were present as a result of the monitoring well installation procedures.

Inorganic Analyses

For all inorganic parameters except pH and cyanide, both unfiltered and filtered samples were analyzed. Unfiltered samples may contain fine-grained materials associated with the aquifer. Transport of this material will not occur in the natural porous media ground water flow regime, but the movement of solid particles is induced by pumping or bailing of the well. Analyses of ground water samples containing this sediment may yield high and variable metal concentrations associated with metals adsorbed to solid surfaces contained in the sample. Thus, filtered samples are more likely to provide consistent and representative results of metals in solution, regardless of well installation or sampling procedures. The results of the inorganics are presented on Table 14.

PH measurements were collected in the field at the time of sample collection and are summarized in a table included in Appendix D. The pH of ground water from the shallow wells was generally between 9 and 12 standard units. The intermediate and deep wells are between 7 and 8 with the exception of well MW-3I, which was between 10 and 11.

Aluminum was detected in each of the unfiltered samples at concentrations ranging from 1,200 ug/l in MW-11I to 183,000 ug/l in MW-4S. Sixty percent of the filtered samples revealed detectable concentrations of aluminum. Concentrations in filtered samples from shallow wells range from 121 ug/l (estimated) in MW-3S to 1,260 ug/l in MW-11S. Concentrations in the intermediate wells range from non-detectable in five of the wells to 761 ug/l in MW-6I. The deep wells had concentrations ranging from undetected to 454 ug/l in MW-5D.

Antimony was detected in unfiltered samples collected from monitoring wells MW-1I, MW-4S, MW-5S, MW-7I and MW-13, at concentrations ranging from 29 ug/l to 121 ug/l. All filtered samples show antimony concentrations below the detection limit.

Arsenic was detected in unfiltered samples collected from all wells with the exception of MW-1D, MW-5I, MW-7S and MW-8I. Concentrations ranged from 8.4 ug/l to 167 ug/l, with the highest concentration observed in MW-2I. Of the filtered samples, arsenic was detected in samples obtained from shallow wells MW-8S, MW-9S, and MW-13 and intermediate wells MW-2I and MW-6I. Arsenic was not detected in any of the deep wells. Only those samples from MW-9S and MW-2I and MW-6I exceeded the NYS Water Quality Standard of 25 ug/l for arsenic. Arsenic was previously detected in several of the intermediate monitoring wells (MW-1I, MW-2I, MW-3I, MW-6I and MW-7I) at concentrations ranging from 10 to 40 ug/l (Phase II Site Investigation, April 1986). Of the three wells which were above the water quality standard at that time, namely MW-2I, MW-3I, and MW-6I, only MW-2I and MW-6I currently are above the standard at the time of the sampling performed for the RI.

Barium was detected in the unfiltered samples from all wells on at least one of the two sampling occasions. Concentrations range from 66 ug/l to 1,940 ug/l. Analyses of the filtered samples revealed barium concentrations in shallow wells ranging from 10 ug/l (estimated) in MW-8S to 218 ug/l in MW-5S. In the intermediate wells, concentrations ranged from 60 ug/l in MW-3I to 277 ug/l in MW-4I. Concentrations in the deep wells ranged from 123 ug/l (estimated) in MW-6D to 360 ug/l at MW-1D. All of the concentrations observed in the ground water at the site were below the NYS Water Quality Standard of 1,000 ug/l.

Beryllium was detected in the unfiltered samples from 18 wells on at least one occasion. Detected concentrations range from 1 ug/l to 14 ug/l. The highest concentration was observed in MW-13 located downgradient of the INS property. Of the filtered samples, all concentrations were below the detection limit.

Cadmium was detected in unfiltered samples from nineteen of the wells at concentrations ranging from 5 ug/l to 225 ug/l. The highest concentration was observed in MW-4S in June 1988. Of the filtered samples, only MW-8I in December 1988 showed a detectable concentration (4.7 ug/l) which is below the NYS Water Quality Standard of 10 ug/l.

Total chromium was detected in unfiltered samples from all wells on both sampling occasions with concentrations ranging from 19 to 1,190 ug/l. In the filtered samples concentrations in the shallow wells ranged from 4.6 ug/l (estimated) in MW-2S to 14 ug/l in MW-9s. In the intermediate wells, concentrations ranged from 5.1 ug/l (estimated) in MW-4I to 18 ug/l in MW-18. Concentrations in the deep wells ranged from 14 ug/l in MW-5D to 24 ug/l in MW-6D. MW-1D, located upgradient of the site, contained chromium at 21 ug/l in the June 1988 sample. None of the filtered samples revealed concentrations exceeding the NYS Water Quality Standard of 50 ug/l for chromium. However, this standard only applies to hexavalent chromium. There is no standard for total chromium.

Cobalt was detected in unfiltered samples from most wells on at least one occasion. Unfiltered concentrations ranged from 7.2 ug/l to 103 ug/l. Cobalt was not detected in any of the filtered samples.

Copper was detected in unfiltered samples from all wells on at least one occasion at concentrations ranging from 4.2 ug/l to 936 ug/l. Concentrations in the filtered samples ranged from undetected to 123 ug/l in MW 6I. Specifically, copper was not detected in shallow wells MW-3S, MW-5S and MW-6S, but was found at 109 ug/l in MW-6I. In the intermediate wells, concentrations ranged from 4.7 ug/l (estimated) in MW-2I to 123 ug/l in MW-6I. Copper concentrations in the deep wells ranged from undetectable in wells MW-1D, MW-4D, MW-5D and MW-7D to 71 ug/l in MW-6D. The NYS

Water Quality Standard of 1,000 ug/l was not exceeded in any wells.

Iron was detected in unfiltered samples from all wells on both occasions at concentrations from 5,170 to 536,000 ug/l. All filtered samples, with the exception of MW-5S and MW-12, had concentrations higher than the NYS Water Quality Standard of 300 ug/l on at least one occasion. Concentrations in the shallow wells ranged from 16 ug/l in MW-5S to 8600 ug/l in MW-9S. In the intermediate wells, concentrations ranged from 195 ug/l in MW-3I to 36,100 ug/l in MW-10. Iron was found in the deep wells at concentrations ranging from 183 ug/l in MW -1D to 30,700 ug/l in MW-7D.

Lead was detected in unfiltered samples from all wells on at least one occasion. The highest concentration observed was 5,350 ug/l in MW-8S, followed by MW-13 with a concentration of 3,210 ug/l. In the filtered samples, lead was detected in six shallow wells at concentrations ranging from 6.7 ug/l in MW-13 to 27.3 ug/l in MW-11S. Lead was only detected in three of the intermediate wells MW-4I (7.5 ug/l), MW-6I (27.6 ug/l), and MW-10I (6.6 ug/l). Only three wells, MW-6I, MW-8S, and MW-11S, contained lead at levels above the water quality standard of 25 ug/l.

Manganese was detected in unfiltered samples from all wells on both sampling dates. Concentrations ranged from 215 ug/l in MW-6S to 326,000 ug/l to MW-11S. Filtered samples had manganese concentrations ranging from 2 ug/l in MW-5S to 2,150 ug/l in MW-7I. Of the filtered samples, 11 wells had concentrations exceeding the standard of 300 ug/l on at least one occasion.

Concentrations in the shallow wells ranged from 2 ug/l (estimated) in MW-5S to 1,320 ug/l in MW-9S. Concentrations in the intermediate wells ranged from 7.4 ug/l (estimated) in MW-3I to 92,150 ug/l in MW-7I. In the deep wells, concentrations ranged from 71 ug/l in MW-5D to 678 ug/l in MW-7D. In general, the concentration of manganese in the shallow wells was lower than that observed in the intermediate or deep wells.

Mercury was detected in the unfiltered samples collected from 17 of the wells on at least one occasion with the highest concentration of 7.2 ug/l observed in MW-5S. All filtered samples with the exception of deep well MW-7D were below the detection limit. The concentration in well MW-7D was 0.34 ug/l. Mercury was previously detected in the Phase II Site Investigation in wells MW-2I and MW-4I at concentrations of 0.9 ug/l and 0.6 ug/l respectively. These levels are all below the NYS Ground Water Quality Standard of 2 ug/l.

Nickel was detected in unfiltered samples from all wells on at least one occasion, at concentrations ranging from 13 ug/l in MW-7S to 501 ug/l in MW-4S. Of the filtered samples, shallow wells MW-4S, MW-8S and MW-10S contained nickel at levels of 9.1 ug/l (estimated), 11 ug/l (estimated), and 9.4 ug/l (estimated) respectively. Of the intermediate wells, MW-6I had a concentration of 12 ug/l (estimated) and MW-7I contained 11 ug/l (estimated). These values are all below the reportable detection limit of the analysis of 9 ug/l. Nickel was also previously detected in samples from MW-1I, MW-2I, and MW-4I at concentrations ranging from 100 ug/l to 280 ug/l. Nickel was not detected in the deep wells.

Silver was detected in the unfiltered samples from most of the wells on at least one occasion with the highest concentration, 56 ug/l, observed in MW-4S. Filtered samples revealed detectable concentrations in intermediate well MW-10I (11 ug/l) and deep well MW-6D (11 ug/l and 4.2 ug/l). None of these values exceeds the NYS Water Quality Standard of 50 ug/l.

Vanadium was detected in unfiltered samples from all wells on at least one occasion at concentrations ranging from 3.5 ug/l in MW-11I to 676 ug/l in MW-3S. Of the filtered samples, vanadium was detected in all of the shallow wells at concentrations ranging from 3.7 ug/l (estimated) in MW-2S to 112 ug/l in MW-12. Zinc was only detected in intermediate wells MW-3I (38 ug/l estimated), MW-6I (26 ug/l estimated) and MW-7I (4.3 ug/l estimated).

Zinc was detected in unfiltered samples from all wells on both sampling dates at concentrations ranging from 32 ug/l in MW-5I to 22,600 ug/l in MW-4S. Of the filtered samples, zinc was detected on at least one occasion in all of the monitoring wells. Concentrations in the shallow wells ranged from 2.3 ug/l in MW-5S to 87 ug/l in MW-8S. In the intermediate wells, concentrations ranged from 4.8 ug/l in MW-11I to 88 ug/l in MW-10I, while concentrations in the deep wells ranged from 6.9 ug/l in MW-6D to 142 ug/l in MW-7D. None of the filtered samples exceed the NYS Water Quality Standard of 5,000 ug/l. Zinc was previously detected in the intermediate wells MW-1 through MW-7, installed during the Phase II investigation, at concentrations ranging from 20 ug/l to 180 ug/l.

As previously stated, filtered samples were not collected for cyanide analysis. In the unfiltered samples, cyanide was detected in nine shallow wells at concentrations ranging from 13.5 ug/l in MW-2S to 359 ug/l in MW-13. Cyanide was detected in intermediate wells MW-3I (16.8 ug/l), MW-5I (14 ug/l), MW-6I (195 ug/l), and MW-7I (12.3 ug/l). Only samples from shallow wells MW-6S, MW-12, and MW-13 were above the NYS Ground Water Quality Standard of 200 ug/l. Cyanide was not detected in any of the deep wells.

Ground Water Sample Summary

Chlorinated organics were observed to be most prevalent in shallow wells MW-5S and MW-9S. Wells MW-5S and MW-9S are located in the vicinity of the settling ponds which may account for the presence of these compounds.

MW-8S, located on the northern side of the site, contained high concentrations of aromatic and phenolic compounds (Figure 13). This suggests that a localized source of these compounds is present in the fill in this area.

Concentrations of PAHs were also prevalent in the shallow monitoring wells with the highest concentrations observed in MW-6S in December 1988. This well is located in the vicinity of and downgradient of the settling ponds (Figure 13).

Of the intermediate wells, MW-6I, located adjacent to and downgradient of the settling ponds, contained the highest concentrations of aromatic hydrocarbons (Figure 13). The fact that the settling ponds were excavated into the native material and the hydraulic conductivity at this well is higher than the surrounding materials suggests that the aromatic compounds present in the sludge at the base of the settling pond (observed in the soil sample collected from Boring D) are migrating through this area.

PCBs were detected primarily in the shallow wells with the exception of intermediate wells MW-3I and MW-11I. Levels observed in the samples were generally higher during the first sampling event. PCBs are generally insoluble in water and preferentially adsorb to soil particles with even greater adsorption to organic matter. The samples collected for PCB analysis were not filtered in the field and they contained suspended soil particles. Since the fill samples were found to contain PCBs, it is likely that the PCBs observed in the shallow wells were adsorbed to the soil particles within the sample and not dissolved in the ground water. Although PCBs were detected in two intermediate wells on both sampling dates, it is not expected that vertical migration of PCBs would readily occur beneath the fill given the presence of organic matter in the upper alluvium deposits which would adsorb PCBs. Horizontal migration of PCBs also does not appear to be occurring as PCBs were detected at low concentrations (14 and 24 ug/l) only during the first sampling event in downgradient wells MW-4S and MW-6S. MW-5S contained 8.5 ug/l and 18 ug/l of PCBs. This may be a result of the high levels of PCBs found in the soils in Boring G (39 ug/kg) and Boring B-3 (63 ug/kg) as well as the USGS (1983) sample collected of the fill in this area (199 ug/kg).

As would be expected, the unfiltered samples contained higher concentrations of all inorganics than the filtered samples. This is due to the suspended sediment present in the unfiltered samples. In general, filtered samples from the shallow monitoring wells contain higher metal concentrations when compared with the intermediate and deep wells except for the ubiquitous elements such as aluminum, calcium, copper, iron, manganese, magnesium, nickel, potassium, silver, sodium and zinc, which were observed at equal or higher concentrations in the intermediate and deep wells.

The five Hooker-Durez indicator compounds were not detected in any of the samples.

Of the two shallow wells located on the INS side of the southern drainage ditch (MW-12 and MW-13), MW-13 generally contained the highest level of organic and inorganic compounds. The highest level of total phenolic compounds (3010 ug/l in June 1988) was observed in this well. In addition, the highest total PCB concentration of 180 ug/l was detected in this well.

With the exception of well MW-6I, the shallow wells generally contained higher concentrations of organic compounds than the intermediate or deep wells. In addition, the shallow wells on the downgradient side of the site contained higher concentrations than those on the upgradient side of the site with the exception of well MW-8S located in the center of the north side of the fill. This suggests that migration of organic compounds from the fill is horizontal towards the river and vertical migration is limited.

The inorganic ground water quality data do not reveal any specific migration pattern; rather concentrations of metals appear to have a random distribution. These data more likely represent the characteristics of the material in the immediate vicinity of the individual wells.

4.07 Chemical Loading

Based on the analytical results discussed in Sections 4.03 through 4.06, the major identified pathway for migration of substances from the Cherry Farm Site is the ground water system. Drainage ditch discharges of sediments is a secondary pathway for migration of substances from the site. Based on data collected, migration of substances from the site appears to be to the Niagara River. This river has been identified as an area of concern to NYSDEC as well as to Erie and Niagara Counties and Canada as discussed in the Niagara River Toxics Committee Report of 1984 (NRTCR). As stated previously in this report (Section 1.03), the NRTCR separated the substances found to be present in the Niagara River into nine groups with Group I being those substances which pose a potential threat to human health or the environment. A list of substances identified in the NRTCR is included in Appendix G. Of the 261 NRTCR substances, 47 have been identified in the ground water at the Cherry Farm site. These substances can be divided into five general groups: volatile organics, polynuclear aromatic hydrocarbons (PAHs), phenols, PCBs, and inorganics. To assess the potential impact of the site on the Niagara River, loading calculations were completed for these groups of substances included in the NRTCR.

In general, the loading calculations were completed using the ground water discharge volumes discussed in Section 3.05.2. Concentrations of those substances identified at each of the four well nests on the west or downgradient side of the site were used to estimate the amount of chemicals which enter the Niagara River from ground water discharge. A detailed discussion of the loading calculations is presented in Appendix G.

The amount of volatile organics entering the river was calculated to be 3.07 x 10^{-2} lb/day (11.2 lb/year). Of the thirteen volatiles used in the calculations, only eight were included in the NRTCR, and of these, only benzene was included in Group I of the substance list.

Approximately 2.26 x 10^{-2} lbs/day (8.24 lbs/year) of polynuclear aromatic compounds were calculated to be potentially entering the river. A total of fourteen compounds were used in these calculations of which twelve are included in the NRTCR. Of the twelve substances included in the NRTCR, eight are included in the Group I substances list.

The phenol calculations reveal a loading rate of 7.24 x 10^{-2} lb/day (26.4 lbs/year) on the Niagara River. Two of the five substances used in these calculations were included in the NRTCR, both of which are in the Group I substance list.

The loading rates for PCBs was calculated to be 1.49 x 10^{-3} lb/day (0.54 lb/year). Of the three Aroclors present, only Aroclor 1248 is not included in the NRTCR. The other two, Aroclor 1242 and Aroclor 1260, are in Group I. As stated previously, however, it is difficult to separate Aroclors 1242 and 1248 when analyzing environmental samples.

Calculations for the inorganic loading rates included only those substances identified in Group I of the NRTCR. A number of the inorganic substances identified from the analyses are considered to be naturally occurring. In general, these substances are the priority pollutant metals with the exception of thallium which is in the Group IID list. Cyanide was also included in the organics loading calculations as it is included in the Group I substances. The calculated loading rate of inorganics to the Niagara River is 1.11×10^{-2} lb/day (4.05 lbs/year).

SECTION 5: CONCLUSIONS

The following presents conclusions regarding the site conditions at the Cherry Farm site. These conclusions are based on data collected during the completion of this Remedial Investigation and previous studies completed at the site. These conclusions establish the basis whereby the Site Risk Assessment, presented in the following section was completed.

- The site is underlain by ten to twenty feet of fill comprised of a inhomogenous mixture of foundry sand, cinders and slag.
- Alluvial deposits, comprised of silts and fine to coarse sand with coarser gravel deposits increasing with depth, underlie the fill to a depth of 50 feet below the ground surface. A thin layer of marsh deposits covers the alluvium throughout most of the site.
- A two to five foot thick glacial till deposit exists beneath the alluvium. The till overlies shale bedrock which was encountered at approximately 55 feet below the land surface.
- Ground water occurs between ten and fifteen feet below the fill surface and within the bottom portion of the fill. Monitoring wells were installed within three ground water flow zones identified at the site: the shallow zone is present within the fill material; the intermediate zone is within the underlying alluvium; and the deep zone is located at the till alluvium interface.
- The ground water flow direction beneath the site in all three monitored horizontal flow zones is from east to west towards

the Niagara River. Vertical hydraulic flow potentials in the ground water suggests that ground water discharges to or has the potential to discharge to the Niagara River. Radial flow of ground water or ground water mounding conditions in the fill were not observed. This suggests that the clay cap material on the landfill surface may be limiting infiltration of precipitation into the fill material and/or the hydraulic conductivity of the fill material allows for relatively rapid dissipation of recharge that may be occurring through the fill.

- The average volume of ground water discharge from the three ground water flow zones identified at the site (estimated using median hydraulic conductivity values and average hydraulic gradients) are as follows: shallow zone - 10,231 gpd; intermediate zone - 2,189 gpd; and deep zone - 432 gpd. The ground water flow velocities were estimated to be 0.45 ft/day in the shallow zone; 0.18 ft/day in the intermediate zone; and 4.6 x 10-3 ft/day in the deep zone.
- Analytical data for the surface soils indicates that the fill exposed along the sides of the landfill face contain detectable concentrations of volatile organics, phenols, PAHs, PCBs, and inorganics.
- The sand casts found along the side of the fill were found to contain PAHs, PCBs, and phthalates.
- Subsurface samples of the fill material contain concentrations of: volatile organics, phenols, PAHs, PCBs, phthalates, and inorganics.

Although the work plan stated that a "Waste Location Map" would be prepared as part of the RI Report, the substances within the fill were found to be randomly distributed. Therefore, no Waste Location Map has been prepared.

- The Hooker-Durez indicator substances were not detected in any of the samples collected as part of the Remedial Investigation.
- The analytical results suggest that the site is not affecting the chemistry of the surface water in the drainage ditches located on the east, north and south side of the site. The higher levels observed in the upstream samples suggested that upstream sources are present.
- The sediment sample results indicate the presence of PCBs in SED-5 located in the center of the southern drainage ditch. This may be the result of erosion of the fill face or the ground water discharge from the INS property. The absence of PCBs in SED-4, located downstream of SED-5 suggests that off-site migration is not occurring via the drainage ditch.
- The ground water analytical data revealed the presence of volatile organics, phenols, PAHs, PCBs, and inorganics. The highest concentrations were generally detected in the shallow (fill) wells. The analytical data suggests that organic compounds are migrating towards the Niagara River. The inorganics analytical data indicate a random distribution which suggests that inorganics found in the ground water may be dependent upon the composition of the material in the vicinity of the individual wells rather than migration of a plume of soluble inorganic compounds.

The analytical data further indicate that lower concentrations are present in the deeper wells as compared to the fill wells. This suggests that vertical migration of the substances identified is limited.

- The worst case chemical loading of volatile organics, phenols, PAHs, PCBs and inorganics to the Niagara River as a result of ground water discharge from the site is conservatively estimated as follows: Volatile Organics - 0.031 lbs/day (11.2 lbs/year); phenols - 0.072 lbs/day (26.4 lbs/year); PAHs - 0.023 lbs/day (8.24 lbs/year); PCBs - 0.0015 lbs/day (0.54 lbs/year); and inorganics - 0.011 lbs/day (4.05 lbs/year).

SECTION 6 - RISK ASSESSMENT

6.01 Introduction

The objective of this section is to provide a qualitative and quantitative evaluation of human health and environmental hazards which may be present at the Cherry Farm Site. This assessment has, for the most part, been developed based on information gathered during the RI investigation presented in Sections 3 and 4 and the conclusions presented in Section 5. An additional source of information was prepared by Engineering Science entitled: Engineering Investigations at Inactive Hazardous Waste Sites in the State of New York, Phase II Investigation for INS Equipment (NYS SITE I.D. 915031), Final Report, September 1986.

A hazardous chemical may present human or environmental risks only if humans, animals, wildlife, or sensitive ecosystems have the potential to be exposed to the chemical in sufficient quantity to affect either the health of exposed individuals or the general ecological balance. Therefore, the first step toward quantifying such risks at hazardous waste sites is the completion of a qualitative analysis that characterizes the potential pathways of exposure. Once these pathways are enumerated and defined, quantitative estimates of risk, if found to be necessary, may be developed. Figure 13 describes the general risk characterization process.

Presented below in Sections 6.02 through 6.04 is a qualitative analysis of exposure pathways. A quantitative assessment of those pathways determined to represent a possible hazard are addressed in section 6.05.

6.02 Qualitative Exposure Pathway Analysis - Approach

6.02.1 Theoretical Considerations

To facilitate a qualitative assessment of exposures related to a typical hazardous waste site, the various exposure scenarios can be classified into four general exposure pathways corresponding to the medium or mechanism of environmental transport:

1. air
2. surface water
3. ground water
4. direct contact.

Exposure to hazardous wastes can, therefore, occur in numerous ways. Examples of the primary potential exposure scenarios related to a typical hazardous waste site include the following:

- Ingestion of surface water or ground water containing dissolved or sediment-bound contaminants
- Inhalation of airborne volatile or particulate-bound contaminants
- Ingestion of biota (e.g., fish) that have bioaccumulated a contaminant released from a waste source
- Dermal absorption or ingestion of residue-containing materials resulting from direct contact with waste materials or affected soils.

A qualitative health assessment considers the potential exposure scenarios relative to what is specifically known regarding the site. Two terms are used in this evaluation when discussing potentially significant exposure pathways; functionality and completeness.

A functional exposure pathway consists of a waste source, a potential release mechanism, and a transport medium. If one or more of these components is missing, there is no physical mechanism for exposure, and the pathway does not function. The waste source consists of the chemical materials of potential environmental or toxicological concern. For the analysis of the Cherry Farm Site, the waste source has been identified as sand-like fill material containing chemical residues typically associated with the foundry and steel industries. General examples of release mechanisms include volatilization, direct contact, and leaching. Transport media include air, surface water and ground water.

A complete exposure pathway consists of a functional pathway which can potentially facilitate an exposure of health or environmental concern and two additional components:

1. A potential receptor population: For example, a functional ground water exposure pathway would be considered complete if there were ground water users hydraulically downgradient of the waste site in the direct line of a ground water contaminant plume.
2. A potential exposure and uptake route: The transported contaminant must have a way of entering the receptor's body. In the ground water example, ingestion of contaminants in drinking water would be a potential uptake exposure route. Based on these considerations, a complete exposure pathway is one which includes the following components:
   a. A waste source and a mechanism of release from it.

b. A viable transport mechanism from the waste source to a potential receptor point.

c. A potential receptor population.

d. An exposure and uptake route leading to absorption of the contaminant, thereby allowing it to exert its toxic effect.

If any one or more of these components is missing, an exposure scenario is by definition incomplete and, therefore, poses no risk to health or the ecological balance.

6.02.2 General Approach

This assessment is divided into four main areas that deal with attributes necessary for a complete risk evaluation. An attribute is a characteristic of the site that supports or refutes the labeling of a pathway as functional and complete.

Specifically, Section 6.02.3 addresses the significance of the site with regard to its location and the presence of particular compounds. Sections 6.02.4 and 6.02.5 discuss the relevant toxicological issues of the site and assumptions made prior to an evaluation of the exposure scenarios. Finally, Section 6.03 and its following subsection address the particular exposure pathways associated with the site.

In carrying out this evaluation, each potential exposure pathway was analyzed for the two pathway criteria of functionality and completeness. The analysis was conducted for existing and future conditions. For future conditions, it was assumed that the site would remain unchanged and that there would be no remediation of the site or any surrounding but affected areas.

Therefore, natural degradation would constitute the mechanism for removal or detoxification of residual materials.

It should be noted, however, that a marina and public park have been proposed as a possible site use (Halcyon Ltd. and Sasaki Associates, 1989). Although not specifically addressed in the risk assessment, this useage is discussed in the concluding remarks presented in Section 6.15.

6.02.3 Site Location and Waste Source Characterization

The Cherry Farm site is an inactive waste disposal site located in Tonawanda, New York and currently owned by the Niagara Mohawk Power Corporation. The surrounding area is industrial.

Based on the information provided to the NYSDEC by Colorado Fuel & Iron Steel Corporation (CF&I) in a letter dated October 10, 1985, a number of industries deposited material on the site since 1945 and possibly earlier. CF&I, the original owner of the site, deposited dust and slag from its blast and open-hearth furnace operation until 1963. The INS Equipment Company also deposited foundry sands from a nearby Chevrolet plant on the property.

As a result, approximately 80% (44.4 acres) of the site is currently covered by fill material. Fill thickness ranges from 10 to 20 feet above the original surface. The total volume of fill material is estimated at 1.075 million cubic yards using the average vertical depth and horizontal extent. Based on soil borings completed by OBG, the majority of the fill consists of foundry sand, sand casts, slag, and black sandy material. In addition to the solid wastes, two settling ponds reportedly used in the past by CF&I to contain liquid wastes were identified in the southwest corner of the property.

The RI sampling program conducted by OBG in 1988 indicated that fill soil and ground water at the site contain various concentrations of heavy metals and organic residues (See Tables 3-14). Iron, lead, nickel, cadmium, and arsenic were detected in fill soil and drainage ditch surface water. A number of semi-volatile and volatile organic compounds were also detected in ground water samples. Monitoring well MW-6I displayed the highest concentrations of volatile organic compounds in ground water. Residues in this well consisted of benzene (350 ppb), toluene (140 ppb), ethylbenzene (76 ppb) and xylene (170 ppb). It is assumed that the significantly higher concentrations of volatiles in MW-6I in comparison to other wells is a result of its proximity to the settling ponds.

Semi-volatile residues detected onsite include PCBs, Aroclors 1248 and 1254 predominant. PCB concentrations in surface soil ranged from 0.16 ppm to 44.0 ppm. These concentrations are representative of soils at the perimeter of the site. Surface soil samples taken from the capped portion of the site, near the softball fields, did not contain detectable levels of PCBs and only low concentrations of volatile organic compounds.

From an examination of the site hydrogeology, it is concluded that the bottom 5 ft of fill material is submerged in ground water. Additionally, the hydrogeologic investigation conducted at the site suggests that site ground water discharges to the Niagara River at an average rate of 10,231 gal/day. As such, it may be concluded that soluble metals and organic compounds in the fill could be leached and transported by ground water.

6.02.4 Assumptions

To complete a qualitative risk assessment, assumptions are made about the waste source including its availability and transport to a potential receptor. The following assumptions were made in the qualitative exposure pathway analyses prepared for the Cherry Farm Site:

1. A waste source consisting of PCBs, PAHs, phthalate esters, VOCs, and metals is present.
2. Areas of exposed waste material and soil along the periphery of the site are potentially subject to erosion by precipitation and periodic flooding of the adjacent wetland. Dissolved or particulate-bound residues may be released to the surface water bodies or to ground water.
3. Ground water is in contact with waste and residue material, thereby leaching compounds to water.

6.03 Qualitative Exposure Pathway Analysis - Results

6.03.1 Air Exposure Pathway

General Considerations

Two general exposure mechanisms were considered to evaluate whether the air exposure pathway is functional and complete:

1. Exposure may occur through the transport of volatilized residues by the action of wind. In this situation, waste

constituents with sufficient vapor pressures (e.g., benzene, toluene, xylenes) may volatilize to the atmosphere. Unless the waste materials or affected soils are directly exposed to the atmosphere, the residues diffuse through stagnant soil air spaces before atmospheric transport can take place. Unless accelerated by pressure in the soil atmosphere, as is sometimes observed during the release of methane at sanitary landfills, volatilization from buried waste materials generally has a low release rate. Thus, buried waste material generally does not represent a significant source of materials volatilized to the atmosphere. Hence, only surficially exposed waste materials generally are considered in the evaluation of functionality and completeness of the volatilization air exposure pathway.

2. Exposure may occur through transport of friable waste materials and particulate-bound residues as fugitive dusts. Fugitive dust emissions may result if exposed waste materials or affected soils are accessible to wind scour, vehicular traffic, or heavy equipment.

For humans and wildlife, the potential exposure route of volatile or particulate emissions is inhalation.

Pathway Attributes - Present Conditions

The air exposure pathway is identified as non-functional and incomplete for existing site conditions. Current attributes of the pathway are summarized in Figure 14 and discussed below.

Non-functional: In 1970 the Cherry Farm Landfill was capped with a layer of clay and clean soil to reduce the possibility of human exposure to airborne dust and volatilized materials. Rye grass was planted to preserve the integrity of the cover and to strengthen the soil layer against wind shear and erosion. The OBG field investigators observed the site as densely vegetated with rye grass and sumac. Based on these field observations, the small amount of exposed fill material, and the absence of a friable surface, the liklihood of exposure to airborne fill particulates is minimal.

A release of volatile residues from the surface soil may occur if the matrix is sufficiently permeable to such transport. A compound must exert sufficient vapor pressure to migrate through the stagnant soil air spaces. During the Phase II survey, HNU readings for volatile constituents taken on the site surface along the side of the fill and upon collection of each soil sample at no time displayed any readings above background levels. The detection limit for the HNU, Model PI 101, was metered to its most sensitive setting (0.1 ppm). Therefore, in the absence of any onsite reading above background at ground level, exposure by the air route would be highly unlikely.

Incomplete: The air transport route is incomplete for the air exposure pathway. Therefore, receptors cannot be exposed by inhalation.

Pathway Attributes - Future No Action

The air exposure pathway is identified as non-functional and incomplete for future (no action) site conditions. Future attributes of the pathway are summarized in Figure 15 and discussed below.

Non-functional: The air pathway is considered to be non-functional for the same reasons described for present conditions. The current conditions are expected to continue in the future.

Incomplete: The future air transport route is considered non-functional. It is not considered further in this evaluation.

6.03.2 Direct Contact Exposure Pathway

General considerations for possible mechanisms for direct contact exposures to residual materials at a site include:

1. Direct contact with the exposed residue containing materials located on site
2. Direct contact with site residues following their transport to off-site locations by air or surface water.

Both of these mechanisms require exposed waste materials or affected surface soils. Under such circumstances, direct contact exposure can occur either by dermal absorption or by direct ingestion.

Pathway Attributes - Present Conditions

The direct contact exposure pathway is identified as functional and complete for existing site conditions. Current attributes of the pathway are described below and summarized in Figure 14.

Functional: Based on the observations made by OBG, direct exposure may occur at the perimeter of the fill material because the sloped sides of the fill mound have not been capped. Although these areas are vegetated, contact with the fill material is possible.

Eight surface soil samples were taken from the sides of the landfill (Figure 2). Detectable residues of PCBs, PAHs, and phthalate esters were present along with heavy metals including arsenic, cadmium, iron, lead, and nickel. Due to the presence of exposed fill material along the perimeter of the landfill, the direct contact route is considered functional.

Complete: In order for the direct contact route to be considered complete, a receptor must be present on the site. This receptor must also directly contact the surficial fill material.

The Cherry Farm site is located in an area dominated by industrial and commercial uses. The nearest private residence is more than a mile away. However, on Tuesday and Thursday afternoons during the spring and summer, the site is used as a private softball field. The two softball fields are located in the center of the site away from the exposed fill material, but players could contact waste should they venture away from the softball field. Therefore, these receptors could contact exposed waste material while walking around the site. The number of people conservatively estimated to be on the site during a game would be less than 300 (conservative estimate used in hazard ranking evaluation of the site), but it is highly unlikely that the majority of these people would contact the surficial materials. Contact with site materials would be short-term and last only the duration of the recreational activity.

Due to the industrial nature of the site, it is not expected that children would frequent the area. In addition, the entrance to the field is normally locked and any other entrance to the site is barred by the Niagara River to the west and a freshwater wetland on the other three sides. Boaters may be able to access the site via the river; however, it is not expected that they would stay on the site for more than a few hours at a time.

In summary, the direct contact route is considered complete due to seasonal use of the softball fields for recreational purposes and the potential for boaters to access the site from the Niagara River. Any exposures arising from this pathway are expected to be short term. The direct contact route will be further considered in a quantitative estimate of risk.

Pathway Attribute - Future No Action

Under the future no action scenario, the direct contact route is assumed to be functional and complete. This decision is based on the continual use of the site for recreational purposes and the potential for boaters to access the site from the Niagara River. Under this scenario, surface residues located along the sides of the landfill may be encountered during casual exploration of the site by softball players or boaters.

6.03.3 Surface Water Exposure Pathway

General Considerations

Transport of waste materials to receptors via the surface water exposure pathway can occur in several ways. Mechanisms of potential significance include:

1. Site runoff of dissolved residues into surface waters
2. Site runoff of particulate-bound residues into surface waters
3. Discharge of ground water containing dissolved residues into onsite surface waters (e.g., ground water seepage into a drainage ditch or lake).

Potential exposure routes for wildlife or humans associated with residues transported in surface water include:

1. Intentional ingestion of drinking water (e.g., use of surface water as a potable water supply by humans)
2. Inadvertent ingestion while swimming or wading in the river
3. Ingestion of residues that bioaccumulate in fish or other edible aquatic biota
4. Dermal contact absorption during recreational activities, like swimming and boating
5. Inhalation of volatiles released during activities in or near surface water.

Pathway Attributes - Current Conditions

The surface water exposure pathway is identified as functional and complete for existing site conditions. This pathway is summarized in Figure 14 and discussed below.

Functional: The surface water pathway is considered functional based on a number of scenarios. First, run-off from precipitation collects in drainage ditches which run parallel along the perimeter of the site. These ditches drain into the Niagara River. Rain water flowing over and penetrating the upper portion of the uncapped fill would be expected to act as a transport mechanism for both suspended solids and water soluble compounds.

The most common chemical parameters identified at the site include VOCs, PCBs, PAHs, phthalate esters, and metals. Most of these compounds are insoluble in water. Benzene, ethylbenzene, toluene, and xylene have a preference for the non-aqueous portion (organic portion) of the solution. However, due to a limited capacity of these compounds to be dissolved in precipitation, these compounds will be further addressed to determine the completeness of the path.

In general, PCBs are considered insoluble in water. These compounds will, however, be transported in water while bound to particulates. The PAH and phthalate compounds (benzo[a]pyrene and bis(2-ethylhexyl) phthalate, respectively) are also generally insoluble in water (Clement Associates, Inc., 1985).

The solubility of metals varies with each element and metallic compounds. Arsenic, cadmium and nickel will form salts which are water soluble. However, lead, which has an affinity for clays and other minerals, is usually transported in water suspended to solids (Callahan et al., 1979).

A second route for surface water exposure is a discharge of ground water containing site residues into the adjacent wetlands or the Niagara River. It has been determined that the deep fill material onsite is below the ground water level (Section 3.04.2). Water soluble compounds contained in the fill material could leach into and be transported by the ground water. Ground water flow is to the west, toward the Niagara River. An estimate of the ground water discharge rate into the River is 10,231 gallons per day (Section 3.05.2). Loading of the Niagara River due to this discharge volume is discussed in the surface water quantitative assessment together with its impact on human health.

Surface water samples were obtained from the site drainage ditches during the 1988 field investigation. The results revealed that compounds comparable to those detected in the fill material were present in the drainage ditch. Upstream surface water and sediment samples collected from the drainage ditch contained the highest concentration of organic and inorganic compounds. In particular, samples from location SW-7 contained high levels of inorganics as well as the highest concentrations of semi-volatile compounds. (Refer to Table 8.) The highest concentrations of volatile organic compounds were also found upstream at location SW-1. The presence of volatile organic compounds, semi-volatiles and inorganics in samples SW-1 and SW-7 suggests an upgradient or upstream source of such components. Therefore, any release of residues into the Niagara River by the Cherry Farm drainage ditches would not constitute the only source of surface water contamination to the River.

In summary, the surface water route is considered functional due to the transport of residues by site runoff and ground water discharge into the site drainage ditches. The release of site contaminants into the Niagara River via drainage ditch discharge is likely based on the presence of site residues detected in drainage ditch samples.

Complete: Based on the assumption that a surface water transport route exists for residues into the Niagara River water, it is possible that humans and wildlife could become exposed to these residues. As indicated in the hazard ranking evaluation, the Niagara River is extensively used for recreation.

Although there are no endangered species in the area, it is evident that the River supports a variety of plant and wildlife including birds, fish, and small mammals. In addition, the wetland adjacent to the site is designated as a protected wetland by the NYSDEC. During the hunting and foraging activities of indigenous wildlife, these animals could experience a chronic exposure to water-borne and/or sediment-borne residues, either from the River, the drainage ditches or the associated wetlands.

Wildlife exposures may be compounded by the tendency of PCBs and some metals to accumulate in tissue. Higher orders of animals may also become exposed to contaminants through the ingestion of fish that have accumulated site compounds.

The occasional presence of human receptors and the continual presence of wildlife proximate to the site indicate that a complete exposure could occur. Exposures via surface water could occur through dermal absorption or ingestion.

Pathway Attributes - Future No Action

Under the future no action scenario, the Cherry Farm site attributes noted under the current conditions scenario would continue. Exposures could result from:

1. Incidental direct contact to the surface water drainage collection system located at the perimeter of the site by humans or wildlife
2. Direct contact with surface water in ditch and River.
3. Direct contact with and the ingestion of drainage ditch surface water during terrestrial and aquatic wildlife activities (hunting and foraging).

For each of these scenarios, an estimate of the risk due to human exposure is provided in the quantitative assessment.

6.03.4 Ground Water Exposure Pathway

General Considerations

The transport of residues towards a receptor requires the following conditions:

1. Waste constituents with sufficient water solubility to become dissolved by and transported with ground water
2. A mechanism by which surface infiltration and/or ground water can contact and leach soluble components of the waste material
3. A mechanism for the movement of the leachate into and with ground water to receptor locations hydraulically downgradient

of the site (e.g., advective, dispersive, or diffusional residue transport).

Potential exposure routes related to the ground water exposure pathway include:

1. Drinking water ingestion
2. Dermal contact while bathing or showering
3. Inhalation of volatiles while bathing or showering.

Pathway Attributes - Present Conditions

The ground water exposure pathway is currently identified as functional but incomplete for existing site conditions. Current attributes of the pathway are summarized in Figure 14 and discussed below.

Functional: Two considerations suggest that the ground water pathway is currently functional at the Cherry Farm site. First, contact between the ground water and fill material has been documented (Section 3.05.2). Second, an analysis of ground water beneath the site has indicated the presence of compounds consistent with those found in the fill material at the Cherry Farm site.

A ground water investigation was conducted by OBG in June and November of 1988 as part of the RI. Samples taken during this investigation revealed the presence of PCBs, phthalate esters, PAHs, VOCs, and metals. The rationale for attributing the residues to the site was the relative concentrations in each monitoring well. Downgradient monitoring (MW2, MW3, MW4, MW5, MW6, MW7) showed concentrations greater than background levels of the same constituents obtained upgradient at MW1 (Hazard Ranking Evaluation Report). Figure 1 shows the relative location of these wells to the site.

The ground water pathway is considered functional due to an observed release of site residues into the ground water.

Incomplete: In order for a ground water pathway to be considered complete, a receptor and potential uptake mechanism by which compounds can be absorbed into the living system must be present. For the human population, the most common uptake mechanism is ingestion of the ground water from a potable ground water well. In the Town of Tonawanda, each residence is supplied by municipal water. This water is obtained from on intakes approximately 3 miles down the Niagara River. Even if potable water wells were to be developed near the site, any building using water from this well would not be within the range of ground water passing through the site. The reason for this is that the ground water direction is toward the Niagara River. Site leachate is not expected to move north or south across the ground water flow. Therefore, any plume would be transported west into the River. As such, there is currently no potential for ground water exposure to humans.

There is no wildlife in the area that would be expected to contact shallow or intermediate ground water prior to its discharge into the Niagara River and adjacent drainage ditches and associated wetland.

Pathway Attribute - Future No Action

The ground water pathway for future conditions under the future no action scenario is considered functional and incomplete. This pathway is summarized in Figure 15 and discussed below.

Functional: The ground water pathway is considered functional under the future no action scenario for the same reasons described for the current condition scenario. Specifically, continued ground water circulation would be expected to leach residues from the existing fill material. It is recognized, however, that materials would be eventually depleted by leaching activities or natural degradation. The time required for such a decrease in residual concentrations cannot be accurately estimated based on current information. The ground water route is considered functional under the scenario that ground water continues to leach residues from the fill material.

Incomplete: For the ground water route to be considered complete, a potential receptor population and uptake mechanism must be present in the future. The most likely mechanism for this scenario is the installation of a private well onsite for use as a potable water supply.

There are currently no governmental regulations restricting the installation and use of wells near the site. It is therefore possible, but not likely, due to industrial zoning, that a residence using private well water would be built on the site.

Due to the local hydraulic gradient, any structure using water from a well located off-site would not be influenced by ground water migrating through the site. The reason for this is that the ground water direction onsite is toward the Niagara River. Site leachate is not expected to move north or south across the ground water flow path. Therefore, any plume would be transported west into the River.

The most reasonable scenario for future conditions does not involve the ground water route. Further development of the area would most likely make use of the available municipal water supply. A number of environmental and economic factors make this scenario more desirable for the township and potential developers than the use of ground water as a potable source. First, as discussed in Section 3.05 of this document, ground water in this area is highly mineralized, often containing dissolved solids of 800 ppm to 5,000 ppm. As a result, this water would require treatment before it could be used as a potable source. Therefore, connecting future buildings to the readily available municipal source would be easier and more economical for the developer than installing private wells.

It is anticipated, therefore, that a receptor will not be present in the future for the ground water pathway. This pathway will not be evaluated further in the quantitative assessment.

6.04 Summary

The objective of the qualitative analysis presented throughout this section was to identify potential human and wildlife exposure pathways which may be of concern at the Cherry Farm site. Each exposure pathway was evaluated for two fundamental pathway attributes: functionality and completeness. Functional pathways were identified based on the potential existence of a physical mechanism by which waste materials can be transported into the environment. From among those pathways considered functional, complete pathways were identified on the basis of 1) a potential receptor population and 2) a potential exposure and uptake mechanism. A summary of the exposure pathway analyses, identifying incomplete and complete pathways, is presented in Figures 14 and 15 for existing and future no action conditions.

Under the scenario for current conditions, the two transport pathways of surface water and direct contact are considered complete. These pathways are based on the assumption that surficial waste materials could lead to a direct contact exposure or can be carried into surface waters.

Under the future scenario, it was determined that the surface water and direct contact pathways would remain complete. The ground water pathway was not considered complete in the future due to the presence of an available municipal water supply.

The purpose of this evaluation has been to provide scenarios by which a waste source could eventually affect a receptor population. Specific quantitative estimates of risk are addressed next.

6.05 Quantitative Exposure Pathway Analysis

6.05.1 Introduction

The following sections provide a quantitative assessment of the potential risks to human health and the environment of the Cherry Farm site. A quantitative risk evaluation is a procedure by which exposure scenarios identified as complete in the qualitative assessment are evaluated according to the existence, magnitude, environmental fate, and toxicological effects of waste components released from the site and transported to receptors. The health risks posed to potential receptors at each identified point of exposure are quantified and compared to acceptable health risk levels for non-carcinogenic and carcinogenic health effects.

6.05.2 Theoretical Considerations

A quantitative risk assessment is conducted only for complete pathways and their identified exposure scenarios. The quantitative risk assessment involves three steps:

1. Selection of waste components to serve as parameters (site parameters) of potential environmental and health significance
2. Measurement or prediction of exposure point concentrations at receptor locations (for instance; surface soil concentration on site for direct contact).

3. Comparison of the measured or predicted exposure point concentrations to relevant action levels established for the protection of human health.

Risk characterization is initially performed using a series of upper bound or worst case exposure and uptake assumptions designed to overestimate the likelihood and magnitude of exposure. These assumptions are applied in order to test, with reasonable certainty, the situations which conclude that the conditions do not represent an unacceptable exposure risk.

The risk characterization process begins with the selection of site parameters. Site parameters for use in the quantitative analysis are based on a waste characterization that considers:

1. The nature, volume, and disposal history of the waste material
2. The waste components' environmental dynamics
3. The toxicology of the waste's components.

The objective of the parameter evaluation is to focus on specific chemicals to provide a manageable set of compounds for further analysis. These compounds represent those waste components which are the most toxic, persistent, and mobile, and thus have the greatest potential to affect the environment. Exposure point concentrations are then established for each selected site parameter. Site-specific data for each parameter and conservative modeling procedures using upper bound estimates depicting worst case scenarios are used in this process.

The predicted or measured exposure point concentrations for each site parameter are first compared to established standards for the protection of human health. Drinking water maximum contaminant levels (MCLs), National Ambient Air Quality Standards (NAAQS), federally approved state water quality standards developed under the Clean Water Act (New York State ambient surface water quality standards), USEPA Health Advisories (SNARLs: Suggested No Adverse Impact Levels), and USEPA ambient water criteria (AWQC) are often used to evaluate target concentration levels. In those cases where the appropriate contaminant action level or standards are not exceeded by the concentrations shown by the complete exposure pathways, it is concluded that there is no measurable health risk to the receptor via those pathways, and the exposure requires no further risk characterization.

If, however, the action level is exceeded, a toxicological assessment is performed. The objective of the assessment is to identify the magnitude of toxic impact, if any. It should be noted that the standards are action levels established with the goal of identifying exposure concentrations that will not produce an adverse effect on human health. Therefore, because of the conservative methodology and margins of safety typically employed to establish these levels, they do not represent levels which, if exceeded, will necessarily produce an adverse effect.

6.05.3 General Approach

The toxicological assessment of exposures which are above the established standards is performed in the following manner. To assess the potential risks associated with a given contaminant level, exposures are quantified for active exposure routes (e.g., ingestion, drinking water, inhalation, dermal absorption) to determine intakes for acute, subchronic, and chronic lifetime exposures of the receptor. For carcinogens, unit risk factors are used. These risk factors are generated from animal test data using recently promulgated guidelines or by performing risk assessments of carcinogens (USEPA, 1986). The risk factor is combined with intake data to derive a quantitative estimate of the incremental cancer risk. This value is compared to the site circumstances, the size of the receptor populations, and other factors in order to determine the acceptability of the exposures. For non-carcinogens (e.g., reproductive, developmental, and systemic toxins), acute toxicity information as well as acceptable daily intakes (ADIs) established by the USEPA or other agencies are used for comparison to estimate exposure levels under acute, subchronic, and chronic conditions.

6.05.4 Health Risk Process

The following quantitative risk assessment addressed, by matrix, the potential health risks that could be posed by exposures to site-related chemicals in ground water, surface water, and soil. The health risks for human receptors were based on an oral exposure considering ingestion of ground water, surface water and soil. The risk analysis developed throughout this section is consistent with that described in the EPA Superfund Public Health Evaluation Manual, October 1986.

As a first step in this section of the risk assessment, site compounds were evaluated in order to select a representative number which could then be carried through the quantitative analysis. These compounds are referred to as site parameters. The purpose of selecting site parameters is to identify those compound with the greatest potential hazard to a receptor. The selection of the parameters is based on the frequency of a compound in a matrix, the concentration of the compound, its persistence and its toxicity.

Once a representative number of site parameters has been identified, the concentration of the parameters in ground water and surface water (maximum and average) at exposure points are compared to the criteria noted in section 6.05.2. This comparison may facilitate the removal of parameters which are below the state action levels for residues in potable water. For those compounds which exceed the state criteria, chronic daily intakes (CDIs) are calculated.

The calculation of chronic daily intakes is based on the premise that the exposure of an individual to a particular compound is related to the concentration of the compound in a matrix multiplied by the exposure of the individual to the matrix. As an example, to estimate a receptor's exposure to benzene in a potable water source, the concentration of benzene in the water would be multiplied by the volume of water consumed from that source by the receptor. As such, the CDIs are based on two values: a human intake factor (HIF) and a concentration of each compound of interest.

HIFs are estimations of normal daily intake of environmental matrices by a human receptor. In order to develop an HIF, a number of assumptions are made. For potable water, HIFs are calculated based on the assumption that an average adult ingests 2 liters of water per day for a 70 kg body weight. This same principle is applied to children, by assessing HIFs based on the ingestion of 1 liter of water per day for a 17 kg body weight.

Intakes are also estimated for incidental ingestion. The exposure resulting from an incidental ingestion of surface water during recreational activities is added to the normal daily intake of water. This intake is estimated at 130 ml per day (USEPA, April 1988). The daily ingestion of soil is also estimated based on current values presented by the USEPA. These values vary widely with the age of the receptor; however, to be conservative, a value of 200 mg/day is adopted for children ages 0-6 years old and a value of 100 mg/day is adopted for receptors over the age of 6.

Another important factor in estimating human intake factors is the length of time that a receptor is exposed to site residues. The daily ingestion of water is considered chronic, occurring each day of the year. However, incidental ingestion may occur for only a few days during a year and possibly only for a few hours on those days. An example which uses this scenario is an exposure due to activities around surface waters. The USEPA's Superfund Exposure Assessment Manual, April 1988, estimates an intake of water equal to 50 ml for 2.6 hr (equivalent to 130 ml/day) for 7 days/yr due to this type of activity. For the incidental ingestion of soil, a conservative estimate of the period for this type of exposure is 180 days. This would be representative of the spring and summer months that the site would be used as a softball field.

In both cases, the incidental intake can be normalized to a year by multiplying it by an appropriate factor (in this case 0.019 or 0.49 for water and soil respectively). A manipulation of the numbers described above yields a human intake factor in liters of water per kilogram of body weight per day (L/kg/day) or kilograms of soil per kilogram of body weight per day (kg/kg/day).

A multiplication of the HIF and the exposure concentrations for individual site parameters yields an estimate of the amount of the compound which would be ingested per day. This value is called the chronic daily intake (CDI) when evaluated with respect to chronic conditions. Common units for a CDI are mg/kg/day.

For site parameters which are not considered to be potential carcinogens the CDIs are compared to acceptable intake levels for chronic exposures (AIC). AICs are developed by a team of research scientists within the USEPA Office of Environmental Criteria and Assessment and the USEPA Office of Research and Development. The AIC represents a concentration at which a compound is not anticipated to cause an effect in humans. In the event that a CDI exceeds the AIC for the same compound, there may be a health risk associated with the site.

In some cases, more than one compound may pose similar hazards to a receptor. For instance, a number of volatile compounds, each below a threshold concentrations, could in combination act upon the nervous system to produce central nervous system depression. However, these compounds, when ingested separately, may not exert a similar effect. In these instances, a hazard index approach is used to assess the overall potential for non-carcinogenic effects posed by the multiple site parameters. This approach assumes that multiple subthreshold exposures could result in an adverse effect and that the magnitude of the adverse effect will be proportional to the sum of the ratios of the CDIs to AICs. When the sum of the ratios is greater than one, there may be a health concern. If appropriate, the site parameters are separated according to their target organs, and individual hazard indices are calculated for each effect.

For those parameters considered by the USEPA to be potential carcinogens, the excess cancer risk posed by each carcinogenic site parameter (if a carcinogen by oral exposure) was calculated. The excess risk of cancer represented by parameters found onsite is calculated using the chronic daily intakes. For a potential carcinogen, the CDI is multiplied by a potency factor. The potency factor is a compound-specific value used to estimate the incremental risk represented by a carcinogen. Potency values are derived by the Environmental Criteria and Assessment Office or the Carcinogen Assessment Group, both divisions of the USEPA. These values are based on epidemiologic studies in humans or on animal studies which are then extrapolated to humans. Potency Factors are presented as inverse mg/kg/day units. Therefore, a risk from a particular compound is presented as the unitless result of the CDI multiplied by the potency factor. The individual risks from each potential carcinogen are additive and, when combined, represent the total incremental risk associated with the site. This risk can then be compared to the USEPA's acceptable range of excess cancer risk (10-5 to 10-7).

6.06 Justification and Selection of Site Parameters

The selection of the following 16 site parameters was based on the frequency of detection within the same environmental matrix, toxicity, persistence, and the existence of toxicity information for these chemicals.

Inorganic

- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Manganese
- Nickel
- Zinc

Organic

- Acetone
- Benzene
- Toluene
- Xylene
- Trichloroethylene
- Benzo[a]Pyrene
- bis(2-ethylhexyl)phthalate
- Aroclor 1248 & 1254

6.06.1 Potential Carcinogens

Arsenic, benzene, benzo[a]pyrene, bis(2-ethylhexyl)-phthalate, PCBs and trichloroethylene are potential carcinogens as classified by the USEPA carcinogen assessment group (CAG) or Health Effects Assessment (HEA).

Two other site parameters, cadmium and nickel, are classified as carcinogens under the inhalation route only. These will not be assessed for carcinogenicity via the oral exposure route.

6.06.2 Non-Carcinogens

Most of the chemicals detected on the site are classified as non-carcinogens as determined through animal experimentation or epidemiologic studies. These compounds may cause various developmental or systemic toxicity including teratogenicity, liver and kidney dysfunction, or central nervous system damage. Some of the compounds listed below (identified by an asterisk) are also classified as a carcinogens due to their various modes of action. In these cases, the compound will be addressed as a non-carcinogen and as a carcinogen if appropriate to the assessment.

Bis(2-ethylhexyl)phthalate*
Cadmium*
Chromium
Lead
Manganese
Nickel
Zinc
Ethylbenzene
Toluene
Xylene

6.06.3 Laboratory Contaminants

A number of volatile and semi-volatile constituents detected by the laboratory can, in most cases, be eliminated from a quantitative analysis because they are associated with sample artifacts or blank contamination which is not related to the collected samples. In the ground water samples collected at the Cherry Farm site, bis(2-ethylhexyl)phthalate (DEHP) was disregarded as a laboratory contaminant. This was based on a review of the blank analysis data provided by the contracting laboratory. Approximately 40% of the samples which contained detectable concentrations of DEHP were associated with laboratory blanks which also contained the compound. As such, this parameter was not evaluated for the ground water matrix. Another common laboratory contaminant, acetone, was used in the evaluation of surface water and ground water because this compound was detected in samples that were not associated with contaminated method, trip, or bailer blanks.

6.067 Toxicological Profiles

6.07.1 Health and Environmental Effects

Toxicity profiles of the site parameters are discussed in Appendix E. Generally, chronic exposures at high concentrations in animal tests have shown that the site parameters are capable of inducing various systemic effects. Acute exposure yielding toxic effects is generally a result of inhalation. A review of the information presented in Appendix E indicates that adverse effects resulting from acute exposure does not occur below concentrations of 100 ppm in air. In many cases, adverse effects from acute exposure occur only under extreme condition, e.g., 3,000 ppm of benzene in the breathing zone. Based on previous monitoring results, it is not believed that concentrations of site parameters are not sufficient to cause an acute reaction. As such, acute exposures will not be assessed in this document.

6.07.2 Environmental Chemistry and Dynamics

The major chemical properties affecting the transport, distribution, and fate of the site parameters are detailed in Appendix F. Site parameters were grouped into classes of similar physiochemical properties (volatiles, semi-volatiles and inorganics).

6.08 Evaluation of the Pathways

The qualitative assessment determined that complete exposure pathways exist for soil and surface water under current conditions. Assuming no remediation at the site, future scenarios may facilitate exposures to site parameters.

Direct contact is addressed in Section 6.10 for people who use the site as a softball field. Section 6.11 quantifies surface water ingestion exposures for adults and children based on incidental and chronic intakes of River water. Quantitation of the surface water ingestion pathway is based on the dilution of ground water by the Niagara River. The dilution factor was calculated based on ground water discharge into the Niagara River divided by the total volume of water discharged out of the Niagara River. A discussion of this calculation is given in Section 6.11. Chronic daily intakes were calculated and health risks were determined for each of these exposures.

6.09 Source of Data

The quantitative evaluation was based on the analytical results from samples collected during the June and November field sampling program in 1988. Maximum and average exposure concentrations were used to calculate current and future health risks posed by site parameters.

Future health risks were based on current site parameter concentrations (1988 sampling). These exposure scenarios are considered to be conservative representations of potential future conditions.

6.10 Soil Ingestion Exposure

The exposure assessment via soil ingestion focused on the following subset of site parameters from the list in Section 6.06.

Arsenic
Cadmium
Chromium
Copper
Lead
Manganese
Nickel
Zinc
Toluene
Bis (2-ethylhexyl)phthalate (DEHP)
Trichloroethylene (TCE)
Polychlorinated Biphenyls
Benzo[a]Pyrene

This subset of site parameters (termed surface soil parameters) was selected to include carcinogenic metals and organic chemicals detected in surface soils in addition to non-carcinogenic site parameters which exceeded acceptable daily intakes.

Average values for metals were computed using the most recent results from the sampling program (11/28/88) performed by OBG. In cases where the site parameter was not detected in the sample, the detection limit concentration was used. A background soil sample was not collected during this program. Therefore, the results could not be compared to background residual levels.

Section 4.02 of this document gives a detailed description of the surface soil analysis. Seven surface soil samples were collected at depths up to 6 inches at locations identified as SS on Figure 1. As described in section 4.02, a number of volatile, semi-volatile and inorganic compounds were detected in the samples. The surface soil parameters were selected in order to address each physiochemical group.

Table 15A and 15B document the exposures represented by each surface soil parameter. Table 15A shows the estimated intake for compounds not considered to be carcinogens. A maximum and an average CDI are calculated for adults and children. The intake is based on the assumptions that adults ingest 100 mg of soil per exposure and children ages 6 and under ingest 200 mg of soil per exposure (OSWER Directive 9850.4).

The CDIs are divided by acceptable daily intakes (AICs) to produce a reference dose (RfD) Fraction. These fractions are then added to determine a final Hazard Index. Hazard Indexes are listed as 0.44, 3.69, and 1.29 for adult maximum, child maximum. and child average respectively. An adult average was not developed since the Hazard Index for adult maximum was less than one. In the case of metals, it is assumed the target organ is the liver or kidneys. The non-carcinogenic organic compounds, acetone and bis(2-ethylhexyl) phthalate, do not add significantly to the Hazard Index.

Arsenic, TCE, PCBs, DEHP, and benzo[a]pyrene were selected as carcinogenic site parameters for surface soil. Table 15B displays the results of the carcinogenic risk attributable to incidental ingestion of the compounds in soil. As in the non-carcinogenic risk, CDIs are used to determine the incremental carcinogenic risk. The CDIs for maximum and average concentrations of the parameters in soil are multiplied by a potency factor. The result is the risk attributable to the individual parameter. The carcinogenic risks are then added to obtain the total risk from soil ingestion. As shown in Table 15B, a maximum risk of 4.05×10^{-4} and an average risk of 1.5×10^{-4} are attributed to this exposure. Both of these risks are above the target risk level set by the USEPA of 10^{-5} to 10^{-7}.

6.11 Surface Water Exposure from the Niagara River

Exposure from surface water can occur through the drainage ditches or through the Niagara River. The Cherry Farm Site was determined not to have a significant effect on the quality of water in the drainage ditches (Section 4.04). Therefore, only exposures resulting from ingestion of Niagara River water could cause a potential health hazard.

Exposure resulting via the surface water route as it applies to the Niagara River is hypothesized to occur through two different mechanisms. A receptor could ingest surface water by accident as in the case of swimming in the Niagara River or could ingest surface water as potable water supplied by a River intake. In order to simplify the human intake calculations, incidental ingestion and chronic intentional ingestion are addressed on two separate tables.

Incidental ingestion is estimated using the data generated during the surface water sampling program conducted on 3/3/89. This represents the most recent data collected on drainage ditch water. The following site parameters were found in the drainage ditch water:

Lead

Manganese

Nickel

Site parameters not detected in the River water were not considered in the quantitative analysis for incidental exposure. In addition, a number of organic and semi-organic compounds were eliminated from the evaluation due to concentrations upstream in the drainage ditch being equivalent or greater than concentrations down stream in the drainage ditch, e.g. PCBs, methylene chloride, and bis(2-ethylhexyl)phthalate. Section 4.04 gives a detailed discussion of the results of surface water analysis. As described in this section, acetone, the only volatile organic site parameter detected in drainage ditch surface water, was not detected in concentrations above the reportable detection limit of 10 ug/L. For this reason, acetone will not be evaluated in the assessment.

Table 16 shows the remaining site parameters that were selected for incidental surface water ingestion. All of the selected parameters are considered to be non-carcinogenic by the USEPA. As such, a Hazard Index approach was used in the assessment as discussed in Section 6.05.4. The chronic daily intakes were determined for adult and juvenile receptors using maximum and average parameter concentrations. The human intake factor (HIF) for incidental ingestion was based on the USEPA criteria of 130 ml/day of exposure, conservatively estimated at 7 days/year (Section 6.05.4). This produced an intake factor of 3.56×10^{-5} for adults and 8.31×10^{-3} for children. The associated RfDs for each parameter are presented on Tables 15 through 17. The summation of the individual RfDs yields a value of 1.9×10^{-3} for adult maximum and 7.8×10^{-3} and 6.2×10^{-4} for child maximum and average respectively. These values are well below the Hazard Index threshold of one.

The second mechanism for potential surface water exposure is intentional ingestion of surface water as a potable water source. As previously discussed in the qualitative evaluation, a surface water intake exists approximately 3 miles downstream of the site which provides potable water for the area. As a conservative, worst case estimate of the effect of the site on this water source, it is assumed that all ground water and drainage ditch discharges at the site are transported directly toward the intake pipe and eventually to a receptor population without previous treatment. This is assumed to be a conservative estimate since the surface water is treated prior to being used as a municipal supply. In addition, the compounds in the ground water and drainage ditches are diluted by approximately 3 miles of River flow. This dilution is further addressed below.

The assessment for this exposure focuses on the following indicator parameters detected in site ground water and drainage ditches:

- Acetone
- Benzene
- Cadmium
- Chromium
- Copper
- Lead
- Manganese
- Nickel
- Polychlorinated Biphenyls
- Toluene
- Xylene
- Zinc

Section 4.04 of this document provides a detailed discussion of the compounds detected in drainage ditch surface waters collected in June and December of 1988.

Section 4.06 of this document provides a detailed discussion of the compounds detected in ground water samples collected in July of 1988 and December of 1988. The assessment for intentional surface water ingestion due to food preparation, beverages, etc., is based on the latest site data available. Site parameters not detected in ground water or drainage ditch surface waters were not considered in the evaluation.

The calculation of chronic daily intake values for residues originating in ground water is essentially the same as that of soil and surface water. A human intake factor is developed for adults and children based on the assumption discussed in Section 6.05.4. The HIF values were calculated as 2.86×10^{-2} for adults and 5.88×10^{-2} for children. The HIF is then multiplied by maximum and average parameter concentration levels to obtain the CDIs. However, for ground water a dilution factor is used to represent the dilution expected when ground water is discharged into surface water. For the Cherry Farm site a dilution factor of 1.43×10^{-6} was calculated from the average volume of ground water flowing through the site into the Niagara River (10,231 gal/day) divided by the volume of water which discharges from the Niagara River each day (57 billion gal/day) (Section 3.05.2, Site Hydrogeology).

The CDI values for each ground water indicator parameter are provided in Table 17A and 17B. Table 17A represents the values produced for the non-carcinogenic parameters in ground water, and Table 17B provides the values produced for the ground water carcinogenic parameters.

A Hazard Index approach is used for non-carcinogenic compounds as explained in section 6.05.4. The tabulated data shows a Hazard Index of 1.0×10^{-4} for adults maximum and a Hazard Index of 2.0×10^{-4} and 2.5×10^{-5} for children maximum and children average, respectively. These values are well below the Hazard Index threshold of one.

The carcinogenic site parameters in ground water, benzene and PCBs, were evaluated based on an ingestion equal to that of the non-carcinogens. Due to the large dilution factor, only the maximum concentrations in ground water were evaluated for each compound. The chronic daily intake multiplied by the potency factor for each compound produced a combined risk for the benzene and PCBs in ground water of 3×10^{-9}, which is well below the EPA criteria of 10^{-6} or one in a million.

6.12 Total Health Risks Related to Ingestion Exposures

The USEPA's reference range for acceptable levels of excess cancer risk is 10^{-5} to 10^{-7}. For the ingestion exposures analyzed, arsenic and PCBs in soil were the only carcinogens among the site parameters that were calculated to pose an excess risk outside of this range. Risk factors in a range of 1.8×10^{-4} and 1.2×10^{-4} were calculated for arsenic while a range of between 2.18×10^{-4} and 3.7×10^{-5} were calculated for PCBs.

A Hazard Index approach was used to assess the overall potential for noncarcinogenic effects posed by multiple site parameters. This approach assumes that multiple subthreshold exposures could result in an adverse effect, and that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures (CDIs) to acceptable exposures (AICs). When the sum of the ratios is greater than one, there may be a concern for a potential health risk.

The Hazard Index for incidental soil ingestion was greater than the hazard indices for surface water ingestion. However, only the Hazard Index for soil ingestion in children was greater than one (maximum =

3.69, average = 1.29). This is primarily due to the presence of lead and chromium in surface soil samples. Both of these compounds have AIC values which are low in comparison to other inorganic compounds (0.0014 and 0.005 respectively).

6.13 Summary

Based on data generated during the remedial investigation (RI), a risk assessment (RA) was conducted in accordance with the guidelines and procedures of the USEPA for evaluating public health risks related to uncontrolled hazardous waste sites (USEPA, 1986). During the field portion of the RI, ground water, drainage ditch surface water and sediments, borings, and surface soil samples were collected and analyzed for parameters contained in the NYSDEC Target Compound List (TCL). Based on the results of the analyses, frequency of detection, environmental mobility, and toxicity, a set of sixteen indicator parameters were chosen from the chemicals detected in these samples. Consistent with the USEPA guidelines, these site parameters were considered with the RA.

The first phase of the RA was a qualitative assessment in which site and waste characterization were performed, and complete exposure pathways were identified. Four exposure pathways were considered for humans and wildlife: 1) air, 2) soil, 3) surface water, and 4) ground water. Exposures by the soil and surface water pathways were concluded to be theoretically possible and were therefore classified as complete and subjected to a quantitative evaluation.

The quantitative assessment included evaluation of 1) incidental ingestion of soil by adults and children, 2) incidental ingestion of surface water by adults and children and, 3) intentional ingestion of surface water by adults and children.

As a first step in the quantitative assessment, the surface water and ground water parameter concentrations were compared to state drinking water standards. Those compounds which exceeded the standard were continued through the evaluation and are listed in Tables 15, 16, and 17. Secondly, concentrations of selected site parameters in surface water, ground water, and soil were used to calculate chronic daily intakes (CDIs). (See Tables 15-17.) Subsequently, the total CDIs for site parameters were calculated and compared to the acceptable intake levels for chronic exposure (AICs) as presented by the USEPA (USEPA, 1986). The results of these calculations are presented in Tables 15A, 16 and 17A. Thirdly, a Hazard Index (HI) approach was used to assess the overall potential for non-carcinogenic effects posed by potential additive effects of exposures to multiple site parameters. This approach assumes that multiple subthreshold exposures could result in an adverse effect and that the magnitude of the adverse effect will be proportional to the sum of the ratios of CDIs to AICs. When the sum of the ratios is greater than one, there may be a concern for a potential health risk. Fourth, the excess cancer risk posed by each carcinogenic site parameter (if a carcinogen by oral exposure) was calculated and compared to the USEPA's acceptable range of excess cancer risk (10^{-5} to 10^{-7}).

Based on an evaluation of the samples concentrations and the potential exposure routes, it was determined that only chronic exposure (exposure lasting a lifetime) to exposed site fill soils pose an unacceptable health risk for the Cherry Farm Site. Lead, benzene and PCBs represent the primary compounds which exceed AICs or the USEPA's acceptable range of excess cancer risk.

The soil Hazard Index for exposures in children exceeded one in both maximum and average parameter concentrations. The Hazard Index ranged from 3.69 to 0.44 with the lowest additive exposure represented by maximally exposed adults. (Average exposure for adults was not calculated based on the acceptable maximum HI.)

The USEPA's acceptable cancer range was exceeded by PCBs and arsenic in soil. The incremental risk for both of these compounds was about 10^{-4}.

6.14 Analysis of Uncertainty

In order to avoid deriving an underestimate of the potential health risks from the site fill material, conservative exposure assumptions were employed. Among these were a high frequency of site visits, repeated encounters with exposed unvegetated fill soils, and the calculated mean surface soil waste content. Given the non-residential nature of the site, it is improbable that a child would visit the area as frequently as assumed in the assessment. Repeated encounters with unvegetated fill soils producing the level of assumed fill soil ingestion are also unlikely. Also, the mean fill soil residue concentrations were calculated using available data for areas where the site is not capped. The actual mean surface fill soil residue concentrations will in effect be considerably lower than the level assumed in the assessment due to the actual large amount of unexposed fill soils that are presently covered by the existing site cap.

The uncapped area of the site, the landfill faces or sides, is estimated as 2.6 percent of the total site area. This value is based on the area of the uncapped portion of the site (65,000 ft^2) divided by the total area of the site including the uncaped portion (2.48 million ft^2). Therefore, the actual area of the site which presents a potental hazard is minimal. As a result, the total risk associated with the site would be proportional to the percentage of the uncapped area.

6.15 Conclusions

Through the completion of a risk assessment, it has been determined that potentially unacceptable health risks may be associated with chronic exposure (exposure lasting a lifetime) to exposed fill soils. Such health risks are primarily related to exposed foundry and steel industry wastes present on the landfill sides. Therefore, the following remedial objectives have been identified as being applicable to eliminating or reducing these potential health risks:

1) Reduce the potential for direct contact exposure with the landfill sites.
2) Control surface runoff.

Although the landfill faces or sides may currently pose a health risk to humans and wildlife due to direct contact and ingestion exposures to site fill soil, these risks may be eliminated in the future through remediation. Potentially applicable remedial activities at the site include the establishment of an effective cap over the fill. Once installed, the cap would prevent direct contact to exposed materials thereby addressing and reducing potential health risks to direct contact and ingestion exposures. Capping of the site would also reduce leaching of soluble waste components into ground water thereby reducing the transport of ground water into the Niagara River.

Remedial alternatives will be developed, screened, and analyzed in detail during the Feasibility Study (FS) of the Cherry Farm Site. The FS is the last stage of the NYSDEC's Remedial Investigation/Feasibility Study (RI/FS) process. The FS will be conducted following the NYSDEC's acceptance of this RI report and will specifically include the following tasks:

- Description of Proposed Response
- Development of Alternatives
- Initial Screening of Alternatives
- Detailed Analysis of Alternatives
- Conceptual Design
- Final FS Report

Niagara Mohawk recognizes the Town of Tonawanda's interest in development of the "Waterfront Region" as evidenced by the recently issued report entitled "Market Analysis and Development Program for the Town of Tonawanda Waterfront" (Halcyon Ltd. and Sasaki Associates Inc., May 1989). As discussed in that report, the Cherry Farm Site is one of several waterfront properties that could play a role in enhancing any future development of the area. In light of this, the forthcoming feasibility study will also address remedial alternatives that would reduce the identified risks such that the property could be developed for future use.

Tables

O'BRIEN & GERE

Table 1

Site History

Niagara Mohawk Power Corporation
Cherry Farm RI

1800's	Erie Canal constructed along eastern portion of site.
1945	Colorado Fuel and Iron (CF&I) disposes of slag and blast furnace waste from its operations.
1963	CF&I enters into agreement with INS to dispose of foundry sand from nearby industry. Two lagoons along the southwest portion of the site.
1970	Niagara Mohawk Power Corporation (NMPC) purchases site from CF&I. Dumping of waste is discontinued. NMPC caps site with clay and planted rye grass.
1978 & 1979	Investigations conducted by Interagency Task Force on Hazardous Wastes.
4/15/80	NYSDEC's Hazardous Waste Disposal Site Report prepared for the site.
6/80	Listing in NYSDEC's Hazardous Waste Disposal Sites In New York State - First Annual Report.
11/18/89	EPA site inspection performed by Fred C. Hart Associates.
3/12/81	Background Report on Cherry Farm prepared by Fred C. Hart Associates.
6/8/81	RECRA Research, Inc. completed report of analytical results for "DEC Inplace Toxics" sampling at Cherry Farm. Total phenols in surface water detected at .01 ppm to 1.0 ppm and chlorinated benzene at 0.02 ppm to 4.5 ppm.
7/82	USGS sampled soil and surface water. Iron, lead, nickel, cadmium, arsenic, detected above background results.
11/26/82	NYSDEC scores site in draft Rationale for Selecting Sites to be Included in State Superfund Evaluation report. Scored 85 points on a scale of 0 to 100.
5/83	USGS sampled soil and surface water. PCB's, toluene, phenol, napthalene and benzene detected.
6/83	Phase I investigations and report completed by NYSDEC (contractors - Engineering Science and Dames & Moore). Does not include 5/83/USGS data.

10/83	Inactive Hazardous Waste Disposal Site Report prepared by NYSDEC. Does not include 5/83 USGS data.
8/84	NYSDEC contacted Niagara Mohawk regarding the need for conducting Phase II investigations. Niagara Mohawk responded with its intention to perform the Phase II study.
4/86	O'Brien & Gere Engineers, Inc. completed a Phase II Investigation. The investigation detected PCBs, Phenols, Polynuclear Aromatic Hydrocarbons and Pthalates in the fill material. Only Phenols and PAH's detected in surface water. Several metals and benzoic acid, PAH's and pthalates were detected in ground water.
5/88	O'Brien & Gere Engineers, Inc. to begin a Remedial Investigation/ Feasibility Study.

PGB:ers/66.18

TABLE 2

WELL SPECIFICATION AND ELEVATIONS TABLE
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

WELL NUMBER	TOP OF PVC ELEV. (FT)	GROUND ELEV. (FT)	SCREENED-ELEV. (FT)	HYDRAULIC CONDUCTIVITY (CM/SEC)	GROUNDWATER ELEVATIONS (FT)						
					8/15/85*	8/28/85*	7/19/88	9/29/88	12/2/88	3/24/89	4/27/89
MW-1I	573.79	572.0	547.8 - 557.8	1.6 X 10 -5	567.66	567.37	566.91	567.30	568.51	568.59	568.58
MW-1D	574.64	572.4	526.9 - 536.9	1.4 X 10 -4	---	---	565.07	564.44	565.37	564.62	564.87
MW-2S	582.45	580.7	562.7 - 572.7	5.35 X 10 -4	---	---	568.41	568.24	568.43	568.65	568.90
MW-2I	582.36	580.3	552.0 - 562.0	7.00 X 10 -4	566.07	566.63	561.30	565.79	566.33	566.32	566.56
MW-3S	582.55	580.2	563.2 - 573.2	1.08 X 10 -2	---	---	569.20	568.97	569.33	569.58	569.62
MW-3I	582.05	580.2	552.1 - 562.1	2.60 X 10 -4	566.36	565.90	566.08	565.58	566.17	566.24	566.45
MW-4S	583.97	581.8	559.8 - 569.8	1.25 X 10 -3	---	---	567.71	567.37	567.68	567.38	567.93
MW-4I	583.31	581.7	551.8 - 561.8	3.4 X 10 -3	565.48	565.61	564.91	564.31	565.31	564.31	564.78
MW-4D	583.87	581.8	527.3 - 537.3	3.2 X 10 -4	---	---	565.02	564.43	565.36	564.60	565.04
MW-5S	578.54	576.5	562.5 - 570.5	1.1 X 10 -2	---	---	564.88	564.67	564.69	565.18	565.40
MW-5I	578.56	576.6	550.5 - 560.5	2.4 X 10 -4	565.56	565.60	564.85	564.33	565.12	564.29	564.81
MW-5D	578.85	576.7	523.5 - 533.5	6.1 X 10 -3	---	---	564.88	564.28	565.24	564.30	564.83
MW-6S	581.55	579.5	562.5 - 572.5	5.8 X 10 -3	---	---	565.45	564.92	564.91	565.82	566.32
MW-6I	578.6	577.9	548.8 - 558.8	6.0 X 10 -3	565.56	565.56	564.86	564.30	565.05	564.35	564.85
MW-6D	581.05	579.1	525.1 - 535.1	3.2 X 10 -3	---	---	564.77	564.19	564.97	564.29	564.77
MW-7S	583.38	581.1	561.4 - 571.4	7.8 X 10 -3	---	---	567.70	567.56	568.07	568.16	568.47
MW-7I	584.08	583.1	552.1 - 562.1	4.6 X 10 -3	565.76	565.72	565.08	564.61	565.37	564.73	565.21
MW-7D	583.72	581.2	529.5 - 539.5	1.9 X 10 -3	---	---	564.81	564.25	565.32	564.29	564.69
MW-8S	588.19	585.7	564.2 - 574.2	7.6 X 10 -3	---	---	569.46	569.04	569.15	569.22	569.62
MW-8I	588.38	585.9	544.4 - 554.4	6.0 X 10 -3	---	---	566.13	565.07	566.23	566.29	566.23
MW-9S	----	578.3	563.3 - 573.3	1.7 X 10 -3	---	---	565.66	564.96	565.55	565.36	565.70
MW-9I	----	578.3	543.3 - 553.3	2.5 X 10 -3	---	---	565.40	564.82	565.35	565.02	565.38
MW-10S	582.52	580.2	560.2 - 570.2	5.2 X 10 -2	---	---	568.17	567.98	568.58	568.71	569.00
MW-10I	582.29	580.2	537.7 - 547.7	1.8 X 10 -3	---	---	565.27	564.73	565.42	565.04	564.54
MW-11S	582.49	580.2	562.2 - 572.2	8.5 X 10 -5	---	---	568.76	568.44	568.78	569.32	569.69
MW-11I	582.57	580.6	540.1 - 550.1	3.0 X 10 -4	---	---	565.97	565.36	565.88	565.78	565.98
MW-12	582.49	581.0	581.0 - 591.0	1.3 X 10 -3	---	---	568.78	568.52	567.85	569.16	569.28
MW-13	585.73	584.1	562.1 - 572.1	3.9 X 10 -2	---	---	568.43	567.81	568.04	568.50	568.45

NOTE: Phase II data.

TABLE 3

ORGANIC ANALYSES - SURFACE SOILS
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	Field #1 Home Plate	Field #1 1,2,3 Bases	Field #2 Home Plate	Field #2 1,2,3 Bases	Sand Cast	Surface Soil #1	Surface Soil #2	Surface Soil #3	Surface Soil #4	Surface Soil #5	Surface Soil #6	Surface Soil #7	Surface Soil #8
Phenol	340 U	110 J	340 U	350 U	370 U	350 U	120 J	360 J	340 U	340 U	350 U	350 U	350 U
4-Methylphenol	340 U	350 U	340 U	350 U	370 U	350 U	360 U	190 J	340 U	340 U	350 U	350 U	350 U
Isophorone	340 U	350 U	340 U	350 U	370 U	350 U	360 U	360 U	340 U	340 U	350 U	350 U	420
2,4-Dimethylphenol	340 U	43 J	340 U	350 U	370 U	350 U	360 U	54 J	340 U	340 U	350 U	350 U	350 U
Naphthalene	340 U	640	340 U	350 U	10 U	510	840	770	200 J	340 U	570	150 J	390
2-Methylnaphthalene	340 U	720	340 U	22 J	21 J	610	910	910	240 J	340 U	520	160 J	380
Dibenzofuran	340 U	180 J	340 U	350 U	330 U	150 J	280 J	220 J	54 J	340 U	150 J	40 J	110 J
Hexachlorobenzene	340 U	350 U	340 U	350 U	330 U	57 J	360 U	49 J	340 U	340 U	350 U	350 U	350 U
Phenanthrene	340 U	690	340 U	150 J	330 U	500	1100	820	200 J	71 J	670	160 J	670
Anthracene	340 U	70 J	340 U	31 J	21 J	47 J	130 J	75 J	340 U	340 U	350 U	350 U	130 J
Di-n-butylphthalate	340 U	37 J	340 U	350 U	330 U	350 U	360 U	360 U	340 U	340 U	350 U	350 U	350 U
Fluoranthene	340 U	250 J	340 U	310 J	330 U	120 J	670	360 U	340 U	97 J	280 J	350 U	1100
Pyrene	340 U	150 J	340 U	270 J	330 U	73 J	180 J	120 J	41 J	340 U	350 U	350 U	381
Benzo(a)anthracene	340 U	350 U	340 U	350 U	330 U	350 U	200 J	360 U	340 U	340 U	350 U	350 U	350 U
Chrysene	340 U	350 U	340 U	230 J	330 U	350 U	360 U	180 J	340 U	340 U	210 J	350 U	570
bis(2-Ethylhexyl)phthalate	520	1400	830	560	42 B	1300	1900	1300	900	820	740	350 U	670 B
Di-n-octylphthalate	340 U	350 U	340 U	350 U	23 J	350 U	360 U	360 U	340 U	340 U	350 U	350 U	350 U
Benzo(b)fluoranthene	340 U	350 U	340 U	250 J	330 U	350 U	290 J	360 U	340 U	340 U	350 U	350 U	570
Benzo(k)fluoranthene	340 U	350 U	340 U	150 J	330 U	350 U	230 J	360 U	340 U	340 U	350 U	350 U	350 U
Benzo(a)pyrene	340 U	350 U	340 U	350 U	330 U	350 U	360 U	360 U	340 U	340 U	350 U	350 U	570
Benzo (g,h,i)perylene	340 U	350 U	340 U	350 U	330 U	350 U	360 U	360 U	340 U	340 U	350 U	350 U	110 J
Methylene Chloride	26 U	8 J	3 J	26 U	25 U	30	33	28	25 J	26 J	31 U	30 U	25 U
Acetone	47 J	35 J	51 U	36 J	46 J	45 J	55 U	54 U	28 J	106	173	77	50 U
Trichloroethene	26 U	27 U	26 U	26 U	25 U	26 U	28 U	27 U	8 J	26 U	31 U	30 U	25 U
Toluene	26 U	27 U	26 U	27 U	25 U	26 U	28 U	27 U	5 J	26 U	31 U	30 U	25 U
PCB	80 U	80 U	80 U	80 U	170*	1400**	10000*	44000*	570*	2700*	1000*	160*	550*

NOTES: All concentrations in ug/kg, dry weight.
Samples collected 6/20/88 - 6/22/88, 7/19/88 and analyzed by OBG Labs Inc.
U - Compound analyzed but not detected.
J - Indicates an estimated value.
B - Compound also found in blank.
* - The predominate aroclors are 1248 and 1254.
** - The predominate aroclor is 1254.

TABLE 4

INORGANIC ANALYSES - SURFACE SOILS
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONWANDA, NY

	Field #1 Home Plate	Field #1 1,2,3 Bases	Field #2 Home Plate	Field #2 1,2,3 Bases	Sand Cast	Surface Soil #1	Surface Soil #2	Surface Soil #3	Surface Soil #4	Surface Soil #5	Surface Soil #6	Surface Soil #7	Surface Soil #8
Aluminum	4270	8050	4360	8430	521	4940	6690	5010	3800	6680	5520	4390	5510
Arsenic	3.78	7.21	4.72	7.06	<1.0	5.45	7.67	5.3	4.22	8.48	6.93	10.7	7.56
Barium	<20	48.8	<20	44.4	<20	66.8	87.4	56	40.9	83.7	58.7	54.5	70.1
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.742	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	9.11	21.7	4.97	0.848	8.44	2.18	1.61	3.06
Calcium	28,500	25,300	30,000	22,700	1640	16,600	20,100	19,300	14,900	33,900	27,800	17,100	21,100
Chromium	9.14	12.5	8.89	13.4	5.58	633	126	150	67.4	122	72.8	56	92
Copper	20.4	17.8	22.3	21.5	7.81	129	124	110	44.2	86.8	75.6	56.3	97
Iron	9,990	15,900	10,600	18,000	2830	51,900	76,100	54,400	30,700	39,100	38,800	27,900	53,200
Lead	6.58	16.1	7.3	17.6	1.97	323	499	239	57.1	277	114	73.6	147
Manganese	270	383	282	397	47	1770	3010	1840	1130	2500	1480	981	1490
Magnesium	6710	6880	6830	6100	519	1260	2100	1130	2830	1470	1830	1150	1370
Mercury	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.584	<0.1	<0.1	<0.1
Nickel	18.3	17.9	17.7	19.4	<4	321	502	81	22.4	29.9	37.8	26.3	42.5
Potassium	522	<500	<500	644	<500	<500	<500	<500	<500	<500	<500	<500	<500
Silver	1.42	<1.0	1.22	1.51	<1	3.43	5.62	2.6	1.12	4.11	2.23	1.44	2.24
Sodium	<500	<500	<500	<500	<500	<500	<500	<500	<500	564	<500	<500	<500
Vanadium	13	20.7	13	20.9	<5	13.6	15.7	15.2	9.82	12.4	11.4	9.78	13.3
Zinc	51	68.4	51.2	74.5	8.81	1410	2390	788	138	1360	419	393	569
Cyanide	<0.1	<0.1	<0.1	<0.1	<0.1	5.44	3.95	3.62	1.88	6.25	7.56	3.81	5.82

NOTE: All concentrations in mg/kg, dry weight.
Samples collected 6/20/88 - 6/22/88, 7/19/88.
Analyzed by OBG Labs Inc.

TABLE 5

ORGANIC ANALYSES - SUB-SURFACE SOILS
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	Boring A	Boring B	Boring C	Boring D	Boring E	Boring F	Boring G
Phenol	410	5600	6900 U	370 U	600	1400	570
4-Methylphenol	390 U	2300	6900 U	370 U	430 U	530	1400
2,4-Dimethylphenol	580	830	6900 U	370 U	1400	410 U	1100
Naphthalene	920	5800	73000	350 J	320 J	390 J	1500
2-Methylnaphthalene	1100	1600	6300 J	290 J	150 J	790	2100
Acenaphthylene	390 U	360 U	5400	370 U	430 U	410 U	760 U
Acenaphthene	55 J	360 U	6900 U	370 U	430 U	410 U	760 U
Dibenzofuran	260 J	360 U	2900 J	73 J	430 U	70 J	360 J
Phenanthrene	870 U	890	19000	300 J	85 J	310 J	1400
Anthracene	130 J	360 U	7900	38 J	430 U	55 J	280 J
Di-n-butylphthalate	390 U	360 U	6900 U	370 U	46 J	410 U	760 U
Fluoranthene	390 U	360 U	22000	370 U	51 J	410 U	760 U
Pyrene	200 J	100 J	12000	130 J	48 J	200 J	370 J
3,3'-Dichlorobenzidine	790 U	720 U	14000 U	740 U	860 U	830 U	1500
Benzo(a)anthracene	130 J	360 U	9700	120 J	430 U	200 J	210 J
Chrysene	180 J	360 U	9000	370 U	430 U	410 U	270 J
bis(2-Ethylhexyl)phthalate	990	1000	6900 U	540	400 J	660	1600
Benzo(b)fluoranthene	390 U	360 U	6900 U	370 U	430 U	160 J	760 U
Benzo(k)fluoranthene	390 U	360 U	6900 U	370 U	430 U	150 J	760 U
Benzo(a)pyrene	390 U	360 U	2800 J	370 U	430 U	120 J	760 U
Acetone	260 B	93 B	690 B	580 B	350 B	11000 B	1600 B
Carbon Disulfide	30 U	27 U	53 U	26	32 U	780 U	57 U
Chloroform	30 U	27 U	15 J	28 U	32 U	780 U	57 U
1,2-Dichloroethane	30 U	27 U	53 U	28 U	32 U	780 U	57 U
2-Butanone	47 JB	45 B	79 B	56 U	65 U	1600 U	56 JB
Benzene	30 U	4 J	53 U	200	32 U	780 U	57 U
Toluene	30 U	18 J	53 U	82	32 U	780 U	57 U
Ethylbenzene	30 U	27 U	53 U	40	32 U	780 U	57 U
Xylene(total)	30 U	59 U	53 U	190	32 U	780 U	57 U
PCB *	7000	800 U	2300	9500	280	89000	39000

NOTES: All concentrations in ug/kg (ppb), dry weight.
Samples collected 6/17/88 - 6/19/88.
Analyses by OBG Labs, Inc.
U - Compound analyzed but not detected.
J - Indicates an estimated value.
B - Compound detected in blank.
* - The predominant aroclor is 1248.

TABLE 6

INORGANIC ANALYSES - SUB-SURFACE SOILS
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	Boring A 10'-12'	Boring B 4'-6'	Boring C 2-4'	Boring D 14'-16'	Boring E 8'-10'	Boring F 6'-8'	Boring G 14'-16'
Aluminum	9890	1800	11900	6280	3760	2400	6030
Arsenic	7.05	3.17	43.7	8.32	2.08	4.64	9.84
Barium	45	<21.9	120	1.5	<26	42.2	58.3
Beryllium	0.598	<0.547	2.05	0.615	<0.65	<0.627	<1.14
Cadmium	4.53	<0.547	2.03	2.18	<0.65	<0.627	6.27
Calcium	11100	2090	56600	26800	1430	13100	14600
Chromium	86.3	8.8	67.5	71.7	7.22	155	92.2
Copper	74.1	23	235	52.6	12.6	73.6	91.6
Iron	34300	8150	197000	33400	6610	40100	46100
Lead	103	23.1	651	103	15.3	26.6	265
Manganese	1340	117	4620	1770	118	1700	2080
Magnesium	1290	830	8850	1140	<650	3050	1630
Mercury	<0.12	<0.109	0.637	<0.113	0.535	<0.126	<0.229
Nickel	27	9.95	62.8	26.8	6.88	28.7	34.3
Silver	2.21	<1.09	9.58	2.67	<1.3	<1.25	2.35
Vanadium	12.5	<5.47	48.2	11.3	<6.5	22.8	<11.4
Zinc	640	30.8	2950	518	29	124	1270
Cyanide	<0.119	<0.109	36.5	0.247	<0.13	<1.125	0.24

NOTES: All concentrations in mg/kg, dry weight.
Samples collected 5/17/88 - 5/19/88.
Analyzed by OBG Labs, Inc.

TABLE 7

ORGANIC ANALYSES - SURFACE WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	NY STATE CLASS A STANDARDS	Surface Water 1		Surface Water 2		Surface Water 3		Surface Water 4		Surface Water 5		Surface Water 6		Surface Water 7	
		7/18/88	12/11/88	7/18/88	12/11/88	7/18/88	3/3/89	7/18/88	12/11/88	7/18/88	12/11/88	7/18/88	12/11/88	7/18/88	12/11/88
Phenol	✓ 1 H	11 U	10 U	11 U	10 U	11 U	13 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	12000 D
2-Chlorophenol	---	11 U	10 U	11 U	10 U	11 U	13 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	16
Benzyl alcohol	---	11 U	10 U	7 J	10 U	11 U	13 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	10 U
4-Methylphenol	---	11 U	10 U	11 U	10 U	11 U	13 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	10
2-Nitrophenol	---	11 U	10 U	11 U	10 U	11 U	13 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	32 T
2,4-Dichlorophenol	0.3* ---	11 U	10 U	11 U	10 U	11 U	13 U	11 U	10 U	11 U	10 U	11 U	10 U	6 J	10 U
4-Chlorophenol	---	11 U	9.52 U	11 U	10 U	11 U	13 U	11 U	9.52 U	11 U	9.52 U	11 U	9.52 U	11 U	250
4-Nitrophenol	---	53 U	48 U	53 U	48 U	56 U	67 U	53 U	48 U	53 U	48 U	53 U	48 U	53 U	25 J
Diethylphthalate	50 * H	11 U	10 U	11 U	10 U	1 J	13 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	10 U
bis(2-Ethylhexyl)phthalate	4 * H	11 U	10 U	27	10 U	24	13 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	10 U
Methylene Chloride	50 * H	5 U	8.5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	---	4 J	10 U	5 J	10 U	10 U	10 U	7 J	10 U	10 U	10 U	10 U	10 U	6 B	10 U
1,2-Dichloroethene(total)	✓ 0.8 ---	5 U	5 U	5 U	15	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chloroform	100 0.2 H	2 J	9.8	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 J	5 U	5 U
Bromodichloromethane	50 * H	1 J	3.3 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

NOTES: All concentrations in ug/l (ppb).
7/18/88 samples analyzed by OBG Labs, Inc.
12/11/88 & 3/3/89 samples analyzed by Versar Inc.
U - Indicates compound analyzed but not detected.
J - Indicates an estimated value.
T - The mass spectrum does not meet EPA CLP criteria for confirmation, but compound presence is strongly suspected.
D - Value from target analyte was calculated from a dilution.
H - Human based.
* - Guidance value.

TABLE 8

INORGANIC ANALYSES - SURFACE WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	NY STATE CLASS A	Surface Water 1		Surface Water 2		Surface Water 3		Surface Water 4		Surface Water 5		Surface Water 6		Surface Water 7	
	STANDARDS	7/18/88	12/11/88	7/18/88	12/11/88	7/18/88	3/3/89	7/18/88	12/11/88	7/18/88	12/11/88	7/18/88	12/11/88	7/18/88	12/11/88
Aluminum	---	683	2700	28400	[153]	33800	453	951	[178]	1390	[98]	709	[63]	1170	4320
Arsenic	50 H	<10	10 U	25.3	49	24.2	[6.8]	<10	10 U	<10	10 U	<10	10 U	41.6	26
Barium	1,000 H	<200	[47]	251	[36]	232	[38]	<200	[47]	<200	[49]	288	[58]	<200	[70]
Calcium	---	46700	64600	47200	388000	40100	115000	124000	132000	126000	131000	133000	130000	179000	420000
Chromium	50 H	9	[8.6]	39	4 U	45	[5.9]	13	4 U	14	4 U	20	4 U	18	13
Cobalt	---	<50	5 U	<50	[46]	<50	[7.1]	<50	5 U	<50	5 U	<50	5 U	<50	[6.7]
Copper	200 H	36	[11]	79	[5.3]	67	6 U	39	4 U	<25	4 U	26	4 U	38	[18]
Iron	300 H	1220	3920	35300	2940	40700	586	1620	236	2350	252	895	422	1660	6210
Lead	50 H	9.7	12	68.5	14	124	59 N	6.5	5 UN	8.7	5 UN	8.3	5 UN	12.7	29
Manganese	300 H	213	186	444	2200	414	318	172	187	213	232	318	350	152	797
Magnesium	35,000 H	9290	15900	17200	204000	17600	46700	18000	18300	18300	18200	18500	19700	18600	42500
Nickel	---	<40	9 U	44	97	47	[16]	<40	9 U	<40	9 U	<40	9 U	<40	9 U
Potassium	---	<5000	[2670]	13300	557000	14900	66400	23000	27100	22600	27200	16700	18900	95400	267000
Silver	50 H	<10	4 U	<10	4 U	<10	3 U	<10	4 U	<10	4 U	<10	4 U	<10	4 U
Sodium	---	13900	17400	17000	449000	12400	87200	59500	119000	59600	120000	66200	154000	126000	338000
Vanadium	---	<50	[5.7]	53	[30]	67	[7.6]	<50	[7.3]	<50	[6.7]	<50	[6]	<50	[40]
Zinc	300 H	29	40	231	81	184	22	35	[14]	38	[13]	75	30	30	107

NOTES:

All concentrations in ug/l (ppb)
7/18/88 samples analyzed by OBG Labs, Inc.
12/11/88 & 3/3/89 samples analyzed by Versar Inc.
U - Compound analyzed but not detected.
[ ] - Greater than or equal to instruments detection limit, but less than required detection limit.
N - Associated spike recovery outside control limits.
H - Human based.

TABLE 9

ORGANIC ANALYSES - SEDIMENT
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	SED 1 12/11/88	SED 2 12/11/88	SED 3 3/3/89	SED 4 12/11/88	SED 5 12/11/88	SED 6 12/11/88	SED 7 12/11/88
Di-n-butylphthalate	670 U	420 U	170 J	520 U	650 U	450 U	490 U
bis(2-Ethylhexyl)phthalate	670 U	420 U	50 J	520 U	650 U	450 U	490 U
Methylene Chloride	6 J	6 U	8 U	8 U	10 U	7 U	7 U
Acetone	21 U	13 U	17 U	9 J	20 U	14 U	15 U
Aroclor-1254	540 U	340 U	440 U	420 U	1000	360 U	400 U
Aroclor-1260	540 U	340 U	440 U	420 U	150 J	360 U	400 U

NOTES: All concentrations in ug/kg, dry weight.
Analyzed by Versar Inc.
U - compound analyzed but not detected.
J - Indicates an estimated value.

TABLE 10

INORGANIC ANALYSES - SEDIMENT
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	SED 1 12/11/88	SED 2 12/11/88	SED 3 3/25/89	SED 4 12/11/88	SED 5 12/11/88	SED 6 12/11/88	SED 7 12/11/88
Aluminum	15600	8210	17900	10600	11500	10100	20900
Antimony	21	16 N	[17] N	22 N	12 N	[14] N	36 N
Arsenic	17	41	11	7.7	12	9.2	77
Barium	138	125	100	151	95	193	388
Beryllium	1.8	[1.3]	[.53]	[1.1]	[0.94]	[0.72]	3.3
Cadmium	1.5 U	1 U	2.2	2.2	2.3	0.99 U	2.1 U
Calcium	53900	48900	46900	66900	56900	67000	72600
Chromium	34	27	25	34	44	158	49
Cobalt	[12]	[12]	[11]	[8.1]	[9.4]	[9.7]	[24]
Copper	44	38	24	31	41	28	53
Iron	32100	25300	28400	23800	27400	20800	45100
Lead	108	41	15 N	121	109	71	60
Manganese	796	689	496	934	907	5750	758
Magnesium	14400	12100	13200	9360	12600	11700	18200
Mercury	0.18 U	0.13 U	0.17 U	0.15 U	0.19 U	0.12 U	0.26 U
Nickel	32	28	30	20	26	20	47
Potassium	2020	1550	4910	1730	2030	1600	3460
Selenium	1.8 U	1.3 U	17 UN	1.5 U	1.9 U	1.2 U	2.6 U
Silver	1.5 U	1 U	1 U	1.2 U	1.6 U	0.99 U	2.1 U
Sodium	[457]	[375]	[345]	[315]	[342]	[233]	[835]
Thallium	3.7 UN	2.6 UN	3.3 UN	3 UN	3.9 UN	2.5 UN	5.2 UN
Vanadium	33	34	34	34	33	72	73
Zinc	176	88	89	673	3970	118	143
Cyanide	<0.92	<0.65	0.82	<0.73	<0.95	<0.62	<1.28

NOTES: All concentrations in mg/kg (ppm). Dry weight.
Analyzed by Versar Inc.
U - Compound analyzed but not detected.
[ ] - Greater than or equal to instrument detection limit, but less than required limit.
N - Associated spike recovery outside control limits.

TABLE 11

VOLATILE ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	NY STATE CLASS GA STANDARD	1 I		1 D		2 S		2 I		3 S		3 I		4 S		4 I		4 D	
		6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
Vinyl Chloride	5.0	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	---	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
✓ Methylene Chloride	50.0*	5 U	3 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
✓ Acetone	P ---	10 U	10 U	5 JB	10 U	7 J	10 U	10 U	10 U	20	10 U	10 U	10 U	10 U	25	10 U	10 U	10 U	10 U
✓ Carbon Disulfide	---	5 U	5 U	5 U	110	5 U	5 U	5 U	40	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	9
✓ 1,1-Dichloroethane	50.0*	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	7	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethene(total)	---	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
✓ 2-Butanone	---	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10	10	10 U	10 U	10 U	10 U
Trichloroethene	10.0	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
✓ Benzene	ND	5 U	5 U	5 U	5 U	1 J	5 U	5 U	5 U	1 J	5 U	1 J	5 U	2 J	5 U	5 U	5 U	5 U	5 U
Bromoform	50.0*	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
✓ 4-Methyl-2-Pentanone	---	10 U	10 U	10 U	10 U	5 J	3 J	10 U	10 U	10 U	10 U	10 U	10 U	50	45	10 U	10 U	10 U	10 U
Tetrachlorethene	0.7*	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
✓ Toluene	50.0*	5 U	5 U	5 U	5 U	2 J	5 U	5 U	5 U	5 U	5 U	1 J	5 U	1 J	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	50.0*	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Styrene	331+	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
✓ Xylene(total)	50.0*	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	7	5 U	5 U	5 U	5 U	5 U
			3		110	155	35		40			25		75	80				9

NOTES: All concentrations in ug/l.
6/27/88 samples analyzed by OBG Labs, Inc. & 11/28/88 analyzed by Versar Inc.
U - Compound analyzed but not detected.
J - Indicates an estimated value.
B - Compound was also found in blank.
T - The mass spectrum does not meet EPA CLP criteria for confirmation, but compound presence is strongly suspected.
* - Guidance standard.
ND - Not detectable.

TABLE 11

VOLATILE ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

		NY STATE CLASS GA STANDARD	5 S		5 I		5 D		6 S		6 I		6 D		7 S		7 I		7 D	
			6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/8	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
✓ Vinyl Chloride	P	5.0	22	4 J	10 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane		---	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride		50.0*	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	25 U	25 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	P	---	11	9	10 U	10 U	10 U	10 U	30	4 J	50 U	50 U	10 U	10 U	7 J	10 U	14	10 U	2 J	10 U
Carbon Disulfide		---	5 U	5 U	5 U	4 J	5 U	10	5 U	5 U	25 U	25 U	5 U	2 J	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	P	50.0*	1 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	25 U	25 U	5 U	5 U	10	5 U	5 U	5 U	5 U	5 U
✓ 1,2-Dichloroethene(total)	P	---	167	90	1 J	5 U	5 U	5 U	5 U	5 U	25 U	25 U	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U
2-Butanone		---	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
✓ Trichloroethene	P	10.0	14	11	5 U	5 U	5 U	5 U	5 U	5 U	25 U	25 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	P	ND	1 J	5 U	5 U	5 U	5 U	5 U	3 J	5 U	260	350	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U
Bromoform		50.0*	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	25 U	25 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-Pentanone		---	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U	10 U	8 J	10 U	10 U	10 U	10 U	10 U
✓ Tetrachlorethene		0.7*	1 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	25 U	25 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	P	50.0*	1 J	5 U	5 U	5 U	5 U	5 U	1 J	5 U	110	140	5 U	5 U	2 J	5 U	5 U	5 U	5 U	5 U
✓ Ethylbenzene	P	50.0*	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	63	76	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U
✓ Styrene	N	331+	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	26	36 T	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Xylene(total)		50.0*	1 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	120	170	5 U	5 U	3 J	5 U	5 U	5 U	5 U	5 U
			214	110							579	772								

NOTES: All concentrations in ug/l.

6/27/88 samples analyzed by OBG Labs, Inc. & 11/28/88 analyzed by Versar Inc.

U - Compound analyzed but not detected.

J - Indicates an estimated value.

B - Compound was also found in blank.

T - The mass spectrum does not meet EPA CLP criteria for confirmation, but compound presence is strongly suspected.

* - Guidance standard.

ND - Not detectable.

TABLE 11

VOLATILE ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

		NY STATE CLASS GA STANDARD	8 S		8 I		9 S		9 I		10 S		10 I		11 S		11 I		12		13	
			6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
Vinyl Chloride	P	5.0	1 J	10 U	10 U	10 U	124	23	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	P	---	3 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride		50.0*	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	3 J	5 U	5 U	5 U	5 U
Acetone	P	---	10 U	10 U	10 U	10 U	10 U	15	5 U	10 U	10 U	10 U	5 U	10 U	17	10 U	6 J	10 U	32	14	39	12
Carbon Disulfide	N	---	5 U	5 U	5 U	52	5 U	7	5 U	19	5 U	5 U	5 U	18	5 U	5 U	5 U	3 J	3 J	5 U	5 U	5 U
1,1-Dichloroethane	P	50.0*	15	12	5 U	5 U	4 J	5 U	5 U	5 U	4 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2 J	5 U	8	7
1,2-Dichloroethene(total)	P	---	8	7	2 J	5 U	39	16	5 U	5 U	2 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Butanone	N	---	5 J	10 U	10 U	10 U	10 U	6 JT	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	12	10 U
Trichloroethene	P	10.0	1 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	P	ND	2 J	5 U	5 U	5 U	1 J	5 U	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1 J	5 U
Bromoform		50.0*	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-Pentanone	N	---	10 U	10 U	10 U	10 U	16	10 U	10 U	10 U	7 J	9 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9 J	5 J
Tetrachlorethene		0.7*	1 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	P	50.0*	12	12	1 J	5 U	2 J	5 U	5 U	5 U	4 J	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	8	3 J
Ethylbenzene	P	50.0*	23	22	1 J	5 U	2 J	5 U	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	3 J	5 U
Styrene		331+	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Xylene(total)		50.0*	100	110	4 J	5 U	9	5 U	5 U	5 U	5	7 T	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	18	8 T
			158	167		52	188															

NOTES: All concentrations in ug/l.
6/27/88 samples analyzed by OBG Labs, Inc. & 11/28/88 analyzed by Versar Inc.
U - Compound analyzed but not detected.
J - Indicates an estimated value.
B - Compound was also found in blank.
T - The mass spectrum does not meet EPA CLP criteria for confirmation, but compound presence is strongly suspected.
* - Guidance standard.
ND - Not detectable.

TABLE 12

SEMI-VOLATILE ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	NY STATE CLASS GA STANDARDS	1 I		1 D		2 S		2 I		3 S		3 I		4 S		4 I		4 D		5 S	
		6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
Phenol P	1	11 U	5 U	11 U	5 U	1 J	5 U	11 U	5 U	31	9 U	11 U	9 U	360	880 D	11 U	5 U	11 U	5 U	22	140
2-Methylphenol	—	11 U	5 U	11 U	5 U	26	5 U	11 U	5 U	11 U	9 U	11 U	9 U	69	260 D	11 U	5 U	11 U	5 U	11 U	9 U
4-Methylphenol	—	11 U	5 U	11 U	5 U	110	5 U	11 U	5 U	11 U	9 U	11 U	9 U	360	1200 D	11 U	5 U	11 U	5 U	36	38
2,4-Dimethylphenol P	—	11 U	5 U	11 U	5 U	120	32	11 U	5 U	11 U	9 U	11 U	9 U	100	430 D	11 U	5 U	11 U	5 U	11 U	9 U
Benzoic acid ✓	—	53 U	25 U	53 U	25 U	53 U	25 U	53 U	25 U	53 U	47 U	53 U	47 U	260 U	25 U	53 U	25 U	53 U	25 U	54 U	47 U
Naphthalene P	10*	11 U	5 U	11 U	5 U	1 J	5 U	11 U	5 U	4 J	9 U	3 J	9 U	53 U	5 U	11 U	5 U	11 U	5 U	5 J	9 U
4-Chloroaniline ✓	—	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U
2-Methylnaphthalene	—	11 U	5 U	11 U	5 U	1 J	5 U	11 U	5 U	5 J	9 U	3 J	9 U	53 U	5 U	11 U	5 U	11 U	5 U	2 J	9 U
2,4,5-Trichlorophenol	—	53 U	25 U	53 U	25 U	1 J	25 U	53 U	25 U	53 U	47 U	53 U	47 U	53 U	19 T	53 U	25 U	53 U	25 U	54 U	47 U
Diethylphthalate	50*	1 J	5 U	1 J	5 U	53 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U
Phenanthrene P	50*	11 U	5 U	11 U	5 U	1 J	5 U	11 U	5 U	4 J	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	3 J	9 U
Anthracene P	50*	11 U	5 U	11 U	5 U	2 J	5 U	11 U	5 U	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U
Di-n-butylphthalate P	770*	3 J	5 U	2 J	5 U	1 J	5 U	11 U	5 U	2 J	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U
Fluoranthene P	50*	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	5 J	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	4 J	9 U
Pyrene P	50*	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	2 J	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	2 J	9 U
bis(2-Ethylhexyl)phthalate P	4200*	3 JB	7 B	15 B	4 JB	29 JB	4 J	25 B	7 B	84 B	11 U	28 B	11 ✓	55 B	17 B	17 B	10 B	11 B	13 B	11 U	9 U
Benzo(b)fluoranthene	0.002*	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	11 U	20
Benzo(k)fluoranthene P	0.002*	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	11 U	22
Benzo(a)pyrene P	ND	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	11 U	15
Chrysene P	0.002*	11 U	5 U	11 U	5 U	2 J	5 U	11 U	5 U	11 U	9 U	11 U	9 U	110 U	5 U	11 U	5 U	11 U	5 U	11 U	16
Benzo(a)anthracene P	0.002*	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	11 U	16
Dibenzofuran	—	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	260 U	5 U	11 U	5 U	11 U	5 U	1 J	9 U
Fluorene ✓	50*	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U
Acenaphthene ✓	20*	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	260 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U
Butylbenzylphthalate ✓	50*	1 U	5 U	1 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	53 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U
3,3'-Dichlorobenzidine ✓	—	21 U	10 U	21 U	10 U	21 U	10 U	21 U	10 U	21 U	19 U	21 U	19 U	53 U	10 U	21 U	10 U	21 U	10 U	22 U	19 U
Acenaphthylene ✓	20*	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	9 U
						317				31			11	1260	2788						267

NOTES: All concentrations in ug/l (ppb).
6/27/88 samples analyzed by OBG Labs, Inc. & 11/28/88 analyzed by Versar Inc.
U - Indicates compound analyzed but not detected.
J - Indicates an estimated value.
B - Indicates compound was also found in blank.
D - Value from target analyte was calculated from a dilution.
* - Guidance value.
ND - Not Detectable.

TABLE 12

SEMI-VOLATILE ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

		NY STATE CLASS GA STANDARDS	5 I		5 D		6 S		6 I		6 D		7 S		7 I		7 D		8 S		8 I	
			6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
Phenol	P	1	11 U	9 U	11 U	9 U	18	43	11 U	17	11 U	9 U	9 J	5 U	11 U	5 U	11 U	5 U	520	1200 D	11 U	5 U
2-Methylphenol		---	11 U	9 U	11 U	9 U	11 U	9 U	11 U	9 U	11 U	9 U	47	5 U	11 U	5 U	11 U	5 U	140	150 D	11 U	5 U
4-Methylphenol		---	11 U	9 U	11 U	9 U	31	9 U	11 U	9 U	11 U	9 U	130	5 U	11 U	5 U	11 U	5 U	530	630 D	11 U	5 U
2,4-Dimethylphenol	P	---	11 U	9 U	11 U	9 U	26	14	15	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	550	500 D	5 J	5 U
Benzoic acid		---	53 U	47 U	53 U	47 U	53 U	47 U	53 U	68	53 U	47 U	54 U	25 U	53 U	25 U	53 U	25 U	53 U	25 U	53 U	25 U
Naphthalene	P	10*	11 U	9 U	11 U	9 U	7 J	23	35	9 U	11 U	9 U	2 J	5 U	11 U	5 U	11 U	5 U	6 J	5 U	3 J	5 U
4-Chloroaniline	N	---	11 U	9 U	11 U	9 U	11 U	9 U	11 U	120	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
2-Methylnaphthalene		---	11 U	9 U	11 U	9 U	3 J	9 U	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	1 J	5 U
2,4,5-Trichlorophenol		---	53 U	47 U	53 U	47 U	53 U	47 U	53 U	47 U	53 U	47 U	54 U	25 U	53 U	25 U	53 U	25 U	53 U	25 U	53 U	25 U
Diethylphthalate		50*	11 U	9 U	11 U	9 U	11 U	9 U	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Phenanthrene	P	50*	11 U	9 U	11 U	9 U	14	58	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	10	5 U	11 U	5 U
Anthracene	P	50*	11 U	9 U	11 U	9 U	3 J	25	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Di-n-butylphthalate		770*	11 U	9 U	11 U	9 U	11 U	9 U	11 U	9 U	3 JB	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Fluoranthene	P	50*	11 U	9 U	11 U	9 U	21	9 U	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Pyrene		50*	11 U	9 U	11 U	9 U	11 U	9 U	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
bis(2-Ethylhexyl)phthalate		4200*	30 B	9 U	31 B	9 U	11 U	9 U	32 B	9 U	20 B	9 U	27 B	13 B	25 B	9 B	20 B	7 B	30 B	14 B	36 B	9 B
Benzo(b)fluoranthene		0.002*	11 U	9 U	11 U	9 U	11 U	84	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Benzo(k)fluoranthene	P	0.002*	11 U	9 U	11 U	9 U	11 U	90	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Benzo(a)pyrene	P	ND	11 U	9 U	11 U	9 U	11 U	63	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Chrysene	P	0.002*	11 U	9 U	11 U	9 U	11 U	72	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Benzo(a)anthracene	P	0.002*	11 U	9 U	11 U	9 U	11 U	76	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Dibenzofuran		---	11 U	9 U	11 U	9 U	2 J	9 U	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Fluorene	P	50*	11 U	9 U	11 U	9 U	10 J	31	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Acenaphthene	P	20*	11 U	9 U	11 U	9 U	11 U	19	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
Butylbenzylphthalate		50*	11 U	9 U	11 U	9 U	11 U	9 U	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
3,3'-Dichlorobenzidine	P	---	21 U	19 U	21 U	19 U	21 U	19 U	21 U	19 U	21 U	19 U	22	10 U	21 U	10 U	21 U	10 U	21 U	10 U	21 U	10 U
Acenaphthylene		20*	11 U	9 U	11 U	9 U	2 J	9 U	11 U	9 U	11 U	9 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U	11 U	5 U
							372	598	50	205			199						1750	4230		

NOTES: All concentrations in ug/l (ppb).
6/27/88 samples analyzed by OBG Labs, Inc. & 11/28/88 analyzed by Versar Inc.
U - Indicates compound analyzed but not detected.
J - Indicates an estimated value.
B - Indicates compound was also found in blank.
D - Value from target analyte was calculated from a dilution.
* - Guidance value.
ND - Not Detectable.

TABLE 12

SEMI-VOLATILE ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

		NY STATE CLASS GA STANDARDS	9 S		9 I		10 S		10 I		11 S		11 I		12		13	
			6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
Phenol	P	1	11 U	10 U	11 U	9 U	8 J	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	30	510	190
2-Methylphenol		---	11 U	10 U	11 U	9 U	22	21	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	390	110
4-Methylphenol		---	11 U	58	11 U	9 U	170	230	11 U	10 U	6 J	10 U	11 U	9 U	9 J	10 U	1600	390 D
2,4-Dimethylphenol	P	---	11 U	10 U	11 U	9 U	100	170	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	510	160
Benzoic acid		---	53 U	50 U	53 U	47 U	53 U	49 U	53 U	49 U	53 U	50 U	53 U	47 U	53 U	50 U	53 U	47 U
Naphthalene	P	10*	33	20	11 U	9 U	8 J	10 U	11 U	10 U	8 J	10 U	11 U	9 U	11 U	10 U	38	9 U
4-Chloroaniline		---	11 U	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
2-Methylnaphthalene		---	23	9 J	11 U	9 U	2 J	10 U	11 U	10 U	9 J	10 U	11 U	9 U	11 U	10 U	19	9 U
2,4,5-Trichlorophenol		---	53 U	50 U	53 U	47 U	53 U	49 U	53 U	49 U	53 U	50 U	53 U	47 U	53 U	50 U	53 U	47 U
Diethylphthalate		50*	11 U	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Phenanthrene	P	50*	13	10 U	11 U	9 U	11 U	10 U	11 U	10 U	6 J	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Anthracene		50*	11 U	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	50 U	11 U	22
Di-n-butylphthalate		770*	11 U	10 U	2 JB	9 U	11 U	10 U	2 JB	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Fluoranthene	P	50*	5 J	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Pyrene		50*	11 U	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
bis(2-Ethylhexyl)phthalate	P	4200*	55	10 U	39 B	19 U	39 B	7 J	20 B	5 J	120 B	13	21 B	13	26	10 U	11 U	16
Benzo(b)fluoranthene		0.002*	11 U	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Benzo(k)fluoranthene		0.002*	11 U	10 U	11 U	9 J	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Benzo(a)pyrene		ND	11 U	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Chrysene		0.002*	11 U	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Benzo(a)anthracene		0.002*	11 U	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Dibenzofuran		---	4 J	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Fluorene		50*	9 J	10 U	11 U	9 U	11 U	10 U	11 U	10 U	2 J	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Acenaphthene		20*	17	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
Butylbenzylphthalate		50*	11 U	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
3,3'-Dichlorobenzidine		---	11 U	20 U	11 U	9 U	21 U	20 U	21 U	20 U	21 U	20 U	21 U	19 U	21 U	20 U	21 U	19 U
Acenaphthylene		20*	11 U	10 U	11 U	9 U	11 U	10 U	11 U	10 U	11 U	10 U	11 U	9 U	11 U	10 U	11 U	9 U
			141	78			292	421				13		13	26	30	3067	888

NOTES: All concentrations in ug/l (ppb).
6/27/88 samples analyzed by OBG Labs, Inc. & 11/28/88 analyzed by Versar Inc.
U - Indicates compound analyzed but not detected.
J - Indicates an estimated value.
B - Indicates compound was also found in blank.
D - Value from target analyte was calculated from a dilution.
* - Guidance value.
ND - Not Detectable.

TABLE 13

PESTICIDE/PCB ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

		NY STATE CLASS GA STANDARDS	1 I		1 D		2 S		2 I		3 S		3 I		4 S		4 I		4 D		5 S	
			6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88
Dieldrin	P	ND	0.10 U	0.09 U	0.10 U	0.09 U	0.10 U	0.20 U	0.10 U	0.09 U	0.50 U	0.09 U	0.10 U	0.09 U	0.50 U	0.10 U	0.10 U	0.09 U	0.10 U	0.09 U	0.50 U	0.10
Aroclor-1242	P	0.1	0.05 U	0.47 U	0.05 U	0.47 U	*	1.80	*	0.47 U	*	2.3	*	1.8	*	2.90 U	0.50 U	0.47 U	*	0.47 U	*	18.00
Aroclor-1248	P	0.1	0.05 U	0.47 U	0.05 U	0.47 U	6.5*	1.00 U	4.0*	0.47 U	11.0*	0.47 U	1.1*	0.47 U	14.0*	0.51 U	0.50 U	0.47 U	0.91*	0.47 U	8.5*	0.50
Aroclor-1260	P	0.1	1.00 U	0.94 U	1.00 U	0.94 U	*	2.00 U	*	0.94 U	*	0.93 U	*	0.93 U	*	1.00 U	1.00 U	0.93 U	*	0.93 U	*	1.00
							6.5	~~3.8~~ 1.8			11.0	2.3		1.8	14				0.91		8.5	19.0

ug/l

NOTES: All concentrations in mg/l.

6/27/88 samples analyzed by OBG Labs, Inc. & 12/11/88 analyzed by Versar, Inc.

U - Compound was analyzed but not detected.

I - Inflated - Sample results suspect; Value is inflated due to early complexity - use with caution.

* - The predominate aroclor is 1248.

ND - Not detectable.

TABLE 13

PESTICIDE/PCB ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	NY STATE CLASS GA	5 I		5 D		6 S		6 I		6 D		7 S		7 I		7 D		8 S		8 I	
	STANDARDS	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88
Dieldrin	ND	0.10 U	0.09 U	0.10 U	0.94 U	1.0 U	0.09 U	0.10U	0.09 U	0.10 U	0.09 U	0.10 U	0.09 U	0.10 U	0.10 U	0.10U	0.09 U	1.0 U	0.20	0.10 U	0.10 U
Aroclor-1242	0.1	0.50 U	0.47 U	0.50 U	4.7 U	*	0.47 U	0.50U	0.47 U	*	0.47 U	0.50 U	0.47 U	*	0.49 U	0.50U	0.47 U	*	6.4	*	0.50 U
Aroclor-1248	0.1	0.50 U	0.47 U	0.50 U	4.7 U	24.0*	0.47 U	0.50U	0.47 U	0.91*	0.47 U	0.50 U	0.47 U	0.5*	0.49 U	0.50U	0.47 U	28.0*	0.47 U	3.80*	0.50 U
Aroclor-1260	0.1	1.0 U	0.94 U	1.0 U	9.4 U	*	0.94 U	1.0 U	0.94 U	*	0.94 U	1.0 U	0.93 U	*	0.98 U	1.0 U	0.93 U	*	0.93 U	*	1.00 U
						24				6.41				0.5				28	6.4	3.8	

ug/l

NOTES: All concentrations in mg/l.
6/27/88 samples analyzed by OBG Labs, Inc. & 12/11/88 analyzed by Versar, Inc.
U - Compound was analyzed but not detected.
I - Inflated - Sample results suspect; Value is inflated due to early complexity - use with caution.
* - The predominate aroclor is 1248.
ND - Not detectable.

TABLE 13

PESTICIDE/PCB ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	NY STATE CLASS GA STANDARDS	9 S		9 I		10 S		10 I		11 S		11 I		12		13	
		6/27/88	12/11/88	6-7/88	11-12/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88	6/27/88	12/11/88
Dieldrin	ND	0.50 U	0.10 U	0.10 U	0.10 U	0.10 U	0.09 U	0.10 U	0.10 U	2.0 U	0.09 U	0.5 U	0.09 U	0.10 U	0.09 U	50.0 U	0.47 U
Aroclor-1242	0.1	*	20.00 I	*	0.49 U	*	0.47 U	0.50 U	0.50 U	*	23.00 I	*	1.10	0.50 U	0.47 U	*	15.00
Aroclor-1248	0.1	69.0*	0.52 U	0.10*	0.49 U	1.0*	0.47 U	0.50 U	0.50 U	65.0*	0.47 U	15.0*	0.47 U	0.50 U	0.47 U	180.0*	2.4 U
Aroclor-1260	0.1	*	1.00 U	*	0.98 U	*	0.93 U	1.00 U	1.00 U	*	0.93 U	*	0.93 U	1.0 U	0.94 U	*	9.9
		69		0.10		1.0				65	23	15	1.10			180	24.9

ug/l

NOTES: All concentrations in mg/l

6/27/88 samples analyzed by OBG Labs, Inc. & 12/11/88 analyzed by Versar, Inc.

U - Compound was analyzed but not detected.

I - Inflated - Sample results suspect; Value is inflated due to early complexity - use with caution.

* - The predominate aroclor is 1248.

ND - Not detectable.

TABLE 14

INORGANIC ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	NY STATE CLASS GA STANDARDS	1 I		1 D		2 S		2 I	
		6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
Aluminum		57800	9420	3530	11300	33900	4610	67000	76000
filtered	---	<200	20 U	226	20 U	358	[156]	<200	[52]
Antimony		<60	29 U	<60	29 U	<60	29 U	<60	29 U
filtered	3*	<60	29 U	<60	29 U	<60	29 U	<60	29 U
Arsenic		49	11	<10	10 U	27.7	19	167	162
filtered	25	<10	10 U	<10	10 U	<10	10 U	29.4	48
Barium		747	306	<200	413	318	[135]	354	493
filtered	1000	244	206	<200	360	<200	[37]	<200	[134]
Beryllium		6	1 U	<5	1 U	<5	1 U	6	5.1
filtered	3*	<5	1 U	<5	1 U	<5	1 U	<5	1 U
Cadmium		7	4 U	<5	4 U	11	4 U	<5	4 U
filtered	10	<5	4 U	<5	4 U	<5	4 U	<5	4 U
Calcium		630000	275000	372000	330000	37400	19100	188000	286000
filtered	---	175000	198000	346000	356000	13400	10000	84500	151000
Chromium		238	76	49	50	135	19	228	178
filtered	---	12	4 U	21	4 U	<10	[4.6]	<10	4 U
Cobalt		50	[9.8]	<50	[7.8]	<50	5 U	50	92
filtered	---	<50	5 U	<50	5 U	<50	5 U	<50	5 U
Copper		194	34	26	31	238	32	249	230
filtered	1000	<25	4 U	<25	4 U	<25	[9.4]	<25	[4.7]
Iron		123000	21900	8080	18900	123000	13900	284000	184000
filtered	300	1410	3090	599	183	721	566	12400	21600
Lead		136	23	12.7	17	490	55	212	236
filtered	25	<5	5 U	<5	5 U	18	10	<5	5 U
Manganese		2580	629	244	437	2360	394	4030	5700
filtered	300	179	203	108	98	69	39	386	763
Magnesium		140000	76800	113000	97500	15300	6370	62200	86800
filtered	35000*	52700	48000	108000	118000	3240	[3300]	18400	33200
Mercury		0.5	0.2 U	<0.2	0.2 U	0.7	0.2 U	<0.2	0.2 U
filtered	2	<0.2	0.2 U	<0.2	0.2 U	<0.2	0.2 U	<0.2	0.2 U
Nickel		250	58	41	41	114	[22]	268	249
filtered	---	<40	9 U	<40	9 U	<40	9 U	<40	9 U
Potassium		6160	[2780]	16800	15100	12400	14300	18300	31000
filtered	---	<5000	[1000]	16200	13000	8420	13600	11100	23000
Silver		28	4 U	17	4 U	<10	4 U	17	[9.9]
filtered	50	<10	4 U	<10	4 U	<10	4 U	<10	4 U
Sodium		98000	122000	117000	1850000	55100	72400	92100	129000
filtered	---	97100	122000	115000	124000	49000	66400	79600	130000
Vanadium		148	[18]	<50	[21]	80	[11]	167	181
filtered	---	<50	3 U	<50	3 U	<50	[3.7]	<50	3 U
Zinc		461	90	44	108	1730	163	1000	1230
filtered	5000	39	[15]	34	38	50	[12]	33	24
Cyanide	200	<10	<10	<10	<10	<10	13.5	<10	<10

	3 S		3 I		4 S		4 I	
	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
Aluminum	123000	36400	2240	11200	183000	46200	66000	17000
filtered	504	[121]	719	504	487	892	<200	20 U
Antimony	<60	29 U	<60	29 U	68	29 U	<60	29 U
filtered	<60	29 U	<60	29 U	<60	29 U	<60	29 U
Arsenic	126	28	<10	10	73.5	16	50.7	18
filtered	<10	10 U	<10	10 U	<10	10 U	<10	10 U
Barium	1180	415	<200	[141]	1160	285	642	397
filtered	<200	[65]	<200	[60]	<200	[23]	231	277
Beryllium	7	[1.6]	<5	1 U	13	[2.7]	6	1 U
filtered	<5	1 U	<5	1 U	<5	1 U	<5	1 U
Cadmium	32	12	<5	4 U	225	48	8	4 U
filtered	<5	4 U	<5	4 U	<5	4 U	<5	4 U
Calcium	327000	133000	45700	104000	273000	55100	405000	295000
filtered	40300	66500	40200	80300	13100	8020	230000	267000
Chromium	1160	357	25	132	620	125	263	86
filtered	<10	[5.4]	<10	4 U	<10	[6.9]	17	[5.1]
Cobalt	72	[33]	<50	[12]	103	[31]	67	[20]
filtered	<50	5 U	<50	5 U	<50	5 U	<50	5 U
Copper	575	167	<25	50	818	171	218	44
filtered	<25	4 U	<25	4 U	<25	[9.4]	<25	4 U
Iron	268000	76600	5170	29400	450000	90000	263000	85800
filtered	344	[35]	504	195	943	1100	20400	31400
Lead	<5	538	5.6	116	11.5	925	236	47
filtered	<5	5 U	<5	5 U	7.6	14	7.5	5 U
Manganese	25500	8000	270	1510	22400	4260	4390	1590
filtered	<15	[2.4]	<15	[7.4]	16	32	717	839
Magnesium	80800	26200	<5000	8410	103000	20600	125000	97100
filtered	<5000	[2270]	<5000	[720]	<5000	[729]	78300	85800
Mercury	<0.2	0.2 U	<0.2	0.2 U	2.2	0.2 U	0.9	0.22 U
filtered	<0.2	0.2 U	<0.2	0.2 U	<0.2	0.2 U	<0.2	0.2 U
Nickel	336	95	<40	66	501	108	343	89
filtered	<40	9 U	<40	9 U	<40	[9.1]	<40	9 U
Potassium	43500	69700	31400	63100	32900	22800	<5000	[3750]
filtered	31200	69600	32800	70900	15700	16800	<5000	[1240]
Silver	26	[6.4]	<10	4 U	56	[9]	26	4 U
filtered	<10	4 U	<10	4 U	<10	4 U	<10	4 U
Sodium	53400	97500	58500	95600	114000	113000	193000	162000
filtered	46300	104000	55300	107000	79300	113000	174000	161000
Vanadium	676	249	<50	69	305	76	174	[36]
filtered	61	[38]	<50	[38]	<50	[9.9]	<50	3 U
Zinc	4090	1260	67	433	22600	4570	1010	217
filtered	23	[3]	23	[5.4]	39	34	37	29
Cyanide	<10	24.4	<10	16.8	<10	29.3	<10	<10

	4 D		5 S		5 I	
	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
Aluminum	64900	90200	46200	37900	3770	3580
filtered	<200	20 U	514	313	284	20 U
Antimony	<60	29 U	69	29 U	<60	29 U
filtered	<60	29 U	<60	29 U	<60	29 U
Arsenic	34.5	48	11.6	15	<10	10 U
filtered	<10	10 U	<10	10 U	<10	10 U
Barium	628	885	1200	1130	<200	[133]
filtered	231	306	<200	218	<200	[106]
Beryllium	6	[4.4]	5	[2.4]	<5	1 U
filtered	<5	1 U	<5	1 U	<5	1 U
Cadmium	7	4 U	21	4 U	<5	4 U
filtered	<5	4 U	<5	4 U	<5	4 U
Calcium	387000	481000	382000	364000	205000	243000
filtered	141000	180000	108000	172000	175000	217000
Chromium	152	152	1090	960	35	31
filtered	17	4 U	<10	4 U	12	4 U
Cobalt	54	73	<50	[36]	<50	5 U
filtered	<50	5 U	<50	5 U	<50	5 U
Copper	180	189	664	505	27	[4.2]
filtered	<25	4 U	<25	4 U	<25	4 U
Iron	142000	158000	424000	332000	22500	25900
filtered	4930	12000	215	[16]	10700	18400
Lead	172	117	<5	1270	17.4	6.9
filtered	6.7	5 U	<5	5 U	<5	5 U
Manganese	2460	3130	21600	19400	1000	1260
filtered	184	278	<15	[2]	695	1100
Magnesium	136000	164000	72400	62600	30300	34600
filtered	55400	69400	<5000	[258]	25100	32100
Mercury	<0.2	0.56	7.2	2.9	<0.2	0.2 U
filtered	<0.2	0.2 U	<0.2	0.2 U	<0.2	0.2 U
Nickel	184	180	166	132	<40	24
filtered	<40	9 U	<40	9 U	<40	9 U
Potassium	9800	19700	34500	33100	<5000	[4400]
filtered	5090	[2850]	28100	29800	<5000	[4170]
Silver	24	4 U	36	29	<10	4 U
filtered	<10	4 U	<10	4 U	<10	4 U
Sodium	55700	47500	47600	34300	62400	82800
filtered	50900	52900	42100	34500	60100	81900
Vanadium	153	161	370	283	<50	9.6
filtered	<50	3 U	<50	[4.1]	<50	3 U
Zinc	572	651	4930	3840	60	32
filtered	87	26	30	[2.3]	31	[14]
Cyanide	<10	<10	<10	83.7	14	12.3

NOTES: All concentrations in ppb.
6/27/88 samples analyzed by OBG Labs, Inc. & 11/27/88 analyzed by Versar Inc.
U - Indicates compound analyzed, but not detected.
[ ] - Greater than or equal to instrument detection limit, but less than required detection limit.
* - Guidance value.

TABLE 14

INORGANIC ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	NY STATE CLASS GA STANDARDS	5 D		6 S		6 I		6 D		7 S		7 I		7 D		8 S		8 I		9 S		9 I	
		6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
Aluminum		60800	27600	1230	15400	75800	54700	38400	25400	28200	1670	52500	15700	39800	32400	55600	18600	5890	6710	48600	12800	61900	21200
filtered	---	454	[20]	572	649	596	761	<200	20 U	1020	236	<200	20 U	<200	20 U	568	648	<200	20 U	<200	605	<200	20 U
Antimony		<60	29 U	<60	29 U	<60	29 U	<60	29 U	<60	29 U	72	29 U	<60	29 U	<60	29 U	<60	29 U	<60	29 U	<60	145 U
filtered	3*	<60	29 U	<60	29 U	<60	29 U	<60	29 U	<60	29 U	<60	29 U	<60	29 U	<60	29 U	<60	29 U	<60	29 U	<60	29 U
Arsenic		30	10	<10	23	106	34	34	15	<10	10 U	31.6	10 U	23.4	10 U	36.6	10 U	<10	10 U	47.7	[6.7]	51	18
filtered	25	<10	10 U	<10	10 U	46	49 U	<10	10 U	<10	10 U	<10	10 U	<10	10 U	<10	13	<10	10 U	<10	43	<10	10 U
Barium		564	498	<200	360	505	407	401	331	<200	[66]	427	234	564	520	670	213	312	305	655	283	678	373
filtered	1000	<200	278	<200	121	<200	[129]	<200	[123]	<200	[49]	<200	[131]	278	339	<200	[10]	269	258	<200	[73]	301	231
Beryllium		6	[1.3]	<5	[1.2]	<5	[3.2]	<5	[1.4]	<5	1 U	5	1 U	<5	[1.3]	6	1 U	<5	1 U	<5	[1.2]	<5	[1]
filtered	3*	<5	1 U	<5	1 U	<5	1 U	<5	1 U	<5	1 U	<5	1 U	<5	1 U	<5	1 U	<5	1 U	<5	1 U	<5	1 U
Cadmium		7	20 U	<5	4 U	<5	4 U	6	20 U	<5	5.1	8	4 U	<5	4 U	15	4 U	<5	4 U	16	4 U	5	4 U
filtered	10	<5	4 U	<5	4 U	<5	4 U	<5	4 U	<5	4 U	<5	4 U	<5	4 U	<5	4 U	<5	[4.7]	<5	4 U	<5	4 U
Calcium		408000	289000	169000	265000	190000	124000	444000	395000	117000	117000	290000	174000	359000	301000	137000	49400	209000	231000	187000	163000	426000	302000
filtered	---	125000	127000	171000	194000	20800	20000	151000	184000	109000	112000	137000	137000	183000	215000	31100	19200	195000	205000	106000	71600	167000	188000
Chromium		158	73	25	225	267	147	137	86	83	61	821	277	132	74	1190	262	42	45	687	237	144	49
filtered	---	14	4 U	17	4 U	<10	[8.6]	24	4 U	<10	4 U	10	4 U	17	4 U	<10	[6.4]	12	4 U	14	[5.9]	18	4 U
Cobalt		50	[21]	<50	[14]	59	63	<50	[29]	<50	5 U	<50	[22]	<50	[21]	<50	[18]	<50	8.7	<50	[27]	<50	[20]
filtered	---	<50	5 U	<50	5 U	<50	5 U	<50	5 U	<50	5 U	<50	5 U	<50	5 U	<50	5 U	<50	5 U	<50	5 U	<50	5 U
Copper		155	56	105	275	318	152	232	82	<25	[12]	262	77	91	50	264	74	26	[19]	627	165	199	56
filtered	1000	<25	4 U	109	[8.3]	123	25	71	4 U	<25	[5.8]	<25	4 U	<25	4 U	<25	[6.6]	<25	4 U	27	[10]	38	4 U
Iron		111000	45100	6160	159000	221000	151000	94900	61200	6870	5780	207000	68000	104000	80100	233000	53400	31000	32200	202000	103000	213000	88600
filtered	300	488	357	462	[86]	4990	7240	7640	9500	462	[67]	15300	15300	22400	30700	815	222	8290	7310	8600	1450	24800	28700
Lead		<5	36	21.9	328	202	133	103	38	18.7	5 U	699	174	84	33	5350	316	22.7	22	964	230	155	42
filtered	25	<5	5 U	5.6	5 U	27.6	21	<5	5 U	<5	5 U	<5	5 U	<5	5 U	26.9	5 U	<5	5 U	<5	5 U	<5	5 U
Manganese		2030	1100	215	6280	4460	3280	2320	1860	1680	1240	18700	6040	2250	1790	5910	1480	1160	1350	5510	3220	3980	2080
filtered	300	71	110	<15	[2.9]	214	225	142	157	<15	[2.4]	2150	1830	615	678	<15	[4.1]	825	872	1320	236	935	884
Magnesium		157000	108000	703000	12000	56100	32600	138000	122000	<5000	[17800]	59700	30600	124000	116000	19600	5580	42300	42400	40400	28100	99000	62700
filtered	35000*	49000	49800	<5000	[205]	<5000	[2150]	44600	47000	<5000	[614]	23300	22500	64000	81000	2350	[98]	39200	37500	16400	9720	33300	32500
Mercury		<0.2	0.2 U	<0.2	2	1	0.52	<0.2	0.2 U	<0.2	0.62	0.6	0.22	<0.2	0.22	0.5	0.2 U	<0.2	0.2 U	1.21	0.2 U	<0.2	0.2 U
filtered	2	<0.2	0.2 U	<0.2	0.2 U	<0.2	0.2 U	<0.2	0.2 U	<0.2	0.2 U	<0.2	0.2 U	<0.2	0.34	<0.2	0.2 U	<0.2	0.5 U	<0.2	0.2 U	<0.2	0.2 U
Nickel		179	67	<40	51	282	181	146	85	<40	[13]	378	136	119	66	363	90	<40	[38]	413	173	159	53
filtered	---	<40	9 U	<40	9 U	<40	[12]	<40	9 U	<40	9 U	<40	[11]	<40	9 U	<40	[11]	<40	9 U	<40	9 U	<40	9 U
Potassium		13200	9840	23800	31100	74200	90400	6590	6550	37600	51900	48500	56200	13200	22200	17800	18600	23100	30600	39000	29500	9660	5670
filtered	---	9250	[3780]	23700	29400	55800	79400	<5000	[2180]	36600	53700	43500	55400	<5000	12800	11300	15500	23000	30100	33900	18400	<5000	[2090]
Silver		25	4 U	<10	13	13	13	20	[5.6]	<10	4 U	20	4 U	20	4 U	16	4 U	12	4 U	15	[9.3]	21	4 U
filtered	50	<10	4 U	<10	4 U	<10	4 U	11	[4.2]	<10	4 U	<10	4 U	<10	4 U	<10	4 U	<10	4 U	<10	4 U	<10	4 U
Sodium		50500	39600	28000	33100	107000	111000	30900	28000	62300	78100	59800	64400	29000	36100	89000	112000	110000	115000	92100	53000	180000	173000
filtered	---	45600	42100	30200	34700	89600	113000	25200	28900	60800	81000	56300	66600	27700	36000	70100	108000	111000	118000	96900	104000	164000	178000
Vanadium		158	53	<50	104	197	126	102	[43]	67	66	436	104	112	57	112	[36]	<50	[17]	182	67	149	[39]
filtered	---	<50	3 U	<50	[13]	<50	[26]	<50	3 U	<50	[37]	<50	[4.3]	<50	3 U	<50	[8.7]	<50	3 U	<50	[9.5]	<50	3 U
Zinc		458	196	82	1210	879	587	386	213	61	34	1160	322	286	157	4360	1160	106	179	2460	676	582	208
filtered	5000	27	[16]	87	2 U	70	36	142	[18]	18	[2.4]	35	22	39	[6.9]	34	[13]	26	21	58	[16]	30	26
Cyanide	200	<10	<10	255	112	101	195	<10	<10	<10	18.5	<10	12.3	<10	40.5	<10	<10	<10	<10	<10	24.3	<10	<10

NOTES: All concentrations in ppb.
6/27/88 samples analyzed by OBG Labs. Inc. & 11/27/88 analyzed by Versar Inc.
U - Indicates compound analyzed, but not detected.
[ ] - Greater than or equal to instrument detection limit, but less than required detection limit.
* - Guidance value.

TABLE 14

INORGANIC ANALYSES - GROUND WATER
CHERRY FARM SITE
NIAGARA MOHAWK POWER CO.
TONAWANDA, NY

	NY STATE CLASS GA STANDARDS	10 S		10 I		11 S		11 I		12		13	
		6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88	6/27/88	11/28/88
Aluminum		32500	10900	31900	8700	47900	38200	12700	1200	32500	10100	123000	99800
filtered	---	402	248	(200	20 U	1260	1220	340	[41]	620	755	460	506
Antimony		(60	29 U	(60	29 U	(60	29 U	(60	29 U	(60	29 U	121	29 U
filtered	3*	(60	29 U	(60	29 U	(60	29 U	(60	29 U	(60	29 U	(60	29 U
Arsenic		27.1	10 U	29.1	10 U	31.4	22	10.7	10 U	40.4	[8.4]	91	30
filtered	25	(10	10 U	(10	10 U	(10	10 U	(10	10 U	(10	10 U	(10	[5.1]
Barium		303	[91]	240	[141]	318	273	(200	[116]	663	222	1940	1340
filtered	1000	(200	[41]	(200	[63]	(200	[23]	(200	[110]	(200	[84]	(200	[58]
Beryllium		(5	1 U	(5	1 U	(5	[2]	(5	1 U	(5	1 U	14	11
filtered	3*	(5	1 U	(5	1 U	(5	1 U	(5	1 U	(5	1 U	(5	1 U
Cadmium		18	4 U	5	4 U	20	14	(5	4 U	10	4 U	44	19
filtered	10	(5	4 U	(5	4 U	(5	4 U	(5	4 U	(5	4 U	(5	4 U
Calcium		194000	114000	288000	202000	68500	52200	80400	66000	235000	97300	734000	633000
filtered	---	69800	111000	170000	180000	23800	18100	61200	64500	73200	66400	151000	132000
Chromium		292	58	148	40	295	156	118	20	452	133	785	561
filtered	---	(10	[4.3]	21	4 U	(10	[8]	(10	4 U	(10	4 U	14	4 U
Cobalt		(50	5 U	(50	[7.2]	(50	[23]	(50	5 U	(50	[7.9]	(50	[38]
filtered	---	(50	5 U	(50	5 U	(50	5 U	(50	5 U	(50	5 U	(50	5 U
Copper		303	43	204	32	306	193	69	[9]	218	62	936	576
filtered	1000	(25	4 U	86	4 U	(25	[17]	(25	4	(25	[7.3]	50	4 U
Iron		107000	14500	120000	56400	116000	78900	60700	19800	69100	18100	536000	417000
filtered	300	327	[40]	33100	36100	2020	1580	15700	17400	207	146	989	690
Lead		323	49	96.6	19	34.5	489	(5	6	694	239	3210	2580
filtered	25	(5	5 U	6.5	5 U	27.3	26	(5	5 U	(5	5 U	6.7	5 U
Manganese		4230	470	2020	888	3260	2610	1280	465	8310	2170	37400	29300
filtered	300	(15	[2.3]	646	579	55	78	599	427	(15	[4.4]	(15	[3.4]
Magnesium		21000	[4250]	67200	40200	14800	11900	18700	13600	49800	8880	70400	46500
filtered	35000*	(5000	[605]	39200	36300	2020	[1780]	12700	13400	(5000	[182]	(5000	[256]
Mercury		0.6	0.2 U	0.23	0.2 U	(2	0.2 U	(2	0.2 U	0.6	0.2 U	2.2	1
filtered	2	(0.2	0.2 U	(0.2	0.2 U	(0.2	0.2 U	(0.2	0.2 U	(2	0.2 U	(0.2	0.2 U
Nickel		133	[31]	107	[29]	164	98	78	[14]	90	[22]	225	181
filtered	---	(40	[9.4]	(40	9 U	(40	9 U	(40	9 U	(40	9 U	(40	9 U
Potassium		40000	51200	(5000	[3140]	13300	15300	(5000	[1220]	108000	108000	54300	65700
filtered	---	37100	47400	(5000	[1840]	5640	9490	(5000	[1190]	85500	108000	43000	56200
Silver		14	4 U	14	4 U	12	[5.2]	(10	4 U	11	4 U	46	35
filtered	50	(10	4 U	11	4 U	(10	4 U	(10	4 U	(10	4 U	(10	4 U
Sodium		66400	76900	42800	46500	56800	80000	87700	102000	91300	86600	89100	79300
filtered	---	63600	76600	41800	49800	49800	69500	90400	101000	74900	90600	78900	76900
Vanadium		112	[30]	92	[17]	103	69	(5	[3.5]	239	122	484	350
filtered	---	(50	[12]	(50	3 U	(50	[12]	(5	3 U	61	112	(50	60
Zinc		1830	374	469	194	3120	2030	410	35	1260	400	9350	6710
filtered	5000	(20	[3.2]	88	24	90	51	41	[4.8]	(20	[4.1]	85	2 U
Cyanide	200	(10	(10	(10	(10	(10	(10	(10	(10	109	317	359	226

NOTES: All concentrations in ppb.
6/27/88 samples analyzed by OBG Labs, Inc. & 11/27/88 analyzed by Versar Inc.
U - Indicates compound analyzed, but not detected.
[ ] - Greater than or equal to instrument detection limit, but less than required detection limit.
* - Guidance value

TABLE 15A

NON-CARCINOGENIC RISK EVALUATION FOR SOIL

Metals:	Soil Max. Conc.	Soil Avrg. Conc.	Intake Adult Max:	Intake Adult Avrg:	Intake Child Max:	Intake Child Avrg:	AIC.	Adult Max. RfD Fraction	Child Max. RfD Fraction	Child Avrg. RfD Fraction
Cadmium	21.7	6.6	1.5×10^{-5}	4.9×10^{-6}	1.3×10^{-4}	3.8×10^{-5}	2.9×10^{-4}	0.052	0.43	0.01
Chromium	633	164.9	4.5×10^{-4}	1.2×10^{-4}	0.0037	9.6×10^{-4}	5×10^{-3}	0.09	0.73	0.19
Copper	129	90.4	9.1×10^{-5}	6.4×10^{-5}	7.0×10^{-4}	5.2×10^{-4}	0.037	0.0025	0.02	0.01
Lead	499	216.2	3.5×10^{-4}	1.5×10^{-4}	2.9×10^{-3}	1.3×10^{-3}	0.0014	0.25	2.07	0.93
Manganese	3010	1775	2.1×10^{-3}	1.3×10^{-3}	0.017	0.01	0.22	0.0096	0.08	0.05
Nickel	502	133	3.5×10^{-4}	9.4×10^{-5}	0.003	8.0×10^{-4}	0.01	0.035	0.29	0.08
Zinc	2390	933	1.7×10^{-3}	6.6×10^{-4}	0.014	0.0054	0.21	0.008	0.07	0.026
Organics:										
Toluene	5×10^{-4}	-	3.5×10^{-10}	-	2.9×10^{-9}	-	0.3	~0	~0	-
DEHP	1.9	1.0	1.3×10^{-6}	7.0×10^{-7}	1.1×10^{-5}	5.8×10^{-6}	0.02	6.7×10^{-5}	5.5×10^{-4}	2.9×10^{-4}
							H.I. =	Tot. 0.44	Tot. 3.69	Tot. 1.29

H.I.: Hazard Index (Summation of the RfD. Fractions)

A hazard index of greater than one indicates a potential health risk.

The human intake of compounds was based on an ingestion of:

Adult Intake Factor: 7.05×10^{-7} Kg soil/Kg body wt./day
Child Intake Factor: 5.8×10^{-6} Kg soil/Kg body wt./day

The concentrations of all compounds are in parts per million.

TABLE 15B

CARCINOGENIC RISK EVALUATION FOR SOIL

Metals:	Soil Max. Conc.	Soil Avrg. Conc.	Intake Adult Max.	Intake Adult Avrg.	Intake Child Max.	Intake Child Avrg.	Potency Factor	Risk Max.	Risk Avrg.
Arsenic	10.7	7.04	7.4×10^{-6}	4.9×10^{-6}	6.25×10^{-5}	4.1×10^{-4}	15	1.8×10^{-4}	1.2×10^{-4}
Organics:									
TCE	8×10^{-4}	-	5.6×10^{-10}	-	4.64×10^{-9}	-	0.11	1.0×10^{-10}	-
PCB	44	7.5	3.1×10^{-5}	5.3×10^{-6}	2.6×10^{-4}	4.0×10^{-5}	4.34	2.18×10^{-4}	3.7×10^{-5}
DEHP	1.9	1.0	1.34×10^{-6}	7.0×10^{-7}	1.1×10^{-5}	5.8×10^{-6}	6.84×10^{-4}	1.48×10^{-9}	7.8×10^{-10}
B[a]P	0.57	-	4.01×10^{-7}	-	3.3×10^{-6}	-	11.5	7.48×10^{-6}	-
								Tot. 4.05×10^{-4}	Tot. 1.5×10^{-4}

Summary of carcinogenic risk at maximum concentrations: 4.05×10^{-4}.
Summary of carcinogenic risk at average concentrations: 1.5×10^{-4}.

Acceptable Range for Risk is 10^{-5} to 10^{-7}

TCE:	Trichloroethylene
PCB:	Polychlorinated Byphenyls
DEHP:	Bis(2-Ethylhexyl)phthalate
B[a]P:	Benzo[a]Pyrene

TABLE 16

RISK EVALUATION FOR SURFACE WATER INCIDENTAL EXPOSURE

Non-Carcinogens:

Metals:	Surface W. Max. Conc.	Surface W. Avrg. Conc.	Intake Adult Max:	Intake Adult Avrg:	Intake Child Max:	Intake Child Avrg:	AIC	Adult Max. RfD Fraction	Child Max. RfD Fraction	Child Avrg. RfD Fraction
Lead	0.059	0.0018	2.1×10^{-6}	6.8×10^{-8}	8.7×10^{-6}	2.6×10^{-7}	0.0014	1.5×10^{-3}	6.2×10^{-3}	1.9×10^{-4}
Manganese	2.2	0.6	7.8×10^{-5}	2.1×10^{-5}	3.2×10^{-4}	8.8×10^{-5}	0.22	3.6×10^{-4}	1.5×10^{-3}	4.0×10^{-4}
Nickel	0.097	0.022	3.5×10^{-6}	7.8×10^{-7}	1.4×10^{-5}	3.2×10^{-6}	0.01	3.5×10^{-5}	1.4×10^{-4}	3.2×10^{-5}
Organics:										
Acetone	0.007	-	2.5×10^{-7}	-	1.0×10^{-6}	-	0.1	2.5×10^{-6}	1.0×10^{-5}	-
							H.I. =	1.9×10^{-3}	7.8×10^{-3}	6.2×10^{-4}

AIC : Chronic ingestion value not to be exceeded; from RfD. or HEA.

H.I.: Hazard Index (Summation of the RfD. Fractions)

A hazard index of greater than one indicates a potential health risk.

Intake: Ingestion of compound; calculated as concentration (PPM) of compound multiplied by daily volume of surface water ingested due to incidental exposure.

The human intake of compounds was based on an ingestion of:

Adult Intake Factor: 3.56×10^{-5} L water/Kg body wt./day
Child Intake Factor: 8.31×10^{-3} L water/Kg body wt./day

Note: The concentrations of all compounds are in parts per million.

TABLE 17A

RISK EVALUATION FOR GROUND WATER RELEASE IN SURFACE WATER

BASED ON INGESTION OF SURFACE WATER

Non-Carcinogens:

Metals:	Ground W. Max. Conc.	Ground W. Avrg. Conc.	Dilution Factor	Intake Adult Max:	Intake Adult Avrg:	Intake Child Max:	Intake Child Avrg:	AIC	Adult Max. RfD Fraction	Child Max. RfD Fraction	Child Avrg. RfD Fraction
Cadmium	0.048	0.008	$1.43x10^{-6}$	$2.0x10^{-9}$	$3.3x10^{-10}$	$4.0x10^{-9}$	$6.7x10^{-10}$	$2.9x10^{-4}$	$6.9x10^{-6}$	$1.4x10^{-5}$	$2.3x10^{-6}$
Chromium	0.96	0.167	"	$3.8x10^{-8}$	$6.0x10^{-9}$	$8.0x10^{-9}$	$1.4x10^{-8}$	$5x10^{-3}$	$7.6x10^{-6}$	$1.6x10^{-5}$	$2.8x10^{-6}$
Copper	0.58	0.121	"	$2.3x10^{-8}$	$5.0x10^{-9}$	$4.8x10^{-8}$	$1.0x10^{-9}$	0.037	$6.2x10^{-7}$	$1.2x10^{-6}$	$2.7x10^{-7}$
Lead	2.58	0.29	"	$1.1x10^{-7}$	$1.2x10^{-8}$	$2.1x10^{-7}$	$2.4x10^{-8}$	0.0014	$7.9x10^{-5}$	$1.6x10^{-4}$	$1.7x10^{-5}$
Manganese	29.3	4.0	"	$1.2x10^{-6}$	$1.6x10^{-7}$	$2.4x10^{-6}$	$3.4x10^{-7}$	0.22	$5.5x10^{-6}$	$1.1x10^{-5}$	$1.5x10^{-6}$
Nickel	0.25	0.09	"	$1.0x10^{-8}$	$3.0x10^{-9}$	$2.1x10^{-8}$	$7.0x10^{-9}$	0.01	$1.0x10^{-6}$	$2.1x10^{-6}$	$7.2x10^{-7}$
Zinc	6.71	0.99	"	$2.7x10^{-7}$	$4.0x10^{-8}$	$5.6x10^{-7}$	$8.2x10^{-8}$	0.21	$1.3x10^{-6}$	$2.7x10^{-6}$	$4.0x10^{-7}$
Organics:											
Acetone	0.11	0.008	"	$4.4x10^{-9}$	$3.3x10^{-10}$	$9.3x10^{-9}$	$6.7x10^{-10}$	0.1	$4.4x10^{-8}$	$9.2x10^{-8}$	$6.7x10^{-9}$
Toluene	0.14	0.01	"	$5.7x10^{-9}$	$4.1x10^{-10}$	$1.1x10^{-9}$	$8.4x10^{-10}$	0.3	$1.9x10^{-8}$	$3.9x10^{-8}$	$2.8x10^{-9}$
Xylene	0.17	0.015	"	$7.0x10^{-9}$	$6.1x10^{-10}$	$1.4x10^{-8}$	$1.3x10^{-9}$	0.01	$7.0x10^{-8}$	$1.4x10^{-8}$	$1.2x10^{-7}$
							H.I. =		$1.0x10^{-4}$	$2.0x10^{-4}$	$2.5x10^{-5}$

Intake: Ingestion of compound; calculated as concentration (PPM) of compound multiplied by daily volume of surface water ingested by a person. The human intake of compounds was based on an ingestion of:

Adult Intake Factor: $2.86x10^{-2}$ L water/Kg body wt./day
Child Intake Factor: $5.88x10^{-2}$ L water/Kg body wt./day

AIC : Chronic ingestion value not to be exceeded; from RfD. or HEA.
RfD Fraction: Intake value divided by AIC.
H.I.: Hazard Index (Summation of the RfD. Fractions)

A hazard index of greater than one indicates a potential health risk.
Concentrations are given in parts per million.

TABLE 17B

CARCINOGENIC RISK EVALUATION FOR GROUND WATER RELEASE IN SURFACE WATER

BASED ON INGESTION OF SURFACE WATER

Carcinogens:

	Surface W. Max. Conc.	Dilution Factor	Intake Adult Max:	Intake Child Max:	P.F.	Risk Max[1]
PCB	0.015	1.43×10^{-6}	6.1×10^{-10}	1.0×10^{-9}	4.34	2.0×10^{-9}
Benzene	0.35	"	1.4×10^{-8}	3.0×10^{-8}	0.052	1.0×10^{-9}
						3x10-$^{-9}$

Intake: Ingestion of compound; calculated as concentration (PPM) of compound multiplied by daily volume of surface water ingested by a person.
The human intake of compounds was based on an ingestion of:
Adult Intake Factor: 2.86×10^{-2} L water/Kg body wt./day
Child Intake Factor: 5.88×10^{-2} L water/Kg body wt./day

P.F.: Potency factor for the particular carcinogen

Risk Max[1]: Maximum incremental risk resulting from human ingestion of suface water from a ground water source.

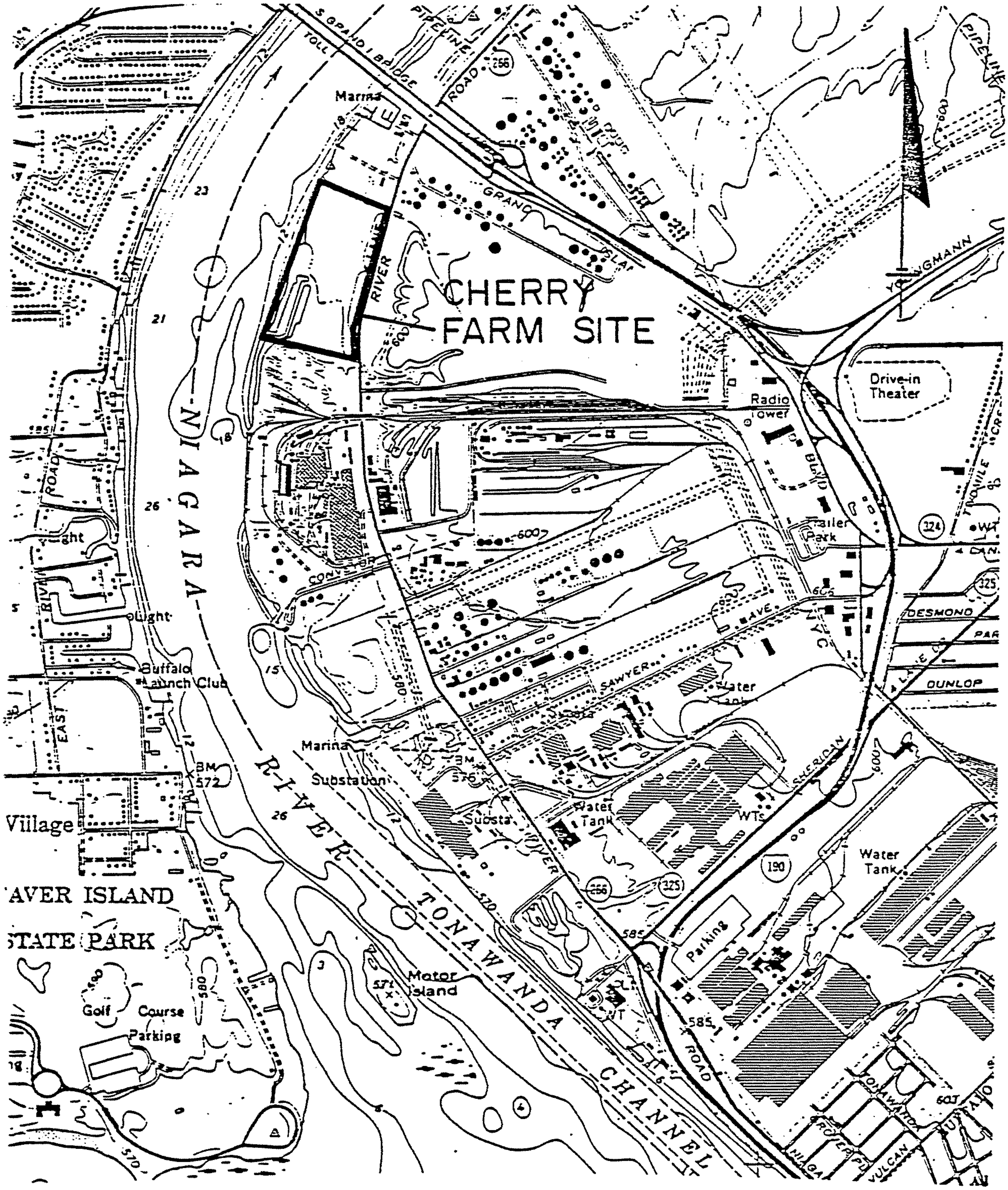
Acceptable Range for Risk = 10^{-5} to 10^{-7}

Note: The concentrations of all compounds are in parts per million.

Figures

O'BRIEN & GERE

FIGURE 1



CHERRY FARM
SITE LOCATION MAP

NIAGARA MOHAWK POWER CORP.
TONAWANDA, NEW YORK

ADAPTED FROM U.S.G.S. (7.5 MIN.) BUFFALO NW N.Y.-
ONTARIO QUADRANGLE 1965

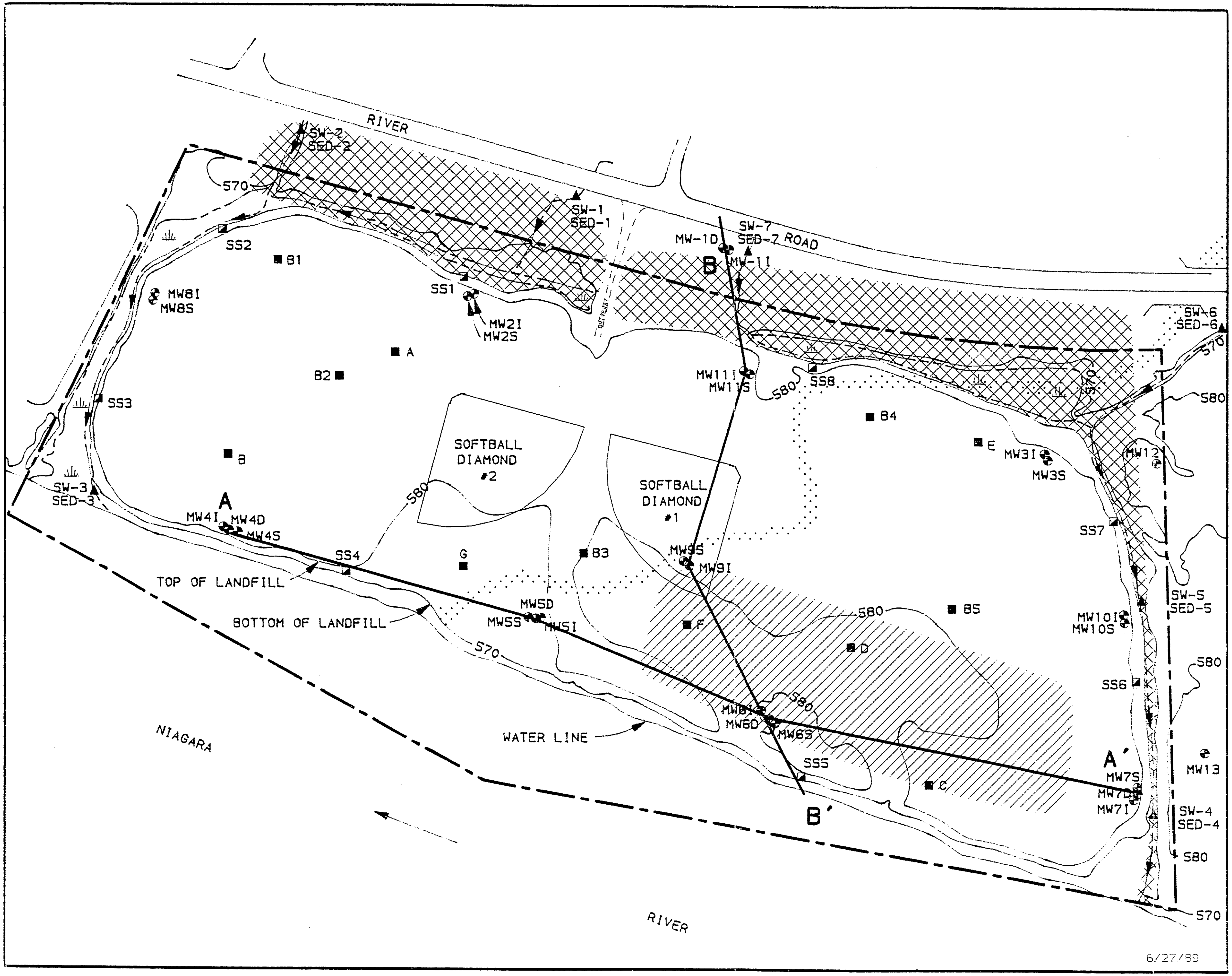
SCALE 1" = 2,000'

O'BRIEN & GERE ENGINEERS, INC.

FIGURE 2

REMEDIAL / INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

SITE MAP



LEGEND

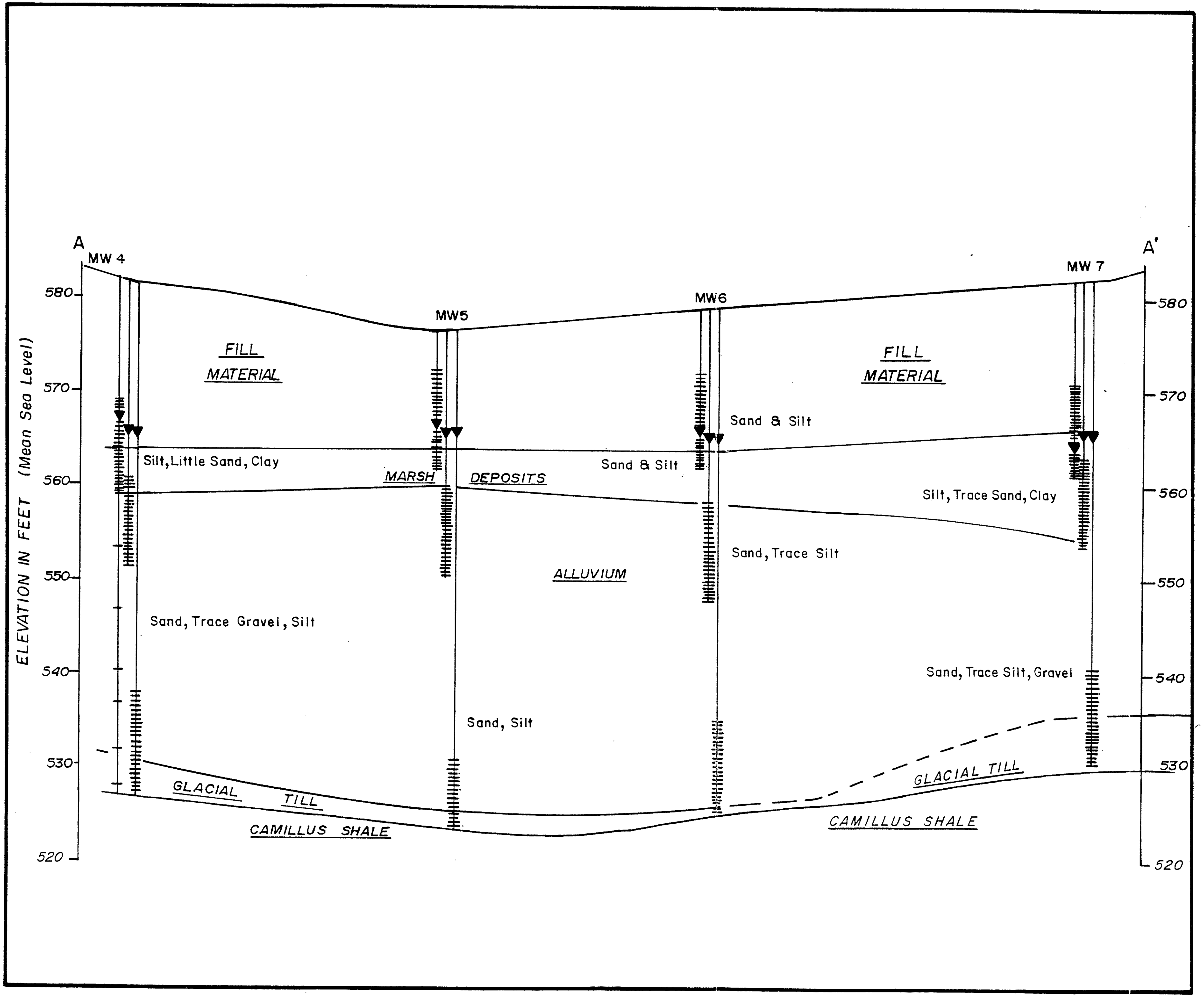
- ---- DRAINAGE DITCH
- — - APPROXIMATE PROPERTY LINE
- ▨ GENERAL AREA OF FORMER SETTLING PONDS
- ⋯ FORMER STREAM CHANNEL
- ◐ MONITORING WELL
- ◪ LANDFILL FACE SAMPLE
- ■ SOIL BORING
- ▲ SURFACE WATER/SEDIMENT SAMPLING
- A—A′ GEOLOGIC CROSS-SECTION
- ▩ DESIGNATED WETLAND

0 200 400
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.
Syracuse, New York

FIGURE 3

REMEDIAL INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK



GEOLOGIC CROSS-SECTION
A — A'

LEGEND

SCREENED INTERVAL
▼ GROUND WATER ELEVATION
~ LITHOLOGIC BOUNDARY

SCALE:
HORIZONTAL: 1" = 200'
VERTICAL : 1" = 10'

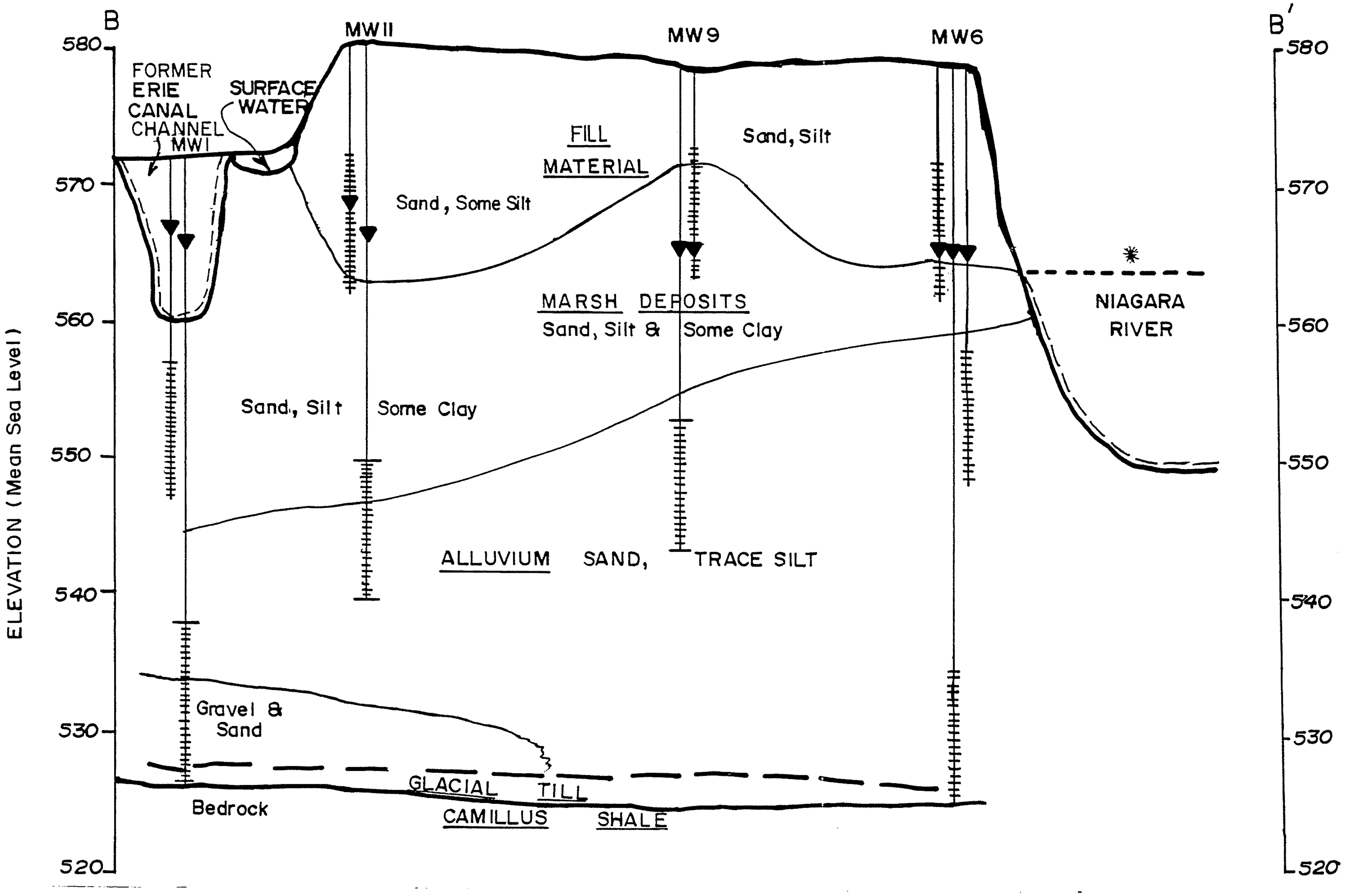
0 100 200
SCALE IN FEET

O'BRIEN & GERE

FIGURE 4

REMEDIAL INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

GEOLOGIC CROSS-SECTION
B — B'



LEGEND

- ǂ SCREENED INTERVAL
- ▼ GROUND WATER ELEVATION
- ～ LITHOLOGIC BOUNDARY
- ✷ ESTIMATED SURFACE WATER ELEVATION

SCALE:

HORIZONTAL : 1" = 200'
VERTICAL : 1" = 10'

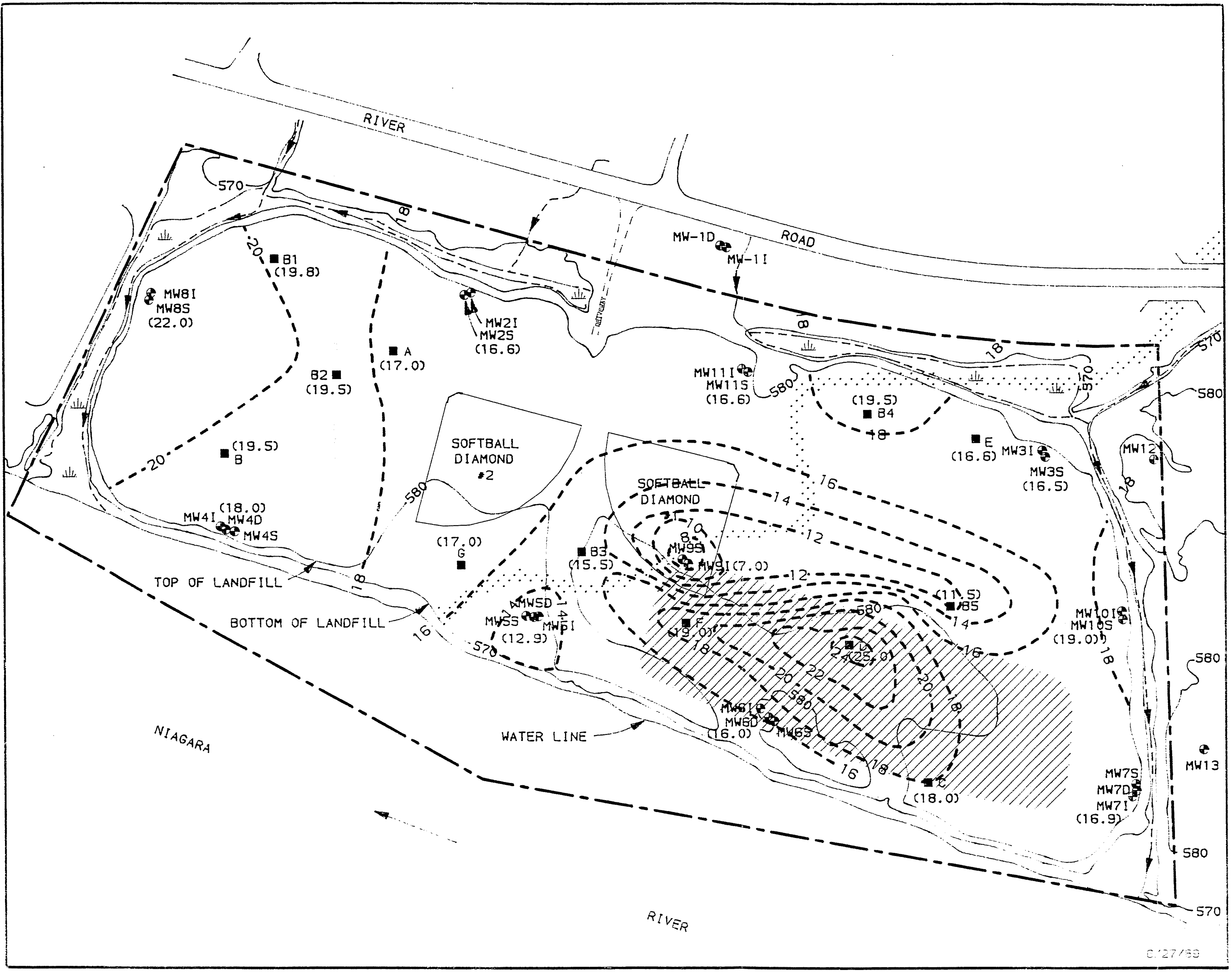
0 100 200
SCALE IN FEET

O'BRIEN & GERE

FIGURE 5

REMEDIAL / INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

FILL THICKNESS CONTOUR MAP



LEGEND

──	DRAINAGE DITCH
━ ━	APPROXIMATE PROPERTY LINE
▨	GENERAL AREA OF FORMER SETTLING PONDS
⋯	FORMER STREAM CHANNEL
◐	MONITORING WELL
(1.9)	FILL THICKNESS (FEET)
■	SOIL BORING
- - -	FILL THICKNESS CONTOUR

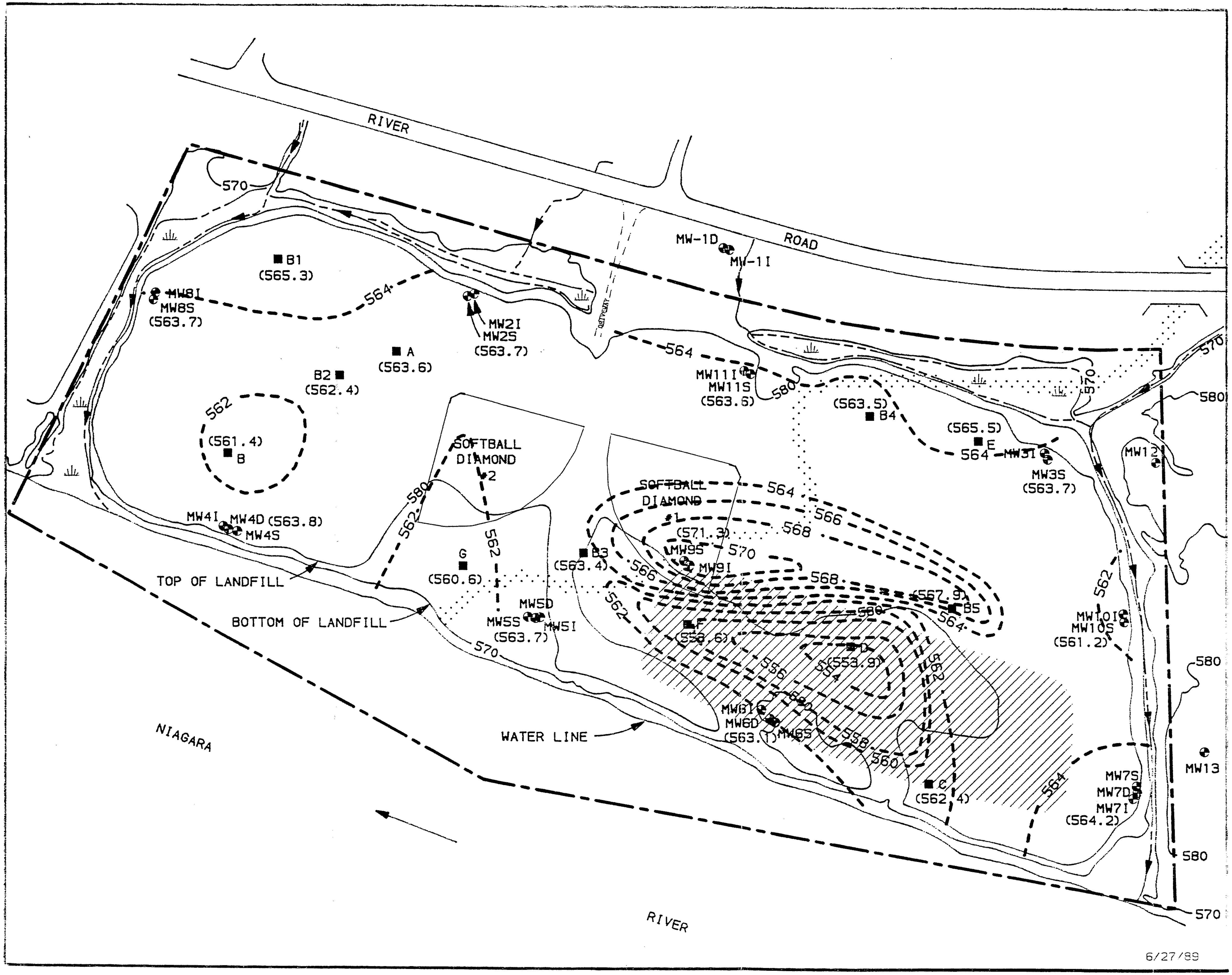
0 200 400
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.
Syracuse, New York

FIGURE 6

REMEDIAL / INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

TOP OF ALLUVIUM CONTOUR MAP



LEGEND

———	DRAINAGE DITCH
━ ━ ━	APPROXIMATE PROPERTY LINE
▨	GENERAL AREA OF FORMER SETTLING PONDS
⋯⋯	FORMER STREAM CHANNEL
◐	MONITORING WELL
(561.2)	BOTTOM OF FILL EL. (FEET)
■	SOIL BORING
– – –	TOP OF ALLUVIUM CONTOUR

0 200 400

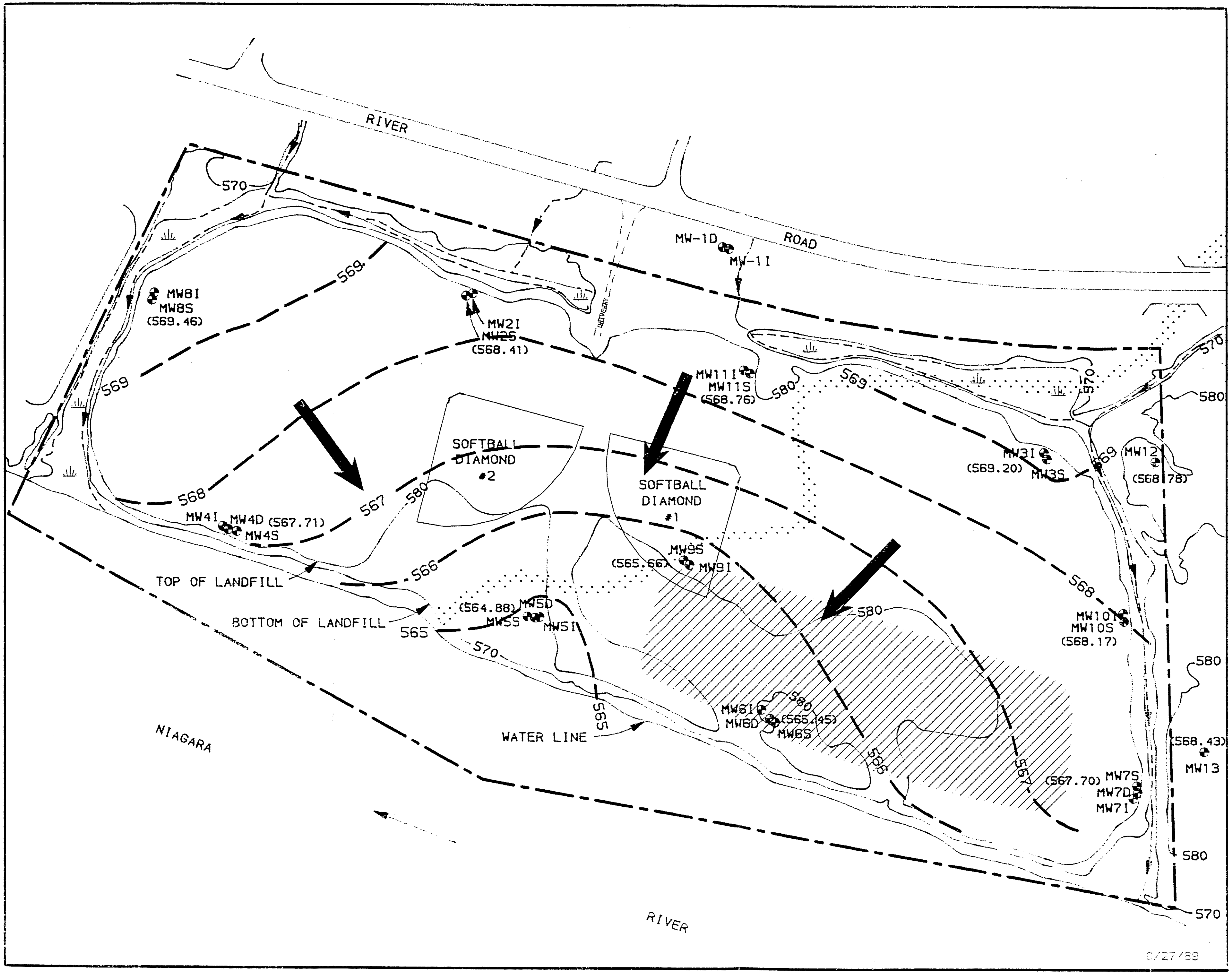
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.
Syracuse, New York

FIGURE 7

REMEDIAL / INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

GROUND WATER FLOW DIRECTION
SHALLOW WELLS
JULY 19, 1988



LEGEND

- DRAINAGE DITCH
- APPROXIMATE PROPERTY LINE
- GENERAL AREA OF FORMER SETTLING PONDS
- FORMER STREAM CHANNEL
- MONITORING WELL
- (568.17) GROUND WATER ELEVATION
- EQUIPOTENTIAL LINE
- GROUND WATER FLOW DIRECTION

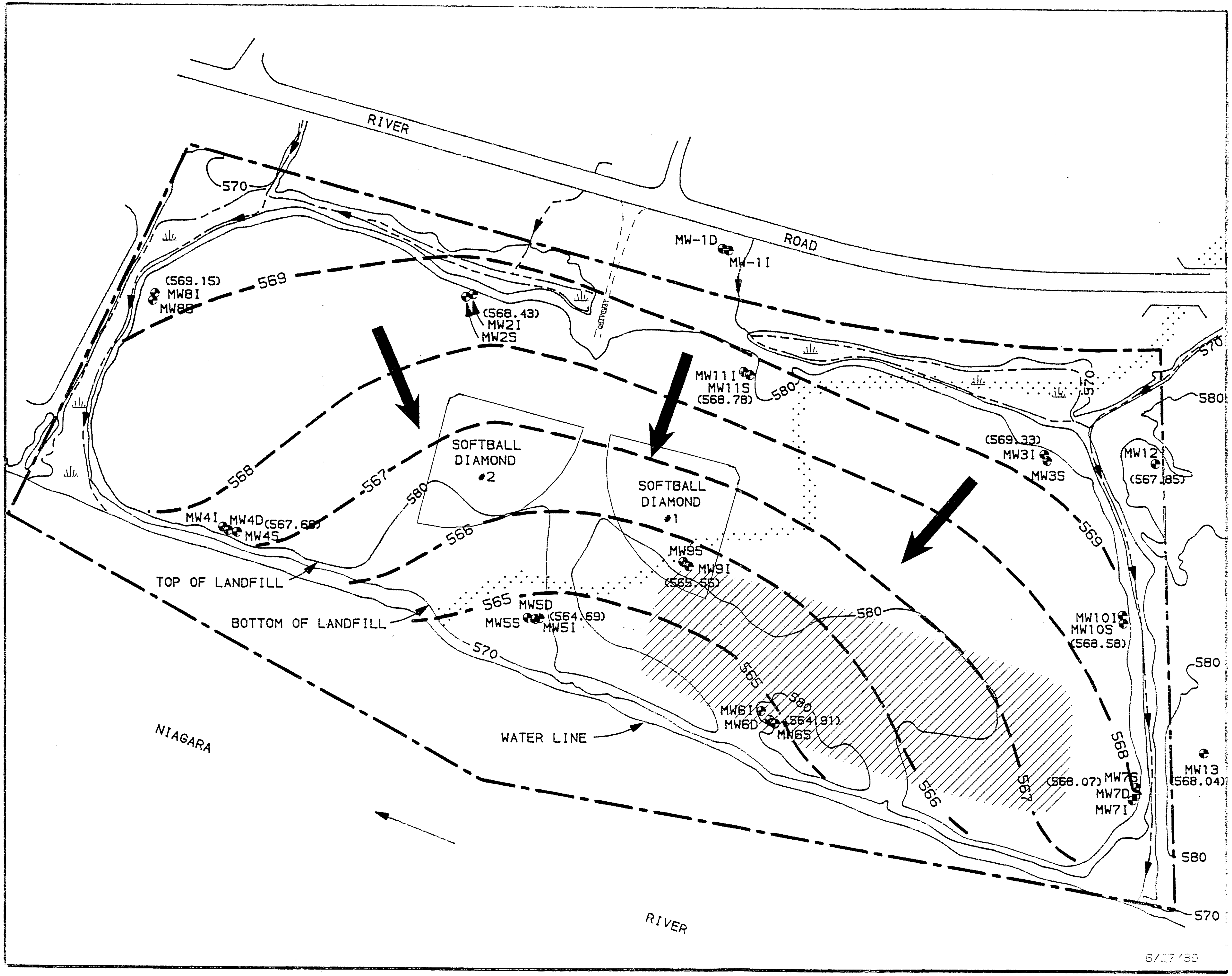
0 200 400
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.

FIGURE 8

REMEDIAL / INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

GROUND WATER FLOW DIRECTION
SHALLOW WELLS
DECEMBER 2, 1988



LEGEND

—	DRAINAGE DITCH
— - —	APPROXIMATE PROPERTY LINE
▨	GENERAL AREA OF FORMER SETTLING PONDS
⋯	FORMER STREAM CHANNEL
●	MONITORING WELL
(568.58)	GROUND WATER ELEVATION
— —	EQUIPOTENTIAL LINE
←	GROUND WATER FLOW DIRECTION

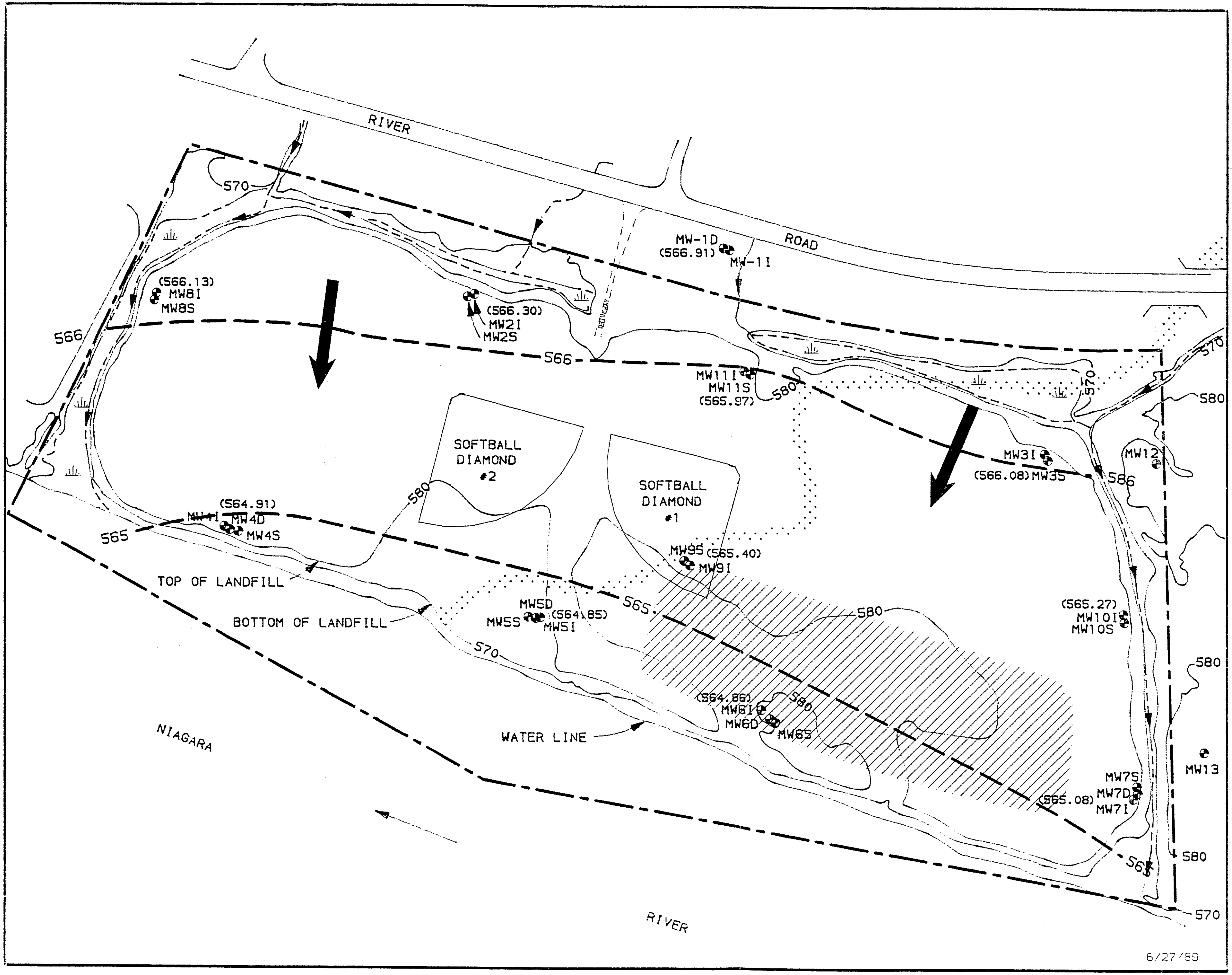
0 200 400
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.
Syracuse, New York

FIGURE 9

REMEDIAL / INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

GROUND WATER FLOW DIRECTION
INTERMEDIATE WELLS
JULY 19, 1988



LEGEND

- —— DRAINAGE DITCH
- — - — APPROXIMATE PROPERTY LINE
- ▨ GENERAL AREA OF FORMER SETTLING PONDS
- ⋯ FORMER STREAM CHANNEL
- ◒ MONITORING WELL
- (565.27) GROUND WATER ELEVATION
- — — EQUIPOTENTIAL LINE
- ⬋ GROUND WATER FLOW DIRECTION

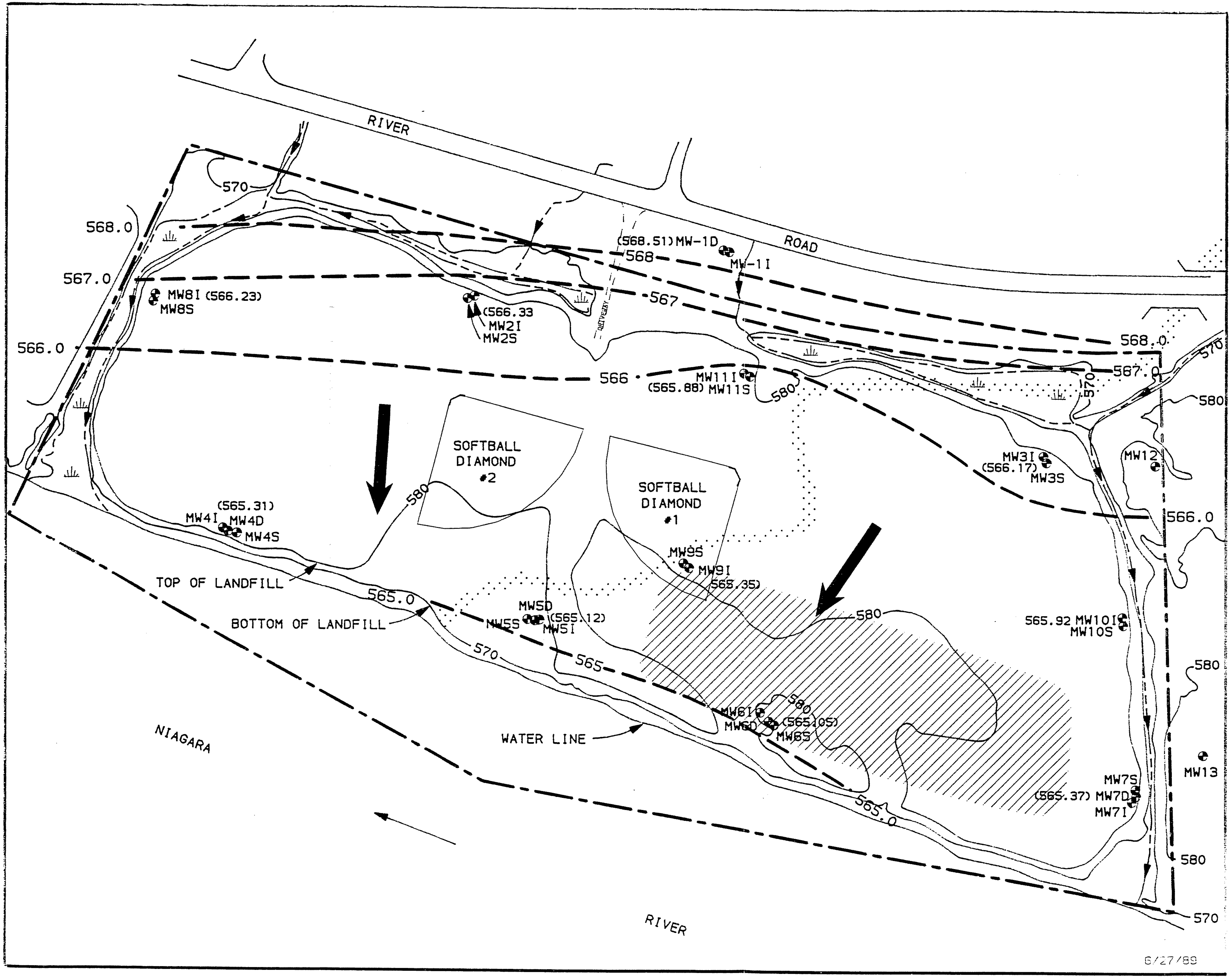
0 200 400
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.
Syracuse, New York

FIGURE 10

REMEDIAL / INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

GROUND WATER FLOW DIRECTION
INTERMEDIATE WELLS
DECEMBER 2, 1988



LEGEND

——	DRAINAGE DITCH
— - —	APPROXIMATE PROPERTY LINE
▨	GENERAL AREA OF FORMER SETTLING PONDS
⋯	FORMER STREAM CHANNEL
●	MONITORING WELL
(565.05)	GROUND WATER ELEVATION
— —	EQUIPOTENTIAL LINE
←	GROUND WATER FLOW DIRECTION

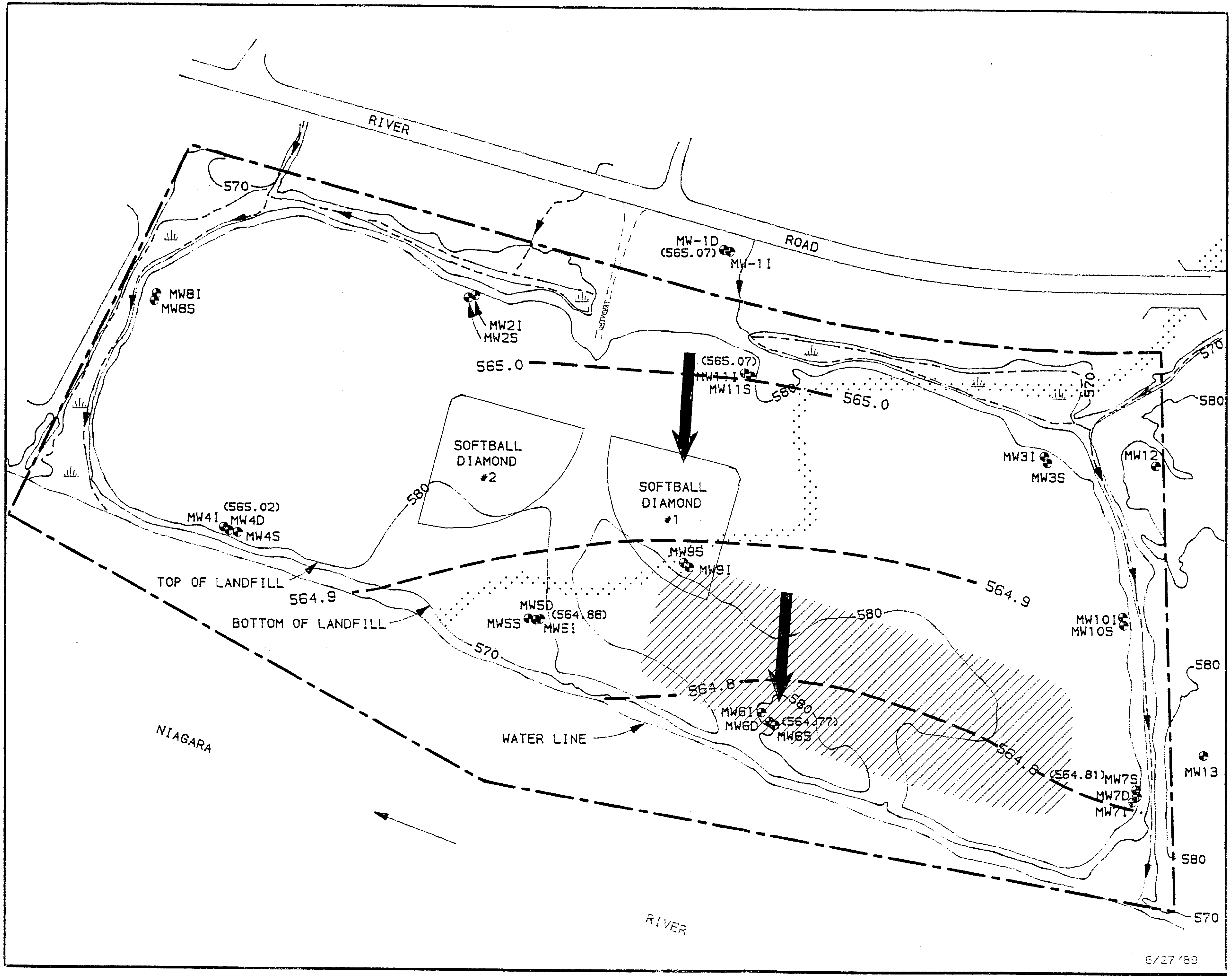
0 200 400
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.
Syracuse New York

FIGURE 11

REMEDIAL / INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

GROUND WATER FLOW DIRECTION
DEEP WELLS
JULY 19, 1988

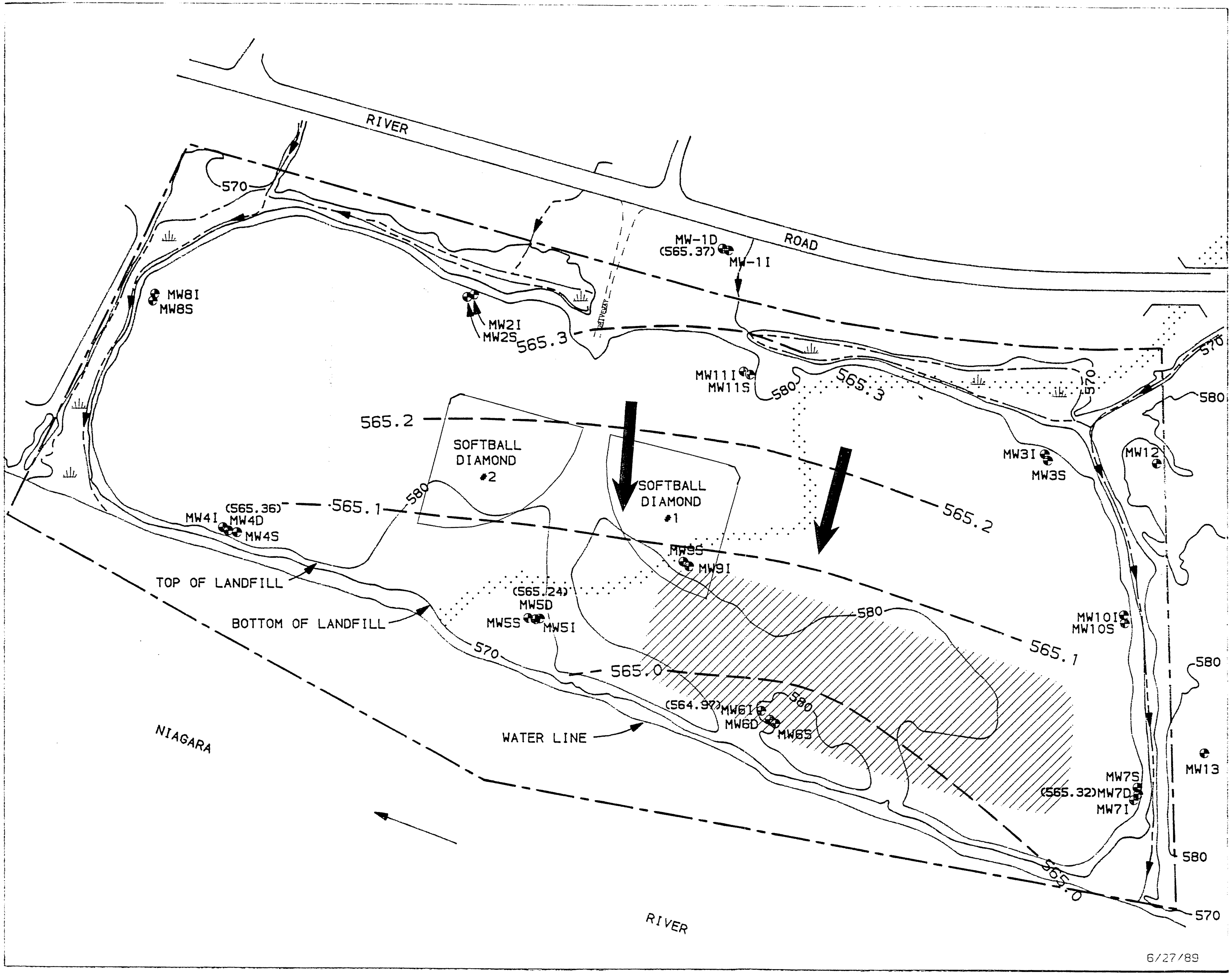


O'BRIEN & GERE
ENGINEERS, INC.
Syracuse, New York

FIGURE 12

REMEDIAL / INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

GROUND WATER FLOW DIRECTION
DEEP WELLS
DECEMBER 2, 1988



LEGEND

DRAINAGE DITCH
APPROXIMATE PROPERTY LINE
GENERAL AREA OF FORMER SETTLING PONDS
FORMER STREAM CHANNEL
MONITORING WELL
(565.24) GROUND WATER ELEVATION
EQUIPOTENTIAL LINE
GROUND WATER FLOW DIRECTION

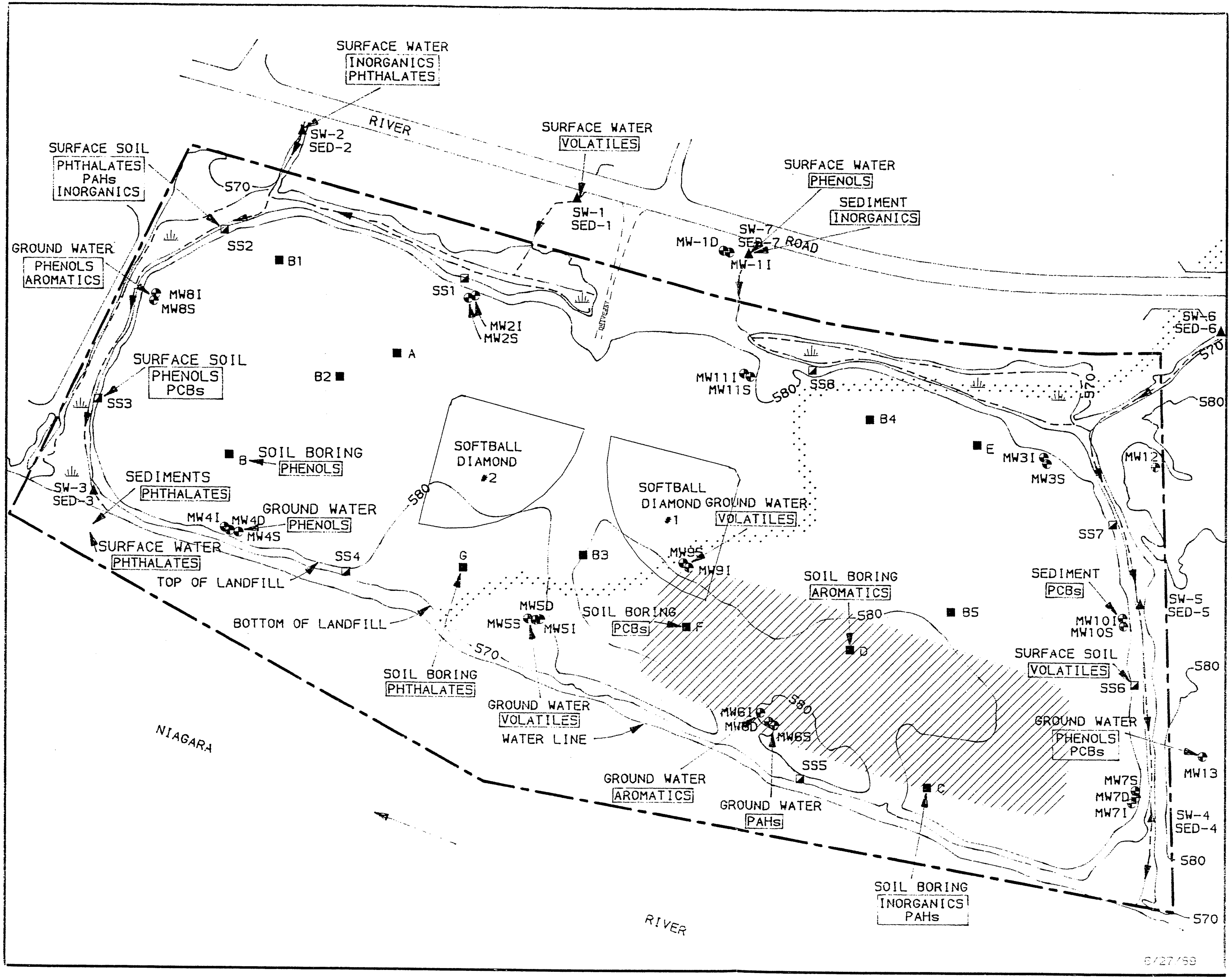
0 200 400
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.
Syracuse, New York

FIGURE 13

REMEDIAL / INVESTIGATION
CHERRY FARM SITE
TONAWANDA, NEW YORK

MAXIMUM CONCENTRATION LOCATION MAP



LEGEND

- DRAINAGE DITCH
- APPROXIMATE PROPERTY LINE
- ▨ GENERAL AREA OF FORMER SETTLING PONDS
- FORMER STREAM CHANNEL
- ◐ MONITORING WELL
- ◩ LANDFILL FACE SAMPLE
- ■ SOIL BORING
- ▲ SURFACE WATER/SEDIMENT SAMPLING

0 200 400
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.

FIGURE 14

RISK CHARACTERIZATION PROCESS

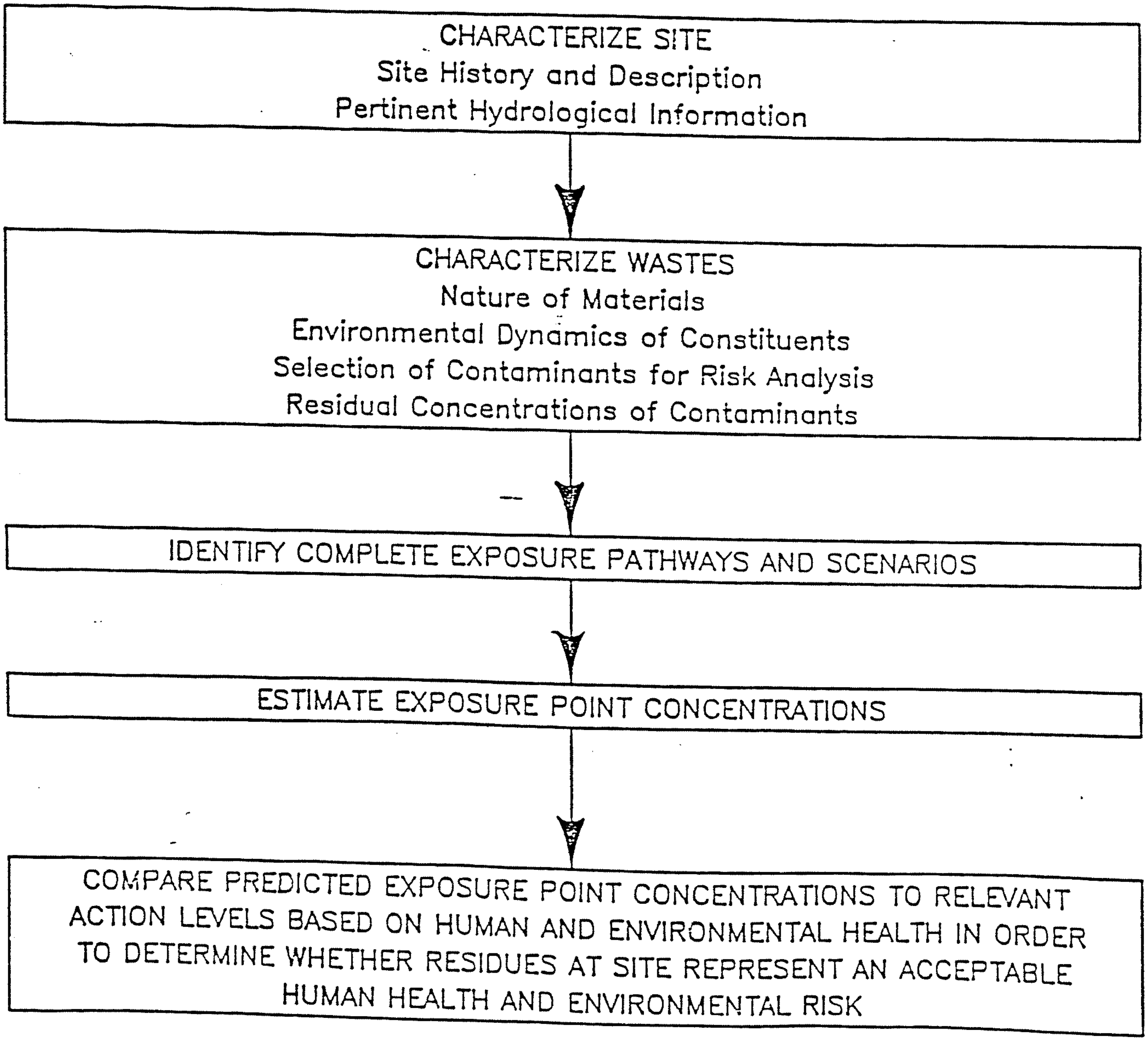
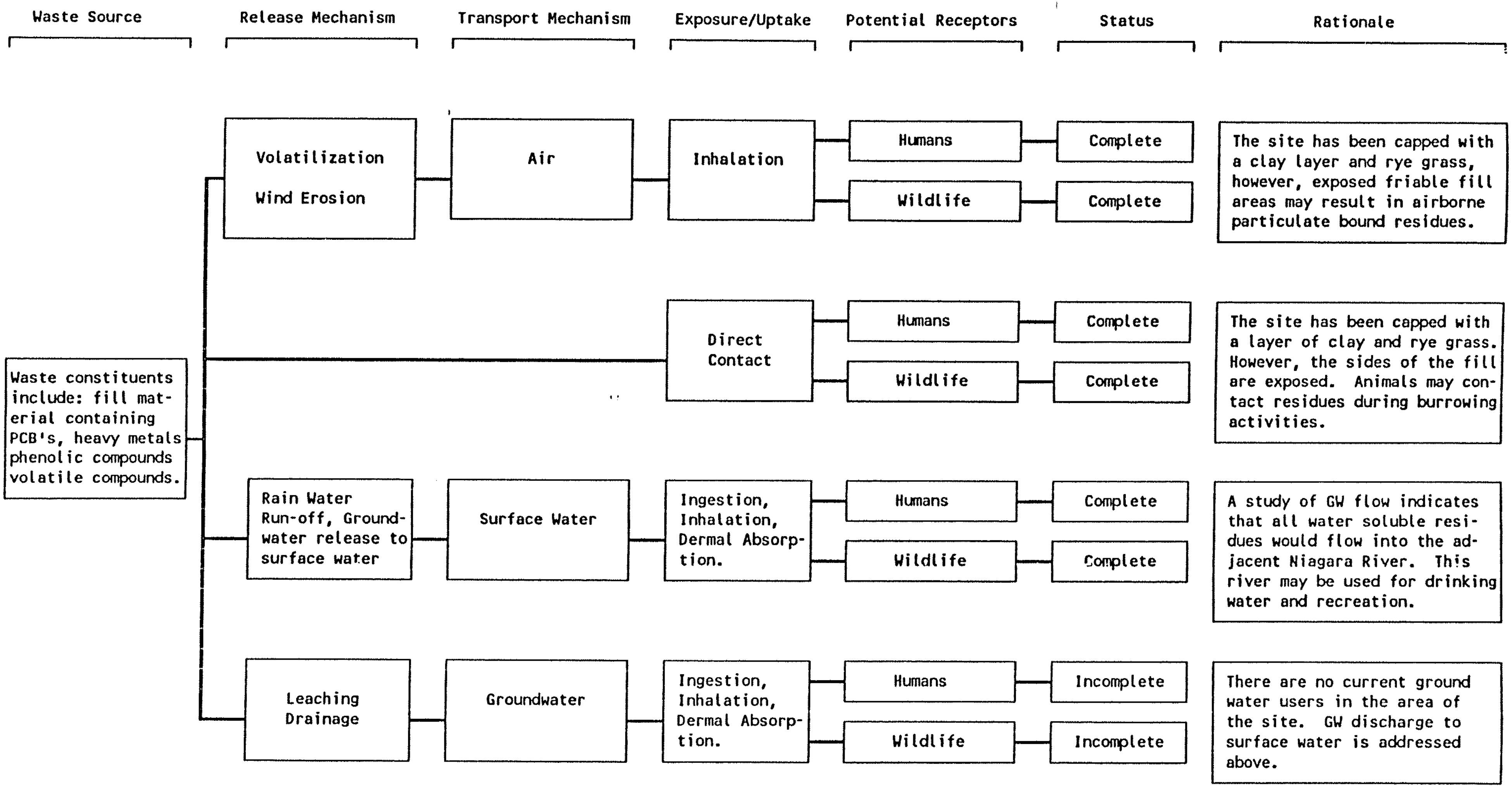


FIGURE 15



Waste constituents include: fill material containing PCB's, heavy metals phenolic compounds volatile compounds.

The site has been capped with a clay layer and rye grass, however, exposed friable fill areas may result in airborne particulate bound residues.

The site has been capped with a layer of clay and rye grass. However, the sides of the fill are exposed. Animals may contact residues during burrowing activities.

A study of GW flow indicates that all water soluble residues would flow into the adjacent Niagara River. This river may be used for drinking water and recreation.

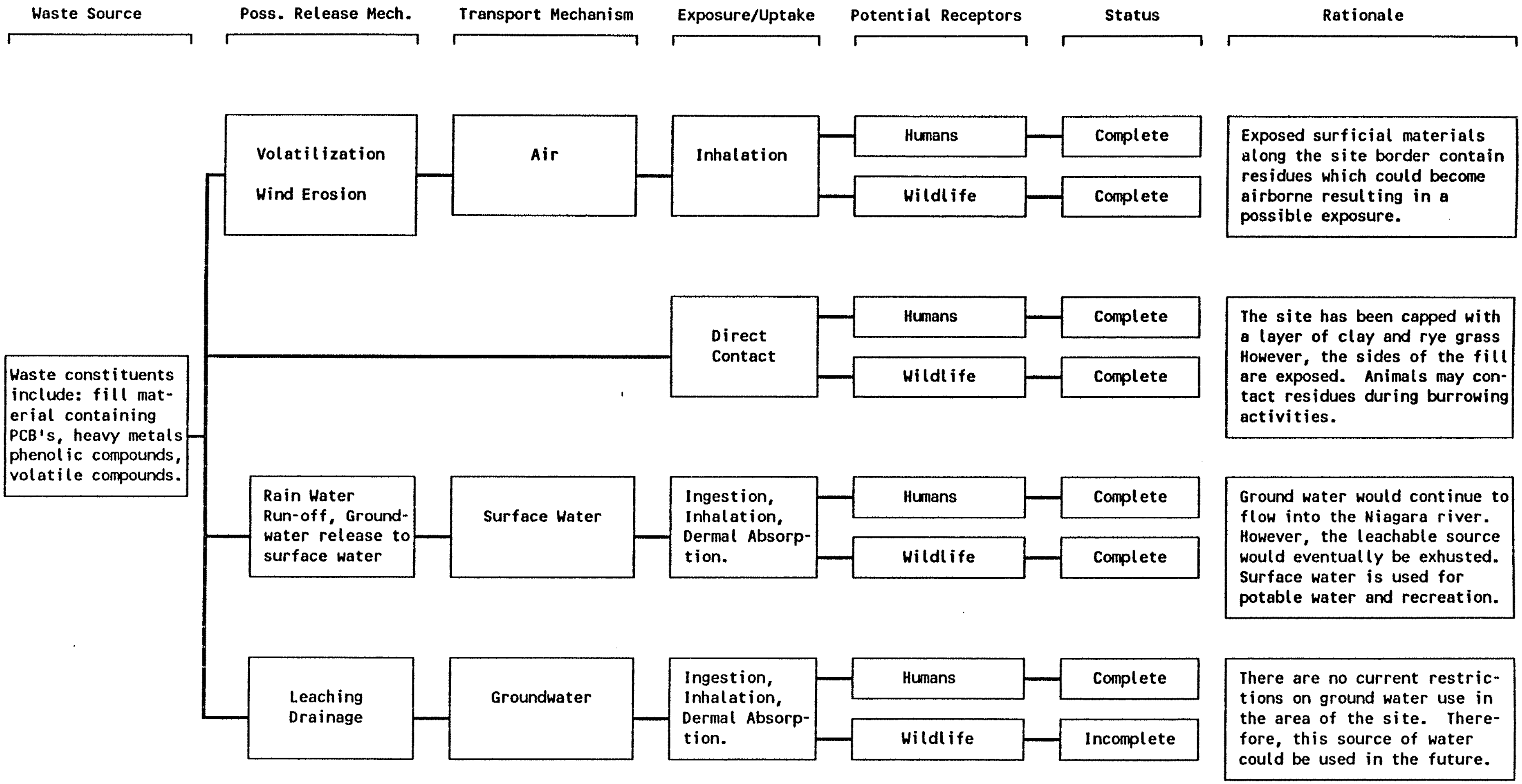
There are no current ground water users in the area of the site. GW discharge to surface water is addressed above.

SUMMARY OF EXPOSURE PATHWAYS - CURRENT CONDITIONS

CHERRY FARM SITE

MAY 23, 1989

FIGURE 16



Waste constituents include: fill material containing PCB's, heavy metals phenolic compounds, volatile compounds.

Exposed surficial materials along the site border contain residues which could become airborne resulting in a possible exposure.

The site has been capped with a layer of clay and rye grass However, the sides of the fill are exposed. Animals may contact residues during burrowing activities.

Ground water would continue to flow into the Niagara river. However, the leachable source would eventually be exhusted. Surface water is used for potable water and recreation.

There are no current restrictions on ground water use in the area of the site. Therefore, this source of water could be used in the future.

SUMMARY OF EXPOSURE PATHWAYS - FUTURE (NO ACTION)

CHERRY FARM SITE

MAY 23, 1989