REMEDIAL INVESTIGATION
AND FEASIBILITY STUDY

PHASE I/PHASE II REMEDIAL INVESTIGATION REPORT, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

River Road Site, Town of Tonawanda
Erie County, New York

(Site Registry No. 9-15-031)

Dvirka and Bartilucci
Consulting Engineers

SEPTEMBER 1993

Dvirka and Bartilucci
CONSULTING ENGINEERS

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September 30, 1993

Shive R. Mittal, P.E.
New York State Department
of Environmental Conservation
Bureau of Western Remedial Action
Division of Hazardous Waste Remediation
50 Wolf Road
Albany, NY 12233

Re: River Road Site
Phase I/II RI/FS Report
Site #9-15-031
D&B No. 1150-5C

Enclosed please find seven (7) final copies of the River Road Phase I/II Remedial Investigation and Feasibility Study report. In accordance with your request I have forwarded on (1) copy to Mr. Jack Hayden at the NYSDEC Buffalo office.

Please feel free to contact me at 908-668-4747 if you require any additional copies or information regarding this report.

Very truly yours,

Edward D. Santoro
Project Manager

EDS/ls
Enclosure
cc: Jack Hayden NYSDEC Region 9
Thomas Maher, D&B
177/10

RIVER ROAD SITE

PHASE I/PHASE II REMEDIAL INVESTIGATION REPORT, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

DVIRKA AND BARTILUCCI
CONSULTING ENGINEERS
SYOSSET, NEW YORK

SEPTEMBER 1993

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RIVER ROAD SITE
PHASE I/PHASE II REMEDIAL INVESTIGATION REPORT, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

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Section 1

1.0 INTRODUCTION

1.1 Project Objectives

The approach to the remedial investigation/feasibility study (RI/FS) for the River Road site is to conduct an integrated field investigation, qualitative health risk assessment and focused feasibility study for the undeveloped portion of the site. The objective of the remedial investigation is to characterize the nature and extent of contamination at the site and assess the need for development of a remedial plan.

This document combines the data and findings of the draft Phase I RI/FS report submitted to NYSDEC in August 1992, with the data and findings of the Phase II remedial investigation which was conducted in December 1992.

The Phase I investigation concentrated on the areas and media of concern identified from previous site investigations. These areas and media comprised groundwater, surface soil and waste piles, and shallow subsurface soil/fill. The Phase II RI/FS investigation further characterized selected specific areas of concern identified in the Phase I investigation, which comprised shallow subsurface soil/fill and groundwater. In addition, the Phase II RI/FS investigation included surface water sediment within the creek margin along the northern border of the site.

The RI/FS work plan and work plan addendum were structured to allow for a phased approach to the collection of field information during the Phase I/II remedial investigations. This phased approach provided for the collection of preliminary data for development of a cost-effective field investigation program and allowed for an assessment to determine if additional data is necessary to conduct the feasibility study. This phased approach typically results in project cost reductions, while still allowing for the development and selection of a cost-effective, environmentally sound, and long-term remedial solution. This approach is consistent with the federal Superfund Amendments and Reauthorization Act (SARA) and the New York State Superfund Program.

The selection of a remedial plan will be dictated by the results of the Phase I/II remedial investigations, health risk and environmental assessment, remedial alternative cost-effective analysis, and policies and direction provided by the New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health.

Succinctly, the objectives of this RI/FS include the following:

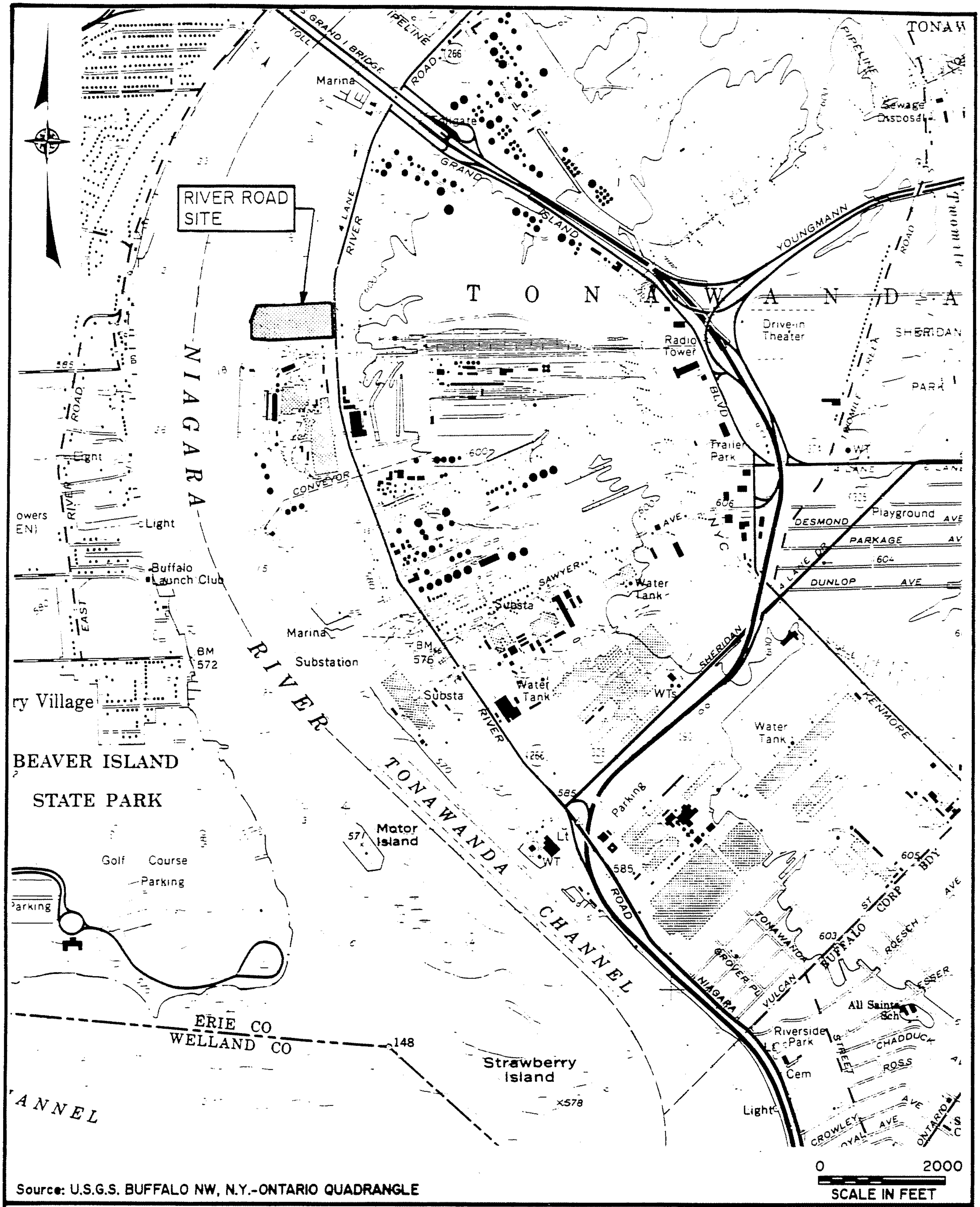
1. Define the nature and extent of waste, contaminated soil and sediment, and groundwater at the site.
2. Determine the potential for migration of contaminants on-site and off-site.
3. Determine the contaminant routes, and potentially impacted areas and receptors.
4. Prepare a qualitative health risk and environmental assessment to determine the need for remedial action at the site.
5. Identify and evaluate remedial alternatives on a preliminary basis.

1.2 Site Background and Physical Setting

1.2.1 Site Location, Ownership and Access

The River Road site (the site) is located in the Town of Tonawanda in Erie County, New York (see Figure 1-1). The site occupies a 23 acre rectangular parcel in an industrial area on the west side of River Road, approximately 3,500 feet south of the Grand Island Bridge. The River Road site (previously known as the INS Equipment site) is comprised of parcels owned by Mr. Matthew Duggan of Amherst, New York (northern half of site), Niagara River World, Inc., and the Clarence Materials Corporation (southern portion of site). The Tonawanda Coke Corporation owns and operates two retention ponds located on the southwestern edge of the site. These ponds are completely enclosed by fencing. On-site activities include Clarence Material's active concrete plant and Tonawanda Coke's operation of the two retention ponds.

Access to the site is from River Road, along the eastern border of the site. The northern, western and southern borders of the site are not fenced, but access from adjacent parcels is somewhat hindered by a stream that runs along the northern boundary and an abandoned Conrail railroad line to the south of the site. The western portion of the site was previously a portion of Rattlesnake Island. Rattlesnake Creek bisected the site in a north-south direction and was filled at some point in the past. Prior site activities included landfilling and disposal of industrial wastes between approximately 1957 and 1970. Fill activities are suspected to have taken place on-site as early as the 1930's during closure of a portion of the Erie Barge Canal, which ran parallel to the Niagara River and passed through the eastern portion of the site (Engineering Science, 1986). A water intake of the Erie County Water Authority is located on the Niagara River approximately three miles downstream from the site. Site facilities are presented on Figure 1-2 and a detailed site map is presented on Figure 2-1 in Section 2.0.



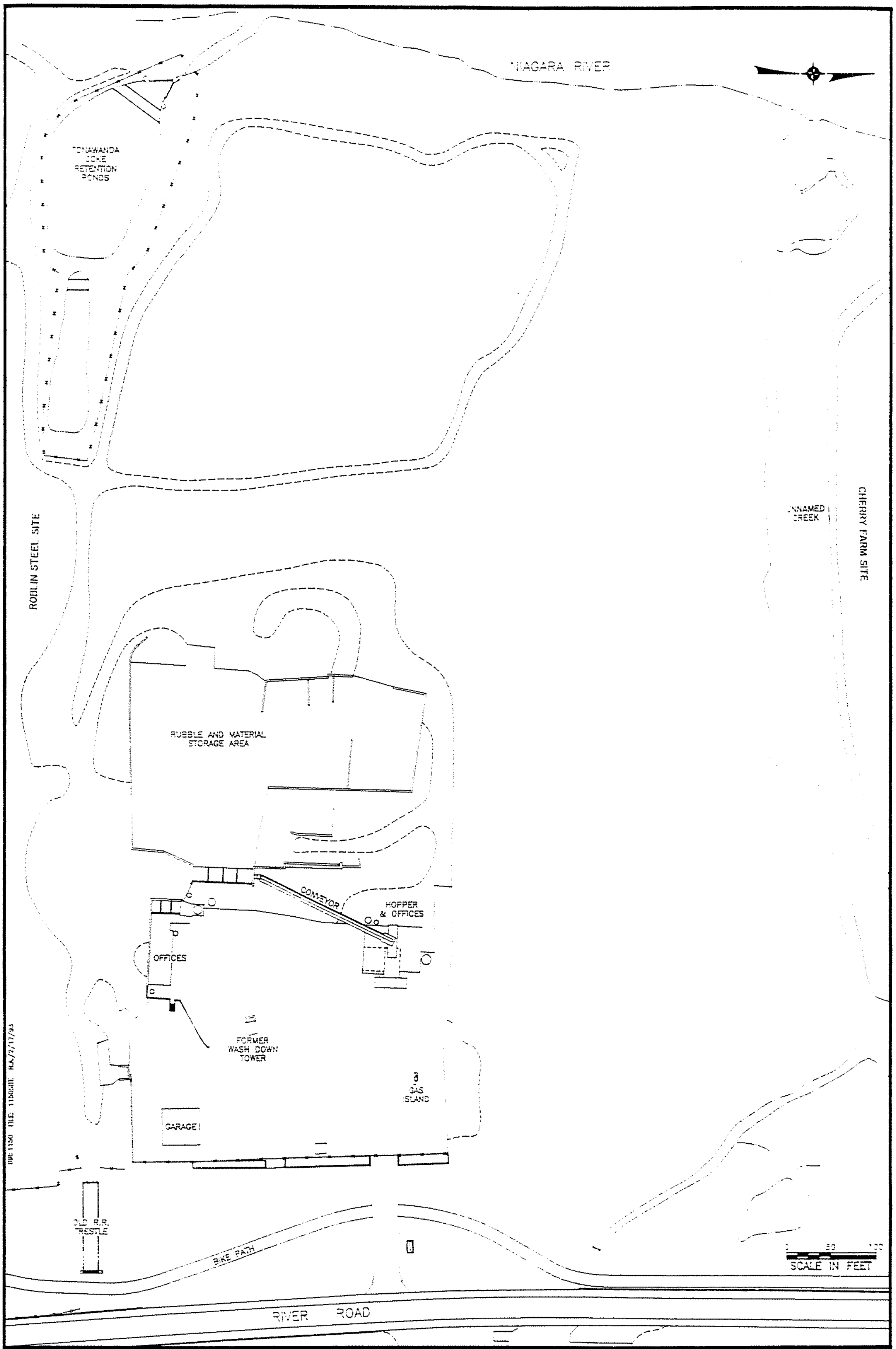
Source: U.S.G.S. BUFFALO NW, N.Y.-ONTARIO QUADRANGLE

RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

SITE LOCATION MAP

Dvirka and Bartilucci
CONSULTING ENGINEERS

FIGURE I - I



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RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK
SITE MAP

FIGURE 1–2

1.2.1.1 - Environmental Setting

The site is located in an industrialized area of Tonawanda, a City of Buffalo suburb. The site is bordered to the north by the Cherry Farm site, which is owned by the Niagara Mohawk Power Company; to the west by the Niagara River; to the south by a former Conrail railroad line and the Roblin Steel site; and to the east by River Road. Both the Cherry Farm site and the Roblin Steel site are registered New York State Superfund sites. In addition, a Federal Superfund site (CERCLA #00206) known as the ENVIROTEK II site is located within the boundaries of the Roblin Steel site. The nearest residential area is located 1.1 miles east of the River Road site.

1.2.1.2 - Demography and Land Use

The site is located within an industrial zone. North of the site, including the Cherry Farm site, is reclaimed industrial land. The industrial corridor extends east of the site approximately to the edge of Route 190 and south below Sheridan Road. Residential areas exist further beyond the Grand Island Bridge to the northeast and Route 190 to the east.

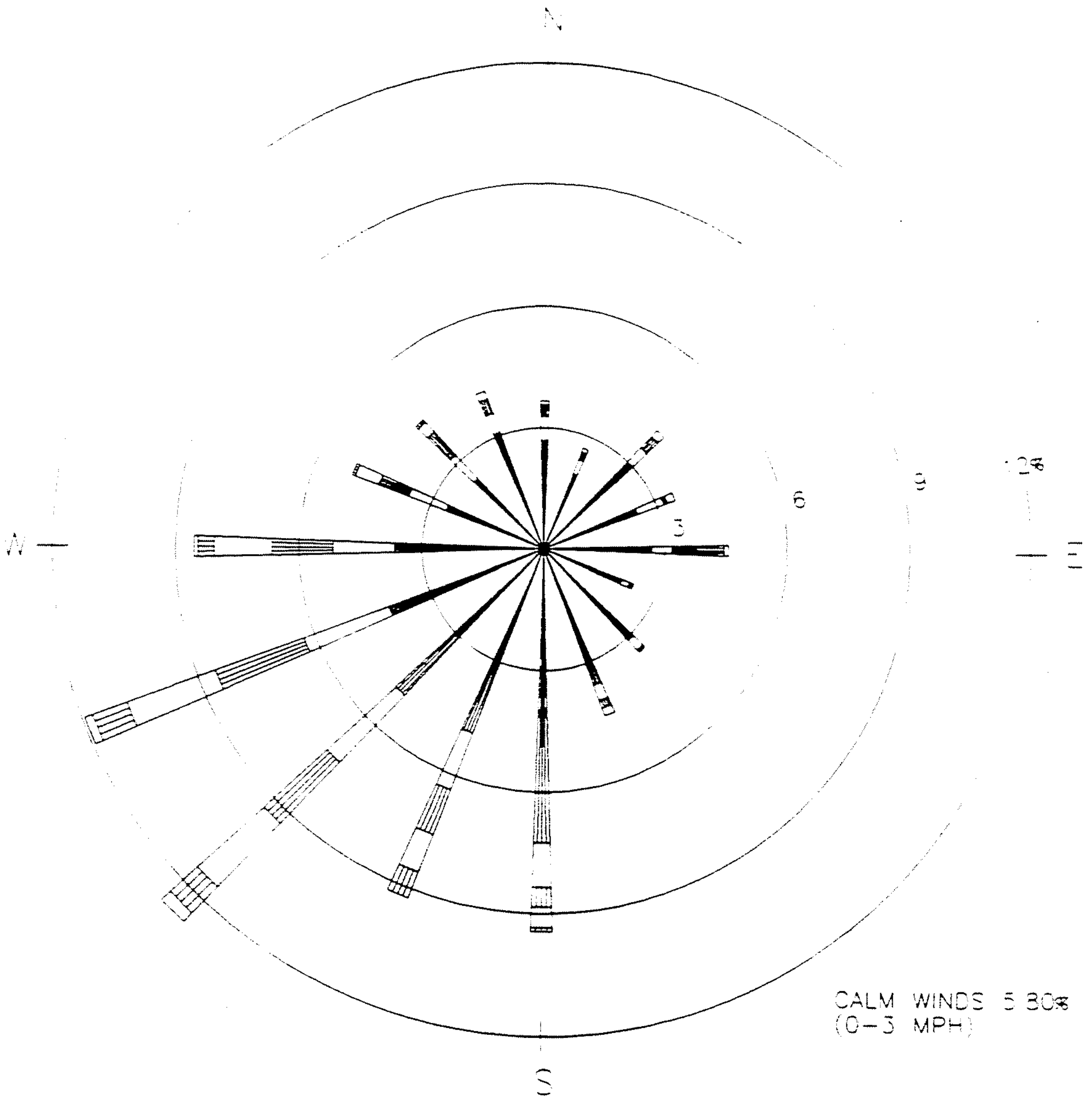
1.2.1.3 - Climate

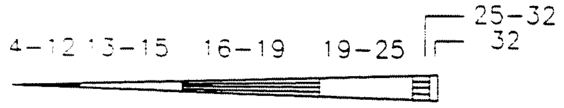
The 1990 average annual precipitation for the Buffalo area was approximately 50.9 inches (NOAA, 1991). The monthly average varies from a low of 1.5 inches in March to a high of 8.7 inches in December. The prevailing average wind direction (at the Buffalo airport) is from the southwest. Figure 1-3 presents a wind rose for the Buffalo airport.

The winters are relatively long, and the summers are relatively short in the Buffalo region, with monthly average temperatures of 33.4°F in January to 71.4°F in July. The 1990 annual average temperature was 50.3°F in this region (NOAA, 1991).

1.2.1.4 - Topography

The site is located in the Erie-Ontario Lake plain physiographic province. This area has little significant topographic relief, except in the vicinity of major drainageways. Elevations in Erie County range from approximately 569 to 1,000 feet above mean sea level (AMSL).





WIND SPEED CLASS BOUNDARIES
(MILES/HOUR)

NOTES:
DIAGRAM OF THE FREQUENCY OF OCCURRENCE FOR EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE - WIND IS BLOWING FROM THE NORTH 3.7 PERCENT OF THE TIME.

WINDROSE
STATION NO. BUF
Buffalo, NY
PERIOD: 1948-1978

Source: NOAA. Data obtained from National Climatic Data Center

RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

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WINDROSE FOR BUFFALO AIRPORT

FIGURE I - 3

The site is located in the Erie-Niagara basin, which borders Lake Erie and the Niagara River on the west, and incorporates the Tonawanda Creek and Cattaraugus Creek basins to the north and south, respectively (RECRA, 1990). The topography in the immediate vicinity of the site is generally flat, with a gentle slope trending to the west. At the present time, the site is filled, reclaimed land, with an average elevation of approximately 585 feet AMSL, which is approximately 25 feet above the Niagara River.

1.2.1.5 - Surface Soil

Blanketing nearly the entire site is a 15 to 20-foot thick layer of waste fill. The fill consists of cinders, slag, fire brick and brown refractory material. In some parts of the site, vegetation has covered this fill material (Engineering Science and Dames and Moore, September 1986).

1.2.1.6 - Surface Water and Drainage

Surface water occurs on the site in two separate features. In the southwest corner of the site, two wastewater retention ponds, connected in series, are maintained by Tonawanda Coke Corporation. These ponds discharge into the Niagara River via an outlet equipped with an oil boom to absorb floating oils (SPDES Permit No. NY000239). Sludge produced by coke fines that settle out is routinely dredged from these ponds (Clare, 1986).

In the northeast corner and along the northern boundary of the site is a westerly flowing stream which conducts water from a pipe beneath River Road into the Niagara River. Additionally, water may enter this stream from an elongated pond on the adjoining Niagara Mohawk property. This stream was dredged by the New York State Department of Transportation (NYSDOT) in July 1985 (Krage, 1985), (Engineering Science and Dames and Moore, September 1986).

1.2.1.7 - Floodplains

Based on a review of the 100-year Floodplain Boundary Map prepared by the Erie County Department of Planning from National Flood Insurance Rate Maps (FIRM), approximately one-third of the River Road site (western and northern portions) lies within the 100-year floodplain of the Niagara River.

The site also lies within the Coastal Zone, as depicted on the Erie County Coastal Zone Boundary Map. The coastal zone in the area of the site extends from the Niagara River to approximately 1,000 feet east of River Road. The approximate boundaries of the 100-year floodplain and the coastal zone in the vicinity of the River Road site are presented on Figure 1-4.

1.2.1.8 - Wetlands

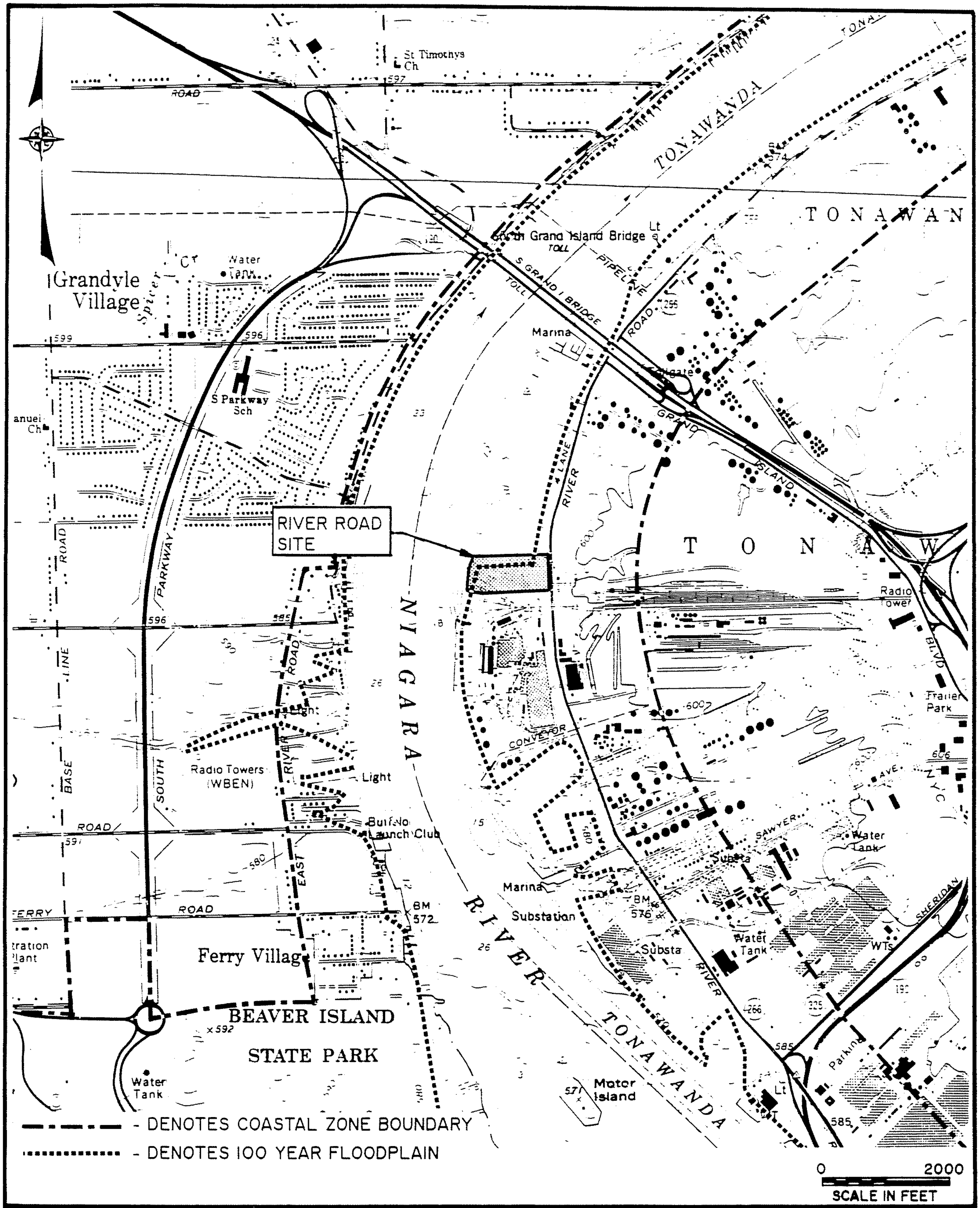
Fresh water wetlands of 12.4 acres or larger, or smaller wetlands of special importance, are protected by New York State pursuant to Article 24 of the Environmental Conservation Law (ECL). The protected area extends 100 feet form the boundary of the wetland. Smaller wetlands of significance are protected by the U.S. Army Corps of Engineers, and are catalogued on Federal Freshwater Wetland Inventory Maps.

A review of the NYSDEC Freshwater Wetland Maps for Erie County indicates a protected wetland located on the site. The wetland, classified as BW-8, is located in the area adjacent to the unnamed tributary that flows along the northern boundary of the site. This tributary enters the site from a culvert under River Road and flows west to the Niagara River. The wetland appears to be most extensive at the tributary's emergence from under River Road, and at its convergence with the Niagara River.

There is one federally protected wetland located in the area of the site based upon a review of the National Wetlands Inventory Maps prepared by the United States Department of the Interior. This wetland, classified POWFx, is located approximately 500 feet south of the site. The location of protected wetlands in the vicinity of the River Road site is presented on Figure 1-5. Wetlands are discussed in greater detail in Section 3.4 of this report.

1.2.1.9 - Endangered Species

Except for occasional transient individuals, no federally or state endangered or threatened species are known to exist within the River Road site. However, according to the New York State National Heritage Program files, critical habitats and protected species may occur within three miles of the site.



RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

100 YEAR FLOODPLAIN AND COASTAL ZONE BOUNDARIES

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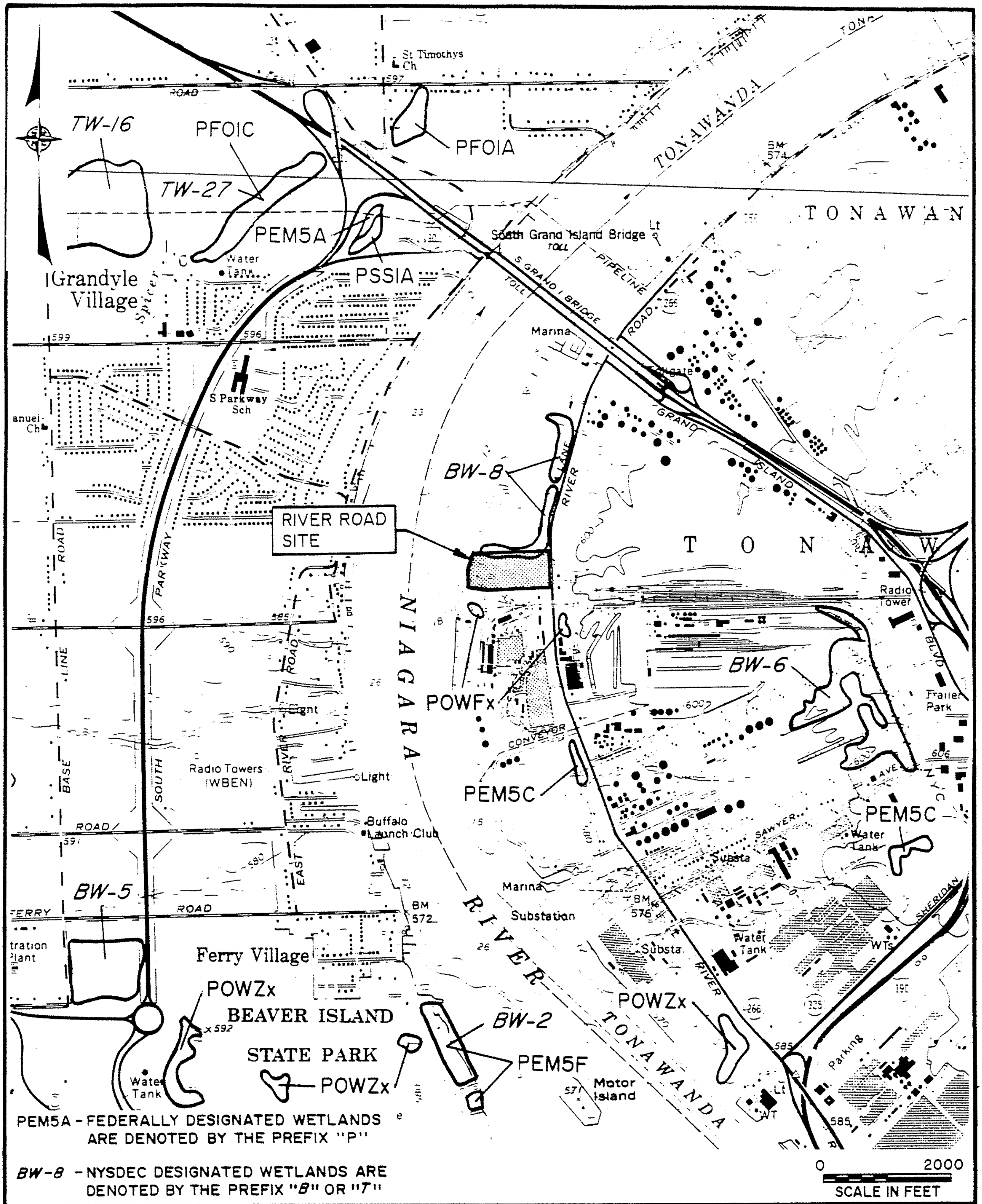
FIGURE I - 4



PEM5A - FEDERALLY DESIGNATED WETLANDS ARE DENOTED BY THE PREFIX "P"

BW-8 - NYSDEC DESIGNATED WETLANDS ARE DENOTED BY THE PREFIX "B" OR "T"

RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

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LOCATION OF NEARBY PROTECTED WETLANDS

FIGURE I - 5

The Great Blue Heron (Ardea herodias), a New York State protected species, is known to inhabit an 8-acre range on Grand Island located west of the site. This species was observed in this area as recently as 1991 and was seen flying over the northwestern border of the site during the RI/FS Phase I field investigation. One threatened plant, stiff leaf goldenrod (Solidago rigida), occurs approximately 3 miles downstream at Isle View Park. Strawberry Island - Motor Island Shoals, located approximately three miles upriver of the site, is a significant fish spawning and waterfowl nesting area. Endangered species and significant habitats are discussed in greater detail in the habitat assessment contained in Section 3.4 of this report.

1.2.1.10 - Geologic Setting

The site is located in the Erie-Ontario lowlands physiographic province. The bedrock in this region is predominantly limestone, dolostone, sandstone and shale. Most of the bedrock formations are deep below the ground surface with regional groundwater flow to the south.

In the recent geologic past, most of New York State, including the site, has been repeatedly covered by a series of continental ice sheets. The activity of the glaciers widened pre-existing valleys and deposited widespread accumulations of till and stratified ice-contact sediments. The melting of ice, ending approximately 12,000 years ago, produced large volumes of meltwater. This water subsequently shaped channels and deposited thick accumulations of stratified, granular sediments.

As glacial ice retreated from the region, meltwater formed lakes in front of the ice margin. This region is covered by lake sediments, the most recent being from Lake Warren (a larger predecessor to Lake Ontario) and from Lake Tonawanda (an elongated lake which occupied an east-west valley and drained north into Lake Iroquois). The sediments consist of blanket sands and beach ridges which are occasionally underlain by lacustrine silts and clays (indicating quiet or deep water deposition).

Granular deposits in this region frequently act as shallow aquifers, whereas lacustrine clays, as well as tills, often inhibit groundwater movement. However, fine-grained, water-lain sediments, such as silts and clays, often contain horizontal laminations and sand seams. These internal features facilitate lateral groundwater movement through otherwise low permeability materials (Engineering Science and Dames and Moore, September 1986).

1.2.1.11 - Groundwater

Previous investigations have identified two aquifers at the site. These investigations characterize the uppermost aquifer as coarse grained lacustrine/alluvial sediments perched on lenses of sand/silt and clays. A lower aquifer exists in the gray till and factures of the bedrock. An aquitard composed of lower permeability lacustrine sediments (primarily silts) separates these two aquifers. Based upon the grain size analyses of the lower, finer grained, lacustrine materials, permeabilities were estimated to be approximately 10^{-6} cm/sec to 10^{-7} cm/sec.

The previous investigations identified a groundwater mound in the south-central part of the site, with radial flow to the west, northwest, north and northeast eventually flowing to the west towards the Niagara River. This result was consistent with each of the earlier studies (Engineering Science and Dames and Moore, September 1986). The buried channel of the canal is not believed to affect the groundwater flow pattern.

1.2.1.12 - Water Supply

The Town of Tonawanda domestic water is supplied by a 15-million gallon per day (mgd) water intake located in the Niagara River approximately 1.8 miles south (downstream) of the site. The intake line leads directly to a water treatment facility located at the foot of Sheridan Drive. Upon treatment, the water is distributed for domestic and industrial use. The Erie County Water Authority maintains a water intake 3 miles downstream of the site in the Niagara River. There is no known use of private wells for potable water supply in the vicinity of the site. A well is known to exist in the Clarence Materials property for the purpose of supplying vehicle wash water.

1.2.1.13 - Storm Water

Storm water runoff is controlled by a collection system consisting of a series of storm sewers, creeks and waterways located throughout the town. This collection system eventually channels the runoff to various points along the Niagara River. During periods of excessive runoff, some water is pumped to a 23 million gallon retention basin located at the foot of Parker Boulevard and Ellicott Creek Road. The basin is part of the wastewater treatment system and water from the basin is pumped to a treatment system before being discharged to the Niagara River.

1.2.1.14 - Wastewater

The Town of Tonawanda wastewater treatment facility is located along Two Mile Creek Road in the town. The treatment facility accepts both industrial and domestic wastewater. The industrial and domestic wastewater is handled separately by the facility; however, both are processed through a two-phase treatment system involving a secondary and tertiary treatment system. The secondary treatment system is a biological, activated sludge process. The tertiary treatment system comprises a chemical precipitation and sand filtration process. The treated water is discharged to the Niagara River.

1.2.2 Site History

The River Road site was originally a wetland area used by the Seaway Corporation (together with the adjacent Cherry Farm site) to dispose of flyash, bottom ash, foundry sand, slag and liquid boiler cleaning waste from approximately 1957 to 1969. During this period, it is alleged that the Hooker-Durez Division may have disposed of phenol tars, possibly containing chlorinated benzenes, at the site. Fill activities at the site, however, may date back to the 1930's, when a portion of the Erie Barge Canal passing through the site parallel to the Niagara River was closed.

The River Road site was originally the subject of a 1983 Phase I Investigation report for the Roblin Steel site, now a separate site (NYSDEC Site No. 915056) located adjacent to the south of the site. In 1967, the Roblin Steel Company purchased the old Wickwire-Spencer steel plant, and used the adjacent parcel (now the River Road site) for disposal of approximately one million gallons of spent sulfuric acid pickle liquor which was spilled directly on the ground surface between 1969 and 1970. The pickle liquor was spilled into slag-filled depressions with the intent of neutralizing the acidic liquor as it percolated through the slag. In addition, an estimated 300,000 to 400,000 tons of foundry sands, probably originating from the Chevrolet plant in Tonawanda was disposed of on the site between 1967 and 1976. Prior to Roblin Steel's acquisition of the property, Wickwire-Spencer used the area to dispose of an undetermined amount of slag material from their steel manufacturing process. This slag covers most of the site, and is reported to extend from 6 to 25 feet deep (RECRA, 1983).

Two settling ponds located on the southwestern portion of the site have been in use since the early 1970's. The two ponds were originally owned and constructed by the Allied Chemical Company (currently Allied Signal), and received effluent from an ammonia still and a light oil still at the Allied Chemical Coke plant. In January 1978, the Tonawanda Coke Corporation acquired the plant, and continues to use the retention ponds to settle coke fines from their wastewater prior to release to the Niagara River (ERM, 1990). The sludge that is periodically removed from the ponds is reportedly returned to the plant for recycling. However, disposal of the sludge on-site was observed by NYSDEC Region 9 personnel during the period of 1969 to 1971 prior to ownership by the Tonawanda Coke Corporation (NYSDEC, 1986), and more recently, fresh spoils were found on-site during the Phase I RI/FS investigation. A State Pollutant Discharge Elimination (SPDES) permit (Permit Number NY-000-2399) has been issued to Tonawanda Coke Corporation for the effluent discharged from these ponds.

Other waste material has been disposed on the site by the Clarence Materials Corporation, which currently owns a portion of the site containing an active concrete plant. This waste is predominantly concrete rubble and is evidenced by visible mounds, several feet in elevation, that are partially covered by vegetation.

The site is also associated with the Cherry Farm site (NYSDEC Site No. 915063) which is located on the parcel north of the site. The Cherry Farm site was utilized as a landfill whose fill area extended onto the River Road site. Between 1945 and 1970, the Cherry Farm site was owned by Colorado Fuel and Iron Steel Corporation (CF&I) which discarded dust and slag from their blast and open hearth furnace operations until 1963. CF&I then entered into an agreement with INS Equipment Company which allowed INS to dispose of foundry sand and sandcasts from the Tonawanda Chevrolet plant (O'Brien & Gere, 1989). These foundry sand and sandcasts from the Chevrolet plant were believed to have been disposed on a portion of the River Road site. During the RI/FS Phase I investigation, remnants of these sandcasts were found adjacent to the creek area at the northern border of the site.

Niagara Mohawk Power Company (NIMO) purchased the Cherry Farm site in 1970. NIMO capped the landfill with approximately six inches of clay, and constructed two athletic fields on top of the cap in the center of the fill area. A Record of Decision document has been issued for this site. Remediation activities will include capping, and groundwater pumping and treatment.

1.2.3 Findings from Previous Investigations

In 1980, Troutman Associates prepared a report regarding groundwater quality at the River Road site at the request of Roblin Steel. Roblin Steel used the site as a disposal area for its steel operations conducted at its plant located adjacent to the south of the site. The program included installation of groundwater monitoring wells, analytical testing of groundwater and determination of fill thickness. The soil boring logs from that study indicated that one well (Troutman Associates well B-5) was contaminated with a black, oily substance with a strong odor. The analytical results also indicated groundwater quality in the general area to be poor, with the fill area contributing a significant amount of contamination (RECRA, 1983). The United States Geological Survey (USGS), in conjunction with the New York State Department of Environmental Conservation (NYSDEC), conducted a preliminary soil sampling program in August 1982. The testholes were drilled to a depth of 6 feet where samples were collected. The results indicated the presence of heavy metal contaminants, including chromium, lead and mercury. A Phase I Investigation report was prepared for the Roblin Steel Company in September 1983 (RECRA Research, Inc.), which described the current River Road site.

In September 1984, the site was the subject of another Phase I Investigation report (referred to as the INS Equipment site) to determine the adequacy of existing information to calculate a Hazard Ranking System (HRS) score. This report indicated that no surface water samples were analyzed at the site (Engineering Science, 1984).

A Phase II RI/FS Investigation of the site (still referred to as the INS Equipment site) was conducted from October 1984 to September 1986 (Engineering Science, 1986). During this investigation, it was determined that three monitoring wells installed on site for the Roblin Steel Company study in 1980 could be used for collection of groundwater samples for the Phase II study. The field investigation for the Phase II study included geophysical (electrical resistivity and magnetometer) surveys to provide subsurface stratigraphic data, and to assist in location of monitoring wells. In addition, sediment, groundwater, surface water and air sampling and analysis was conducted to define the extent of potential contamination at the site (Engineering Science, 1986).

Groundwater samples were collected in August 1985, as part of the Phase II RI/FS Investigation. The four samples collected were analyzed for organics (GC/MS scan), phenolics, mercury, chromium, lead and cadmium. Additional samples were collected in June 1986 for reanalysis of semivolatile compounds. Metals were not detected in any of these samples. Total phenolics concentrations of 230 ug/l and 130 ug/l were detected in the central and northwestern portion of the site, respectively. These concentrations exceed the New York State standard of 1.0 ug/l. Benzene was also detected in the eastern portion of the site at levels higher than NYSDEC water quality standards. A groundwater sample collected from the eastern portion of the site had a benzene concentration of 5.3 ug/l, while samples in the western portion of the site had concentrations of 12 ug/l and 96 ug/l. Other organic compounds detected included 2-butanone, toluene, xylene, 1,1 dichloroethane and ethylbenzene (Engineering Science, 1986).

Surface water samples were collected from the creek that runs along the northern edge of the site, in an upgradient and downgradient location. These samples were analyzed for cadmium, chromium, lead, mercury, phenolics and organic constituents. Additional surface water samples were collected in June 1986, for analysis of semivolatile compounds. Conclusions of that study indicated that there were no increases in metal contamination levels from the upgradient to the downgradient sample locations. A high concentration (330 ug/1) of phenolics was detected in the downgradient sample. The phenolic contamination in this sample consists of 2-methyl phenol, 2,4-methyl phenol and 4-methyl phenol. This concentration exceeds the water quality standard of 1 ug/l suggested by NYSDEC, and is above the concentration of 20 ug/l present in the upgradient water sample (Engineering Science, 1986).

The Phase II RI/FS Investigation (Engineering Science, 1986) attributes the high concentration of phenolic compounds found in the stream to waste materials disposed at both the River Road site and the Cherry Farm site located immediately north of the stream. Phenols may be the result of the Tonawanda Coke Corporation operations, or of the phenol tars alleged to be disposed of by the Hooker-Durez Division. A surface water sample collected for an investigation of the adjacent Cherry Farm site exhibited elevated levels of phenols (5,320 ug/1) in a tributary to the stream that flows between the two sites. This appears to indicate that the surface water is being contaminated with phenols from the Cherry Farm site. According to this study, no organic contaminants were found in the surface water samples that could be attributed to the River Road site.

Sediment samples were collected in the immediate vicinity of the surface water samples, and were analyzed for the same constituents. Higher levels of cadmium, chromium and lead were found in the downgradient sample. Organic contamination in the downstream sample included phenolics (0.1 mg/kg) and several polycyclic aromatic hydrocarbons (PAHs). PAH compounds are a by-product of coal burning processes, and are constituents of flyash, coal tar, coke fines and slag wastes. The creek was reportedly dredged by the New York State Department of Transportation after these samples were collected (Engineering Science, 1986).

Upwind and downwind air quality monitoring was conducted at the River Road site as part of the Phase II RI/FS Investigation. In July 1985, total organic vapor readings on site were 1.0 ppm to 2.0 ppm over background levels of 0.0 ppm. These concentrations of organic vapors were not considered adequate for scoring an observed air release in the HRS score because no soil or leachate samples with elevated organic concentrations were collected concurrent with the organic vapor readings (Engineering Science, 1986).

1.3 Overview of the Remedial Investigation and Report Organization

The River Road Phase I/II remedial investigation (RI) was designed in a phased approach to provide for the characterization of the nature and extent of the contamination at the site. In conjunction with the NYSDEC, the objectives of the RI were developed and the approach designed. The approach of the Phase I RI utilized the existing data obtained from previous investigations (discussed in Section 1.2.3, above) as the basis for its design. This approach enabled the investigation to focus on the further assessment of surface soil and waste piles, subsurface soil and groundwater quality through the implementation of a field program. The Phase II RI approach was based on the findings and recommendations developed from the Phase I investigation, which determined the need for further characterization of subsurface soil and the groundwater, as well as characterization of the surface water sediment. Results of both the Phase I and Phase II investigations are discussed in this report.

This report is presented in a fashion which allows for a logical and ordered progression of the description and findings of the investigation. Section 1.0 discusses the project's objectives and background, as well as a review of the site history, including a discussion of previous investigations and a summary of their results. Section 2.0 is a description of the field program including, in detail, the surface soil/waste pile, subsurface soil, surface water sediment and groundwater investigations. Section 3.0 discusses the results of the physical and ecological characteristics of the study area, including subsections on geology, hydrogeology and ecology. Section 4.0 describes the analytical results, and nature and extent of the contamination on-site, including discussions on the standards, guidelines and criteria for the various sampling medium, and data validation.

Section 5.0 is a summary of the findings of the Phase I/II remedial investigations including specific discussions on surface soil and waste pile sample results, subsurface soil, surface water sediment, fill material and buried wastes, and groundwater. Also included in Section 5.0 is a discussion of additional recommended remedial investigation. Section 6.0, Qualitative Health Risk Assessment, presents a qualitative analysis of the hazards, exposures and risks based on the types of contaminants identified on-site and the reported concentrations. Section 7.0 provides a preliminary evaluation of the remedial alternatives available and comparison of these alternatives to technologies currently recommended at nearby sites. Section 7.0 also includes conclusions and recommendations of the feasibility study.

Section 2

2.0 STUDY AREA INVESTIGATION

2.1 Site Facilities

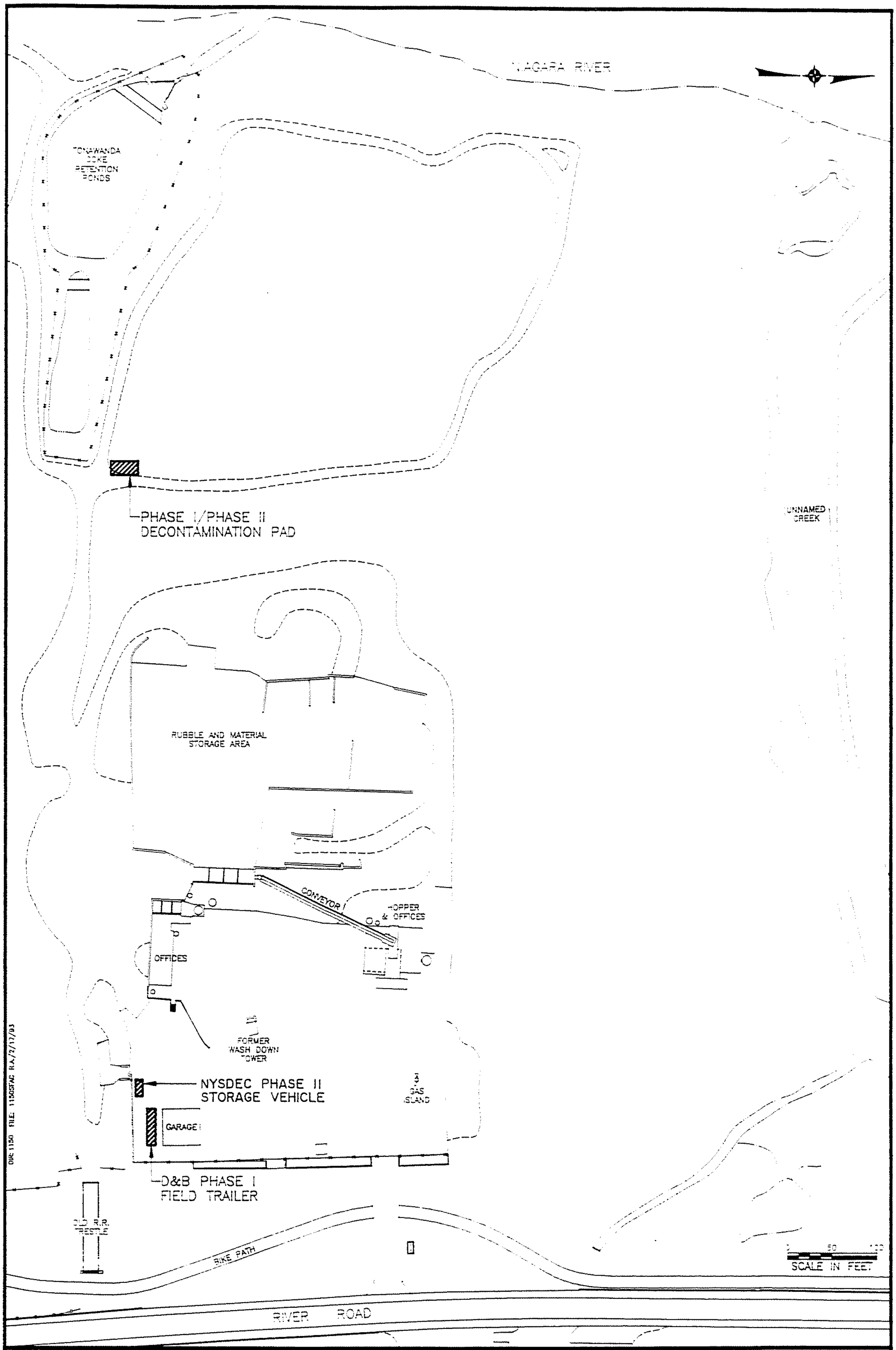
The River Road site occupies 23 acres of property along the east side of the Niagara River. The site is situated in an industrialized area that includes both active and inactive facilities. Two active facilities are located on the River Road site: Clarence Materials Corporation and the Tonawanda Coke Corporation.

The Clarence Materials Corporation is a concrete manufacturing plant located on the southeastern portion of the site. The Clarence Materials facility includes concrete/aggregate hoppers, offices and garage area surrounding a concrete parking lot/driveway. Located near the offices is a small inactive water tower which was subsequently dismantled and removed prior to the start of the Phase II RI/FS investigation. The facility is bounded on the east by a chain link fence topped with barbed wire. The fence runs north-south and is accessed only by a gate (see Figure 2-1). The facility opens at 7 a.m. and operates until 4-6 p.m., depending on scheduled concrete deliveries.

The Tonawanda Coke Corporation owns and operates two retention ponds located on the southwestern edge of the site. The two ponds are connected in series. The ponds discharge to the west to a channel which discharges into the Niagara River (SPDES Permit Number NY000239). The ponds are completely enclosed by fencing and are routinely dredged. Recently dredged spoil, presumably from this dredging activity, has been noted on the River Road site during the Phase I remedial investigation.

The field operations undertaken during the Phase I investigation involved the establishment of a field office trailer at the site. The office trailer was located adjacent to the Clarence Materials garage on the facility property. No office trailer was utilized during the Phase II RI/FS investigation, however, a small cargo truck was provided by NYSDEC for use as an equipment storage facility (see Figure 2-1).

The equipment decontamination area was located adjacent to the Tonawanda Coke retention ponds for both the Phase I/II investigations. The Phase I decontamination pad was rectangular in shape and approximately 15 feet by 30 feet in size and was constructed of a plastic liner and planking to support vehicles. The Phase II decontamination pad was also rectangular in shape and approximately 12 feet by 24 feet in size, and was constructed of a plastic liner and planking to



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RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

SITE FACILITIES MAP

FIGURE 2-1

support vehicles (see Figure 2-1). Wastewater generated as a result of steam cleaning of equipment and supplies was transferred into DOT-approved, ring top, 55-gallon drums. Drums generated during the investigation were stored near the decontamination pad. The decontamination pad was removed at the conclusion of each phase field program.

2.2 Phase I/II Field Activities

2.2.1 Aerial Photography and Topographic Mapping

Aerial photography and topographic mapping services were performed by Lockwood Aerial Mapping of Rochester, New York prior to the start of the Phase I field investigation. A copy of the photo and map are presented in Appendix A. The aerial photograph was taken on March 3, 1992, at an original scale of 1 inch = 500 feet and enlarged to 1 inch = 50 feet. The photograph was used to generate a base map of the site and immediate surrounding areas upon which the surveyed data points, such as well locations, were transferred. The aerial photograph also provides a means to visually characterize the entire site area in terms of topographic relief, and location of physical features and sampling points.

2.2.2 Surveying Program

Ground survey for the Phase I/II field investigation was performed by Om P. Popli of Rochester, New York. The survey included establishing on-site vertical and horizontal control, locating and establishing elevations for 17 groundwater monitoring wells, five staff gauges, six surface water sediment sample locations, as well as locating 10 on-site and two off-site surface soil sample locations and 17 test trench locations. Horizontal control is tied to the New York State Plane Coordinate System and vertical control is tied to the National Geodetic Vertical Datum (NGVD) of 1929. The survey data collected during the RI/FS investigation is presented in Appendix H.

2.2.3 Soil, Waste Pile and Sediment Investigation

2.2.3.1 - Surficial Soil and Waste Pile Sampling

Surficial soil samples were collected from locations having obvious waste material or areas in which sparse or stressed vegetation were found during the Phase I field investigation. These samples include five waste piles (S-3, S-4, S-10, S-11 and S-12) and seven surface soil samples

(S-1, S-2, S-5, S-6, S-7, S-8 and S-9). These samples were collected to characterize the surficial materials at the River Road site. Ten samples were collected on-site (see Figure 2-2), and two background samples were collected off-site (see Figure 2-3). Due to the industrialized nature of the site area, the two background samples (S-1 and S-2) were collected approximately 1.5 miles east of the site at Sheradan Park.

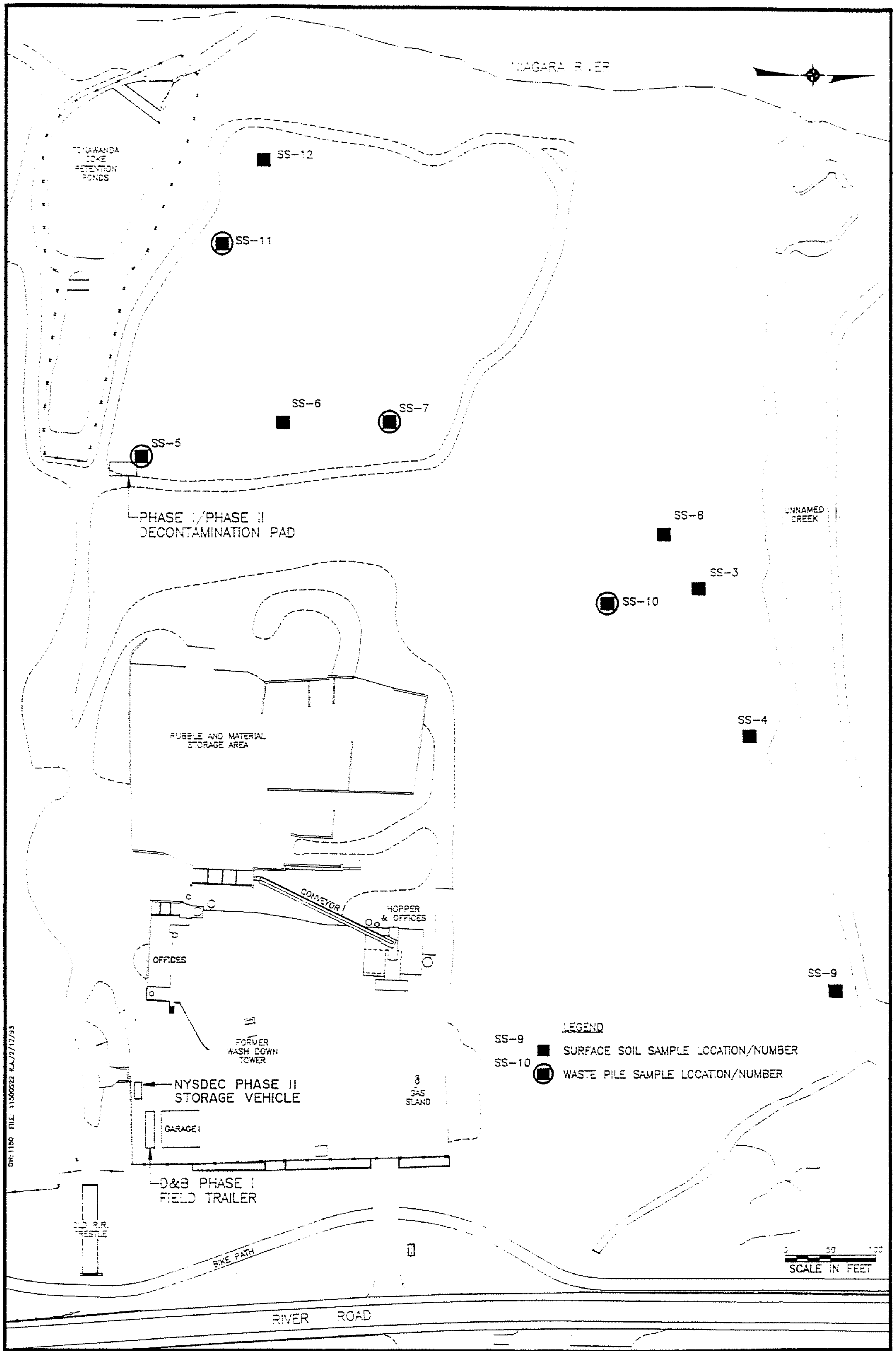
The surficial samples were collected from 0 to 6 inches below the surface with dedicated, sterile polystyrene disposable sampling scoops. A clean pair of latex gloves was used by the sampler at each sample location. Immediately after collection, the samples were transferred to the appropriate laboratory supplied sample jars. The sample jars were stored in coolers for holding during the day. At the completion of the day's sampling, the jars were wrapped in bubble wrap and repacked in the cooler with ice. Attached to the underside of the cooler lid was the completed chain of custody form sealed in a Ziploc bag. The cooler was then sealed and secured with packaging tape before being delivered to the carrier for overnight delivery to Nytest Environmental, Inc. laboratory in Port Washington, New York. Nytest is an approved New York State Department of Health (NYSDOH) laboratory and is Contract Laboratory Protocol (CLP) certified.

The surface soil/waste pile samples were analyzed for Target Compound List (TCL) +30 parameters. The results of the surface soil/waste pile sampling are discussed in Section 4.3.1. Appendix F contains the data as supplied by the laboratory. No surface soil or waste pile samples were collected as part of the Phase II RI/FS investigation.

2.2.3.2 - Subsurface Soil/Test Trench Sampling

Seventeen test trenches were excavated at the site to characterize the shallow subsurface soil and identify the presence of buried waste and drums (see Figure 2-4) during the Phase I field investigation. The test trenches were excavated using a track mounted Kamatsu backhoe with a 2-foot wide bucket and 16-foot reach.

The test trenches ranged in depth from 9 feet at test trench TT-06 to 1 foot at TT-13, and had a maximum length of 32 feet at TT-10. The shallow limited excavation depths were the result of refusal on dense slag material. However, at TT-07 and TT-12A, shallow depth to groundwater, and at TT-08, a buried drum containing a semi-liquid orange colored material, prevented continued excavation in accordance with the approved procedures identified in the Phase I RI/FS work plan.



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RIVER ROAD SITE
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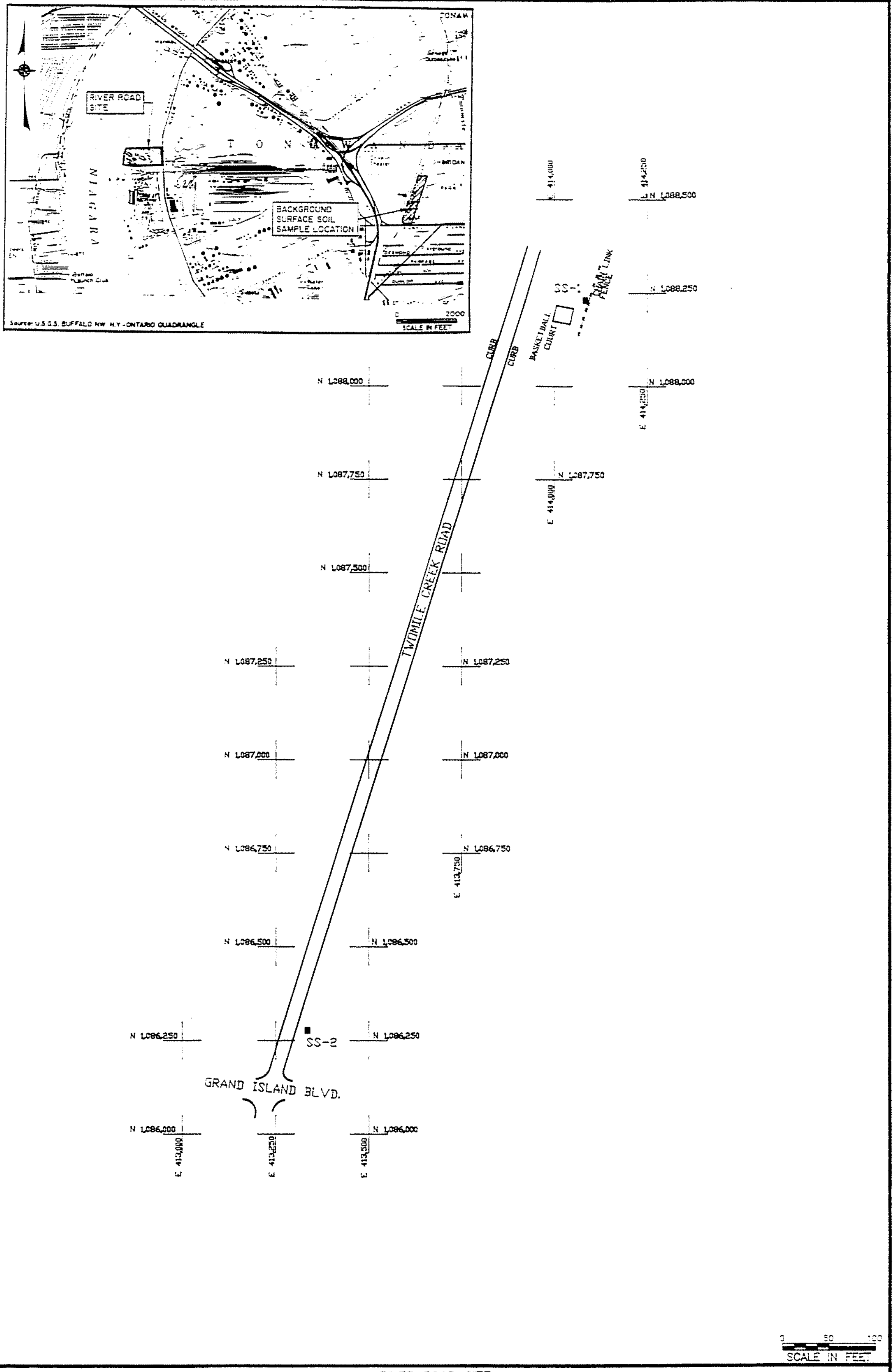
TONAWANDA, NEW YORK
PHASE I ONSITE SURFACE SOIL/WASTE PILE
SAMPLE LOCATIONS

FIGURE 2-2



Source: U.S.G.S. BUFFALO NW N.Y.-ONTARIO QUADRANGLE

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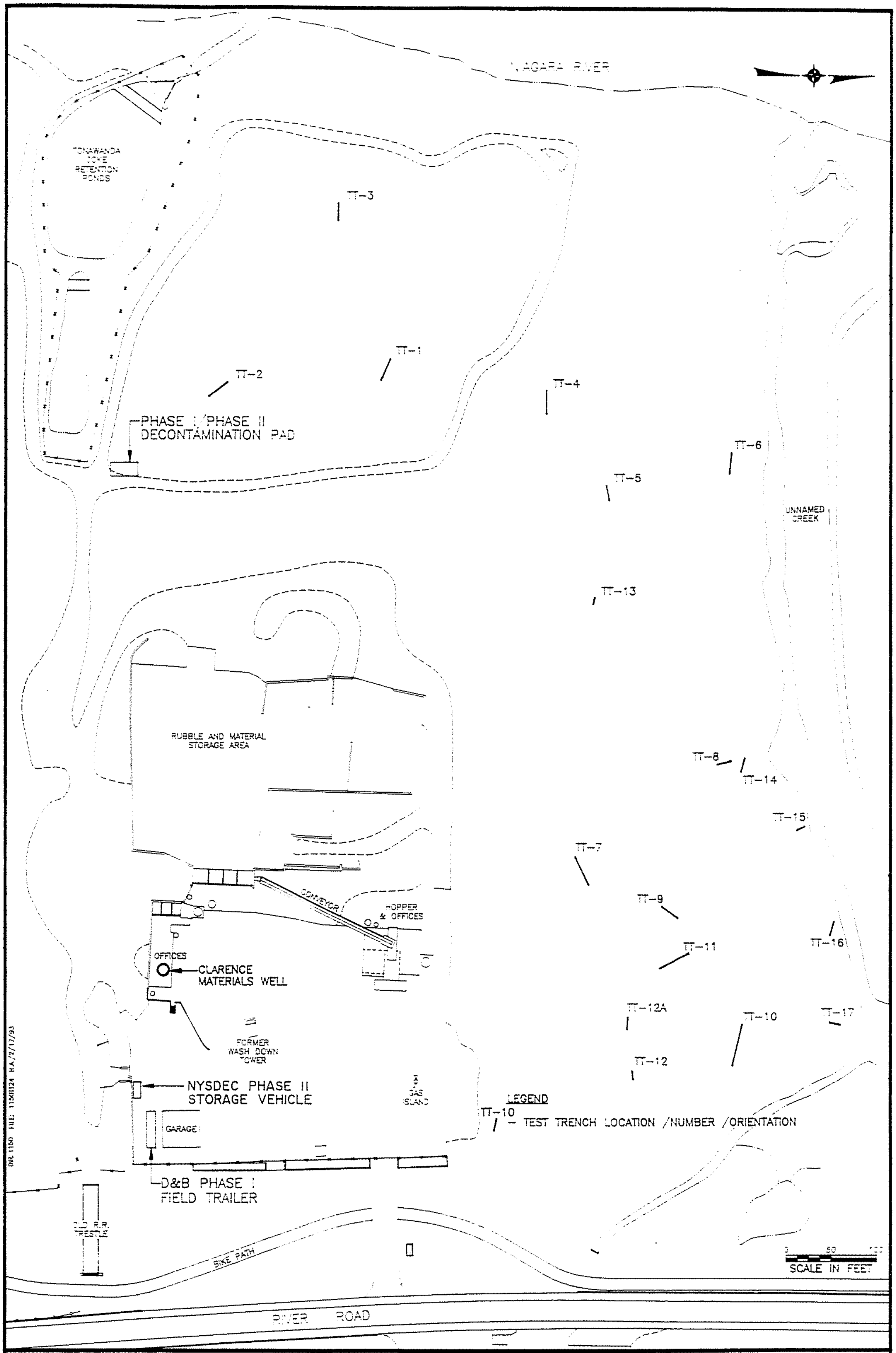
PHASE I OFF- SITE SURFACE SOIL SAMPLE LOCATIONS

FIGURE 2-3



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RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

PHASE I TEST TRENCH LOCATIONS

FIGURE 2-4

Soil samples were collected for both geologic and chemical assessment during excavation of the test trenches. The samples for geologic assessment were transferred to labeled Ziploc bags and stored in a designated drum on-site for reference purposes only. Based upon on-site monitoring devices utilized during the test trenching program, 14 soil samples were collected from the trenches in appropriate containers for chemical analysis. These samples were selected based primarily on the detection of volatile organic compounds as determined by the FID or PID. The sample displaying the highest reading from the test pit was selected for analysis. If, however, no samples showed elevated readings or if all readings were equal, then the sample with visual presence of contaminants (staining) was selected. Samples for chemical analysis were collected from the backhoe bucket and transferred directly to laboratory supplied sample jars using dedicated, sterile polystyrene disposable sampling scoops and sterile wooden spatulas. These samples were then placed in coolers and wrapped in bubble wrap, and packed with ice for shipping to the laboratory.

Analysis of samples collected from the test trenches varied based on the findings in the trench. If no elevated levels of volatile organic compounds were detected as a result of field screening, then the sample was analyzed for TCL +30. However, if elevated levels of organic compounds were observed on the Flame Ionization Detector (FID) or Photoionization Detector (PID), or if product or staining was observed on the soil, further characterization of the sample was necessary. The additional characterization/analyses were TCLP, RCRA characteristics and EPTOX, which were performed on samples collected from TT-02, TT-05 and TT-14. Samples collected from TT-03 were analyzed for TCLP and RCRA characteristics, and samples collected from TT-08B and TT-11B were only analyzed for RCRA characteristics. No soil samples were collected from TT-04, TT-13 and TT-15 based upon vapor monitoring results and visual observations.

At the completion of constructing each test trench, the test trench was backfilled with the excavated material. The material was placed in the test trench in the approximate reverse order that it was removed. The material was then tamped down in place.

Prior to entering the site and before leaving the site, the entire backhoe was decontaminated by high pressure steam cleaning. As defined in the work plan, the backhoe bucket was decontaminated between trench excavations only if contaminated soil or waste material adhered to the bucket. This was not required during the trenching program.

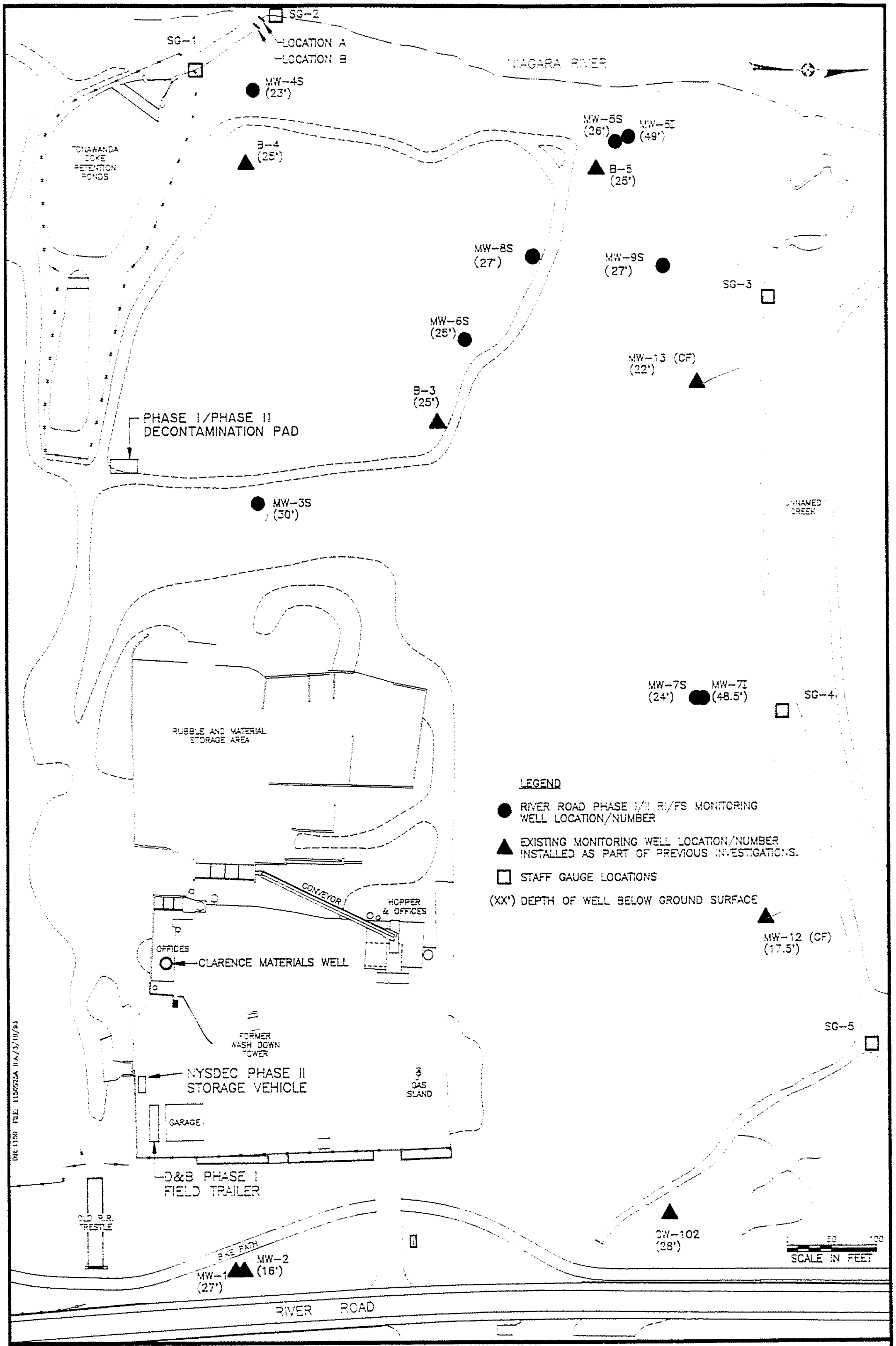
2.2.3.3 - Subsurface Soil/Borehole Sampling

During the Phase I investigation, seven boreholes (five shallow and two intermediate depth) were drilled on-site for construction of groundwater monitoring wells and the collection of subsurface soil samples. (Details of the well construction are discussed in Section 2.2.4.3.) The boreholes were constructed by Kendrick Drilling, Inc. of Chester, New York using a Diedrich D-50, track mounted drill rig with 4 1/4-inch ID hollow stem augers. Figure 2-5 presents the locations of the monitoring wells/boreholes on-site.

Six of the seven boreholes were sampled. Sampling was conducted with 2-foot long, 2-inch diameter, carbon steel, split barrel samplers (split spoon) in accordance with ASTM D-1586 methods. Samples were collected at 5-foot intervals starting at the ground surface and continuing to the completion of the borehole. The samples were collected by attaching the split spoon to the end of a drill string and setting the split spoon at the base of the borehole (sample interval). The split spoon was then driven with a 140-pound hammer until it had penetrated 2 feet into the soil or until the hammer had struck a minimum of 50 times (or "blows") with the spoon penetration less than 6 inches into the soil. The split spoon was then retrieved from the borehole and opened for inspection. The MW-5S borehole was not sampled due to its close proximity to the MW-5D borehole, which was sampled.

Upon retrieving the split spoon from the borehole, the split spoon was immediately opened and screened with a FID or PID for the presence of volatile organic compounds. The sample was then measured for recovery and classified in accordance with the Burmister Soil Classification System.

Soil samples collected from between the ground surface and the water table at boreholes MW-4S, MW-5I, MW-6S and MW-7I were selected for laboratory analysis. The criteria for selecting soil samples for laboratory analysis was based primarily on the detection of volatile organic compounds as determined by the FID or PID. The sample displaying the highest reading from each borehole was selected for analysis. If, however, no sample showed elevated readings or if all readings were equal, then the sample with visual presence of contaminants (staining) was selected. If no sample was stained, then the sample immediately above the water table was selected.



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MONITORING WELL AND STAFF GAUGE LOCATION MAP

FIGURE 2-5

Soil Samples were collected at the following depth intervals: MW-4S, 5 to 7 feet; MW-5I, 10 to 12 feet; MW-6S, 5 to 7 feet and MW-7I, 5 to 7 feet.

Upon selection of the sample for laboratory analysis, the soil was transferred to the appropriate laboratory supplied jars. The jars were then handled in the same manner for packaging and shipping as described in Section 2.2.3.1.

Selected soil samples were analyzed for TCL +30 parameters; however, due to the use of nonapproved sample containers (Ziploc bags) during the sample collection process, the results were deemed suitable for screening purposes only.

No soil sample was collected from borehole MW-3 for chemical analysis due to the significant thickness of weathered concrete and concrete fill material from the ground surface to a depth of 20 feet below grade (or 5 feet below the water table). It was decided that a sample of this material would not be representative of the soil beneath the surface.

Soil samples selected for geologic analysis were either kept in appropriately labeled Ziploc bags or transferred to glass storage jars supplied by the driller.

Split spoon samplers were decontaminated by first scrubbing and washing with a nonphosphate detergent and then steam cleaned with a high pressure steam cleaner.

Soil cuttings were placed in DOT-approved, 55-gallon, ring-top drums and stored at the drum storage area.

During the Phase II remedial investigation, four subsurface soil samples, two from boreholes MW-8S and MW-9S, were collected in the northwestern quadrant of the site. Figure 2-5 shows the location of the soil borings.

The Phase II boreholes were constructed by Buffalo Drilling Company, Inc. of Buffalo, New York with a Diedrich D-50 truck-mounted drill rig using 4-1/4-inch inside diameter hollow stem augers. Soil samples were collected in accordance with ASTM D-1586 with 2-inch outside diameter split spoon samplers.

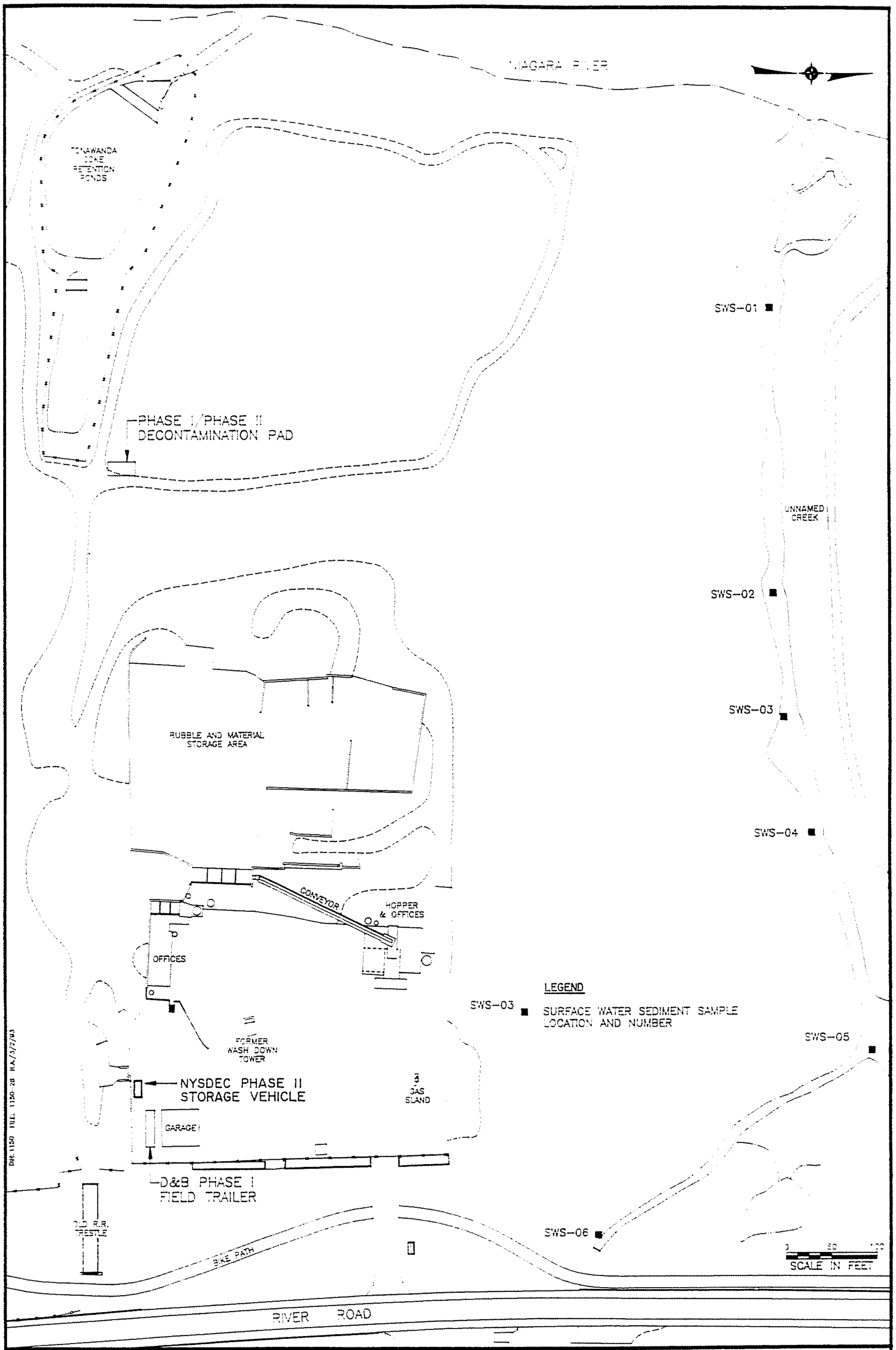
Soil samples were collected at 5-foot intervals starting at the ground surface. Upon retrieving and opening the split spoon sampler, the soil was immediately screened with a photoionization detector to determine the presence of organic vapors. The soil was geologically logged and immediately transferred to the appropriate laboratory supplied sample jars. The jars were labeled and stored in a cooler until shipment to the laboratory at the end of the day.

The criteria for selecting the soil samples for laboratory analyses during the Phase II RI/FS investigation were based on organic vapor readings and/or visual staining for samples collected between the groundwater and the water table. After each sample was collected and placed in a laboratory-supplied jar, the two samples displaying the highest organic vapor readings and/or staining were selected for analyses. At borehole MW-8S, the samples selected for laboratory analysis were collected from the 5-7 foot and the 15-17 foot sample intervals. At borehole MW-9S the samples were collected at the 5-7 foot and 10-12 foot sample intervals. The remaining soil samples were placed in sample jars provided by Buffalo Drilling, labeled and stored in a 55-gallon drum at the drum staging area. Soil samples were shipped within 48 hours of collection to the laboratory for analysis. The subsurface soil samples were analyzed for full TCL +30 parameters.

2.2.3.4 - Surface Water Sediment Sampling

During the Phase II RI/FS investigation, surface water sediment samples were collected at six locations along the unnamed creek along the northern boundary of the site. Surface water samples, collected for the Cherry Farm RI investigation did not reflect elevated levels of contaminants and were not sampled in the present remedial investigation. The surface water sediment samples are numbered SWS-01 through SWS-06 and are shown on Figure 2-6.

The samples were collected using a clean 2-inch diameter 1.5 foot long Butyrate plastic sampling tube. The sampling tube was pressed into the sediment to a depth of 6 inches below the sediment surface. The sampling tube was retrieved, and the retained sample was transferred directly to the laboratory supplied sample jars. At location SWS-03, the sediment sample was collected using the sampling tube in conjunction with the Wildco Inc. sediment core sampler due to the presence of noncohesive sediments. The sample jars were labeled and placed into a cooler for storage until shipment to the laboratory for analysis.



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PHASE II SURFACE WATER SEDIMENT SAMPLE LOCATION MAP

FIGURE 2 - 6

Analysis of the surface water sediment samples included TCL +30 parameters less volatile organic compounds for five of the six samples. Sample SWS-03 was analyzed for full TCL +30 parameters. Due to previously collected data from the Cherry Farm site which indicated lower organic contamination at the other locations along the creek relative to the SWS-03 location, VOC analysis was not selected.

2.2.4 Monitoring Well Program

2.2.4.1 - Monitoring Well Locations

Nine borings and groundwater monitoring wells were constructed at seven locations across the western portion of the site during the Phase I/II programs (see Figure 2-5 for locations). The monitoring wells are numbered MW-3S, MW-4S, MW-5S, MW-5I, MW-6S, MW-7S, MW-7I, MW-8S and MW-9S. Wells MW-3S through MW-7I were constructed during the Phase I program, Wells MW-8S and MW-9S were constructed during the Phase II program.

During the Phase I investigation, MW-3S was originally located along the south central edge of the site in the approximate area of the former Rattlesnake Creek as identified in the work plan. Field observations made before the start of the drilling program indicated that this area was subject to frequent truck traffic and dumping. As a result, and with concurrence from NYSDEC, the well location was moved northwest approximately 250 feet to the base of the western toe of slope of the concrete rubble pile. The well location was again moved approximately 150 feet north along the toe of the slope just prior to drilling the borehole due to the presence of concrete on the ground surface, which was not identified previously due to snow cover.

Data collected from MW-3S was used to assess both the quality of water flowing radially from the concrete rubble pile as well as the effects of the rubble pile on the water table and groundwater flow direction.

Well MW-4S is located at the southwest corner of the site, downgradient of two waste piles, and near the Tonawanda Coke retention ponds. Data collected from this location will help assess if the waste piles have affected the groundwater quality in this area.

MW-5S and MW-5I are located in the west central portion of the site along the Niagara River. This area was identified in the previous Phase II RI/FS Investigation as a magnetically anomalous area.

MW-6S was constructed in the west central portion of the property just south of the main access road for the site. MW-6S is located adjacent to an area of stressed vegetation.

MW-7S and MW-7I are located in the north central portion of the site just downgradient of a drum disposal area and in the approximate area of the former Rattlesnake Creek channel. Groundwater data collected in this area will help determine if the groundwater has been affected by sources in the drum disposal area. The drum disposal area is located in the northeastern portion of the site and is identified as such due to the presence of discarded drums in the ground surface. Additional data collected during the drilling of MW-7I was used to confirm the location of the former Rattlesnake Creek.

Wells MW-8S and MW-9S were constructed during the Phase II RI/FS investigation to further assess subsurface soil and groundwater conditions in the northwest quadrant, specifically the light nonaqueous phase liquid identified in well MW-5S during groundwater sampling conducted during Phase I. Well MW-8S was located approximately midway between wells MW-6S and well couplet MW-5. Well MW-9S was located approximately midway between wells MW-13 and well couplet MW-5. Wells MW-12 (CF) and MW-13 (CF) were constructed during the Cherry Farm Remedial Investigation.

2.2.4.2 - Monitoring Well Depths

The monitoring wells were constructed to monitor two zones in the alluvial/lacustrine aquifer: the water table and the base of the alluvial/lacustrine aquifer. The wells constructed to monitor the water table are designated with the suffix "S" and are MW-3S, MW-4S, MW-5S, MW-6S, MW-7S, MW-8S and MW-9S. These wells ranged in depth from 23 feet at MW-4S to 30 feet at MW-3S. See Table 2-1 for a summary of well construction details.

The base of the alluvial aquifer is monitored by the intermediate depth wells. These wells are designated with the suffix "I" and are MW-5I and MW-7I. MW-5I was set at 49 feet below the ground surface and MW-7I was set at 48.5 feet below the ground surface.

2.2.4.3 - Monitoring Well Construction and Installation

The groundwater monitoring wells were constructed of 2-inch diameter, Schedule 40 PVC, flush joint riser pipe and 0.010-inch slot well screen. The shallow wells were constructed with 15 feet of well screen set approximately 10 feet below the water table. The intermediate wells were constructed with 10 feet of screen.

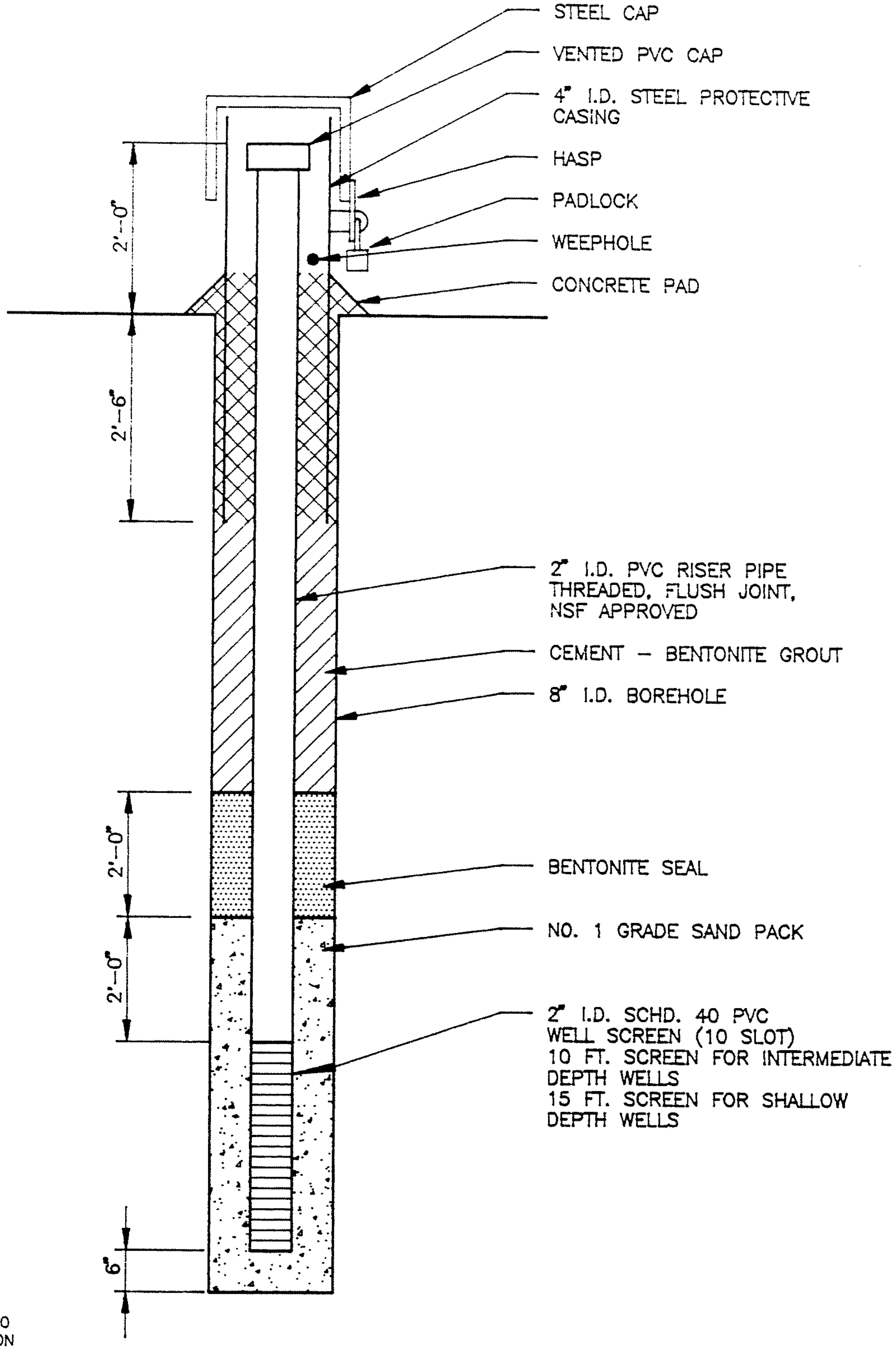
The monitoring wells were installed by first drilling a borehole to the completion depth. The boreholes were drilled using 4 1/4-inch ID hollow stem auger, and sampled at 5-foot intervals (see Section 2.2.3.3 for details of borehole sampling).

Upon completing the borehole, Number 1, grade quartz sand was placed in the the augers to form a 6-inch bed at the desired depth of well construction. Following the placement of the sand at the base of the borehole, the well screen and riser pipe were inserted into the augers so that 2 feet of riser pipe remained above the ground surface. Clean, Number 1 grade quartz sand was then placed into the annular space around the well pipe to a depth of 2 feet above the top of the well screen. During placement of the sand pack, the augers were slowly removed so that the augers were raised at approximately the same rate the sand pack accumulated in the borehole. This technique significantly reduces the risk of borehole collapse around the well screen. Upon completing the sand pack placement, a 2-foot thick layer of bentonite was placed above the sand pack. However, during the construction of MW-7I, a bridge of bentonite formed in the augers after placing only 6 inches of bentonite above the sand. The bridge was then partially broken and approximately 3 feet of bentonite slurry was added to complete the bentonite seal.

In the intermediate depth wells, a cement-bentonite slurry was placed in the annular space to a depth of approximately 2.5 to 3 feet below grade. The remaining annular space was backfilled with concrete mix. A 5-foot long, 4-inch diameter, protective steel casing with locking cap was placed around the well pipe at the ground surface. The protective casing was set at 2.5 feet into the concrete mix. A final concrete pad was placed around the base of the protective casing. This pad was constructed with a surface sloping radially away from the center.

In the shallow depth wells, the annular space above the bentonite seal was backfilled with concrete gravel mix due to the limited space that needed to be filled. The wells were then completed in the same manner as the two intermediate depth wells as described above.

Figure 2-7 shows the typical well construction details. Actual well construction details are presented in Appendix C. Table 2-1 presents a summary of the well construction details.



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TYPICAL MONITORING WELL CONSTRUCTION DETAIL

FIGURE 2 - 7

Table 2-1

PHASE I/PHASE II GROUNDWATER MONITORING WELL CONSTRUCTION SUMMARY

Well Number	Ground Surface Elevation (amsl)	Top of PVC Elevation (amsl)	Screen Length (ft)	Well Depth Below Grade (ft)	Screened Material
Phase I					
MW-1*	575.7	577.01	5	27	Alluvial/Lacustrine
MW-2*	575.8	576.97	10	16	Alluvial/Lacustrine
MW-3S	584.4	586.55	15	30	Fill
MW-4S	579.4	582.51	15	23	Fill
MW-5S	582.3	584.58	15	26	Fill
MW-5I	582.9	585.13	10	49	Alluvial/Lacustrine
MW-6S	585.6	587.62	15	25	Fill
MW-7S	581.7	583.74	15	24	Fill
MW-7I	581.5	583.22	10	48.5	Alluvial/Lacustrine
MW-12*(CF)	581.00	582.49	10	17.5	Fill
MW-13*(CF)	584.10	585.73	10	22	Fill
CW-102*	574.3	575.68	10	28	Fill/Alluvial/ Lacustrine
B-3*	586.2	587.90	2	25	Fill
B-5*	581.7	583.80	2	25	Alluvial/Lacustrine
B-4*	581.8	583.16	2	25	Alluvial/Lacustrine
Phase II					
MW-8S	585.7	588.40	15	27	Alluvial/Lacustrine
MW-9S	584.6	587.25	15	27	Alluvial/Lacustrine

Note:

*Existing well
amsl - Above mean sea level
(CF) - Well installed as part of the Cherry Farm investigation.

variation of no greater than 10 percent. The turbidity value of 75 NTUs was agreed as being sufficiently low turbidity for sample collection by the NYSDEC project manager. Upon meeting this criteria, well development was stopped. Table 2-2 shows the final field turbidity values.

During well development, groundwater was pumped into DOT-approved 55-gallon drums and stored at the drum staging area.

2.2.4.5 - Water Level Measurements

Three rounds of water level measurements were collected from the wells and staff gauges located across the site (see Figure 2-5 for well and staff gauge locations). Measurements were collected on April 2, April 15 (Phase I), and December 8, 1992 (Phase II). Water levels were collected with a Keck water level meter by lowering the electronic probe into the well until the audio signal was sounded, at which point the depth to water was measured at the surveyed point at the top of the inner riser pipe.

Staff gauge measurements were also collected using the Keck water level meter. The probe was lowered from the top of the staff gauge until the audio signal sounded. The measurement was read from the top of the staff gauge from the marked survey point.

Due to the presence of light nonaqueous phase liquid (LNAPL) in wells MW-5S, MW-6S and MW-8S during the December 8 round of water levels, an oil/water interface probe was used to measure the depth to water and LNAPL. These measurements were also collected by measuring the depth to water/LNAPL from the surveyed measuring point.

The water level and oil/water interface probes were decontaminated by washing the probes with an Alconox and water solution and rinsing with dionized water. The decontamination fluids were collected in a DOT-approved, 55-gallon drum and stored at the drum storage area.

2.2.4.6 - Groundwater Sampling

Two rounds of groundwater samples comprising 26 samples were collected at the River Road site during the period between April 13-15, and December 8-12, 1992. Eleven wells were sampled during the April sampling event, which included the seven wells installed wells as part of the Phase I remedial investigation (MW-3S, MW-4S, MW-5S, MW-5I, MW-6S, MW-7S and

Table 2-2

FINAL PHASE I/PHASE II WELL DEVELOPMENT TURBIDITY VALUES

Well Number	Final Turbidity (NTUs)
Phase I	
MW-3S	10
MW-4S	7.6
MW-5S	14
MW-5I	32
MW-6S	*
MW-7S	155
MW-7I	62
Phase II	
MW-8S	10.2
MW-9S	71

* Turbidity meter malfunction prevented recording of final value; however, the two previous turbidity values recorded were 9 and 10 NTUs.

Table 2-3

SUMMARY OF PHASE I/PHASE II GROUNDWATER AND LNAPL LEVEL ELEVATIONS

Well Number	Top of Measuring Pt.	4/2/92	4/15/92	12/8/92	LNAPL Level 12/10/92
MW-1	577.01	566.87	566.23	566.76	NO
MW-2	576.97	572.47	571.96	572.18	NO
MW-3S	586.55	570.75	570.69	570.78	NO
MW-4S	582.51	570.12	570.04	570.18	NO
MW-5S	584.58	566.97	*	566.80(1)	567.08
MW-5I	585.13	566.80	566.30	566.67	NO
MW-6S	587.62	570.57	570.47	570.49(1)	570.50
MW-7S	583.22	570.80	570.74	571.34	NO
MW-7I	583.74	567.00	566.45	566.38	NO
MW-8S	588.40	NI	NI	569.88(1)	570.10
MW-9S	587.25	NI	NI	569.65	NO
CW-102	575.68	568.82	567.68	568.91	NO
MW-12	582.49	569.61	569.57	569.66	NO
MW-13	585.73	569.09	569.06	569.14	NO
B-3	587.90	570.65	570.56	570.61	NO
B-4	583.16	NS	NS	566.90	NO
B-5	583.80	NC	566.49	566.82	NO
Staff Gauge Number					
SG-1	569.66	568.31	568.26	567.76(RS)	
SG-2	566.92	566.47	565.77	566.52	
SG-3	573.56	NC	569.36	569.47	
SG-4	573.80	570.70	570.55	Dry	
SG-5	573.55	570.72	571.15	571.55	

Notes:

LNAPL	- Light nonaqueous phase liquid.
NO	- No product observed.
*	- Water level could not be collected due to LNAPL.
NC	- Water level not collected.
NI	- Wells installed during Phase II investigation, November 1992.
NS	- Well not sampled during Phase I investigation.
(RS)	- Staff gauge resurveyed (top of measuring pt. at 570.72), December 1992.
(1)	- Adjusted water level elevation.

MW-7I), three existing wells (MW-1, MW-2 and CW-102) and the Clarence Materials well previously utilized for vehicle washdown. The samples collected were analyzed for TCL +30 parameters plus hexavalent chromium.

Fifteen wells were sampled during the Phase II RI/FS investigation, which included the five Phase I wells listed above, six existing wells including three wells not previously sampled (MW-1, MW-2, CW-102, B-3, B-4 and B-5) and two Cherry Farm site wells located on the River Road site (MW-12 and MW-13). These groundwater samples were analyzed for semivolatile compounds, pesticides/PCBs, metals and cyanide. Samples of LNAPL were collected from Wells MW-5S and MW-8S. The LNAPL was analyzed for PCBs, total petroleum hydrocarbons and semivolatile organic compounds. Figure 2-5 shows the well locations.

The groundwater samples were collected from the monitoring wells by first covering the ground surface around the well area with a clean sheet of polyethylene plastic sheeting. The plastic sheeting prevented accidental contact of the ground surface with the water level meter, bailer, bailer rope and other clean items. The monitoring well was then opened and head space monitored for volatile organic compounds. A static water level reading was collected and the well volume calculated to determine the minimum volume of water to be purged from the well.

Purging was conducted by bailing the necessary volume of water with a dedicated, polyethylene disposable bailer. The purge water was monitored for pH, temperature, conductivity and turbidity. Conductivity was not measured during Phase I due to a meter malfunction. Approval was obtained from the NYSDEC to discontinue conductivity measurements. All purge water was collected in 55-gallon drums and stored in the drum staging area. The drums were labeled according to job name, well number, contents and date. Purging was continued until the pH and temperature and conductivity had stabilized and the turbidity values were below approximately 75 NTUs as approved by NYSDEC. Typically, three to five well volumes are needed to achieve stabilization of the pH and temperature; however, at most wells, a turbidity of less than 75 NTUs was not achieved immediately after purging. As a result, the wells were allowed to settle before collecting samples.

Groundwater samples were collected by slowly lowering the bailer into the well. After the bailer was retrieved, a small portion of the sample was decanted and measured for turbidity. Samples with a turbidity of less than 75 NTUs were then immediately collected in the appropriate laboratory supplied sample jars. Samples with a turbidity of approximately 75 NTUs or greater were field filtered for the inorganics/metals portion of the sample.

Field filtering was performed by transferring the inorganics portion of the groundwater sample to a precleaned filter flask. The sample was then filtered through a 0.45 micron filter. A portion of the filtered sample was then remeasured for turbidity and the value recorded. The procedure was repeated using new filters until sufficient volume of sample was filtered to fill the appropriate laboratory sample jar. Field filtering was conducted during Phase I only.

After collecting the groundwater samples in the appropriate sample bottles, labeling was completed, and the bottles wrapped in bubble wrap and packed in a cooler with ice. A completed chain of custody form was taped to the underside of the cooler lid. The cooler was then secured with a custody seal and wrapped with packing tape. The cooler was then shipped to the laboratory within 48 hours.

The Clarence Materials washdown well was sampled during the Phase I investigation. The well is located in a small warehouse near the southeastern portion of the site. The washdown well consists of a 6 to 8-inch diameter well drilled to approximately 50 feet below grade. The well is cased with 42 feet of 6-inch diameter steel casing with the casing seated in bedrock. The well head is set about 2 feet below the concrete floor of the warehouse in an access way. The access way is about 4 feet by 4 feet square with a steel mesh cover. A large pallet of material was stored on the mesh cover preventing easy access to the well head. The well has not been operated for approximately 2 1/2 to 3 years. The well is serviced by a submersible pump set of an unknown depth. The pump discharges to a 1 1/2-inch steel pipe, which leads to the washdown tower near the middle of the Clarence Materials facility approximately 200 feet away (subsequently removed after the Phase I investigation). The steel pipe is buried beneath the ground surface and emerges at the base of the tower. A ball valve is located in the steel pipe 2 feet above the ground surface. The groundwater sample was collected at this valve.

Prior to collecting the groundwater sample, the washdown well was purged by turning on the pump. The well was purged of at least 220 gallons immediately prior to collecting the sample. The previous day, Clarence Materials personnel pumped the well for approximately 10 to 15 minutes discharging an unknown quantity of water to confirm that the pump was still operational. The 220 gallons purged immediately prior to collecting the groundwater sample was collected in 55-gallon drums. pH, temperature and turbidity were monitored until these parameters stabilized. The groundwater sample was collected from the in-line ball valve at the base of the washdown tower.

During the April groundwater sampling event (Phase I), while purging MW-5S, a layer of light nonaqueous phase liquid (LNAPL) approximately 3/10-inch thick was observed floating in the well. The measurement was made by directly measuring the thickness of LNAPL floating on the sample of water collected by the bailer. Consequently, MW-5S was purged and sampled last so as to eliminate the potential of cross-contamination of other wells through the use of shared downhole tools even though the tools are cleaned between use. In addition to analyzing the groundwater for TCL +30 parameters and hexavalent chromium, approximately 75 ml of LNAPL was decanted from the bailer into two 40 ml vials and analyzed for total petroleum hydrocarbons (TPHC). The presence of LNAPL at this location is consistent with observations made during the 1980 Troutman Associates investigation. It was reported that a "black oily substance with strong odor between 12.5 and 16.5 feet in depth" was observed during the drilling of B-5. The B-5 well in that study is located less than 50 feet to the southeast of MW-5S. Results from that 1980 report show elevated levels of iron (310 mg/l) and total organic carbon (14.5 mg/l) from this well sample.

During the Phase II sampling event, LNAPL was observed in wells MW-5S, MW-6S and MW-8S. LNAPL samples were collected from wells MW-5S and MW-8S. Well MW-6S did not contain enough LNAPL to permit sample collection.

2.2.5 Surface Water Flow Measurements

The River Road site property contains two predominant surface water features, the Tonawanda Coke retention ponds along the southwestern site border, which discharges to a channel which discharges directly to the Niagara River, and the unnamed tributary along the northern border of the site. During the field investigation, five staff gauges were installed; two in the retention pond discharge channel and three in the unnamed tributary along the northern site border. Three sets of data were collected from these gauges. Staff gauge 1 was damaged and required replacement and resurveying prior to the start of the Phase II field work.

Flow measurements were collected at two locations along the Tonawanda Coke discharge channel and are designated as Location A and Location B (see Figure 2-5 for locations). Location A is approximately 6 feet up channel from the point where the channel enters the Niagara River. Location B is 14 feet up channel from the same point. The measurements were collected by first measuring the cross-sectional area perpendicular across the channel at each location. An approximate flow velocity is calculated by floating an object down the center of the channel and measuring the rate at which the objects floats from Location B to Location A. Three velocity rates were measured, and the flow determined by use of the following equation:

$$Q = VA$$

Where: Q = Flow
V = Average velocity
A = Cross-sectional area

"Q" was calculated at two locations, A and B. The lack of free flowing water in the unnamed stream precluded estimates of flow for this surface water feature.

2.2.6 Air Monitoring

Air monitoring was conducted at the site daily during the Phase I/II field investigation. The monitoring included ambient/background readings for volatile organic compounds (VOCs) with the OVA and/or MicroTip meter, as well as monitoring the borehole head space and test trenches for VOCs. VOC levels were recorded on the daily air monitoring forms and are presented in Appendix J. Dust levels were also recorded during the Phase I/II program.

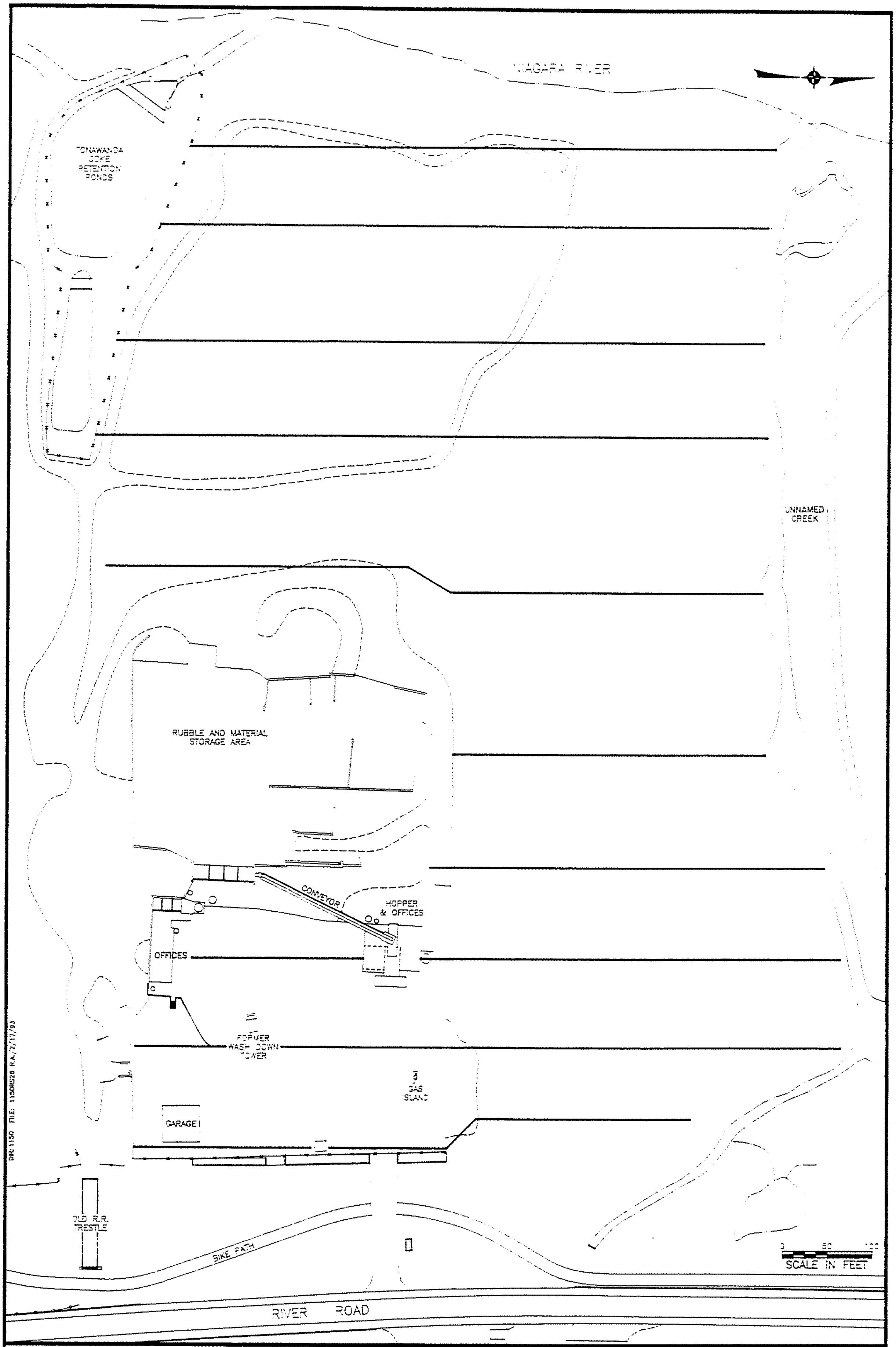
The OVA and MicroTip meters were calibrated at the beginning of each day in accordance with the work plan and the results recorded on the daily calibration log forms.

2.2.7 Radiation Survey

A radiation survey was conducted during the Phase I investigation to determine if radioactive sources exist at the site. The survey consisted of monitoring for alpha, beta and gamma radiation with a Geiger counter along north-south running survey lines (see Figure 2-8) and along existing access roads that cross the site. Data was read continuously and recorded if readings consistently read above expected normal background levels of 0.05 mi/rm (Appendix J).

2.2.8 Health and Safety Program

As part of the project work plan, a Health and Safety Plan was prepared during the development of the Phase I RI work plan in order to establish occupational health and safety requirements, responsibilities, and procedures to protect workers during the field investigation at



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PHASE I RADIATION SURVEY LINE LOCATIONS

FIGURE 2 - 8

the River Road site. Review of the Phase I data by the Health and Safety officer was also performed to assure appropriate Health and Safety efforts continued during the Phase II RI/FS investigation. The requirements for worker health and safety were based on the following:

- The Standard Operating Safety Guides. US Environmental Protection Agency (EPA), Office of Emergency and Remedial Response;
- The Occupational Health and Safety Administration (OSHA) Regulations, 29 CFR Parts 1019.120 and 1926;
- Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH, OSHA, USCG and EPA;
- Health and Safety Procedures for Hazardous Waste Sites. Dvirka and Bartilucci Consulting Engineers; and
- Superfund Amendments and Reauthorization Act (SARA), Title I, Section 126.

Activities associated with the Phase I/II RI were performed in accordance with this Health and Safety Plan. A detailed description of the Health and Safety Plan is contained in the work plan and work plan addendum.

As part of the conduct of the Phase I remedial investigation test trenching program, a cascade air supply system and level B protective equipment was utilized. This level of protection was deemed prudent while evaluating the extent and content of potential buried drum material. This work consisted of three members of the field team (two samplers and one backhoe operator) in level B and one health and safety officer in self-contained breathing apparatus (SCBA) in an upwind safe zone for emergency rescue (if required).

2.2.9 Quality Assurance/Quality Control and Sampling Program

As part of the remedial investigation, and project work plan and work plan addendum, a Quality Assurance and Quality Control (QA/QC) Plan was prepared which developed and described the detailed sample collection and analytical procedures to be used to ensure high quality, valid data collected as part of this project. This QA/QC Plan included detailed descriptions of the following:

- Objective and Scope
- Data Usage

- Monitoring Network Design and Rationale
- Monitoring Parameters
- Schedule of Tasks and Outputs
- Project Organization and Responsibility
- Data Quality Requirements and Objectives
- Sampling Procedures
- Decontamination Procedures
- Laboratory Sample Custody Procedures
- Field Management Documentation
- Calibration Procedures and Preventive Maintenance
- Documentation, Data Reduction and Reporting
- Data Validation
- Performance and System Audits
- Corrective Action
- Trip Blanks
- Field Blanks
- Matrix Spikes/Matrix Spike Duplicates
- Method Blanks
- Field Management Forms
- NYSDEC Sample Identification, Preparation and Analysis Summary Forms
- Data Validation Reporting Forms

Work undertaken during the Phase I/II RI was performed in accordance with the procedures outlined in the QA/QC Plan contained in the Phase I RI work plan and Phase II work plan addendum.

2.2.10 Data Validation

Nytest Environmental, Inc., which is a NYSDOH and Environmental Laboratory Approval Program (ELAP) approved laboratory meeting requirements for performing sample analysis according to 1991 Analytical Services Protocols (ASP), was utilized to perform all the chemical analyses for the samples obtained during the Phase I/II RI. Summary documentation regarding data validation was completed by the laboratory using NYSDEC forms and submitted with the data package as required in the work plan.

Section 3

3.0 PHYSICAL AND ECOLOGICAL CHARACTERISTICS OF STUDY AREA

3.1 Surface Features

Presently, the site can be divided into two portions: the developed southeastern portion, which is characterized by the presence of the Clarence Materials Corporation, its structures and facilities; and the undeveloped western and northeastern portions, which an characterized as filled, reclaimed land.

The Clarence Materials portion of the site is situated in part on a flat concrete parking lot and unpaved ground surface. Immediately north of the active portion of the facility is a fill area with mounds of soil fill overgrown with brush and small trees. Directly west, behind the facility, is a large concrete rubble pile. The rubble pile is approximately 20 feet high and greater than 700 feet in both width and length.

The western portion of the site is relatively flat with several large mounds scattered across this area. The mounds vary in composition from soil covered slag to slag, concrete and scrap metal. Additionally, a 4-foot high ridge runs north-south starting from near the northwest edge of the rubble pile and ends near the unnamed stream channel. The ridge is approximately 500 feet long. At the western and northern edge of the site, the ground surface drops dramatically to the edge of the Niagara River and stream. The decline varies from approximately 10 feet near the east end of the stream to greater than 15 feet along the Niagara River.

3.1.1 Surface Water Flows

The staff gauge network described in Section 2.2 was set up in part, to provide estimates of flow discharges from the predominant surface water features on-site. Based upon the formulas presented in that section, the discharge or flow from the Tonawanda Coke retention pond is calculated to be approximately 3,200 gal/min at Location A and 3,000 gal/min at Location B for an average flow of about 3,100 gal/min. Flow measurements could not be collected from the unnamed stream located along the northern portion of the site, due to the lack of measurable free-flowing water in the stream during the Phase I/Phase II remedial investigations.

3.2 Site Geology

Four stratigraphic units have been identified at the River Road site. Three of these units are believed to exist continuously across the site. These units, in descending order, are:

- Fill Material
- Marsh Deposits (noncontinuous)
- Alluvial/Lacustrine Sediments
- Till

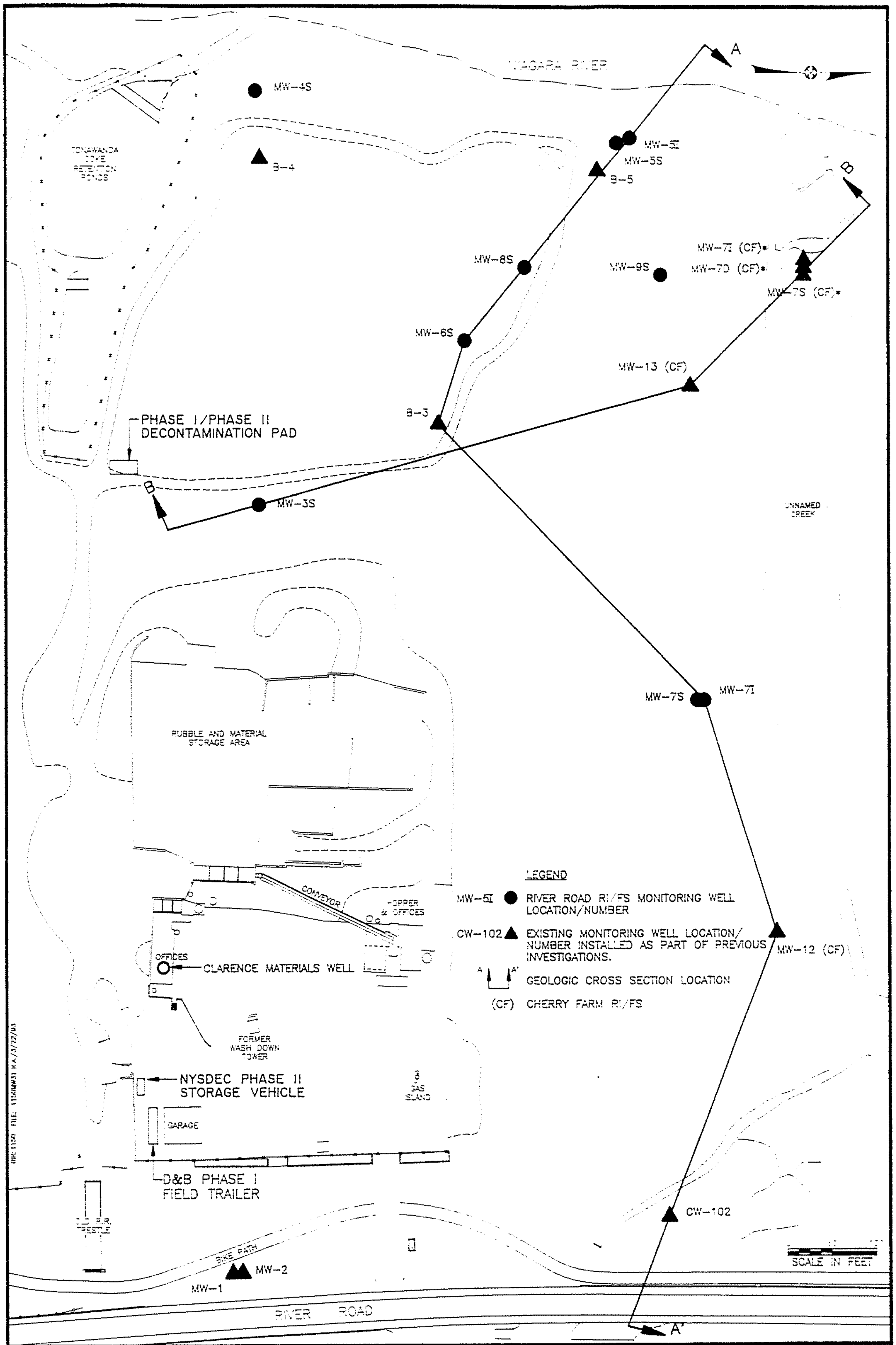
The four stratigraphic units are consistent with previous reported studies; however, some differences regarding these units were observed. A discussion of each of these units is presented below.

3.2.1 Fill Material

Covering the undeveloped portion of the site is a thick layer of fill material. The thickness of the fill varies. At its thickest, the fill was measured greater than 25 feet at B-3. The base of the fill material is an irregular surface which ranges from 560 feet AMSL to 570 feet AMSL. This irregularity is a common feature in filled areas. Based upon the Phase I and Phase II field investigation results, geological cross-sections were prepared and are located in Figure 3-1. Figures 3-2 and 3-3 show the fill material in cross-section view.

The fill material varies in composition, generally including foundry sand, furnace bricks (whole and broken), wood (lumber), metal, slag and slag chunks, cloth, plastic and cardboard. The most abundant type of fill, based on visual observations, is foundry sand and slag.

The foundry sand was encountered in each borehole. The sand ranged in color from gray to brown to black and appears to be uniform in grain size. These sands were clean and free of other materials, and were found to exist throughout the entire thickness of the fill material, as well as laterally across the site.



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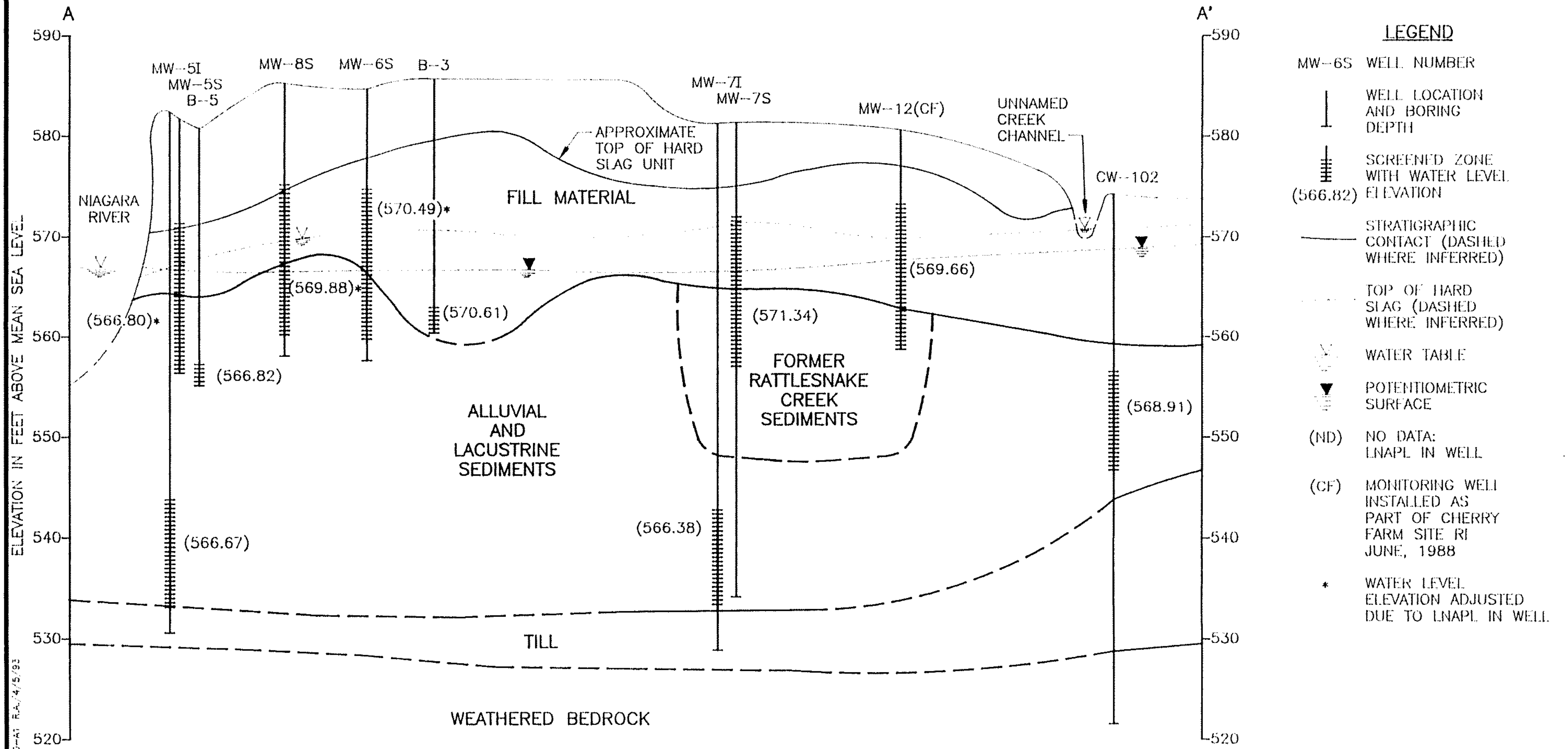
GEOLOGIC CROSS SECTION LOCATIONS

FIGURE 3-1



SCALE: HORIZ. 1"=150'
VERT. 1"=10'
VERTICAL EXAGGERATION = 15x

NOTES:
WATER LEVEL ELEVATION IN FEET ABOVE MEAN SEA LEVEL

WATER LEVEL DATA COLLECTED ON DECEMBER 8, 1992

DR: 1150 FILE: 1150-A1 RA/4/5/93

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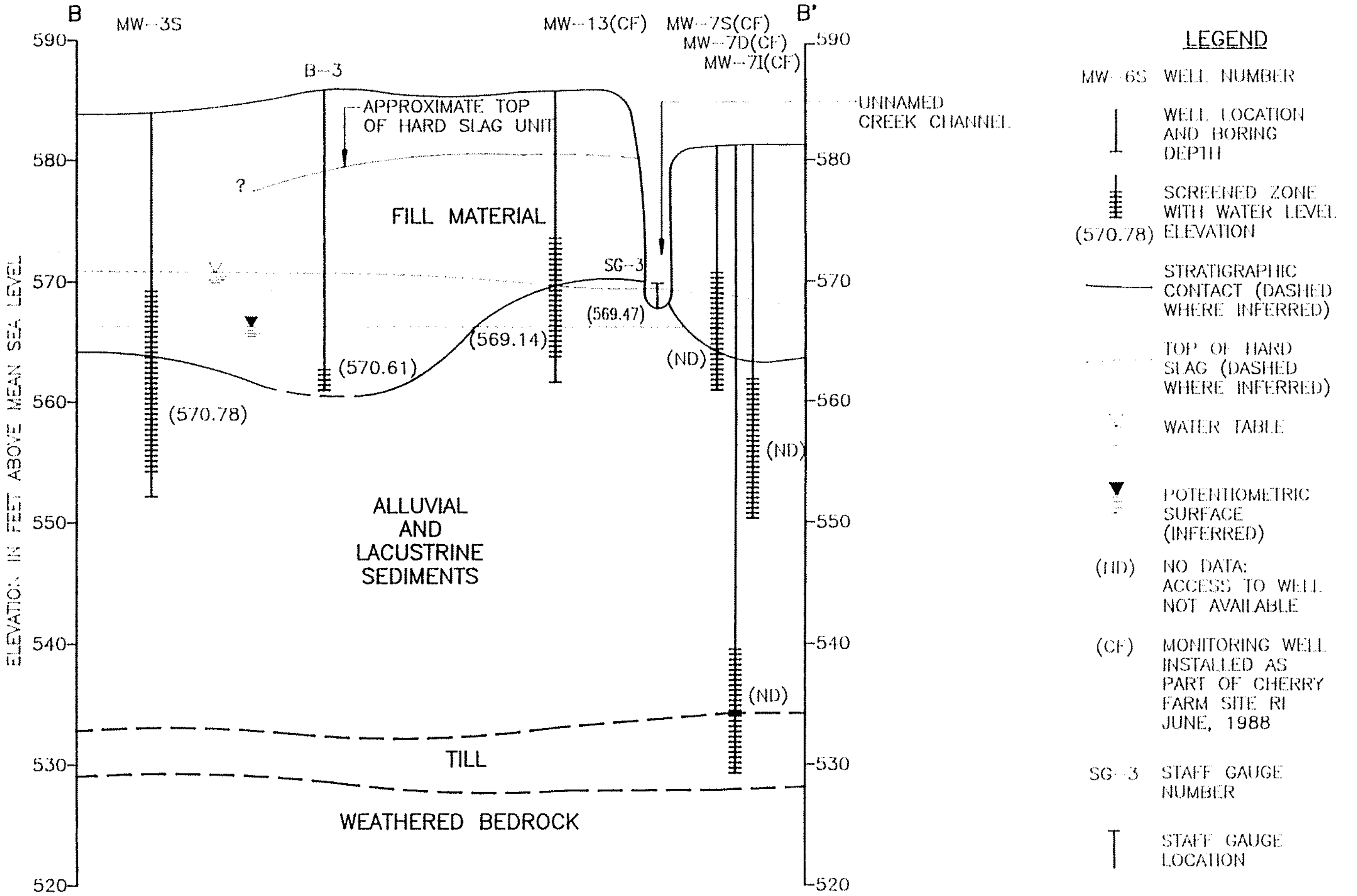
GEOLOGIC CROSS SECTION A–A'

FIGURE 3-2



SCALE: HORIZ. 1"=150'
VERT. 1"=10'
VERTICAL EXAGGERATION = 15x

NOTES;
WATER LEVEL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL

WATER LEVEL DATA COLLECTED ON DECEMBER 8, 1992

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GEOLOGIC CROSS SECTION B--B'

FIGURE 3-3

The slag is characterized as a gray to tan solid and dense material resembling a solidified, once molten liquid with occasional vapor pockets and pieces of metal. The slag was encountered in two forms: as sand to boulder size pieces in the fill matrix and as a continuous unit within the fill material.

The continuous slag unit was encountered throughout the north, central and western portions of the site. Test trench and borehole data indicate that the surface of the continuous slag ranged from 0 feet below grade at test trench TT-03 to 10 feet below grade at MW-6A. Overall, the slag unit was encountered in 12 of the 17 test trenches and in borehole MW-6A and MW-6B. As a result, these 12 test trenches and two boreholes could not be advanced further.

In the eastern portion of the site, test trenches TT-7 and TT-11B encountered buried refuse in the fill, consisting of cloth, plastic, wood and metal. The refuse was found to be in isolated pockets rather than in horizontal layers. The refuse was confined to the subsurface, generally 6 feet in depth or less.

3.2.2 Marsh Deposits

Marsh deposits were sporadically encountered at MW-8S. These sediments consisted of silt, roots and reeds. Since a portion of the site is located within a wetland area, the absence of the marsh deposits at other locations may be a result of filling practices. Traces of sand and clayey silts were found at monitoring wells MW-7S and MW-7I, along with traces of roots, rhizomes and twigs suggesting the influence of deposits from the former Rattlesnake Creek. These marsh deposits were not contiguous across the site.

3.2.3 Alluvial/Lacustrine and Alluvial Sediments

Alluvial and alluvial/lacustrine sediments were identified at the site at two locations. The first location is a stratigraphic sequence of alluvial/lacustrine sediments found beneath the fill material. The second location is a linear deposit of recent alluvium located along the unnamed creek which runs along the northern border of the site.

The stratigraphic sequence of alluvial/lacustrine sediments were identified in each borehole constructed at the site. However, only three borings, MW-5I, MW-7I and CW-102, completely penetrated these sediments. Data from these three locations indicate the thickness of the alluvial/lacustrine sediments to be 32 feet, 34 feet and 15 feet, respectively.

The alluvial/lacustrine sediments ranged from black, dark gray and brown silt to clayey silt to gray and brown fine and coarse sand with lesser amounts of silt, clay and gravel. Coarse sediments ranged from subangular to rounded and were mostly quartz.

The alluvial and lacustrine sediments are thickest beneath the undeveloped portion of the site. Borehole data indicates a maximum thickness of 34 feet at MW-7I; however, cross section B-B' (Figure 3-3), drawn through the site, suggests the alluvial and lacustrine sediments may be as thick as 37 feet (near MW-13). The alluvial and lacustrine sediments thin towards the east where at CW-102 were the sediments were measured at 15 feet thick. Based on the boring log of CW-102, the thinning of the alluvial/lacustrine deposits is a result of a thickening of the base till unit.

Alluvial sediments were also identified as a lineal deposit located along the unnamed creek which runs along the northern border of the site. These deposits are described as black, brown and red silts, clays and fine sand with occasional mica with occasional roots. The thickness of those sediments could not be assessed since samples were collected from zero-6 inches in depth.

3.2.4 Till

Gray till was encountered at MW-5I and MW-7I and noted in boring logs from well CW-102 at depths of 49 feet, 48.5 feet and 30 feet below grade. The gray till consisted of coarse, subrounded sand and gravel with little clay and silt in the interstitial spaces. At MW-7I, 2 feet of till was penetrated before split spoon and auger refusal at 50.5 feet below grade. Weathered shaley limestone was recovered in the tip of the 48 to 50 foot split spoon indicating the presence of a weathered bedrock surface at 50.5 feet below grade. The log of CW-102 indicates the till to be 16 feet thick at the eastern portion of the site.

Based on data from MW-5I, MW-7I and CW-102, the till unit is thickest (approximately 16 feet) at the eastern portion of the site, then thins considerably to the west toward the Niagara River to a thickness of approximately 2 feet. The thin till unit near the Niagara River is further supported by data collected from the adjacent Cherry Farm site, which reports a till unit of approximately 4 feet thick.

3.3 Site Hydrogeology

3.3.1 Hydrogeologic Conditions

The previous Phase II RI/FS Investigation (Engineering Science, 1986) identified two aquifers: the "uppermost aquifer" which consisted of "coarse grain soils in the upper zone of lacustrine and alluvial sediments" and a "lower aquifer" in the gray till (approximately 20 feet thick) and fractures of the bedrock. This Phase II RI/FS Investigation also reported that these two aquifers were separated by low permeability lacustrine sediments (permeability value estimated on the order of 10^{-6} to 10^{-7} cm/sec). The investigation also defined the presence of a groundwater mound located in the south central part of the site with radial flow to the west, northwest, north and northeast.

The remedial investigation for the Cherry Farm site located immediately north of the River Road site identified three zones in the unconsolidated aquifer. These zones are the shallow fill zone, the intermediate zone within the alluvium and the deep zone at the till/alluvium interface.

The shallow zone of the Cherry Farm site was monitored by 12 wells. Flow in the shallow zone was noted to be to the west toward the Niagara River with an average gradient of 0.006 ft/ft. The calculated discharge ranged from 130 gpd to 79,200 gpd with a mean discharge of 10,200 gpd. From these values, the groundwater velocity was determined to average 0.45 ft/day.

The Cherry Farm RI Report also noted that the intermediate zone was monitored by 11 wells. Flow in this zone was noted to also be toward the Niagara River at an average gradient of 0.0016 ft/ft. Discharge in this zone was calculated to range from 20 to 7,500 gpd with a mean discharge of 2,189 gpd. The groundwater velocity was calculated to be 1.8×10^{-2} ft/day.

Five wells monitored the deep zone as part of the Cherry Farm investigation. Groundwater flow in this zone moves at an average velocity of 4.6×10^{-3} ft/day in a westerly direction toward the Niagara River. Discharge was calculated to average 430 gallons per day.

The hydrogeologic results of the River Road Phase I and Phase II remedial investigation confirmed the presence of the "uppermost aquifer." This aquifer consists of the saturated fill material and the alluvial/lacustrine sediments. The aquifer ranges in thickness from 26 feet at CW-102 to 38 feet at MW-7I, and averages approximately 32 feet. For the purposes of this report, the uppermost aquifer has been divided into two zones: the upper zone or water table and the lower zone or base of the alluvial and lacustrine sediments.

The upper zone is located in the lower saturated fill material where the water table is present and in the upper portion of the alluvial/lacustrine sediments. Currently, 13 monitoring wells monitor this zone. They include seven wells installed as part of the remedial investigation, MW-3S, MW-4S, MW-5S, MW-6S, MW-7S, MW-8S, and MW-9S; three wells installed during the 1980 Trautman investigation, B-3, B-4 and B-5; MW-12 and MW-13, which were installed during the 1989 Cherry Farm site RI, and well MW-2, which was installed by the NYSDEC in 1988.

The lower zone is located in the lower portion of the alluvial and lacustrine sediments immediately above the gray till. This zone is monitored by three wells, MW-5I and MW-7I installed as part of this investigation, and CW-102 which was installed in 1988.

Monitoring well MW-1 is not screened solely within the upper or lower zone but rather across the two, and therefore not utilized in the present analysis to determine the water table or piezometric surface contour maps. However, water quality data collected from this well will be used in assessing the groundwater quality.

The "lower aquifer," as identified during the 1986 Phase II RI/FS Investigation, was not encountered in the Phase I and Phase II RI. As previously reported, the "lower aquifer" consisted of the 20 foot thick till unit and the fractured upper bedrock. Data from soil borings MW-5I, MW-7I, and logs of CW-102 indicated the till to be about 16 feet thick at CW-102 and tapers to approximately 2 feet thick under the undeveloped portion of the site (see Figures 3-2 and 3-3). Previous accounts of the till thickness under the site were based solely on data obtained from one boring (CW-102) located at the far eastern edge of the property.

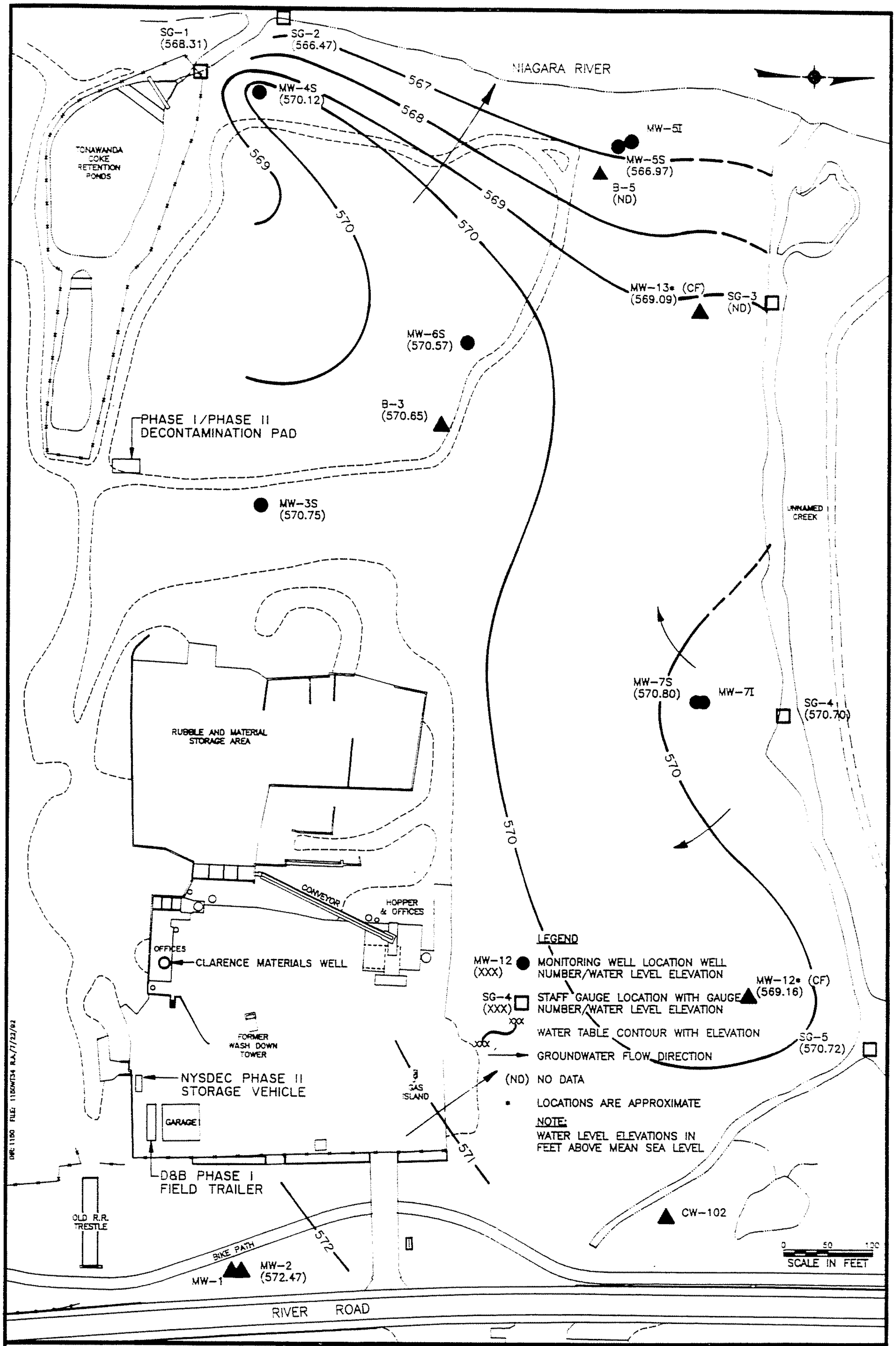
Three rounds of water levels were collected on April 2, April 15, (Phase I RI) and December 8, 1992 (Phase II RI). From these data, a water table and potentiometric surface contour map was constructed for each of the dates (see Figures 3-4 through 3-9). The contour maps and hydrogeologic characteristics of each zone are discussed below.

3.3.1.1 - Water Table

The water table is found primarily in the fill material at elevations ranging from 572 to 566 feet AMSL. A summary of the water table elevation data was previously presented in Section 2.2.4.5 (Table 2-3). The water table is characterized by both recharge and discharge areas resulting in fairly complex flow patterns. Figures 3-4, 3-6 and 3-8 represent the water table and predominant groundwater flow direction based upon data collected on April 2, April 15, and December 8, 1992.

Groundwater flow at the water table is generally to the west toward the Niagara River. However, a local radial flow pattern is strongly suggested to exist. The radial flow pattern likely exists as a result of a large concrete rubble pile located at the southeastern area of the undeveloped portion of the site. The rubble pile is an area of greater groundwater storage and acts as an area of recharge to the groundwater as a result of daily dumping of concrete mix and wash water from the Clarence Materials operation. Although no direct water level data exists from the rubble pile itself, the rubble pile's effect on the water table in the surrounding area is apparent in the form of minor components of radial flow to the north and northeast. These effects have been consistently observed during the Phase I/II investigation as well as previous investigations.

Another area of recharge exists at the unnamed creek along the northern border of the site. This area of recharge is intermittent and is much smaller in magnitude. The unnamed creek transmits surface water runoff from the east across River Road to the Niagara River. Higher water levels measured at SG-4 relative to MW-12 during April 2 and 15 suggest that the unnamed creek water level is perched and consequently has created a minor component of flow in the southerly and northerly directions, against the general site gradient. This temporary condition occurs due to the excessive runoff during the spring and during periods of heavy precipitation, and is supported by the December 8 water levels (low runoff period) which shows dry conditions in the unnamed creek. Further evidence of the east portion of the unnamed creek as a recharge zone exists further west along the creek where the water level in the creek is consistent with the surrounding water table elevation, suggesting that the creek is in hydraulic equilibrium with the surrounding water table.



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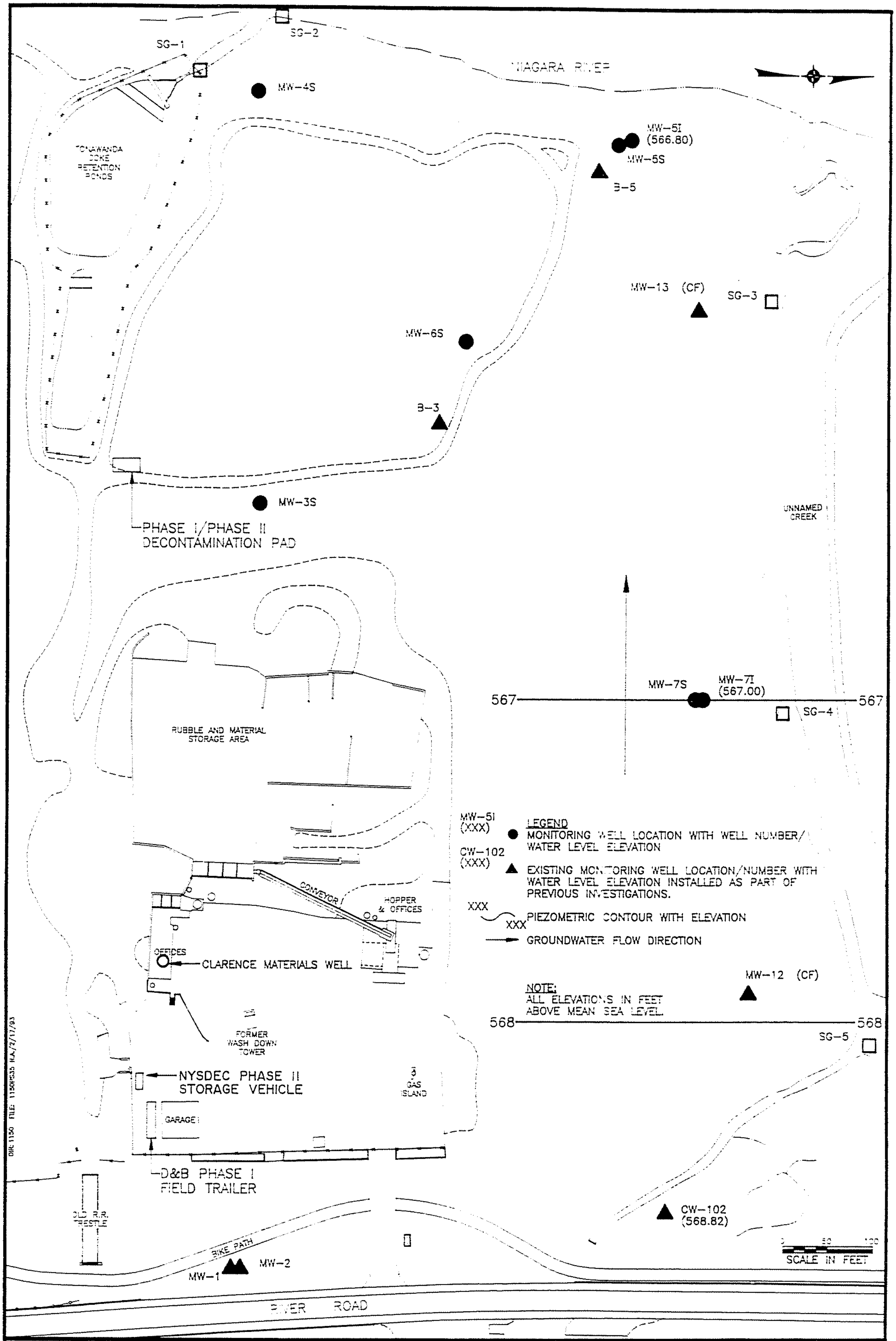
WATER TABLE CONTOUR MAP AS MEASURED ON 4/2/92

FIGURE 3-4



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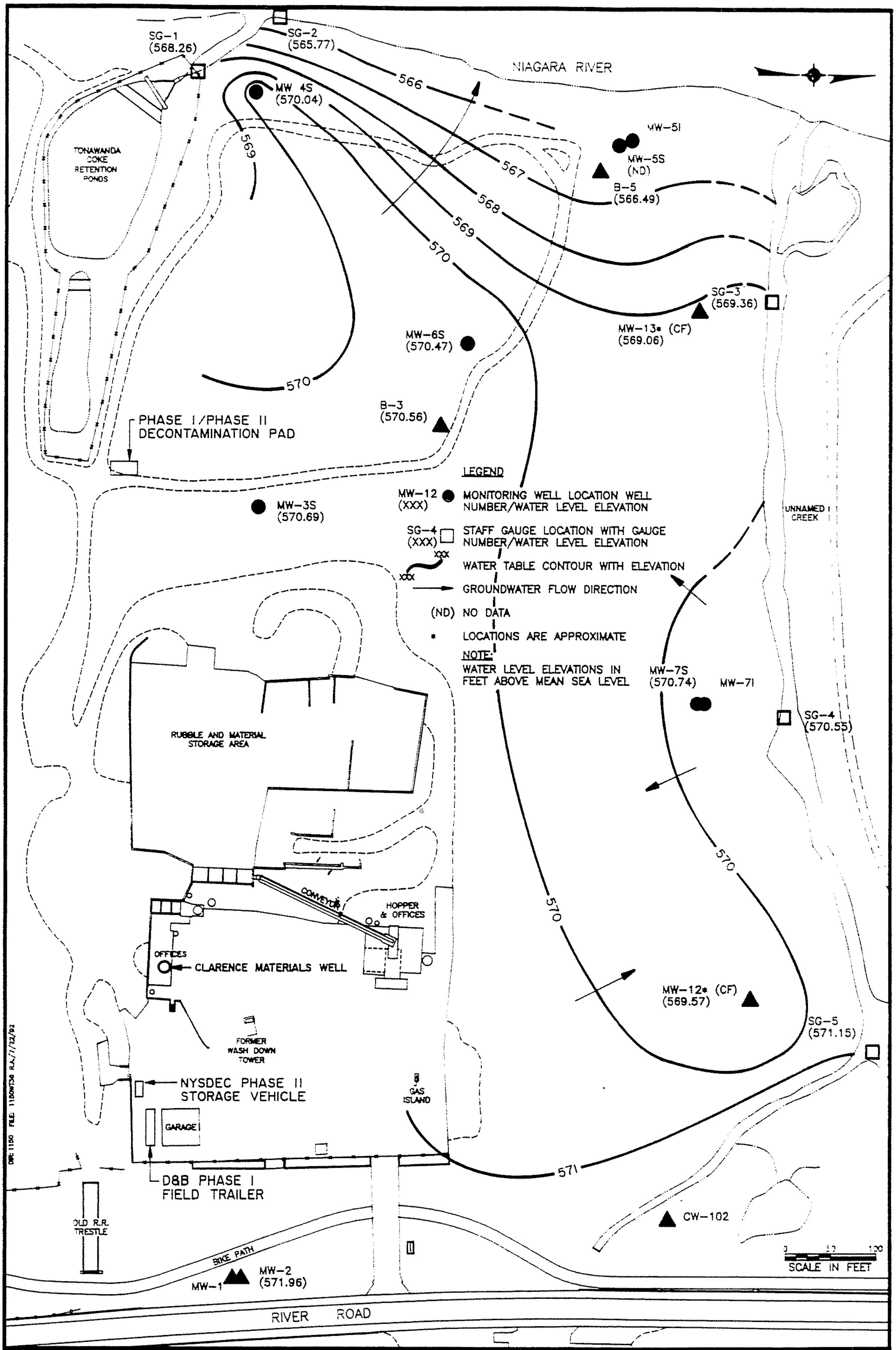
PHASE I PIEZOMETRIC SURFACE CONTOUR MAP AS MEASURED ON 4/2/92

FIGURE 3-5



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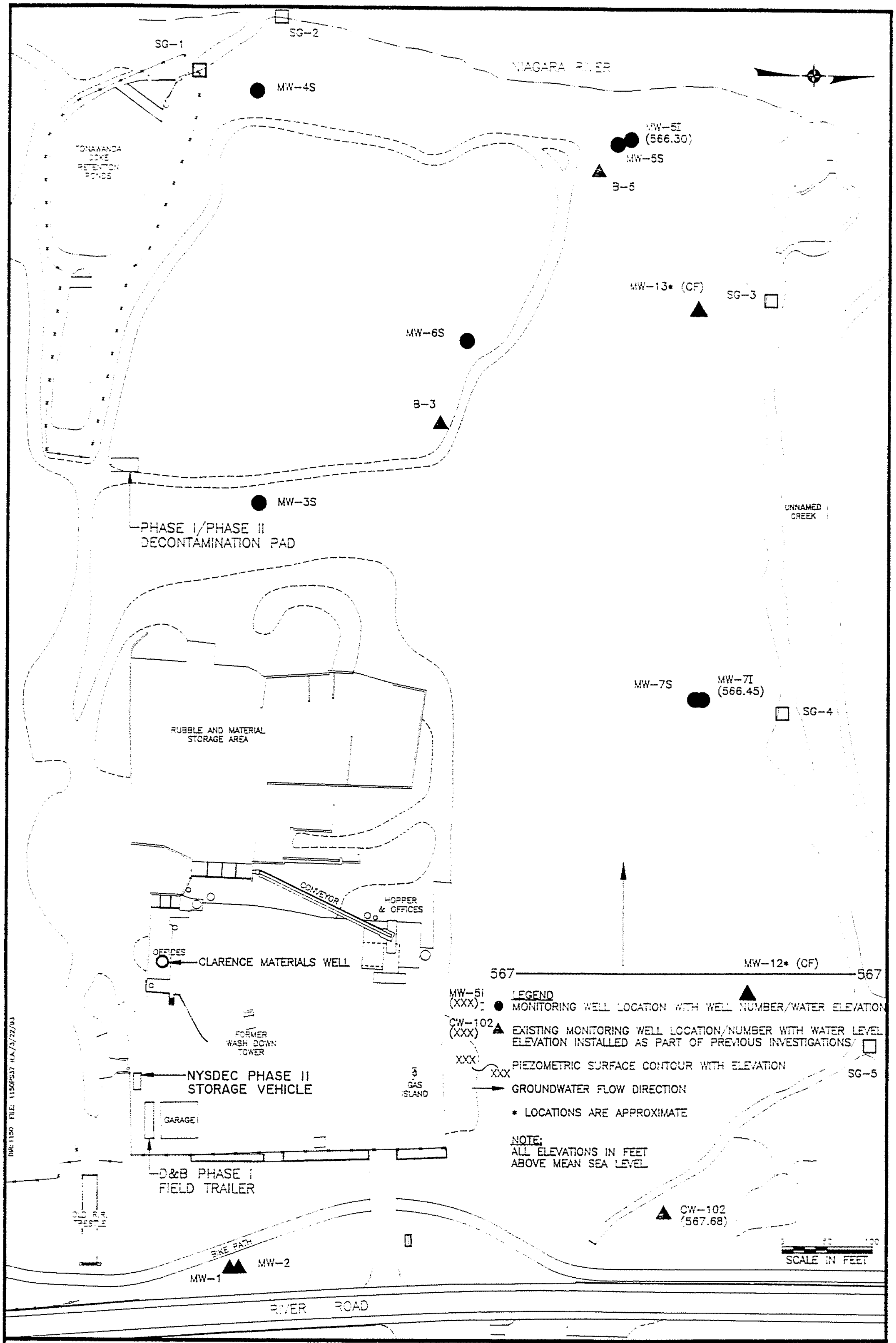
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

WATER TABLE CONTOUR MAP AS MEASURED ON 4/15/92

FIGURE 3-6



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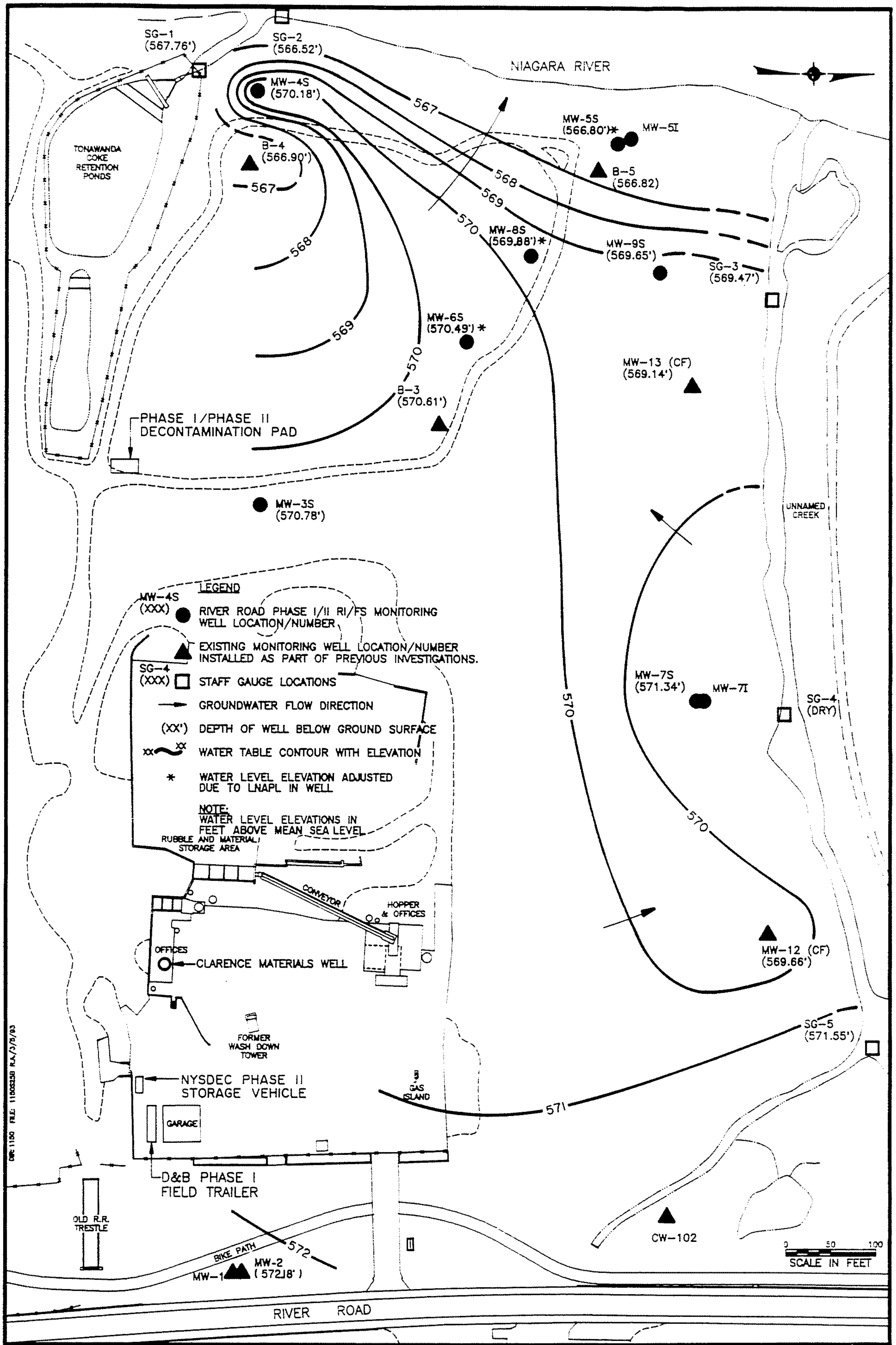
PHASE I PIEZOMETRIC SURFACE CONTOUR MAP AS MEASURED ON 4/15/92

FIGURE 3-7



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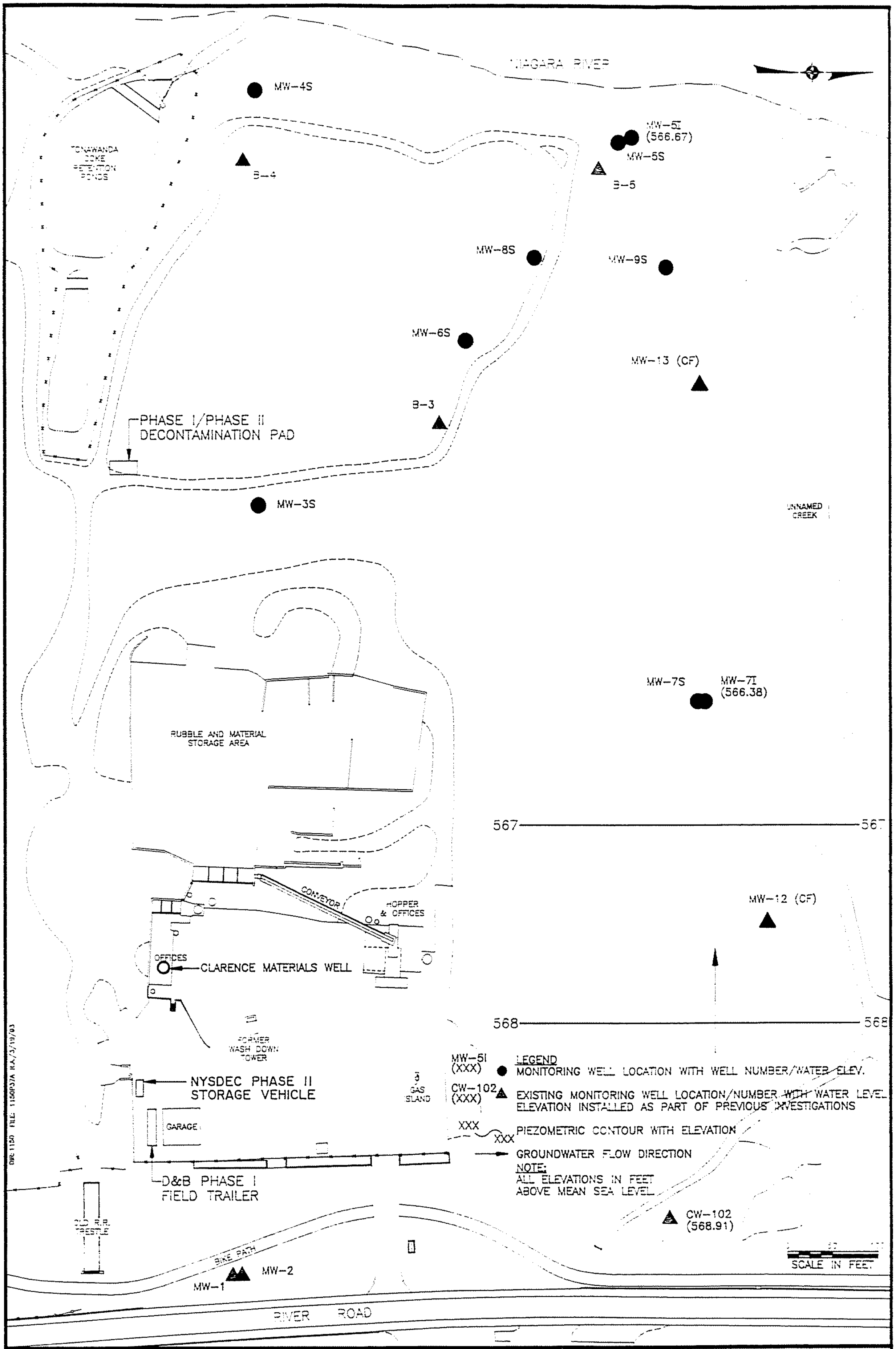
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK
WATER TABLE CONTOUR MAP AS MEASURED ON 12/8/92

FIGURE 3-8



LEGEND

MW-5I (XXX) ● MONITORING WELL LOCATION WITH WELL NUMBER/WATER ELEV.

CW-102 (XXX) ▲ EXISTING MONITORING WELL LOCATION/NUMBER WITH WATER LEVEL ELEVATION INSTALLED AS PART OF PREVIOUS INVESTIGATIONS

XXX ~ XXX PIEZOMETRIC CONTOUR WITH ELEVATION

→ GROUNDWATER FLOW DIRECTION

NOTE:
ALL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL

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TONAWANDA, NEW YORK

PHASE II PIEZOMETRIC SURFACE CONTOUR MAP AS MEASURED ON 12/8/92

FIGURE 3-9

The combination of groundwater recharge zones at the concrete rubble pile and the unnamed creek has created convergent flow in the northeast quadrant of the site. This results in the 570 feet contour to extend to the northeastern portion of the site.

The 570-foot contour also extends to the southwest quadrant of the sit ein the area of MW-4S. This is partially a result of influences from the concrete rubble pile and possibly zones of differential permeability due to variations in the fill/slag material.

Due to the lack of groundwater data in the area of the concrete rubble pile and limited groundwater and stratigraphic data available in the area of MW-4S and the northeast quadrant, groundwater flow in those areas cannot be completely understood. However, based on available groundwater data, a firm understanding of groundwater flow across the site is presented in this report.

The hydraulic gradient at the water table as measured on April 2, 1992, ranges from 0.0015 feet/feet between wells MW-3S and MW-4S to 0.043 feet/feet near the river between well MW-4S and SG-2. At the upgradient portion of the site between wells MW-2 and MW-12, the gradient is 0.0052 feet/feet.

Hydraulic gradients measured at these same locations on April 15 and December 8, 1992 are: 0.0015 feet/feet and 0.0014 feet/feet at wells MW-3S and MW-4S, respectively; 0.050 feet/feet and 0.043 feet/feet at MW-4S and SG-2, respectively; and 0.0016 feet/feet and 0.004 feet/feet at the upgradient location MW-2 and MW-12, respectively.

In situ permeability tests (slug tests) were not performed as part of the Phase I and Phase II investigations. However, slug tests were conducted during previous investigations on five of the previously installed wells that monitor the uppermost aquifer. Results of these slug tests indicate that horizontal permeabilities (K_H) at these locations ranged as much as three orders of magnitude from 1.7×10^{-2} cm/sec to 5.8×10^{-5} cm/sec.

Well Number	Rising Head Test	Falling Head Test
MW-12	2.7×10^{-3} cm/sec	6.6×10^{-4} cm/sec
MW-13	1.7×10^{-2} cm/sec	6.2×10^{-2} cm/sec
B-3	5.8×10^{-5} cm/sec	5.8×10^{-5} cm/sec
B-4	2.9×10^{-4} cm/sec	8.8×10^{-4} cm/sec
B-5	3.5×10^{-4} cm/sec	4.4×10^{-4} cm/sec

Based on these permeability values, the geometric mean is calculated to be 8.6×10^{-4} cm/sec (3.4×10^{-4} ft/sec).

Based on the assumed value of mean hydraulic conductivity for the site of 3.4×10^{-4} ft/sec, an approximate discharge (Q) and velocity (V) can be calculated using the formulas:

$$Q = KIA$$

Q = Discharge (gallons per day)
K = Hydraulic conductivity (gpd/ft^2)
I = Hydraulic gradient (ft/ft)
A = Cross section area (ft^2)

and:

$$V = \frac{KI}{7.5N}$$

V = Velocity (feet/day)
K = Hydraulic conductivity (ft/sec)
I = Hydraulic gradient (ft/ft)
N = Porosity* of the saturated medium

*For the purposes of these calculations, the value of N will be 0.45.

The calculated groundwater discharge (Q) in the upper zone at the western edge of the site is approximately 29,000 gallons per day, which is within the range of 130 to 79,200 gpd reported in the Cherry Farm RI report (1989) and near the mean of 10,200 gallons per day. The velocity of the groundwater moving through the upper portion of the aquifer near the river is 0.113 ft/day or 41.3 ft/year. A discussion of the estimated contaminant loading to the Niagara River is discussed in Section 6 of this report. This value is within the limits of the reported velocity range of 2.1 to 1,291 feet/year in the Cherry Farm RI report.

3.3.1.2 - Potentiometric Surface at the Base of the Alluvial and Lacustrine Sediments

Three monitoring wells are screened at the base of the alluvial and lacustrine sediments, MW-5I, MW-7I and CW-102. The potentiometric surface measured in these wells on April 2, 1992 ranges from 566.80 feet AMSL at MW-5I to 568.82 feet AMSL at CW-102 and on April 15, 1992 ranged from 566.30 feet AMSL at MW-5I to 567.68 feet AMSL at CW-102, and on December 8, 1992 ranged from 566.67 feet AMSL at MW-5I to 568.91 feet AMSL at CW-102. On all three dates, the groundwater flow direction is westerly (see Figures 3-5, 3-7 and 3-9).

Horizontal gradients measured between wells MW-5I and CW-102 on the three dates ranged from 0.0017 ft/ft on April 2, 0.0012 ft/ft on April 15 and 0.0019 ft/ft on December 8, and averaged 0.0016 ft/ft. These gradients are approximately 4 to 6 times greater than the average gradient of 0.0003 ft/ft reported in the Cherry Farm RI Report (1989) for the same zone.

Vertical gradients measured at wells MW-7S and MW-7I on April 2 and 15, and December 8, 1992 show head differences at the MW-7 couplet of 3.8 feet, 4.3 feet and 5.0 feet, respectively, indicating a downward vertical gradient. However, at the MW-5 couplet located near the river, the vertical gradient reverses to a slight downward potential of 0.2 feet as measured on April 2.

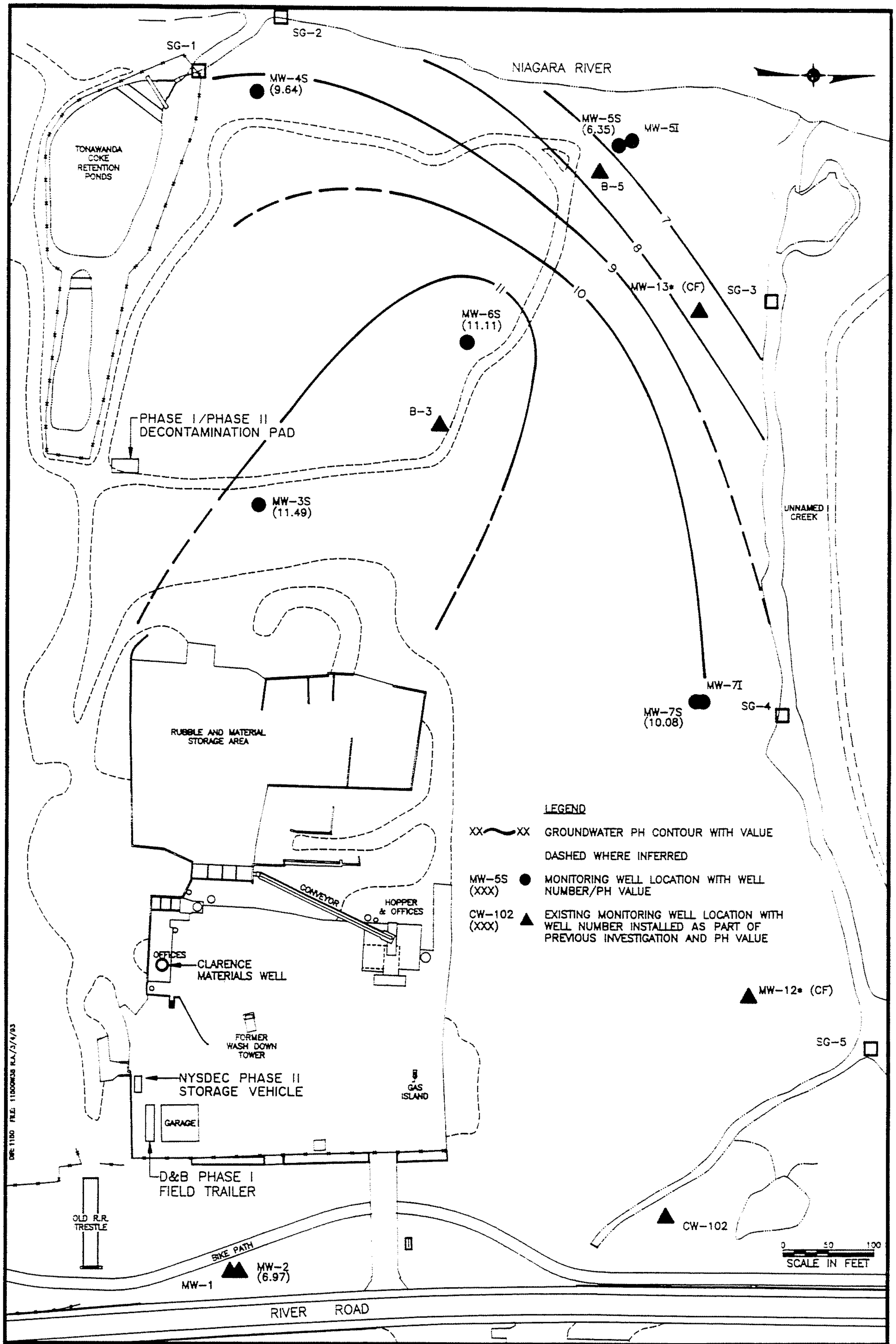
A slug test was conducted on well CW-102 (intermediate zone) during the previous Phase II RI/FS Investigation. Results of this slug test indicate that the permeability of this zone in the vicinity of CW-102 is approximately 4.6×10^{-5} to 9.1×10^{-5} cm/sec, or a mean of 6.0×10^{-5} cm/sec (2.0×10^{-5} ft/sec). Based on this mean, an approximate groundwater velocity near CW-102 is calculated to be 1.66×10^{-3} ft/day or 0.61 ft/year.

No discharge (Q) value could be calculated in the lower zone near the Niagara River due to the lack of permeability data in this area of the site. However, a discharge value for the eastern portion of the site is estimated to be 2.73×10^{-4} ft^3/sec. This value is based solely on data collected from CW-102.

Measurements of pH were conducted on groundwater samples obtained during the April/Phase I well development event and the December/Phase II groundwater sampling event. Based upon these data, pH contours were prepared for the site and are presented on Figures 3-10 and 3-11. Very high pH levels, as high as 10-11 pH units, were found in groundwater. Presumably, these levels result from percolation of rain water through the concrete rubble pile and from cement manufacturing operations at Clarence Materials.

3.4 Ecology

The terrestrial and aquatic ecology at the River Road site and adjacent areas is assessed in this section. This habitat assessment conforms to the Step 1 Habitat Assessment Effort Guidelines presented in the NYSDEC document, entitled "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites." The purpose of this assessment is to describe the existing ecology at the River Road site, including a site specific description of major habitat types and associated fish and wildlife populations, as well as the identification of any significant on-site resources.



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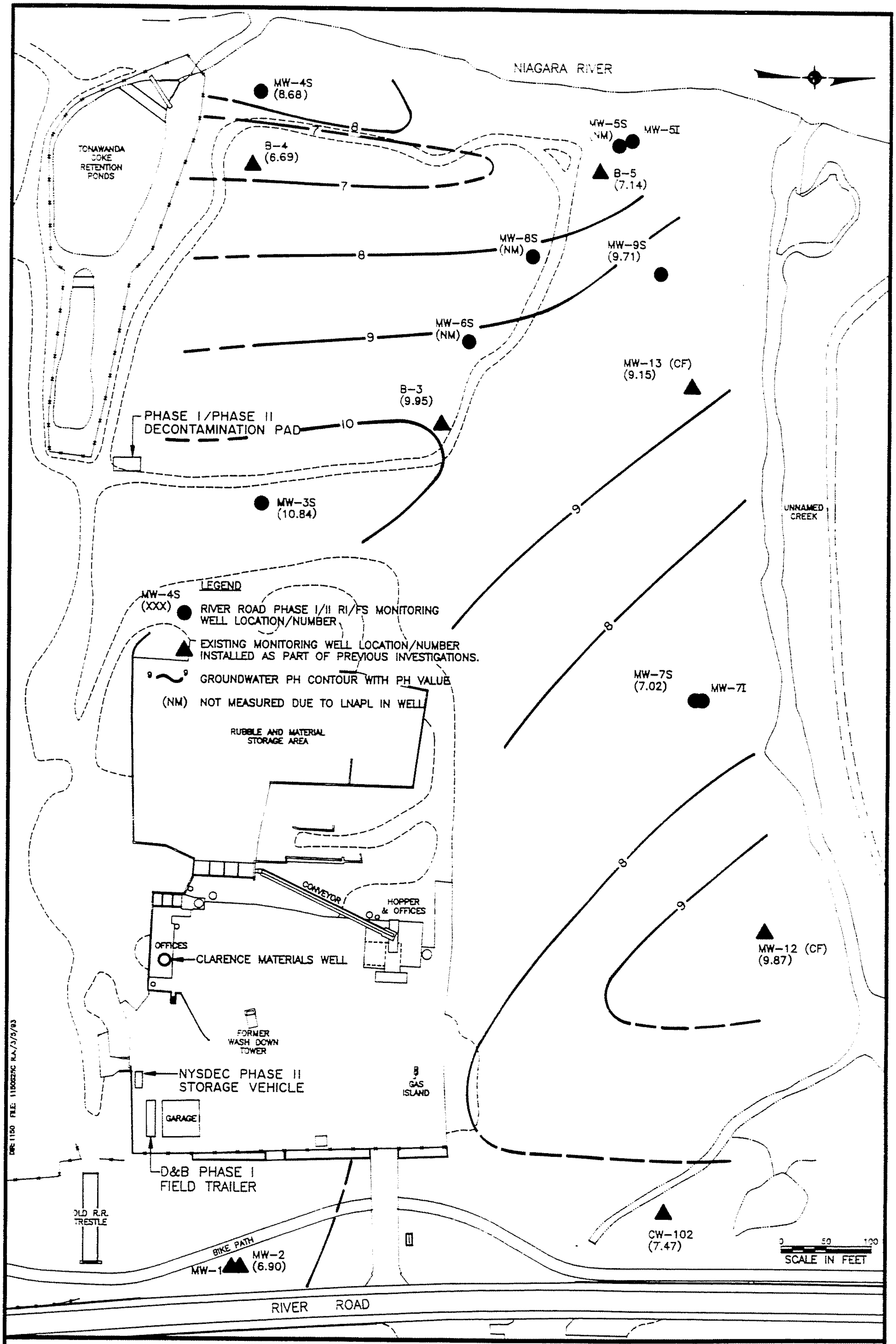
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK
PHASE I GROUNDWATER PH CONTOUR MAP 4/15/92

FIGURE 3-10



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RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK
PHASE II GROUNDWATER PH CONTOUR MAP 12/8/92

FIGURE 3-11

The information contained in this assessment was obtained during the Phase I RI field program and subsequent site walkovers and is supplemented with data from outside sources including the NYSDEC, the Erie County Planning Department and the United States Fish and Wildlife Service.

3.4.1 Major Habitat Types

The River Road site is located in the Erie-Niagara basin, which borders Lake Erie and the Niagara River on the west, and incorporates the Tonawanda Creek and Cattaraugus Creek basins to the north and south, respectively. The topography in the vicinity of the site is generally flat, with a gentle slope trending to the northwest. The average elevation of the site is approximately 585 feet AMSL, which is approximately 25 feet above the Niagara River. Land surrounding the site is primarily industrial. The Niagara River borders the site on the west, and a small stream corridor runs east to west along the northern boundary.

Past activities on the site included the land disposal of flyash, bottom ash, foundry sand, slag and liquid boiler waste from approximately 1957 to 1976. The entire site was at one time a wetland area. The majority of the site is currently reclaimed land comprised of climax vegetation and open grassland vegetation that has become established in large areas of previously disturbed land. Emergent wetland vegetation is also present along the stream corridor which runs along the northern boundary of the site and in a smaller wetland area adjacent to the settling lagoons in the southwest portion of the site.

Major plant associations or communities identified on-site include:

- Disturbed Lands: Areas of obvious disturbance, past disposal areas and partially filled regions;
- Grassland Habitat: Uncultivated areas characterized by typical upland grasses and wildflowers;
- Emergent Wetland Habitat: Low-lying areas adjacent to open water areas typified by hydrophilic emergent wetland species;
- Open Water Habitat: Open water habitat on the River Road site includes the unnamed tributary 158-13c and the Niagara River;
- Climax Vegetation Habitat: Areas characterized by stands of mature trees and shrubs of varying density; and
- Debris Pile Habitat: Typified by visible rubble mounds partially covered by vegetation.

Figure 3-12 illustrates the approximate location of each community. The major communities found on the River Road site are described below.

Disturbed Land

Disturbed lands are considered to be those areas which exhibit outward signs of past use, including roadways, areas of exposed refuse, abandoned tanks and areas of disruption due to site investigation activities, such as well drilling. A considerable portion of the River Road site has been disturbed in the past by landfill activities, and exhibits signs of this activity. In many of these areas, portions of buried materials, such as drums, are visible protruding through sparsely vegetated surfaces. Disturbed lands support plant species such as grasses and weeds that can reproduce quickly and colonize small areas between disturbances. Such plants include clover (Trifolium spp.) and Chicory (Cichorium intybus).

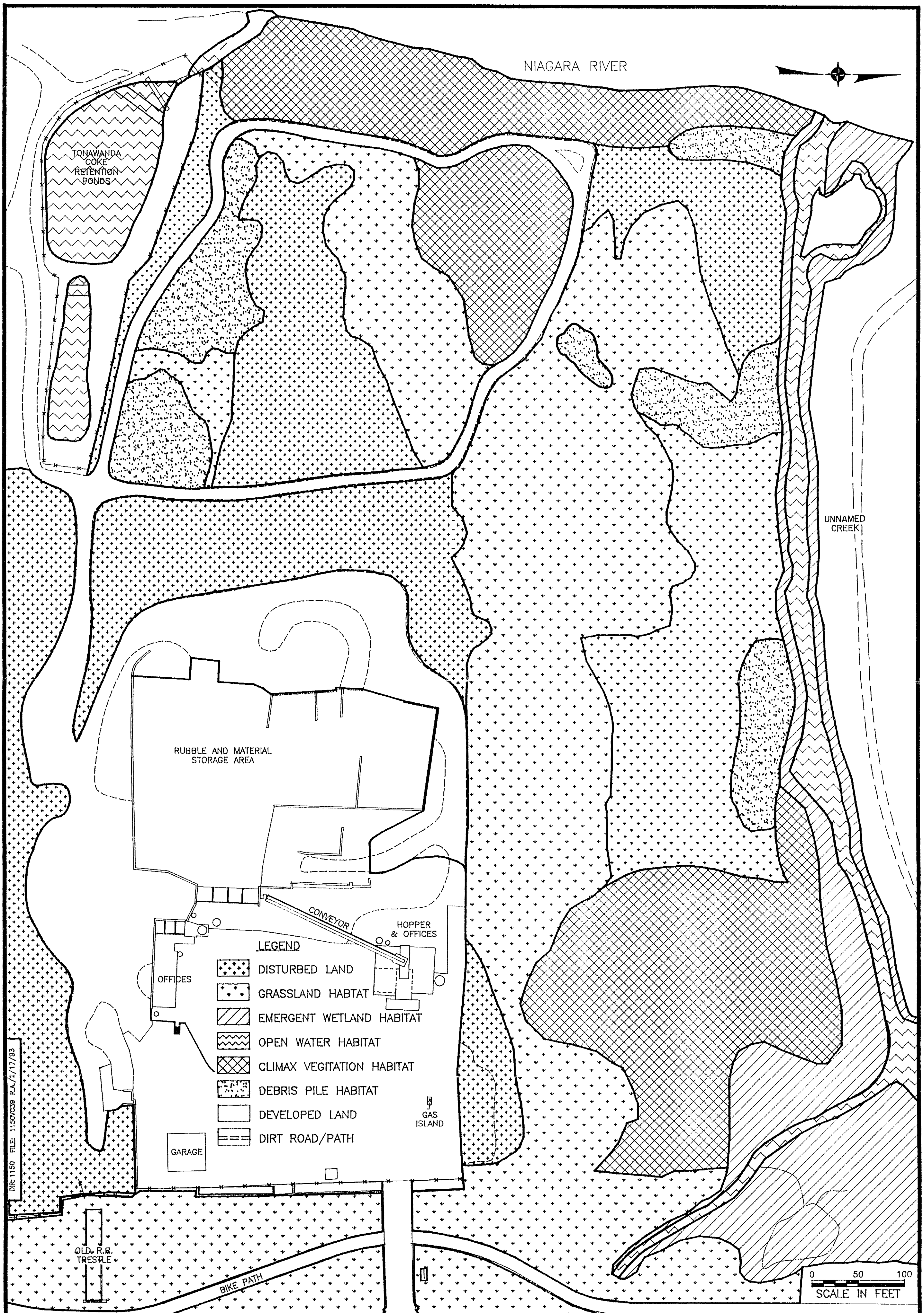
Grassland Habitat

Grassland areas exist over portions of the center of the site that were disturbed by past land disposal activities and were long since abandoned. These disturbed lands support typical upland grasses and wildflowers, and are found in between many areas of disturbed land and climax vegetation. Species identified in the grassland habitat areas include smooth crabgrass (Digitaria ischaemum) and goldenrod (Soldago spp.)

Emergent Wetland Habitat

Emergent habitats are found in low-lying areas of the site which tend to retain moisture. These areas border sections of the flowing water and semi-standing water of the Niagara River and the unnamed stream (Tributary 158-13c) located along the northern boundary of the site. These habitats provide for emergent wetland plant species, such as soft rush (Juncus effusus), cattails (Typha sp.) and giant reed (Phragmites communis).

An extensive area of emergent wetland habitat is found along the northern border of the site, adjacent to Tributary 158-13c. This habitat is part of a NYSDEC freshwater wetland (BW-8). A smaller open water area with less extensive emergent vegetation is located on the southwest portion of the site between the overflow of the lagoons and the Niagara River. Wetlands are discussed further in Section 3.4.3.



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RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

VEGITATIVE COVERTYPES

FIGURE 3 - 12

Open Water Systems

Open water systems associated with the River Road site include NYSDEC Tributary 158-13c and the Niagara River. Tributary 158-13c enters the site from a culvert under River Road at the northeastern portion of the site, and forms the approximate northern boundary of the site until it feeds a marshland area adjacent to the Niagara River. The stream and adjacent areas comprise NYSDEC protected wetland BW-8. Vegetation along the stream bank is associated with the protected wetland, and can be classified as palustrine emergent in most areas.

The width of the tributary is highly variable due to areas where the tributary ponds and areas where the tributary narrows from the restrictions of the steep banks. However, at a location marked by SG-4 the tributary is approximately 15 feet wide. The tributary banks range in height from approximately 1 foot near the culvert where the tributary enters the site to approximately 15 feet near the west side of the site before it discharges to the Niagara River. The tributary bottom at locations marked by SG-3, SG-4 and SG-5 was covered with vegetation, however, at the mouth of the tributary, where it enters the Niagara River, slag was observed at the surface.

During the Phase I investigation, less than one foot of water was observed at the locations marked by staff gauges SG-3, SG-4 and SG-5. The water was very turbid and brown. The brown turbid water was observed entering the site via the culvert.

The reach of the Niagara River along the site is approximately 650 feet long. Bank heights are approximately 10-15 feet high and are steep. The river bottom material along portions of the shoreline is comprised of slag. It is not known how far out into the river the slag material extends.

During the investigation, the Niagara River water was relatively nonturbid. A small, open water system is also located between the lagoon overflow and the Niagara River in the southwest portion of the site. Section 3.4.2 contains a further discussion of open water courses in the area of the River Road site.

Climax Vegetation

These areas are characterized by stands of mature trees and some low scrub of varying density. Areas of climax vegetation on the River Road site are located adjacent to the stream corridor which runs along the northern border of the site. Larger areas are also present in the northeast portion of the site and in the western portion of the site near the banks of the Niagara River. Extensive growth of staghorn sumac (Rhus typhina) characterize the medium density shrubs in these areas, with more dense growth close to the Niagara River bank. Trees established in the climax areas along the Niagara River and in the northeast portion of the site are predominantly maple (Acer spp.) and oak (Quercus spp.)

Debris Pile Habitat

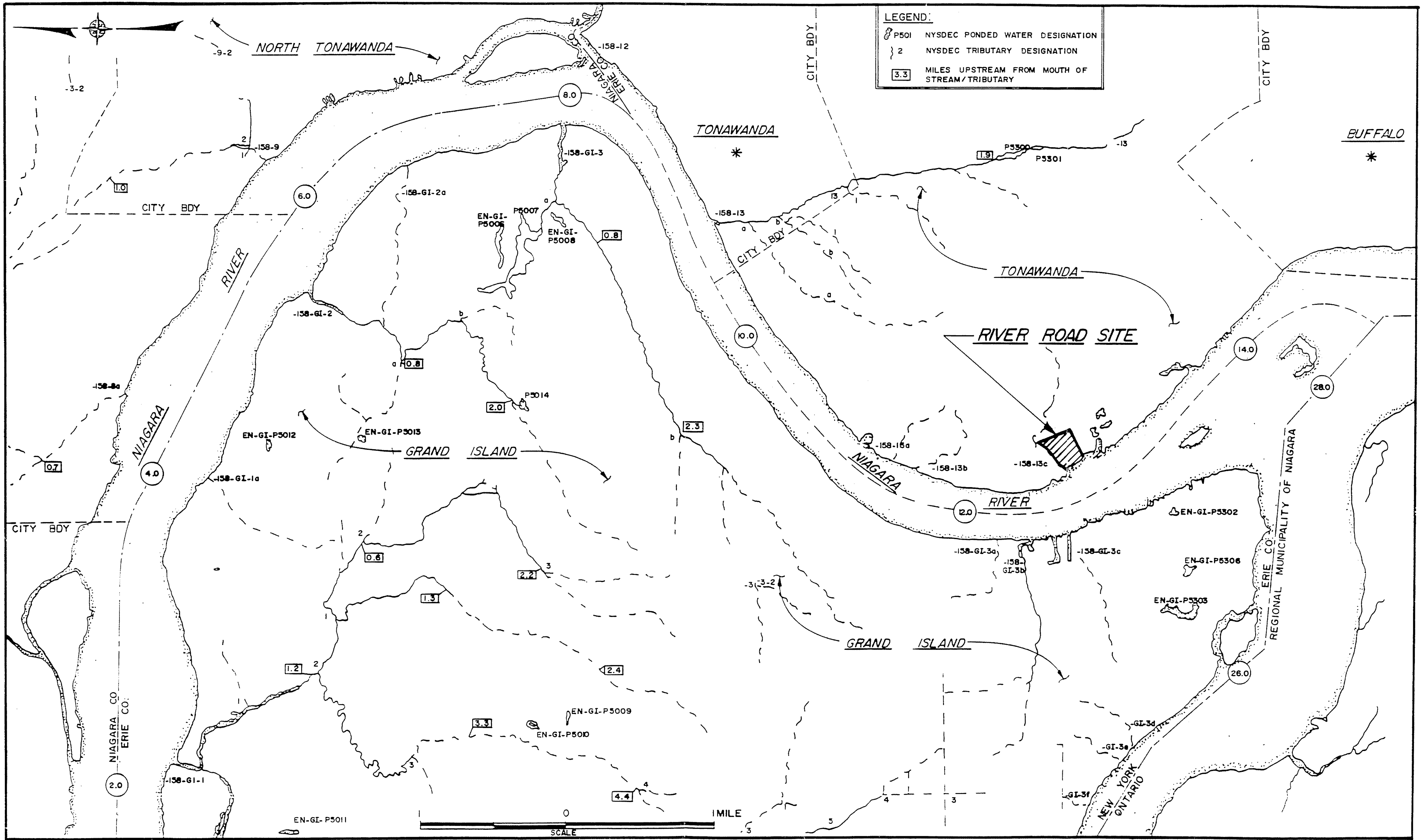
Debris pile habitats are considered separate from disturbed lands on this site since the age of these areas has allowed them to form a unique habitat. These areas, most likely used for disposal by an adjacent concrete plant, are predominantly concrete rubble covered by vegetation evidenced by visible mounds several feet in elevation.

3.4.2 Open Water Systems

Open water systems in the vicinity of the River Road site include Tributary 158-13c, a small area adjacent to the settling lagoons and the Niagara River. Figure 3-13 illustrates the location of these systems and their corresponding NYSDEC Index Numbers in relation to the site.

As stated previously, an unnamed stream, designated as Tributary 158-13c, is present along the northern portion of the site. The stream enters the northeast corner of the site from a culvert under River Road, and flows west through a regulated wetland area along the northern border of the site until it emerges with the Niagara River. NYSDEC tributary maps indicate that the stream appears to be intermittent, although substantial flow was observed during field surveys.

Surface water samples were taken from the stream in upgradient and downgradient locations in 1985 as part of the Phase II RI/FS Investigation (Engineering Science, 1986). These samples were analyzed for cadmium, chromium, lead, mercury, phenolics and organic constituents. Additional surface water samples were collected in June 1986 for analysis of semivolatile compounds. Analytical results show no increase in metal contamination levels from the upgradient to the downgradient sample locations. A high concentration (330 ug/l) of phenolics was detected in the downgradient sample. The phenolic contamination in this sample consists of 2-methyl phenol, 2,4-methyl phenol and 4-methyl phenol. This concentration exceeds the water quality standard of 1 ug/l suggested by NYSDEC, and is above the concentration of 20 ug/l present in the upgradient water sample (Engineering Science, 1986).



RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

TRIBUTARY MAP

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FIGURE 3 - 13

The 1986 Phase II RI/FS Investigation attributes the high concentration of phenolic compounds found in the stream to waste materials disposed of at both the River Road site and the Cherry Farm site located immediately north of the stream. As described in the Phase II RI/FS Investigation Report, phenols may be the result of the Tonawanda Coke Corporation operations, or the phenol tars alleged to be disposed of by the Hooker-Durez Division. A surface water sample collected for an investigation of the adjacent Cherry Farm site reportedly exhibited elevated levels of phenols (5,320 ug/l) in a tributary to the stream that flows between the two sites. This appears to indicate that the surface water is being contaminated with phenol from the Cherry Farm site. No organic contaminants were found in the surface water samples that could be attributed to the River Road site as discussed in that study.

Sediment samples were collected in the immediate vicinity of the surface water samples and were analyzed for the same constituents. Higher levels of cadmium, chromium and lead were found in the downgradient sample. Organic contamination in the downstream sample included phenolics (0.1 mg/kg) and several polycyclic aromatic hydrocarbons (PAHs). PAH compounds are a by-product of coal burning processes, and are constituents of flyash, coal tar, coke fines and slag wastes. The creek was reportedly dredged by the New York State Department of Transportation (NYSDOT) after these last samples were taken (Engineering Science, 1986).

A small open water area is located in the southwest portion of the site where overflow from the settling lagoons flows approximately 175 feet to the Niagara River. This open water system is characterized by a rocky/slag bottom with sparse emergent vegetation. Crayfish appear to flourish in this area.

The Niagara River is the primary waterway in the vicinity of the River Road site. Located adjacent to and west of the site, the approximately 36-mile long river flows north, connecting Lake Erie in the south to Lake Ontario in the north. The river also forms the border between New York State and Ontario, Canada. The average flow of the river is in excess of 200,000 cubic feet/second, providing a large variety of fish habitats and fishing opportunities (Section 3.4.6). This waterway provides municipal and industrial water supplies and is a source of power generation, commerce, recreation and tourism for the United States and Canada.

The Niagara River is divided into the Upper Niagara River and the Lower Niagara River, which are separated by Niagara Falls. The River Road site is located adjacent to a stretch of the river known as Tonawanda Channel (or East Channel), approximately 12 miles upstream of Niagara Falls, 28 miles upstream of Lake Ontario and 8 miles downstream of Lake Erie.

A 1984 study prepared by the Niagara River Toxics Committee (NRTC) investigated municipal and point source discharges to the river. The total quantified load of USEPA priority pollutants from point sources was estimated to be 3,087 pounds per day. The report concluded that of the 3,087 pounds of priority pollutants being discharged to the river daily, 83 percent were inorganic pollutants such as heavy metals and cyanides and 17 percent were organic pollutants.

Over 215 hazardous waste disposal sites were identified in Erie and Niagara Counties, of which 164 were used by major industries along the river. Comparisons of concentrations of chemicals in Lake Erie and Lake Ontario were made by the NRTC. Twenty-four chemicals were shown to exist at higher concentrations at the Lake Ontario end of the Niagara River than the Lake Erie end, thus suggesting that the Niagara River is the source of these chemicals. In addition, the water quality in the West Branch (Chippewa Channel) of the River was better than that in the East Branch (Tonawanda Channel).

In a Biological Survey of Buffalo Harbor conducted by the United States Department of the Interior Fish and Wildlife Service (1984), baseline biological data was collected for the Black Rock Canal, Small Boat Harbor and Strawberry Island areas. The Black Rock Canal is the main shipping channel through the Upper Niagara River. The Small Boat Harbor at Buffalo Harbor gets heavy use by recreational craft. Strawberry Island is a prime spawning and nursery area in the Upper Niagara River. The Buffalo Harbor area extends from approximately five miles upstream of the site to three miles upstream, and Strawberry Island is approximately one and one-half miles upstream.

Included in this study was a survey of benthic sites in the study area. Twenty-two different taxa were identified at these sites and are presented on Table 3-1. The most diverse invertebrate fauna occurred in the Black Rock Canal in a silt and organic muck substrate. The largest component of these samples was oligochaetes, which are indicative of polluted waters.

TABLE 3–1
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Benthic Invertebrates Captured In Buffalo Harbor/Niagara River Area – 1983 *

COMMON NAME	SCIENTIFIC NAME	LOCATION FOUND		
		BLACK ROCK CANAL	STRAWBERRY ISLAND	SMALL BOAT HARBOR
Hydroids	*Hydra americana*	X	X	
Flatworms	*Dugesia tigrina*		X	
Proboscis worms	*Prostema spp.*		X	
Roundworms	Nematoda	X	X	
Aquatic earthworms	*Aeolosoma sp.*	X		X
Leeches	*Helobdella stagnalis*		X	
	Helobdella elongata		X	
	Placobdella montifera		X	
Seed shrimp	Podocopa	X		
Copepods	Cyclopoida	X		
Scuds	*Gammarus spp.*	X		X
Caddisflies	*Hydropsyche sp.*	X	X	
	Psychomyia sp.	X		
Midges	Chironomidae	X	X	X
Blackflies	*Simulium sp.*	X	X	X
Snails, Limpets	*Bithynia tentaculata*	X	X	X
	Pleurocerca sp.	X		
	Planorbidae	X		X
Clams, Mussels	*Sphaerium sp.*	X	X	X

* Captured By Ponar Dredge

Source: U.S. Department of the Interior Fish and Wildlife Service, 1984. Biological Survey of Buffalo Harbor.

At the Strawberry Island area, Hydropsyche sp. were the most common (48.2%), with chironomid larvae (11.4%) and Oligochaetes (10.5%). Other taxa identified in this area included Helobdella elongata (a leech), Dugesia tigrina (a flatworm) and Prostoma spp. (a proboscis worm). The bottom substrates in this area were hard, which result in lower densities of invertebrates than silt and organic substrates. Insect larvae, which need cleaner water conditions, were more prevalent around Strawberry Island, while fewer Oligochaetes were found.

The invertebrate population in the Small Boat Harbor area, which had essentially a sandy clay substrate, was dominated by Oligochaetes and chironomid larvae. Oligochaetes comprised 74.4 percent of the samples, while chironomids comprised an additional 15.4 percent (USDOI, 1984).

The New York State Department of Environmental Conservation (NYSDEC) collected fish from the Niagara River for analyses of chemical constituents in 1984. Table 3-2 presents the results of these analyses. This data indicates PCB concentrations from 0.18 ug/g to 2.99 ug/kg on the Upper River, while lower river locations had concentrations from 0.60 ug/g to 5.29 ug/g. Concentrations above trace amounts were also found of the pesticides DDT and Chlordane. It is estimated that 47,710 anglers visited the Niagara River (25,710 in the Upper River, 22,000 in the Lower River) in 1988, fishing primarily for bass, muskellunge, walleye (yellow pike) and yellow perch.

The Niagara River is an important winter habitat for 15,000 to 20,000 ducks, including greater scaup (Aythya marila), canvasback (A. Valisineria), common merganser (Mergus merganser), red-breasted merganser (Mergus serrator), oldsquaw (Clanqula hymalis) and common goldeneye (Bucephala clanqula). NYSDEC collected adult male common goldeneye near their time of arrival on wintering grounds of the Upper Niagara River (November to December) and just prior to their spring migration (February to March) to identify and measure organochlorine contaminants in fat tissues (Foley and Batcheller, 1988). The results of this study are summarized below.

The accumulation of persistent compounds in ducks is considered a concern since humans consuming waterfowl from the river are exposed to contaminants. The objectives of the study were to compare changes in contaminant concentrations in birds from their

TABLE 3–2
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Niagara River Fish Contaminant Data – 1984 (ug/l – Standard Filets)

LOCATION	SPECIES	ANALYSES								
		PCB	DDT	DIELDRIN	ENDRIN	HCB	LINDANE	MIREX	CHLORDANE	HEPTACHLOR EPOXIDE
UPPER RIVER										
Strawberry Island	Smallmouth bass	2.99	0.15	0.01	LT0.01	LT0.01	0.01	LT0.01	0.09	LT0.01
	Rock bass	0.30	0.05	LT0.01	LT0.01	LT0.01	LT0.01	LT0.01	0.03	LT0.01
	Yellow perch	0.18	0.03	LT0.01	LT0.01	LT0.01	LT0.01	LT0.01	0.02	LT0.01
	Carp	1.92	0.27	0.01	LT0.01	LT0.01	0.05	LT0.01	0.14	0.01
North Grand Island Bridge	Smallmouth bass	2.32	0.13	0.01	LT0.01	LT0.01	LT0.01	LT0.01	0.05	LT0.01
	Rock bass	0.78	0.06	LT0.01	LT0.01	LT0.01	0.01	LT0.01	0.02	LT0.01
	Yellow perch	0.39	0.05	LT0.01	LT0.01	LT0.01	LT0.01	LT0.01	0.02	LT0.01
North Tonawanda	Smallmouth bass	1.76	0.13	0.02	LT0.01	LT0.01	0.06	LT0.01	0.07	LT0.01
	Rock bass	1.41	0.05	LT0.01	LT0.01	LT0.01	LT0.01	LT0.01	0.04	LT0.01
	Yellow perch	0.37	0.02	LT0.01	LT0.01	LT0.01	LT0.01	LT0.01	0.02	LT0.01
	Brown bullhead	2.10	0.07	0.01	LT0.01	LT0.01	0.01	LT0.01	0.05	LT0.01
	Carp	2.52	0.16	0.01	LT0.01	LT0.01	0.01	LT0.01	0.18	LT0.01
LOWER RIVER										
Lewiston	Carp	2.52	0.16	0.01	NA	NA	NA	NA	NA	NA
	American eel	5.29	0.81	0.08	LT0.01	LT0.01	0.05	0.17	0.63	LT0.01
	Smallmouth bass	3.16	0.38	0.02	LT0.01	LT0.01	0.01	0.07	0.09	LT0.01
	Rock bass	1.25	0.12	LT0.01	LT0.01	LT0.01	LT0.01	0.03	0.03	LT0.01
	Yellow perch	0.60	0.07	LT0.01	LT0.01	LT0.01	LT0.01	0.02	0.01	LT0.01
FDA ACTION LEVEL		2.0	5.0	0.3	0.3	NAL	NAL	0.1	0.3	0.3

LT=less than   NA=not analyzed   NAL=no action level   FDA=U.S. Food & Drug Administration

Source: NYSDEC

arrival on the river in early winter 1984 to their departure in the spring of 1985. The study area included the north end of Grand Island and portions of the river and its shoreline in the cities of North Tonawanda and Niagara Falls, approximately 10 miles downstream of the River Road site. The study area included shoreline adjacent to two hazardous waste sites: Love Canal and the One Hundred Second Street Dump Site.

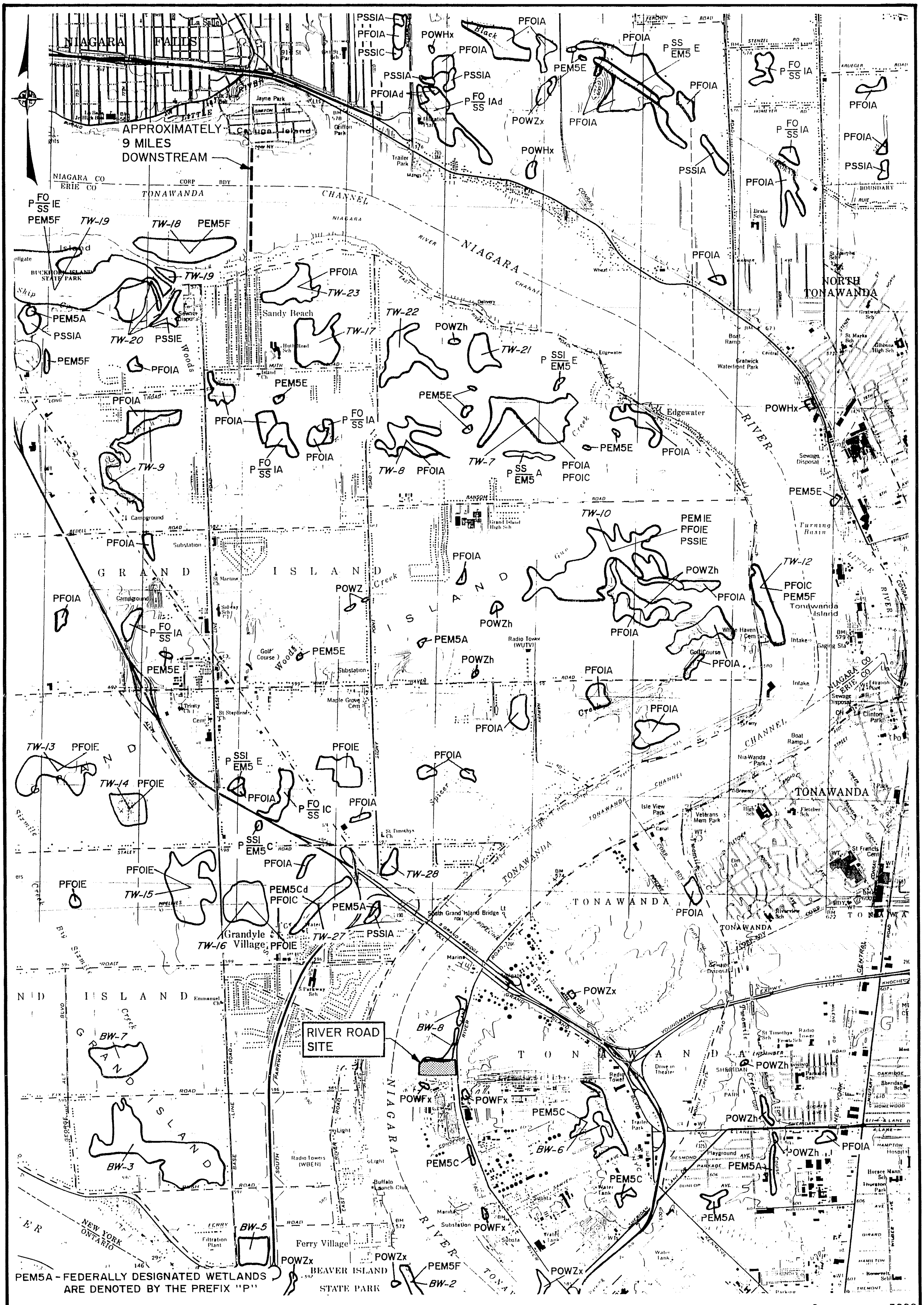
Residues of organochlorine chemicals were found in fat tissues of all adult birds. PCBs increased from a mean of 19.8 to 34.6 ppm between the winter and spring periods, respectively. Residues of DDT detected in adult birds collected in the winter period ranged from 0.01 ppm to 0.52 ppm, while concentrations in the spring period ranged from 0.06 ppm to 1.27 ppm. All organochlorine residues were higher in the spring period than the winter period, except oxy chlordane and mirex, which did not change. Prey species were assumed to be the source of contaminants (Foley and Batcheller, 1988).

It should be noted that population changes were observed during these periods, most likely attributable to severe ice conditions on Lake Erie and Lake Ontario. Therefore, there was no way to be sure that birds taken for the spring sample were present in early winter. Therefore, contaminant data may represent birds using Lake Erie, the Niagara River and Lake Ontario. In any case, environmentally persistent organochlorine compounds appear to increase in birds wintering in the Lake Erie-Niagara River-Lake Ontario system.

The Niagara River is a valuable water supply source for the region. Water supply intakes for communities in both Niagara and Erie Counties are located approximately four miles downstream of the River Road site. These include Lockport City (population 25,000), North Tonawanda County (population 36,000) and Tonawanda City (population 18,538) Intakes for Tonawanda Water District #1 (population 91,269) and the Erie County Water Authority are located approximately four miles upstream of the site.

3.4.3 Wetlands

Wetlands 12.4 acres or greater in size are regulated by the NYSDEC under Article 24 of the Environmental Conservation Law. Wetland acreage less than 12.4 acres is regulated by the Federal Government (U.S. Army Corps of Engineers). There is one protected wetland located within the River Road site. Figure 3-14 indicates the location of protected wetlands on and 9 miles downstream of the River Road site.



PEM5A - FEDERALLY DESIGNATED WETLANDS ARE DENOTED BY THE PREFIX "P"

BW-8 - NYSDEC DESIGNATED WETLANDS ARE DENOTED BY THE PREFIX "B" OR "T"

RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

Dvirka and Bartilucci
CONSULTING ENGINEERS

LOCATION OF PROTECTED WETLANDS

FIGURE 3 - 14

Wetland BW-8 is a NYSDEC regulated wetland located along the northern boundary of the site. This wetland begins where Tributary 158-13c enters the site from under River Road, and is present on the River Road site and the adjacent Cherry Farm site along the stream corridor to its convergence with the Niagara River.

NYSDEC has indicated that wetland BW-8 should be protected during remediation of the Cherry Farm site. Consideration should be given to remediation of wetland sediments if contaminants are found to have migrated from the site.

Federally protected wetland POWFx is located approximately 500 feet south (upstream) of the site. Several regulated wetlands are present downstream of the site along the Niagara River. These include the NYSDEC wetland TW-12 (PF01C on Federal Wetland Inventory maps) located approximately four miles north of the site on the west shoreline of the river (Grand Island). Buckhorn Island State Park (TW-18, TW-19) is located approximately ten miles downstream of the site, along the northern shoreline of Grand Island. This 500-acre area is the largest coastal wetland complex in western New York and is considered a significant habitat for its large cattail, rush and grass marsh plant life and as a waterfowl wintering area and common area for tern nesting and feeding. Also located downstream of the site are several smaller federally regulated wetlands. These include PEM5E and POWHx, both located approximately five miles from the site along the eastern riverbank.

3.4.4 Mammals

Evidence of the presence of various mammals was found on-site during the Phase I/II RI field program. This was particularly evident by the presence of two partially consumed bird carcasses. An eastern cottontail (Sylvilagus floridanus) was observed on-site, and has been confirmed by NYSDEC to use the adjacent Cherry Farm site as well. Also muskrats (Ondatra zibethicus) were seen in and around the creek area during the Phase II program.

3.4.5 Birds

The site hosts a number of common species of birds which typically frequent disturbed lands and mature tree stands. Observed during field surveys were numerous black capped chickadees (Parus atricapillus) and a single northern oriole (Icterus galbulla) in the mixed wooded areas of the site. Several hawks (Buteo spp.) were observed on more than one occasion circling high above the site, apparently hunting for prey. These birds did not descend and the species could not be positively identified. NYSDEC Division of Fish and Wildlife, however, has confirmed the presence of red tailed hawk (Buteo jamaicensis) on the adjacent Cherry Farm site, and these birds could be of the same variety.

In addition, many species of birds found in Erie County and in the Town of Tonawanda can be presumed to frequent the site. Table 3-3 contains the New York State Bird Atlas listing for Erie County, New York.

3.4.6 Fish

No species of fish were observed in Tributary 158-13c during field surveys on the River Road site. Due to its intermittent nature, this stream would serve as a conduit for transient fish species moving out of the ponded water habitat upstream. Invertebrate species such as crayfish, however, were observed in the channel leading from the settling lagoons to the Niagara River in the southwest portion of the site.

As discussed previously, the Niagara River supports a wide variety of fish habitats and fishing opportunities. Approximately 47,000 anglers visited the Niagara River in 1988 (25,000 to the Upper River and 22,000 to the Lower River); fishing primarily for smallmouth bass (Micropterus dolomieui), muskellunge (Esox Masquinongy), and walleye (Perca flavescens). Table 3-4 lists fish species of the Niagara River.

During the Phase I field investigation, a significant fish kill was observed in the Niagara River along the riverbank of the site. This event appeared to be limited to the single species alewife (Alosa Pseudoharengus) and resulted in a significant number of dead fish washed upon the shoreline. The cause of this event is unknown, but may be attributed to temperature change or other impact caused by the spring thaw of ice in upstream locations.

3.4.7 Reptile and Amphibians

Due to the conduct of the Phase I/II field investigation in the early spring and winter, few reptile and amphibian species were noted on-site. However, the River Road site contains habitat which may support a number of reptiles and amphibians. This includes the wetland area and

TABLE 3-3
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Bird Atlas Listing For Erie County, New York

COMMON NAME	SCIENTIFIC NAME	BREEDING		
		POSSIBLE	PROBABLE	CONFIRMED
Mallard	*Anas platyrhynchos*			X
Red-tailed hawk	*Buteo jamaicensis*			X
Northern harrier	*Circus cyaneus*			X
American kestrel	*Falco sparverius*		X	
Ring-necked pheasant	*Phasianus colchicus*		X	
Killdeer	*Charadrius vociferus*			X
Common snipe	*Gallinago gallinago*			X
Rock dove	*Columba livia*			X
Mourning dove	*Zenaida macroura*			X
Eastern screech-owl	*Otus asio*		X	
Great horned owl	*Bubo virginianus*		X	
Chimney swift	*Chaetura pelagica*	X		
Ruby-throated hummingbird	*Archilochus colubris*	X		
Belted kingfisher	*Ceryle alcyon*	X		
Northern flicker	*Colaptes auratus*			X
Hairy woodpecker	*Picoides villosus*		X	
Downy woodpecker	*Picoides pubescens*	X		
Eastern kingbird	*Tyrannus tyrannus*			X
Willow flycatcher	*Empidonax traillii*			X
Tree swallow	*Tachycineta bicolor*			X
Barn swallow	*Hirundo rustica*			X
Purple martin	*Progne subis*			X
Blue jay	*Cyanocitta cristata*			X
American crow	*Corvus brachyrhynchos*			X
Brown thrasher	*Toxostoma rufum*			X
American redstart	*Setophaga ruticilla*	X		
Song sparrow	*Melospiza melodia*			X
Common yellowthroat	*Geothlypis trichas*	X		
House sparrow	*Passer domesticus*			X
Eastern meadowlark	*Sturnella magna*	X		
Red-winged blackbird	*Agelaius phoeniceus*			X
Northern oriole	*Icterus galbula*			X
Common grackle	*Quiscalus quiscula*			X
Brown-headed cowbird	*Molothrus ater*	X		
Scarlet tanager	*Piranga olivacea*	X		

TABLE 3–3 (Cont.)
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Bird Atlas Listing For Erie County, New York

COMMON NAME	SCIENTIFIC NAME	BREEDING		
		POSSIBLE	PROBABLE	CONFIRMED
American robin	*Turdus migratorius*			X
Wood thrush	*Hylocichla mustelina*		X	
Veery	*Catharus fuscescens*	X		
Cedar waxwing	*Bombycilla cedrorum*			X
European starling	*Sturnus vulgaris*			X
Red–eyed vireo	*Vireo olivaceus*		X	
Warbling vireo	*Vireo gilvus*	X		
Blue–winged warbler	*Vermivora pinus*	X		
Yellow warbler	*Dendroica petechia*			X
Ovenbird	*Seiurus aurocapillus*	X		
Northern cardinal	*Cardinalis cardinalis*	X		
Rose–breasted grosbeak	*Pheucticus ludovicianus*	X		
Indigo bunting	*Passerina cyanea*			X
House finch	*Carpodacus mexicanus*		X	
American goldfinch	*Carduelis tristis*	X		
Rufous–sided towhee	*Pipilo erythrophthalmus*			X
Savannah sparrow	*Passerculus sandwichensis*	X		
Chipping sparrow	*Spizella passerina*			X
Field sparrow	*Spizella pusilla*		X	
Swamp sparrow	*Melospiza georgiana*			X

Source: NYSDEC

TABLE 3-4
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Fish Species of the Niagara River

FAMILY	COMMON NAME	SCIENTIFIC NAME
Petromizontidae	Sea lamprey	*Petromyzon marinus*
	American brook lamprey	*Lampetra lamottei*
Acipenseridae	Lake sturgeon	*Acipenser fulvescens*
Lepisosteidae	Longnose gar	*Lepisosteus osseus*
Amiidae	Bowfin	*Amia calva*
Clupeidae	Alewife	*Alosa pseudoharengus*
	Gizzard shad	*Dorosoma cepedianum*
Salmonidae	Pink salmon	*Oncorhynchus gorbuscha*
	Coho salmon	*Oncorhynchus kisiutch*
	Chinook salmon	*Oncorhynchus tshawytscha*
	Rainbow trout	*Oncorhynchus mykiss*
	Atlantic salmon	*Salmo salar*
	Brown trout	*Salmo trutta*
	Lake trout	*Salvelinus namaycush*
	Brook trout	*Salvelinus fontinalis*
	Lake whitefish	*Coregonus clupeaformis*
Osmeridae	Smelt	*Osmerus mordax*
Umbridae	Central mudminnow	*Umbra limi*
Esocidae	Grass pickerel	*Esox americanus vermiculatus*
	Northern pike	*Esox lucius*
	Muskellunge	*Esox masquinongy*
	Chain pickerel	*Esox niger*
Aphredoderidae	White perch	*Aphredoderus sayanus*
Cyprinidae	Goldfish	*Carassius auratus*
	Carp-goldfish hybrid	*none*
	Redside dace	*Clinostomus elongatus*
	Carp	*Cyprinus carpio*
	Central stoneroller	*Campostoma anomalum*
	Hornyhead chub	*Nocomis biguttatus*
	River chub	*Nocomis micropogon*
	Golden shiner	*Notemigonus crysoleucas*
	Emerald shiner	*Notropis atherinoides*
	Common shiner	*Notropis cornutus*
	Blacknose shiner	*Notropis heterolepis*
	Spottail shiner	*Notropis hudsonius*
	Spotfin shiner	*Notropis spilopterus*
	Mimic shiner	*Notropis volucellus*

TABLE 3–4 (Cont.)
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Fish Species of the Niagara River

FAMILY	COMMON NAME	SCIENTIFIC NAME
Cyprinidae (Cont'd.)	Sand shiner	*Notropis stramineus*
	Bluntnose minnow	*Pimephales notatus*
	Fathead minnow	*Pimephales promelas*
	Longnose dace	*Rhinichthys cataractae*
	Blacknose dace	*Rhinichthys atratulus*
	Creek chub	*Semotilus atromaculatus*
Catostomidae	Quillback sucker	*Carpiodes cyprinus*
	White sucker	*Catostomus commersoni*
	Lake chubsucker	*Erimyzon sucetta*
	Northern hog sucker	*Hypentelium nigricans*
	Silver redhorse	*Moxostoma anisurum*
	Golden redhorse	*Moxostoma erythrurum*
	Shorthead redhorse	*Moxostoma macrolepidotum*
	Greater redhorse	*Moxostoma valenciennesi*
Ictaluridae	Black bullhead	*Ictalurus melas*
	Yellow bullhead	*Ictalurus natalis*
	Brown bullhead	*Ictalurus nebulosus*
	Channel catfish	*Ictalurus punctatus*
	Stonecat	*Noturus flavus*
	Tadpole madtom	*Noturus gyrinus*
Anguillidae	American eel	*Anguilla rostrata*
Cyprinodontidae	Banded killifish	*Fundulus diaphanus*
Gadidae	Burbot	*Lota lota*
Atherinidae	Brook silverside	*Labidesthes sicculus*
Gasterosteidae	Brook stickleback	*Culaea inconstans*
	Threespine stickleback	*Gasterosteus aculeatus*
Percopsidae	Trout perch	*Percopsis omiscomaycus*
Percichthyidae	White perch	*Morone americana*
	White bass	*Morone chrysops*
Centrarchidae	Rock bass	*Ambloplites rupestris*
	Green sunfish	*Lepomis cyanellus*
	Pumpkinseed	*Lepomis gibbosus*
	Bluegill	*Lepomis macrochirus*
	Longear sunfish	*Lepomis megalotis*
	Smallmouth bass	*Micropterus dolomieui*
	Largemouth bass	*Micropterus salmoides*
	White crappie	*Pomoxis annularis*
	Black crappie	*Poxomis nigromaculatus*
Percidae	Yellow perch	*Perca flavescens*
	Sauger	*Stizostedion canadense*
	Walleye	*Stizostedion vitreum*

TABLE 3–4 (Cont.)
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Fish Species of the Niagara River

FAMILY	COMMON NAME	SCIENTIFIC NAME
Percidae (Cont'd.)	Blue pike	*Stizostedion vitreum glaucum*
	Eastern sand darter	*Ammocrypta pellucida*
	Greenside darter	*Etheostoma blennioides*
	Rainbow darter	*Etheostoma caeruleum*
	Iowa darter	*Etheostoma exile*
	Fantail darter	*Etheostoma flabellare*
	Johnny darter	*Etheostoma nigrum*
	Tessellated Johnny darter	*Etheostoma olmstedi*
	Logperch	*Percina caprodes*
	Blackside darter	*Percina maculata*
Sciaenidae	Freshwater drum	*Aplodinotus grunniens*
Cottidae	Mottled sculpin	*Cottus bairdi*
	Slimy sculpin	*Cottus cognatus*

Source:NYSDEC

stream corridor along the northern boundary of the site, the small channel adjacent to the settling lagoons in the southwest portion of the site, and the Niagara River. These areas provide suitable habitat for a number of snake species. What may have been a common garter snake (Thamnophis sirtalis) or eastern ribbon snake (Thamnophis sauritus) was glimpsed briefly during a field survey in the wetland area where the stream first enters the site near River Road. Anurans that were not observed, but may utilize these habitats include American toad (Bufo americanus) and green frog (Rana clamitans). Table 3-5 lists plant and animal species found on the River Road site. Table 3-6 identifies those species along with the associated major plant community.

3.4.8 Rare Species and Critical Habitats

Based upon a review of the Significant Habitat Unit and the NY Natural Heritage Program Files, there are not significant habitats or rare species located on or immediately adjacent to the River Road site. Except for occasional transient individuals, no federally listed or proposed endangered or threatened species are known to exist by the United States Department of the Interior on the River Road site. One threatened plant, the stiff leaf goldenrod (Solidago rigida), occurs approximately three miles downstream at Isle View Park. A compilation of federally listed and proposed endangered and threatened species in New York is presented on this table. None of the species listed on Table 3-7 were found on the River Road site.

There are, however, several valuable fish and wildlife habitat areas in the vicinity of the site. The Strawberry Island-Motor Island shallows, located approximately one and one half miles south (upstream of the site, is a large area of riverine littoral zone in the Niagara River that includes Strawberry Island, Motor Island, and the southern tip of Grand Island. This area measures approximately 400 acres and is considered rare in the Great Lakes Plain ecological region. The area is characterized by an extensive shallow shoal area (generally less than six feet deep at mean low water) containing beds of submergent aquatic vegetation, and emergent wetland vegetation in shoreline areas.

The Strawberry Island-Motor Island shallows is considered an extremely valuable fish and wildlife habitat by NYSDEC and NYS Department of State, and is one of the most important fish spawning areas in the Upper Niagara River. This area is one of only two principal spawning grounds for Muskellunge (Esox masquinongy) in the river, and is also a productive spawning area for small mouth bass (Micropterus dolomieui), yellow perch, (Perca flavescens) and other resident species.

TABLE 3–5
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Plant And Animal Species Inhabiting The River Road Site

COMMON NAME	SCIENTIFIC NAME	OCCURRENCE	
		PROBABLE	CONFIRMED
Plant Species			
Queen Annes' lace	*Daucus carola*		X
Chicory	*Cichorium intybus*		X
Field bindweed	*Convolvus arvenisis*		X
Rough dandelion	*Taraxacum officinale*		X
Smooth dandelion	*Taraxacum spp.*		X
Virginia creeper	*Parthenocissus quinquefolia*		X
Blue lettuce	*Lactuca spp.*		X
Field sow thistle	*Sonchus aruensis*		X
Burs	*Xanthium spp.*		X
Red maple	*Acer rubrum*		X
Goldenrod	*Soldago spp.*		X
Clover	*Trifolium spp.*		X
Soft rush	*Juncus effusus*		X
Giant reed	*Phragmites communis*		X
Cattails	*Typha spp.*		X
Fools parsley	*Aethusa cynapium*		X
Sumac	*Rhus spp.*		X
Animal Species			
Grey squirrel	*Sciurus carolinensis*	X	
Eastern cottontail	*Sylvilagus floridanus*		X
Field mouse	*Peromyscus spp.*	X	
House mouse	*Mus musculus*	X	
Vole	*Microtus pennsylanicus*	X	
Garter snake	*Thamnophis sirtalis*		X
Eastern ribbon snake	*Thamnophis sauritus*	X	
Shrew	*Sorex spp.*	X	
Green frog	*Rana clamitans*	X	
Black–capped chickadee	*Parus atricapillus*		X
Northern oriole	*Icterus galbulla*		X
Hawks	*Buteo spp.*		
Red–tailed hawk	*Buteo jamaicensis*	X	

TABLE 3–6
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Animal And Vegetative Covertypes* Within The River Road Site

TYPE	DISTURBED LANDS	GRASSLANDS	EMERGENT WETLAND	OPEN WATER	CLIMAX VEGETATION	DEBRIS PILE
Plant Species						
Queen Anne's lace	X	X				
Clover	X	X				X
Chicory	X	X				X
Goldenrod	X	X				
Fescues		X			X	
Soft rush			X			
Giant reed			X			
Cattails			X			
Sumac		X			X	
Red maple					X	
Animal Species						
Grey squirrel					X	
Eastern cottontail		X			X	
Field mouse	X	X				X
Vole		X				
Snakes		X	X			
Frogs		X	X	X		
Black–capped chickadee		X			X	
Northern oriole		X			X	
Hawks		X				
Crayfish			X	X		

* *Animal and plant lists refer to the most abundant types only.*

TABLE 3-7
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Federally Listed and Proposed Endangered and Threatened Species In New York

COMMON NAME	SCIENTIFIC NAME	STATUS	DISTRIBUTION
FISH			
Sturgeon, shortnose	*Acipenser brevirostrum*	E	Hudson River, Atlantic coastal rivers
REPTILES			
Turtle, green	*Chelonia mydas*	T	Oceanic summer visitor coastal waters
Turtle, hawksbill	*Eretmochelys imbricata*	E	Oceanic summer visitor coastal waters
Turtle, leatherback	*Dermochelys coriacea*	E	Oceanic summer resident coastal waters
Turtle, loggerhead	*Caretta caretta*	T	Oceanic summer resident coastal waters
Turtle, atlantic ridley	*Lepidochelys kempii*	E	Oceanic summer resident coastal waters
BIRDS			
Eagle, bald	*Haliaeetus leucocephalus*	E	Entire state
Falcon, peregrine	*Falco peregrinus*	E	Entire state–Restablishment to former breeding range in progress
Plover, piping	*Charadrius melodus*	E	Great Lakes Watershed
		T	Remainder of coastal NY
Tern, roseate	*Sterna dougalli dougalli*	E	Southeastern coastal portions of state
MAMMALS			
Bat, indiana	*Myotis sodalis*	E	Entire state
Cougar, eastern	*Felis concolor cougar*	E	Entire state probably extinct
Whale, blue	*Balaenoptera musculus*	E	Oceanic

E=endangered T=threatened P=proposed

TABLE 3–7 (Cont.)
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Federally Listed and Proposed Endangered and Threatened Species In New York

COMMON NAME	SCIENTIFIC NAME	STATUS	DISTRIBUTION
MAMMALS (Cont'd)			
Whale, finback	*Balaenoptera Physalus*	E	Oceanic
Whale, humpback	*Megaptera novaeangliae*	E	Oceanic
Whale, right	*Eubalaena glacialis*	E	Oceanic
Whale, sei	*Balaenoptera borealis*	E	Oceanic
Whale, sperm	*Physeter catodon*	E	Oceanic
MOLLUSKS			
Snail, chittenango	*Succinea*	E	
ovate amber	*chittenangoensis*	T	Madison County
Mussel, dwarf wedge	*Alasmidonta heterodon*	E	Orange County lower Neversink River
BUTTERFLIES			
Butterfly, karner blue	*Lycaeides melissa samuelis*	PE	Albany,Saratoga,Warren and Schenectady Counties
PLANTS			
Monkshood, northern wild	*Aconitum noveboracense*	T	Ulster County
Pogonia, small whorled	*Isotria medeoloides*	E	Entire state
Swamp pink	*Helonias bullata*	T	Staten Island presumed extirpated
Gerardia, sandplain	*Agalinis acuta*	E	Nassau and Suffolk Counties
Fern, american hart's tongue	*Phyllitis scolopendrium*	T	Onondaga and Madison Counties
Orchid, eastern prairie fringed	*Platanthera leucophea*	T	Not relocated in New York
Bulrush, northeastern	*Scirpus ancistrochaetus*	E	Not relocated in New York
Roseroot, leedy's	*Sedum integrifolium ssp. Leedyi*	PT	West shore of Seneca Lake

E=endangered   T=threatened   P=proposed

Source:U.S. Fish and Wildlife Service

This valuable habitat area is also one of the most important waterfowl wintering areas (November to March) in the northeastern United States, especially for diving ducks. Animal abundance surveys conducted by NYSDEC for the period 1976 to 1985 indicate average concentrations of over 14,000 birds in the Upper Niagara River each year (25,400) in peak year). This includes approximately 8,500 common and red-breasted mergansers (Mergus merganser and Mergus serrator, respectively), 2,600 common goldeneye (Bucephala clanqula), 1,900 canvasbacks (Anthya valisineria), 1,200 scaup (Anthya marila) and lesser numbers of black duck (Anas rubripes), mallard (Anas platyrhynhos), bufflehead (Bucephala albeola), and oldsquaw (Clanqula hymalis).

This area is located in the Upper Niagara River, considered a significant coastal habitat and waterfowl nesting area. This area services as a major feeding and resting area for these birds, probably influenced by the large amount of ice cover in other parts of the region. Summer use of the area by birds is not known to be significant, but common terns (Sterna hirundo), a threatened species, have been reported to feed in the area, but the extent of their use has not been documented by NYSDEC.

Buckhorn Island wetlands, located approximately 10 miles downstream of the site along the north shore of Grand Island, contains the most significant undeveloped marsh on the Niagara River and is another rare large riverine littoral zone. This 500-acre area is protected wetland and is considered a prime habitat for a variety of fish species an waterfowl, including a nesting and feeding area for common terns (Sterna hirundo).

A significant coastal habitat comprised of the Grand Island tributaries falls within three miles to the west of the site. These areas include important spawning grounds for several fish species, and important nesting and feeding grounds for waterfowl and the tern colony on the Niagara River.

In addition, the Niagara River Remedial Action Plan currently being developed by NYSDEC describes the extensive loss of wooded and natural shoreline habitat of the entire river, and the need for restoration of these habitats. NYSDEC suggests that site remediation plans consider these habitats and not preclude future restoration efforts.

3.4.9 Biological Associations Found in the Project Vicinity

The area surrounding the River Road site is predominantly developed (industrial). Extending from the site in a 2.5-mile radius results in open water and developed land to the west, developed land (industrial) and small open areas (reclaimed disposal areas) to the north and east and developed (industrial) areas to the south. Figure 3-15 illustrates the area surrounding the River Road site.

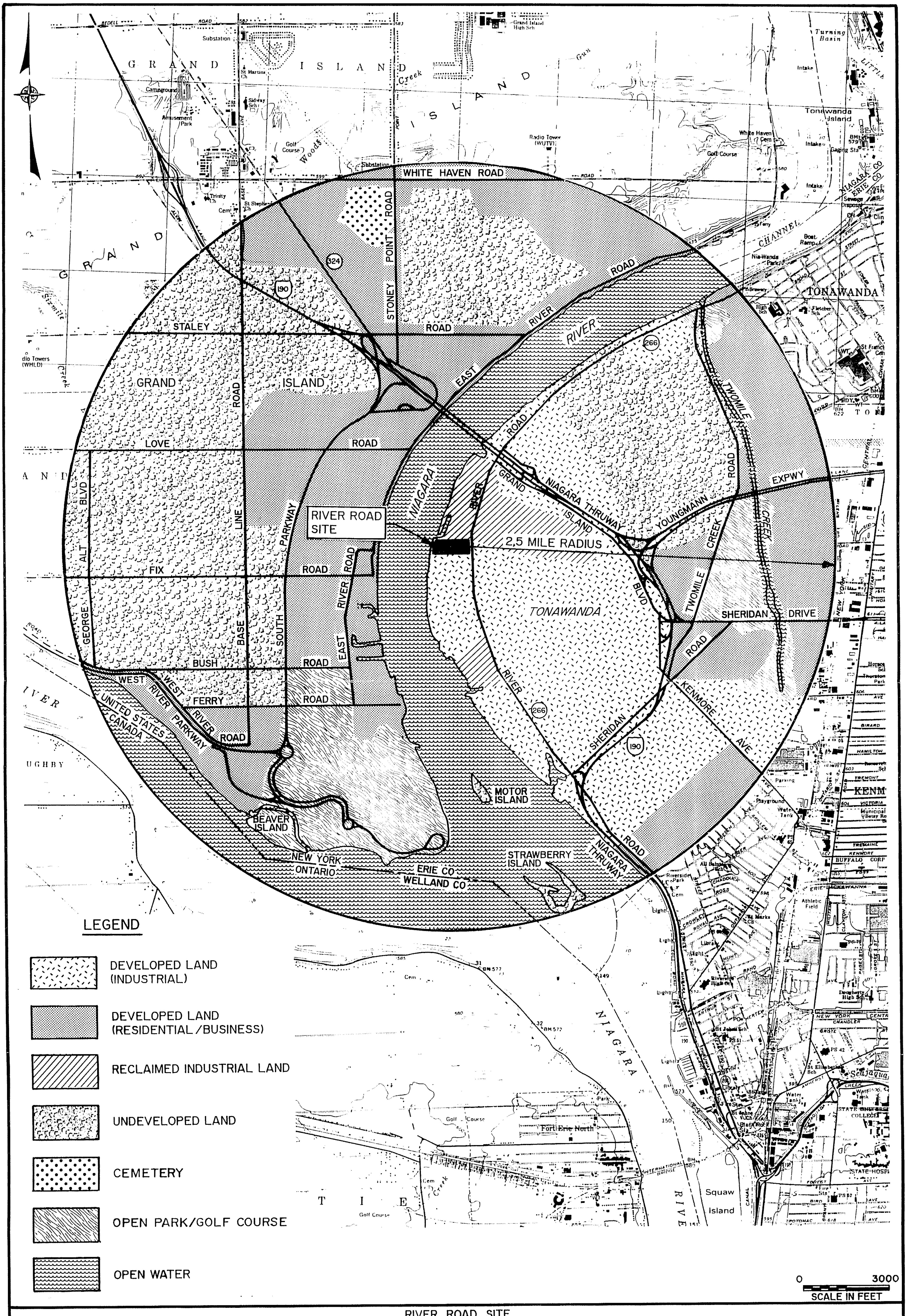
3.4.10 Observations of Stress Potentially Related to Site Contaminants

Several areas in the approximate center of the undeveloped area of the River Road site are sparsely vegetated and/or discolored. Visible spoil piles of coke fines and cinder material are found along the southern border of the site, west of the Clarence Materials property, as well as large debris piles, some of which were the site of surficial soil sample collections. There were indications of stress potentially related to on-site contaminants observed on the site. As noted previously, along the river bordering the site, a significant number of dead fish were observed during Phase I along the shoreline, the cause of which is unclear but may be related to spring thaw cycle in the river. As discussed previously, fish and waterfowl utilizing the Niagara River have accumulated contaminants, but the degree to which the River Road site has contributed to this condition cannot be determined.

3.4.11 Habitat Values of Vegetative Zones Within the Project Site

The assessment of habitat value provides for assessments of primary functions such as food chain production, specialized habitat and hydrologic interaction. As part of the analysis, cultural values concerning recreation, aesthetics or other special features must be taken into consideration.

The information gathered during the Phase I/II RI can provide for a hierarchy of habitat values for the cover types found at the River Road site. It should be noted that this approach is highly subjective. Those functions assumed to be valuable in relative efficiency or importance are ranked as 3 (high), 2 (moderate) or 1 (low). Specific factors and brief descriptions which were utilized in the habitat value analysis of the River Road site qualitative evaluation are as follows:



RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

2.5 MILE VICINITY MAP

Dvirka and Bartilucci
CONSULTING ENGINEERS

FIGURE 3 - 15

- Nutrient Transport Function - Transport of nutrients in detrital-based food chains is strongly dependent on the hydrologic characteristics of the particular ecosystem. For example, wetlands located in lower lying areas export more detrital material than do the higher marsh areas infrequently affected by creek/river overflow. Similarly, detrital transport in riverine systems is dependent on the river flow regime, especially during periods of peak discharge. In contrast, very little detrital material is exported from isolated ponds and marshes, except during periods of episodic overflow resulting from exceptionally high precipitation.

- Food Chain Support - This function refers to the secondary productivity values of consumer species that a particular ecosystem can support. Secondary productivity is an overall measure of the efficiency of the habitat in terms of available nutrients to higher trophic levels.

- Hydroperiod - This factor refers to the frequency of inundation either by river flow runoff or direct precipitation. Areas of good hydrologic linkage help maintain a regular interchange of nutrients and other materials necessary to support diverse flora and fauna.

- Elevational Location - From the above, it is apparent that hydrologic relationships will progressively deteriorate as the depth of flooding decreases. The weakest hydrologic linkages exist in those areas physically isolated from other areas in the system.

- Cultural Evaluation - This particular factor is difficult to assess in specific detail because of the number of socio-economic considerations which may be involved. Hence, the evaluation in relation to local residential, commercial or industrial development is largely left to the professional judgment of the field personnel on a specific case-by-case basis.

- Recreation - Recreation is a vital personal and social need which provides opportunity for self-expression, physical exercise and a change of pace from normal or routine activities. Outdoor recreation is a major leisure activity and is growing in national importance with a trend towards a higher standard of living. A significant portion of the total recreational output is water based or water related. As such, greater weight is given to those types of habitats.

- Socio-Economic - This factor pertains to benefits which can be attributed directly to renewable resources, recreational enjoyment or other features associated with a particular habitat.

- Aesthetics - Selected types of habitats are distinctive landscape features which can please the aesthetic sense through the intrinsic appreciation of natural beauty. Wetlands or any other type of natural landscape can also be offensive if their features have been adversely modified by incompatible human activities. Aesthetic value can be largely determined by the degree of visual diversity and contrast between the physical elements, such as landforms, water bodies, vegetation types and land use types.

- Food Chain Production - This factor determines the growth of vegetation in a habitat and influences the populations and secondary productivity of animals that feed on the plants, or that feed at high trophic levels in the community.

- Primary Productivity - Primary productivity is a measure of the stored food potential of the vegetation in excess of that used by the plants in metabolism. This determination provides an overall measure of the energy input directly available to the consumer species. It should be noted that the possible range of productivity values, both within and between particular environments, is extremely variable and dependent on a number of local conditions. For the present analysis, literature values for primary productivity as a function of biomass were utilized.

- Water Purification Factor - Through a variety of physical, biological and chemical processes, some habitats function to naturally purify water by removing organic and mineral particulate matter from runoff and/or rives and streams. For example, wetlands may be significant in minimizing some of the harmful effects of pollutants introduced into natural ecological systems by the activities of man. Thus, wetlands, especially when part of riverine or estuarine systems, an be an integral part of water quality and pollution control objectives.

Based upon the above factors, a qualitative analysis of the habitat value of the vegetative communities on the River Road site is presented on Table 3-8. Based upon these results, those habitats in descending order from high to low value are as follows:

- Emergent wetland habitat
- Open water habitat
- Climax vegetation habitat
- Grassland habitat
- Debris pile habitat
- Disturbed land

TABLE 3-8
RIVER ROAD SITE
REMEDIAL INVESTIGATION, QUALITATIVE HEALTH RISK ASSESSMENT AND PRELIMINARY FEASIBILITY STUDY

Quantitative Habitat Values (a)

EVALUATION FACTORS	HABITAT TYPE					
	EMERGENT WETLAND	OPEN WATER	CLIMAX VEGETATION	GRASSLAND	DEBRIS PILE	DEVELOPED
Food Chain Production	*3*	*2*	*1*	*2*	*1*	*1*
Primary Productivity *Nutrient Transport* *Food Chain Support (i.e.,Nesting)*	*3*	*2*	*3*	*2*	*2*	*1*
Hydroperiod	*3*	*3*	*1*	*1*	*1*	*1*
Elevational Location	*2*	*3*	*1*	*1*	*1*	*1*
Cultural Evaluation	*1*	*1*	*1*	*1*	*1*	*1*
Recreation *Socio-Economic* *Aesthetics*	*2*	*2*	*2*	*1*	*1*	*1*
Water Purification Factor	*3*	*1*	*1*	*1*	*1*	*1*
TOTALS	*17*	*14*	*10*	*9*	*8*	*7*

(a) Scoring as follows:

3-High Value
2-Moderate Value
1-Low Value

Section 4

4.0 NATURE AND EXTENT OF CONTAMINATION

This section provides a discussion of the results of the field activities and sampling, and the nature, extent and significance of contamination found during the Phase I and II remedial investigations for the River Road site.

4.1 Identification of Standards, Criteria and Guidelines

A presentation of standards, criteria and guidelines that are applicable or relevant and appropriate to the River Road site and this remedial investigation/feasibility study is provided below.

4.1.1 Surface and Subsurface Soil

For the purpose of interpretation of surface and subsurface soil analytical results from the Phase I/II investigation, individual elements and groups of compounds have been identified as contaminants of concern for the River Road site. The contaminants of concern (based upon toxicity characteristics and elevated concentrations found at the site) are volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), carcinogenic polycyclic aromatic hydrocarbons (CPAHs), polychlorinated biphenyls (PCBs), and lead and mercury. Guidance values indicating significant contamination which may require remediation have been identified based upon review of applicable guidance documents, such as NYSDEC Draft Cleanup Policy (December 1991), and discussions with New York State Department of Health (NYSDOH) and NYSDEC.

To further develop soil remediation guidance values associated with these contaminants, the results from the analysis of the background surface soil samples collected as part of this investigation were utilized to assist in the selection of guidance values. These guidance values are utilized in part as the basis for the Qualitative Health Risk Assessment prepared as part of this Phase I/II RI/FS report. This risk assessment identifies compounds that pose unacceptable risks on-site where specific exposure pathways exist, and defines/refines remediation guidelines.

Table 4-1 lists the groups of chemicals found at the site and the soil remediation guidance values utilized for the discussion of the analytical results obtained during this investigation. These levels were based upon site information and similar guidance levels used for other sites of this nature. These guidance values were discussed with the NYSDEC and NYSDOH prior to use in this report.

Table 4-1

CATEGORIES OF COMPOUNDS OF CONCERN

Volatile Organic Compounds (VOCs)

Chloromethane
Bromomethane
Vinyl chloride
Chloroethane
Methylene chloride
2-Propane
Carbon disulfide
1,1-Dichloroethene
1,1-Dichloroethane
1,2-Dichloroethene (total)
Chloroform
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethene
Carbon tetrachloride
Vinyl acetate
Bromodichloromethane
1,2-Dichloropropene
cis-,3-Dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-Trichloroethene
Benzene
Trans-,3-Dichloropropene
Bromoform
4-Methyl-2-Pentanone
2-Hexanone
Tetrachloroethene
1,1,2,2-Tetrachloroethene
Toluene
Chlorobenzene
Ethylbenzene
Styrene
Xylene (total)

The soil remediation guidance value for total VOCs in soil is 1 mg/kg

Table 4-1 (continued)

CATEGORIES OF COMPOUNDS OF CONCERN

Polycyclic Aromatic Hydrocarbons (PAHs)

Naphthalene
Acenaphthylene
Acenaphthene
Flourene
Phenanthrene
Anthracene
Flouranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b)flouranthene
Benzo(k)flouranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)pyrene

The soil remediation guidance value for total PAHs in soil is 100 mg/kg. It should be noted that the total PAH value also incorporates selected carcinogenic PAHs. Both guidance values are applied to the data.

Carcinogenic Polycyclic Aromatic Hydrocarbons (CPAHs)

Benzo(a)anthracene
Benzo(b)flouranthene
Benzo(k)flouranthene
Benzo(a)pyrene
Chrysene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene

The soil remediation guidance value for total CPAHs in soil is 10 mg/kg

Polychlorinated Biphenyls (PCBs)

Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260

The soil remediation guidance value for total PCB in surface soil is 1 mg/kg and in subsurface soil is 10 mg/kg

Table 4-1 (continued)

CATEGORIES OF COMPOUNDS OF CONCERN

Inorganic Compounds (metals)

Lead (Pb)
Mercury (Hg)
Cadmium (Cd)
Chromium (Cr)
Copper (Cu)
Cobalt (Co)
Aluminum (Al)
Cyanide (Cn)

The soil remediation guidance value for lead in soil is 500 mg/kg and mercury in soil is 10 mg/kg

The guidance value established for total volatile organic compounds (VOCs) of 1 mg/kg is based upon the value suggested by NYSDOH. VOCs, even though they have not been found at high concentrations in the soil, can be present in the groundwater and can be considered as a contaminant of concern.

Polycyclic aromatic hydrocarbons (PAHs) is a subgroup of a larger class of compounds known as semivolatile organic compounds or base neutral/acid extractables. Since most of the compounds in the semivolatile group were not detected at the site, it was determined that the PAH subcategory of this group be established to allow for a detailed evaluation of the data. The approach used to select a guidance value of 10 mg/kg for carcinogenic PAHs and 100 mg/kg for total PAHs was based upon selection of conservative values from information provided by NYSDOH, which suggested a range of 1-10 mg/kg for carcinogenic PAHs and 10-100 mg/kg for total PAHs.

PCBs have also been identified as a contaminant of concern at the River Road site. Guidance values of 1 mg/kg for surface soil and 10 mg/kg for subsurface soil have been selected. These values are based upon NYSDEC proposed cleanup policy and NYSDOH recommendations.

For lead, a concentration of 500 mg/kg has been selected for a guidance value at the River Road site. This guidance value was determined to be appropriate based upon the industrial use of the site, levels of lead (43.8 mg/kg and 178 mg/kg) found in the background surface soil samples and suggestions provided by NYSDOH.

A concentration of 10 mg/kg for mercury has been selected as a guidance value for the site in keeping with levels of concern used in other programs. The soil data was also evaluated using a soil criteria value of 2 mg/kg based upon recommendations provided by the NYSDEC Bureau of Fish and Wildlife.

In summary, the following guidance values are used to evaluate surface soil and subsurface soil contamination.

Total VOCs	- 1 mg/kg
Total PAHs	- 100 mg/kg
Total Carcinogenic PAHs	- 10 mg/kg
Total PCBs	- 1 mg/kg (surface soil) 10 mg/kg (subsurface soil)
Total Lead	- 500 mg/kg
Total Mercury	- 10 mg/kg

4.1.2 Surface Water Sediment

The criteria for assessment of surface water sediment were developed from guidance present in the NYSDEC document entitled "Sediment Criteria December 1989." The assessment for sediment requires that the criteria be normalized to the percentage of total organic carbon (TOC) in the collected sample. Based upon discussions with NYSDEC Division of Fish and Wildlife, a low to high range of criteria was developed based upon the ranges of TOC in the collected samples (1.6 percent to 4.1 percent). All criteria were derived from a wildlife residue basis as presented in the NYSDEC guidance document. In selected cases where wildlife residue criteria were not available, other criteria such as the aquatic toxicity or human health residue basis were utilized for comparison to sediment contaminant levels found.

4.1.3 Groundwater

For the review and interpretation of groundwater analytical results, the guidance values for the River Road site were taken from the NYSDEC Technical and Operational Guidance Series (TOGS) - Ambient Water Quality Standards and Guidance Values (effective date September 1, 1991 which were revised on November 15, 1991 as a result of amendment to 6NYCRR parts 700-705). The NYSDEC TOGS water quality standards (ST) and guidance values (GV) provide ambient pollutant concentrations developed to protect New York State groundwater and refers to their best classified usage. Analytical results obtained for groundwater samples are compared to Class GA groundwater standards.

4.2 Data Validation

4.2.1 Phase I/Phase II Data Validation

Samples collected during the Phase I/II RI field sampling effort were analyzed primarily for Target Compound List (TCL) +30 parameters. Six test trench samples were also analyzed for Toxicity Characteristics Leaching Procedure (TCLP) and RCRA characteristics (ignitability, corrosivity and reactivity), and the groundwater samples were also analyzed for hexavalent chromium. The samples encompassed a number of media including groundwater, surface soil, waste material, subsurface soil, surface water sediment and light nonaqueous phase liquid (LNAPL).

All samples were analyzed and validated in accordance with the 1991 New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP). Four monitoring well soil samples obtained during the Phase I field investigation were not collected in conformance with NYSDEC requirements and it was agreed upon between the NYSDEC and Dvirka and Bartilucci Consulting Engineers that the sample results would be used for screening purposes and that ASP deliverables and validation of these samples were not required.

Gel Permeation Chromotography (GPC) cleanup was not performed on the base neutral/acid (BNA) extractable fraction for samples RRSS05, RRSS11, RRTT08 and RRTT11. The 1991 NYSDEC ASP requires that GPC cleanup be performed on every soil sample extract.

Samples for semivolatiles for test trench samples collected as part of the Phase I investigation, RRTT07, RRTT08, RRTT12 and RRTT14, and samples RRMW5S, RRMW6S, RRB4TA, RRB5TA, RRMN8S(5-7) and RRMW5S0, collected as part of the Phase II RI/FS investigation, required reanalysis due to internal standard area counts and/or surrogate recoveries not meeting QC requirements by being outside of recovery limits (refer to Table 4-2). Data usability was based primarily upon a determination of which sample analyses exhibited the best surrogate spike and/or internal standard recoveries. Both the results of the first and second and/or diluted analysis were reviewed to determine data usability.

Samples RRSS06, RRSS09, RRSS12, RRTT07 and RRTT09 required reanalysis of the pesticide/PCB fraction at a secondary dilution due to the presence of interferences and in order to quantify the concentrations of PCBs (refer to Table 4-2).

Samples RRSS03, RRSS07, RRSS08 and RRTT09 from the Phase I investigation, and samples RRMW4S, RRMW13GF, RRMW8S, RRMW9S, RRMW8S(15-17) and RRMW9S(5-7) collected during the Phase II RI/FS investigation, required reanalysis of the semivolatile fraction at secondary dilutions due to compound concentrations exceeding the instrument calibration range in the initial analysis (refer to Table 4-2).

The original semivolatile extracts for samples RRSWS1, RRSWS3, RRSWS4, RRSWS5 and RRSWS6 contained sediment and/or multiphased layers. These samples were re-extracted within the 10 day holding time allotted for re-extraction. Only the re-extracts were analyzed. This data is deemed usable for environmental assessment.

Table 4-2

PHASE I/PHASE II DATA VALIDATION SUMMARY
(Contractual Compliance with 1991 NYSDEC ASP)

Group	Sample Number	Matrix	VOA	BNA	Pest/PCBs	Metals	TCLP	Recra	Hexavalent Chromium
PHASE I DATA									
Groundwater	RRMW1	Water	OK	OK	OK	OK	NA	NA	
	RRMW2	Water	OK	OK	OK	OK	NA	NA	
	RRMW3S	Water	OK	OK	OK	OK	NA	NA	
	RRMW4S	Water	OK	OK	OK	OK, see note 8	NA	NA	
	RRMW5S	Water	OK	OK, see note 7	OK	OK, see note 8	NA	NA	
	RRMW5I	Water	OK	OK	OK	OK	NA	NA	
	RRMW6S	Water	OK	OK, see note 11	OK	OK	NA	NA	
	RRMW7S	Water	OK	OK	OK	OK	NA	NA	
	RRMW7I	Water	OK	OK	OK	OK	NA	NA	
	RRMWCM	Water	OK	OK	OK	OK	NA	NA	
	RW102	Water	OK	OK	OK	OK	NA	NA	
	RRMW8S								
	RRMW9S								
	RRMWFB	Water	OK	OK	OK	OK	NA	NA	
	RRMWTB	Water	OK	NA	NA	NA	NA	NA	
	Trip Blank	Water	OK	NA	NA	NA	NA	NA	
Surface Soil	RRSS01	Soil	OK	OK	OK	OK	NA	NA	NA
	RRSS02	Soil	OK	OK	OK	OK	NA	NA	NA
	RRSS03	Soil	OK	OK, see note 1	OK	OK	NA	NA	NA
	RRSS04	Soil	OK	OK	OK	OK	NA	NA	NA
	RRSS05	Soil	OK	No, see note 2	OK	OK	NA	NA	NA
	RRSS06	Soil	OK	OK	OK, see note 3	OK	NA	NA	NA
	RRSS07	Soil	OK	OK, see note 1	OK	OK	NA	NA	NA
	RRSS08	Soil	OK	OK, see note 1	OK	OK	NA	NA	NA
	RRSS09	Soil	OK	OK	OK, see note 3	OK	NA	NA	NA
	RRSS10	Tar	OK	OK	OK	OK	NA	NA	NA
	RRSS11	Soil	OK	No, see note 2	OK	OK	NA	NA	NA
	RRSS12	Soil	OK	OK	OK, see note 3	OK	NA	NA	NA
	RRSSFB	Water	OK	OK	OK	OK	NA	NA	NA

Table 4-2 (continued)

PHASE I/PHASE II DATA VALIDATION SUMMARY
(Contractual Compliance with 1991 NYSDEC ASP)

Group	Sample Number	Matrix	VOA	BNA	Pest/PCBs	Metals	TCLP	Recra	Hexavalent Chromium
PHASE I DATA (continued)									
Monitoring Well Soil*	RRMW4S	Soil							
	RRMW5IAS	Soil							
	RRMW6S	Soil							
	RRMW7IA	Soil							
	RRMWFBS	Water	OK	OK	OK	OK	NA	NA	NA
Test Trench	RRTT01	Soil	OK	No, see note 10	No, see notes 3,9	OK	NA	NA	NA
	RRTT02	Soil	OK	OK	OK	OK	NA	NA	NA
	RRTT03	Soil	OK	No, see note 10	OK	OK	OK met	NA	NA
	RRTT05	Soil	OK	OK	No, see note 9	OK	OK met	NA	NA
	RRTT06	Soil	OK	OK	OK	OK	OK met	NA	NA
	RRTT07	Soil	OK	OK, see note 4	OK, see note 3	OK	NA	NA	NA
	RRTT08	Soil	No, see note 5	No, see notes 2,6	OK	OK	OK met	NA	NA
	RRTT09	Soil	OK	OK, see note 1	OK, see note 3	OK	NA	NA	NA
	RRTT10	Soil	OK	OK	OK	OK	NA	NA	NA
	RRTT11	Soil	OK	No, see note 2,7	OK	OK	OK, met	NA	NA
	RRTT12	Soil	OK	No, see note 1,10	No, see notes 3,9	OK	NA	NA	NA
	RRTT14	Soil				OK	OK, met	NA	NA
	RRTT16	Soil				OK	NA	NA	NA
	RRTT17	Soil				OK	NA	NA	NA

*Samples did not require formal validation due to collection method.

Table 4-2 (continued)

PHASE I/PHASE II DATA VALIDATION SUMMARY
(Contractual Compliance with 1991 NYSDEC ASP)

Group	Sample Number	Matrix	VOA	BNA	Pest/PCBs	Metals
PHASE II DATA						
Groundwater	RRMW1	Water	NA	OK	OK	OK
	RRMW2	Water	NA	OK	OK	OK
	RRMW3S	Water	NA	OK, see note 22	OK	OK
	RRMW4S	Water	NA	OK, see note 12	OK	OK
	RRMW5S	Water	NA	OK, see note 6	OK	OK
	RRMW6S	Water	NA	OK, see note 7	OK	OK
	RRMW7S	Water	NA	OK	OK	OK
	RRMW8S	Water	NA	OK, see note 13	OK	OK
	RRMW9S	Water	NA	OK, see note 14	OK	OK
	RRMW13CF	Water	NA	OK, see note 15	OK	OK
	CW102DM	Water	NA	OK	OK	OK
	RRMW12CF	Water	NA	OK	OK	OK
	RRB3TA	Water	NA	OK	OK	OK
	RRB4TA	Water	NA	OK, see note 20	OK	OK
	RRB5TA	Water	NA	OK, see note 6, 23	OK	OK
Surface Water Sediment	RRSWS-1	Soil	NA	NO, see note 24, 25	OK	OK
	RRSWS-2	Soil	NA	NO, see note 24	OK	OK
	RRSWS-3	Soil	OK	NO, see note 24,25	OK	OK
	RRSWS-4	Soil	NA	NO, see note 24,25	OK	OK
	RRSWS-5	Soil	NA	NO, see note 24,25	OK	OK
	RRSWS-6	Soil	NA	NO, see note 24,25	OK	OK
Monitoring Well Soil	RRMW8S(5-7)	Soil	OK	NO, see note 7,24	OK	OK
	RRMW8S(15-17)	Soil	OK, see note 17	NO, see note 18,24	OK	OK
	RRMW9S(5-7)	Soil	OK	NO, see note 19,24	OK	OK
	RRMW9S(10-12)	Soil	OK	NO, see note 24	OK	OK
LNAPL	RRMW5SO	Oil	NA	OK, see note 21	OK	NO
	RRMW8SO	Oil	NA	OK, see note 16	OK	NO

Table 4-2 (continued)

PHASE I/PHASE II DATA VALIDATION SUMMARY
(DEFINITION OF DATA QUALIFIERS)

Table Qualifiers:

OK:	No problems found with data.
OK, see note:	Data is 100% contractually compliant, but qualifiers exist. Check the listing below for a more detailed explanation.
No, see note:	Data is not 100% contractually compliant. However, data may be usable for assessment. Check the listing below for a more detailed explanation.
NA:	Not Applicable

Notes:

1. Sample required secondary dilution due to bis(2-ethylhexyl)phthalate exceeding calibration range. Data from initial analysis should be used except for bis(2-ethylhexyl)phthalate, which should come from the diluted run.

2. GPC cleanup not performed. Data deemed valid for assessment purposes.

3. Secondary dilution was required due to the presence of interferences and quantification was not possible. Use PCB results from diluted run for environmental assessment.

4. Sample required re-extraction at medium level. Medium level sample was analyzed twice for RRTT07RE and RRTT07RR. Data from RRTT07RR is deemed the "best set" of data.

5. Sample analyzed two days out of holding time. Data is deemed usable but estimated.

6. Sample required reanalysis due to internal standard area counts and surrogate recoveries. Use data from reanalysis since more contractually compliant.

7. Sample required reanalysis due to internal standard area counts. Data from initial analysis should be used for environmental assessment.

8. Sample required dissolved metal analysis also.

9. Due to the high concentration of PCBs detected, the sample should have been analyzed by GC/MS for confirmation. Data is deemed valid.

10. Due to a contract deficient blank, requirements were not met. Data deemed usable for environmental assessment.

11. Sample required secondary dilution due to the concentration of 2,4-dimethylphenol exceeding the calibration range. Data from the initial analysis should be used except for 2,4-dimethylphenol which should come from the diluted run.

Table 4-2 (continued)

PHASE I/PHASE II DATA VALIDATION SUMMARY
(DEFINITION OF DATA QUALIFIERS)

Notes:

12. Sample required secondary dilution due to the concentration of naphthalene exceeding the calibration range. Data from the initial analysis should be used except for naphthalene which should come from the diluted run.

13. Sample required secondary dilution due to the concentrations of phenol, 2 methylpheneol, 4 methylphenol, 2,4 Dimethylphenol, phenanthrene and flouranthene exceeding the instrument calibration range. Data for the above compounds should be taken from the diluted run with all other results coming from the initial analysis.

14. Sample required secondary dilution due to the concentrations of phenol, 2 methylphenol, 4 methylphenol and 2,4 dimethylphenol exceeding the instrument calibration range. Results for the above compounds should be taken from the diluted run with all others coming from the initial run.

15. Sample required secondary dilution due to the concentrations of 4-methylphenol and 2,4-dimethylphenol exceeding the instrument calibration range. Data from the initial run should be used except for 4 methylphenol and 2,4-dimethylphenol which should come from the diluted run.

16. Sample was reanalyzed at a secondary dilution due to matrix interference.

17. Sample required secondary dilution due to the concentration of total xylenes exceeding the instrument calibration range. Data from the initial run should be used except for the result of total xylenes which should come from the diluted run.

18. Sample required secondary dilution due to the concentration of phenanthrene, flouranthene, and bis(2 ethylhexyl)phthalate exceeding the instrument calibration range. The results for the above compounds should come from the diluted run with all other results being taken from the initial run.

19. Sample required secondary dilution due to the concentration of phenanthrene exceeding the instrument calibration range. Data from the initial analysis should be used except for phenanthrene which should be taken form the diluted run.

20. Sample required reanalysis due to noncompliant surrogate recoveries in the initial run. However, reanalysis was performed five days outside of the 40 day holding time. Results are replicated so use the data from the initial analysis.

21. Sample required reanalysis due to noncompliant surrogate recoveries and internal standard area counts. Reanalysis had similar results so the data from the initial run should be used.

22. Sample was re-extracted due to poor surrogate recoveries in the initial run. The sample was re-extracted 40 days out of holding time. Data for both runs is comparable so data from initial analysis should be used for environmental assessment.

Table 4-2 (continued)

PHASE I/PHASE II DATA VALIDATION SUMMARY
(DEFINITION OF DATA QUALIFIERS)

Notes:

23. Reanalysis performed outside of the 40 day holding time. Data not qualified since results were comparable.

24. Sample analysis was performed nine days and ten days outside of the 40 day from VTSR holding time. Data is qualified as estimated with the results deemed usable for environmental assessment.

25. Sample was re-extracted due to sediment present in the initial extract based on re-extraction holding times (ten days from VTSR). Samples met QC requirements.

The following samples collected during the Phase II field investigation were analyzed for semivolatile organics outside of the 40 day holding time from VTSR: RRSWS-1, RRSWS-2, RRSWS-3, RRMW9S(5-7) and RRMW9S(10-12). The results for these samples have been qualified as estimated but deemed usable for environmental assessment.

A total of 71 Phase I and II samples were analyzed (which includes Quality Assurance/Quality Control samples). As a result of the data validation, some of the data, although valid, was deemed estimated. A summary assessment of the sample results is provided in Table 4-2. The data usability report, which presents the methodology for choosing the best set of data, is contained in Appendix E of this report. The usability report contains Tables 1 and 2, which provide a more detailed description of the individual sample results. The original data validation documentation, upon which the usability report is based, is contained in the usability report.

4.3 **Phase I/Phase II Analytical Results**

The contaminants encountered and their frequency of detection at the River Road site for surface and subsurface soils, surface water sediment, groundwater and light nonaqueous phase liquid are presented in Table 4-3. Each matrix will be discussed in the following sections.

4.3.1 Surface Soil and Waste Piles

Seven surface soil samples and five waste pile samples were collected during the Phase I investigation at the River Road site. None were collected during Phase II. Results of these samples are used to characterize the chemical quality of the surficial medium of the site. Table 4-4 summarizes the sample results for the analytes of concern identified for the site. Figure 4-1 presents the sample locations and concentrations of the contaminants that exceed guidance values. Complete analytical results for the surface soil and waste pile samples are presented in Appendix F.

Most of the samples were collected in the undeveloped portion of the site, and two background samples (RRSS01 and RRSS02) were collected approximately 1.5 miles to the east of the site along Two Mile Creek Road (see Figure 2-3). The soil and waste pile samples were analyzed for TCL +30 parameters. Results of the two off-site samples were either nondetectable or had low concentrations for the TCL analytes. It should be noted, however, that sample RRSS01 collected nearest the playground on Two Mile Creek Road contained a number of tentatively identified semivolatile compounds (see Appendix F).

TABLE 4-3
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION
CONTAMINANT DETECTION FREQUENCY FOR SURFACE SOIL

CONTAMINANT	Number of detections/ number of samples collected	Concentration Min - Max	Location of Maximum (Sample ID)
VOLATILE ORGANICS (ug/kg)			
Methylene Chloride	12/12	3 - 12	RRSS04 & RRSS07
SEMIVOLATILE ORGANICS (ug/kg)			
Phenol	3/12	26 - 50	RRSS12
4-Methylphenol	4/12	33 - 120	RRSS06
2,4-Dimethylphenol	4/12	43 - 53	RRSS12
Naphthalene	7/12	150-110000	RRSS11
2-Methylnaphthalene	9/12	49-13000	RRSS11
Acenaphthylene	3/12	110-4700	RRSS05
Acenaphthene	3/12	71-3700	RRSS11
Dibenzofuran	8/12	60-6100	RRSS11
Diethylphthalate	1/12	310-310	RRSS01
Fluorene	3/12	180-4000	RRSS11
N-Nitrosodiphenylamine	3/12	30-96	RRSS12
Phenanathrene	11/12	41-31000	RRSS11
Anthracene	9/12	24-5000	RRSS11
Carbazole	6/12	23-5300	RRSS11
Di-n-butylphthalate	8/12	30-1200	RRSS11 & RRSS05
Fluoranthene	10/12	100-43000	RRSS11
Pyrene	11/12	88-71000	RRSS10
Butylbenzylphthalate	2/12	55-100	RRSS04
Benzo(a)anthracene	10/12	44-22000	RRSS11
Chyrsene	10/12	79-32000	RRSS11
bis(2ethylhexyl)phthalate	12/12	1000-500000	RRSS10
Di-n-octylphthalate	1/12	68-68	RRSS12
Benzo(b)fluoranthene	8/12	140-34000	RRSS11
Benzo(k)fluoranthene	8/12	110-17000	RRSS11
Benzo(k)pyrene	8/12	87-28000	RRSS11
Indeno(1,2,3-cd)pyrene	5/12	170-23000	RRSS11
Benzo(ghi)perylene	3/12	110-2300	RRSS11
PESTICIDE/PCBs (ug/kg)			
Heptachlor Epoxide	2/12	4.4-4.7	RRSS05
Endosulfan II	1/12	14-14	RRSS05
4-4' DDT	2/12	6.5-22	RRSS05
Aroclor-1248	2/12	71-250	RRSS07
Aroclor-1254	4/12	79-1600	RRSS09
Aroclor-1260	3/12	40-940	RRSS06
METALS (mg/kg)			
Aluminum	12/12	25.8-24800	RRSS03
Antimony	8/12	14.9-46.7	RRSS11
Arsenic	11/12	4-75.7	RRSS03
Barium	11/12	33.6-461	RRSS03
Beryllium	8/12	0.59-3.9	RRSS03
Cadmium	4/12	1.9-16.6	RRSS09
Calcium	11/12	3790-51100	RRSS02
Chromium	11/12	19.1-130	RRSS04
Cobalt	11/12	4.8-20.8	RRSS03
Copper	11/12	16.1-236	RRSS04
Iron	12/12	92.1-93600	RRSS11
Lead	12/12	4.3-892	RRSS06
Magnesium	11/12	647-15400	RRSS02
Manganese	12/12	2.5-2960	RRSS09
Mercury	3/12	.14-.89	RRSS11
Nickel	12/12	18.8-79.6	RRSS04
Potassium	10/12	517-4320	RRSS02
Selenium	1/12	1.4-1.4	RRSS09
Silver	3/12	2.9-5.5	RRSS04
Sodium	6/12	165-552	RRSS03
Vanadium	12/12	6.4-232	RRSS10
Zinc	12/12	52.6-2460	RRSS09
Cyanide	1/12	1.5-1.5	RRSS11

TABLE 4 -3 (continued)
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION
CONTAMINANT DETECTION FREQUENCY FOR MONITORING WELL SOIL BORINGS

CONTAMINANT	Number of detections/ number of samples collected	Concentration Min - Max	Location of Maximum (Sample ID)
VOLATILE ORGANICS (ug/kg)			
Methylene Chloride	8/8	3–170	RRMW8S(15–17 FT)
Acetone	3/8	10–160	RRMW8S(15–17 FT)
Carbon Disulfide	1/8	1–1	RRMW9S(5–7 FT)
1,1–Dichloroethane	1/8	8–8	RRMW8S(15–17 FT)
Trichloroethene	1/8	5–5	RRMW8S(15–17 FT)
Benzene	3/8	2–3	RRMW9S(5–7 FT)
2–Hexanone	1/8	220–220	RRMW8S(15–17 FT)
Tetrachloroethene	1/8	9–9	RRMW8S(15–17 FT)
Toluene	4/8	2–290	RRMW8S(15–17 FT)
Ethylbenzene	1/8	140–140	RRMW8S(15–17 FT)
Total Xylenes	1/8	1100–1100	RRMW8S(15–17 FT)
SEMIVOLATILE ORGANICS (ug/kg)			
Phenol	6/8	130–2600	RRMW8S(5–7 FT)
bis(2–chloroethyl)ether	2/8	770–1100	RRMW7IA
1,4–Dichlorobenzene	1/8	52–52	RRMW8S(5–7 FT)
2–Methylphenol	5/8	6–780	RRMW8S(5–7 FT)
4–Methylphenol	8/8	32–3200	RRMW8S(5–7 FT)
2,4–Dimethylphenol	6/8	63–1300	RRMW6S
1,2,4–Trichlorobenzene	1/8	420–420	RRMW8S(5–7 FT)
Naphthalene	8/8	49–10000	RRMW8S(15–17 FT)
4–Chloroaniline	1/8	3200–3200	RRMW8S(15–17 FT)
2–Methylnaphthalene	8/8	32–7000	RRMW8S(15–17 FT)
Dimethylphthalate	1/8	50–50	RRMW8S(5–7 FT)
Acenaphthylene	3/8	42–270	RRMW9S(5–7 FT)
2,6–Dinitrotoluene	1/8	510–510	RRMW9S(5–7 FT)
Acenaphthene	6/8	9–6900	RRMW8S(15–17 FT)
Dibenzofuran	5/8	45–1400	RRMW7IA
Fluorene	7/8	82–6500	RRMW8S(15–17 FT)
4,6–Dinitro–2–methylphenol	1/8	500–500	RRMW8S(5–7 FT)
N–Nitrosodiphenylamine	3/8	100–570	RRMW9S(5–7 FT)
Phenanathrene	8/8	10–44000	RRMW8S(15–17 FT)
Anthracene	7/8	22–5600	RRMW8S(15–17 FT)
Carbazole	3/8	19–140	RRMW6S
Di–n–butylphthalate	7/8	7–290	RRMW4S
Fluoranthene	7/8	46–45000	RRMW8S(15–17 FT)
Pyrene	7/8	40–8000	RRMW8S(15–17 FT)
Butylbenzylphthalate	5/8	65–270	RRMW4S
Benzo(a)anthracene	5/8	150–5600	RRMW8S(15–17 FT)
Chyrsene	6/8	210–8700	RRMW8S(15–17 FT)
bis(2ethylhexyl)phthalate	7/8	120–11000	RRMW4S
Di–n–octylphthalate	7/8	5–370	RRMW8S(15–17 FT)
Benzo(b)fluoranthene	5/8	170–3800	RRMW8S(15–17 FT)
Benzo(k)fluoranthene	5/8	81–4100	RRMW8S(15–17 FT)
Benzo(a)pyrene	4/8	140–2500	RRMW8S(15–17 FT)
Indeno(1,2,3–cd)pyrene	1/8	1100–1100	RRMW8S(15–17 FT)
4–Chlorophenol	2/8	780–6880	RRMW8S(15–17 FT)

TABLE 4 -3 (continued)

RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION
CONTAMINANT DETECTION FREQUENCY FOR MONITORING WELL SOIL BORINGS

CONTAMINANT	Number of detections/ number of samples collected	Concentration Min - Max	Location of Maximum (Sample ID)
PESTICIDE/PCBs (ug/kg)			
Endosulfan II	1/8	2.4–2.4	RRMW9S(10–12 FT)
Methoxychlor	1/8	99–99	RRMW8S(15–17 FT)
Endrin aldehyde	2/8	4.2–150	RRMW8S(15–17 FT)
Aroclor–1242	1/8	780–780	RRMW7S
Aroclor–1248	3/8	300–3500	RRMW8S(5–7 FT)
Aroclor–1254	5/8	240–5000	RRMW4S
Aroclor–1260	2/8	570–1500	RRMW8S(5–7 FT)
METALS (mg/kg)			
Aluminum	8/8	1000–15000	RRMW4S
Antimony	7/8	5.5–133	RRMW9S(5–7 FT)
Arsenic	7/8	4.68–44.3	RRMW9S(5–7 FT)
Barium	8/8	13.4–163	RRMW8S(5–7 FT)
Beryllium	4/8	0.37–1.25	RRMW4S
Cadmium	3/8	10.6–60.1	RRMW4S
Calcium	8/8	4040–66700	RRMW4S
Chromium	8/8	12.7–416	RRMW9S(5–7 FT)
Cobalt	6/8	5–53.8	RRMW9S(5–7 FT)
Copper	8/8	8.1–491	RRMW9S(5–7 FT)
Iron	8/8	7730–407000	RRMW9S(5–7 FT)
Lead	8/8	11.3–1170	RRMW4S
Magnesium	8/8	439–2870	RRMW4S
Manganese	8/8	159–4020	RRMW4S
Mercury	2/8	0.239–0.275	RRMW4S
Nickel	8/8	5.69–267	RRMW9S(5–7 FT)
Potassium	6/8	273–1250	RRMW8S(5–7 FT)
Selenium	2/8	1.5–2.38	RRMW7IA
Silver	2/8	2–7.75	RRMW4S
Sodium	7/8	103–527	RRMW4S
Vanadium	7/8	1.1–24.6	RRMW9S(5–7 FT)
Zinc	8/8	34–4370	RRMW4S
Cyanide	3/8	0.31–6.39	RRMW4S

TABLE 4 -3 (continued)
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION
CONTAMINANT DETECTION FREQUENCY FOR TEST TRENCH SOIL

CONTAMINANT	Number of detections/ number of samples collected	Concentration Min - Max	Location of Maximum (Sample ID)
VOLATILE ORGANICS (ug/kg)			
Methylene Chloride	10/14	2-920	RRTT08
Acetone	1/14	22-22	RRTT12A
Carbon Disulfide	2/14	5-7	RRTT07
4-Methyl-2-Pentanone	1/14	40-40	RRTT11
Tetrachloroethene	1/14	530-530	RRTT08
Toluene	4/14	2-6400	RRTT08
Ethylbenzene	3/14	68-1900	RRTT08
Total Xylenes	3/14	250-11000	RRTT08
SEMIVOLATILE ORGANICS (ug/kg)			
Phenol	3/14	130-7500	RRTT08
2-Methylphenol	1/14	360-360	RRTT12A
4-Methylphenol	7/14	41-1600	RRTT12A
2,4-Dimethylphenol	4/14	140-440	RRTT07
Naphthalene	11/14	74-27000	RRTT08
2-Methylnaphthalene	13/14	72-12000	RRTT08
Acenaphthylene	2/14	50-59	RRTT06
Acenaphthene	2/14	160-13000	RRTT07
Dibenzofuran	10/14	22-12000	RRSS11
Diethylphthalate	2/14	96-310	RRTT12A
Fluorene	3/14	510-12000	RRSS11
Hexachlorobenzene	1/14	430-430	RRTT09
Pentachlorophenol	1/14	80-80	RRTT05
Phenanathrene	13/14	110-86000	RRTT08
Anthracene	12/14	19-17000	RRTT08
Carbazole	4/14	8-16000	RRTT08
Di-n-butylphthalate	11/14	59-8500	RRTT08
Fluoranthene	13/14	89-49000	RRTT08
Pyrene	13/14	85-14000	RRTT08
Benzo(a)anthracene	10/14	54-6700	RRTT08
Chyrsene	10/14	79-9500	RRTT08
bis(2ethylhexyl)phthalate	14/14	330-23000	RRTT09
Di-n-octylphthalate	4/14	56-430	RRTT12A
Benzo(b)fluoranthene	7/14	86-5400	RRTT08
Benzo(k)fluoranthene	7/14	58-3600	RRTT08
Benzo(k)pyrene	6/14	60-2100	RRTT08
Indeno(1,2,3-cd)pyrene	2/14	580-770	RRTT07
Benzo(ghi)perylene	1/14	580-580	RRTT09
PESTICIDE/PCBs (ug/kg)			
Aroclor-1248	3/14	350-5900	RRTT12A
Aroclor-1254	10/14	33-21000	RRTT09
Aroclor-1260	3/14	430-2100	RRTT14

TABLE 4 -3 (continued)
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION
CONTAMINANT DETECTION FREQUENCY FOR TEST TRENCH SOIL

CONTAMINANT	Number of detections/ number of samples collected	Concentration Min - Max	Location of Maximum (Sample ID)
METALS (mg/kg)			
Aluminum	14/14	3130–33900	RRTT11
Antimony	12/14	12.1–144	RRTT11
Arsenic	14/14	4.4–44.7	RRTT11
Barium	14/14	23.2–734	RRTT11
Beryllium	11/14	0.72–2.7	RRTT06
Cadmium	4/14	5.5–180	RRTT09
Calcium	14/14	3580–66300	RRTT03
Chromium	14/14	31.3–1650	RRTT11
Cobalt	14/14	4.7–50.4	RRTT11
Copper	14/14	25.4–2110	RRTT11
Iron	14/14	20300–290000	RRTT11
Lead	14/14	13.1–7740	RRTT09
Magnesium	14/14	505–9130	RRTT03
Manganese	14/14	423–19400	RRTT09
Mercury	8/14	0.12–1.6	RRTT09
Nickel	14/14	12.4–213	RRTT14
Potassium	12/14	414–6500	RRTT09
Selenium	1/14	6.5–6.5	RRTT09
Silver	1/14	28.5–28.5	RRTT09
Sodium	13/14	113–1300	RRTT09
Thallium	2/14	1.2–2.3	RRTT09
Vanadium	12/14	5.5–123	RRTT03
Zinc	14/14	36.7–23900	RRTT09
Cyanide	7/14	0.54–1.5	RRTT05 & RRTT12
RECRA CHARACTERISTICS			
pH	7/7	6.52–8.9	RRTT06
TCLP CONSTITUENTS (ug/l)			
Arsenic	3/6	134–673	RRTT08
Barium	3/6	1290–2100	RRTT11
Chromium	3/6	4.4–423	RRTT11
Lead	2/6	90–112	RRTT11

TABLE 4 -3 (continued)
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION
CONTAMINANT DETECTION FREQUENCY FOR SURFACE WATER SEDIMENT

CONTAMINANT	Number of detections/ number of samples collected	Concentration Min - Max	Location of Maximum (Sample ID)
VOLATILE ORGANICS (ug/kg)			
Methylene Chloride	1/1	170–170	RRSWS3
Acetone	1/1	62–62	RRSWS3
Benzene	1/1	2–2	RRSWS3
Toluene	1/1	2–2	RRSWS3
SEMIVOLATILE ORGANICS (ug/kg)			
Phenol	3/6	21–89	RRSWS2
4–Methylphenol	1/6	90–90	RRSWS1
2,4–Dimethylphenol	1/6	120–120	RRSWS1
Naphthalene	4/6	86–370	RRSWS6
2–Methylnaphthalene	4/6	63–170	RRSWS6
Acenaphthene	1/6	620–620	RRSWS6
Dibenzofuran	4/6	18–380	RRSWS6
Diethylphthalate	1/6	160–160	RRSWS2
Fluorene	3/6	17–610	RRSWS6
Phenanathrene	6/6	57-2000	RRSWS6
Anthracene	5/6	7–270	RRSWS6
Carbazole	4/6	8–310	RRSWS6
Fluoranthene	6/6	120–880	RRSWS6
Pyrene	6/6	87–490	RRSWS6
Benzo(a)anthracene	1/6	110–110	RRSWS6
Chyrsene	1/6	220–220	RRSWS6
bis(2ethylhexyl)phthalate	5/6	210–460	RRSWS2
Di–n–octylphthalate	1/6	9–9	RRSWS5
PESTICIDE/PCBs (ug/kg)			
Heptachlor	2/6	4–6.1	RRSWS1
Endosulfan I	1/6	4.4–4.4	RRSWS1
Aroclor–1248	4/6	110–180	RRSWS4
Aroclor–1254	2/6	350–640	RRSWS1
Aroclor–1260	4/6	260–470	RRSWS4
METALS (mg/kg)			
Aluminum	6/6	8090–20800	RRSWS3
Arsenic	6/6	5.9–25.4	RRSWS1
Barium	6/6	83.1–188	RRSWS1
Beryllium	6/6	0.74–1.5	RRSWS3
Cadmium	1/6	4.2–4.2	RRSWS1
Calcium	6/6	39200–71000	RRSWS1
Chromium	6/6	26.8–122	RRSWS3
Cobalt	6/6	6.7–14.3	RRSWS6
Copper	6/6	25.9–57.2	RRSWS1
Iron	6/6	19200–41100	RRSWS3
Lead	6/6	30.8–314	RRSWS1
Magnesium	6/6	5380–17700	RRSWS3
Manganese	6/6	761–4170	RRSWS1
Nickel	6/6	16.8–28	RRSWS3
Potassium	6/6	1460–5140	RRSWS3
Sodium	6/6	242–471	RRSWS3
Vanadium	6/6	21.6–47.9	RRSWS3
Zinc	6/6	136–1750	RRSWS1
Cyanide	2/6	1.1–1.6	RRSWS5
Cyanide with sulfide removed	6/6	0.27–1.22	RRSWS4
Amenable cyanide	3/6	0.2–0.24	RRSWS1

TABLE 4 -3 (continued)
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION
CONTAMINANT DETECTION FREQUENCY FOR GROUNDWATER

CONTAMINANT	Number of detections/ number of samples collected	Concentration Min - Max	Location of Maximum (Sample ID)
VOLATILE ORGANICS (ug/l)			
Methylene Chloride	4/11	2–7	RRMWCM
Acetone	1/11	10–10	RRMW1
1,1–Dichloroethene	1/11	58–58	RRMW6S
1,1–Dichloroethane	1/11	3–3	RRMW6S
1,2–Dichloroethene (total)	3/11	1–50	RRMW6S
2–Butanone	1/11	4–4	RRMW5S
Bromodichloromethane	3/11	1–270	RRMW6S
Dibromochloromethane	3/11	1–14	RRMW6S
Benzene	1/11	3–3	RRMW3S
Bromoform	1/11	4–4	RRMW6S
Tetrachloroethene	2/11	2–3	RRMW6S
1,1,2,2–Tetrachloroethane	1/11	1–1	RRMW6S
Chlorobenzene	1/11	4–4	RRMW5S
Ethylbenzene	1/11	1–1	RRMW5S
SEMIVOLATILE ORGANICS (ug/l)			
Phenol	9/26	1–650	RRMW9S
2–Methylphenol	6/26	2–530	RRMW9S
4–Methylphenol	11/26	1–1900	RRMW9S
Nitrobenzene	4/16	2–6	RRMW6S
2,4–Dimethylphenol	13/26	1–880	RRMW9S
Naphthalene	10/26	1–310	RRMW4S
2–Methylnaphthalene	6/26	1–14	RRMW8S
2,4,6–Trichlorophenol	3/26	1–5	RRMW8S
2,4,5–Trichlorophenol	5/26	2–8	RRMW7S
2–Chloronaphthalene	2/26	1–4	RRMW8S
Dimethylphthalate	2/26	4–9	RRMW8S
Acenaphthylene	6/26	1–3	RRMW8S
2,6–Dinitrotoluene	1/26	13–13	RRMW5S
Acenaphthene	13/26	1–29	RRMW8S
Dibenzofuran	6/26	2–22	RRMW8S
Diethylphthalate	6/26	1–2	RRMW5S & RRMW13CF
Fluorene	12/26	1–38	RRMW8S
4–Nitroaniline	1/26	21–21	RRMW13CF
N–Nitrosodiphenylamine	9/26	1–28	RRMW5S
Pentachlorophenol	2/26	1–2	RRMW6S
Phenanathrene	11/26	1–160	RRMW8S
Anthracene	9/26	1–27	RRMW8S
Carbazole	9/26	1–38	RRMW4S
Di–n–butylphthalate	7/26	1–1	RRMW1 & 5S & 7S & CW102 & 13CF
Fluoranthene	8/26	1–88	RRMW8S
Pyrene	8/26	1–84	RRMW8S
Benzo(a)anthracene	3/26	6–18	RRMW8S
Chyrsene	3/26	7–24	RRMW8S
bis(2ethylhexyl)phthalate	15/26	1–36	RRMW8S
Di–n–octylphthalate	2/26	1–2	RRMW5S
Benzo(b)fluoranthene	2/26	3–12	RRMW8S
Benzo(k)fluoranthene	3/26	3–10	RRMW8S
Benzo(a)pyrene	2/26	2–10	RRMW8S

TABLE 4 -3 (continued)
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION
CONTAMINANT DETECTION FREQUENCY FOR GROUNDWATER

CONTAMINANT	Number of detections/ number of samples collected	Concentration Min - Max	Location of Maximum (Sample ID)
PESTICIDE/PCBs (ug/l)			
alpha–Chlordane	1/26	0.65–0.65	RRMW5S
Aroclor–1248	3/26	2.6–17	RRMW8S
Aroclor–1254	1/26	5.4–5.4	RRMW5S
Aroclor–1260	2/26	3.4–6.6	RRMW8S
METALS (ug/l)			
Aluminum	25/26	36.3–2580	RRMW6S
Antimony	5/26	38.8–102	RRMW5S
Arsenic	7/26	5.6–12.3	RRCW102DM
Barium	26/26	16.4–307	RRB3TA
Calcium	26/26	14700–508000	RRMW5S
Cobalt	1/26	8–8	RRMW5S
Copper	7/26	4.3–7.4	RRMWCM
Iron	26/26	37.1–42600	RRMW5S
Lead	15/26	2.6–160	RRMW4S
Magnesium	22/26	618–95800	RRMW5I
Manganese	25/26	5.1–4170	RRMW5S
Mercury	10/26	0.21–4.8	RRMW2
Nickel	2/26	20.7–26.3	RRMW9S
Potassium	25/26	810–102000	RRMW12CF
Selenium	3/26	5.4–6.8	RRMW9S
Sodium	26/26	15800-140000	RRMW2
Thallium	3/26	5.7–20.9	RRMW8S
Vanadium	6/26	5.4–132	RRMW12CF
Zinc	14/26	5.7–389	RRMW4S
Cyanide	19/26	10–870	RRB3TA
Hexavalent Chromium	1/11	90–90	RRMW5S

TABLE 4 - 3 (continued)
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION
CONTAMINANT DETECTION FREQUENCY FOR LIGHT NON-AQUEOUS PHASE LIQUIDS

CONTAMINANT	Number of detections/ number of samples collected	Concentration Min - Max	Location of Maximum (Sample ID)
SEMIVOLATILE ORGANICS (ug/kg)			
Naphthalene	1/2	100000-100000	RRMW8SO
2-Methylnaphthalene	1/2	54000-54000	RRMW8SO
Dimethylphthalate	1/2	6600-6600	RRMW5SO
Acenaphthylene	2/2	6400-12000	RRMW8SO
Acenaphthene	2/2	21000-65000	RRMW8SO
Dibenzofuran	2/2	22000-43000	RRMW8SO
Fluorene	2/2	38000-97000	RRMW8SO
Phenanathrene	2/2	22000-360000	RRMW8SO
Anthracene	2/2	35000-49000	RRMW8SO
Carbazole	1/2	7800-7800	RRMW5SO
Di-n-butylphthalate	2/2	2800-6800	RRMW8SO
Fluoranthene	2/2	130000-220000	RRMW8SO
Pyrene	2/2	100000-190000	RRMW8SO
Benzo(a)anthracene	2/2	33000-49000	RRMW8SO
Chyrsene	2/2	43000-60000	RRMW8SO
bis(2ethylhexyl)phthalate	2/2	76000-110000	RRMW8SO
Di-n-octylphthalate	2/2	2500-4300	RRMW8SO
Benzo(b)fluoranthene	2/2	20000-31000	RRMW8SO
Benzo(k)fluoranthene	1/2	17000-17000	RRMW5SO
Benzo(a)pyrene	1/2	14000-14000	RRMW5SO
PESTICIDE/PCBs (ug/kg)			
Aroclor-1248	2/2	57000-130000	RRMW5SO
Aroclor-1260	2/2	22000-28000	RRMW8SO
TOTAL PETROLEUM HYDROCARBONS			
GC Fingerprint	0/1		

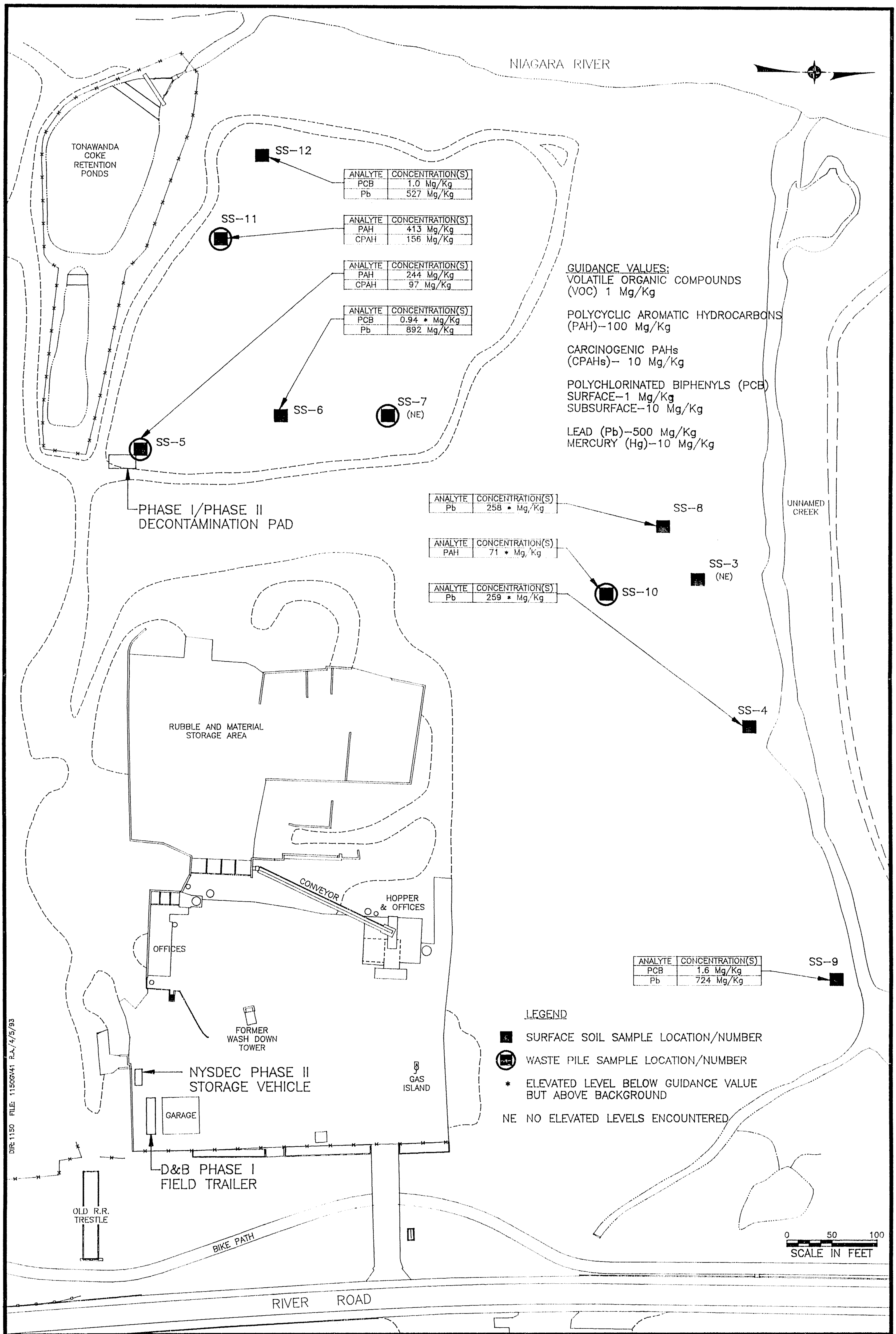
Table 4-4

SUMMARY OF SURFACE SOIL AND WASTE PILE RESULTS FOR PRIMARY ANALYTES OF CONCERN

Sample	Total VOCs (mg/kg)	Total PAHs (mg/kg)	Total Carcinogenic PAHs (mg/kg)	Total PCBs (mg/kg)	Total Lead (mg/kg)	Total Mercury (mg/kg)
RRSS01	ND	1.71	0.4	ND	43.8	ND
RRSS02	ND	11.17	0.97	ND	178	ND
RRSS03	0.01	2.09	1.04	0.111	149	ND
RRSS04	0.012	0.041	ND	ND	258	ND
RRSS05	0.003	244.2*	97*	0.94	27.8	0.78
RRSS06	0.008	3.74	2.4	0.38	892*	0.14
RRSS07	0.012	1.82	0.4	0.32	21.7	ND
RRSS08	0.009	0.73	ND	ND	258	ND
RRSS09	0.011	1.36	0.581	1.6*	724*	ND
RRSS10	0.005	71	ND	ND	4.3	ND
RRSS11	0.003	413.3*	156*	ND	73	0.89
RRSS12	0.008	2.33	1.08	1*	527*	ND

ND - Not Detected.

*Concentration exceeds soil guidance value.



SS-12

ANALYTE	CONCENTRATION(S)
PCB	1.0 Mg/Kg
Pb	527 Mg/Kg

SS-11

ANALYTE	CONCENTRATION(S)
PAH	413 Mg/Kg
CPAH	156 Mg/Kg

SS-5

ANALYTE	CONCENTRATION(S)
PAH	244 Mg/Kg
CPAH	97 Mg/Kg

SS-6

ANALYTE	CONCENTRATION(S)
PCB	0.94 * Mg/Kg
Pb	892 Mg/Kg

SS-8

ANALYTE	CONCENTRATION(S)
Pb	258 * Mg/Kg

SS-10

ANALYTE	CONCENTRATION(S)
PAH	71 * Mg/Kg

SS-4

ANALYTE	CONCENTRATION(S)
Pb	259 * Mg/Kg

SS-9

ANALYTE	CONCENTRATION(S)
PCB	1.6 Mg/Kg
Pb	724 Mg/Kg

GUIDANCE VALUES:
VOLATILE ORGANIC COMPOUNDS
(VOC) 1 Mg/Kg

POLYCYCLIC AROMATIC HYDROCARBONS
(PAH)-100 Mg/Kg

CARCINOGENIC PAHs
(CPAHs)- 10 Mg/Kg

POLYCHLORINATED BIPHENYLS (PCB)
SURFACE-1 Mg/Kg
SUBSURFACE-10 Mg/Kg

LEAD (Pb)-500 Mg/Kg
MERCURY (Hg)-10 Mg/Kg

LEGEND

■	SURFACE SOIL SAMPLE LOCATION/NUMBER
◉	WASTE PILE SAMPLE LOCATION/NUMBER
*	ELEVATED LEVEL BELOW GUIDANCE VALUE BUT ABOVE BACKGROUND
NE	NO ELEVATED LEVELS ENCOUNTERED

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REMEDIAL PHASE I/II INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

ONSITE SURFACE SOIL/WASTE PILE EXCEEDENCE OF SOIL REMEDIATION GUIDANCE VALUES

FIGURE 4-1

No elevated levels of total volatile organic compounds (VOCs) were identified in the surface soil and waste pile samples. Results ranged from undetected VOCs at RRSS01 and RRSS02, to 0.012 mg/kg of methylene chloride at RRSS04 and RRSS07; however, methylene chloride is a common laboratory contaminant and was found in the field blank.

Two waste pile samples, both located near the Tonawanda Coke retention ponds, had reported total polycyclic aromatic hydrocarbons (PAHs) values which exceed the guidance criteria of 100 mg/kg. Waste pile samples RRSS05 and RRSS11 had reported concentrations of 244.2 mg/kg and 413.3 mg/kg, respectively. Both samples were collected from waste piles which consisted of black to black-brown sediment. No other surface soil sample result exceeded the 100 mg/kg guidance value. RRSS10 represents a sample of tar-like material. This material contained only one PAH compound (pyrene) identified at a concentration of 71 mg/kg. Carcinogenic PAHs above guidance values were noted in waste pile samples RRSS05 and RRSS11. Surface soil samples were below guidance values for these compounds.

Two surface soil samples were found to meet or exceed the soil guidance criteria of 1 mg/kg for polychlorinated biphenyls (PCBs). RRSS08, located along the northeast portion of the site along the unnamed stream, had a reported concentration of 1.6 mg/kg, and RRSS12, located at the southwest portion of the site just north of the Tonawanda Coke retention ponds, had a reported concentration of 1.0 mg/kg. In addition, sample RRSS05, located just east of RRSS12, had a reported concentration of 0.94 mg/kg. Although the latter sample had a level below the NYSDOH guidance value, it can be considered as elevated. No pesticides were detected in the soil/waste pile samples.

Three samples, RRSS06, RRSS09 and RRSS12, collected from the site exceeded the guidance value for lead of 500 mg/kg. Respectively, the lead concentrations are 892 mg/kg, 724 mg/kg and 527 mg/kg. The location of these samples are not restricted to any particular area of the site or in association strictly with waste piles or surface soil, but are distributed across the study area and represent both surficial media (two surface soil samples and one waste pile sample).

Mercury levels were detected in only three samples and were at levels well below the guidance value of 10 mg/kg. Mercury was detected in samples RRSS05 at 0.78 mg/kg, RRSS06 at 0.14 mg/kg and RRSS11 at 0.89 mg/kg. These three samples are associated with both waste piles (RRSS05 and RRSS11) and surface soil (RRSS06) located in the southwestern quadrant of the site, north of the Tonawanda Coke retention ponds. Additionally, the three samples were identified as similar in color, which ranged from black to black-brown.

Based on the results, surface soil contamination appears to be located in two areas on the River Road site. The first area is located north of the Tonawanda Coke retention ponds and is characterized by spoil piles of sediment apparently dredged from the retention ponds. The contamination in this area includes lead (RRSS06 at 892 mg/kg and RRSS12 at 527 mg/kg), PCBs (RRSS12 at 1.0 mg/kg), PAHs (RRSS05 at 244.2 mg/kg and RRSS11 at 413.3 mg/kg) and carcinogenic PAHs (97 mg/kg at RRSS05 and 156 mg/kg at RRSS11). Sample RRSS05 was collected from a newly deposited pile of dredge spoils and sample RRSS11 was collected from an older overgrown pile, both of which were similar in color. The second area is located in the northeast portion of the drum disposal area. Sample RRSS09 contained elevated levels of lead (724 mg/kg) and PCBs (1.6 mg/kg).

4.3.2 Subsurface Soil, Fill Material and Buried Waste

Twenty-two subsurface soil samples were collected from 14 test trenches and six soil borings located throughout the site during the Phase I investigation. The soil samples collected were analyzed for TCL +30 parameters. Selected samples were additionally analyzed for RCRA characteristics, EPTOX and TCLP parameters. The selection of samples for the additional analysis was based on both visual observations (soil staining) and instrumentation measurements (total organic vapors). Results of the subsurface chemical analyses for the analytes of concern are summarized on Table 4-5 and presented in Figure 4-2. Appendix F contains the summarized laboratory data.

4.3.2.1 - Boreholes

Soil samples selected for chemical analysis were collected from six of the seven borehole locations (MW-4S, MW-5S, MW-6S and MW-7I during Phase I and MW-8S and MW-9S during Phase II). As discussed in Section 2.2.3.3, no sample was selected from the MW-3 borehole due to the presence of concrete from the ground surface to below the water table. Samples RRMW4S, RRMW6S and RRMW7IA were collected at 5 to 7 feet below grade and sample RRMW5IAS was collected at 10 to 12 feet below grade. Samples collected from MW-8S were collected from 5 to 7 and 15 to 17 feet below grade and samples collected from MW-9S were collected from 5 to 7 and 10 to 12 feet below grade. Results of the chemical analyses for the four borehole samples collected during Phase I are used for screening purposes only.

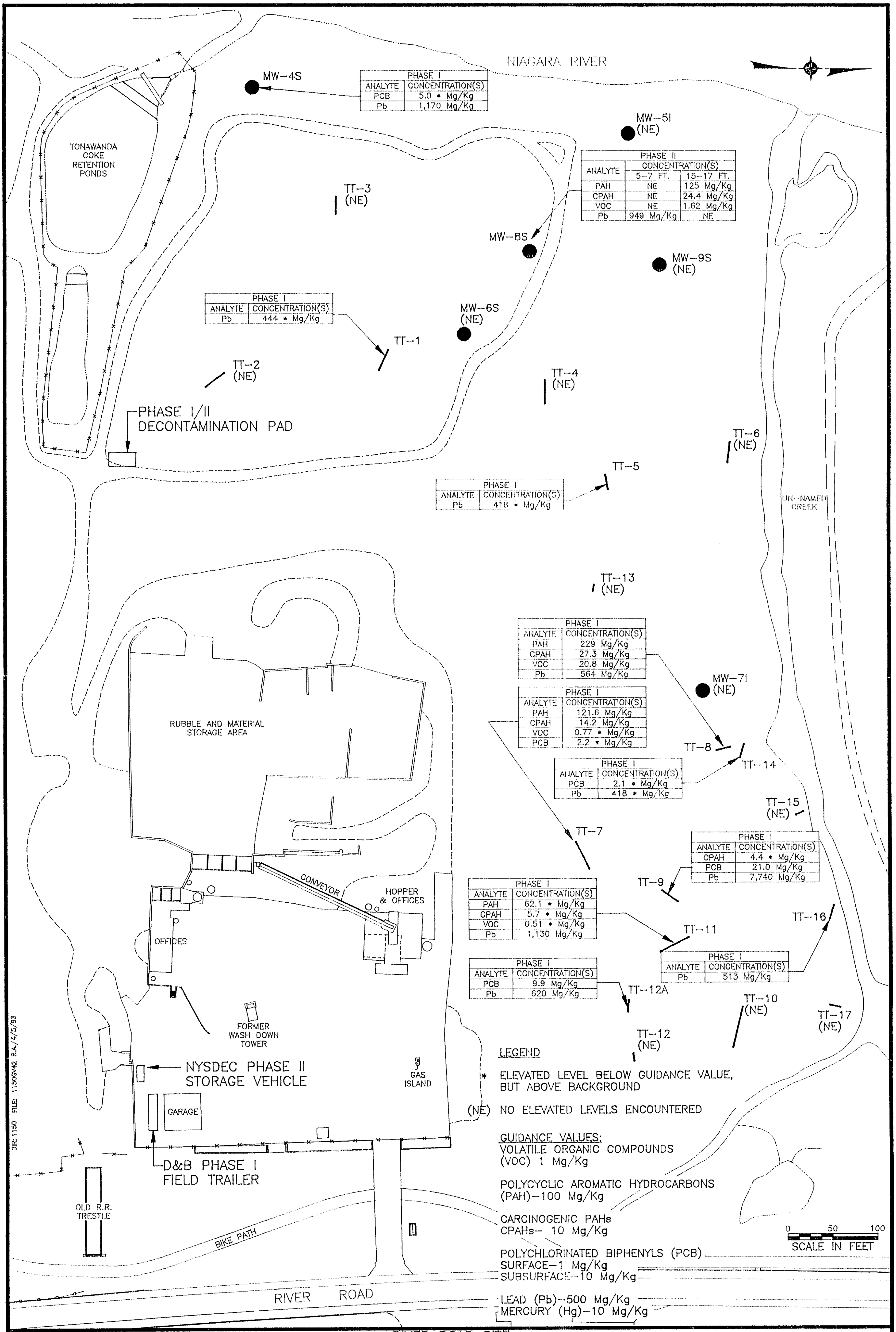
Table 4-5

SUMMARY OF SUBSURFACE SOIL RESULTS FOR PRIMARY ANALYTES OF CONCERN

Sample Number	Total VOCs (mg/kg)	Total PAHs (mg/kg)	Total Carcinogenic PAHs (mg/kg)	Total PCBs (mg/kg)	Total Lead (mg/kg)	Total Mercury (mg/kg)
RRMW4S	0.004	4.93	1.36	5	1,170*	0.275
RRMW5IAS	0.025	0.94	ND	0.25	46.8	ND
RRMW6S	0.003	2.54	0.36	0.54	12.4	ND
RRMW7IA	0.017	10.22	0.96	1.6	306	0.239
RRTT01	0.004	2.99	1.4	1.5	444	0.32
RRTT02	0.024	1.44	0.37	0.03	13.1	ND
RRTT03	0.002	1.14	0.43	ND	67.5	0.13
RRTT05	ND	0.91	0.13	0.9	418	0.15
RRTT06	0.017	1.31	0.61	0.31	102	0.12
RRTT07	0.773	127.8*	14.2*	2.16	150	0.12
RRTT08	20.75*	228.7*	27.3*	0.64	564*	ND
RRTT09	0.01	8.5	4.39	21*	7,740*	1.6
RRTT10	0.002	ND	ND	0.21	85.9	ND
RRTT11	0.51	62.1	5.7	0.34	1,130*	0.21
RRTT12A	0.03	5.94	1	9.9	620*	0.16
RRTT14	ND	7.4	ND	2.1	418	ND
RRTT16	ND	0.42	ND	0.58	513*	ND
RRTT17	0.002	0.25	ND	0.78	183	ND
MW-8S(5-7)	0.073	3.49	0.63	5	949*	ND
MW-8S(15-17)	1.62*	67	15.6*	3.4	187	ND
MW-9S(5-7)	0.189	24.9	7.35	1.36	152	ND
MW-9S(10-12)	0.088	0.11	ND	ND	11.3	ND

ND - Not Detected

*Concentration exceeds soil guidance value.



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TONAWANDA, NEW YORK

PHASE I/II SUBSURFACE SOIL EXCEEDENCE OF SOIL REMEDIATION GUIDANCE VALUES

FIGURE 4-2

Results for total volatile organic compounds (VOCs) ranged from 0.003 mg/kg in sample RRMW6S to 1.62 mg/kg in MW-8S at 15-17 feet. These results are below the soil guidance value of 1.0 mg/kg except at MW-8S. The VOCs identified at boring MW-8S are methylene chloride, acetone, 1,1-dichloroethane, trichloroethene, benzene, tetrachloroethene, toluene, ethylbenzene and total xylenes; however, methylene and acetone are laboratory contaminants. Total xylene was reported at a concentration of 1.1 mg/kg.

Total PAH concentrations ranged from 0.11 mg/kg in sample MW-9S at 10-12 feet to 67 mg/kg in sample MW-8S at 15-17 feet. These results are below the soil guidance value of 100 mg/kg. Carcinogenic PAHs of 15.6 mg/kg exceeded the guidance value of 10 mg/kg in the soil from boring MW-8S.

Concentrations of PCBs were not found in the borehole samples in excess of the guidance value of 10 mg/kg. Total PCB values ranged from nondetected at MW-9S at 10-12 feet to 5 mg/kg at RRMW4S and MW-8S at 5-7 feet. The primary PCB isomers identified were Aroclor-1248 in RRMW6S, MW-8S and MW-9S at 5-7 feet, respectively, and Aroclor-1242 in RRMW7IA; Aroclor-1254 at MW-8S at 15-17 feet; and Aroclor-1260 at MW-8S and MW-9S at 5-7 feet.

Three pesticides were identified in the borehole samples. Endosulfan II at a concentration of 2.4 ug/kg and endrin aldehyde at an estimated concentration of 4.2 ug/kg were detected at MW-9S at 10 to 12 feet. At MW-8S (15 - 17 feet), methoxychlor was identified at an estimated concentration of 99 ug/kg and endrin aldehyde was identified at a concentration of 150 ug/kg.

Results of the inorganic analysis (metals) indicated that sample RRMW4S and sample MW-8S from 5 to 7 feet exceeded the guidance value for lead with levels of 1,170 mg/kg and 949 mg/kg, respectively. Mercury levels were not found at levels above the guidance values.

4.3.2.2 - Test Trenches

Eighteen test trenches were constructed throughout the site during the Phase I investigation. No test trenches were constructed in Phase II. The criteria for collecting the samples was based on elevated organic vapor readings and visual staining of the soil. Subsurface soil samples were collected from 14 of the 18 test trenches. Samples were not collected from test trenches TT-4, TT-3, TT-5 and TT-12. Subsurface samples were collected from approximately 1 foot below the ground surface at TT-6 and TT-7 to approximately 7.5 feet below the ground surface at TT-6.

All subsurface test trench soil samples were analyzed for TCL +30 parameters. Additional analysis for RCRA characteristics, and EPTOX and TCLP parameters were selected based on field observations. Table 4-4 presents the results of the test trench samples for the analytes of concern, and Tables 4-6 and 4-7 present the results of RCRA and TCLP analyses from samples collected during the Phase I RI field program, respectively. Results of the EPTOX analysis are presented in Appendix F. Based upon the RCRA and TCLP results presented, the seven samples analyzed for these parameters are characterized as nonhazardous. None of the reported quantities were in excess of maximum concentrations. Results of the test trench analyses are presented on Figure 4-2.

The soil guidance value for total volatile organic compounds (VOCs) of 1 mg/kg was exceeded in one sample. Sample RRTT08 contained 20.75 mg/kg total VOCs. With the exception of methylene chloride, the volatile organic compounds identified in sample RRTT08 are tetrachloroethene (0.53 mg/kg), toluene (6.4 mg/kg), ethylbenzene (1.9 mg/kg) and xylenes (total of 11 mg/kg). Two other samples (RRTT07 and RRTT11) collected from test trenches located in the drum disposal area had reported concentrations of total VOCs that were elevated. These samples contained total VOC levels of 0.773 and 0.506 mg/kg, respectively.

Samples RRTT07 and RRTT08 both had reported concentrations of PAHs that exceed the soil guidance value of 100 mg/kg. These concentrations are 127.8 mg/kg and 228.7 mg/kg, respectively. Both samples were collected from test trenches located in the drum disposal area. Sample RRTT08 was collected at 2.5 feet below grade from immediately beneath a buried 55-gallon drum, which seeped an unidentified red paste during trenching operations and RRTT07 was collected at approximately six feet below the ground surface in an area that was covered with five 55-gallon drums. Three of the drums were open and contained charred lumber. The remaining two drums were closed but appeared empty. Carcinogenic PAHs exceeded the 10 ug/kg soil guidance values in samples RRTT07 and RRTT08 collected in the northeast quadrant of the site.

Total PCBs were identified in excess of the subsurface soil guidance value (10 mg/kg) in sample RRTT09 at a concentration of 21 mg/kg. Sample RRTT09 was collected in the approximate center of the drum disposal area. Elevated concentrations of PCBs were also detected in this area in samples RRTT07, RRTT14 and RRTT12A with reported concentrations ranging between 2.2 mg/kg to 9.9 mg/kg. The primary PCB isomer identified is Aroclor-1254; however, in sample RRTT07, other isomers, Aroclor-1248 (1.5 mg/kg) and Aroclor-1260 (0.6 mg/kg) were also identified.

TABLE 4-6
RIVER ROAD SITE
TEST TRENCH AND MONITORING WELL SOIL SAMPLE RESULTS
RCRA CHARACTERISTICS

	RRTT03	RRTT05	RRTT06	RRTT08	RRTT11	RRTT14	RRMW7IA	MAXIMUM ALLOWABLE LEVELS
RCRA CHARACTERISTICS	3/24/92	3/25/92	3/25/92	3/10/92	3/10/92	3/26/92	3/17/92	
pH	6.52	8.65	8.9	8.15	7.52	7.82	7.81	----
Ignitablility, F PM	>212	>212	>212	>212	>212	>212	>212	140
Corrosivity, inches/year	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.250
Reactivity to Cyanide, PPM	<1	<1	<1	<1	<1	<1	<1	----
Reactivity to Sulfide, PPM	<1	<1	<1	<1	<1	<1	<1	----
Total Solids, %	NR	NR	NR	NR	NR	NR	77.4	----

NOTES

<: less than

>: greater than

NR: not required

----: not established

TABLE 4-7

RIVER ROAD SITE
TEST TRENCH SOIL SAMPLE RESULTS
TCLP CONSTITUENTS

	RRTT03	RRTT05	RRTT06	RRTT08	RRTT11	RRTT14	MAXIMUM ALLOWABLE
	3/24/92	3/25/92	3/25/92	3/10/92	3/10/92	3/26/92	LEVEL
TCLP CONSTITUENTS	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)
Benzene	U	U	U	U	U	U	500
Carbon Tetrachloride	U	U	U	U	U	U	500
Chlordane	U	U	U	U	U	U	30
Chlorobenzene	U	U	U	U	U	U	100000
Chloroform	U	U	U	U	U	U	6000
o-Cresol	U	U	U	U	U	U	200000
m+p-Cresol	U	U	U	U	U	U	200000
Cresol	U	U	U	U	U	U	200000
2,4-D	U	U	U	U	U	U	10000
1,4-Dichlorobenzene	U	U	U	U	U	U	7500
1,2-Dichloroethane	U	U	U	U	U	U	500
1,1-Dichloroethylene	U	U	U	U	U	U	700
2,4-Dinitrotoluene	U	U	U	U	U	U	130
Endrin	U	U	U	U	U	U	20
Heptachlor(and its epoxide)	U	U	U	U	U	U	8
Hexachlorobenzene	U	U	U	U	U	U	130
Hexachloro-1,3-butadiene	U	U	U	U	U	U	500
Hexchloroethane	U	U	U	U	U	U	3000
Lindane	U	U	U	U	U	U	400
Methoxychlor	U	U	U	U	U	U	10000
Methyl ethyl ketone	U	U	U	U	U	U	200000
Nitrobenzene	U	U	U	U	U	U	2000
Pentachlorophenol	U	U	U	U	U	U	100000
Pyridine	U	U	U	U	U	U	5000
Tetrachloroethylene	U	U	U	U	U	U	700
Toxaphene	U	U	U	U	U	U	500
Trichloroethylene	U	U	U	U	U	U	500
2,4,5-Trichlorophenol	U	U	U	U	U	U	400000
2,4,6-Trichlorophenol	U	U	U	U	U	U	2000
2,4,5-TP (Silvex)	U	U	U	U	U	U	1000
Vinyl chloride	U	U	U	U	U	U	200
Arsenic	U	U	U	673	626	134	5000
Barium	U	U	U	1290	2100	1490	100000
Cadmium	U	U	U	U	U	U	1000
Chromium	U	U	U	250	423	4.4 B	5000
Lead	U	U	U	90	112	U	5000
Mercury	U	U	U	U	U	U	200
Selenium	U	U	U	U	U	U	1000
Silver	U	U	U	U	U	U	5000

QUALIFIERS

U: compound analyzed for but not detected

B: constituent found above the IDL but below the CRDL

Results of the metals analysis indicate that five test trench samples exceeded the soil guidance value of 500 mg/kg for lead. These samples are RRTT08 (564 mg/kg), RRTT09 (7,740 mg/kg), RRTT11 (1,130 mg/kg), RRTT12A (620 mg/kg) and RRTT16 (513 mg/kg). These test trenches were constructed in a location identified as the drum disposal area in the northeastern portion of the property between the creek and the Clarence Materials property. The two highest test trench concentrations of lead (7,740 mg/kg and 1,130 mg/kg), are in the center of the drum disposal area. The other three samples that exceeded the guidance value are located on the perimeter of the drum disposal area. Additionally, samples RRTT01, RRTT05 and RRTT14 had reported lead values that approached the 500 mg/kg guidance value. The concentrations are 417 mg/kg, 418 mg/kg and 444 mg/kg, respectively. Mercury values for the test trench samples did not exceeded the guidance value.

4.3.3 Surface Water Sediment

Based upon a review of the adjacent Cherry Farm site data during the Phase I RI/FS, which indicated elevated levels of contaminants in the creek separating the Cherry Farm and River Road site, samples of surface water sediment were collected in Phase II and analyzed for semivolatiles, pesticide/PCBs and metal parameters (one surface water sediment sample was also analyzed for volatile compounds). Results of the surface water sediment analyses indicated the presence of semivolatile organic compounds (SVOCs), pesticides, PCBs and metals which exceed the range of surface water sediment criteria for each category of concern. No volatile organic compounds (VOCs) were detected above surface water sediment criteria. Table 4-8 summarizes the surface water sediment sample results and Figure 4-3 presents the data for the analytes of concern. Appendix F contains the laboratory data. The surface water sediment criteria are compiled in accordance with NYSDEC guidance and are compound specific and normalized to the total organic carbon concentration in the sediment sample.

The SVOCs identified above the surface water sediment criteria are phenol in samples RRSWS-1, RRSWS-2 and RRSWS-3 at concentrations of 81 ug/kg, 89 ug/kg and 21 ug/kg, respectively (criteria 9.0-24.6 ug/goc), and benzo(a)anthracene and chrysene at RRSWS-6 at a concentration of 110 ug/kg and 220 ug/kg, respectively (criteria 10.5-28.7 ug/goc for each compound).

PCBs were identified at each surface water sediment sample location. The total PCB concentration at each sample location are: 640 ug/kg at RRSWS-01, 350 ug/kg at RRSWS-02, 370 ug/kg at RRSWS-03, 650 ug/kg at RRSWS-04, 530 ug/kg at RRSWS-05 and 410 ug/kg at RRSWS-06. The criteria for each PCB isomer is 0.08-0.24 ug/goc respectively.

Table 4-8

SUMMARY OF SURFACE WATER SEDIMENT RESULTS FOR PRIMARY ANALYTES OF CONCERN

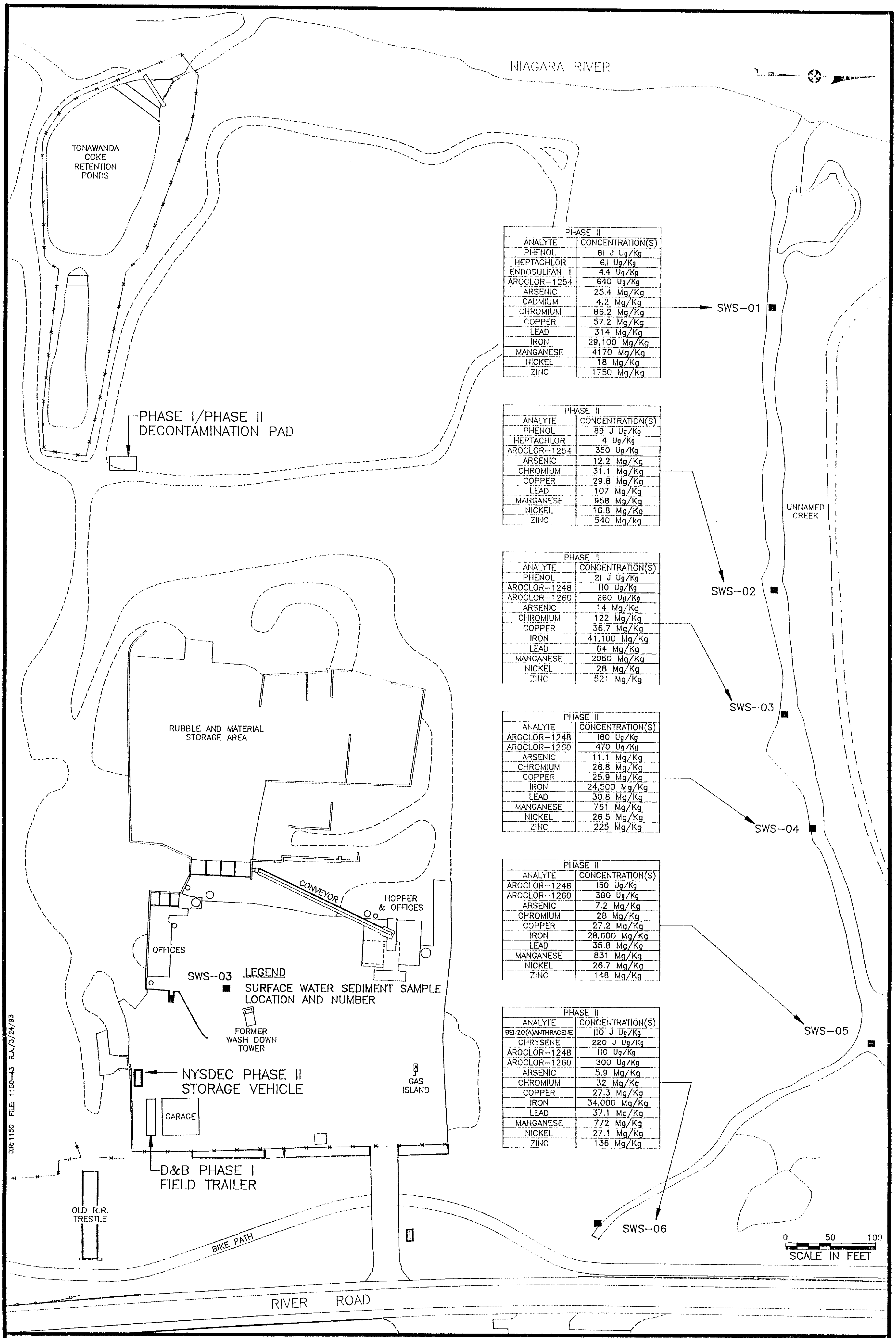
Sample Number	Total VOCs (mg/kg)	Total PAHs (mg/kg)	Total Carcinogenic PAHs (mg/kg)	Total PCBs (mg/kg)	Total Lead (mg/kg)	Mercury (mg/kg)
RRSWS-1	NA	0.764**	ND	0.64*	314*	ND
RRSWS-2	NA	0.501**	ND	0.35*	107*	ND
RRSWS-3	0.236	0.573**	ND	0.37*	64.*	ND
RRSWS-4	NA	0.271	ND	0.65*	30.8*	ND
RRSWS-5	NA	0.566	ND	0.53*	35.8*	ND
RRSWS-6	NA	5.57**	0.33	0.41*	37.1*	ND

ND - Not Detected

NA - Not analyzed

* Concentrations exceed NYSDEC sediment criteria for wildlife residue basis or aquatic toxicity basis.

** Total PAH concentrations contain individual residual PAH compounds which exceed sediment criteria/ranges.



PHASE II	
ANALYTE	CONCENTRATION(S)
PHENOL	81 J Ug/Kg
HEPTACHLOR	6.1 Ug/Kg
ENDOSULFAN 1	4.4 Ug/Kg
AROCLOR-1254	640 Ug/Kg
ARSENIC	25.4 Mg/Kg
CADMIUM	4.2 Mg/Kg
CHROMIUM	86.2 Mg/Kg
COPPER	57.2 Mg/Kg
LEAD	314 Mg/Kg
IRON	29,100 Mg/Kg
MANGANESE	4170 Mg/Kg
NICKEL	18 Mg/Kg
ZINC	1750 Mg/Kg

PHASE II	
ANALYTE	CONCENTRATION(S)
PHENOL	89 J Ug/Kg
HEPTACHLOR	4 Ug/Kg
AROCLOR-1254	350 Ug/Kg
ARSENIC	12.2 Mg/Kg
CHROMIUM	31.1 Mg/Kg
COPPER	29.8 Mg/Kg
LEAD	107 Mg/Kg
MANGANESE	958 Mg/Kg
NICKEL	16.8 Mg/Kg
ZINC	540 Mg/kg

PHASE II	
ANALYTE	CONCENTRATION(S)
PHENOL	21 J Ug/Kg
AROCLOR-1248	110 Ug/Kg
AROCLOR-1260	260 Ug/Kg
ARSENIC	14 Mg/Kg
CHROMIUM	122 Mg/Kg
COPPER	36.7 Mg/Kg
IRON	41,100 Mg/Kg
LEAD	64 Mg/Kg
MANGANESE	2050 Mg/Kg
NICKEL	28 Mg/Kg
ZINC	521 Mg/Kg

PHASE II	
ANALYTE	CONCENTRATION(S)
AROCLOR-1248	180 Ug/Kg
AROCLOR-1260	470 Ug/Kg
ARSENIC	11.1 Mg/Kg
CHROMIUM	26.8 Mg/Kg
COPPER	25.9 Mg/Kg
IRON	24,500 Mg/Kg
LEAD	30.8 Mg/Kg
MANGANESE	761 Mg/Kg
NICKEL	26.5 Mg/Kg
ZINC	225 Mg/Kg

PHASE II	
ANALYTE	CONCENTRATION(S)
AROCLOR-1248	150 Ug/Kg
AROCLOR-1260	380 Ug/Kg
ARSENIC	7.2 Mg/Kg
CHROMIUM	28 Mg/Kg
COPPER	27.2 Mg/Kg
IRON	28,600 Mg/Kg
LEAD	35.8 Mg/Kg
MANGANESE	831 Mg/Kg
NICKEL	26.7 Mg/Kg
ZINC	148 Mg/Kg

PHASE II	
ANALYTE	CONCENTRATION(S)
BENZO(A)ANTHRACENE	110 J Ug/Kg
CHRYSENE	220 J Ug/Kg
AROCLOR-1248	110 Ug/Kg
AROCLOR-1260	300 Ug/Kg
ARSENIC	5.9 Mg/Kg
CHROMIUM	32 Mg/Kg
COPPER	27.3 Mg/Kg
IRON	34,000 Mg/Kg
LEAD	37.1 Mg/Kg
MANGANESE	772 Mg/Kg
NICKEL	27.1 Mg/Kg
ZINC	136 Mg/Kg

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RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK
PHASE II SURFACE WATER SEDIMENT EXCEEDENCE OF BUREAU OF
FISH AND WILDLIFE SEDIMENT CRITERIA

FIGURE 4-3

Pesticides were identified in samples RRSWS-1 and RRSWS-2 (each of the pesticides have a criteria of 0.48-1.23 ug/goc). Specifically, these pesticides are heptachlor and endosulfan I at concentrations of 6.1 ug/kg and 4.4 ug/kg, respectively at RRSWS-1 and heptachlor at a concentration of 4 ug/kg at RRSWS-2.

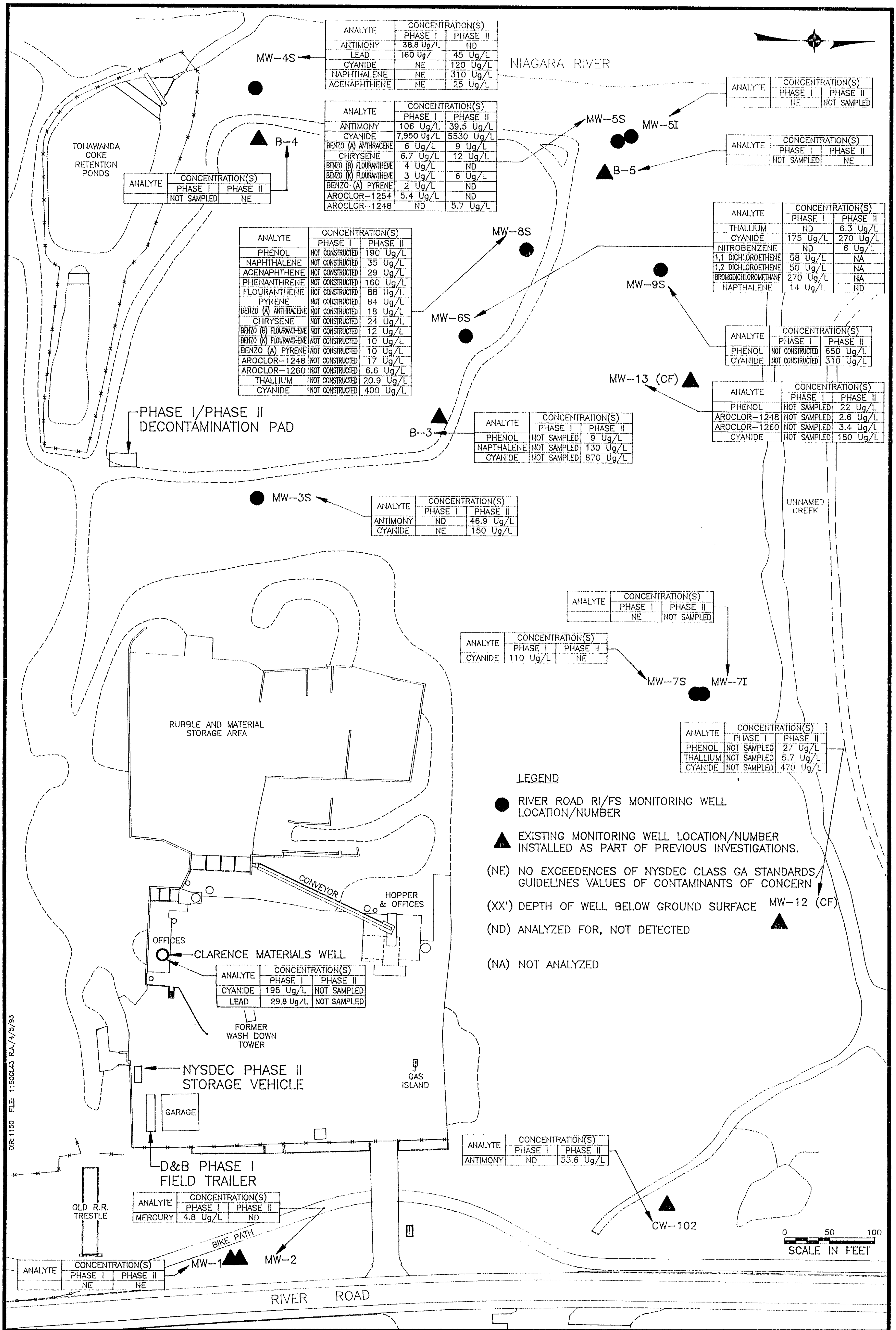
All six surface water sediment samples exceeded the sediment criteria of 23 mg/kg for lead. For samples RRSWS-1 through RRSWS-6, the lead concentrations are 314 mg/kg, 107 mg/kg, 64 mg/kg, 30.8 mg/kg, 35.8 mg/kg and 37.1 mg/kg, respectively. Mercury was not detected in any of the surface water sediment samples.

4.3.4 Groundwater

During the Phase I investigation, eleven wells were sampled for groundwater quality. These wells were: MW-1, MW-2, MW-3S, MW-4S, MW-5S, MW-5I, MW-6S, MW-7S, MW-7I, CW-102 and the Clarence Materials well. These samples were analyzed for TCL+30 parameters plus hexavalent chromium. During Phase II, fifteen wells were sampled for groundwater quality. These wells were MW-1, MW-2, MW-3S, MW-4S, MW-5S, MW-6S, MW-7S, MW-8S, MW-9S, MW-12, MW-13, B3, B4, B5 and CW-102. The samples collected during Phase II were analyzed for semivolatile compounds (SVOCs), pesticides/PCBs, metals and cyanide. In addition, samples of the light nonaqueous phase liquid (LNAPL) detected in wells MW-5S and MW-8S were collected and analyzed for PCBs, total petroleum hydrocarbons (TPHCs) and SVOCs.

The contaminants identified in the groundwater are discussed in terms of the zone in which they are identified and exceedances of the NYSDEC Class GA groundwater standards and guidelines. The locations of the wells and concentrations which exceeded standards/guidelines for both the organic and inorganic fractions are presented on Figure 4-4. The laboratory analytical results are presented in Appendix F of this report.

Groundwater samples were collected from each well after purging a minimum of three well volumes. Turbidity was measured during the well purging process until the turbidity values were below 50 NTUs. This was usually accomplished before the three well volumes were removed. However, during the Phase I sampling event, the turbidity in wells MW-4S and MW-5S did not achieve a value below 50 NTUs. A a result, both filtered and unfiltered samples were collected from these wells.



ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
ANTIMONY	38.8 Ug/L	ND
LEAD	160 Ug/	45 Ug/L
CYANIDE	NE	120 Ug/L
NAPHTHALENE	NE	310 Ug/L
ACENAPHTHENE	NE	25 Ug/L

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
	NE	NOT SAMPLED

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
ANTIMONY	106 Ug/L	39.5 Ug/L
CYANIDE	7,950 Ug/L	5530 Ug/L
BENZO (A) ANTHRACENE	6 Ug/L	9 Ug/L
CHRYSENE	6.7 Ug/L	12 Ug/L
BENZO (B) FLOURANTHENE	4 Ug/L	ND
BENZO (K) FLOURANTHENE	3 Ug/L	6 Ug/L
BENZO (A) PYRENE	2 Ug/L	ND
AROCLOR-1254	5.4 Ug/L	ND
AROCLOR-1248	ND	5.7 Ug/L

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
	NOT SAMPLED	NE

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
	NOT SAMPLED	NE

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
THALLIUM	ND	6.3 Ug/L
CYANIDE	175 Ug/L	270 Ug/L
NITROBENZENE	ND	6 Ug/L
1,1 DICHLOROETHENE	58 Ug/L	NA
1,2 DICHLOROETHENE	50 Ug/L	NA
BROMODICHLOROMETHANE	270 Ug/L	NA
NAPTHALENE	14 Ug/L	ND

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
PHENOL	NOT CONSTRUCTED	190 Ug/L
NAPHTHALENE	NOT CONSTRUCTED	35 Ug/L
ACENAPHTHENE	NOT CONSTRUCTED	29 Ug/L
PHENANTHRENE	NOT CONSTRUCTED	160 Ug/L
FLOURANTHENE	NOT CONSTRUCTED	88 Ug/L
PYRENE	NOT CONSTRUCTED	84 Ug/L
BENZO (A) ANTHRACENE	NOT CONSTRUCTED	18 Ug/L
CHRYSENE	NOT CONSTRUCTED	24 Ug/L
BENZO (B) FLOURANTHENE	NOT CONSTRUCTED	12 Ug/L
BENZO (K) FLOURANTHENE	NOT CONSTRUCTED	10 Ug/L
BENZO (A) PYRENE	NOT CONSTRUCTED	10 Ug/L
AROCLOR-1248	NOT CONSTRUCTED	17 Ug/L
AROCLOR-1260	NOT CONSTRUCTED	6.6 Ug/L
THALLIUM	NOT CONSTRUCTED	20.9 Ug/L
CYANIDE	NOT CONSTRUCTED	400 Ug/L

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
PHENOL	NOT CONSTRUCTED	650 Ug/L
CYANIDE	NOT CONSTRUCTED	310 Ug/L

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
PHENOL	NOT SAMPLED	22 Ug/L
AROCLOR-1248	NOT SAMPLED	2.6 Ug/L
AROCLOR-1260	NOT SAMPLED	3.4 Ug/L
CYANIDE	NOT SAMPLED	180 Ug/L

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
PHENOL	NOT SAMPLED	9 Ug/L
NAPTHALENE	NOT SAMPLED	130 Ug/L
CYANIDE	NOT SAMPLED	870 Ug/L

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
ANTIMONY	ND	46.9 Ug/L
CYANIDE	NE	150 Ug/L

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
	NE	NOT SAMPLED

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
CYANIDE	110 Ug/L	NE

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
PHENOL	NOT SAMPLED	27 Ug/L
THALLIUM	NOT SAMPLED	5.7 Ug/L
CYANIDE	NOT SAMPLED	470 Ug/L

LEGEND

●	RIVER ROAD RI/FS MONITORING WELL LOCATION/NUMBER
▲	EXISTING MONITORING WELL LOCATION/NUMBER INSTALLED AS PART OF PREVIOUS INVESTIGATIONS.
(NE)	NO EXCEEDENCES OF NYSDEC CLASS GA STANDARDS/GUIDELINES VALUES OF CONTAMINANTS OF CONCERN
(XX')	DEPTH OF WELL BELOW GROUND SURFACE
(ND)	ANALYZED FOR, NOT DETECTED
(NA)	NOT ANALYZED

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
CYANIDE	195 Ug/L	NOT SAMPLED
LEAD	29.8 Ug/L	NOT SAMPLED

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
ANTIMONY	ND	53.6 Ug/L

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
MERCURY	4.8 Ug/L	ND

ANALYTE	CONCENTRATION(S)	
	PHASE I	PHASE II
	NE	NE

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RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK
PHASE I/II EXCEEDENCE OF NYSDEC CLASS GA GROUNDWATER STANDARDS/GUIDELINES

FIGURE 4-4

4.3.4.1 - Upper Zone

Wells that monitor the upper zone were sampled during both the Phase I and Phase II investigations. During Phase I, six wells that monitor the upper zone were sampled: MW-2, MW-3S, MW-4S, MW-5S, MW-6S and MW-7S. During Phase II, 13 wells that monitor the upper zone were sampled: MW-2, MW-3S, MW-4S, MW-5S, MW-6S, MW-7S, MW-8S, MW-9S, B3, B4, B5, MW-12 and MW-13.

Volatile organic compounds (VOCs) that exceeded state standards/guidelines were identified in only one well (MW-6S). The specific compounds and concentrations are 1,1-dichloroethene (58 ug/l), total 1,2-dichloroethene (50 ug/l) and bromodichloromethane (270 ug/l).

Several semivolatile organic compounds, primarily PAHs, were identified above standards and guidelines in the groundwater samples collected during both Phase I and Phase II. These compounds are phenol, nitrobenzene, napthalene, acenaphthene, phenanthrene, flouranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)flouranthene, benzo(k)flouranthene, and benzo(a)pyrene. Most of these contaminants are carcinogenic PAHs.

PCBs were identified above standards in wells MW-5S, MW-8S and MW-13CF at concentrations of 4.7, 23.6, and 6 ug/l, respectively. The PCB isomers identified were Aroclor-1254 during Phase I, and Aroclor-1248 and Aroclor-1260 during Phase II. The PCB concentration identified in these wells is probably related to the LNAPL identified in the area. An adequate quantity of the LNAPL material could not be collected to perform PCB analysis during Phase I; however, LNAPL samples were collected during Phase II from wells MW-5S and MW-8S. Analysis of the LNAPL is discussed below.

Antimony was found to exceed the Class GA groundwater guidance value (3 ug/l) at wells MW-4S and MW-5S during Phase I and wells MW-3S and MW-5S during Phase II. During the Phase I sampling, filtered samples of MW-4S indicated that antimony was not detected, whereas filtered samples from MW-5S resulted in a concentration of 106 ug/l. This suggests that the antimony in the area of MW-4S is particulate bound, whereas in the area of MW-5S, antimony is dissolved.

During Phase I, lead was identified in excess of the groundwater standard of 25 ug/l at the Clarence Materials well (29.8 ug/l). Also, the unfiltered sample collected from well MW-4S contained a concentration of 160 ug/l. During Phase II, lead was again identified in well MW-4S at a concentration of 45 ug/l. Lead was not identified above the groundwater standard at any other location.

Mercury was identified in the upgradient well MW-2 during Phase I at a concentration of 4.8 ug/l. This result is above the groundwater standard of 2 ug/l. Mercury was not identified above the groundwater standard during Phase II.

Iron exceeded the groundwater standard of 300 mg/l in four of six wells in Phase I and nine wells in Phase II. Magnesium was found at elevated levels in two wells in Phase I and four wells during Phase II. Sodium was found at elevated levels in six wells in Phase I and eleven wells in Phase II. Thallium was detected at three well locations in Phase II.

Groundwater quality standards for cyanide (100 ug/l) were exceeded in three wells during Phase I. Also, the unfiltered sample for MW-5S contained cyanide at a concentration of 7,950 ug/l. Cyanide was identified at nine locations above the groundwater standard of 100 ug/l during Phase II, with the highest level reported at MW-5S (5,530 ug/l).

A comparison of Phase I/II exceedances of Class GA groundwater standards/guidelines for upgradient and on-site locations is presented in Table 4-9. In the majority of cases, exceedances of standards were noted in wells nearer to the Niagara River (wells MW-3S, MW-4S, MW-5S, MW-6S and MW-8S). The majority of semivolatile compounds and the PCBs above standards were found at wells MW-5S and MW-8S where the LNAPL was present.

Elevated levels of mercury were found at the upgradient well MW-2 during the Phase I investigation. Conversely, elevated levels of cyanide, thallium and hexavalent chromium were found downgradient when compared to upgradient samples during Phase I and II.

4.3.4.2 - Lower Zone

Four wells monitored the lower zone: MW-1, MW-5I, MW-7I and CW-102. During the Phase I investigation, groundwater quality exceedances in these wells were limited to the metals; iron, magnesium, manganese and sodium. Wells MW-1 and CW-102 showed elevated levels of antimony, iron, magnesium, manganese, and sodium in Phase II (Wells MW-5I and MW-7I were not sampled during Phase II).

Table 4-9

SUMMARY OF EXCEEDANCES OF GROUNDWATER STANDARDS/GUIDELINES

PHASE I

Parameters	Upgradient		On-site	
	ug/l	Well	ug/l	Well
Volatiles				
1,1-Dichloroethene	--	--	58	(6S)
1,2-Dichloroethane	--	--	50	(6S)
Bromodichloromethane	--	--	270	(6S)
Semivolatiles				
Benzo(a)anthracene	--	--	6	(5S)
Chrysene	--	--	6.7	(5S)
Benzo(b)flouranthene	--	--	4	(5S)
Benzo(k)flouranthene	--	--	14	(5S)
Benzo(a)pyrene	--	--	2	(5S)
Naphthalene	--	--	14	(6S)
Pesticides/PCBs				
Aroclor-1254	--	--	5.4	(5S)
Inorganics				
Antimony	--	--	38.8	(4S)
Antimony	--	--	102	(5S)
Iron	--	--	1,330	(3S)
Iron	--	--	8,690	(4S)
Iron	--	--	42,600	(5S)
Iron	--	--	64,700	(5S)
Iron	--	--	4,840	(5I)
Iron	--	--	961	(7S)
Iron	--	--	3,010	(6S)
Iron	1,670	(CW102)	1,390	(7I)
Lead	--	--	160	(4S)
Lead	--	--	29.8	(CM)
Magnesium	81,000	(MW1)	44,300	(5S)
Magnesium	--	--	48,700	(5S)
Magnesium	39,200	(MW2)	95,800	(5I)
Magnesium	--	--	40,700	(7I)
Magnesium	--	--	38,700	(CM)
Manganese	687	(MW2)	1,330	(4S)
Manganese	--	--	4,170	(5S)
Manganese	--	--	4,270	(5S)
Manganese	--	--	3,670	(5I)
Manganese	--	--	660	(6S)
Mercury	4.8	(MW2)	--	--

Table 4-9 (continued)

SUMMARY OF EXCEEDANCES OF GROUNDWATER STANDARDS/GUIDELINES

PHASE I (continued)

Parameters	Upgradient ug/l	Upgradient Well	On-site ug/l	On-site Well
Inorganics (continued)				
Cyanide	--	--	7,950	(5S)
Cyanide	--	--	110	(7S)
Cyanide	--	--	195	(CM)
Cyanide	--	--	175	(6S)
Hexavalent chromium	--	--	90	(5S)

PHASE II

Parameters	Upgradient ug/l	Upgradient Well	On-site ug/l	On-site Well
Volatiles				
	No VOC samples collected during Phase II			
Semivolatiles				
Phenol	--	--	180	(8S)
Phenol	--	--	650	(9S)
Phenol	--	--	27	(12CF)
Phenol	--	--	22	(13CF)
Phenol	--	--	9	(B3)
Nitrobenzene	--	--	6	(6S)
Nitrobenzene	--	--	21	(8S)
Napthalene	--	--	310	(4S)
Napthalene	--	--	21	(8S)
Napthalene	--	--	130	(B3)
Acenaphthene	--	--	25	(8S)
Phenanthrene	--	--	160	(8S)
Flouranthene	--	--	88	(8S)
Benzo(a)anthracene	--	--	9	(5S)
Benzo(a)anthracene	--	--	18	(8S)
Benzo(b)flouranthene	--	--	12	(8S)
Benzo(k)flouranthene	--	--	4	(5S)
Benzo(k)flouranthene	--	--	10	(8S)
Benzo(a)pyrene	--	--	10	(8S)
Pesticides/PCBs				
Aroclor-1248	--	--	5.7	(5S)
Aroclor-1248	--	--	17	(8S)
Aroclor-1248	--	--	2.6	(13CF)
Aroclor-1260	--	--	6.6	(8S)
Aroclor-1260	--	--	3.4	(13CF)

Table 4-9 (continued)

SUMMARY OF EXCEEDANCES OF GROUNDWATER STANDARDS/GUIDELINES

PHASE II (continued)

Parameters	Upgradient		On-site	
	ug/l	Well	ug/l	Well
Inorganics				
Antimony	--	--	46.9	(3S)
Antimony	--	--	39.5	(5S)
Antimony	53.6	(CW102)	--	--
Iron	5430	(MW-1)	4,340	(4S)
Iron	864	(MW-2)	38,600	(5S)
Iron	3270	(CW102)	1200	(6S)
Iron	--	--	26,600	(7S)
Iron	--	--	5,620	(8S)
Iron	--	--	5150	(B4)
Iron	--	--	1530	(B5)
Lead	--	--	45	(4S)
Manganese	107*	(MW-1)	255*	(4S)
Manganese	1230	(MW-2)	1,510	(5S)
Manganese	100*	(CW-102)	178*	(6S)
Manganese	--	--	432	(7S)
Manganese	--	--	438	(8S)
Manganese	--	--	232*	(B4)
Manganese	--	--	884	(B5)
Thallium	--	--	6.3	(6S)
Thallium	--	--	20.9	(8S)
Thallium	--	--	5.7	(12CF)
Cyanide	--	--	150	(3S)
Cyanide	--	--	120	(4S)
Cyanide	--	--	5,530	(5S)
Cyanide	--	--	270	(6S)
Cyanide	--	--	400	(8S)
Cyanide	--	--	310	(9S)
Cyanide	--	--	470	(12CF)
Cyanide	--	--	180	(13CF)
Cyanide	--	--	870	(B3)

ND - Not Detected

* Concentrations in excess of Class GA groundwater standard of 500 ug/l for total iron and manganese.

Iron was identified during Phase I above Class GA groundwater standard of 300 ug/l at wells MW-5I, MW-7I and CW-102, and at MW-1 and CW-102 during Phase II.

Elevated levels of cyanide were noted in all intermediate wells, except for the upgradient wells MW-1 and MW-2. Levels ranged from a low of 0.11 ug/l at MW-7S to 0.795 mg/l at MW-5.

Elevated levels of magnesium and manganese, above groundwater standards were found at MW-5I. Also, iron, manganese and sodium were detected at elevated levels in MW-1, MW-5I, MW-7I and CW-102 during both the Phase I and II investigations.

4.3.5 Light Nonaqueous Phase Liquid

During construction and development of well MW-5S in Phase I, a light nonaqueous phase liquid was identified at the groundwater interface. A small quantity (approximately 40 ml) of the LNAPL was obtained and analyzed for total petroleum hydrocarbons. However, due to an insufficient volume of LNAPL in the well, a full TCL +30 analysis could not be performed. TPHC was not detected, which suggests a non hydrocarbon based LNAPL is present at this location. Elevated levels of PCBs were found in groundwater samples from this well.

During Phase II, 2.3 feet of LNAPL was measured in well MW-5S, as well as 1.56 feet in well MW-8S and 0.06 feet in well MW-6S. Consequently, LNAPL samples were collected from wells MW-5S and MW-8S and analyzed for semivolatile organic compounds (SVOCs) and pesticides/PCBs. Well MW-6S did not contain sufficient volume of LNAPL to sample. Results of this analysis are presented in Table 4-10 and are shown on Figure 4-5.

The results indicate the presence of numerous PAHs, including carcinogenic PAHs at very high levels at a total concentration of 1291.1 mg/kg at well MW-8S and at a total concentration of 494.1 mg/kg at well MW-5S. Maximum concentrations of individual SVOCs were detected at Well-8S and include the following; naphthalene 100 mg/kg, acenaphthene 65 mg/kg, dibenzofuran 43 mg/kg, flourene 97 mg/kg, phenathrene 360 mg/kg, arthracene 49 mg/kg, flouranthene 200 mg/kg, pyrene 190 mg/kg benzo (a) anthracene 49 mg/kg, bis(2-Ethylhexyl) phthalate 10 mg/kg in addoition benzo (k) flouranthene, 17 mg/kg and benzo (a) pyrene, 14 mg/kg were also found at MW-5.

TABLE 4–10
RIVER ROAD SITE
LIGHT NON–AQUEOUS PHASE LIQUID SAMPLE RESULTS
SEMIVOLATILE ORGANICS

SAMPLE IDENTIFICATION	RRMW5SO*	RRMW5SORE*	RRMW8S0*	RRMW8SODL*
DATE OF COLLECTION	12/10/92	12/10/92	12/10/92	12/10/92
DILUTION FACTOR	2.5	2.5	5	10
SEMIVOLATILE ORGANIC COMPOUNDS	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Phenol	U	U	U	U
bis(2–Chloroethyl)ether	U	U	U	U
2–Chlorophenol	U	U	U	U
1,3–Dichlorobenzene	U	U	U	U
1,4–Dichlorobenzene	U	U	U	U
1,2–Dichlorobenzene	U	U	U	U
2–Methylphenol	U	U	U	U
2,2'–oxybis(1–chloropropane)	U	U	U	U
4–Methylphenol	U	U	U	U
N–Nitroso–di–n–propylamine	U	U	U	U
Hexachloroethane	U	U	U	U
Nitrobenzene	U	U	U	U
Isophorone	U	U	U	U
2–Nitrophenol	U	U	U	U
2,4–Dimethylphenol	U	U	U	U
bis(2–Chloroethoxy)methane	U	U	U	U
2,4–Dichlorophenol	U	U	U	U
1,2,4–Trichlorobenzene	U	U	U	U
Naphthalene	U	U	100000	92000 DJ
4–Chloroaniline	U	U	U	U
Hexachlorobutadiene	U	U	U	U
4–Chloro–3–methylphenol	U	U	U	U
2–Methylnaphthalene	U	U	54000	50000 DJ
Hexachlorocyclopentadiene	U	U	U	U
2,4,6–Trichlorophenol	U	U	U	U
2,4,5–Trichlorophenol	U	U	U	U
2–Chloronaphthalene	U	U	U	U
2–Nitroaniline	U	U	U	U
Dimethylphthalate	U	6600 J	U	U
Acenaphthylene	U	6400 J	U	12000 DJ
2,6–Dinitrotoluene	U	U	U	U
3–Nitroaniline	U	U	U	U
Acenaphthene	21000 J	22000 J	56000	65000 DJ
2,4–Dinitrophenol	U	U	U	U
4–Nitrophenol	U	U	U	U
Dibenzofuran	22000 J	23000 J	43000 J	43000 DJ
2,4–Dinitrotoluene	U	U	U	U
Diethylphthalate	U	U	U	U
4–Chlorophenyl–phenylether	U	U	U	U
Flourene	38000	42000	78000	97000 DJ
4–Nitroaniline	U	U	U	U
4,6–Dinitro–2–methylphenol	U	U	U	U
N–Nitrosodiphenylamine	U	U	U	U
4–Bromophenyl–phenylether	U	U	U	U
Hexachlorobenzene	U	U	U	U
Pentachlorophenol	U	U	U	U
Phenanthrene	22000 J	21000 J	350000	360000 D
Anthracene	35000	39000 J	49000 J	49000 DJ
Carbazole	7800 J	U	U	U
Di–n–butylphthalate	2800 J	5800 J	6800 J	U
Flouranthene	130000	120000	220000	200000 D
Pyrene	100000	98000	180000	190000 D
Butylbenzylphthalate	U	U	U	U
3–3'–Dichlorobenzidine	U	U	U	U
Benzo (a) anthracene	33000	34000	49000 J	42000 DJ
Chrysene	43000	43000	60000	53000 DJ
bis(2–Ethylhexyl)phthalate	U	76000	110000	100000 D
Di–n–octylphthalate	2500 J	2300 J	4300 J	3400 DJ
Benzo(b)flouranthene	20000 J	19000 J	31000 J	U
Benzo(k)flouranthene	17000 J	16000 J	U	U
Benzo(a)pyrene	U	14000 J	U	U
Indeno(1,2,3–cd)pyrene	U	U	U	U
Dibenz(a,h)anthracene	U	U	U	U
Benzo(g,h,i)perylene	U	U	U	U
4–Chlorophenol	U	U	U	U
TOTAL PAHs	459000	474400	1073000	1160000
TOTAL CARCINOGEN PAHs	113000	126000	140000	95000
TOTAL SVOCs	494100	588100	1291100	1356400

QUALIFIERS
D: Result from diluted run
E: Compound concentration exceeds instrument calibration range
J: Compound found at a concentration below the detection limit

NOTES
DL: Sample analyzed at a secondary dilution
RE: Sample reanalyzed
*: Sample analyzed at medium level
Samples for LNAPL material
are on a non–liquid basis
as such all data is reported in ug/kg.

TABLE 4–10 (continued)
RIVER ROAD SITE
LIGHT NON–AQUEOUS PHASE LIQUID SAMPLE RESULTS
SEMIVOLATILE ORGANICS

SAMPLE IDENTIFICATION	RRMW5SO*	RRMW5SORE*	RRMW8S0*	RRMW8SODL*
DATE OF COLLECTION	12/10/92	12/10/92	12/10/92	12/10/92
DILUTION FACTOR	2.5	2.5	5	10
TENTATIVELY IDENTIFIED COMPOUNDS	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Unknown	17000 J	19000 J	190000 J	230000 J
Unknown	17000 J	28000 J	170000 J	230000 J
Unknown alkane	46000 J	46000 J	130000 J	360000 J
C_9H_{10} aromatic hydrocarbon	NA	NA	NA	NA
$C_{12}H_{10}$ aromatic hydrocarbon	NA	NA	NA	NA
Dimethyl naphthalene isomer	NA	NA	NA	NA
Unknown alkane	60000 J	74000 J	620000 J	440000 J
Unknown alkane	76000 J	40000 J	370000 J	570000 J
Unknown aromatic	NA	NA	NA	NA
Unknown aromatic	NA	NA	NA	NA
Unknown aromatic	NA	NA	NA	NA
Substituted benzene	94000 J	97000 J	NA	NA
Substituted benzene	18000 J	19000 J	NA	NA
Substituted phenol	NA	NA	NA	NA
Unknown cycloalkane	17000 J	18000 J	120000 J	220000 J
Unknown	20000 J	39000 J	150000 J	NA
Unknown	20000 J	22000 J	650000 J	NA
Unknown cycloalkane	21000 J	52000 J	380000 J	NA
Unknown	26000 J	99000 J	NA	NA
Unknown alkane	79000 J	28000 J	80000 J	1500000 J
Unknown	50000 J	180000 J	NA	NA
Unknown	50000 J	34000 J	NA	NA
Unknown alkane	41000 J	34000 J	400000 J	1500000 J
Unknown	NA	50000 J	NA	NA
Substituted benzene	14000 J	24000 J	NA	NA
Unknown cycloalkane	48000 J	28000 J	NA	NA
Unknown aromatic	NA	NA	NA	NA
Unknown aromatic	NA	NA	NA	NA
Unknown aromatic	NA	NA	NA	NA
Unknown aromatic	NA	NA	NA	NA
Unknown aromatic	NA	NA	NA	NA
Unknown aromatic	NA	NA	NA	NA
Unknown alkane	NA	NA	180000 J	370000 J
Unknown alkane	NA	NA	130000 J	300000 J
Unknown alkane	NA	NA	520000 J	660000 J
Unknown alkane	NA	NA	140000 J	750000 J
Unknown alkene	NA	NA	NA	NA
Substituted phenol	NA	NA	NA	NA
Unknown alkane	NA	NA	630000 J	190000 J
Unknown alkane	NA	NA	230000 J	4800000 J
Unknown alkane	NA	NA	230000 J	700000 J
Unknown alkane	NA	NA	95000 J	250000 J
Substituted phenol	NA	NA	NA	NA
Substituted phenol	NA	NA	NA	NA
Unknown	NA	NA	NA	NA
Unknown	NA	NA	NA	NA
Unknown	NA	NA	NA	NA
Unknown	NA	NA	NA	NA
Unknown cycloalkane	110000 J	110000 J	NA	NA
Unknown cycloalkane	50000 J	NA	NA	NA
Unknown alkane	NA	NA	200000 J	3100000 J
Unknown alkane	NA	NA	NA	1000000 J
Unknown alkane	NA	NA	NA	3300000 J
Unknown alkane	NA	NA	NA	350000 J
Unknown alkane	NA	NA	NA	480000 J

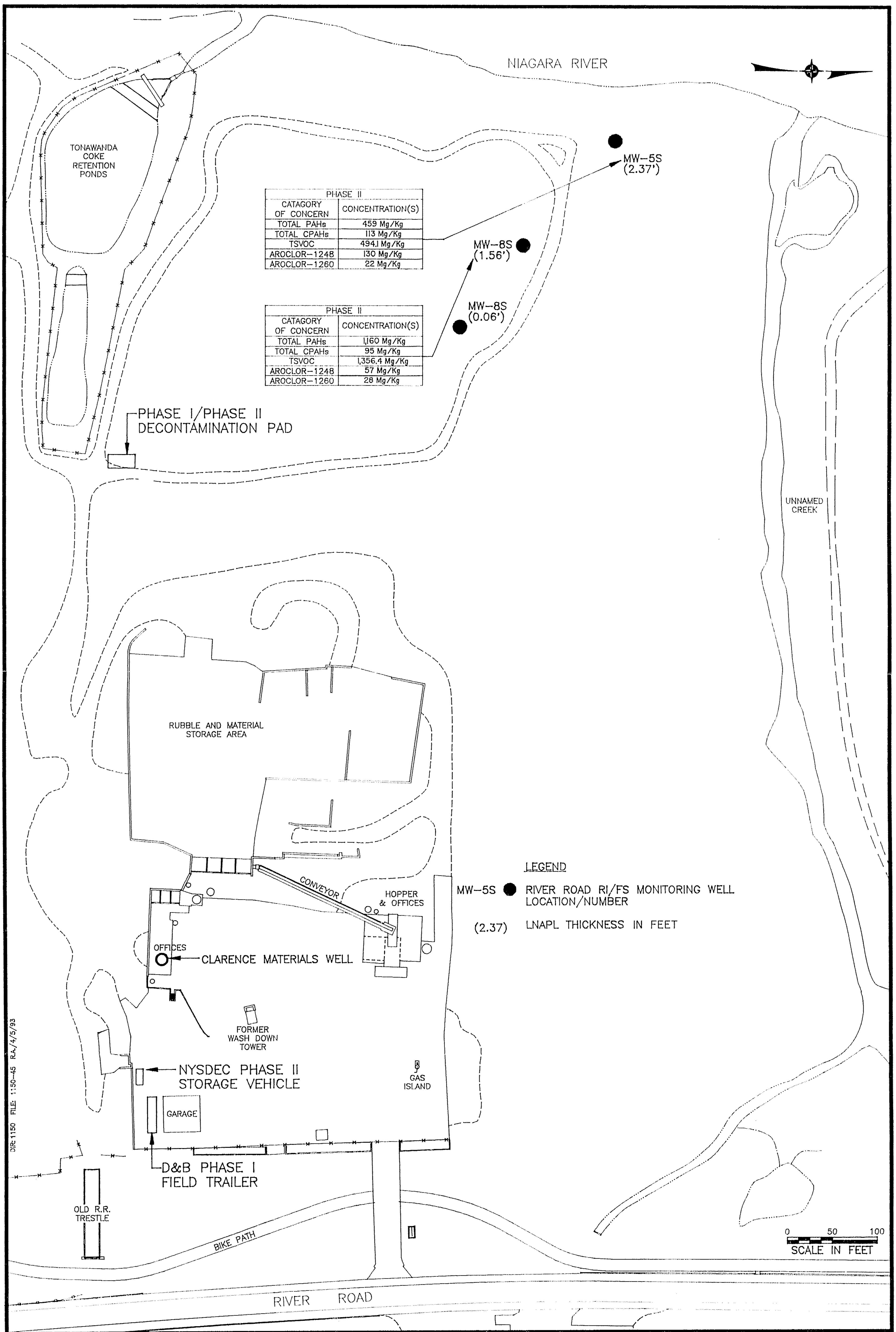
QUALIFIERS
J: Estimated value

NOTES
DL: Sample analyzed at a secondary dilution
RE: Sample reanalyzed
NA: Not Applicable
*: Sample analyzed at medium level

TABLE 4-10 (continued)
RIVER ROAD SITE
LIGHT NON-AQUEOUS PHASE LIQUID SAMPLE
PESTICIDE/PCBs

SAMPLE IDENTIFICATION	RRMW5SO	RRMW8S0
DATE OF COLLECTION	12/9/92	12/9/92
DILUTION FACTOR	3	3
PESTICIDE/PCB COMOUNDS	(ug/kg)	(ug/kg)
alpha-BHC	U	U
beta-BHC	U	U
delta-BHC	U	U
gamma-BHC (Lindane)	U	U
Heptachlor	U	U
Aldrin	U	U
Heptachlor epoxide	U	U
Endosulfan I	U	U
Dieldrin	U	U
4,4'-DDE	U	U
Endrin	U	U
Endosulfan II	U	U
4,4'-DDD	U	U
Endosulfan sulfate	U	U
4,4'-DDT	U	U
Methoxychlor	U	U
Endrin ketone	U	U
Endrin aldehyde	U	U
alpha-Chlordane	U	U
gamma-Chlordane	U	U
Toxaphene	U	U
Aroclor-1016	U	U
Aroclor-1221	U	U
Aroclor-1232	U	U
Aroclor-1242	U	U
Aroclor-1248	130000	57000
Aroclor-1254	U	U
Aroclor-1260	22000	28000

QUALIFIERS
U: Compound analyzed for but not detected



PHASE II	
CATAGORY OF CONCERN	CONCENTRATION(S)
TOTAL PAHs	459 Mg/Kg
TOTAL CPAHs	113 Mg/Kg
TSVOC	494.1 Mg/Kg
AROCLOR-1248	130 Mg/Kg
AROCLOR-1260	22 Mg/Kg

PHASE II	
CATAGORY OF CONCERN	CONCENTRATION(S)
TOTAL PAHs	1,160 Mg/Kg
TOTAL CPAHs	95 Mg/Kg
TSVOC	1,356.4 Mg/Kg
AROCLOR-1248	57 Mg/Kg
AROCLOR-1260	28 Mg/Kg

LEGEND

MW-5S ●	RIVER ROAD RI/FS MONITORING WELL LOCATION/NUMBER
(2.37)	LNAPL THICKNESS IN FEET

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Consulting Engineers

RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK

PHASE II RESULTS OF LIGHT NONAQUEOUS PHASE LIQUID ANALYSIS

FIGURE 4-5

Results of the pesticide/PCB analysis of the LNAPL indicated the presence of high levels of Aroclor-1248 and Aroclor-1260 in wells MW-5S and MW-8S. Concentrations of Aroclor-1248 and Aroclor-1260 in wells MW-5S and MW-8S are 130 ug/kg and 22 ug/kg, and 57 ug/kg and 28 ug/kg, respectively.

4.3.6 Air

Air monitoring for organic vapors and particulates was conducted throughout the Phase I/II RI field investigation using a photoionization detector (PID) or a flame ionization detector (FID), and a digital dust indicator, respectively.

The results of the air monitoring during the nonintrusive activities indicated that organic vapors were not detected above background levels and fugitive dust indicating suspended particulate matter, was not detected at levels of concern (greater than 0.15 mg/m^3).

During drilling activities, air monitoring was conducted at the borehole opening and in the work space breathing zone. Results indicated that at three locations (MW-5S, MW-6S and MW-7S) elevated readings (5 ppm to greater than 1,000 ppm) were observed when the depth of the borehole was at approximately the water table. Level C respiratory protection was used during continuation of the drilling after organic vapor levels decreased to a range acceptable for organic vapor cartridge use. Level D respiratory protection was resumed when organic vapor levels fell to below 5 ppm in the work space breathing zone. During Phase II, no elevated readings were observed above 5 ppm in the work space during the drilling of wells MW-8S and MW-9S.

Test trench construction was conducted in Level B respiratory protection because of the possibility of encountering buried drums. Elevated levels of organic vapors were not observed in the work area breathing zone; however, levels ranging from 5 ppm to greater than 1,000 ppm were detected from the excavated soil. Corresponding chemical analysis indicated that only sample, RRTT08, contained elevated volatile organic compounds at a total concentration of 20.75 mg/kg. Air monitoring results ranged from 10 to 14 ppm for organic vapors released from the test trench.

4.3.7 Radiation Survey

No elevated levels of radiation were consistently observed on the site. At three locations, radiation levels approached 0.06 to 0.07 mi/rm; however, the values could not be duplicated upon returning to the locations. Although these observed levels of 0.06 to 0.07 mi/rn are above the expected background level of 0.05 mi/rn, they are considered within normal variations of the ambient radiation level.

4.4 Comparison to Adjacent Sites

In view of the close proximity of the adjacent Cherry Farm site and the probability of disposal of similar wastes and contaminants at the River Road site, it is useful to assess in a qualitative manner, the contaminants and relative levels between these two sites. These data are presented in Table 4-11. Comparison of data ranges for both sites show levels of total PAHs and mercury to be elevated at the River Road site compared to data reported for Cherry Farm. In addition, VOCs and lead results for test trench samples at River Road were higher than the subsurface sample results for the Cherry Farm site.

In surface soils, PAHs and carcinogenic PAHs (CPAHs) were at higher levels at the River Road site, while VOCs and PCBs were higher at the Cherry Farm site. Subsurface soils contained higher levels of PAHs, CPAHs, lead, mercury and antimony at the River Road site. Levels of VOCs and PCBs were higher at the Cherry Farm site. Levels of arsenic in subsurface soils were similar at both sites.

Surface water sediment samples collected in the creek between the two sites (although collected in similar locations) did not show consistent results. Samples collected from the River Road Phase II RI/FS investigation showed elevated levels of PAHs, and CPAHs which were not reported in previous Cherry Farm site data for the creek. The earlier results did show elevated levels of PCBs and lead, which were confirmed in the River Road Phase II samples.

Results for groundwater samples for the River Road site were generally lower or nondetected when compared to the Cherry Farm data. However, the LNAPL encountered at the River Road site was not found during Cherry Farm investigation. This LNAPL material contains numerous and elevated PAH and CPAH contaminants, as well as PCBs.

Table 4-11

COMPARISON OF ENVIRONMENTAL DATA COLLECTED FOR THE CHERRY FARM SITE TO THE RIVER ROAD PHASE I/II INVESTIGATION

Compounds by Group	Cherry Farm Site	River Road Site
Surface Soil (mg/kg)		
Total PCBs	0-44	ND-1.6
Total PAHs	0-4.87	0.041-413
Total Carc. PAHs	NR	ND-156.0
Total VOCs	0.003-0.17	ND
Total Pb	1.97-899	4.3-892
Total Hg	0-0.381	ND-0.89

Subsurface Soil (mg/kg)		Test Trench	Borehole
Total PCBs	0-89	ND-21	ND-5
Total PAHs	0.65-161.7	ND-228.7	0.11-67.0
Total Carc. PAHs	NR	ND-27.3	ND-15.6
Total VOCs	0-538	ND-20.75	ND-1.62
Total Pb	15.3-651	13-7.74	12.4-1,170
Total Hg	0.109-0.637	ND-1.6	ND-0.275
Total Sb	NR	ND-144	ND-133
Total As	2.0-43.7	4.4-44.7	1.1-44.3

Surface Water Sediment (ug/kg)	Cherry Farm Site	River Road Site
Total PCBs	ND-1000	350-650
Total PAHs	ND	271-5570
Total Carc. PAHs	ND	ND-330
Total VOCs	ND-9	23.6
Total Pb	41-121	30.8-315
Total Hg	ND	ND

Groundwater (ug/l)	6/27/88	11/28/88	4/15/92	12/9/92
Vinyl Chloride	0-124	0-23	ND	NA
1,1-dichloroethane	0-15	0-12	ND-58	NA
1,2-Dichloroethene (total)	0-167	0-90	ND-50	NA
Trichloroethene	0-14	0-11	ND	NA
Benzene	0-260	0-350	ND-3(J)	NA
Tetrachloroethene	0-1	0	ND-3(J)	NA
Toluene	0-110	0-140	ND	NA
Ethylbenzene	0-63	0-76	ND-1(J)	NA
Xylene	0-120	0-170	ND	NA
Bromodichloromethane	--	--	ND-270	NA

Table 4-11 (continued)

COMPARISON OF ENVIRONMENTAL DATA COLLECTED FOR THE CHERRY FARM SITE TO THE RIVER ROAD PHASE I/II INVESTIGATION

	Cherry Farm Site		River Road Site	
Groundwater (continued)	6/27/88	11/28/88	4/15/92	12/9/92
Phenol	ND-520	ND-1,200	ND-1(J)	ND-180
Nitrobenzene	NR	NR	ND-4(J)	ND-6
Naphthalene	ND-38	ND-23	ND-14	ND-310
Acenaphthene	ND-17	ND-19	ND-5(J)	ND-25
Phenanthrene	ND-4(J)	ND-58	ND-8(J)	ND-160
Flouranthene	ND-21	ND	ND-20	ND-88
Benzo(b)flouranthene	ND-20	ND-84	ND-4(J)	ND-12
Benzo(k)flouranthene	ND-22	ND-90	ND-3(J)	ND-10
Benzo(a)pyrene	ND	ND-63	ND-2(J)	ND-10
Chrysene	ND-2	ND-72	ND-7(J)	ND-24
Benzo(a)anthracene	ND	ND-76	ND*	ND-18
PCBs ug/l	69	35.4	ND-5.4	ND-23.6
Pb ug/l	27.6	5-5,350	ND-29.8	ND-45
Hg	ND	ND	ND-4.8	ND-0.93
Sb	ND	ND	ND-106	ND-53.6
As	ND-46	ND-48	ND-10	ND-12.3

ND - Not Detected

NA - Not Analyzed

NR - Not Reported

J - Compound found below detection limit

*Data for present investigation is for dibenzo(a,h)anthracene.

Section 5

organisms. This, combined with the erosional nature of the area adjacent to the creek and potential adverse impacts to the creek, suggest that the surface soil these areas be considered for remediation.

- Groundwater Underlying the Western Area of the Site

  Based upon elevated levels of PAHs, PCBs, metals and cyanide, as well as the presence of a nonaqueous phase liquid in the northwest quadrant of the site, groundwater could pose a threat to the Niagara River. The data from the LNAPL shows extensive contamination of this material with PCBs and semivolatile compounds comprising primarily PAHs, many of which are carcinogenic. This contamination, combined with the potential for seepage to the Niagara River, requires groundwater in this area to be considered for remediation.

- Creek Sediment

  Data collected as part of the River Road remedial investigation, as well as data previously collected from the adjacent Cherry Farm site studies suggests contribution of a number of contaminants, notably PAHs, PCBs and selected metals, to the creek from the adjoining River Road/Cherry Farm sites. The potential for contact by aquatic organisms and transport of these contaminants to the Niagara River and suggests that the creek sediment be considered for remediation.

Design-Support Investigation

Based upon the results of the Phase I/Phase II remedial investigation, as well as previous studies conducted for the River Road site, the following is recommended for a design-support investigation to define the extent of contamination to develop a remedial plan for the site.

- Seepage Survey and Sampling

  Given the lack of data documenting seepages of contaminated groundwater from the northern area of the site to the Niagara River and creek, it is recommended that a reconnaissance be undertaken both during a dry period and following a period of significant rainfall and samples be collected if seepages are found. These samples would be analyzed for semivolatiles, PCBs, metals and cyanide.

- Creek Sediment Sampling

  Based on the results of the Phase II River Road remedial investigation, it is clear that some of the creek sediments are contaminated, in particular with PCBs. These sediments are not being addressed as part of the Cherry Farm site remediation; however, there is a potential threat to ecology in the creek itself and releases to the Niagara River. As a result, it is recommended that additional study be conducted of the sediment in the creek to define the extent of contamination. This study would comprise collection of surface water samples and sediment samples at six locations with sediment samples collected at a depth of 2 and 4 feet to provide a vertical contaminant profile. Additionally, storm flow studies are suggested to ascertain the sediment contamination transported during a storm event, for the purposes of ascertaining contaminant loadings to the Niagara River.

- Additional Monitoring Wells

  The extent of the LNAPL material in proximity to the Niagara River is only partially known. In order to design a groundwater remediation system, two to three additional shallow groundwater wells should be installed between MW-4S, MW-5S and the creek margin to define the lateral extent of this material.

- Pump Testing

  To provide information for the design of a groundwater extraction system, a pump test should be conducted in the northwest quadrant of the site.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations discussed in this section are based upon site observations and sample results obtained from the Phase I and II remedial investigations, as compared to remediation guidelines selected for soil, New York State Fish and Wildlife surface water sediment criteria, and standards and guidance values for groundwater, as well as the results of previous investigations.

5.1 Surficial Soil and Waste Piles

The River Road site contains areas in which disposal of coke/cinder-like spoils (which are characterized as coke fines), miscellaneous debris with metal shards and steel drums has occurred. In general, surficial soil on the western portion of the site shows elevated levels of lead and/or polycyclic aromatic hydrocarbons (PAHs). Samples collected from the coke waste piles in the southwestern portion of the site show high concentrations of PAHs, including carcinogenic PAHs. A few soil samples collected in the northeast corner of the site show levels marginally exceeding guidance values for polychlorinated biphenyls (PCBs). In addition, samples of the tar-like material at the center of the site show elevated levels of semivolatile organic compounds (pyrene and bis(2-ethylhexyl)phthalate). No elevated levels of volatile organic compounds (VOCs) were detected in surficial soil and waste pile samples.

Based on these results, the areas of concern on-site regarding surface soil include primarily the area north of the Tonawanda Coke retention ponds and the area within the northeastern portion of the site adjacent to the unnamed intermittent creek which borders the site on the north in the location used for the disposal of drums.

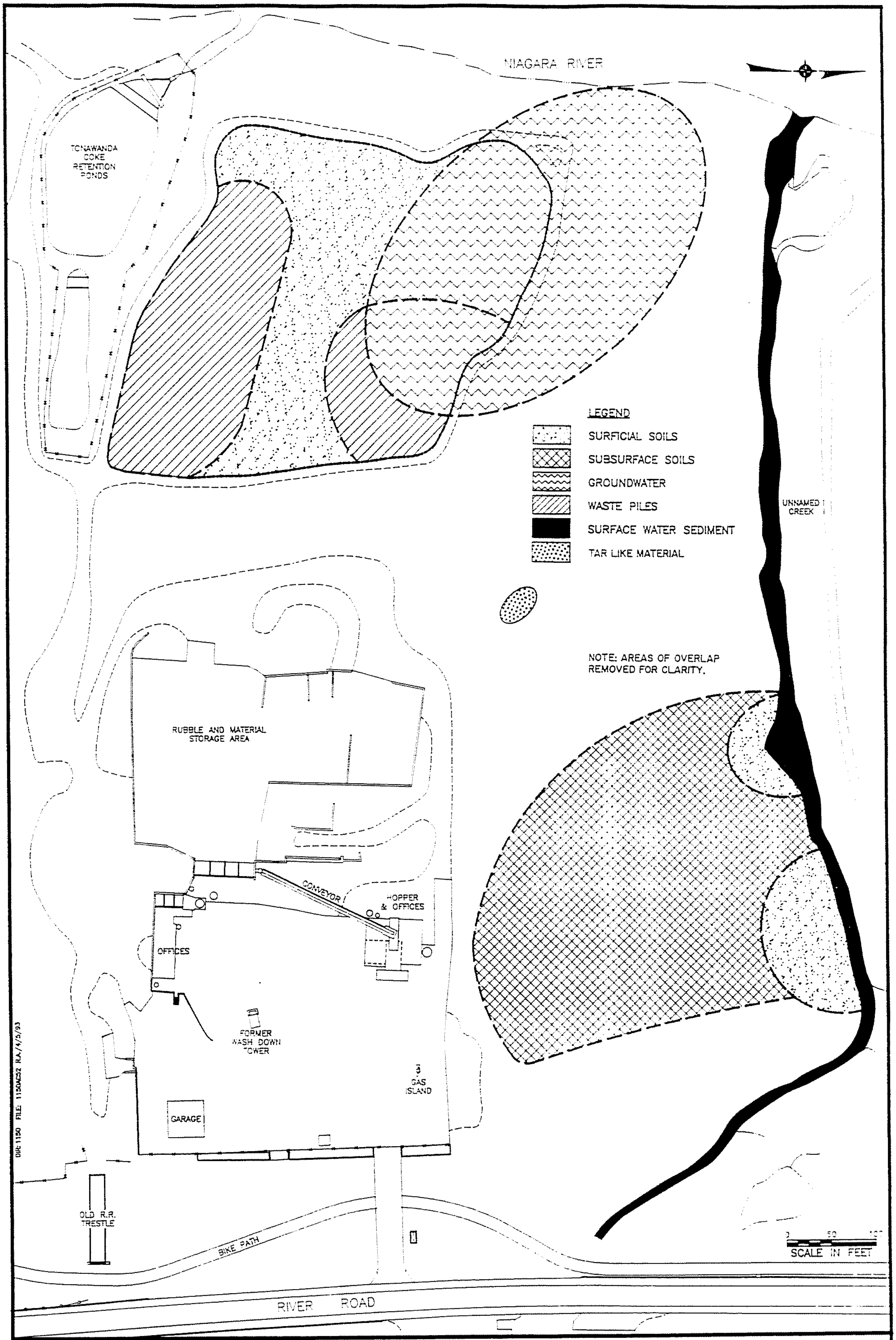
The coke/cinder spoil piles range in thickness from 1 to 2 feet in height to 10 to 12 feet in height. Based upon an estimate of the area of the three spoil piles and an assumption of cinder/fill thickness of 2 feet in the flat areas (surficial soil in the southwest portion of the site), the three waste piles (two are along the Tonawanda Coke retention ponds and portrayed as one area) are estimated to contain approximately 6,000 cubic yards of material and the cinder fill in the flat areas is estimated to be approximately 14,500 cubic yards in volume under and around the spoil piles. In addition, the volume of surficial soils near the creek in the northeastern quadrant of the site is estimated to be approximately 2,000 cubic yards.

Based upon site observations and chemical data, it does not appear that surficial soil on the site is a significant source of either surface water or groundwater contamination. However, this material is considered a potential threat to human health and terrestrial organisms as a result of direct contact, ingestion or inhalation. Figure 5-1 presents the generalized locations of areas of concern on-site to be considered for remediation.

5.2 Subsurface Soil/Fill Material/Buried Waste

Data from the subsurface soil, fill material and buried waste generally reflects an exceedance of guidance values for total VOCs, PAHs, CPAHs and PCBs in the northeastern quadrant of the site in the drum disposal area. In addition, PCB contamination, which did not exceed the guidance value, was also noted sporadically outside this area. On a site-wide basis, elevated levels of lead were detected in subsurface soil with levels well over the guidance value in soil from a monitoring well boring in the southwest quadrant and test trenches in the northeast quadrant of the site. In addition, although not exceeding the guidance value, elevated levels of lead were found in samples collected from test trenches located near the center of the site (TT-1, TT-5 and TT-14). Mercury levels for subsurface soil did not exceed guidance criteria. Only one elevated level of VOCs was encountered above the guidance value in the subsurface soil (test trench 8). PAH levels exceeded the guidance value in soil collected from test trenches in the northeast quadrant of the site. Carcinogenic PAHs also exceeded the guidance value at test trenches in this area, as well as near the river at soil boring MW-8S.

The subsurface soil, fill material and waste, given the proximity to the surface, do not constitute a direct threat to human health. However, since the contaminated material is only a few feet below the ground surface, it does pose a potential risk to terrestrial organisms inhabiting the site. Also, any excavation into this subsoil would bring contaminants to the surface and create a potential route of exposure. Overall, the low levels of contaminants encountered in the groundwater on a site-wide basis do not suggest that extensive contamination of groundwater is occurring as a result of contaminated subsurface soil and buried waste materials, although in an area underlying a layer of light nonaqueous phase liquid (LNAPL), some groundwater contamination is evident. The generally low levels of groundwater contamination may be due in part to the relatively impermeable nature of the underlying slag material which retards percolation of contaminants into the groundwater, as well as the affinity of these contaminants to adsorb onto soil particles. Key areas of concern for the subsurface soil at the River Road site would be in areas of erosion, such as areas bordering the creek in the northeastern portion of the site, although contaminated subsurface soil can also pose a threat to groundwater. Review of the soil contamination data and comparison to contaminants in groundwater underlying the site show large areas in which subsurface soils exceed the NYSDEC Soil Cleanup Objectives for Protection of Groundwater Quality. The estimated volume of these materials (including waste piles and surficial soils) is approximately 275,000 cubic yards.



RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TONAWANDA, NEW YORK
AREAS OF CONCERN

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FIGURE 5–1

5.3 Groundwater

Groundwater samples from the upper zone and intermediate zones, when compared to NYSDEC Class GA groundwater standards and guidelines, showed exceedances for VOC contaminants in only one monitoring well, MW-6S located in the northwestern quadrant of the site. Semivolatile/PAH exceedances were detected in wells near the river, and two Cherry Farm wells MW-12CF and MW-13CF, in the vicinity of the creek, as well as in well B-3 (also in the northwestern portion of the site). The groundwater samples from monitoring wells near the river also exceeded the standard for PCBs. In addition, wells MW-5S, MW-6S and MW-8S contained a light nonaqueous phase liquid which was also found in the northwest quadrant of the site during previous investigations.

Groundwater data for metals show widespread elevated levels for iron, sodium, manganese and magnesium. However, elevated levels in excess of Class GA standards for heavy metals of concern were predominantly encountered at wells located along the river in the western portion of the site. Cyanide was found essentially in all shallow wells throughout the site, in particular at well MW-5S. It should be noted that mercury levels in groundwater on-site were below Class GA standards; however, the upgradient sample collected from monitoring well MW-2, nearest River Road, exceeded the standard for this metal suggesting an off-site source of contamination.

Based upon the results of this investigation, groundwater contamination appears to be primarily confined to the upper/fill zone above the alluvial deposits at the site. The primary concern from groundwater contamination at the site would appear to be migration to the Niagara River, especially since the majority of exceedances of standards for semivolatiles, PCBs metals of concern and cyanide occurred in wells closest to this area, in particular, in the northwest portion of the site.

5.4 Light Nonaqueous Phase Liquid

LNAPL was found in monitoring wells nearest the river in the northwest portion of the site. Samples of this material showed very high levels of semivolatile organic compounds (SVOCs) most of which are PAHs, including carcinogenic PAHs. Elevated levels of PCBs were also found in these samples. The proximity of this contamination to the Niagara River is considered a key area of concern.

5.5 Surface Water Sediment

Semivolatile organic analyses of surface water sediment collected from the creek which borders the northern boundary of the site indicated total PAHs at levels which exceeds the NYSDEC sediment criteria at four of six locations with the highest level reported nearest River Road. PCBs in creek sediment exceeded NYSDEC guidance values in all six sediment samples.

Inorganic chemical analyses of the surface water sediment showed lead levels in a consistent increasing trend towards the Niagara River. As a result, creek sediments throughout the entire length bordering the site warrant concern.

The relative contaminant contribution of the River Road site versus the Cherry Farm site to the creek is unknown. Comparison of upstream to downstream levels for the six sediment creek sample locations suggests contaminant contribution to the creek from the Cherry Farm and/or River Road site for contaminants such as PCBs, PAHs and lead. Contaminant contribution to the creek is primarily in the middle and riverward/western areas of the creek as compared to upstream/eastern locations.

5.6 Recommendations

Based upon the findings and conclusions regarding the nature and extent of contamination, and assessment of contaminant fate and transport at the River Road site, the following recommendations are presented to address site remediation and the need for additional information to further delineate the extent of contamination to support remedial design.

Site Remediation

- Coke/Cinder Waste Piles

  Based upon elevated levels of PAHs and carcinogenic PAHs associated with these waste piles, and the potential for human and terrestrial organism contact and, to a lesser extent, off-site migration of contaminants, the waste piles should be considered for remediation. These spoil piles are located in the area north of the Tonawanda Coke retention ponds.

- Surficial Soil

  Based on elevated levels of PAHs, PCBs and lead, surface soil in the area north of the Tonawanda Coke retention ponds and the area within the northeastern quadrant of the site adjacent to the creek could pose a potential threat to human health and terrestrial organisms. This combined with the erosional nature of the area adjacent to the creek and potential adverse impacts to the creek, suggest that the surface soil these areas be considered for remediation.

- Groundwater Underlying the Western Area of the Site

  Based upon elevated levels of PAHs, PCBs, metals and cyanide, as well as the presence of a nonaqueous phase liquid in the northwest quadrant of the site, groundwater could pose a threat to the Niagara River. The data from the LNAPL shows extensive contamination of this material with PCBs and semivolatile compounds comprising primarily PAHs, many of which are carcinogenic. This contamination, combined with the potential for seepage to the Niagara River, requires groundwater in this area to be considered for remediation.

- Creek Sediment

  Data collected as part of the River Road remedial investigation, as well as data previously collected from the adjacent Cherry Farm site studies suggests contribution of a number of contaminants, notably PAHs, PCBs and selected metals, to the creek from the adjoining River Road/Cherry Farm sites. The potential for contact by aquatic organisms and transport of these contaminants to the Niagara River and suggests that the creek sediment be considered for remediation.

Design Support Investigation

Based upon the results of the Phase I/Phase II remedial investigation, as well as previous studies conducted for the River Road site, the following is recommended for a design-support investigation to define the extent of contamination to develop a remedial plan for the site

- Seepage Survey and Sampling

  Given the lack of data documenting seepages of contaminated groundwater from the northern area of the site to the Niagara River and creek, it is recommended that a reconnaissance be undertaken both during a dry period and following a period of significant rainfall and samples be collected if seepages are found. These samples would be analyzed for semivolatiles, PCBs, metals and cyanide.

- Creek Sediment Sampling

  Based on the results of the Phase II River Road remedial investigation, it is clear that some of the creek sediments are contaminated, in particular with PCBs. These sediments are not being addressed as part of the Cherry Farm site remediation; however, there is a potential threat to ecology in the creek itself and releases to the Niagara River. As a result, it is recommended that additional study be conducted of the sediment in the creek to define the extent of contamination. This study would comprise collection of surface water samples and sediment samples at six locations with sediment samples collected at a depth of 2 and 4 feet to provide a vertical contaminant profile. Additionally, storm flow studies are suggested to ascertain the sediment contamination transported during a storm event, for the purposes of ascertaining contaminant loadings to the Niagara River.

- Additional Monitoring Wells

The extent of the LNAPL material in proximity to the Niagara River is only partially known. In order to design a groundwater remediation system, two to three additional shallow groundwater wells should be installed between MW-4S, MW-5S and the creek margin to define the lateral extent of this material.

- Pump Testing

To provide information for the design of a groundwater extraction system a pump test should be conducted in the northwest quadrant of the site.

Section 6

6.0 QUALITATIVE HEALTH RISK ASSESSMENT UPDATE

As presented in the Phase I Remedial Investigation/Feasibility Study Workplan and the Phase II Workplan Addendum, the approach used to perform the human health risk assessment for the River Road site is to identify contaminants of concern at the site, define routes of exposure of these site contaminants, define migration pathways, identify potential receptors, evaluate a health risk assessment performed for the adjacent Cherry Farm site and prepare a qualitative assessment of contaminant risk associated with the River Road site. The environmental assessment consists of a qualitative evaluation of potential impacts to flora and fauna at the site caused by the level and extent of contamination identified as a result of the Phase I/II field investigations.

6.1 Risk Assessment Methodology

The goals of the baseline health risk and environmental assessment are to:

- Provide a qualitative analysis of human health risks under the current site conditions;
- Identify the qualitative potential impacts to flora and fauna posed by existing contamination at the site; and
- Provide a basis for determining contaminant levels that can remain on-site while providing adequate protection of human health and the environment.

As part of the RI/FS Investigation and site assessment, a list of indicator chemical groups and levels of concern for soils within selected areas of the site were developed for the River Road site based upon discussions with NYSDEC and the New York State Department of Health and are presented in Section 4.1. Briefly, these levels are as follows:

Total Volatile Organic Compounds (VOCs)	(Soil)	1 mg/kg
Total Polycyclic Aromatic Hydrocarbons (PAHs)	(Soil)	100 mg/kg
Total Carcinogenic PAHs (CPAHs)	(Soil)	10 mg/kg
Total Polychlorinated Biphenyls (PCBs)	(Surface Soil)	1 mg/kg
	(Subsurface Soil)	10 mg/kg
Lead	(Soil)	500 mg/kg
Mercury	(Soil)	10 mg/kg*

*This value is utilized as a level of concern from previous studies. The New York State DEC Bureau of Fish and Wildlife guideline for this element is 2 mg/kg.

These parameters and levels of concern have been previously identified from other studies in the region. Indicator chemicals are generally selected to represent the most toxic, mobile and persistent contaminants at the site, as well as those compounds which exceed ARARs, and which are detected most frequently and at the highest concentrations. Identification of the indicator chemical groups enable the risk assessment to focus on the contaminants of greatest potential risk to human health and the environment.

In the present analysis, cadmium was considered as a parameter of concern. However, review of the Phase I/II RI/FS data for this element showed the majority of analyses were nondetect. Sporadic levels were encountered in surface and subsurface soils and in one sample of surface water sediment. All groundwater and TCLP analyses were nondetect for this element. Given the above, cadmium was removed from consideration as a parameter of concern. Although a mercury level of 10 mg/kg was utilized for review purposes, the data was also evaluated for the NYSDEC Bureau of Fish and Wildlife guidance value of 2 mg/kg.

The criteria for assessment of surface water sediment were developed from guidance present in the NYSDEC document entitled "Sediment Criteria December 1989." The assessment for sediment requires that the criteria be normalized to the percentage of total organic carbon (TOC) in the collected samples. All criteria were derived from an aquatic toxicity basis as presented in the NYSDEC guidance document. In selected cases where aquatic toxicity criteria were not available, other criteria such as the wildlife residue values or human health residue basis were utilized for comparison to sediment contaminant levels found.

For the review and interpretation of groundwater analytical results, the guidance values for the River Road site were taken from the NYSDEC Technical and Operational Guidance Series (TOGS) - Ambient Water Quality Standards and Guidance Values (September 1991). The NYSDEC TOGS water quality standards (ST) and guidance values (GV) provide ambient pollutant concentrations developed to protect New York State groundwater and refers to their best classified usage. Analytical results obtained for groundwater samples were compared to Class GA groundwater standards.

Utilizing data from the Phase I/II investigations, site reconnaissance, and previous site investigations and documentation for the adjacent Cherry Farm site, the contaminant sources, migration pathways, and human and ecological exposure points resulting from the indicator chemicals are identified and evaluated. Potential human exposures include ingestion, either directly from soil or through contaminated biota, inhalation of dust, and dermal contact with contaminated soil and fugitive dust from the River Road site by on-site workers (Clarence Materials Corporation), children who may play at this site, and off-site individuals and children in the vicinity of the site.

Based on this information, the following assumptions were made in the qualitative exposure pathway analyses prepared for the River Road site.

- A waste source consisting of elevated levels of PCBs, PAHs, CPAHs and lead is present;
- Areas of exposed waste material and contaminated soil along the periphery of the site, and contaminated sediments in the creek, which forms the northern boundary of the site, are potentially subject to erosion by precipitation and periodic scouring from storm water flows. As a result of this action, dissolved or particulate-bound contaminants may be released to the surface water bodies, including the Niagara River;
- Groundwater is in contact with waste and contaminated soil. Dissolved contaminants may be released to groundwater, and possibly to surface waters via seeps and underflow;
- A Light Nonaqueous Phase Liquid (LNAPL), which is present near the Niagara River, may be directly released to the river through seepages or contaminants in the LNAPL may be released into groundwater underlying this material and discharged as underflow; and
- Areas of exposed waste material and contaminated soil on the site are potentially subject to wind scour, vehicular traffic and excavation equipment, and particulate-bound contaminants may be released to the air during these events.

A presentation of the potential pathways and release mechanisms for the River Road site is presented on Table 6-1 and is discussed further below.

6.2 Hazard Identification

The areas of concern identified on-site as presented in Section 5.0 of this report show a number of locations and waste sources on the River Road site. To qualitatively assess the exposures related to the site, the various exposure scenarios can be classified into the following general release mechanisms:

- Volatilization;
- Wind erosion (dust);
- Direct contact;
- Overland runoff;

Table 6-1

SUMMARY OF POTENTIAL EXPOSURE ROUTES FOR THE RIVER ROAD SITE

Contaminant Source	Contaminants of Concern	Potential Exposure	Route of Migration	Potential Receptors
Waste Piles	PAHs, CPAHs, Pb	Dermal contact, ingestion and inhalation of fugitive dust emissions	Dust and surface water runoff	On-site/off-site
Surficial Soil	PAHs, CPAHs, PCBs, Pb	Dermal contact, ingestion and inhalation of fugitive dust emissions in barren areas	Dust and surface water runoff	On-site/off-site
Subsurface Soil	VOCs, PAHs, CPAHs, PCBs, Pb	Dermal contact, ingestion and inhalation during construction	Leaching to groundwater, surface water runoff and dust generated during construction	On-site
Buried Drum Waste[1]	VOCs, PAHs, CPAHs, Pb	Dermal contact, ingestion and inhalation of dust during construction.	Leaching to groundwater, surface water runoff and dust generated during construction	On-site
Groundwater Seepage	PAHs, PCBs, Sn, Cn, Cr^{+6}	Dermal contact and ingestion, and indirect uptake through bioaccumulation in biota	Discharge to Niagara River and creek	On-site/off-site
LNAPL Seepage	PAHs, CPAHs, PCBs	Dermal contact and ingestion, and indirect uptake through bioaccumulation in edible biota	Discharge to Niagara River and creek	Off-site
Surface Water[2]	Al, Cu, Fe	Dermal contact and ingestion, and indirect uptake through bioaccumulation in edible biota	Discharge to Niagara River and direct contact	On-site/off-site
Surface Water Sediment	VOCs, PAHs, CPAHs, PCBs, Pb	Dermal contact and ingestion, and indirect uptake through bioaccumulation of contaminants in edible biota	Discharge to Niagara River and direct contact	On-site/off-site

[1] Although drum wastes were not directly sampled as part of the River Road Site Phase I/II RI/FS, the contaminants of concern were found to exceed NYSDEC/NYSDOH guidance values in areas where buried drums which contained liquids were uncovered.

[2] Not sampled as part of the River Road Phase Site I RI/FS. Data presented is from the adjacent Cherry Farm Site RI/FS.

- Infiltration to groundwater;
- Seepages/underflow of groundwater or LNAPL;
-

Scour of creek sediments.

Direct exposures to hazardous materials at the River Road site from the above seven release mechanisms can occur in a number of ways.

- Ingestion of surface water, groundwater, aquatic sediments and/or contaminated soil containing dissolved or particulate-bound contaminants;
- Inhalation of airborne volatile or particulate-bound contaminants;
- Ingestion of biota (e.g., fish) that have bioaccumulated contaminants; and
- Dermal absorption of contaminants via direct contact with waste, LNAPL, contaminated soil, surface water and sediment.

In addition to the above, ecological impacts can also occur from site contaminants. These impacts occur from contact by terrestrial and/or aquatic organisms to contaminated surficial materials, surface water runoff and groundwater or LNAPL seepages.

The qualitative health assessment considers the potential contaminant releases relative to the contaminant concentration at the site, identification of the exposed population, assessment of the exposure pathway and uptake route, and estimation of the exposure concentration for the respective pathways. Typically, in a qualitative health risk assessment, a worst case approach using maximum contaminant levels reported compared to guidance values and criteria can be used. In the qualitative approach, a comparison of the exposure pathway and uptake route which allows exposure of contaminants at levels of concern to a receptor (human and wildlife) is made. These are generally referred to as functional components and complete components. The components of each category are as follows:

> Functional Exposure Pathway - This pathway requires that a waste source, release mechanism and transport mechanism be present. If any one or some of these components is missing, the pathway is considered nonfunctional.
>
> Complete Pathway - This pathway requires that a functional pathway exists, as well as potential receptors to the exposure and an exposure/uptake route. If one or more of these components is missing, an exposure assessment is incomplete and poses a low risk.

6.3 Exposure Assessment

The existing River Road site is an inactive waste disposal site in Tonawanda, New York. The site is bounded by two other hazardous waste sites, the Cherry Farm site to the north and to the south by the Roblin Steel site. Approximately 1/3 of the River Road site is overlain by spoil mounds of waste material, coke/cinder debris or miscellaneous metal debris, steel drums and slag mounds. Portions of the site are underlain at a depth of approximately four to ten feet by a dense slag layer. In the northeastern edge of the site near the creek margin, sand casts from foundry operations were uncovered during the remedial investigation.

Figure 5-1 presented in Section 5.0 of this report, illustrates the generalized locations of areas of concern on-site. The proposed remedial actions for these areas are discussed in Section 7.0 of this report.

Surficial Soils

In general, surficial soils collected from the site show elevated levels of lead, polycyclic aromatic hydrocarbons (PAHs) and carcinogenic PAHs (CPAHs). Samples from the coke waste piles in the southwestern portion of the site show high concentrations of PAHs, including carcinogenic PAHs. The coke/cinder spoil piles range in thickness from 1 to 2 feet in depth to 10 to 12 feet in depth. Soil samples collected at locations in the northeastern quadrant and the southwestern quadrant of the site show levels marginally exceeding guidance values for polychlorinated biphenyls (PCBs). In addition, samples of the tar-like material at the approximate center of the site show elevated levels of semivolatile organic compounds, pyrene and bis(2-ethylhexyl)phthalate. No elevated levels of volatile organic compounds (VOCs) were detected for surficial soil and waste pile samples. Cadmium was detected in 25 percent of the surface soils evaluated with the detected levels ranging from 1.9 to 16.6 ppm. Mercury levels in soils were below the 2 mg/kg NYSDEC Bureau of Fish and Wildlife threshold.

Regarding the surficial materials encountered, the areas of concern on-site include primarily the area north of the Tonawanda Coke retention ponds in the southwestern quadrant of the site and the area within the northeastern portion of the site adjacent to the unnamed intermittent creek which borders the site on the north.

Subsurface Soils

Data from the subsurface soil, fill material and buried waste reflects an exceedance of guidance values for total VOCs, PAHs, CPAHs and PCBs in the northeastern quadrant of the site. In addition, PCB contamination, which did not exceed the guidance values, was also noted sporadically outside this area. On a sitewide basis, elevated levels of lead were detected in subsurface soil with levels well over the guidance value in soil from monitoring well in the southwest corner of the site (Well 4S) and in test trenches within the northeastern quadrant of the site. In addition, although not exceeding the guidance value, elevated levels of lead were found in samples collected from test trench 1 in the southwestern quadrant and test trench 5 in the northwestern quadrant of the site. Mercury levels for subsurface soil did not exceed guidance criteria. No VOCs were encountered over the guidance value in borehole soil samples collected. One elevated level of total VOC was encountered at test trench 8 in the northeastern quadrant above the guidance value. This sample was presumed to reflect the contents of a partially filled buried drum under which the sample was taken. PAH levels exceeded the guidance value in soil collected from the northwestern quadrant of the site and carcinogenic PAHs exceeded the guidance value in this area and near the river at soil boring 8S. Two borehole soils and four test trench soil samples contained detectable levels of cadmium. However, TCLP analyses of the elevated test trench sample did not exceed the test criteria. Mercury levels were below the 2 mg/kg NYSDEC Bureau of Fish and Wildlife threshold.

Groundwater

Groundwater samples from the upper zone and intermediate zone, when compared to NYSDEC Glass GA groundwater standards and guidelines, showed exceedances for the VOC contaminants 1,1-dichloroethene, 1,2-dichloroethene and bromodichloromethane in monitoring wells in the northwestern quadrant of the site. A number of polycyclic aromatic hydrocarbon exceedances were noted in wells in the northwestern portion of the site bordering the Niagara River and in wells in the vicinity of the creek throughout this area. The groundwater samples from monitoring wells near the river also exceeded the guidance value for PCBs. Three wells from this area also contained a light nonaqueous phase liquid which contained high levels of PAHs, CPAHs and PCBs. The majority of the maximum reported levels of these groups of contaminants were found in wells associated with the presence of the LNAPL material.

Groundwater data for metals show widespread elevated levels of lead, aluminum, barium, iron, sodium and magnesium. However, elevated levels in excess of Class GA standards for heavy metals were predominantly encountered at wells located along the western boundary of the site nearest the river. Cyanide was found essentially in all shallow wells throughout the site, in particular at well 5S, and at the Clarence Materials washdown well. It should be noted that mercury levels in groundwater on-site were below Class GA standards; however, the upgradient sample collected from monitoring well 2, nearest River Road, exceeded the groundwater standard for this metal.

Light Nonaqueous Phase Liquid

Light nonaqueous phase liquid material was found in three monitoring wells in the western portion of the site near the river. Samples of this material showed very high levels of semivolatile compounds, including a number of PAH and CPAH compounds, and PCB isomers.

The predominant concern from groundwater and LNAPL contamination at the site would appear to be migration to the Niagara River and near the mouth of the unnamed creek, as well as introduction of these contaminants into the underlying groundwater, especially since the majority of exceedances of groundwater standards for volatiles, semivolatiles, PCBs and metals of concern occurred in wells closest to this area, in particular, along the western border of the site.

Surface Water Sediment

Samples of surface water and sediment collected from the unnamed creek bordering the northern portion of the site indicated PAH contamination of the sediments above NYSDEC criteria at four of the six locations sampled with the highest level at the location nearest River Road. PCBs exceeded the guidance value in sediment samples from all six locations. Lead levels in creek sediments showed a consistently increasing trend towards the Niagara River.

Organic analyses of surface water performed as part of the previous Cherry Farm RI/FS found chloroform at estimated levels upstream of the site, but this compound was not detected elsewhere in the creek and it is a typical laboratory contaminant. Other organic compounds were not detected. Inorganic chemical analyses of surface water from this earlier study suggest that iron, aluminum and copper levels increased at downstream locations.

The relative contaminant contribution of the River Road site versus the Cherry Farm site to the creek is unknown. Comparison of upstream to downstream levels for the three creek locations suggests sediment contributions to the creek from the Cherry Farm and/or River Road site for contaminants such as PCB Aroclor-1254 and 1260, PAHs, CPAHs and lead which were all elevated in creek sediment. Other parameters, not noted above, remained at similar levels, or were not reported, at the creek locations adjacent to the River Road site.

A comparison of contaminant concentrations in excess of NYSDEC guidance values and criteria is presented in Section 4, Table 4-3 for each matrix evaluated in the Phase I/II Remedial Investigation. Values for VOCs, semivolatiles, carcinogenic PAHs, PCBs and inorganic contaminants exceed groundwater standards. Regarding on-site soils, a number of PAHs and carcinogenic PAHs, and inorganic contaminants exceed human ingestion criteria. Therefore, a potential for elevated human health risk and ecological impacts is assumed. Aquatic sediments collected from the unnamed creek contained levels over the aquatic toxicity threshold for CPAHs, PCBs and certain metal contaminants.

6.4 Pathway Analysis

6.4.1 Air Pathway

In accordance with NYSDEC draft cleanup policy guidelines (October, 1991), sites, which have not been remediated, are characterized as uncontrolled sources. As a rule, for volatile contaminants, if the concentration of the contaminated medium (in the case of River Road site surficial soils) is less than the appropriate ambient guideline for that chemical, it is highly unlikely that volatilization would create air quality concerns. The approach to this characterization is briefly discussed as follows:

- o Determine the emission routes for the ten volatile or semivolatile chemicals with the highest concentration;
- o Estimate baseline air concentrations for these ten chemicals (using emission rates as input); and
- o Measure baseline air concentrations.

Air monitoring conducted on site during the remedial investigation did not detect measurable levels of volatile contaminants. Isolated incidents of measurable levels did occur during borehole and test trench construction on site when waste materials were exposed.

A release of volatile contaminants from the surface soil may occur if the matrix is sufficiently permeable for such transport. A compound must exert sufficient vapor pressure to migrate through the stagnant soil air spaces. During the Phase I/II Remedial Investigation, flame ionization and photoionization readings for volatile constituents taken on the site surface, along the side of the fill/waste piles and upon collection of each soil sample at no time indicated readings above background levels. Therefore, this route of exposure can be considered an insignificant risk.

Given the lack of cover of the spoil piles on site, the air exposure pathway is identified as functional for existing site conditions due to the lack of cover, waste pile materials and lack of site entrance controls from the northern or southern borders. However, it is considered incomplete on a sitewide basis for volatile contaminants due to the low levels encountered.

Regarding fugitive dust transmitted via the air pathway at the site, the presence of elevated levels of PAHs and CPAHs and to a lesser extent, lead in the northwestern and southwestern portions of the site, combined with a lack of cover waste piles would allow for dispersion of fugitive dust by wind action. This would provide the potential for inhalation of these materials by site workers and others entering the site. As such, the fugitive dust pathway is considered functional and complete for the site.

6.4.2 Direct Soil Contact Pathway

The direct contact exposures to waste material and contaminated soil at the site include:

- Direct contact with the exposed wastes and soil located on site;
- Direct contact with site contaminants following their transport to off-site locations by air or surface water; and
- Direct contact to subsurface soils due to construction activities or erosional events which expose these materials.

For direct contact, the potential receptor (humans and wildlife) require exposure to waste material or contaminated soil. Under these circumstances, direct contact exposure can occur either by dermal absorption or by direct ingestion.

Based on site observations and surficial soil/waste pile sampling, direct exposure may occur at the exposed spoil mounds. Since these areas are poorly vegetated and slope erosion of the mound would expose "fresh" material, contact with the contaminated waste material is possible. For the direct contact route to be considered complete, a receptor must be present on the site in direct contact to the surface and/or subsurface fill material.

Due to the industrial nature of the site and the fact that the nearest residences are over 1 mile away, it is not expected that children would frequent the area. However, northern and southern site borders are not fenced and persons could assess the site from these areas. In addition, 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. Subsurface soils could be directly contacted by site workers during construction activities on-site.

In summary, the direct contact exposure pathway is identified as functional and complete for existing site conditions. This is due to the lack of site access controls combined with seasonal use of the riverine area for recreational purposes and the potential for boaters to access the site from the Niagara River. In addition, the proposed development of parkland on the Cherry Farm site to the north would increase the proximity of recreational users in the site area. Any exposures arising from this pathway are expected to be short term. From an ecological perspective, terrestrial organisms can come in direct contact to contaminants through use of the site as habitat or for foraging purposes. Regarding subsurface soils, the direct contact exposure pathway can be considered functional and complete for construction or excavation activities performed on site.

6.4.3 Surface Water Pathway

Transport of waste material and contaminated aquatic sediments to receptors via surface water and contaminated aquatic sediment exposure pathway can occur in several ways. Mechanisms of transport include the following:

1. Site runoff of dissolved and particulate bound contaminants into surface waters.
2. Discharge of groundwater containing dissolved contaminants into on-site surface waters (e.g., groundwater seepage and/or underflow into the unnamed creek and/or Niagara River).
3. Discharge of contaminated LNAPL directly into river or creek waters or indirectly into groundwater and subsequently to surface waters.

4. Movement of contaminated surface water sediment into proximity of human and wildlife receptors.

Potential exposure routes for humans or wildlife associated with contaminants transported in surface water related to the site include:

- Ingestion of drinking water from the Niagara River (potable water is obtained from the river approximately three miles downstream of the site);
- Ingestion during a recreational activity in the river or creek;
- Ingestion of contaminants that bioaccumulate in fish or other edible biota;
- Dermal absorption during recreational activities, like swimming and boating, as well as direct contact with contaminated sediments in the creek and LNAPL seepages along the creek or river; and
- Ecological impacts to terrestrial organisms burrowing through contaminated soil or sediments, or lethal and sublethal effects to aquatic biota from site runoff, LNAPL seepages, groundwater infiltration or contaminated aquatic sediments.

The surface water pathway is considered functional based on a number of scenarios. First, levels within the surficial sediments in the creek are above criteria for a number of PAHs and CPAHs and PCBs, iron, lead cadmium and manganese Runoff from precipitation collects in the creek which runs along the northern perimeter of the site and drains into the Niagara River. Rainwater flowing over and penetrating the upper portion of the fill would be expected to act as a transport mechanism for both suspended solids via erosion and leaching of water soluble compounds into the surface water systems along the margins of the site.

The most common chemical parameters identified at the site include PCBs, PAHs and metals. Most of these compounds are not readily soluble in water, but may be transported into surface waters as particulate bound contaminants. For example, 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, but can be conveyed to surface water in a similar way. In view of the high levels of PAHs, CPAHs and PCBs in the LNAPL material, and the close proximity of this material to the mouth of the creek and river, direct exposure of LNAPL to surface waters is considered functional.

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 having suspended solids (Callahan et al., 1979).

From an examination of the site hydrogeology, it is concluded that the bottom portion of fill material is submerged in groundwater. Additionally, the hydrogeologic investigation conducted at the site suggests that site groundwater discharges to the Niagara River at an average rate of approximately 30,000 gallons per day. As such, it may be concluded that soluble metals and organic compounds in the fill could be leached and transported by groundwater from the site.

Based on the assumption that a surface water transport route exists for contaminants into the Niagara River, it is possible that humans and wildlife could become exposed to these contaminants. The Niagara River is extensively used for recreation. However, the extensive dilution afforded by the Niagara River within the Tonawanda - North Tonawanda sub area would provide rapid dilution of site contributed contaminants (previous estimates at Tonawanda Island suggest a river flow of 62,000 CFS). From a risk standpoint, the area of concern would be confined primarily to the creek area which would allow direct potential contact by children and biota within this area.

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, from the creek or the associated wetlands. In this regard, the high levels of PAHs, CPAHs, PCBs and metal contaminants in sediments collected from the creek warrant concern. The vertical extent of these residues are unknown, but appear to be throughout the length of the creek. Storm water flow through the creek can act to mobilize these contaminated sediments downstream to the Niagara River. In this regard, 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 aquatic biota that have accumulated site contaminants.

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

In summary, the surface water route is considered functional and complete due to the transport of contaminants by site runoff and groundwater discharge into the creek areas. The release of site contaminants into the Niagara River via the creek discharge is based on the presence of residues detected in creek samples collected during the Phase II RI/FS investigation. The relative contribution of the River Road site to this creek versus Cherry Farm is unknown at the present time. However, the elevated levels of PAHs, CPAHs, PCBs and metals in surface water sediments in the creek warrant concern and require additional study to assess the vertical extent of contamination prior to arriving at the proper type of remediation.

Regarding site loadings to the river, the Niagara River Toxics Management Plan (1990) relates objectives of the Niagara River Secretariat. The goals of the management plan include implementation of programs to reduce toxic loadings to the river. These steps include quantification and, in the case of priority toxic compounds, provide for a commitment of 50% reduction of these toxics to the river. As presented in this report, the groundwater interchange to the surface water and the potential for direct seepage of LNAPL material, especially in the northwestern quadrant of the site, is unknown at the present time.

6.4.4 Groundwater Pathway

The transport of groundwater contaminants towards a receptor requires the following conditions:

- o Waste constituents with sufficient water solubility to become dissolved by and transported with groundwater;
- o Solubility of the contaminants found in the LNAPL to become dissolved by and transported into groundwater;
- o A mechanism by which surface infiltration and/or groundwater can contact and leach soluble components of the waste material; and
- o A mechanism for the movement of the leachate into and with groundwater to receptor locations hydraulically downgradient of the site (e.g., advective, dispersive or diffusional residual transport).

Potential exposure routes related to the groundwater exposure pathway include:

- o Drinking water ingestion from private groundwater wells;
- o Ingestion of contaminants which bioaccumulate in edible biota; and
- o Ecological impacts from acute and chronic levels of contaminants in surface waters.

Two considerations suggest that the groundwater pathway is currently functional at the site. First, contact between the groundwater and fill material and groundwater and LNAPL material has been documented. Second, an analysis of groundwater beneath the River Road site has indicated the presence of compounds consistent with those found in the fill and LNAPL materials at the site.

One route for surface water exposure is a discharge of groundwater containing site contaminants into the adjacent creek or the Niagara River. In this regard, elevated levels of PAHs, CPAHs, PCBs and metals have been reported in groundwater samples from wells along the western border of the site primarily in proximity to wells where the LNAPL materials were encountered. Water soluble compounds contained in the fill and LNAPL materials could leach into and be transported by the groundwater. Groundwater flow is to the west, toward the Niagara River. The lower level of groundwater contaminants in the center of the site may be in direct response to the high pH levels (pH of 11.0) in groundwater near the center of the site which appear to be reducing the solubility of groundwater metals in this area. Solubility would tend to increase as the pH approaches 7.0 (near the northwestern border of the site. Based on an estimate of the groundwater discharge rate from the upper zone at the western edge of the site into the river of approximately 30,000 gallons per day (see Section 3.3.1.1) and using the maximum concentrations detected during the Phase I and II RI/FS program, the daily loadings from the site for the groundwater contaminants of concern are as follows:

<u>Groundwater</u>

Total VOCs - 0.0078 lbs/day (assumes no volatilization)

Total PAHs - 0.0122 lbs/day (assumes no removal via filtration in groundwater)

Carcinogenic PAHs - 0.0013 lbs/day (assumes no removal via filtration in groundwater)

Total PCBs - 0.0005 lbs/day

Lead - 0.0028 lbs/day

Mercury - 0.00008 lbs/day

For comparison purposes, the 1989 - 1990 total priority pollutant loading from the site into the Niagara River was estimated by the USEPA to be 2.6 lbs/day. For all discharges to the river, the total loading for all contaminants estimated by the NYSDEC was 546 lbs/day (Draft Niagara River Remedial Action Plan Summary, March 1993). Due to a lack of a flow component for the LNAPL material, loadings to the river from this material cannot be estimated at the present time.

The groundwater pathway is considered functional due to an observed release of site residues into the groundwater specifically in the western portion of the site.

In summary, for a groundwater 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 groundwater from a potable groundwater well. In the Town of Tonawanda, residences and commercial establishments are supplied by municipal water. This water is obtained from intakes approximately three miles downstream of the site in the Niagara River. This water is subsequently treated and tested prior to distribution to water users. If potable water wells were to be developed near the site, the well would not be within the range of groundwater passing through the site because the predominant groundwater direction is toward the Niagara River. Site leachate is not expected to move north or south across the groundwater flow gradient. Therefore, any plume would be transported west into the River. As such, there is currently a potential for direct groundwater exposure to humans. As such, the groundwater exposure pathway for humans is currently identified as functional, but incomplete for existing conditions. However, the levels of contaminants contained in the groundwater and LNAPL components are at levels which warrant concern. As such, remediation of these areas will be evaluated further.

From an environmental perspective, the potential for contaminant migration through groundwater from the River Road site must, given the lack of seepage information, be considered functional and complete for existing conditions. As noted in the Draft Niagara River Remedial Action Plan Summary (March 1993). "Disposal sites located in the fill areas along the river, in general, are the sites having the greatest potential for contaminant migration due to the nature of geologic materials and the short contaminant travel distance to the River." Clearly, this is in keeping with the conditions identified at the River Road site.

6.5 Summary and Conclusions

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 River Road 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 contaminants 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 Table 6-2 for the existing site conditions.

Under 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 and contaminated soil could lead to direct contact through dermal, inhalation and ingestion exposures, or can be carried into surface waters. The subsurface soil contamination would also be considered complete if on-site excavation or construction occurs. The volatization pathway is considered incomplete due to the lack of these types of contaminants in surficial soils. The groundwater pathway, with the exception of the northwestern quadrant of the site is considered incomplete. The groundwater pathway in the northwestern quadrant of the site is considered unknown at the present time and warrants further study for the presence of leachate seeps and assessment of health risk and ecological impacts. The LNAPL pathway is considered functional, but unknown due to a lack of information regarding seepages of this material to the river or creek. Overall, the direct groundwater pathway to human receptors was not considered complete due to the presence of an available municipal water supply. However, due to the elevated levels encountered, the groundwater and LNAPL will be considered for remediation. The Clarence Materials washdown well sampled during the RI/FS investigation is not used and should be properly abandoned.

Comparison of Risk to the Cherry Farm Site

Although beyond the scope of the qualitative risk assessment, it is useful to assess the levels of contaminants found in the Phase I/II Remedial Investigation for the River Road site to the levels of contaminants and risks developed in the Cherry Farm study. In this comparison, a qualitative estimate of risk compared to Cherry Farm is made based upon the maximum contaminant levels

TABLE 6-2

Summary of Exposure Pathways for the River Road Site

Waste Source	*Release Mechanism*	*Transport Mechanism*	*Exposure/Uptake*	*Potential Receptors*	*Status*	*Rationale*
Constituents include: *PAHs* – Surface soils, waste piles, LNAPL, and ground water samples at wells 5S, 6S, and 8S and creek sediments. *Carcinogenic PAHs* – subsurface soils, waste piles, LNAPL and ground water water samples at wells 5S, 6S, and 8S, and creek sediments. *PCBs* – Surface soils adjacent to creek area, creek sediments, LNAPL and ground water samples at wells 5S, 6S, and 8S. *Lead* – Surface soils, subsurface soils and LNAPL and ground water samples at wells 4S, 5S, S and 8S. *Other Heavy Metals* – sporadic throughout site and creek sediments.	Volatilization	Air	Inhalation	Humans	Incomplete (except during excavations)	Low Volatile Levels
				Wildlife	Incomplete (except during excavations)	Low Volatile Levels
	Wind erosion (dust)	Air	Inhalation	Humans	Complete	Exposed waste piles and contaminated surface soil may result in airborne particulate bound contaminants.
				Wildlife	Complete	
	Direct contact	Surface soil, subsurface soil and creek sediment	Dermal absorption and ingestion	Humans	Complete	Waste pile spoils are exposed. Animals may contact waste material and contaminated soil during burrowing activities. Lack of site access/egress controls allow for human contact. Subsurface soil contact would occur during construction or erosion events.
				Wildlife	Complete	
	Surface runoff, groundwater release to surface water sediment movement	Surface water and surface water sediment	Direct ingestion, ingestion of contaminated biota, inhalation and dermal absorption	Humans	Complete	Groundwater flow indicates water soluble and particulate bound nonsoluble residues would flow into Niagara River and creek. Both may be used for recreational purposes and as a wildlife habitat.
				Wildlife	Complete	
	Leachate drainage of groundwater and seepages of LNAPL	Groundwater and LNAPL	Ingestion, inhalation and dermal absorption	Humans	Unknown	Content and extent of leachate or seepages along the banks of the creek and/or Niagara River is unknown.
				Wildlife	Unknown	

encountered at the River Road site. The health risk assessment performed as part of the remedial investigation for the Cherry Farm site and qualitative assessment of the risk at the River Road site is presented on Table 6-3.

Based upon the overall evaluation of sample concentration and exposure routes, the Cherry Farm risk assessment determined that chronic exposure to exposed surficial soils contaminated with lead, arsenic, PCBs and benzene posed an unacceptable health risk. Although not directly comparable due to dilution factors and uptake rates, the relative risk based upon average surface and subsurface soil levels encountered at the River Road site would be more unacceptable for cadmium and lead. Similarly, for carcinogens in soil, significantly higher levels of benzo (a) pyrene, benzo (a) anthracene, chrysene and benzo (a and k) flouranthene at the River Road site would suggest a more unacceptable risk compared to that presented for the Cherry Farm site. Conversely, the risk of groundwater release to surface water would be less than that calculated for Cherry Farm. Regarding the LNAPL material found at the River Road site, this type of material was not detected at the Cherry Farm site. The levels of PAHs, CPAHs, PCBs and lead would suggest an unacceptable risk from these materials if releases (seepages) occurred at the River Road site.

Table 6-3

RISK COMPARISON OF THE CHERRY FARM SITE AND QUALITATIVE RISKS FOR THE RIVER ROAD SITE

Matrix*	Risk of Concern	Remarks for Cherry Farm	Qualitative Human Health Risk Comparison for River Road
Surface soil	Carcinogenic compounds	Above acceptable risk level	Above acceptable risk level for PAHs, CPAHs, Pb
Surface water incidental ingestion	Noncarcinogenic compounds	Below threshold	Below threshold
Surface water intentional ingestion	Noncarcinogenic compounds	Below threshold	Below threshold
Groundwater	Carcinogenic compounds	Below threshold	Below threshold

* The matrices presented above are those presented in the Cherry Farm Risk Assessment. That document did not summarize the risks for subsurface soil, also, LNAPL material was not encountered at that site.

Section 7

7.0 PRELIMINARY FEASIBILITY STUDY

7.1 Approach

As part of the NYSDEC's program to investigate and remediate the River Road site, a remedial investigation and feasibility study was undertaken. The purpose of this RI/FS is to determine the nature, extent and sources of contamination (presented in Sections 1.0 - 5.0 of this document), identify the qualitative risks to human health and the environment (Section 6.0), and perform a preliminary feasibility study to identify potential remedial technologies. The preliminary feasibility study for the River Road site considers portions of the adjacent Cherry Farm feasibility study to the maximum extent practicable, while considering compliance with existing NYSDEC guidance as prescribed in the Technical Action Guidance Memorandum (TAGM) documents for conducting the feasibility study (FS) process. Based upon the levels of contaminants encountered at the River Road site a Phase III Feasibility Study which determines the effectiveness, implementability and cost of selected remedial activities will be developed. The Phase III FS will be performed in accordance with TAGM requirements.

The Preliminary FS process identifies and screens the potentially applicable remedial technologies. In large part, the feasible alternatives developed and evaluated for the Cherry Farm site were used as a basis for this study. Additional technologies not considered in this previous adjacent site effort, which have merit for the River Road site, were also included in this preliminary feasibility study, as appropriate.

The approach of the preliminary feasibility study is to initially develop remedial action objectives for medium-specific or operable unit specific goals to protect human health and the environment. The goals consider the contaminants and contaminant concentrations (as determined by the remedial investigation), the exposure routes and potential receptors (as determined by the qualitative risk assessment), and the acceptable contaminant or risk levels or range of levels. Acceptable contaminant or risk levels include standards, criteria and guidelines (SCGs) which were identified and compared to existing conditions on the site in the RI report.

Development of general response actions includes identification of classes of response actions which could be implemented for remediation of the site. Potential general response actions include no action, containment, on-site and in situ treatment, or removal followed by off-site treatment and/or secure disposal.

Potentially applicable remedial technologies identified for the Cherry Farm site were evaluated for each general response action for the River Road site. Technologies which were not technically applicable or unproven were eliminated from further consideration. Screening of alternatives will consider effectiveness and implementability as discussed below. The remaining technologies will be carried forward to the Phase III feasibility study screening for evaluations.

Screening of technologies includes a preliminary evaluation of effectiveness and implementability in accordance with NYSDEC criteria. Effectiveness evaluation includes consideration of the following:

1. The potential effectiveness of process options in handling the estimated areas or volumes of media, and meeting the remediation goals identified by the remedial action objectives.
2. The potential impacts to human health and the environment during the construction and implementation phase.
3. The proven effectiveness and reliability of the process with respect to the contaminants and conditions at the site.

Implementability includes both the technical and administrative feasibility of implementing the technology or alternative. Administrative feasibility considers institutional factors such as the ability to obtain necessary permits for on-site or off-site actions, the ability to comply with certain institutional aspects of SCGs, the availability and capacity of treatment, storage and disposal services, the availability of equipment and skilled labor to implement the technology, the ability to design, construct and operate the alternative and acceptability to the regulatory agencies and the public. In accordance with NYSDEC requirements, costs are not considered at this stage of the Feasibility Study process.

The results of the screening process includes a list of technologies which will be carried forward for detailed evaluation as part of the Phase III Feasibility Study.

7.2 Contaminant and Risk Assessment Comparison of the River Road Site to the Cherry Farm Site

7.2.1 Surface Soil

As presented in Section 4.4 of this document, the relative ranges of contaminants by group in surface soils at the River Road and Cherry Farm sites suggest higher levels of PAHs, carcinogenic PAHs, and, to a lesser extent, mercury at the River Road site. Conversely, levels of total PCBs and VOCs were found at higher levels at the Cherry Farm site. Total lead levels in surface soils were essentially similar at both locations.

From a comparative risk perspective, levels of VOCs found at the River Road site were not at levels of concern. However, exposed waste piles and contaminated surficial soils contained elevated levels of PAHs, carcinogenic PAHs and lead. Mercury levels were below the 2 mg/kg New York State Bureau of Fish and Wildlife threshold. The exposure pathway for these contaminants was determined to be complete and poses a risk to human and wildlife receptors.

7.2.2 Subsurface Soils

Subsurface soil samples collection at the River Road site encompassed both test trench and borehole samples. In general, test trench samples are considered to be more indicative of a worst case contaminant screen because sample collection areas were chosen with an eye towards obvious alterations (e.g., the presence of buried metal material suggested by previous magnetometer surveys, areas with drums on the surface, or areas of surface discoloration or depressional areas) which would possibly contain contaminants. In this regard, with the notable exception of lead, all test trench samples contained higher levels of contaminants when compared to borehole samples.

Subsurface soil levels of carcinogenic PAHs, antimony, mercury and lead at the River Road site were higher than Cherry Farm, although the reported mercury level was below the 2 mg/kg New York State Bureau of Fish and Wildlife threshold. Levels of total PAHs and arsenic are considered nearly similar, while levels of PCBs and VOCs were found at greater levels at the Cherry Farm site.

7.2.3 Groundwater

Groundwater contaminants were generally found in elevated concentrations at the Cherry Farm site than at River Road. Notable exceptions include PAHs, CPAHs, PCBs and metals. Elevated groundwater levels of contaminants were found at the River Road site, especially in areas underlying the light nonaqueous phase liquid (LNAPL).

The lack of potential human receptors at the River Road site (exclusive of possible contact with groundwater and LNAPL seepages) suggests that this pathway is functional but not complete for this matrix. However, given the lack of information concerning potential seepages of contaminated groundwater, particularly in the northwestern quadrant of the site, combined with the elevated levels of PAHs and CPAHs in the LNAPL material are a source of concern and potential risk to human health and wildlife. As such, remedial actions to address groundwater and LNAPL materials will be evaluated.

7.2.4 Surface Water

No surface water samples were collected during the Phase I/II Remedial Investigation at the River Road site. However, surface water and sediment samples were collected from the creek bisecting the River Road site and Cherry Farm site from three locations in July and December of 1988, as part of the Cherry Farm RI/FS, and at six locations in 1993. In this study, organic analyses of surface water found chloroform at estimated levels upstream of the site, but this compound was not detected elsewhere in the creek. Other organic compounds were not detected. Inorganic chemical analyses of surface water suggest iron, aluminum and copper levels increased at downstream locations.

Regarding surface water sediment results, Cherry Farm site station SED-5 (at approximately the midpoint of the creek at the northern border of the River Road site) revealed high concentrations of PCBs, predominantly Aroclor-1254 and 1260, at levels of 1,000 mg/kg and 150 mg/kg, respectively, which were not detected in upstream samples. Other organic compounds were not detected at the three stations.

Inorganic results for sediment show elevated levels of cadmium, copper, lead and zinc at downstream locations.

The relative contaminant contribution of the River Road site versus the Cherry Farm site to the creek is unknown. In summary, comparison of upstream to downstream levels for the three creek locations suggests contaminant contributions to the creek sediment from the Cherry Farm and/or River Road site for contaminants such as PCBs, cadmium, copper, lead and zinc.

The health risk assessment performed for the Cherry Farm site RI/FS suggested that the surface water route of exposure was considered functional and that a release of contaminants into the Niagara River is likely. However, this risk assessment found that the relative risk from surface water contamination to the Niagara River was well below the hazard index threshold (1.9×10^{-3} and 7.8×10^{-3} for adult and child maximum Reference Dose fraction (RFD), respectively) for incidental ingestion. Direct ingestion as a potable water source (1.0×10^{-4} and 2.0×10^{-4} for adult and child maximum RFD, respectively) was also well below the hazard index threshold. The relative hazards of exposures to surface water sediment, including the elevated levels of PCBs, were not presented in the Cherry Farm report and are considered unknown.

7.2.5 Risk Assessment Exposure Pathways

The overall objective of remedial action for the River Road site is to meet the applicable standards, criteria and guidelines (SCGs), and to mitigate the incremental risk to human health and the environment. Accomplishment of this objective requires that potential exposure to contaminants through various environmental pathways be reduced to applicable SCGs. Preliminary SCGs for the River Road site include NYSDEC Soil Cleanup Criteria Guidelines, New York Class GA Groundwater Standards and Guidance Values, New York State Class A Surface Water Standards and Guidance Values, and site specific concentrations determined for identified contaminants of concern by NYSDEC and the New York State Department of Health (NYSDOH). The potential pathways for exposure of humans and other biota to contaminants from the River Road site include the following:

- Incidental ingestion of contaminated soil;
- Dermal contact with contaminated soil;
- Inhalation of fugitive dust from contaminated soil;
- Ingestion of contaminated surface water and groundwater;
- Dermal contact with contaminated surface water, groundwater and surface water sediment; and

- Ingestion of contaminated biota.

Except for seepages, human exposure to contaminated groundwater does not appear to be of concern at the site. There are no nearby potable water wells, and the groundwater in the vicinity of the site flows in a westerly direction towards the Niagara River and is not used as a source of drinking water for local residents. The relatively small contaminant loadings to the river would be diluted and pose little risk to downstream receptors.

Comparison of the River Road site risks to the adjacent Cherry Farm site shows a greater unacceptable risk of exposure at the River Road site for cadmium, lead and carcinogenic PAH contaminants versus the Cherry Farm site, while groundwater risk would be less than that calculated for Cherry Farm.

7.3 Remedial Action Objectives

Remedial action objectives are goals developed for the protection of human health and the environment. Definition of these objectives require an assessment of the contaminants and media of concern, exposure routes and receptors, and the remediation goals for each respective exposure route. Typically, remediation goals are established based upon standards, guidance values or criteria. For this Preliminary Feasibility Study, the following remediation criteria, as developed by NYSDEC and NYSDOH and utilized at other superfund sites, are used:

- Surface Soil/Subsurface Soil - NYSDOH/NYSDEC criteria for levels of concern as follows:

Total PAHs	100 mg/kg
Total Carcinogenic PAHs	10 mg/kg
Total PCBs (Surface)	1 mg/kg
Total PCBs (Subsurface)	10 mg/kg
Total VOCs	1 mg/kg
Lead	500 mg/kg
Mercury	10 mg/kg*

*This value is utilized as a level of concern for previous studies. The New York State Bureau of Fish and Wildlife value for this element is 2 mg/kg.

- Groundwater - NYSDEC Class GA groundwater standards and guidance values.
- Surface Water - NYSDEC Class A water quality criteria.
- Surface Water Sediment - Sediment criteria derived from bioassay/bioaccumulation literature based upon laboratory in situ testing for the protection of aquatic organisms.

The remedial action objectives developed for the River Road site based upon existing information are as follows:

1. Prevent direct contact exposure (dermal absorption, inhalation and incidental ingestion) with contaminated waste piles and surface soils which contain elevated levels of PAHs, carcinogenic PAHs and lead.
2. Prevent or reduce the potential for surface runoff from surficially contaminated portions of the site to transport contaminants off site. This also includes reduction of erosion of subsurface materials from exposed side slopes into surface water or surface water sediments.
3. Prevent contaminant loading to the unnamed creek or the Niagara River via contaminated groundwater and seepages.

The above objectives are presented in Table 7-1, along with the remedial action objectives. The groundwater pathway for the western portion of the site was found to be contaminated especially in areas underlying LNAPL material. The wells nearest the Niagara River were noted to contain elevated levels of PAHs, carcinogenic PAHs and selected metals. As discussed in the conclusions of the Phase I/II RI report, the relative impacts of groundwater via seepages, and contaminated creek sediment is unknown, however, there is the potential for adverse impacts. As such, this feasibility study will address remedial actions for surface and subsurface soils, and waste piles and groundwater. Surface water sediment remediation will be addressed as part of the Cherry Farms remedial program.

7.4 Identification and Evaluation of Remedial Action Technologies

7.4.1 Introduction

As part of the Cherry Farm RI/FS, an identification and analysis of potentially applicable remedial technology types were evaluated. A discussion of those technologies and others is presented below. It should be noted that at the Cherry Farm site, the groundwater pathway, based upon elevated levels of volatile organic compounds, was noted as a key element of the site remedial plan. Activities regarding groundwater contaminants for the River Road site will be discussed within Section 7.4.4 dealing with institutional actions.

In general, response actions which satisfy remedial objectives for a site include institutional, containment, removal or treatment actions. In addition to the above, USEPA guidance under CERCLA requires the evaluation of a no action alternative in addition to the above.

TABLE 7 - 1

Remedial Action Objectives

Exposure Pathways	*Environmental Media*	*Remedial Action Objectives*
1. Ingestion of contaminated soil	Soil	Reduce exposure or contaminant concentrations to acceptable levels as defined by NYSDEC/ NYSDOH.
2. Dermal exposure to contaminated soil	Soil	Reduce exposure or contaminant concentrations to acceptable levels as defined by NYSDEC/ NYSDOH.
3. Ingestion of contaminated surface water	Surface Water	Eliminate/reduce discharges to the creek/ Niagara River.
4. Dermal exposure to contaminated surface water and surface water sediment	Surface Water and Sediment	Eliminate/reduce discharges to the creek.
5. Ingestion of contaminated fish	Water	Control consumption of biota from creek area. Eliminate/reduce contaminant concentrations to New York State Class A Surface Water Quality Standards and groundwater levels to NYS Class GA Groundwater Standards. Reduce sediment contaminant concentrations or exposure to below acute/chronic toxicity limits.
6. Inhalation of fugitive dust from contaminated soil	Air	Reduce exposure or contaminant concentrations to levels that comply with NYSDEC ambient guideline concentrations.
7. Ingestion of contaminated groundwater/ LNAPL	Groundwater/ LNAPL	Eliminate/reduce levels encountered.
8. Dermal exposure to contaminated groundwater/ LNAPL	Groundwater/ LNAPL	Eliminate/reduce levels encountered.

The evaluation of possible remedial technologies requires the development of objectives for contaminant-specific cleanup criteria. In addition, each response action for each medium of interest must satisfy the remedial action objectives for the site or the specific operable unit. Technology types and process options are identified by standard treatment technologies or use of Superfund Innovative Technology Evaluation (SITE) treatment systems. The screening process options or technology types are performed by determining their ability to meet specific remedial action objectives, their technical implementability, and their short-term and long-term effectiveness.

7.4.2 Identification of New York State Standards, Criteria and Guidelines (SCGs)

This section provides a detailed presentation of public health and environmental criteria that are applicable or relevant and appropriate to this New York State Superfund site and remedial investigation/feasibility study. A large number of potential federal and New York State standards and guidance values were available for consideration; however, only the New York State standards, criteria and guidelines (SCGs) for groundwater and water supply are applicable for preparation of this FS. The standards and guidance values selected for this FS, as discussed previously, are the quality standards for Class GA groundwater defined under 6NYCRR 703 which includes references to 10NYCRR Subpart 5-1 Public Water Supplies, 10NYCRR Part 170 - Sources of Water Supply and 40 CFR Part 141 - Safe Drinking Water Act (maximum contaminant levels for drinking water), and NYSDEC Class A surface water quality standards for the Niagara River. All of the current standards and guidance values referenced in NYCRR 703.5(a)(2) have been summarized in the NYSDEC Technical and Operational Guidance Series (TOGS) (1.1.1) Ambient Water Quality Standards and Guidance Values, effective September 1990 which were revised on November 15, 1991 as a result of amendment to 6 NYCRR Parts 700-705 effective September 1, 1991.

Pursuant to the National Contingency Plan (NCP), Applicable or Relevant and Appropriate Requirements (ARARs) are to be considered when formulating, screening and evaluating remedial alternatives at National Priorities List (NPL) sites. ARARs may be categorized as contaminant-specific, location-specific or action-specific. Although the River Road site is a New York State Superfund site and not a federal NPL site, federal statutes, regulations and programs may apply to the site where state standards or guidelines do not exist. A summary of the preliminary remediation ARARs, including the New York State SCGs for groundwater and surface water for the River Road site is presented in Table 7-2.

TABLE 7 – 2

SCGs and Preliminary Remediation ARARs for the River Road Site

Statue, Regulation or Program	*Applicability*	*Category*
Water Quality Standards for Surface and Groundwater (6 NYCRR Parts 700 - 705)	Applicable to all sources of surface and groundwater	Action-specific; Contamination-specific; Location-specific
NYSDOH Requirements for General Organic Chemicals in Drinking Water (PHL; Sections 201 and 205)	Applicable to sources of potable water supply.	Contaminant-specific;
NYSDEC Air Guide-1 (New York State Air Guidelines for Control of Toxic Ambient Air Contaminants)	Applicable where remedial activities will impact ambient air quality.	Action-specific; Contaminant-specific
Clean Air Act	Applicable where remedial activities will impact ambient air quality.	Action-specific; Contaminant-specific
NYSDEC Hazardous Waste Treatment Storage and Disposal Facility Permitting Requirements (6 NYCRR Part 373)	Applicable groundwater protection standards and to potential treatment, storage and disposal of hazardous wastes.	Action-specific; Contaminant-specific
Safe Drinking Water Act/USEPA Health Advisories 40 C.F.R. Parts 141, 142 and 143)	Applicable Maximum Contaminant Levels to sources of groundwater and potable water supply where more stringent or where specific NYSDEC standards or guidelines do not exist.	Contaminant-specific
Resource Conservation and Recovery Act-Groundwater Protection Standards (40 CFR Part 264, 90-264,109)	Applicable standards to sources of groundwater and potable water supply where more stringent or where specific NYSDEC standards or guidelines do not exist.	Contaminant-specific
Resource Conservation and Recovery Act-Subtitle C/Hazardous and Solid Waste Ammendments/New York State Hazardous Waste Management Regulations.	Applicable to the treatment, storage, transportation and disposal of hazardous wastes and wastes listed under 6 NYCRR Part 371.	Action-specific
Clean Water Act - Ambient Water Quality Criteria (EPA 44/5-86-001)	Applicable to alternatives involving treatment with point-source discharges to surface water.	Action-specific; Contaminant-specific; Location-specific

TABLE 7-2 (CONT'D)

Statute, Regulation or Program	*Applicability*	*Category*
Occupational Safety and Health Administration (OSHA) Regulations (29 CFR 1900–1999)	Applicable to workers and work place throughout implementation of investigation activities and remedial actions.	Action-specific; Contaminant-specific; Location-specific
Hazardous Materials Transportation	Applicable to off-site transport of hazardous materials.	Action-specific
New York State Uniform Procedures Act	Applicable to projects requiring a State Pollutant Discharge Elimination System permit.	Action-specific
State Pollutant Discharge Elimination System Permit Program	Applicable to projects which discharge treated effluent to surface waters or groundwaters of New York State.	Action-specific; Contaminant-specific; Location-specific

Although preliminary remediation goals have been established based upon appropriate standards (e.g., SCGs and ARARs), final acceptable exposure levels will be based upon results of the risk assessment, and the evaluation of expected exposures and associated risks for each alternative or the establishment of cleanup levels based on acceptable levels of risk. In this regard, the NYSDOH in conjunction with NYSDEC, based upon hazardous site investigations/activities in the Niagara River area, have developed categories of compounds and levels of concern for inactive hazardous waste sites in industrially zoned areas. These guidelines, which were presented in Section 7.3, have been utilized in the RI/FS process.

7.4.3 No-action

The no-action alternative will be considered and will serve as a baseline to compare and evaluate the effectiveness of other actions. Under the no-action scenario, limited remedial response actions may be considered including site access restrictions, sign posting and monitoring. Signs would be posted to notify the public of the presence of hazardous waste, and routine environmental sampling (groundwater sampling from monitoring wells) would be conducted to evaluate changes over time in environmental (groundwater) conditions at and in the vicinity of the site. Surface water monitoring will be addressed under the Cherry Farm site remedial effort. Continued groundwater monitoring would be necessary to ascertain the level of any natural attenuation which may be occurring or any increase in contamination necessitating further remedial action. Natural attenuation, as opposed to active remediation and/or restoration, relies on naturally occurring physical and biological processes to reduce contaminant concentrations.

7.4.4 Institutional Actions

The Cherry Farm site feasibility study screened three types of institutional technologies for groundwater and two for soils. These were access restrictions, monitoring for groundwater and soils, and alternate water supply (for groundwater). The alternate water supply alternative was determined to be not applicable due to a lack of private domestic wells in the area of the site and the presence of a municipal water supply. In the case of the River Road site, the currently inactive Clarence Materials washdown well can be characterized as a potential water supply in the site area and should be considered for proper abandonment to ensure that this well is no longer used. Both access restrictions (such as construction of a fence around the site) and continued monitoring of wells is considered potentially applicable to the River Road site, with restrictions regarding the use of the Clarence Materials well as part of this action. Groundwater collection actions including extraction (pumping wells) and interceptor trenches are considered potentially applicable and will be evaluated further. Also, applicable to the River Road site, are deed restrictions which prohibit/restrict use of the site.

7.4.5 Containment Actions

Contaminant containment technologies include subsurface barriers, such as slurry walls, caps and secure landfills. These technologies are designed to prevent migration of contaminants from the contaminated area. The technologies do not provide any treatment for the contained waste (except for stabilized waste disposal in secure landfills). NYSDEC ranks on-site containment technologies fourth out of five possible remedial technology categories and off-site land disposal as fifth (in order of preference, these are: destruction, separation/treatment, solidification/chemical fixation, isolation and containment, and off-site land disposal).

The Cherry Farm site FS considered two types of containment/land disposal remedial technologies for site soils with six basic process options as follows:

Cap	RCRA Asphalt Concrete Multi-media
Land Disposal	On-site landfill Commercial/off-site landfill

The land disposal option at a commercial landfill was considered infeasible for the Cherry Farm site due to the volume of contaminated material which would need to be removed. At the River Road site, estimates of removal of surficial waste material are considerably less than at Cherry Farm (approximately 275,000 cubic yards of material versus 1.0 million cubic yards at the Cherry Farm site). As such, the process options for off-site disposal at a secure landfill considered for Cherry Farm site are applicable for River Road. Regarding the on-site landfill option, this technology will be considered further in the Phase III Feasibility Study.

With regard to capping, asphalt and concrete caps have some advantage over earthen cover in that these technologies would limit infiltration by precipitation. However, the practicality of coverage of large areas of the site with these materials is questionable. Also, the esthetics of this technology adjacent to the parkland area being planned for the Cherry Farm site reduces the desirability of the asphalt and concrete capping approaches. Given the more natural appearance of the soil cover utilized with the earth cover, RCRA cap or multi-media cap technologies, these latter capping technologies are considered more desirable and will be considered further for use in the preliminary feasibility study.

Resource Conservation and Recovery Act (RCRA) Cap

This technology consists of constructing a RCRA cap over the entire surface of the site. The cap would prevent direct contact with contaminated soils and would minimize infiltration of rain water through the contaminated soil and further contamination of groundwater. It could also eliminate the flow of contaminated runoff to surface water. A RCRA cover typically includes three sections. The top section consists of vegetated topsoil and a soil layer. The middle section contains a sand and gravel filter which prevents clogging of the underlying drainage layer. The bottom section is comprised of a flexible membrane liner (FML), which overlies and protects a low permeability FML/compacted soil/clay layer. The relative thickness of the RCRA cap (±8 feet) would reduce its utility on the River Road site when compared to the multimedia cap. Although potentially applicable, this will not be discussed further.

Multi-media Cap

This technology consists of a three layered system comprised of a vegetated topsoil upper layer, underlain by a drainage layer followed by a low permeability layer comprised of clay or FML. The thickness of the multi-media cap is approximately 3 feet. This cover also precludes infiltration of precipitation and runoff of contaminants. This technology is considered potentially applicable and will be considered further.

Earth Cover

This technology provides for the placement and grading of a ±2 foot topsoil and/or gravel cover over the contaminated areas of the site. This cover mitigates direct contact with runoff of contaminated surface soils. However, it does not preclude infiltration of precipitation.

Slurry Wall

This technology involves constructing a slurry wall completely or partially around the site in conjunction with a RCRA or multi-media cap. The slurry wall would prevent migration of contaminated groundwater from the site. It would be keyed into a low permeability clay layer to prevent migration of contaminants beneath the wall. Since on-site backfill is not available, off-site backfill would be used in the soil-bentonite slurry. Extraction wells would be installed to provide gradient control across the slurry wall. A continuous slurry wall along the western and northern borders of the site could be installed. Given the shallow hard slag material on-site, this alternative will be costly to construct; however, it will be considered further.

River/Creek Bank Stabilization

In conjunction with one of the above containment actions, a protective covering and/or rip/rap placement along the borders of the creek and river bank is considered as a potential remedial action. This technology would provide reduced erosion of creek banks and exposure of subsurface contaminants. As presently envisioned, bank stabilization would probably require grubbing, clearing and grading of the side slopes of the creek bank coincident with rip/rap placement. In addition, to reduce scour via storm water runoff, gravel could also be placed directly in the creek margin. The remediation of creek sediments will be under the Cherry Farm RI/FS program. As such, remediation of this area will not be evaluated in the Phase III feasibility study for the River Road site.

7.4.6 Groundwater Collection Actions

Technologies for groundwater extraction remove the groundwater for further treatment. Potentially applicable extraction technologies for the River Road site include extraction wells and trench drains. Each of these technologies is discussed below.

Groundwater Extraction Wells

Groundwater extraction involves the removal of contaminated groundwater and LNAPL using subsurface pumps installed in groundwater extraction wells. A pumping system consisting of separate pumps for the LNAPL and aqueous phases is commonly used when both dissolved contaminants and a floating LNAPL phase are present. Contaminated groundwater containing dissolved contaminants are typically removed using a conventional extraction well and pump design. The extraction wells would be located downgradient of the area of contaminated groundwater. The groundwater would be pumped with submersible pumps at a rate determined by slug tests and/or pump tests. Based on the desired flow rate, the required number of extraction wells can be determined. A field study would be needed prior to design and implementation of an extraction well system.

Removal of the floating LNAPL phase will require the use of scavenger pumps or skimmers set within the LNAPL zone in the extraction wells. Oil/water interface probes will also be installed. The probes will be used as controllers to prevent the scavenger pumps from removing groundwater. LNAPL removed by the scavenger pumps will be piped to a holding tank on the surface for off-site treatment.

Trench Drain System

In a trench drain system, trenches are installed downgradient of the groundwater area. The trenches lead to sumps. Groundwater is pumped from the sumps to a treatment system. Because the system is a typically passive withdrawal system but can be active with the installation of a pump in the trench, it would likely require more time to remove a given volume of groundwater than an active system such as extraction wells. Trench drains do not draw the groundwater into the trenches as do extraction wells. A second disadvantage of a trench drain system for the River Road site is the presence of the LNAPL phase.

Trench drains may be applicable in shallow zones where contaminated groundwater exists. A disadvantage to this use would be the large quantity of suspended solids that would runoff into the trenches. The suspended solids may interfere with the oil/water separation process. A large amount of solids would settle to the bottom of the separator. Any solids carryover to the organics removal process may inhibit effective operation of the process.

7.4.7 Removal Actions

The removal of contaminated soils was considered for the Cherry Farm site. This technology was considered infeasible due to the volume of material at that site. The considerably reduced volume at the River Road site would allow for this action to be considered potentially applicable for waste piles, surface and subsurface soils, and will be considered further. The hard slag layer underlying portions of the site would create difficulty for the removal of contaminated subsurface soils.

Water Separation

Oil/water separators will be used to remove petroleum products (e.g., suspended oil droplets) that are not removed by the oil scavenger pump/skimmer system. Such treatment will be performed prior to further treatment for heavy metals removal and organics removal. The water/oil mixture flows into the separator and through oleophilic (oil-attracting) and hydrophobic tubes or ribs. Upon contact with the tubes, oil particles greater than approximately 20 microns in diameter coalesce to form larger particles. As the particles increase in size, buoyancy forces increase and the particles rise to the surface. Oil at the surface is skimmed and stored in an internal storage container or external tank. Typically, an oil/water separator will remove sufficient petroleum hydrocarbons such that the remaining concentration in the aqueous phase is less than 10 ppm.

Groundwater Discharge Options

Treated groundwater may be discharged to the sanitary sewer, the storm water sewer, or the groundwater via injection wells or infiltration galleries or basins. Discharge to the sanitary sewer would require approval of the Town of Tonawanda Sewage Treatment Plant (TSTP). The TSTP would require treatment standards which meet required pretreatment program requirements for the contaminants detected in the groundwater at the River Road site. Typically, those wastewater treatment plant industrial pretreatment standards are generally less stringent than standards for discharge to surface water or groundwater. As such, disposal by discharge to TSTP may allow a lesser degree of on-site treatment than would be required for the other disposal options.

Discharge to the storm water sewer or surface water would require a New York State Pollutant Discharge Elimination System Permit. Recharge to groundwater would also require a SPDES permit.

7.4.8 Treatment Actions

For the preliminary feasibility study for the River Road site, four types of treatment technologies and twelve process options were considered as follows:

Thermal Treatment for Soils	Rotary kiln Fluidized bed In situ vitrification
Chemical/Physical Treatment for Soils	Stabilization Soil washing
Chemical/Physical Treatment for Groundwater	Air Stripping Carbon Adsorption UV Oxidation Chemical Precipitation Ion Exchange
Biological	Aerobic Anaerobic

The above technologies were all considered infeasible or not considered for the Cherry Farm site due to volumes of material, or in effectiveness to treat all contaminants of concern or combinations of contaminants found. At the River Road site, the lesser volumes of surficial waste material would allow for thermal treatment technologies to be considered. Chemical/physical methods of treatment for groundwater were considered for the Cherry Farm site. The potential treatment technology options for the River Road site are described below.

7.4.8.1 - Thermal Treatment

Thermal separation processes remove PCBs, volatiles and semivolatiles from soil by volatilization. They do not treat heavy metals present in the soil. The organics are condensed and sent to a liquid injection incinerator off-site for destruction. Volatized metals can be retained by air pollution control devices and properly disposed. Treated/stabilized soil can be backfilled on-site.

Commercial thermal separation processes are available from several vendors for on-site treatment of contaminated soils. These processes, incorporating separation and treatment, are ranked second among the five remedial technology categories classified by the NYSDEC. Three of several commercially available processes are described below.

Closed-loop Thermal Separation

One on-site thermal separation process tested in the USEPA Superfund Innovative Technology Evaluation (SITE) Program is a closed loop process. The process involves feeding contaminated soil to a slowly rotating kiln (very similar to a rotary kiln incinerator) and heating it to a temperature between 500°F and 800°F with an external heat source (propane burners). Water, PCBs and other organics are volatilized or steam stripped. The vapors are carried out of the dryer in a nitrogen gas stream. The exiting gas stream passes through a scrubber and two heat exchangers for particulate removal and condensation of the water and organics. Condensed organics and water enter a phase separator where the floating organics are removed. Water is recirculated to the scrubber. The nitrogen gas leaving the second heat exchanger is heated in an electric induction heater and passes through a blower. Five to ten percent of the carrier nitrogen gas is passed through a particulate filter and carbon absorption unit before being vented to the atmosphere. The remainder of the carrier gas is reheated to between 400°F and 700°F and recirculated to the dryer.

The closed-loop separation process has been laboratory-scale and pilot-scale tested on soils containing PCBs, volatiles and semivolatiles. Results of these tests indicate that the process can achieve a destruction and removal efficiency (DRE) of 99.99% for hazardous organic constituents. In one laboratory-scale test, the system reduced the PCB concentration of a clay soil from 36,935 ppm to less than 2 ppm (CWM, 1989).

The SITE demonstration showed that the process can reduce PCB concentrations in sandy soils from 2,000 ppm to less than 25 ppm. The 25 ppm level was the cleanup level specified in the Re-Solve Superfund site Record of Decision (ROD). Test results indicated that reduction to 10 ppm or less could be achieved consistently (SCS, 1990).

The closed-loop separation process is not designed to treat heavy metals present in soils. The heavy metals would either remain in the soil, or be volatilized and collected in the gas treatment system.

Anaerobic Thermal Separation

Another on-site thermal separation process operates under anaerobic conditions. In this process, contaminated soil that is charged to the processor passes through three zones. In the preheat zone, low-temperature hydrocarbons and water are volatilized at temperatures up to 500°F. Oils and heavy hydrocarbons are volatilized in the reaction zone at temperatures between 700°F and 1,150°F under anaerobic conditions. The water and oil removed from the processor are condensed and collected in separate vapor train equipment.

Some thermal cracking usually occurs in the reaction zone, creating light hydrocarbons and coke (char). This cracking is a result of pyrolysis. The coke may be burned in the combustion zone between 1,000°F and 1,500°F to provide all or part of the heat requirements for the process. Hot sand from the combustion zone is recycled back to the reaction zone to provide the necessary heat for pyrolysis. Part of the sand is cooled for discharge, heating incoming solids in the preheat zone by thermal conduction through an annulus wall. Treated soil for organic contaminants can be backfilled on-site or disposed of as a nonhazardous waste.

The anaerobic thermal separation process has been evaluated on petroleum refinery waste and PCB-contaminated soil. It exceeds the best demonstrated available technologies criteria defined in the August 1988 Land Disposal Restrictions Rule. The process has been selected for use to remediate 60,000 cubic yards of PCB-contaminated soil at the OMC Superfund site in Waukegan, Illinois, beginning in early 1991 (SCS, 1990).

Hazardous volatile and semivolatile organics, and PCBs would be removed from the soil in the preheat or reaction stage. Air emissions from the process would be minimal. The process would not treat metals present in the soil.

Fluidized Bed Thermal Separation

Another on-site thermal separation process volatilizes PCBs and other organics in co-current fluidized bed. In the bed, contaminated soil is contacted with heated air (320°F to 400°F), forcing the water, organics and entrained solids into the air stream. Gas exits the fluidized bed and passes through a cyclone and baghouse for solids removal. From the baghouse, the gas enters a venturi scrubber and plate washer for cooling by a recirculated water stream. The gas then passes through finned coolers and a refrigerated chiller. The water vapor and organics condense in the water stream, coolers and chiller. Contaminated water is pumped to a contaminated water storage tank.

Cooled gases pass through two carbon filters for removal of residual organic contaminants. As the beds become exhausted, the system is shut down and the beds replaced. Carbon filters in parallel could be used to avoid the need for a shutdown.

The contaminated water is pumped to a centrifuge, where the organic compounds are spun out into a sludge ready for disposal. Liquid from the centrifuge enters a water filtration system that includes a sand filter, a clarifier and two activated carbon beds. Clean water is pumped to a clean water storage tank for testing prior to discharge in an approved manner. This process is effective in the treatment of organics, but not inorganics.

In summary, thermal separation processes could effectively treat the PCBs and other organics in the contaminated soil, but are not suitable for heavy metals. As such, these technologies will not be considered further.

Incineration Technologies

With this treatment technology, the contaminated soil would be excavated and burned at high temperatures (greater than 1,200°F) for destruction of the PCBs, volatiles and semivolatiles found at the River Road site. A few vendors, including Ogden Environmental Services (OES), O.H. Materials Corporation, ECOVA Corporation and Weston Services, have transportable incineration systems that have obtained the required TSCA permits for PCB incineration. The Ogden Environmental Services system is a circulating bed combustor, the O.H. Materials Corporation and ECOVA Corporation units are infrared incineration systems and Weston Services operates a portable rotary kiln incinerator.

Incineration systems are classified as destruction processes. As such, they are ranked first among the five remedial technology categories classified by the NYSDEC. All of the systems mentioned above provide on-site treatment of the waste. Other vendors, including Rollins Environmental Services and General Electric, have permitted off-site rotary kiln incinerators. Contaminated soil could be transported to these facilities for incineration.

The circulating bed combustor of OES consists of a combustion chamber, cyclone, flue gas cooler, baghouse, scrubber (if necessary) and ash conveyor system. Contaminated soil is fed into the solids return leg and combines with return solids from the cyclone to enter the combustion chamber. A fan fluidizes the soil particles. The high velocity of the air maintains a uniform temperature of 1,600°F around the combustion loop formed by the combustion chamber and the cyclone. Limestone added with the contaminated soil effectively neutralizes acid gases generated by the combustion process and controls sulfur dioxide emissions. Flue gas exits the loop above the cyclone while the cyclone returns solid particles to the combustion chamber. Flue gas enters a cooling chamber and then passes through a baghouse for particulate removal before leaving through the exhaust stack. If acid gases pose a problem, a scrubber system would be placed in front of the baghouse. Ash is drawn from the bottom of the combustion chamber for disposal or treatment. The circulating bed combustor can process four tons per hour of contaminated soil.

The OES circulating bed combustor was tested successfully on waste from the McCall Superfund site in California and PCB-laden soil at Alaska's Swanson River Oil Field. The system achieved a DRE exceeding 99.99% on such contaminants as benzene, toluene, xylene, ethylbenzene, naphthalene, 2-methylnaphthalene and 1,1,1-trichloroethane at the McCall Site (EPA, 1989). The DRE for the system burning the PCB-contaminated soil at Swanson River exceeded 99.9999% (Warner, 1989). The Swanson River data was submitted to EPA as part of OES' application for a TSCA permit to burn PCBs. Subsequently, EPA issued a TSCA permit to OES for the burning of PCBs in the circulating bed combustor. The permit is applicable in all ten EPA regions. Currently, OES has four operable circulating bed combustors.

The O.H. Materials Corporation and ECOVA Corporation infrared incineration systems use infrared heating elements in the primary combustion chamber to provide the heat necessary for the combustion and desorption of organics in the contaminated soil. The systems have a primary combustion chamber (PCC) and secondary combustion chamber (SCC). In the PCC, infrared heating elements at 1,600°F desorp the organics from the soil. Some organics are combusted in the presence of combustion air. The gas stream enters the SCC where it is exposed to a temperature of 2,200°F and combustion air for the complete destruction of the organic compounds. Exhaust from the SCC passes through a Calvert scrubber for emissions control. The system can process five tons per hour of contaminated soil.

The ECOVA Corporation infrared incineration system was tested under the Superfund Innovative Technology Evaluation (SITE) Program at the Peak Oil site in Florida and the Rose Township Demode Road site in Michigan. It also was tested at the Florida Steel Corporation Mill site and the Twin Cities Army Ammunition Plant in Minnesota. All of these tests were performed on soils containing PCBs and other organic compounds. The system was capable of achieving RCRA-mandated DREs of 99.99% for hazardous organics and the TSCA-mandated DRE of

99.9999% for PCBs (EPA, 1989). TSCA trial burns at the Florida Steel Corporation site achieved the necessary DRE for PCBs (99.9999%), resulting in a TSCA permit for the ECOVA infrared incineration system, applicable in all ten EPA regions.

The transportable rotary kiln incinerator of Weston Services also has a TSCA permit applicable in all ten EPA regions. The system consists of a primary combustion chamber operating between temperatures of 1,200°F and 2,200°F. A fabric filter baghouse controls particulate emissions and a packed tower scrubber treats acid gas emissions. The system can process approximately six tons per hour of contaminated soil.

Incineration technologies could effectively destroy the organic compounds in the soil at the River Road site, however, they would not destroy the heavy metals in the soil. Because of the high temperatures of the incineration process, some metals would be volatilized. Volatilized metals would be condensed and collected in the off-gas treatment system. Nonvolatile metals would remain in the soil, and would likely need to be stabilized prior to either on-site or off-site disposal. Incineration off-site at a RCRA/TSCA permitted facility would be feasible for the River Road site contaminants. However, on-site or off-site incineration technologies will not destroy metal contaminants. As a result, incineration technologies will not be considered further.

7.4.8.2 - In Situ Vitrification

With the in situ vitrification process, the contaminated soil is melted into a nonleachable, glass-like solid. The technology utilizes four molybdenum electrodes inserted into the ground, spaced in a square configuration with eighteen foot sides. Since soil does not usually have the electrical conductivity necessary to start the process, a graphite or glass frit is placed on the ground surface between the electrodes to start the melt. Electricity heats the mass to between 1,600°F and 2,000°F, and pyrolysis the organics present in the soil. The heat melts the soil, incorporating any inorganics (i.e., heavy metals) into he structure of the melt. Organic off-gases are collected in a fume hood, and quenched and scrubbed before discharge to the atmosphere. Filters and activated carbon used to treat the scrubber water from the off-gas treatment system are placed on the soil for vitrification in a future vitrification setting.

Vitrification is typically performed on a 30-foot by 30-foot area to a depth of 30 feet or a total soil mass of 800 to 1,000 tons. Usually, it is not possible to attain both the areal dimensions and the depth with a single setting. If a soil mass of 800 to 1,000 tons is contained in a 30-foot by 30-foot by 15-foot cube, a single setting would not effectively vitrify material to a depth of 30 feet.

There are a couple of site specific disadvantages in utilizing in situ vitrification at the River Road site. The soil volume loss upon vitrification may affect the stability of the structures (Clarence Materials) on the site. Also, soil moisture could pose an operational problem. Vitrification cannot proceed until all moisture in the soil is vaporized. The amount of electricity required to melt one pound of soil is the same as that required to vaporize one pound of water. The soil at the River Road site may contain considerable moisture since the water table comes to within three to five feet of the ground surface. Thus, vitrification may require considerably more energy than at other sites where the water table and soil moisture content are lower.

Over ninety full-scale, pilot-scale, and bench-scale tests have been conducted with the in situ vitrification system. It has been shown capable of meeting the destruction and removal efficiency of 99.99% for hazardous organics and 99.9999% for PCBs (Chemical Engineering, October 1990). A treatability study on sediments from the New Bedford Harbor Superfund site using vitrification showed a destruction and removal efficiency of greater than 99.9999 percent for the PCBs at the site. Test results indicate that there was minimal migration of PCBs from the vitrified sediment to the surrounding soil. The study concluded that vitrification could effectively treat the New Bedford Harbor PCB-contaminated sediment (Battelle, 1988).

The system, however, has not been used to remediate any Superfund sites yet, and as such, it is not a fully proven technology. Many of its tests have been with radioactive and metallic materials. In situ vitrification has not been proven effective on a commercial scale for many of the semivolatiles detected at the River Road site. In addition, in one recent pilot scale test, operational difficulties were encountered and the test was discontinued.

Because of potential operational difficulties, and the lack of proven experience remediating Superfund sites, in situ vitrification will not be considered further.

7.4.8.3 - Chemical/Physical Treatment

Stabilization

There are currently many variations of stabilization technologies commercially available. Most are designed for inorganic contaminants. These technologies treat contaminated soil or waste with Portland cement, pozzolans and other reagents (some of which are proprietary) to produce a stable, nonleachable solid material. The stabilized material experiences a volume increase, generally in the range of 10 to 50 percent. If the stabilization process is performed on-site, the stabilized material could be backfilled on-site. If the process is performed at an off-site, secure land disposal facility, the stabilized material could be disposed of at the facility.

Stabilization additives may chemically destroy or form bonds with the organic contaminants present in the waste, reducing their susceptibility to leaching. Inorganic contaminants, such as heavy metals, are encapsulated in the cementitious matrix. These technologies primarily reduce the mobility of the contaminants in the waste material.

Two stabilization systems have demonstrated effectiveness in treating waste containing organics and inorganics such as those found at the River Road site. These systems were developed by Qualtec and Wastech. Both are on-site treatment systems. Solidification/stabilization technologies are ranked third among the five possible remedial action technology categories classified by NYSDEC.

The Qualtec system mixes contaminated soil with Portland cement, pozzolans, and other additives to produce a nonleachable solid. The system was used to remediate the Pepper's Steel and Alloys Superfund site where the contaminants were PCBs, lead and arsenic. Results from tests performed on the solid generated by the Qualtec system at the site indicated that the soil has become stronger and less leachable with time (Dole, 1990). The Qualtec system has not been proven effective on waste containing semivolatile organics such as those found at the River Road site and will not be considered further.

The Wastech system consists of three steps. First, the soil is mixed with an appropriate catalyst and a reagent containing a hydrophobic carbon chain. The reagent molecularly bonds with the organics in the soil. Next, a reagent with hydrophilic and hydrophobic carbon chains is added. This reagent bonds with the molecularly bound organics to form stabilized micelles. Finally, a mixture of pozzolans and Portland cement is combined with the soil to form a strong, impermeable cementitious matrix that resists leaching.

Wastech has tested its system on a variety of soils and sludges containing PCBs, volatiles, semivolatiles and metals. Tests on the stabilized solids indicate that the solid resists leaching of organic compounds. TCLP extracts have contained volatiles and semivolatiles at concentrations less than the regulatory limit (Wastech, 1990). Although technically applicable to the River Road site, there would be difficulties in disposing of the solidified mass at the site. Assuming a 50% volume increase in the solidified material, the redeposited material would rise considerably above the existing grade. As such, this process will not be considered further.

7.4.8.4 - Soil Washing

Soil washing technologies physically separate soils so that the contaminants, which are primarily associated with the fine size fraction of the soils, are separated from the uncontaminated larger size fraction of the soils. The washing fluid may be composed of water and/or a surfactant capable of removing the contaminants from the soil. Either a solid-solid or liquid-solid separation is conducted where the contaminant can be leached by the fluid, or the contaminant is stripped from the particles with which it is associated.

The products of the soil washing process are clean soil, wash water containing an oily phase, dissolved contaminants and/or precipitated solids, and a finer fraction containing adsorbed organics and precipitated soils. The result is high levels of contaminants concentrated into a relatively small volume of material, thereby simplifying the ultimate treatment or disposal of the contaminated media.

Soil washing technologies can be effective for removing organics and inorganics from the soils depending on contaminant concentrations, soil characteristics and process capability.

One company that has completed a full-scale soil washing site remediation is Northwest Enviroservice, Inc. This process has been recently used to address oil contaminated sand in a chemical sludge pond at a Superfund site in Issaquah, Washington. The mobile soil washing unit is a physical cleaning process utilizing scrubbers, heaters or pressure jets, and chemical oxidation to wash the soils. Process capacity ranges from 20 to 25 tons per hour. The process works most efficiently on particles greater than a 270 mesh screen size. Efficient cleaning of the finer clay fractions (less than 270 mesh) may require a combination of other technologies. Complex waste mixtures, such as metals with organics, make it difficult to formulate a washing fluid. Pilot scale testing on lead using this process indicates it can reduce lead levels of 1,000 mg/kg to less than 50 mg/kg in site soils. However, this study utilized fine sands. The process is also suitable for total recoverable petroleum hydrocarbons (TRPHs) where levels of 11,000 mg/kg in site soils were reduced to below 23 mg/kg in a pilot study.

Soils at the River Road site have been classified as alluvial deposits and till which may be difficult to treat utilizing this process. Additionally, the complex waste mixtures at the site containing both organics and inorganics may make it difficult to formulate a washing fluid. This process may be suitable for treating TRPH contaminated soils in the former tank storage area.

Another soil washing process, developed by Bergman, USA, has been proven successful in the USEPA SITE program. The pilot scale process addressed PCB contaminated sediments from the Saginaw River in Michigan. The process has also been demonstrated as effective for heavy metals and petroleum hydrocarbons. This process utilizes physical and chemical separation techniques such as crushing, screening, gravity concentration, froth flotation and mechanical dewatering. Surfactants, chelating agents, coagulants and flocculents may also be added to aid in the separation process.

The technology is theoretically applicable to most organic compounds, most metals and certain inorganic compounds. It will likely address organics and metal contamination at the River Road site and may address semivolatile organics contamination; however, treatability studies conducted recently at another NYS Hazardous Waste Site (U.S. Steel) show that this technology was not suitable for nonhomogeneous soils (such as those encountered at the River Road site) and were not effective for removals of selected metals, PAHs and PCB contaminants. As a result, this technology will not be considered further.

7.4.8.5 - Solvent Extraction

Several solvent extraction processes that may be effective in treating the soil at the River Road site are discussed below. Each is an on-site treatment process. The processes are separation/treatment processes and would be ranked second among the five remedial action technology categories classified by the NYSDEC.

Triethylamine Extraction

The on-site triethylamine (TEA) extraction process is designed to remove organic compounds (PCBs, volatiles and semivolatiles) from soil or sludge to produce a noncontaminated soil. In the process, the soil is washed in the first extraction stage with TEA at 40°F to remove organics. The TEA/organics/water mixture is decanted from the washer and heated to 130°F to separate the TEA/organics and water phases. The TEA is steam stripped from the TEA/organics mixture and the water, and recycled to the washer for reuse in further extraction stages. The organics are generally incinerated off-site in a liquid injection incinerator. The water is discharged to a surface water body or a waste water treatment plant. Washed soil, before discharge, is dried in the soil contactor (a combination washer/dryer) to remove residual TEA. The TEA removed is condensed and recycled to the washer.

The triethylamine extraction process was tested by USEPA at the General Refining Superfund site near Savannah, Georgia. The waste at the site contained relatively low levels of PCBs (5-15 ppm). After processing the 3,700 cubic yards of sludges, the residual solids contained less than 0.1 ppm PCBs (Weimer, 1989).

The TEA process can be used to treat soils containing PCBs and semivolatiles found at the River Road site. Treatability studies would be required to determine the number of extraction stages needed to achieve the desired soil cleanup level. The process would not treat the metals in the soil.

Acurex Extraction

In this on-site solvent extraction process, a proprietary solvent removes PCBs and other organics from contaminated soil. It does not treat the metals in the soil. The process has been pilot-scale tested and proved able to reduce PCB concentrations of soil greater than 1,900 ppm with a removal efficiency of approximately 99.9% (EPA, 1986). It has not been developed to or proven on a commercial scale.

The soil/solvent mixture is agitated in the soil contactor. At the end of the extraction cycle, contaminated solvent is decanted from the contactor and stored in a contaminated solvent tank. The contaminated solvent is pumped to a reboiler where the solvent is stripped from the PCBs and condensed for reuse. The concentrated PCBs can be incinerated or treated with an alternative treatment process.

Methanol Extraction

With this on-site technology, PCBs and other organic compounds are extracted from predried soils with methanol. Metals are not treated. A carbon bed removes the PCBs and other organics from the methanol after the extraction. Methanol, with a low concentration of PCBs, is sold as fuel while the carbon contaminated with PCBs and other organics is incinerated. Clean soils are dried, removing residual methanol, and backfilled at the site. Sewage sprayed on the soil microbiologically degrades any remaining methanol. The system was field tested in 1986 on PCB-contaminated soil at Minden, West Virginia in 1986. The system reduced the PCB concentration from 400 ppm to 25 ppm. Since the field test, the methanol extraction process has not been developed to a commercial scale by its vendor because of the costs associated with materials handling and processing.

Acetone/Kerosene Extraction Plus Inorganic Acid Extraction

This on-site process uses organic solvents (acetone and kerosene) to extract organic compounds and an inorganic solvent to extract metals from soils. The process involves several steps:

- Contaminated soil is separated into solid and liquid fractions by centrifugation or filtration;
- The solid fraction is washed with acetone to extract organics. The acetone/organics/water mixture is decanted and goes to a liquid-liquid extractor. Acetone is steam stripped from the soil and recycled to the washer;
- In the liquid-liquid extractor, the organics transfer to the kerosene (stripping solvent), a hydrophobic solvent amenable to destruction. The kerosene/organics mixture from the extractor is incinerated off-site in a liquid injection incinerator. The acetone/water mixture is distilled with the acetone returning to the washer and the water going to an adsorption unit;
- Water from the filter or centrifuge is processed in an adsorption unit which utilizes clean solids or other solid medium. The solid, after exhaustion, is sent to the washer. Clean water can be discharged to surface water or a sanitary sewer; and
- Solids stripped of acetone are washed with an inorganic acid to remove heavy metals. The acid/metal solution is placed in a liquid-liquid extractor where the metals are transferred to another acid so that the leaching acid can be recycled. The metals may be recovered by electrolytic precipitation or chemically precipitated and stabilized prior to land disposal.

Metals removal is accomplished by sending the soil devoid of organics through the same processes using inorganic acids as the solvents.

The acetone/kerosene extraction plus inorganic acid extraction has successfully treated PCBs, volatiles, semivolatiles, and heavy metals in bench-scale and pilot-scale tests (Blank, 1990). According to ART International, a commercial scale system will be available for on-site use by 1991.

Since either the solvent extraction processes either remove only organics (and not metals) or are not proven/available on a commercial scale, solvent extraction processes will not be considered further.

7.4.8.6 - Dechlorination

Dechlorination processes chemically or photochemically remove chlorine atoms from PCBs, dioxins and other chlorinated hydrocarbons in contaminated soil. These processes consist of reactors where the chlorinated organics are extracted from the soil with a solvent and reacted with nucleophiles or ultraviolet light to remove the chlorines. The reactions detoxify the organic compounds. The liquid is decanted. Solvents and reagents used may be recovered for recycling to the reactor. Waste liquid is treated prior to discharge in conformance with applicable regulations. Soil can be backfilled on-site.

Dechlorination processes are destruction processes. They would be ranked first among the five remedial action technology categories classified by the NYSDEC. Commercial systems are available for on-site treatment of halogenated organics-contaminated soil. Two dechlorination systems that were evaluated for treating contaminants at the River Road site are described below.

Alkali Metal-Polyethylene Glycol (APEG) Process

The alkali metal-polyethylene glycol (APEG) process removes chlorine from aromatic compounds, such as PCBs and halogenated aliphatics. It results in the chemical destruction of chlorinated organic compounds, and the formation of polyethylene glycol ethers and either potassium chloride or sodium chloride. Near total dechlorination of the aromatics is possible under favorable conditions (EPA, 1990).

The APEG process uses either sodium polyethylene glycol (MaPEG) or potassium polyethylene glycol (KPEG) as the reagent, and dimethyl sulfoxide as a co-solvent. Laboratory tests have revealed that KPEG is at least two times more reactive than NaPEG in the PCB destruction process. Also, KPEG is less sensitive to the water content of the soil (EPA, 1990).

The process is carried out in a rotating mixer. Contaminated soil is charged to the mixer and the reagent, a mixture of polyethylene glycol, sodium or potassium hydroxide, and dimethyl sulfoxide (a co-solvent), is added. The reagent added is at a temperature of 150°C. At the end of the reaction, the reagent/soil slurry is pumped to a centrifuge where the solids and liquids are separated. The soil is washed several times with water to remove residual reagent. Reagent and wash water are separated in the reagent recovery system with the reagent being recycled to the reactor and wash water being recycled to the centrifuge. The waste from the process will be approximately one reactor volume of reagent. This reagent can be burned in an off-site incinerator. If significant concentrations or inorganics are not in the soil, the treated soil can be backfilled on-site.

The APEG process was designed for the destruction of PCBs and other chlorinated aromatics. While the River Road site contains these compounds, it also is contaminated with a variety of semivolatile compounds and lead. The APEG process would treat the halogenated aliphatics, but at a slower rate than the halogenated aromatics. It would volatilize those organics with boiling points below 150°C. The volatilized compounds are collected in a condensate trap and sent off-site for incineration. The process would not treat the nonhalogenated aliphatics or aromatics, nor would it treat the heavy metals contaminants of concern. As such, it will not be considered further.

Light Activated Reduction of Chemicals (LARC) Process

The LARC process uses UV light and an optimized reducing environment to dehalogenate various chlorinated compounds, including PCBs, that have been solvent extracted. Isopropanol is the solvent used for the extraction.

In the process, contaminated soil and isopropanol are contacted in the extractor. After a holding time of 15 to 20 minutes, the isopropanol containing chlorinated organics is decanted from the extractor and pumped to a distillation column where the isopropanol is recovered for recycle to the extractor and the chlorinated organics concentrated. Soil from the extractor goes through a second extractor where the extraction process is repeated. Soil from the second extractor is vacuum stripped for recovery of the isopropanol. Concentrated halogenated organics are pumped to a UV light reactor where hydrogen gas is bubbled through the solution. The UV light assists in dechlorination of the organics. Effluent from the reactor can be incinerated in a liquid injection incineration off-site. Assuming low levels of inorganic contaminants, washed soil can be backfilled on-site.

The LARC process can chemically dechlorinate many of the halogenated organic compounds found at the River Road site. The technology is, however, not effective for the nonhalogenated volatile and semivolatile organics at the site, nor is it effective for heavy metals. As a result, this process and dechlorination in general, will not be considered further.

7.4.8.7 - Soil Vapor Extraction

Soil vapor extraction is a process used for the removal of volatiles and some semivolatiles from the unsaturated zone of soils. Volatiles and semivolatiles can be present in the unsaturated zone as dissolved components of the aqueous phase, constituents adsorbed to the soil materials, or components in the aqueous or gas phases of the void space of the soil. Soil vapor extraction can be used effectively if the organic compounds have Henry's Law Constants greater than 0.001. Also, the void space of the soil must have sufficient air-filled porosity for vapor transport.

A typical soil vapor extraction system consists of vacuum extraction wells that are screened in the unsaturated zone of subsurface soil contamination. Wells are placed throughout the contaminated area and connected to a common blower via a manifold system. The blower induces air flow in the soil, stripping and volatilizing the organic compounds in the air stream. Stripped contaminants from the blower are either discharged directly to the atmosphere or passed through a treatment system, based on applicable air pollution control requirements. Treatment options include carbon adsorption, catalytic incineration and conventional vapor incineration.

A soil vapor extraction system could effectively remove the volatiles and a fraction of the semivolatiles at the River Road site. It would not, however, remove PCBs or heavy metals. It is not known if the system would strip semivolatiles from the soil. For these reasons, a soil vapor extraction system will not be considered further as a possible remedial technology for the site.

7.4.8.8 - Chemical/Physical Treatment For Groundwater

Air Stripping

Air stripping is used for removal of volatile and some semivolatile organic compounds from groundwater. The groundwater is pumped to the top of a tower containing a packed bed or trays. As the water flows downward through the tower, air from a blower enters the bottom of the tower and moves countercurrently upward. As the water contacts the air, volatile and semivolatile compounds with dimensionless Henry's Law Constants greater than approximately 0.001 transfer from the liquid phase to the vapor phase and are carried in the air stream out of the top of the tower. The air leaving the tower may be discharged directly to the atmosphere, or may pass through a carbon adsorption system or catalytic incineration system for removal and/or destruction of the organic compounds. The need for treatment is dictated by applicable air pollution control regulations.

An air stripping system could remove many of the volatiles and a fraction of the semivolatiles from the groundwater at the River Road site. It is doubtful that is could remove the unknown semivolatiles at the site. An air stripper would not be capable of removing the PCBs and inorganics from the groundwater. Since air stripping could not treat many of the contaminants present in the groundwater, it will not be considered further.

Carbon Adsorption

Carbon adsorption is a proven technology used at numerous hazardous waste sites for groundwater cleanup involving organic compounds. Water is pumped through a drum or canister containing a bed of activated carbon. The drum or canister is sized to provide sufficient retention time for adsorption of organics from the water. Depending on the cleanup levels, the effluent from the canister may pass through another canister prior to discharge. When the carbon bed becomes exhausted, it is regenerated, incinerated or disposed in a RCRA landfill. Systems which utilize large quantities of carbon, as would be expected for the River Road site, generally either set up a carbon regeneration system on-site, or make arrangements for off-site regeneration. Such an arrangement is usually more economical than landfill disposal or off-site treatment.

Isotherms are used to predict the carbon usage rate in terms of adsorptive capacity for specific compounds. Compounds most easily adsorbed by carbon are those with a molecular weight above 50 and a boiling point above 20 degrees centigrade. Ideally, the higher the concentration of the compound to be adsorbed, the greater the capacity of the carbon to remove it. Carbon adsorption capacities for organics can vary by several orders of magnitude, depending on the specific compound.

Practically all organics (volatiles, semivolatiles and PCBs) can be removed from the groundwater by adsorption on carbon. Isotherms can be used to predict the carbon usage rates for individual known compounds, but would not give an accurate determination of the carbon usage rate for the mixture of compounds detected at the site. Also, carbon usage rates cannot be predicted for the unknown compounds at the River Road site since these compounds do not have established isotherms. Carbon adsorption will be considered for use as a secondary technology for use combined with chemical precipitation for removal of metals in the remedial alternatives to be evaluated.

UV/Oxidation

UV/oxidation is a proven technology for the treatment of certain hazardous waste. Ultraviolet light, ozone, and/or hydrogen peroxide combine to oxidize a wide variety of organic compounds present in contaminated water. The UV light catalyzes the formation of hydroxyl radicals from the hydrogen peroxide and ozone. the organics are oxidized by the hydroxyl radicals. An advantage of the system is that there are no hazardous emissions or residuals that would require further treatment or disposal.

Commercially available systems utilize either a baffle wall structure or a multi-stage reactor. In the baffle wall structure, a series of baffle walls is constructed to increase the contact time between the UV light/ozone/hydrogen peroxide and contaminants, and UV lights are placed vertically along the path of flow. In a multi-stage reactor, several small reactors are used in series to achieve the high destruction efficiency.

Phenols, chlorophenols, trihalomethanes, methylene chloride, perchloroethylene (PCE), trichloroethylene (TCE), and PCBs are some of the compounds that can be destroyed by the UV/oxidation process. The process would likely be able to treat a large portion of the organic contaminants found at the River Road site but not metals. As such, this technology will not be considered.

Chemical Precipitation

Precipitation for heavy metals removal (with pH adjustment) is a well-established technology. There are three types of metals precipitation systems. Each adjusts the pH of the water to the level at which the metals in the water have their lowest solubility. The three metals precipitation systems are:

- The carbonate system
- The hydroxide system
- The sulfide system

The carbonate system is difficult to control and relies on the use of soda ash and pH adjustment in the range of 8.2 to. 8.5.

The hydroxide system is most widely used in the removal of metals. The system uses either lime, sodium hydroxide, or magnesium hydroxide to raise the pH of the water to precipitate the metals.

The sulfide system is effective in the removal of metals, except for arsenic. The increased removal is offset by the susceptibility of sulfide sludges to oxidize, resulting in the resolubilization of the metals.

Adjustment of pH and precipitation systems have been successfully used to treat industrial wastewater and groundwater. The systems are most efficient when the metals in the water have minimum or near minimum solubilities within a narrow pH range. In this situation, very small quantities of the metal are discharged in the effluent.

A disadvantage for the systems results when the metals in the waste stream have their minimum solubilities at widely varying pHs. When the systems adjust the pH of the solution to a fixed level, they are able to remove more of some metals and less of others. Some of the metals are less soluble than others. Metals that do not have their minimum solubility at the pH of the solution may solubilize and pass through the system.

Another disadvantage of the systems, in comparison with iron-based coprecipitation, is the volume of sludge generated. In general, pH adjustment and precipitation systems generate a larger volume of sludge than an iron-based coprecipitation system. They would have greater sludge disposal costs.

The above systems consist of a reaction tank(s), flocculator, and a sludge handling system for thickening and dewatering. Because of the disadvantages outlined, they will not be considered further.

Iron-Based Coprecipitation

In this technology, soluble ferrous ions are added to the waste stream at a predetermined rate (usually about four times the total amount of all the metals). Such systems usually operate in a pH range of 7.0 to 8.0. The oxidation of ferrous ions in the waste stream results in the precipitation of iron and the other metals. Heavy metals are entrapped in an insoluble iron matrix when iron is precipitated from the solution. This iron matrix can be defined as a gelatinous ferric "oxy" hydroxide formation, in which other metals are attached or adsorbed to the iron particles.

Iron-based coprecipitation has a couple of advantages over pH adjustment and precipitation. The technology generates a smaller volume of sludge in comparison with pH adjustment and precipitation systems. Also, its effectiveness depends on the solubility of iron, not on the solubility of all of the metals present in the water. It is best applied where the water already has a high iron and manganese concentration which is the case at the River Road site.

The system consists of a reaction tank, clarifier, and sludge handling system for thickening and dewatering.

Ion Exchange

The ion exchange process involves the reversible exchange of ions in solution with ions retained on a reactive solid material, i.e., ion exchange resin. An ion exchange resin has either an ability to exchange positively-charged ions (cation exchange) or negative-charged ions (anion exchange). A typical ion exchange system consists of a fixed bed of ion exchange resin with anions or cations held by electrostatic forces to the charged sites. As wastewater passes through the resin, metal ions exchange with the cations or anions at the charged sites. When the resin reaches its breakthrough point and is exhausted, it is regenerated by passing an acid through it to desorb the metals. The acid solution must be treated prior to discharge. Some systems electrolytically recover the metals from the regenerant acid so the regenerant can be reused. Others simply precipitate the metals from the regenerant.

Ion exchange systems are used primarily for treatment of industrial wastewater and demineralization of process water. The technology may encounter difficulties in treating groundwater. Colloidal particles and bacteria may foul the resin. If metals and metal complexes (e.g., permanganate and chromate) are present, anion and cation exchange resins both would be needed for treatment of the water. Also, the metals must be precipitated from the regenerant before the regenerant can be discharged. This operation would create a hazardous sludge for disposal.

Based on the foregoing information regarding metals treatment technologies, iron-based coprecipitation is the technology of choice. It will be considered further.

7.4.8.9 - Bioremediation

Bioremediation options for contaminated soil generally include on-site land farming systems or bioreactors. In either case, microbes are mixed with the organics-contaminated soil and given time to metabolize the organics. For efficient performance, the process would require temperatures greater than 60°F. Bioremediation of PCBs proceeds more slowly as the number of chlorines in the PCB molecule increases. According to the USEPA, only one vendor has a commercially permitted bioremediation process for treatment of PCB-contaminated waste.

Bioremediation systems require the development of a culture of bacteria capable of metabolizing all of the organic contaminants present at a site. The River Road site contains a large number of volatile, semivolatile and PCB compounds. Some of these compounds may be degraded by a specific bacteria, while others may be biologically refractory in the presence of the same culture. It may be difficult to develop a culture that can metabolize all of the compounds, and treatment of the soil with microbes would require more time than other alternatives.

A treatability study with bioremediation on the PCB-contaminated sediment from New Bedford Harbor. The study concluded that a culture could be developed to degrade the PCBs in the sediment. However, only the di- and trichlorinated biphenyls experienced a significant degradation under the conditions that would be used to treat large quantities of sediment. Dechlorination of the less-degraded PCB isomers would be required to enhance the degradation rate (Radian, 1988).

Although bioremediation may be able to treat many of the semivolatiles at the River Road site, the treatment would progress slowly, particularly for PCBs. Additionally, many of the semivolatiles at the site are not readily degradable. A bioremediation system would not treat the metals in the soil. As such, this technology will not be considered further.

7.4.9 Evaluation Summary of Remedial Technologies

In this section, the technologies described above for each of the contaminated media and operable units at the River Road site are reviewed. Determinations are made about which technologies may be most effective at the River Road site. The technologies judged most effective will be combined into remedial alternatives as part of the Phase III Feasibility Study and screened in accordance with the NYSDEC TAGM. A summary and screening of these technologies is presented in Table 7-3.

Based on the evaluation of remedial technologies for soil contaminants identified at the River Road site (primarily semivolatiles, PCBs and metals), there are a limited number of technologies that appear to be promising for remediation of the site. These remaining technologies are institutional actions (fencing, deed restrictions and monitoring), containment (capping through the use of a permeable or impermeable cap, cutoff trench or slurry wall, groundwater removal through an extraction system (wells or trenches) with groundwater treatment (on-site and/or off-site), on-site waste consolidation and capping, and excavation and off-site disposal). These technologies will be evaluated as components of remedial alternatives for the site as part of the Phase III Feasibility Study.

TABLE 7 – 3
RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION REPORT

Summary and Screening of Technologies and Process Options for the River Road Site

Remedial Technology	*Processing Options*	*Description*	*Screening Comments*
NO ACTION		No action (with posting of signs and monitoring).	Required for consideration by NCP.
MONITORING	Groundwater/Seepage Monitoring	Continued monitoring of groundwater and seepages as part of No Action.	Potentially applicable
INSTITUTIONAL ACTIONS			
SITE FENCING	None	Perimeter fencing to restrict site access.	Potentially applicable
LEGAL RESTRICTIONS	Deed Restrictions	Deed covenants to restrict site use.	Potentially applicable
MONITORING	Groundwater/Seepage Monitoring	Continued monitoring of wells and seeps if they exist.	Potentially applicable
CONTAINMENT ACTIONS			
CAPPING	Earth Cover	Two feet soil or gravel cover.	Potentially applicable
	RCRA Cap	Clay and synthetic membrane and soil cover.	Potentially applicable, but may not provide significant advantages over the multi media cap
	Multi Media Cap	Clay or synthetic membrane and soil cover.	Potentially applicable
CREEK/RIVER BANK STABILIZATION	Rip/Rap	Protective covering of riprap to reduce bank erosion of contaminated soil.	Potentially applicable, to be addressed as part of the Cherry Farm site remedial activity
SUBSURFACE BARRIER	Slurry Wall	Bentonite slurry wall to limit horizontal migration of contaminated groundwater.	Potentially applicable
LAND DISPOSAL	Excavation & On–Site Landfill	Waste placed on–site in a secure/RCRA landfill	Feasible but may be costly due to constraints of slag layer at shallow depths and cost of construction.
COLLECTION ACTIONS			
EXTRACTION WELLS	Pretreatment Prior to Discharge	Removal of contaminated groundwater and LNAPL.	Potentially applicable
TRENCH DRAINS	Pretreatment Prior to Discharge	Removal of contaminated groundwater and LNAPL or diversion of groundwater into the site.	Potentially applicable

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RIVER ROAD SITE
PHASE I/II REMEDIAL INVESTIGATION REPORT

Summary and Screening of Technologies and Process Options for the River Road Site

Remedial Technology	*Processing Options*	*Description*	*Screening Comments*
REMOVAL ACTIONS			
REMOVAL	Excavation and Off-Site Disposal	Waste placed in commercial RCRA/TSCA landfill	Feasible for waste piles, surficial soils and selected subsurface soils.
	Excavation and Incineration Off-Site	Waste incinerated at a commercial RCRA/TSCA permitted facility	Not feasible for metals.
	Oil/Water Separator	Removal of nonaqueous phase liquid products in groundwater.	Potentially applicable
	Groundwater Discharge	Treated groundwater is discharged to treatment plant.	Potentially applicable
TREATMENT ACTIONS (ON-SITE)			
CHEMICAL/PHYSICAL TREATMENT	Stabilization	Stabilization of waste material.	Not effective for organic contaminants.
	Soil Washing	Separation of contaminants from soils.	Not effective for nonhomogeneous soils.
	Solvent Extraction	Extraction of contaminants.	Not effective for metal contaminants.
	Dechlorination	Treats halogenated organics.	Not effective for semi-volatile compounds or metal contaminants.
	In Situ Vitrification	Solidification of contaminants in place.	Not commercially proven at superfund sites.
	Soil Vapor Extraction	Volatilizes contaminants in soil.	Not effective for PCBs, PAHs, or metals.
	Air Stripping	Removes volatile contaminants from groundwater.	Not effective for PAHs, CPAHs, PCBs, or metals.
	Carbon Adsorption	Removes organic compounds from groundwater.	Potentially applicable
	UV Oxidation	Removes volatiles, some semi volatiles, & PCBs.	Not effective for all semi volatiles or metals
	Chemical Precipitation	Removes metals from groundwater.	High volume of sludge generated, not effective for organic contaminants; therefore, not feasible. In combination with air stripping or carbon adsorption this may be possible.
	Iron Based Coprecipitation	Removes metals from groundwater.	Effective for most metals, potentially effective when combined with carbon adsorption.
	Ion Exchange	Removes metals from groundwater.	Technology may be difficult to treat groundwater.
THERMAL SEPARATION	Thermally Separates Wastes	Treats PCBs, volatiles, and semi volatiles	Not effective for metals.
INCINERATION	Combustion of Wastes	Destroys PCBs, volatiles and semivolatiles; metals which are volatilized can be captured.	Not effective for metals.
BIOLOGICAL TREATMENT	Bioremediation	Treats organic compounds.	Not effective for metals and PCBs in general.