MALCOLM PIRNIE

CITY OF ROCHESTER
REMEDIAL INVESTIGATION REPORT

ROCHESTER FIRE ACADEMY SITE

MAY 1991
Revised DECEMBER 1991

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MALCOLM PIRNIE

TABLE OF CONTENTS

MALCOLM PIRNIE

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

Page

MALCOLM PIRNIE

LIST OF TABLES

TABLE OF CONTENTS (continued)

LIST OF TABLES (continued)

TABLE OF CONTENTS (continued)

LIST OF TABLES (continued)

TABLE OF CONTENTS (continued)

LIST OF TABLES (continued)

LIST OF FIGURES

MALCOLM PIRNIE

TABLE OF CONTENTS (CONTINUED)

LIST OF FIGURES (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF FIGURES (CONTINUED)

APPENDICES
(presented in separate volume)

1.0 EXECUTIVE SUMMARY

1.1 BACKGROUND

The Rochester Fire Academy site is a 21-acre tract of land used as a training facility by the City of Rochester Fire and Police Departments. The site is located adjacent to the Genesee River in the City of Rochester, Monroe County, New York in an urbanized area consisting mainly of commercial development. The training areas at the site are primarily used by the City Fire and Police departments and other outside agencies totalling over 3,000 users annually. The Genesee Valley Park Area, which abuts the eastern boundary of the training and disposal areas, is a wooded area traversed by a recreational bike path. Access by unauthorized personnel to this area is currently restricted by fencing.

The Fire Academy site consists of four distinct areas, three of which have been involved with the facility's chemical use and disposal. These three areas of concern are the North Disposal Area, the Training Grounds Area, and the South Disposal Area, which are 2.5, 5.4 and 0.8 acres in size, respectively. The remaining area, the Police Obstacle Course and Firing Range, is not believed to have received any potentially hazardous wastes.

Since its inception in 1954 through 1980, the Fire Academy accepted solvents, fuels and other organic chemicals from local industries and other sources for use (i.e., burning) during training activities. These flammable liquids, in addition to metallic sludge residues and construction and demolition (C&D) debris, were either burned and/or disposed of at the three disposal areas. The New York State Department of Environmental Conservation (NYSDEC) began investigating the facility's disposal practices in 1980 and subsequently directed the removal of over 200 drums and numerous chemical reagent bottles.

The NYSDEC listed the Rochester Fire Academy site in the New York State Registry of Inactive Hazardous Waste Disposal Sites (Site No. 828015) and assigned the site a "Class 2" classification based upon the findings of State Superfund Phase I and Phase II studies. As a result of this classification, the NYSDEC required that a Remedial Investigation/Feasibility Study (RI/FS) be conducted to determine the nature and extent of hazardous waste contamination at the site, evaluate potential risks, and identify feasible alternatives for site remediation. During 1989, the City of Rochester entered into a Consent Order Agreement with NYSDEC to conduct an RI/FS at the Fire Academy. During the period of November 1989 through August 1990, Malcolm Pirnie conducted the field investigation activities required by the RI scope of work.

1.2 RI FIELD INVESTIGATION

Preliminary non-intrusive surveys were conducted at the Fire Academy site to better define the areal extent of known disposal areas (North Disposal and South Disposal Areas); identify the occurrence and location of disturbed soil, buried metallic objects, radioactive materials and detectable organic soil gas vapors on site and in the immediate surrounding area; and to provide a basis for final selection of soil boring, test pit, and ground water monitoring well installation locations. These surveys identified several areas with elevated volatile organic vapor concentrations and a number of unidentified geophysical anomalies which are representative of either different soil types (or contamination) and/or buried metallic materials. This information/data was used for final selection of RI soil sampling and ground water monitoring well installation locations. Details concerning the results of the preliminary survey is documented in an Interim Remedial Investigation (RI) Report (Malcolm Pirnie Inc. 1990).

The geologic and hydrogeologic investigations for the Rochester Fire Academy Remedial Investigation (RI) were conducted from November 1989 through May 1990. Field activities performed to characterize the geologic and hydrogeologic conditions at the site involved the following tasks:

- drilling of twenty-two (22) borings at eleven (11) locations including continuous split spoon soil sampling of the deepest borehole at location;
- installation of twenty-one (21) monitoring wells and one (1) piezometer;
- development of all newly installed monitoring wells/piezometer;
- in-situ hydraulic conductivity testing of all newly installed wells/piezometer;
- installation of two (2) staff gauges in the Genesee River adjacent to the site; and
- monitoring of water levels in the Genesee River, the newly installed wells/piezometer and existing wells.

1.3 GEOLOGIC/HYDROGEOLOGIC CONDITIONS

The current Remedial Investigation at the Fire Academy Site has provided an extensive geologic data base. Interpretation of site geology and hydrogeology is based upon this database, as well as information provided in the literature concerning regional geologic and hydrogeologic conditions. Stratigraphic units identified during the RI from youngest to oldest include:

- fill of variable composition;
- alluvium associated with deposition of the Genesee River; and
- dolostone bedrock.

A total of two (2) water-bearing zones occur on site. The saturated fill and alluvial deposits comprise the overburden water-bearing zone and the upper 10 to 20 feet of bedrock comprise the bedrock aquifer. The general direction of ground water flow in the overburden water-bearing zone is east toward the Genesee River. Horizontal flow velocity within this zone were calculated to range from 0.02 to 0.46 feet per day. Ground water discharges to the Genesee River as well as recharges the bedrock during seasonally high water levels.

The direction of ground water flow in the bedrock aquifer is toward the northeast. The occurrence of ground water is primarily restricted to bedding plane fractures and interconnected solution voids with the frequency of water-bearing openings decreasing with depth. Horizontal flow velocities within the upper portion of the bedrock range from 4.3 to 6.5 feet per day. The bedrock aquifer discharges to the Genesee River.

A site water balance was conducted for the North and South Disposal Areas and the Training Grounds Area. General water balance calculations determined that the approximate ground water outflow to the Genesee River from the North Disposal Area, South Disposal Area and the Training Grounds Area is 207, 573 and 1,033 ft^3/day, respectively.

1.4 SITE CONTAMINATION CHARACTERIZATION

The characterization of site contamination was accomplished by analysis of soil, sediment, surface water, and ground water samples. Samples were collected during the period of April - October 1990.

1.4.1 Soil Sampling and Analysis

The preliminary non-intrusive surveys identified 29 areas of elevated volatile organic vapor concentrations and 21 unidentified EM anomalies, which are representative of either different soil types, contaminated soil/fill, or buried metallic objects. A total of 41 discrete survey anomalies were selected for further investigation by environmental sampling. The remaining anomalies were attributable to either buried utilities or conductive soil conditions in the Police Obstacle Course and Firing Range Area where no waste disposal is known to have occurred. The sampling program at survey anomalies, which included the sampling of eleven (11) test pit excavations, twenty (20) surficial soil locations, and eleven (11) shallow soil borings, three (3) of which were advanced into the saturated zone and completed as monitoring wells.

Contamination in the North Disposal Area is primarily inorganic in nature and appears to be limited to the visual extent of fill material. The fill exhibits substantial concentrations of iron, cadmium, copper, lead, and silver. Organic contamination consists principally of chlorinated hydrocarbons, PAHs, phthalate esters, and PCBs at low to trace concentrations.

A substantial amount of the contamination identified in soil/fill of the Training Grounds Area is associated with historic spills and leaks of various types of fuels that have been stored and used in the northern portion of this Area. Maximum concentrations of volatile organics, PAHs, phthalate esters, and PCBs occur in soil/fill in the vicinity of the fuel storage tanks and fuel transmission line. An accumulation of free product in the vicinity of the underground fuel transmission line in monitoring well MW-14S contributes to soil contamination. The extent of this free product has not been defined. It is also apparent, however, that lower concentrations of volatile organics, PAHs, phthalates, and PCBs are present at portions of the Area that are removed from the storage tanks and fuel transmission line. Cadmium, lead, and antimony have been detected at elevated concentrations in soils in this Area.

The Firing Range Area has little organic or inorganic contamination of soil at the locations sampled.

Organic contamination of soil in the South Disposal Area consists primarily of chlorinated hydrocarbons and PCBs. However, a large variety of additional organic compounds were identified at low concentration. Inorganic soil contamination is primarily iron, cadmium, copper, lead, and silver. The sampling results indicate that both the organic and inorganic contamination is principally associated with the incineration residue that occurs in this Area.

Low to trace concentrations of volatile organics occur at one location within the Genesee Valley Park Area. The principle contaminant of concern identified in the Area is cadmium, which occurs locally.

Contamination in the Genesee Valley Canal Area is characterized by low concentrations of PAHs, which are likely associated with the bedding material of the railroad formerly located in this area.

No 2,3,7,8 tetrachlorodibenzo-p-dioxin was detected in the Fire Academy site soils.

1.4.2 Sediment Sampling and Analysis

Sediment samples were collected from two (2) on-site drainage swales. Contaminants were not detected in the swale receiving drainage from the North Disposal Area. However, low to trace concentrations of volatile organics, PAHs and PCBs were detected in sediment from the swale receiving drainage from the South Disposal Area. Sediment samples collected from the Genesee River show only a slightly elevated concentration of toluene in downstream sediment relative to upstream locations.

1.4.3 Surface Water Sampling and Analysis

On-site water sampling of three (3) ponds and two (2) drainage swales indicated the presence of volatile organic contamination at low concentrations in a pond located in the South Disposal Area. Elevated lead concentrations were detected in each of the ponds in the North and South Disposal Areas and the Training Grounds Area and in the drainage swale which receives drainage from the South Disposal Area. Contamination was not detected in the Genesee River samples.

1.4.4 Ground Water Sampling and Analysis

Ground water sampling and analysis at the Rochester Fire Academy site has demonstrated that organic and, to a lesser extent, inorganic contaminants occur in the overburden and bedrock ground water. The character of organic contaminants in ground water corresponds to the nature and extent of contaminants present in the soil/fill material overlying the aquifer.

Trace concentrations of chlorinated volatile organics were found in all upgradient bedrock wells. Therefore, an upgradient source of chlorinated hydrocarbons hydraulically upgradient of the Fire Academy facility is indicated.

Iron and manganese are the most widespread inorganic contaminants that have been identified in ground water of the Fire Academy. The source of the metals is most likely the mobilization of naturally occurring iron and manganese from the aquifer matrix due to anaerobic conditions in the ground water. Former waste disposal practices have likely influenced metal concentrations in ground water by providing organic material that contributes to the anaerobic conditions. Other trace metals, in particular lead, also occur locally in ground water at elevated concentrations.

North Disposal Area - Organic contaminants were not detected in the overburden ground water, but low concentrations of chlorinated hydrocarbons occur in the upper bedrock. Based on ground water flow patterns, the source of these contaminants is probably the northern portion of the Training Grounds Area.

Training Grounds Area - Contaminated soil/fill material near the storage tanks, the burn pits and throughout much of the southern portion of the Training Grounds Area are contributing organic contaminants to the ground water due to the leaching of contaminated soil by infiltrating precipitation during periods of low ground water levels, and by direct contact between ground water and contaminated soils during periods of high ground water levels. The upper bedrock ground water is more highly contaminated than the shallow overburden ground water at the monitoring well locations downgradient of the Training Grounds. Therefore, it appears that organic contaminants are most likely migrating to the upper bedrock due to a downward hydraulic gradient at localized source areas within the Training Grounds. Contaminant migration then occurs preferentially through the highly permeable upper bedrock zone. There is also potential for chlorinated and aromatic hydrocarbons to enter the ground water from low density free product encountered between the fuel storage tanks and the burn pits near an underground fuel transmission line.

South Disposal Area - The leaching of organic contaminants from the soil/fill material contributes moderate to high concentrations of chlorinated hydrocarbons and low concentrations of phenolic compounds and PCBs to the overburden and bedrock ground water. In contrast to the vertical distribution of contaminants in the Training Grounds and North Disposal Areas, which increase in concentration with depth, ground water contaminant concentrations decrease in the South Disposal Area with depth. This is probably due to the close proximity of monitoring well cluster MW-7S/7I/7D to the source of contamination.

1.4.5 Contaminant Migration

Migration pathways are identified below:

- overland runoff and mechanical transport of contaminated soil/fill material;
- continuous release of soluble constituents of the low density free product located in the area of MW-14S to ground water within the shallow overburden;
- migration of solubilized contaminants in the soil/fill into ground water due to infiltration of precipitation and/or contact with ground water; and
- lateral movement of contaminated ground water through the shallow overburden and bedrock water-bearing zones, with ultimate discharge to the Genesee River.

The major pathway of contaminant migration from the Rochester Fire Academy site is ground water flow from the overburden and bedrock water-bearing zones to the Genesee River. The primary contaminants migrating to the river are volatile organics with a total loading of 250 Kg/year, and total iron and manganese with a total load of

360 Kg/year. Volatile organics originate from the leaching of contaminated soil/fill material and, locally, from the solubilization of free phase product. Total iron/manganese loading is produced from the mobilization of naturally occurring metals, which results from the release of waste oils and oxidizable materials to the shallow ground water. Trace metals, if present in the aquifer matrix or the waste materials, are not being mobilized, under the existing conditions, to a degree that would contribute a substantial load to the river.

1.5 PUBLIC HEALTH AND ENVIRONMENTAL CONCERNS

Following agency review of the analytical results presented within this report, it was determined that further sampling and analysis was necessary to better define the lateral and vertical extent of soil contamination. In addition, in order to address the contamination present in the ground water, pump testing was determined to be necessary to better establish the hydraulic characteristics of the aquifer and to provide ground water for treatability evaluations. This new data will be evaluated in conjunction with the data presented herein to fully define the contamination present at the site in a supplemental report. Therefore, the public health and environmental concern will be presented in the Supplemental RI report taking into account all data collected during both investigations.

2.0 INTRODUCTION

2.1 SITE LOCATION AND DESCRIPTION

The Rochester Fire Academy site is a 21-acre tract of land used as a training facility by the City of Rochester Fire and Police Departments. This site is located on the west bank of the Genesee River at 1190 Scottsville Road in the City of Rochester, Monroe County, New York (Figure 2-1).

The site is bordered to the northwest by the former Genesee Valley Canal and the former Consolidated Railroad (ConRail) right-of-way. The location of the former Canal is apparent as a linear depression in the ground surface. The railroad runs along the southeastern bank of the Canal, as evidenced by a 10-15 foot wide path of slag and cinder bedding material.

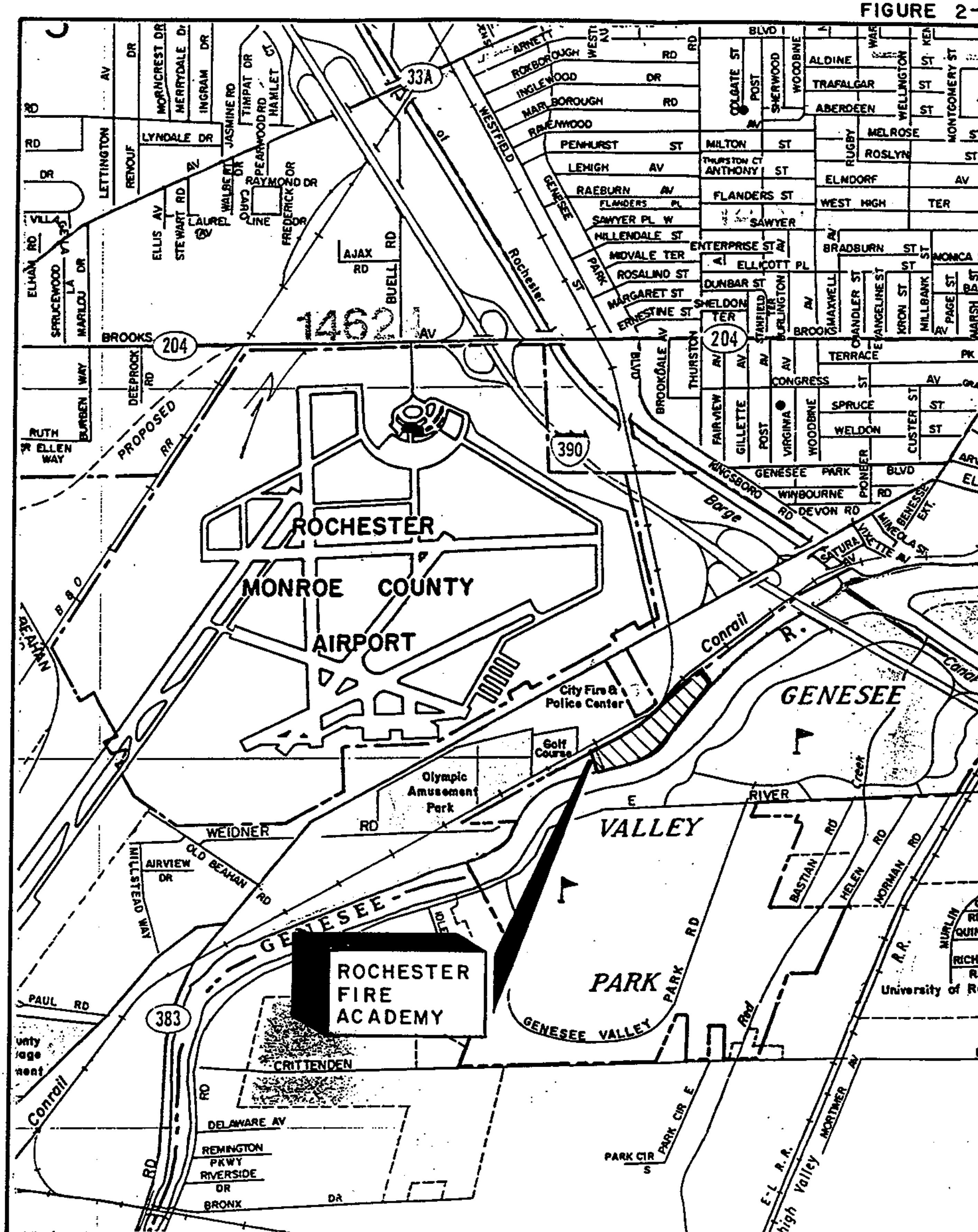
A 75 to 125-foot portion of the City of Rochester's Genesee Valley Park is located along the southeastern edge of the Fire Academy site. The park is traversed by a paved bicycle path and encompasses a New York State Department of Environmental Conservation (NYSDEC) designated wetland between the bicycle path and the west bank of the Genesee River.

The City of Rochester has erected a 7-foot high chain-link fence around the perimeter of the site, including the portion of the Genesee Park adjacent to the site, except where the Genesee River forms the eastern boundary of the park. Consequently, the portion of the bicycle path located adjacent to the site is not presently accessible to the public.

The 21-acre Fire Academy site consists of four distinct areas, three of which have been involved with the facility's chemical use and disposal (Figure 2-2). These three areas of concern are the North Disposal Area, the Training Grounds Area, and the South Disposal Area, which are 2.5, 5.4 and 0.8 acres in size, respectively. The remaining area, the Police Obstacle Course and Firing Range, and two adjacent areas included in the Remedial Investigation study area, the Genesee Valley Park Area and the Genesee Valley Canal Area, are not believed to have received any potentially hazardous wastes.

The North Disposal area is generally flat and overgrown with small trees and underbrush. This area was utilized for drum disposal. Drums placed in this area were

FIGURE 2-1



ROCHESTER FIRE ACADEMY

RI/FS

SITE LOCATION MAP

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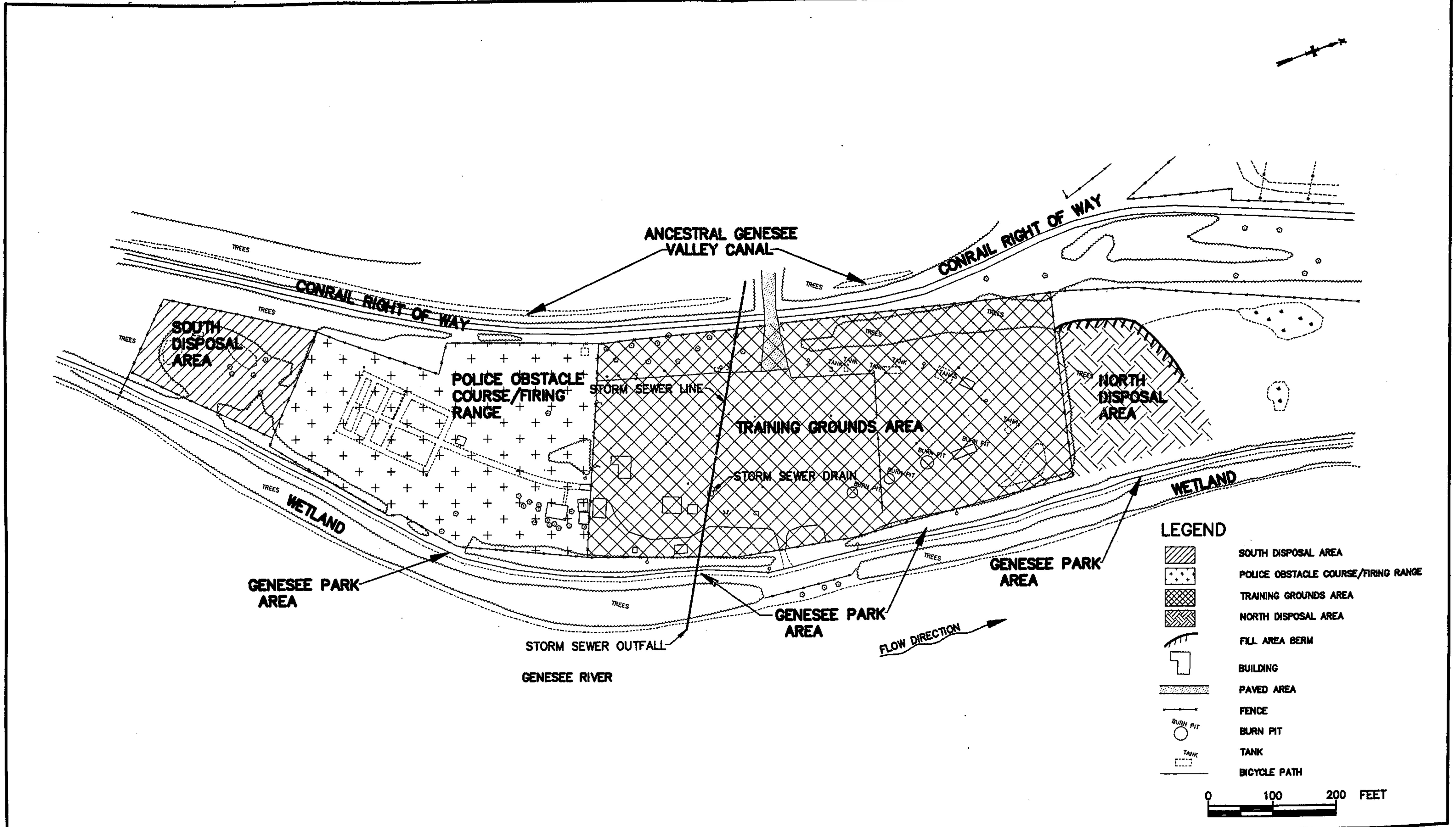
JULY 1990



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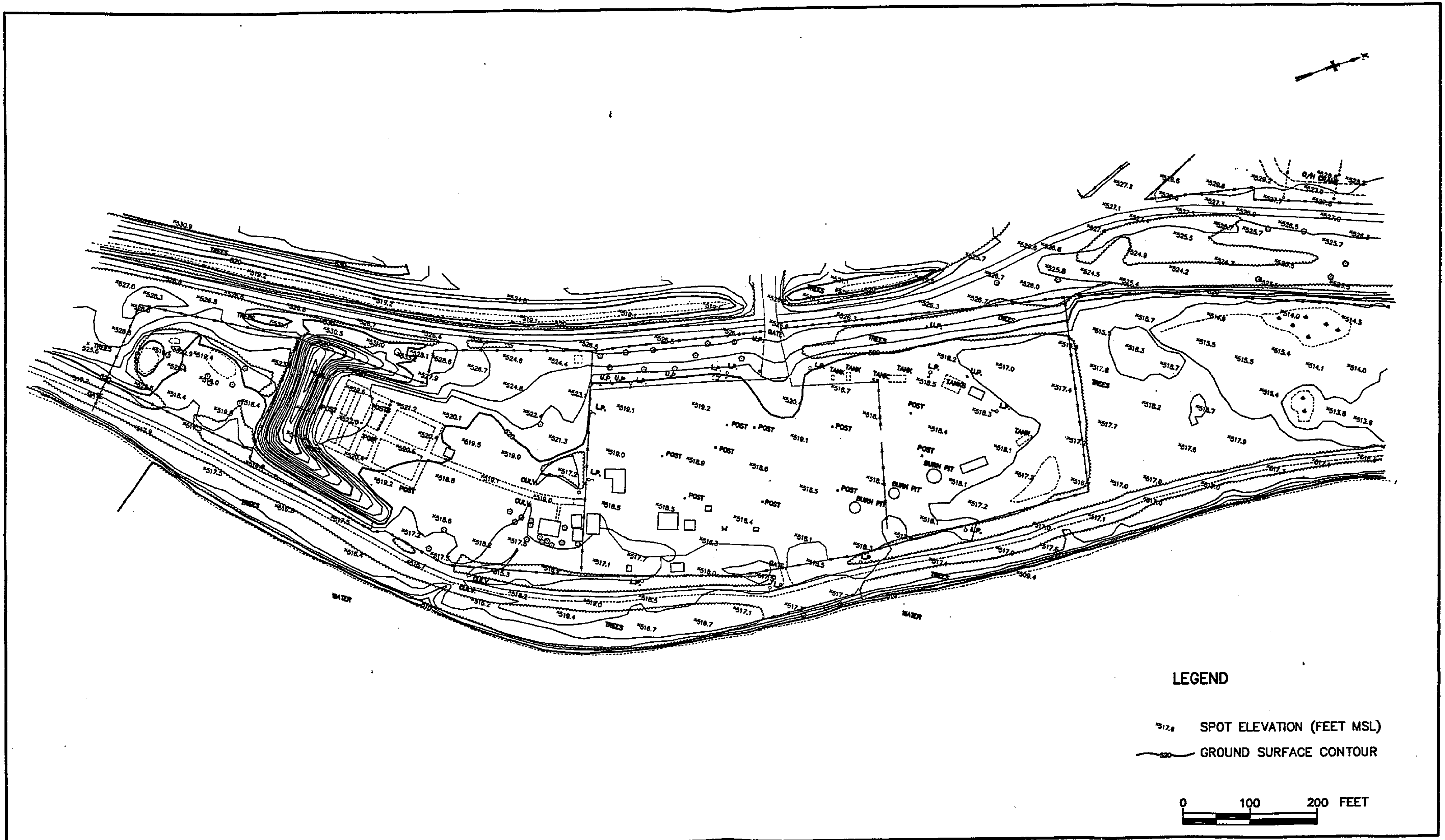
ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS

SPECIFIC AREAS AT ACADEMY SITE

CITY OF ROCHESTER

MARCH 1991



ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS

SITE TOPOGRAPHY

CITY OF ROCHESTER

MARCH 1991

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ROC-04-F32

apparently crushed and buried using heavy construction equipment. A discontinuous layer of coarse-textured soil and debris covers the drums. Additionally, construction and demolition debris is present in this area. Drum fragments are visible at the face of the berm along the north-northwest edge of the fill area.

The Training Grounds Area, which is centrally located at the site, contains several small buildings, fuel storage tanks, burn pits, and fire training equipment. A three-inch thick layer of crushed stone covers native soil materials within the Training Grounds Area. A small surface runoff retention basin is located in its northeast corner. A stormwater sewer, which originates at the Fire Academy parking lot to the west of the site on Scottsville Road passes under the center of this area.

The South Disposal Area is located in the southwest corner of the site. Drummed and uncontained wastes were disposed of in this area. A number of drums were previously removed from this area resulting in several depressions which have since filled with water.

2.2 SITE HISTORY

The Rochester Fire Academy has been owned and operated by the City of Rochester as a training facility used by the City's Fire and Police Departments since its inception in 1954. Prior to 1954, the area was undeveloped park land. During the period from approximately 1954 through 1980, the Fire Academy accepted flammable liquids from local industries and other sources for training activities. No records were kept on materials accepted by the Fire Department for burning practices. On-site personnel indicated that solvents, paint thinners and other organic chemicals in addition to metallic residue sludge-like materials were burned and/or disposed of at the Training Grounds and North and South Disposal Areas.

Aerial photographs taken during the period from 1961 to 1970 indicate that disposal activities had occurred in the North and South Disposal Areas. By 1976, other aerial photographs indicate that waste disposal activities in the Northern Disposal Area had ceased, although the Southern Disposal Area remained "disturbed". The New York State Department of Environmental Conservation (NYSDEC) began investigating the facility's disposal practices in 1980 and subsequently directed the removal of over 200 drums and numerous chemical reagent bottles from the three area of concern. Late in 1981, Empire

Soils Investigations of Buffalo, New York was retained by the City of Rochester to perform a soil sampling and analysis program. Inorganic and organic constituents were detected in soil samples collected from the Training Grounds Area. During 1982, the City of Rochester applied to the NYSDEC for a hazardous waste treatment, storage and disposal permit, but the application was rejected and the Fire Training Academy ceased the practice of using industrial wastes for training purposes. Subsequently, the Fire Academy Site was placed on the NYSDEC's Registry of Inactive Hazardous Waste Disposal Sites (Site No. 828015).

Since being identified as a hazardous waste disposal site, the Fire Academy site has been the subject of NYSDEC Phase I (Recra Research, Inc. 1983) and Phase II (Recra Research, Inc. 1985) State Superfund investigations. Based on the results of these preliminary investigations, the NYSDEC assigned the site a "Class 2" designation in late 1986 and directed the City of Rochester to remediate the site. City personnel who use the site and union representatives have raised concerns about potential health effects. In response to these concerns, a 3-inch deep layer of crushed stone was placed over soil in the actively-used portions of the Training Grounds Area in the spring of 1987 to minimize personnel contact with contaminated soil. In early 1988, the Monroe County and New York State Departments of Health, and the National Institute for Occupational Safety and Health requested the City to limit public access to the site. Consequently, the City erected a fence around the Genesee Valley Park Area and northern portion of the training grounds and repaired the existing fencing around the remainder of the Training Grounds Area and the South Disposal Area.

2.3 PURPOSE OF STUDY

As a result of the Fire Academy's Class 2 designation, the NYSDEC has required that a Remedial Investigation/Feasibility Study (RI/FS) be conducted to determine the nature and extent of hazardous waste contamination at the site, evaluate potential risks, and identify feasible alternatives for site remediation. Subsequently, during 1989 the City of Rochester entered into a Consent Order Agreement with NYSDEC to conduct an RI/FS at the Fire Academy as the first step in the remediation process.

The City of Rochester contracted Malcolm Pirnie, Inc. to perform the required RI/FS. During the period of November 1989 through August 1990, Malcolm Pirnie conducted the field investigation activities required by the RI scope of work. The purpose of this document is to present the findings of the Remedial Investigation.

2.4 SCOPE

The approach of the required RI/FS investigative and reporting activities was identified in the Order-on-Consent (Appendix A). This scope was specifically based upon a Work Plan/Quality Assurance Plan (Malcolm Pirnie, 1988a), addended to incorporated modifications/additions based upon NYSDEC/NYSDOH review comments (Malcolm Pirnie, 1988b). This NYSDEC approved Work Plan, as addended, includes a Remedial Investigation Plan which identifies all the field investigative activities and methodology, including sample collection procedures and analytical protocol, that were employed to perform the investigation and the quality assurance/quality control procedures.

During the course of the field investigative activities, a number of modifications to the scope of work and/or investigative procedures were recommended on the basis of new information discovered and/or mitigating circumstances encountered in the field. All such modifications were implemented after mutual agreement by Malcolm Pirnie, NYSDEC and City of Rochester. A chronology of all modifications is presented in Appendix B.

Collectively, the Work Plan/Quality Assurance Plan and the documents presented in Appendix B define the specific methodology that was employed to generate the data presented in this document. This methodology will only be referenced and/or summarized in the text of this document as appropriate for interpretation of results and findings. The reader is referred to the Work Plan (Malcolm Pirnie, 1988a and 1988b) and Appendix B for a detailed presentation of the specific investigative procedures and methods employed.

3.0 PHYSIOGRAPHY, CLIMATE, AND SOILS

3.1 LAND USE AND DEMOGRAPHY

The training areas of the site, the Training Grounds Area and Obstacle Course/Firing Range Area, are primarily used by the City Fire and Police departments. The Fireman's Training Grounds Area is utilized by over 2,000 industrial, Academy, and other users annually. The Obstacle Course/Firing Range Area is utilized by Police in-service training personnel, recruits, special response team, K-9 units and other outside agencies (i.e., Federal, State, County and local government agencies) totalling over 1,000 users annually. The Genesee Valley Park, which abuts the eastern boundary of the site, is a wooded area that is traversed by a recreational bicycle path. According to the City of Rochester Parks Operations Manager, use of the park in the vicinity of the Fire Academy Site consists of approximately 30 recreational users per day during the summer months. Recreational use decreases to 5-15 users per day during the winter months. Use is restricted by fencing on the North and South Site perimeters; however, unauthorized personnel were observed on the bicycle path within the site boundaries during the site investigation. The wooded area between the bicycle path and the Genesee River has been designated as a New York State Class II Wetland Area (County Wetland Number RH-2-II). There are no critical habitats of endangered species identified in this area.

The abandoned channel of the former Genesee Valley Canal is located along the southwestern site boundary. This area has been recently purchased by the City of Rochester. The northern portion of the Canal adjacent to the site has been infilled. The canal was completed in 1856 and connected the City of Olean with the City of Rochester. The canal was abandoned in 1887. Railway service, recently abandoned, ran parallel to the ancestral canal channel.

The Rochester Fire Training Academy Site is located in an urbanized area that generally consists of commercial development. The site is currently zoned General Commercial per land use zoning mapping obtained from the City of Rochester Department of Community Development.

The nearest residential area is approximately 1/4-mile to the southwest. A water well is known to provide a source of supply for one resident. The household water supply was tested by the County Health Department and was determined to be within ground water quality standards. Table 3-1 presents the 1980 population and the number of drilled and dug wells used as a primary or secondary water supply source for zip code areas in the vicinity of the Fire Academy Site (see Figure 3-1).

3.2 TOPOGRAPHY

The Fire Academy Site is located within the Genesee Valley Region. The topographic relief in this region is generally low. Major topographic features in the area includes: a beach ridge present a few miles to the north of the City of Rochester; a lake plain extending northward from the beach ridge to Lake Ontario; and glacially-derived landforms including end moraines, till plains, kames and drumlins south of the beach ridge.

The Fire Academy Site is located within the Genesee River flood plain, an area that is generally flat lying with occasional relief associated with past landfilling and excavation activities. The surface of the Training Grounds Area is relatively flat and is covered with approximately three (3) inches of coarse gravel. A man-made berm, steeply rising to a height of 22 feet above grade, serves as a backstop for the Police Firing Range. The remainder of the obstacle course/firing range is relatively flat.

The North Disposal Area is somewhat mounded with construction and demolition (C & D) debris partially crushed drums, and foundry sand. This landfilling activity has resulted in gentle downward slope toward the north. The South Disposal Area has been landfilled and partially excavated with local relief varying between 3 to 5 feet.

A channel-like narrow depressed area (approximately ten feet deep) is present along the southwestern edge of the site. This depressed area is the ancestral channel of the Genesee Valley Canal. The canal channel is in-filled along the western boundary of the North Disposal area. Parallel to the canal along the entire western boundary of the Fire Academy site, there is a slightly mounded ridge of railroad ballast fill material from the pre-existing ConRail railway. A topographic contour map is provided in Figure 3-2.

3.3 DRAINAGE

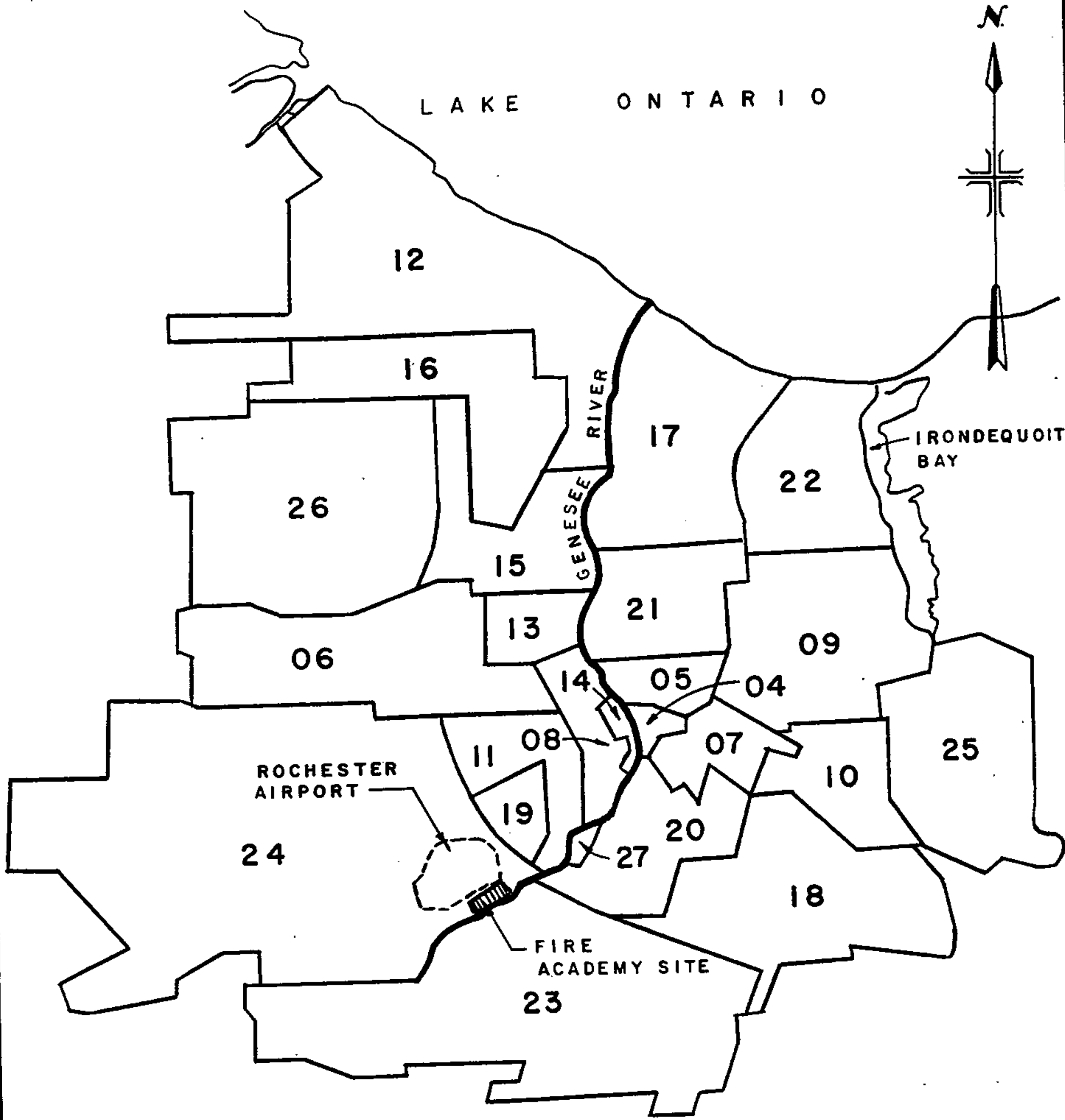
The regional drainage characteristics are discussed in Section 6.2. Surface water drainage at the Fire Academy site is toward the Genesee River. Discrete on-site drainage

TABLE 3-1

ZIP CODE AREA POPULATION AND WATER SUPPLY WELLS IN THE VICINITY OF THE FIRE ACADEMY SITE

ZIP CODE	1980 POPULATION	DRILLED WELL	DUG WELL
14608	15,137	0	0
14611	22,009	11	0
14619	16,849	11	0
14620	27,208	8	6
14623	28,053	66	4
14624	34,674	264	13
14627	2,895	0	0

Source: National Water Well Association Database



NOTE: 146 + TWO DIGITS SHOWN = ZIP CODE
SOURCE: U.S. POSTAL SERVICE, ROCHESTER, N.Y.

ROCHESTER FIRE ACADEMY
RI / FS
ZIP CODE AREAS

CITY OF ROCHESTER, NEW YORK NOVEMBER 1990

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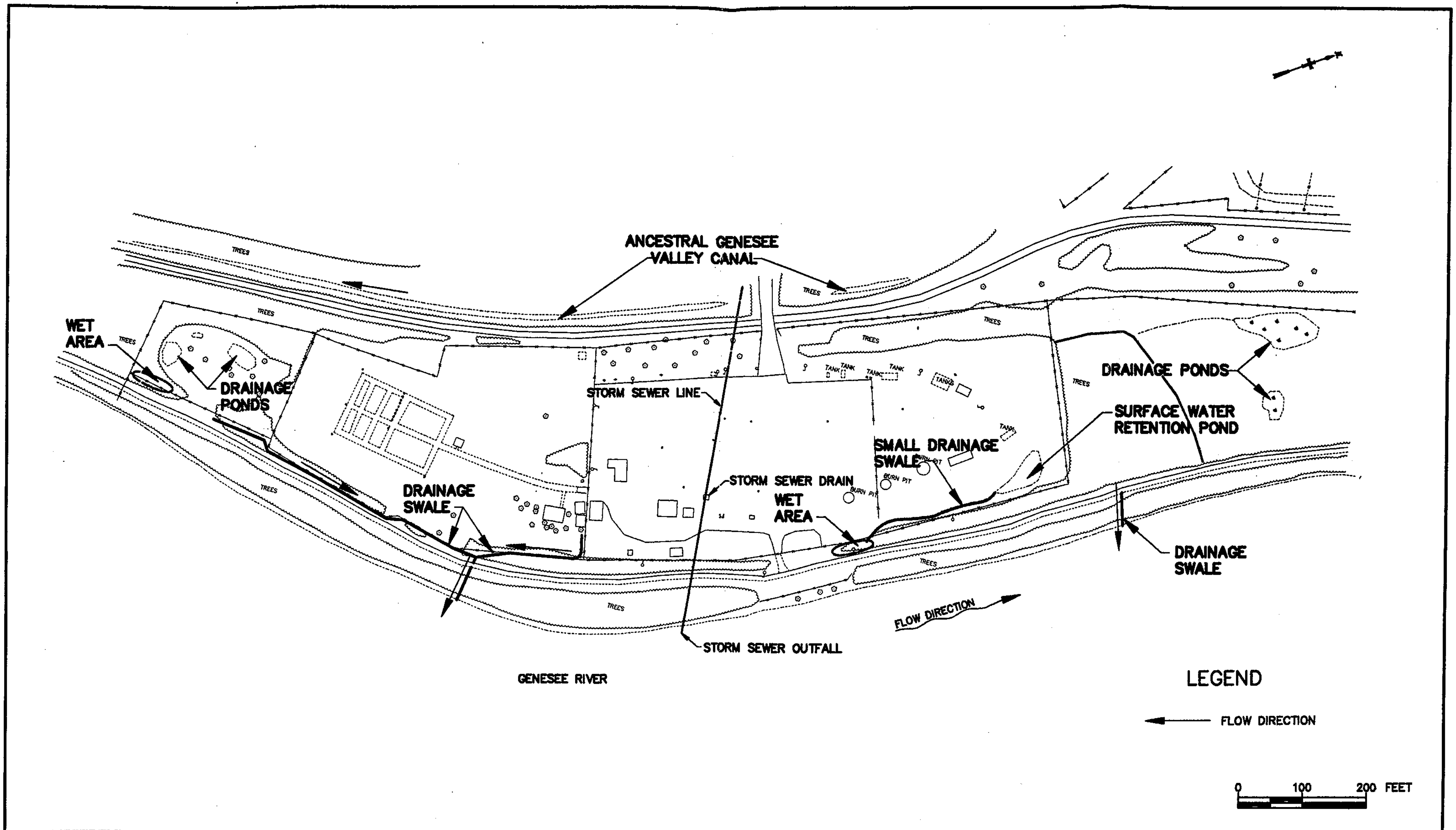
FIGURE 3–3



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ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS

ON–SITE DRAINAGE AREAS

CITY OF ROCHESTER MARCH 1991

areas are shown in Figure 3-3. The Training Grounds Area drains via a storm sewer located near the center of the area and a drainage swale along the southeastern boundary of the area. Surface water flowing into the storm sewer drain is discharged beneath the Training Grounds area via a storm sewer outfall and directly discharges to the Genesee River. Some surface water ponding occurs in the northeast corner of the training grounds area behind a small surface water retention berm. South of the surface water retention pond is a small drainage swale formed by the shallow excavation of soil during construction of a one to two-foot berm along the fence line east of the burn pit area. A small portion of the flow in the swale recharges the wet area near the exit gate. This wet area seasonally expands into the vicinity of the burnpits. Overland flow occurs during periods of heavy precipitation where surface runoff moves across the wetland area and discharges directly into the Genesee River.

A shallow pond exists slightly north of the North Disposal Area. Ponding is attributed to the low permeability of the surface soil and the near surface water table (described in Section 4.0). During periods of heavy precipitation, the ponded area overflows and the surface water flows toward the wetland area ultimately discharging to the Genesee River.

Two (2) shallow ponds are present within the South Disposal Area which collects surface water during periods of heavy precipitation. Surface water not collected by the ponds drains to a swale originating near the gate at the east side of the South Disposal Area. This swale drains northward paralleling the fence along the police obstacle course/firing range where it merges with a drainage swale originating in the police obstacle course/firing range area. The two drainage swales merge at a 12-inch diameter corrugated culverts which underlies the bike path, and is conveyed directly to the Genesee River. The former Genesee Valley Canal, located along the western boundary of the site, appears to drain to the south.

3.4 CLIMATOLOGY

A National Oceanic and Atmospheric Administration (NOAA) weather station is located at the Greater Rochester International Airport, approximately 0.5 miles west of the site.

The climate of the Rochester area is characterized as humid continental and is influenced by Lake Ontario, which tends to moderate temperatures throughout the year. Precipitation is evenly distributed throughout the year and is also influenced by the near proximity of the lake. Table 3-2 presents climatic data for a 30 year period of record (1960 - 1989).

The site climate can be generally defined from the following statistics:

Mean Average Annual Precipitation	32.64 inches
Mean Average Annual Temperature	47.8° F
Maximum Average Annual Temperature	56.3° F
Minimum Average Annual Temperature	39.3° F

Wind direction is generally from the west southwest with a mean wind speed of 9.7 mph.

Snow and frozen soil conditions from November through April may influence potential remedial alternatives. The following is the monthly mean snowfall for the past 30 year period of record:

November	6.5 inches
December	19.4 inches
January	22.9 inches
February	22.4 inches
March	13.9 inches
April	3.4 inches

The last killing frost occurs in late April. In the Fall, the growing season is extended by the influence of the warmer waters of the lake, with the first killing frost occurring in late October.

Climatological data were obtained for the months of November 1989 and April through August 1990, the period during which the Remedial Investigation field studies were performed. These data are compared with the 30-year averages in Table 3-3.

3.5 SOILS

The native soil cover in the vicinity of the Fire Academy Site has been extensively disturbed (excavated, mixed with fill and/or paved or covered). A large portion of the site is covered with fill material. Soils present in the area prior to site development were

TABLE 3-2

METEOROLOGICAL DATA FOR 1960 - 1989
AT THE GREATER ROCHESTER INTERNATIONAL AIRPORT

AVERAGE MONTHLY TEMPERATURE (°F)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean	24.6	24.5	32.9	45.1	56.9	66.4	71.4	69.3	62.5	51.4	39.8	28.9	47.8
Max.	31.5	31.9	40.6	54.1	66.8	76.5	81.3	78.9	72.1	60.2	46.6	35.2	56.3
Min.	17.6	17.1	25.2	36.1	46.9	56.3	61.4	59.7	52.92	42.5	33.0	22.6	39.3

AVERAGE MONTHLY PRECIPITATION (in.)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean	2.46	2.36	2.61	2.58	2.89	3.00	3.07	2.89	2.77	2.74	2.69	2.58	32.64

TABLE 3-3

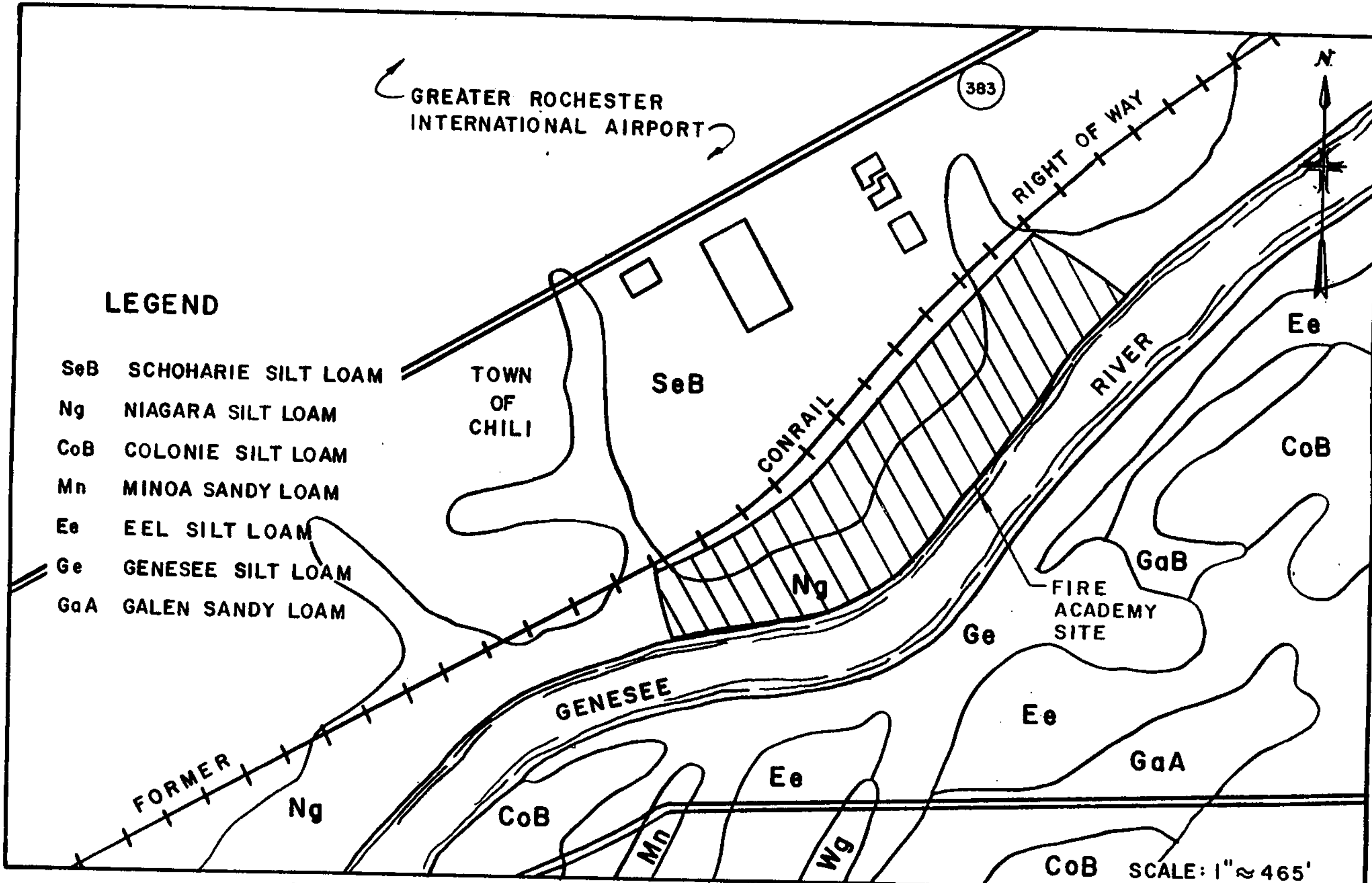
COMPARISON OF PERIOD SPECIFIC PRECIPITATION DATA TO 30-YEAR AVERAGES

MONTH/YEAR OF FIELD ACTIVITY		PERIOD SPECIFIC PRECIPITATION (inches)	30-YEAR AVERAGE PRECIPITATION (inches)
November	1989	2.01	2.69
December	1989	1.58	2.58
January	1990	1.61	2.46
February	1990	3.93	2.36
March	1990	1.56	2.61
April	1990	3.58	2.58
May	1990	5.76	2.89
June	1990	2.88	3.00
July	1990	3.05	3.07
August	1990	3.59	2.89
September	1990	3.36	2.77
October	1990	4.37	2.24
November	1990	2.27	2.69
TOTAL		39.55	35.33

mapped by the U.S. Department of Agriculture Soil Conservation Service (1973). Figure 3-4 illustrates the various soil types in the vicinity of the site. As depicted, two soil types occur on-site: the Niagara Silt Loam (Ng) and the Schohaire Silt Loam (SeB).

The two native soil types appear to have similar compositional characteristics. The Niagara Silt Loam is described as a dark brown to yellow brown silt and very fine sand with some clay. This soil type is described as poorly drained. The Schohaire Silt Loam is a dark brown to reddish brown silt and clay and is moderately well drained. The range of pH values for the Niagara Silt Loam and the Schohaire Silt Loam are 6.1-7.6+ and 6.5-7.6+, respectively.

Overlying the native soils are various types of fill material. The Training Grounds area is currently covered with a three-inch layer of coarse angular gravel. In the North Disposal area, a 2-3 foot layer of sandy construction and debris fill material, including some foundry sand, extends approximately 200 feet northeastward of the Training Ground Area, covering the native soil material. Ash and cindery material, as well as other fill material, covers the native soils in the South Disposal Area. The fill materials across the site appear to be well drained. The fill material is described in detail in Section 5.3.1.



NOTE: FROM U.S. SOIL CONSERVATION SERVICE, 1973

MALCOLM PIRNIE

ROC - 04

ROCHESTER FIRE ACADEMY
RI/FS
SOILS MAP IN THE VICINITY OF THE ROCHESTER FIRE ACADEMY SITE

CITY OF ROCHESTER, NEW YORK JULY 1990

FIGURE 3-4

4.0 PRELIMINARY SITE SURVEYS

A preliminary investigation was conducted at the Fire Academy site to (a) better define the areal extent of known disposal areas (North Disposal and South Disposal Areas); (b) identify the occurrence and location of disturbed soil, buried metallic objects, radioactive materials and detectable organic soil gas vapors on site and in the immediate surrounding area; and (c) to provide a basis for final selection of soil boring, test pit, and ground water monitoring well installation locations. The investigation activities included:

- preparation of a site map by areal photogrammetry;
- establishment of a grid coordinate system to be used to orient the non-intrusive surveys;
- completion of a radiological survey to detect presence of any radioactive materials at the ground surface;
- completion of a shallow (vadose zone) soil gas survey using a portable organic vapor analyzer;
- completion of an electromagnetic (EM) terrain conductivity survey to define areas of disturbed soil and to locate buried metallic material/objects; and
- interpretation of the data to identify areas of potential contamination (anomalous field conditions) for further investigation.

A description of the preliminary surveys and discussion of the survey findings has been presented in an Interim Remedial Investigation (RI) Report (Malcolm Pirnie, Inc. 1990). The major findings of the preliminary surveys are summarized in this Section.

4.1 INVESTIGATIVE METHODOLOGY

The methods used to perform the preliminary surveys have been presented in the Interim RI report (Malcolm Pirnie, Inc., February 1990).

4.2 SUMMARY OF SURVEY RESULTS

4.2.1 Radiological Survey

For purposes of the survey, an elevated radiation level was defined as any value above two times background. Background was established to be less than 0.02 mR/hr. No area with radioactivity greater than twice that of the natural background level (>0.02 to 0.04 mR/hr) was detected at the Rochester Fire Academy site. Therefore, it was concluded that radioactive materials are not present at ground surface at the site.

4.2.2 Geophysical/Soil Organic Vapor Screening Surveys

Visual observations and the findings of the geophysical and soil vapor surveys for each area of the site are summarized in this section. The grid that was established to provide locational control is illustrated in Figure 4-1.

4.2.2.1 North Disposal Area

This area is blanketed by coarse backfill with fill thicknesses estimated on the basis of field observations to exceed four (4) feet, locally. Drums/drum fragments are partially exposed at the following grid reference locations (Figure 4-1):

E2420, N1115	E2545, N1095
E2480, N975	E2580, N1045
E2510, N1120	

A number of geophysical (conductive) anomalies typical of buried metallic material were encountered in the North Disposal Area. The majority of these anomalies correlated with known locations of exposed drums. Additional conductive anomalies were encountered at the following grid references (Figure 4-1):

E2460, N1125	E2520, N1080
E2570, N1075	E2600, N970

An area of low terrain conductivity characteristic of coarse soils and/or fill was encountered approximately 100 feet (E2700, N975) north of the metallic anomalies.

Soil vapor survey results in the North Disposal Area indicated the presence of low concentrations (to a maximum of 5.1 ppm) of total volatile organic vapors in the shallow soil/fill in an area centered around E2500, N1050.

4.2.2.2 South Disposal Area

Visual observations in the South Disposal Area indicate the presence of foundry sands and/or ash fill and a number of partially exposed drums/drum fragments at grid reference E1075, N1140 (Figure 4-1). Partially exposed drums were also observed at grid reference E1075, N1050; E1115, N1100; and E1120, N1060. Broken laboratory bottles and other metallic debris were also noted in the area.

Several terrain conductivity anomalies, representative of buried metallic material, were observed in this area at the following grid references: E1010, N1075; E1020, N1100; and E1075, N1125. It was hypothesized that two of these anomalies (E1010, N1075; E1075, N1125) might also be associated with conductive soils (i.e., contaminated or fine-grained).

Soil vapor survey results in the South Disposal Area indicate the presence of volatile organic vapors (to 13 ppm) in the shallow soil/fill at locations centered around grid reference E1050, N1050.

4.2.2.3 Training Grounds Area

Numerous geophysical anomalies were encountered in the Training Grounds area. For the most part, these anomalies are believed to represent anthropogenic surface features (i.e., fences, structures, tanks etc.) or buried metal pipes/utilities which are readily identifiable. Certain high terrain conductivity anomalies, representative of buried metallic material, were encountered at grid references E1660, N820; E1790, N910; E1840, N820; and E2320, N1060.

Volatile organic vapor concentrations are elevated above background over much of the Training Grounds Area with the highest vapor concentrations detected at the following locations:

Grid Reference Location	Soil Gas Concentration (ppm)	Potential Source
E1800, N900	15	open area - unidentified
E1850, N850	17	adjacent to block structure
E1850, N950	22	open area - unidentified
E2175, N1050	70	above-ground storage tank
E2200, N1025	300	above-ground storage tank
E2200, N1050	250	above-ground storage tank
E2250, N1000	90	open area - unidentified
E2250, N1050	18 (kerosene odor)	adjacent to building
E2300, N1100	10	open area - unidentified

These elevated concentrations are likely related to accidental spills/releases associated with past combustible chemical handling practices and fire fighting exercises.

4.2.2.4 Police Obstacle Course and Firing Range Area

Several high terrain conductivity anomalies were encountered within the Obstacle Course and Firing Range Area. Two of the smaller anomalies located at grid references E1300, N1010 and E1375, N960, indicated buried metallic material. Areas of high terrain conductivity (E1500, N1050) and low conductivity (E1475, N850) representative of fine-textured (or contaminated) soil/fill, and coarse-textured soil/fill, respectively, were also observed. The remaining geophysical anomalies appear to correlate with known anthropogenic features.

A terrain conductivity traverse was performed along the apex of the firing range berm. Based on quadrature and in-phase responses along the survey profiles (see Interim RI Report), the southcentral portion of the berm appears to contain metallic debris. Elevated conductivity (quadrature responses) along the northwestern leg of the berm was attributed to fine-textured fill used in constructing the berm.

The soil vapor survey results within the Obstacle Course/Firing Range were generally within the expected range of background values (0 to 0.6 ppm). Slightly elevated soil organic vapor values were encountered at grid references E1250, N900 (1.2 ppm); E1250, N950 (0.6 ppm); and E1550, N900 (2.0 ppm).

4.2.2.5 Genesee Valley Park Area

A terrain conductivity traverse was performed north to south along the bicycle path. Quadrature and in-phase responses were observed at grid reference E2900, N950 (culvert); E2325, N825; E1600, N750; and E1475, N775 (possibly a culvert). The source of the remaining two anomalies was not apparent. An area of elevated quadrature response, characteristic of fine textured (or contaminated) soil was encountered immediately east (E1350, N850) of the firing range berm.

Organic vapors were detected in the shallow subsurface adjacent to the bicycle path immediately east of the following locations: the South Disposal Area (E1000, N1000; concentration to 2.5 ppm); the Obstacle Course/Firing Range (E1600, N750; concentration to 7 ppm); and the Training Grounds (E2100, N800; concentration to 24 ppm).

4.2.2.6 Genesee Valley Canal Area

This area located immediately west of Fire Academy site encompasses both an abandoned railroad corridor and a linear depression associated with the former Genesee Valley Canal.

A series of geophysical traverses were conducted in the area both parallel (north to south) and perpendicular (east to west) with the orientation of the railroad corridor (see Appendix B). The quadrature and in-phase responses recorded during the survey traverses are typical of what would be anticipated from the soil/fill materials in the area (e.g., the cinder/slag used as railroad bedding) and from known utilities. No unexplained geophysical anomalies are present in the area.

With the exception of a single location, volatile organic vapor concentrations were within the range expected for background. An organic vapor concentration of 0.8 ppm was observed at grid reference E1800, N1150.

4.2.3 Summary

The preliminary non-intrusive surveys identified several areas with elevated volatile organic vapor concentrations and a number of unidentified geophysical anomalies which are representative of either different soil types (or contamination), and buried metallic materials. The major anomalies are listed by grid reference location in Table 4-1, along with the methods that were recommended for the subsequent intrusive investigation of these anomalies. The findings of the further investigation are presented in Section 7 of this report.

TABLE 4-1

ROCHESTER FIRE ACADEMY SITE - RI/FS
SUMMARY OF MAJOR SURVEY ANOMALIES

AREA	GRID REFERENCE/ LOCATION	TYPE OF ANOMALY	RECOMMENDED INVESTIGATION METHOD
NORTH DISPOSAL AREA	E2460, N1125	Buried metal	test pit
	E2480, N975	Exposed drums	surficial sample
	E2500, N1100	OVs* (0.9 ppm)	surficial sample
	E2520, N1080	Buried metal	test pit
	E2550, N1000	OVs* (0.9 ppm)	surficial sample
	E2575, N1075	Buried metal	test pit
	E2600, N970	Buried metal	test pit
	E2700, N975	Low conductive soil/fill	test pit
	E2500, N1050	OVs* (5.1 ppm)	boring
SOUTH DISPOSAL AREA	E1010, N1075	Buried metal/ conductive soil	test pit
	E1030, N1100	Buried metal	test pit
	E1050, N1050	OVs* (13 ppm)	boring
	E1050, N1150	OVs* (5.4 ppm)	boring
	E1075, N1125	Buried metal/ conductive soil	test pit
	E1100, N1050	OVs* (4.4 ppm)	surficial sample
TRAINING GROUNDS	E1660, N820	Buried metal	test pit
	E1700, N1050	OVs* (8.0 ppm)	boring/monitoring well
	E1790, N910	Buried metal	review utility mapping
	E1800, N900	OVs* (15 ppm)	surficial sample
	E1800, N1000	OVs* (3.0 ppm)	surficial sample
	E1850, N850	OVs* (17 ppm)	boring
	E1850, N950	OVs* (22 ppm)	surficial sample
	E2100, N950	OVs* (1.1 ppm)	surficial sample
	E2200, N900	OVs* (3.0 ppm)	surficial sample
	E2320, N1060	Buried metal	test pit
	E2175, N1050	OVs* (70 ppm)	surficial sample boring
	E2200, N1025	OVs* (300 ppm)	surficial sample boring
	E2200, N1050	OVs* (250 ppm)	surficial sample boring
	E2250, N1000	OVs* (90 ppm)	boring/monitoring well
	E2250, N1050	OVs* (18 ppm)	boring/monitoring well
	E2300, N1100	OVs* (10 ppm)	surficial sample
POLICE OBSTACLE COURSE & FIRING RANGE	E1300, N1010	Buried metal	review utility mapping
	E1375, N960	Buried metal	review utility mapping
	E1475, N850	High conductive soil/fill	no further investigation
	E1500, N1050	Low conductive soil/fill	no further investigation
	E1200, N1000 B*	Buried metal	no further investigation
	E1400, N1050 B*	High conductive soil/fill	no further investigation
	E1250, N950	OVs* (0.6 ppm)	surficial sample
	E1550, N900	OVs* (2.0 ppm)	surficial sample
BICYCLE PATH	E1000, N1000	OVs (2.5 ppm)	surficial sample
	E1250, N900	OVs* (1.2 ppm)	surficial sample
	E1350, N850	High conductive soil/fill	boring
	E1475, N775	Buried metal (possibly culvert)	review utility mapping
	E1600, N700	OVs* (5.0 ppm)	surficial sample
	E1600, N750	Buried metal	review utility mapping
	E1600, N750	OVs (7.0 ppm)	monitoring well

TABLE 4-1 (continued)

ROCHESTER FIRE ACADEMY SITE - RI/FS
SUMMARY OF MAJOR SURVEY ANOMALIES

AREA	GRID REFERENCE/ LOCATION	TYPE OF ANOMALY	RECOMMENDED INVESTIGATION METHOD
BICYCLE PATH (continued)	E1750, N750	OVs* (0.8 ppm)	surficial sample
	E1800, N740	Storm sewer bedding	test pit
	E1900, N750	OVs* (0.8 ppm)	surficial sample
	E2025, N775	Surface Staining (elevated OVs)	boring/monitoring well
	E2100, N800	OVs* (24.0 ppm)	boring
	E2325, N850	Buried metal	review utility mapping
	E2650, N950	Downgradient North Area	surficial sample
GENESEE VALLEY CANAL AREA	E1800, N1150	OVs (0.8 ppm)	surficial sample

NOTES: OVs = Organic Vapor in soil/fill measured in ppm concentration by HNu photoionization detector.
B = Firing range berm
NA = Not applicable

5.0 GEOLOGY AND HYDROGEOLOGY

5.1 INVESTIGATIVE METHODOLOGY

The geologic and hydrogeologic investigations for the Rochester Fire Academy Remedial Investigation (RI) were conducted from November 1989 through May 1990. The scope of these investigations and specific work tasks performed were in accordance with the Work Plan (Malcolm Pirnie Inc., 1988) and addendum (Malcolm Pirnie Inc., October 1988) as modified on the basis of the findings of the preliminary surveys (Malcolm Pirnie, Inc. February 1990).

Field activities performed to characterize the geologic and hydrogeologic conditions at the site involved the following tasks:

- drilling of twenty-two (22) borings at eleven (11) locations including continuous sampling of the deepest borehole at each location;
- installation of twenty-one (21) monitoring wells and one (1) piezometer;
- development of all newly installed monitoring wells/piezometer;
- in-situ hydraulic conductivity testing of all newly installed wells/piezometers;
- installation of two (2) staff gauges in the Genesee River adjacent to the site; and
- monitoring of water levels in the Genesee River, the newly installed wells/piezometer and existing wells.

5.1.1 Borehole/Monitoring Well Completion

Twenty-one (21) boreholes/monitoring wells were completed in accordance with the recommendations presented in the Interim RI Report, February 1990 at the locations shown in Figure 5-1.

Stratigraphic information used to characterize the overburden material was obtained during borehole advancement using continuous split spoon sampling techniques in the deepest well at each triplet/couplet well location and at each single well location. Split spoon samples were logged and placed in labeled sample jars for archiving purposes. Sample descriptions/boring logs are presented in Appendix C.1.

Three (3) well clusters were installed at locations MW-6, MW-7, and MW-8. These clusters included a shallow overburden well with the screened portion of the well straddling the water table, an intermediate bedrock well screened in the upper portion of the bedrock, and a deeper bedrock well screened ten feet below the top of the rock. For description purposes, the shallow wells have been identified by a "S", the intermediate wells by an "I", and the deep wells by a "D".

Well pairs consisting of a shallow overburden well and an intermediate bedrock well were installed at four (4) locations: MW-9, MW-10, MW-11 and MW-12.

Single shallow wells were installed at three (3) locations: MW-13, MW-14, and MW-15. Additionally, a decision was made in the field to add a single intermediate bedrock well (MW-16I) and a piezometer PZ-9 (documented in Appendix B). The piezometer (PZ-9) was installed in the lower overburden to determine if lower overburden and the upper bedrock are hydraulically connected. Monitoring well MW-16I was installed to provide additional geologic/hydrogeologic data and water quality information for the extreme northern area of the site.

The monitoring well installation procedures and construction details are documented in Appendices C.2 and C.3, respectively. Well construction details are summarized in Table 5-1.

The following soil samples were collected from some boreholes for physical testing:

- Shelby tube samples (undisturbed soil samples) were collected from boreholes MW-9S at 12-14 feet and MW-6I at 12-14 feet and 32-34 feet to determine the vertical hydraulic conductivity of the overburden at those locations; and
- split-spoon samples collected from each screened zone of the upgradient shallow wells and the piezometer (MW-6S, MW-9S, PZ-9, and MW-10S) were submitted to the laboratory for grain size analysis.

In order to minimize the risk associated with handling potentially contaminated soils, only soil samples collected from upgradient boreholes were submitted for testing. Soil testing results are discussed in Section 5.3.

To better define the bedrock underlying the site, samples of bedrock were obtained from all intermediate and deep boreholes using either an HQ (4" diameter) or an NX (3"

TABLE 5-1
ROCHESTER FIRE ACADEMY RI/FS
WELL CONSTRUCTION SUMMARY

WELL BORE #	GROUND ELEV	TOP OF PVC RISER ELEVATION	BOREHOLE DIAMETER (in) (1)	BOREHOLE DEPTH/ BOTTOM EL	BOTTOM PERMANENT CASING DEPTH/ELEV	TOP OF SEAL DEPTH/ELEV	TOP PRIMARY SAND PACK DEPTH/ELEV	TOP OF SCREEN DEPTH/ELEV	SCREEN BOTTOM DEPTH/ELEV	BASE OF SUMP DEPTH/ ELEV	PRIMARY SAND PACK BOTTOM DEPTH/ELEV	TYPE OF SAND PACK	SCREENED INTERVAL/ LENGTH (ft) x SLOT SIZE (in)
MW-6S	526.3	527.86	10"	17.1 509.2	N/A (2)	2.4 523.9	4.4 521.9	6.3 520.0	16.3 510.0	16.5 509.8	17.1 509.2	#2	6.3 – 16.3 10 x 0.010
MW-6I	526.2	528.01	10"/4"	45.1 481.1	N/A	30.5 495.7	34.0 492.2	35.0 491.2	45.0 481.2	45.1 481.1	45.1 481.1	#4	35.0 – 45.0 10 x 0.010
MW-6D	526.3	528.19	10"/4"	54.4 471.9	N/A	37.5 488.8	43.0 483.3	44.0 482.3	54.0 472.3	54.1 472.2	54.4 471.9	#4	44.0 – 54.0 10 x 0.010
MW-7S	517.4	519.38	10"	13.6 503.8	N/A	1.5 515.9	2.8 514.6	3.0 514.4	13.0 504.4	13.2 504.2	13.6 503.8	#2	3.0 – 13.0 10 x 0.010
MW-7I	517.4	519.57	10"/3"	41.0 476.4	31.0 486.4	24.8 492.6	28.8 488.6	30.8 486.6	40.8 476.6	41.0 476.4	41.0 476.4	#4	30.8 – 40.8 10 x 0.010
MW-7D	517.3	519.54	10"/3"	50.2 467.1	31.0 486.3	37.5 479.8	43.0 474.3	45.0 472.3	50.0 467.3	50.2 467.1	50.2 467.1	#4	45.0 – 50.0 10 x 0.010
MW-8S	517.5	519.73	10"	14.2 503.3	N/A	1.5 516.0	3.0 514.5	4.0 513.5	14.0 503.5	14.0 503.5	14.2 503.3	#2	4.0 – 14.0 10 x 0.010
MW-8I	517.3	520.00	10"/4"	41.5 475.8	31.0 486.3	25.0 492.3	29.5 487.8	30.3 487.0	40.3 477.0	40.3 477.0	40.5 476.8	#4	30.3 – 40.3 10 x 0.010
MW-8D	517.2	519.77	10"/4"	50.0 467.2	31.0 486.2	38.5 478.7	42.5 474.7	43.8 473.4	48.8 468.4	49.0 468.2	49.0 468.2	#4	43.8 – 48.8 5 x 0.010
PZ-9	526.8	528.73	10"	38.6 488.2	N/A	29.0 497.8	31.8 495.0	33.1 493.7	38.1 488.7	38.2 488.6	38.6 488.2	#2	33.1 – 38.1 5 x 0.010
MW-9S	526.6	528.22	10"	14.9 511.7	N/A	1.9 524.7	3.9 522.7	4.8 521.8	14.8 511.8	14.9 511.7	14.9 511.7	#2	4.8 – 14.8 10 x 0.010
MW-9I	526.5	528.55	10"/4"	49.6 476.9	N/A	34.1 492.4	38.1 488.4	39.5 487.0	49.5 477.0	49.6 476.9	49.6 476.9	#4	39.5 – 49.5 10 x 0.010

NOTES:

(1) Diameter of overburden portion of borehole/Diameter of bedrock portion of borehole.

(2) Not Applicable (permanent casing not installed in overburden wells and upgradient bedrock wells).

All depths in feet below ground surface

All elevations in feet above mean sea level

All wells have 2" diameters

TABLE 5-1

ROCHESTER FIRE ACADEMY RI/FS

WELL CONSTRUCTION SUMMARY

WELL BORE #	GROUND ELEV	TOP OF PVC RISER ELEVATION	BOREHOLE DIAMETER (in) (1)	BOREHOLE DEPTH/ BOTTOM EL	BOTTOM PERMANENT CASING DEPTH/ELEV	TOP OF SEAL DEPTH/ELEV	TOP PRIMARY SAND PACK DEPTH/ELEV	TOP OF SCREEN DEPTH/ELEV	SCREEN BOTTOM DEPTH/ELEV	BASE OF SUMP DEPTH/ ELEV	PRIMARY SAND PACK BOTTOM DEPTH/ELEV	TYPE OF SAND PACK	SCREENED INTERVAL/ LENGTH (ft) x SLOT SIZE (in)
MW-10S	523.9	525.62	10"	20.0 503.9	N/A (2)	5.1 518.8	7.9 516.0	9.8 514.1	19.8 504.1	20.0 503.9	20.0 503.9	#2	9.8 – 19.8 10 x 0.010
MW-10I	523.9	525.61	10"/4"	43.0 480.9	N/A	26.9 497.0	31.1 492.8	32.8 491.1	42.8 481.1	43.0 480.9	43.0 480.9	#4	32.8 – 42.8 10 x 0.010
MW-11S	517.3	518.94	10"	14.3 503.0	N/A	1.5 515.8	3.0 514.3	4.1 513.2	14.1 503.2	14.3 503.0	14.3 503.0	#2	4.1 – 14.1 10 x 0.010
MW-11I	517.4	519.79	10"/4"	35.2 482.2	25.0 492.4	18.7 498.7	22.7 494.7	25.0 492.4	35.0 482.4	35.2 482.2	35.2 482.2	#4	25.0 – 35.0 10 x 0.010
MW-12S	518.6	521.23	10"	14.0 504.6	N/A	1.5 517.1	3.0 515.6	3.8 514.8	13.8 504.8	14.0 504.8	14.0 504.6	#2	3.8 – 13.8 10 x 0.010
MW-12I	518.8	521.36	10"/3"	35.0 483.8	25.0 493.8	19.0 499.8	23.0 495.8	26.8 492.0	31.8 487.0	32.0 486.8	32.5 486.3	#4	26.8 – 31.8 5 x 0.010
MW-13S	519.4	521.75	10"	16.1 503.3	N/A	2.0 517.4	4.0 515.4	5.9 513.5	15.9 503.5	16.1 503.3	16.1 503.3	#2	5.9 – 15.9 10 x 0.010
MW-14S	518.1	520.55	10"	14.4 503.7	N/A	1.5 516.6	3.4 514.7	4.2 513.9	14.2 503.9	14.4 503.7	14.4 503.7	#2	4.2 – 14.2 10 x 0.010
MW-15S	517.7	520.18	10"	14.0 503.7	N/A	1.5 516.2	3.0 514.7	3.8 513.9	13.8 503.9	14.0 503.7	14.0 503.7	#2	3.8 – 13.8 10 x 0.010
MW-16I	516.1	519.43	10"/4"	29.4 486.7	19.5 496.6	12.3 503.8	16.9 499.2	19.2 496.9	29.2 486.9	29.4 486.7	29.4 486.7	#4	19.2 – 29.2 10 x 0.010

NOTES:

(1) Diameter of overburden portion of borehole/Diameter of bedrock portion of borehole.

(2) Not Applicable (permanent casing not installed in overburden wells and upgradient bedrock wells).

All depths in feet below ground surface

All elevations in feet above mean sea level

All wells have 2" diameters

diameter) core barrel. Each rock core was logged in the field by a field geologist and placed in a labeled wooden core box for archiving purposes. Bedrock core logs are presented in Appendix C.1.

5.1.2 Monitoring Well/Piezometer Development

Monitoring wells/piezometer were developed by either bailing or a combination of bailing and suction lift pumping until turbidity values were less than 50 NTU or until at least 10 to 20 well volumes were removed, and no visual improvement in turbidity was observed and pH and specific conductivity had stabilized. Wells were monitored for pH, temperature, specific conductivity, and turbidity in accordance with the Work Plan. A summary of well/piezometer development data and methodology is presented in Table 5-2. Well development data sheets are presented in Appendix C.4.

5.1.3 Hydraulic Conductivity Testing

In-situ hydraulic conductivity testing was conducted on all new wells and the piezometer. In accordance with the Work Plan, rapidly recharging wells were tested using the "rising head" method with changes in water levels recorded by an electronic pressure transducer and data logger. Slower recharging wells were monitored with an electronic water level indicator and stopwatch. Monitoring well MW-6D, a very slow recharging well, was monitored over a period of several days as it recovered from installation/development. The data from the deeper wells/piezometer, which have fully saturated screens were analyzed using SLUGIX Inc. software by the methods of Hvorslev (1951). Data from the shallow wells which have partially saturated screens were analyzed using SLUGIX software by the methods of Bouwer and Rice (1976).

Pressure packer testing was performed in each of the deeper bedrock boreholes MW-6D, 7D and 8D. The following intervals were tested in each borehole:

MW-6D 10-20 feet below the top of rock (Single Packer)
0-10 feet below the top of rock (Double Packer)

MW-7D 13-20 feet below top of rock (Single Packer)
0-10 feet - Not tested due to borehole collapse

MW-8D 13-20 feet below top of rock (Single Packer)
0-10 feet below top of rock (Double Packer)

TABLE 5-2
ROCHESTER FIRE ACADEMY RI/FS
WELL DEVELOPMENT DATA

WELL #	pH	TEMP oC	SPECIFIC CONDUCTANCE (uhmos)	TURBIDITY (NTU)	FIELD OBSERVSERVATION	TOTAL VOL REMOVED/WELL VOLUMES	METHOD	COMPLETION DATE
MW-6S	7.02	10.4	1850	48	CLEAR	5.3 / 5	BAILER	5/4/90
MW-6I	7.76	16.7	1150	25	CLEAR, SULFIDE ODOR	30.5 / 6	BAILER/SUCTION PUMP	5/2/90
MW-6D	7.42	14.2	1225	35	CLEAR, SULFIDE ODOR	49.5 / 7	BAILER/SUCTION PUMP	5/2/90
MW-7S	6.53	12.2	990	53	CLEAR, SOLVENT ODOR	21 / 10	BAILER	5/9/90
MW-7I	7.56	12.5	1150	20	CLEAR, OIL SHEEN	63 / 10	BAILER/SUCTION PUMP	5/9/90
MW-7D	7.50	16.7	1500	32	CLEAR, SULFIDE ODOR	45 / 6	BAILER/SUCTION PUMP	5/9/90
MW-8S	6.11	11.1	300	30	CLEAR	45.5 / 28	BAILER	5/8/90
MW-8I	7.11	12.7	1150	>100	TURBID, LIGHT GRAY	83 / 14	BAILER	5/8/90
MW-8D	7.28	12.9	2200	19	CLEAR, SULFIDE ODOR	38 / 6	BAILER	5/8/90
PZ-9	7.11	14.6	1050	24	CLEAR	50.5 / 10	BAILER/SUCTION PUMP	5/2/90
MW-9S	7.06	8.7	600	47	CLEAR	10.8 / 6	BAILER	5/1/90
MW-9I	7.19	12.5	1100	46	CLEAR, SULFIDE ODOR	185 / 29	BAILER/SUCTION PUMP	5/1/90
MW-10S	7.08	9.8	800	15	CLEAR	10 / 4	BAILER	5/4/90
MW-10I	7.14	13.3	1050	46	CLEAR, SULFIDE ODOR	25.4 / 5	BAILER	5/3/90
MW-11S	6.74	9.2	1350	>100	TURBID, LIGHT BROWN	18 / 10	BAILER	5/8/90
MW-11I	7.15	11.0	1300	42	SLIGHTLY CLOUDY	55 / 11	BAILER	5/8/90
MW-12S	6.00	9.8	760	46	CLEAR	19.5 / 13	BAILER	5/9/90
MW-12I	6.79	15.1	1475	35	CLEAR, SULFIDE ODOR	50 / 11	BAILER/SUCTION PUMP	5/9/90
MW-13S	7.02	9.4	1800	33	CLEAR	9.2 / 4	BAILER	5/10/90
MW-14S	6.71	10.2	1900	>100	TURBID, FUEL OIL ODOR	24 / 12	BAILER	5/11/90
MW-15S	6.60	10.5	750	41	CLEAR	13 / 7	BAILER	5/10/90
MW-16I	7.12	10.6	1200	>100	TURBID, SULFIDE ODOR	81 / 19	BAILER	5/8/90

	pH mean	pH std dev	pH min	pH max	Specific Conductance mean	Specific Conductance std dev	Specific Conductance min	Specific Conductance max
'S' series wells (shallow overburden)	6.69	0.39	6.00	7.08	1110	576	300	1900
'PZ' piezometer (lower overburden)	7.11	0.00	7.11	7.11	1050	-	1050	1050
'I' series wells (upper bedrock)	7.23	0.30	6.79	7.76	1197	134	1050	1475
'D' series wells (deeper bedrock)	7.40	0.11	7.28	7.50	1642	503	1225	2200

Packer testing procedures were in conformance with the Work Plan. Results from these analyses are discussed in Section 5.4 Site Hydrogeology. Documentation of pressure and slug tests data collection/analysis is presented in Appendices C.5.1 and C.5.2, respectively.

5.1.4 Ground Water and Genesee River Water Level Monitoring

Water levels were collected in all existing and newly installed wells on several occasions during the month of April and May 1990. These water levels were used to determine vertical and horizontal hydraulic gradients and determine ground water flow directions in the overburden and bedrock beneath the site.

Additionally, two staff gauges were established near shore in the Genesee River to monitor river water levels. A summary of water level data collected is presented in Table 5-3. Locations of the staff gauges are shown in Figure 5-1.

5.2 REGIONAL GEOLOGIC/HYDROGEOLGIC CONDITIONS

5.2.1 Regional Geology

The regional geology of the Genesee Valley Region generally consists of Lower Paleozoic (Ordovician to Devonian) sedimentary bedrock veneered by glacially-derived deposits. The bedrock beneath the overburden dips gently to the south with a gradient of approximately 40 to 60 feet per mile. The older bedrock units (Ordovician in age) are exposed in the northern portion of the region. The bedrock becomes successively younger (Middle Devonian) towards the south. The bedrock exposed along the Genesee River from the Niagara Escarpment (located south of the City of Rochester) toward Lake Ontario in a series of water falls (Upper Falls, Middle Falls, Lower Falls).

In the City of Rochester, the Lockport Group is exposed at the Upper Falls and along the Erie Barge Canal (approximately 1/2 mile north of the site). The Lockport Group in this area consists of three dolostone formations: the Decew - olive gray to brown gray medium grained enterolithic dolostone with rare gypsum filled vugs; the Penfield - dark gray to brown gray laminated quartz-rich dolostone with abundant crinoid fragments; and the Oak Orchard (youngest) - brown gray laminated medium grained dolostone with ubiquitous stylolites and vugs with secondary mineralization occurring in some openings in the rock. Further to the south, the Salina Group overlies the Lockport Group. The bedrock unit

TABLE 5-3

ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF GROUND WATER/SURFACE WATER ELEVATIONS

WELL #	GROUND SURFACE ELEVATION (1)	DATES: 4/6/90	4/13/90	4/18/90	4/20/90	4/23/90	4/24/90	4/30/90	5/7/90	5/11/90	5/14/90	5/18/90	5/21/90	5/24/90	8/27/90	8/30/90
MW-1	517.8	513.28	514.53		510.56	510.89	513.16	512.60	513.36	512.77	513.72	513.96	513.98	513.47	512.34	512.34
MW-2	517.1	512.67	512.49		511.82	512.26	513.01	512.36	513.58	512.76	513.70	513.98		513.27	512.11	511.93
MW-3	516.9	511.31	512.92		511.09	511.14	512.78	512.43	512.96	512.51	513.12	513.18	513.18	512.85	510.15	510.01
MW-4	520.1	516.77	516.88		516.25	516.56		517.13	517.14	516.84	517.59	518.31	518.30	517.86	513.88	513.71
MW-5	517.7	515.30	515.51		514.95	515.16	516.22	515.67		515.50	516.15	516.81	516.75	516.35	512.90	512.90
MW-6S	526.3			DRY	511.42	512.98	513.38	515.30	513.34	515.16	516.05	520.28	517.99	516.32	514.69	514.32
MW-6I	526.2			514.64	514.03	514.06	514.39	514.26	514.89	514.55	515.35	516.13	516.35	515.81	513.76	513.71
MW-6D	526.3			514.68	513.89	513.94	514.28	514.06	514.59	514.13	514.81	515.46	515.56	515.30	513.01	512.94
MW-7S	517.4					516.68	516.64	516.26	516.32	516.12	516.51	517.06	516.98	516.75	513.13	512.78
MW-7I	517.4								514.99	514.66	515.54	516.36	516.57	516.03	513.72	513.62
MW-7D	517.3								514.96	514.62	515.41	516.23	516.44	516.03	513.72	513.59
MW-8S	517.5				513.31	513.98	513.77	513.08	513.75	513.13	514.55	514.68	514.88	514.13	511.18	510.93
MW-8I	517.3				512.05	511.91	512.76	512.27	513.16	512.50	513.10	513.44	513.45	513.20	512.15	512.10
MW-8D	517.2				512.17	512.01	512.82	512.27	513.19	512.48	513.08	513.42	513.44	513.18	512.27	512.07
PZ-9	526.8			520.14	520.00	520.39	520.28	520.32	517.20	516.91	518.16	519.74	520.03	519.32	515.28	514.98
MW-9S	526.6			522.55	522.52	522.70	522.67	522.46	522.54	522.51	523.16	523.24	523.02	522.71	516.87	516.27
MW-9I	526.5		515.30	514.37	514.02	514.23	514.34	514.47	515.27	514.97	515.87	516.79	517.15	516.57	513.98	513.85
MW-10S	523.9					518.96	519.01	518.58	518.41	519.28	519.33	519.89	520.27	519.62	515.01	514.62
MW-10I	523.9					512.43	512.95	512.65	513.47	512.84	513.43	513.81	513.86	513.66	512.36	512.26
MW-11S	517.3							514.89	514.84	514.44	516.00	516.10	516.54	515.24	509.71	509.64
MW-11I	517.4							511.55	512.57	511.98	512.56	512.82	512.79	512.64	511.91	511.89
MW-12S	518.6								514.46	514.06	515.69	516.49	516.38	514.94	511.91	511.78
MW-12I	518.8								513.62	512.85	513.86	514.19	514.11	512.48	511.95	511.86
MW-13S	519.4								517.32	517.09	517.65	518.24	518.19	517.95	514.42	515.25
MW-14S	518.1								516.27	516.15	516.39	517.13	517.04	516.74	(2)	(2)
MW-15S	517.7								514.65	514.12	515.23	515.60	515.68	514.79	513.23	513.48
MW-16I	516.1							511.41	512.43	511.53	512.03	512.15	512.07	511.92	511.61	511.53
STAFF GAUGE	513.9 *										512.95	512.66	512.91	513.08	511.64	511.54
STAFF GAUGE	513.4 *										512.20	512.03	512.10	512.26	511.62	511.49

NOTES: (1) All elevations in feet above mean sea level

(2) LNAPL Present in well: LNAPL Elevation/Ground Water Elevation – 514.15/511.95 (8/27/90) & 513.75/512.65 (8/30/90)

BLANK SPACE – water level not recorded (well not completed)

* – Elevation of "0" mark

directly overlying the Oak Orchard Formation is the Pittsford shale member of the Vernon Formation. The complete stratigraphic section of the bedrock units in the Genesee Valley Region as modified by Brett (per. comm., 1991) is provided in Figure 5-2.

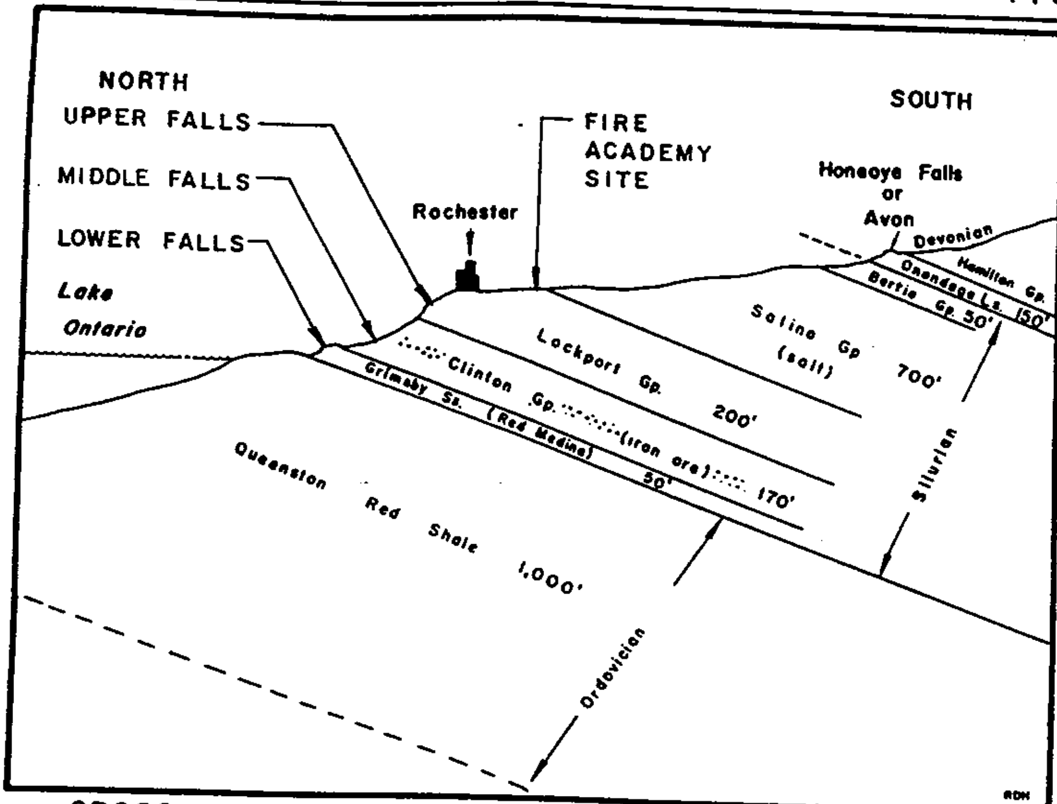
Generally, deposition during glacial advance/retreat is responsible for the sediments that directly overlie the bedrock. The depositional and geomorphic history of the Genesee Valley has bee the subject of many geologic studies. Regional geologic summaries are included in the work of Leverett (1902), Fairchild (1932a, 1932b), MacClintock and Apfel (1944) and Muller (1965, 1967). Geomorphological changes of the Genesee Valley Region is included in the work of Muller et. al. (1988). These glacial deposits consist of till, glaciofluvial and glaciolacustrine sediments. The till is generally composed of dense, poorly sorted clay, silt, sand, gravel, cobble and boulder size material usually directly overlie bedrock. Glaciolacustrine deposits generally overlie the till or bedrock. These deposits were laid down by proglacial lakes, formed during different periods of ice advances and retreats and generally consist of varied silt and clay. A succession of ice regression have produced a series of parallel beach ridges indicative of ancestral lake shorelines. In proximity to the Genesee River, recent alluvial deposits mantle the sedimentary bedrock. These deposits consist of stratified silt, sand, gravel, and cobble size material with assorted vegetative matter.

5.2.2 Regional Hydrogeology

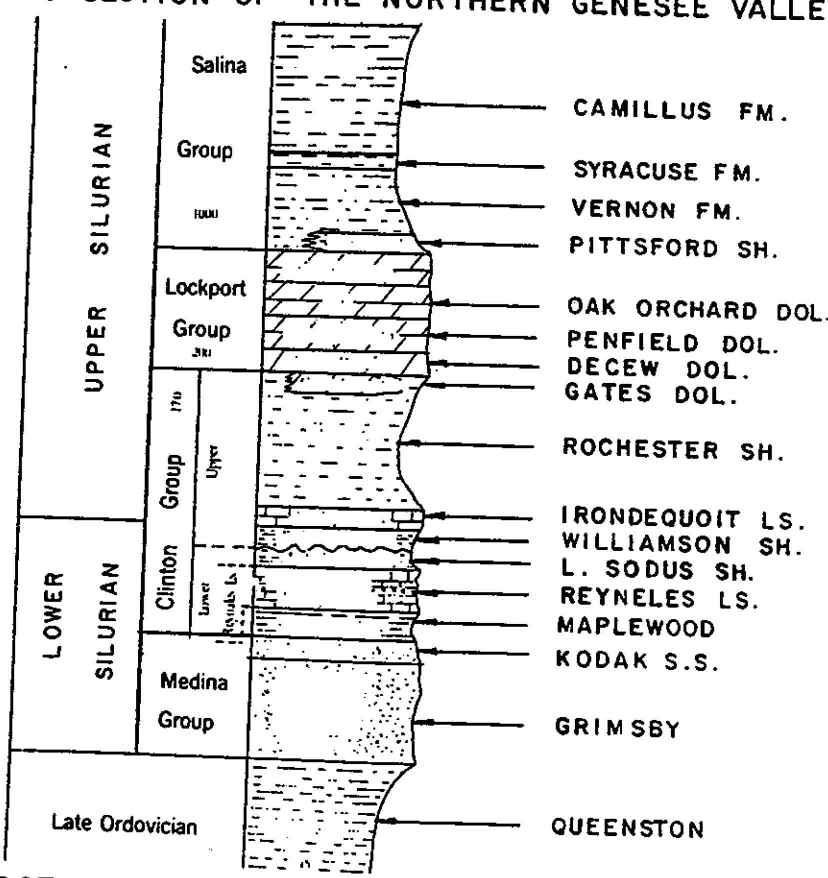
Ground water occurs in significant quantities within the coarser grained deposits of the glacially-derived overburden material. These deposits generally include, but are not limited to, glaciofluvial and beach ridge deposits. A major source of ground water in the overburden in this region is the coarse grained deposits of the sediment-filled valley of the ancestral channel of the Genesee River and its tributaries southeast of the City of Rochester (Young, 1983). The regional direction of ground water flow is to the north down the regional slope towards Lake Ontario. Locally ground water flow directions vary as a result of topography, pumping and surface water boundary conditions.

The bedrock in this region is generally water-bearing. Available yields for water supply use are highly dependent on the distribution and interconnection of fractures and/or solution cavities within the rock. In the Lockport Group, the upper portion of the bedrock (upper 10 feet) is typically highly fractured and contains numerous solution cavities

FIGURE 5 -2



CROSS SECTION OF THE NORTHERN GENESEE VALLEY



SOURCE: GRASSO, 1983; MODIFIED BY BRETT, PER. COMM., 1991

MALCOLM PIRNIE

ROC - 04

ROCHESTER FIRE ACADEMY
RI/FS
STRATIGRAPHIC SECTION IN THE VICINITY OF THE GENESEE VALLEY

CITY OF ROCHESTER, NEW YORK

MAY 1991

(Johnston, 1964). These properties provide for a highly transmissive water-bearing zone within the upper bedrock. The frequency of fractures generally decreases with depth. The recharge of the bedrock aquifer is principally through downward leakance through the overburden and direct infiltration in areas of bedrock exposure. The general direction of ground water flow in this region is toward Lake Ontario and deeply scoured valleys.

While water supplies for some rural areas in this region are obtained from ground water, the water supply for the City of Rochester is obtained from Hemlock Lake and Lake Ontario. The Monroe County Water Authority obtains its water supply from Lake Ontario.

5.3 SITE GEOLOGY

The current Remedial Investigation at the Fire Academy Site has provided an extensive geologic data base. Interpretation of site geology and hydrogeology is based upon this database, as well as information provided in the literature concerning regional geologic and hydrogeologic conditions.

Stratigraphic units identified during the RI from youngest to oldest include:

- fill of variable composition;
- alluvium associated with deposition of the Genesee River; and
- dolostone bedrock.

The detailed descriptions of these geologic units were derived from the borehole logs presented in Appendix C.1 and are described in the following sections.

Table 5-4 summarizes the stratigraphic data base obtained from wells/boreholes completed during the RI. The table presents survey data and a summary of the stratigraphic unit thicknesses. The locations of cross sections of the site are shown on Figure 5-3 and the stratigraphic profiles are presented in Figures 5-4 through 5-8.

5.3.1 Fill Material

The composition of the fill material varies with location across the site. In the North Disposal Area, fill extends approximately 200 feet north of the fence separating the disposal

TABLE 5–4
ROCHESTER FIRE ACADEMY RI/FS
STRATIGRAPHIC SUMMARY

WELL #	GROUND SURFACE ELEV	FILL MATERIAL FEET BELOW GRADE / TOP ELEV	ALLUVIAL DEPOSITS: BROWN SILTY SAND FEET BELOW GRADE / TOP ELEV	ALLUVIAL DEPOSITS: MOTTLED BROWN/ GRAY SILTY SAND FEET BELOW GRADE / TOP ELEV	ALLUVIAL DEPOSITS: BROWN CLAYEY SILT FEET BELOW GRADE / TOP ELEV	ALLUVIAL DEPOSITS: GRAY CLAYEY SILT FEET BELOW GRADE / TOP ELEV	ALLUVIAL DEPOSITS: GRAY OR BROWN SAND and GRAVEL FEET BELOW GRADE / TOP ELEV	BEDROCK FEET BELOW GRADE / TOP ELEV
MW–6D	526.3	0 – 4.0 526.3	–	–	4.0 – 18.0 522.3	18.0 – 31.0 508.3	31.0 – 34.0 495.3	34.0 492.3
MW–7D	517.3	0 – 0.3 517.3	0.3 – 4.0 517.0	4.0 – 10.0 513.0	–	–	10.0 – 30.2 505.2	30.2 487.1
MW–8D	517.2	–	0 – 4.0 517.2	4.0 – 11.0 513.2	–	–	11.0 – 30.0 506.2	30.0 487.2
MW–9I	526.5	0 – 6.0 526.5	–	–	6.0 – 19.0 520.5	–	19.0 – 38.1 (1) 507.5	38.1 488.5
MW–10I	523.9	0 – 2.3 523.9	–	–	2.3 – 14.9 521.6	14.9 – 17.5 509.0	17.5 – 24.0 (2) 508.4	31.0 492.9
MW–11I	517.4	–	0 – 4.0 517.4	4.0 – 10.7 513.4	–	–	10.7 – 24.1 506.7	24.1 493.3
MW–12I	518.8	–	0 – 7.0 518.8	7.0 – 12.1 511.8	–	–	12.1 – 24.0 (3) 506.7	24.0 494.8
MW–13S	519.4	0 – 1.0 519.4	–	–	1.0 – >16.0 518.4	–	–	–
MW–14S	518.1	0 – 2.9 518.1	2.9 – 4.0 515.2	4.0 – 10.5 (4) 514.1	–	–	10.5 – >14.0 507.6	–
MW–15S	517.7	–	0 – 4.0 517.7	4.0 – 11.4 513.7	–	–	11.4 – >14.0 506.3	–
MW–16I	516.1	–	0 – 4.0 516.1	4.0 – 9.3 512.1	–	–	9.3 – 18.5 (5) 506.8	18.5 497.6

NOTES:

(1) Brown sand and gravel in MW–9I

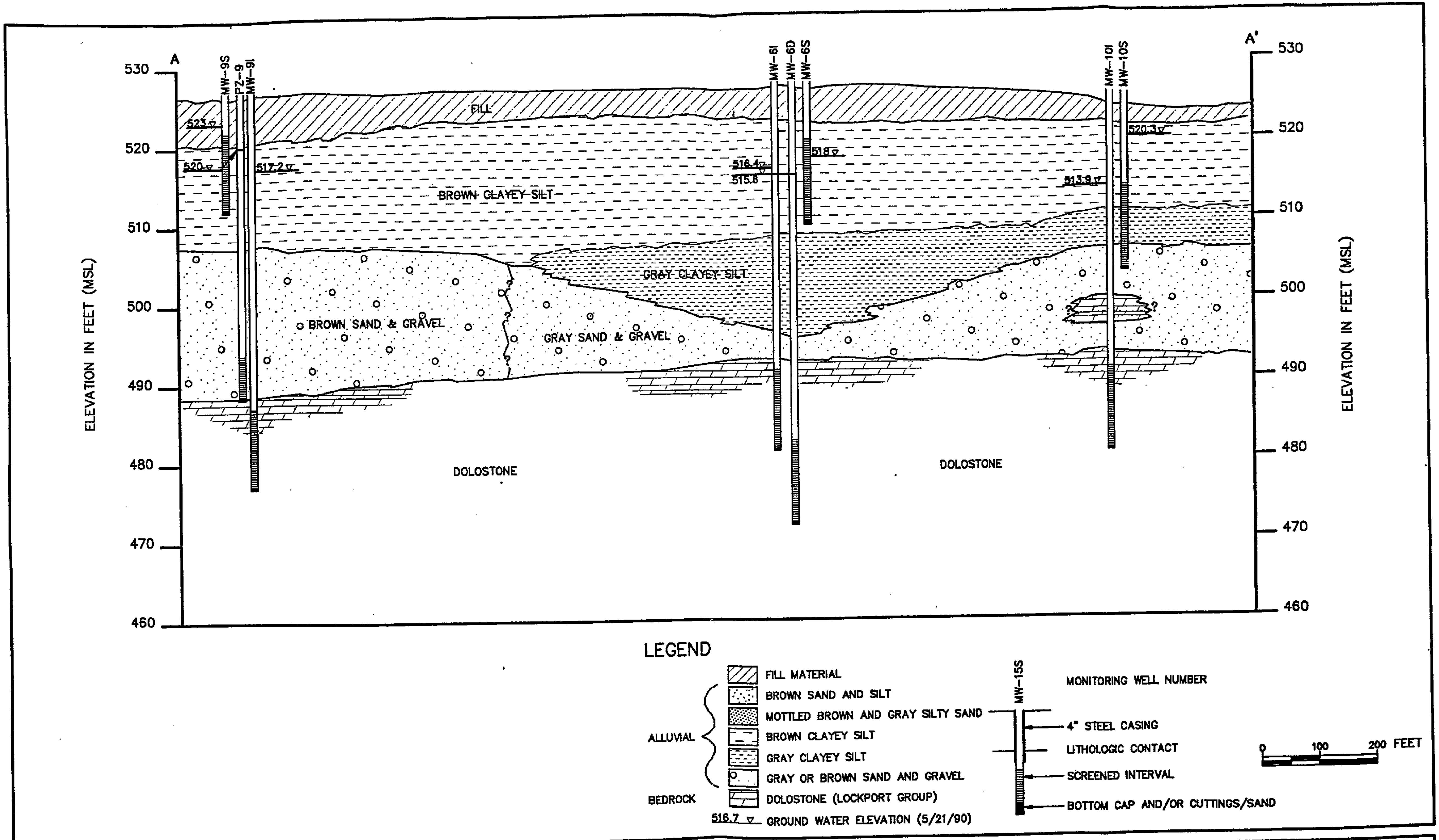
(2) A bedrock boulder or shelf was encountered from 24.0–27.5 ft below grade in MW–10I, basal gravel was encountered from 27.5 to 31.0 ft below grade

(3) Brown sand and gravel from 14.4–18.3 ft and 22.0–24.0 ft in MW–12I

(4) Brown sand from 8.0–10.5 ft in MW–14S

(5) Brown sand and gravel from 12.7–18.5 ft in MW–16I

All elevations are given in feet above mean sea level



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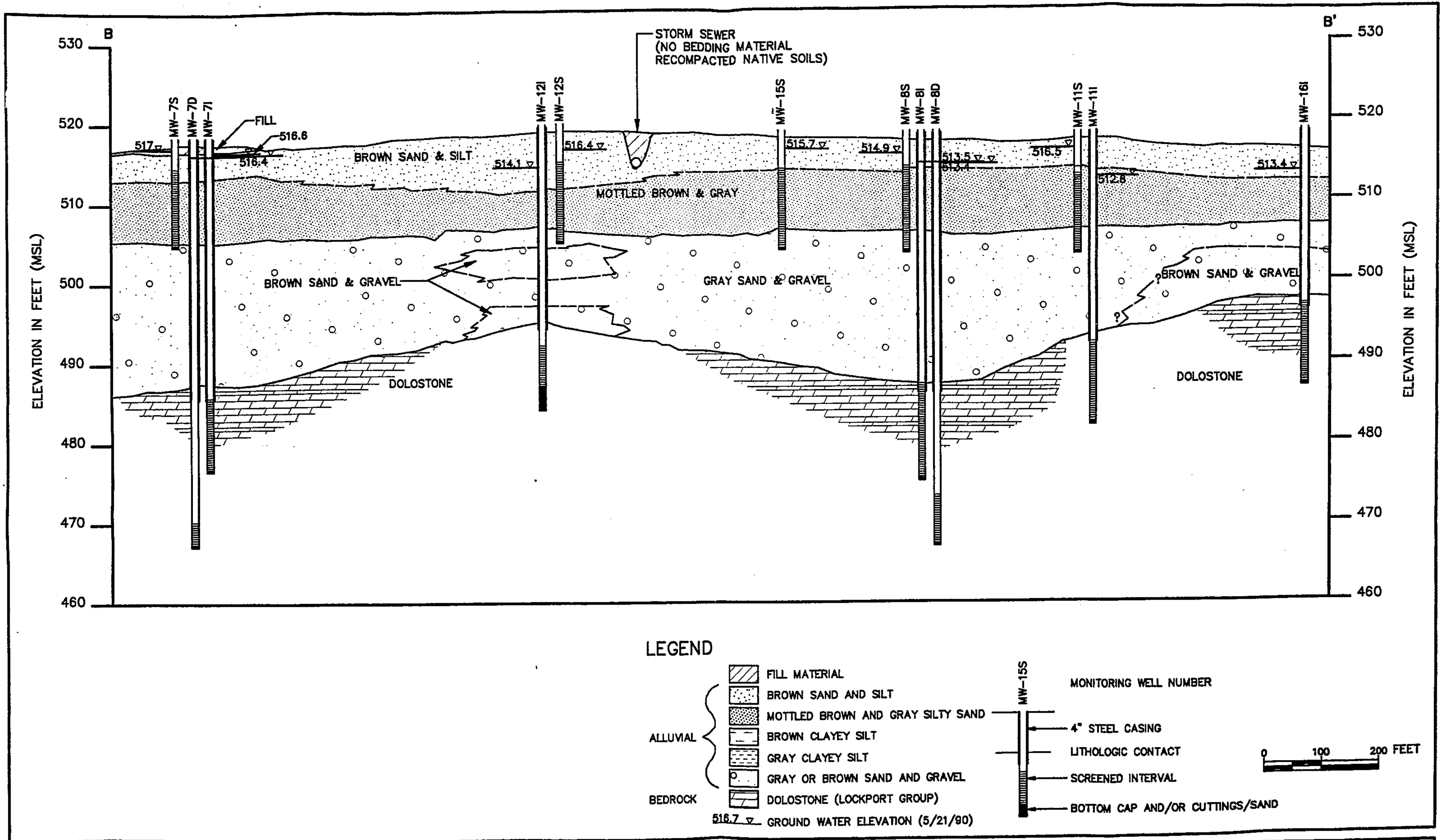
ROC-04-CAA

CITY OF ROCHESTER
REMEDIAL INVESTIGATIONS

CROSS SECTION A – A'

ROCHESTER FIRE ACADEMY

MARCH 1991



CITY OF ROCHESTER
REMEDIAL INVESTIGATIONS
CROSS-SECTION B – B'

ROCHESTER FIRE ACADEMY

MARCH 1991

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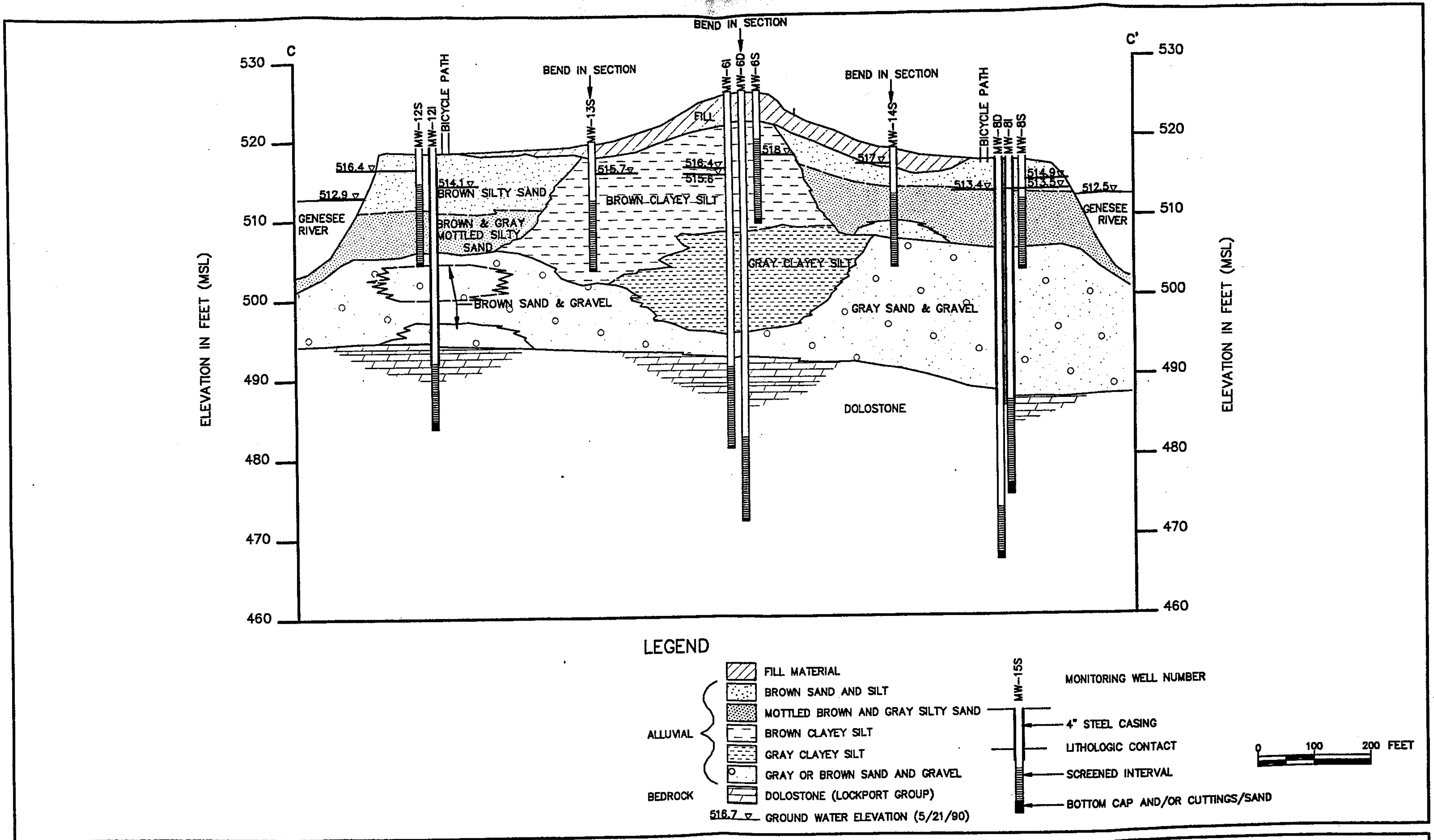
ROC-04-CBB



CITY OF ROCHESTER
REMEDIAL INVESTIGATIONS

CROSS SECTION C – C'

ROCHESTER FIRE ACADEMY MARCH 1991

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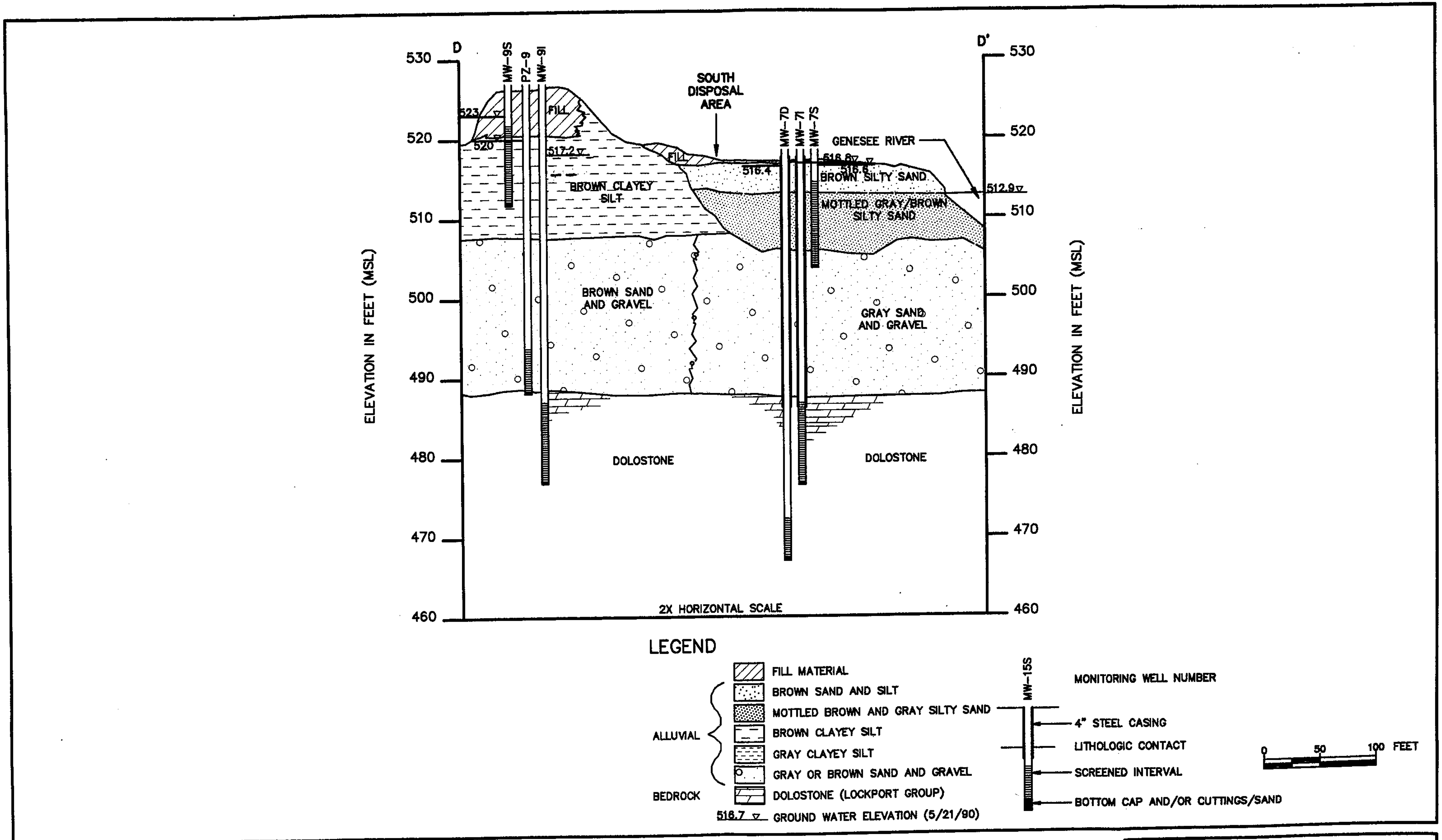
ROC-04-CCC

FIGURE 5-7



MALCOLM PIRNIE

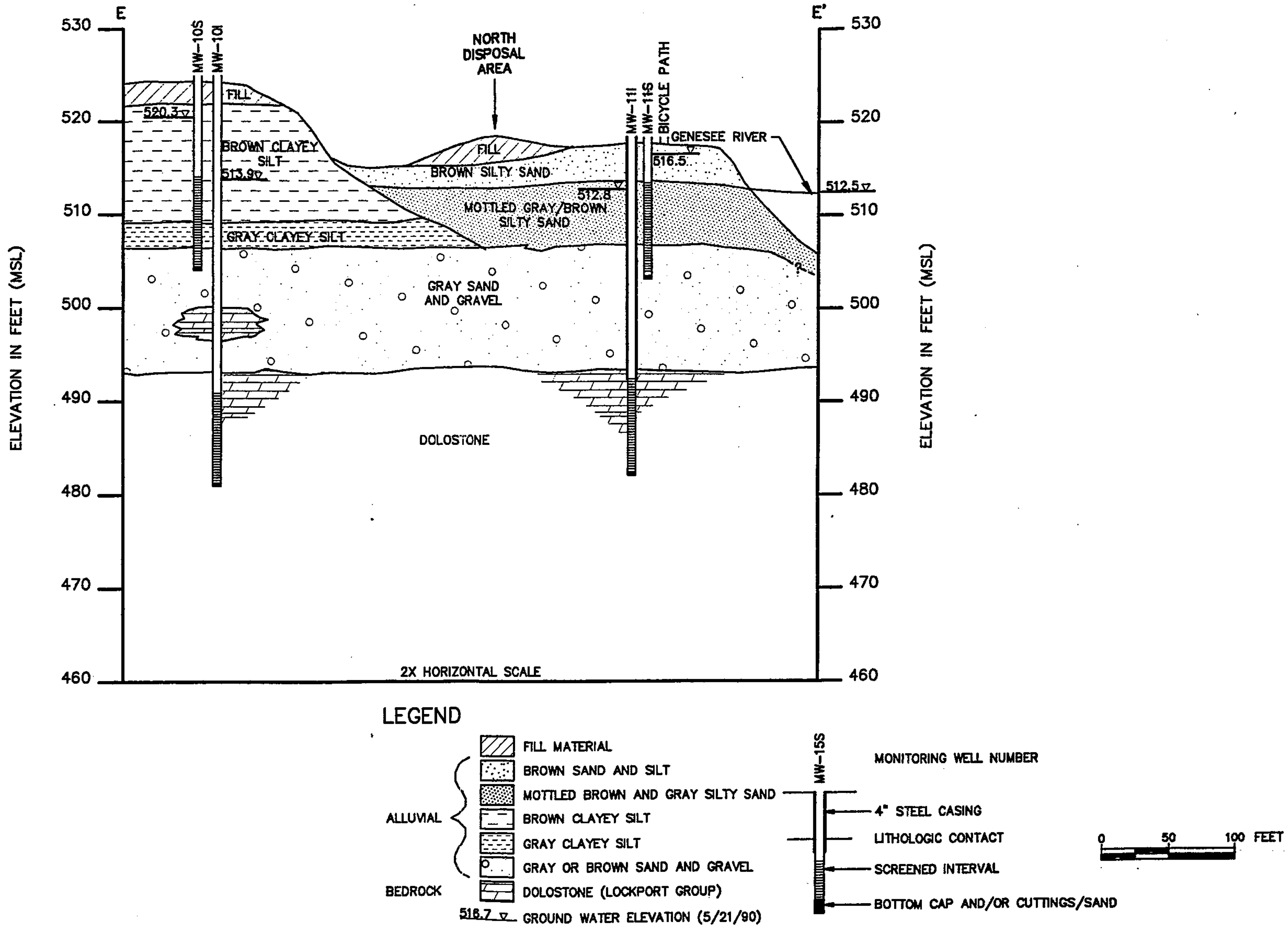
ROC-04-CDD

CITY OF ROCHESTER
REMEDIAL INVESTIGATIONS

CROSS SECTION D – D'

ROCHESTER FIRE ACADEMY

MARCH 1991



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ROC-04-CEE

CITY OF ROCHESTER
REMEDIAL INVESTIGATIONS
CROSS SECTION E – E'

ROCHESTER FIRE ACADEMY

MARCH 1991

area and Training Grounds. The fill generally consists of debris (bricks, glass, automotive parts), cinders and foundry sand (black silty-sand) placed directly above native soil. Drum fragments were also observed in this area. No fill was observed north of this area. Moisture conditions observed within the fill during the field investigation were generally dry to wet. Based upon soil boring and test pit excavation data, the thickness of the fill in this area ranges from 0-4 feet.

The fill in the Training Grounds Area consists of a 3-inch layer of coarse angular gravel overlying a dark gray to black silty fine to medium sand with some gravel. Moisture conditions vary from dry to moist. The thickness of the fill in this area varied from 0.3 feet (TP-8) to 2.9 feet (MW-14S).

In the South Disposal Area, the fill consists of reworked native soil from previous excavation and landfilling, and black sandy silt with ash and cinder-like material from prior burning practices. Some construction and debris fill is present in addition to drum and glass fragments, and a few laboratory reagent bottles. Based upon soil boring and test pit excavations, the thickness of the fill in this area ranges from 0 - 2.5 feet.

Along the western site boundary, the fill consists of railway ballast material consisting of black coarse sand and slag and clayey silt interbedded with cinder-like material associated with the former Genesee Valley Canal. The thickness of the fill in this area ranged from 4.0 feet (MW-10I) to 6.0 feet (MW-9I).

As shown in cross sections B-B'; C-C' and D-D', fill was not encountered in the Genesee Valley Park Area east of the bicycle path.

5.3.2 Alluvial Deposits

Alluvium attributed to depositional activities of the Genesee River was encountered across the entire site. The depositional materials are bedded, and have been subdivided into several distinct units with differing grain size and color. These units include: brown silty sand; mottled brown/gray silty sand; brown on gray clayey silt; and gray or brown sand and gravel.

The alluvium ranges in thickness from 18.5 feet (MW-16I) to 32.1 feet (MW-9I). As shown in cross section C-C'; the brown sandy silt unit ranges from 7.0 feet (MW-12I) to 1.1 feet (MW-14S) and thins to extinction to the west, away from the river. The mottled gray/brown silty sand unit was encountered in all of the eastern boreholes. Its thickness varies from 5.1 feet (MW-12I) to 7.4 feet (MW-15S).

Further to the west of the Genesee River (cross section A-A') the fill is underlain by alluvial overbank deposits (boreholes MW-6, MW-9, MW-10, and MW-13). These deposits consist of a brown or gray clayey silt. In boreholes MW-6 and MW-10, the brown clayey silt is underlain by gray clayey silt. Fine sand and silt layers are occasionally present in both of these units.

The color difference most likely represents oxidizing/reducing conditions (i.e., brown and gray to oxidizing and reducing environments, respectively). These differing conditions indicate that the gray unit most likely restricts the downward movement of ground water.

The brown clayey silt ranges in thickness from 12.6 (MW-10I) to greater than 15.0 feet (MW-13S). The gray clayey silt ranges in thickness from 2.6 feet (MW-10I) to 13 feet (MW-6D).

Gray or brown sand and gravel deposits directly overlie the bedrock across the entire site. In general, grain size coarsens downward within the unit. At several locations vegetative matter was observed. This unit ranges from 3.0 feet (MW-6D) to 20.2 feet (MW-7D) and averages 14.2 feet in thickness.

Table 5-5 presents the grain size analysis results for samples collected from the screened interval in the upgradient shallow wells and the piezometer. These results support visual observations made during field activities. Other soils testing results for these samples, including vertical permeability and Atterberg Limits, are also summarized in Table 5-5. The complete soil testing report is provided in Appendix C.6.

5.3.3 Bedrock

The bedrock beneath the site consists of a hard dark medium to coarse grained, laminated dolostone of the Middle Silurian Lockport Group. Stylolites and solution vugs (some mineralized with dolomite, gypsum and/or sphalerite crystals) are common. Some larger solution cavities occur in areas where dolomitized, weathered biostromes are present. The dolostone is shows distinct fracturing along horizontal bedding planes. The frequency of fracturing decreases with depth.

TABLE 5-5
SUMMARY OF GRAIN SIZE ANALYSIS, ATTERBERG LIMITS AND VERTICAL PERMEABILITY

GRAINSIZE:

BOREHOLE NO.	SAMPLE DESCRIPTION	SAMPLE INTERVAL (ft)	% GRAVEL	% SAND	% SILT	% CLAY
MW-6S	Brown Clayey Silt	4-10	0.0	15.7	58.8	25.5
	Brown Clayey Silt	10-16	1.3	11.2	53.6	33.9
MW-9S	Sandy Fill/Brown Clayey Silt	4-8	6.8	39.4	45.3	8.5
PZ-9	Gray Sand/Gravel	32-38	38.3	37.6	21.8	2.3
MW-10S	Gray Sand/Gravel	16-20	19.5	27.7	37.4	15.4

ATTERBERG LIMITS:

BOREHOLE NO.	SAMPLE DESCRIPTION	SAMPLE INTERVAL (ft)	% GRAVEL	% SAND	% SILT	% CLAY	PLASTIC LIMIT%	LIQUID LIMIT%	PLASTICITY INDEX
MW-9S	Brown Clayey Silt	8-16	5.2	2.4	61.5	30.9	15	26	11
MW-10S	Brown Clayey Silt/ Gray Clayey Silt	8-16	0.0	1.4	83.4	15.2	18	21	3

NOTE (1): Insufficient sample quantity to test MW-6S

VERTICAL PERMEABILITY:

BOREHOLE NO.	SAMPLE DESCRIPTION	SAMPLE INTERVAL (ft)	PERMEABILITY (cm/S)
MW-6S	Brown Clayey Silt	12-14	4.2×10^{-8}
	Gray Sand/Gravel	32-34	Non-cohesive sample; unable to test
MW-9S	Brown Clayey Silt	12-14	2.0×10^{-7}

The bedrock unit was encountered at depths ranging from 38.1 (MW-9I) to 18.5 (MW-16I) feet below ground surface. Based upon the physical features described, the bedrock is probably the Oak Orchard Formation of the Lockport Group. The younger Vernon Shale or Pittsford Shale was not encountered during the Remedial Investigation. The Lockport Group/Vernon Shale contact is believed to be further south of the site. The total thickness of the Lockport Formation in this area is approximately 170 feet (Zenger, 1965). Beneath the Lockport Group lies the Gates Limestone member of the Rochester Shale.

The upper surface of the bedrock is slightly undulated but generally rises toward the northeast (Figure 5-9). In the MW-10I borehole, rock was initially contacted at 24.0 feet below ground surface. The borehole was subsequently cored to a depth of 27.5 feet where gravel was encountered. Bedrock coring resumed at 31.0 feet below ground surface. The sequence of rock-gravel-rock can be interpreted as a boulder outlier overlying basal gravel, a bedrock bench eroded by prior fluvial events, or a gravel filled solution channel.

5.4 SITE HYDROGEOLOGY

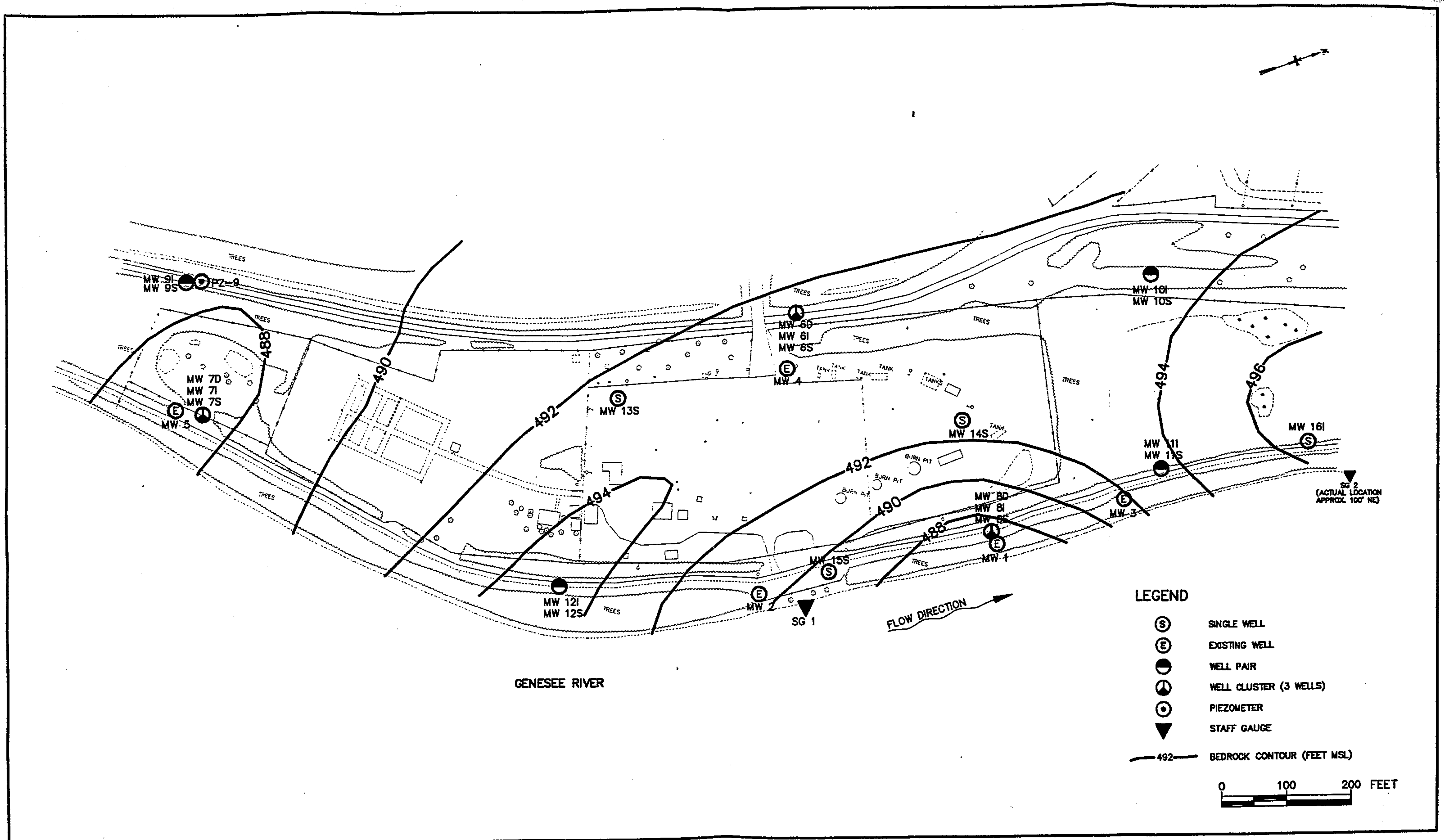
5.4.1 Hydrostratigraphic Units

Hydrostratigraphic units are sequences of geologic materials that possess similar hydrogeologic properties including hydraulic conductivity, storage and porosity. The hydrostratigraphy of the site, as derived from an assessment of hydraulic properties of the geologic units previously described, is illustrated in Table 5-6. The two major hydrostratigraphic units are:

- an overburden water-bearing zone consisting of fill material, and alluvium;
- a bedrock aquifer.

The overburden water-bearing zone varies in saturated thickness from about 21.5 to 34.5 feet. The unit thickness increases near the southwestern site boundary. An isopach map of this unit, based upon the first round of ground water sampling (May 1990), is presented in Figure 5-10.

The bedrock aquifer which directly underlies the shallow water-bearing zone is comprised of dolostone bedrock of the Lockport Group. Based upon the reported thickness



MALCOLM PIRNIE

ROC-04-F49

ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS

TOP OF BEDROCK CONTOUR MAP

CITY OF ROCHESTER

MARCH 1991

TABLE 5-6
ROCHESTER FIRE ACADEMY RI/FS
CORRELATION OF GEOLOGIC AND HYDROGEOLOGIC UNITS

GEOLOGIC UNIT	HYDROGEOLOGIC UNIT
FILL SILT, SAND, GRAVEL, C&D DEBRIS, ASH and CINDERS	*OVERBURDEN WATER-BEARING ZONE*
ALLUVIAL DEPOSITS BROWN SILTY SAND / BROWN CLAYEY SILT MOTTLED BROWN AND GRAY SILTY SAND / GRAY CLAYEY SILT GRAY OR BROWN SILTY SAND AND GRAVEL	*OVERBURDEN WATER-BEARING ZONE* SEMI-CONFINING LAYER
BEDROCK DOLOSTONE	*BEDROCK AQUIFER*

of this unit (Zenger, 1965), the saturated thickness of this aquifer is approximately 150 to 170 feet although aquifer potential is probably restricted to the upper 10 to 20 feet of the unit.

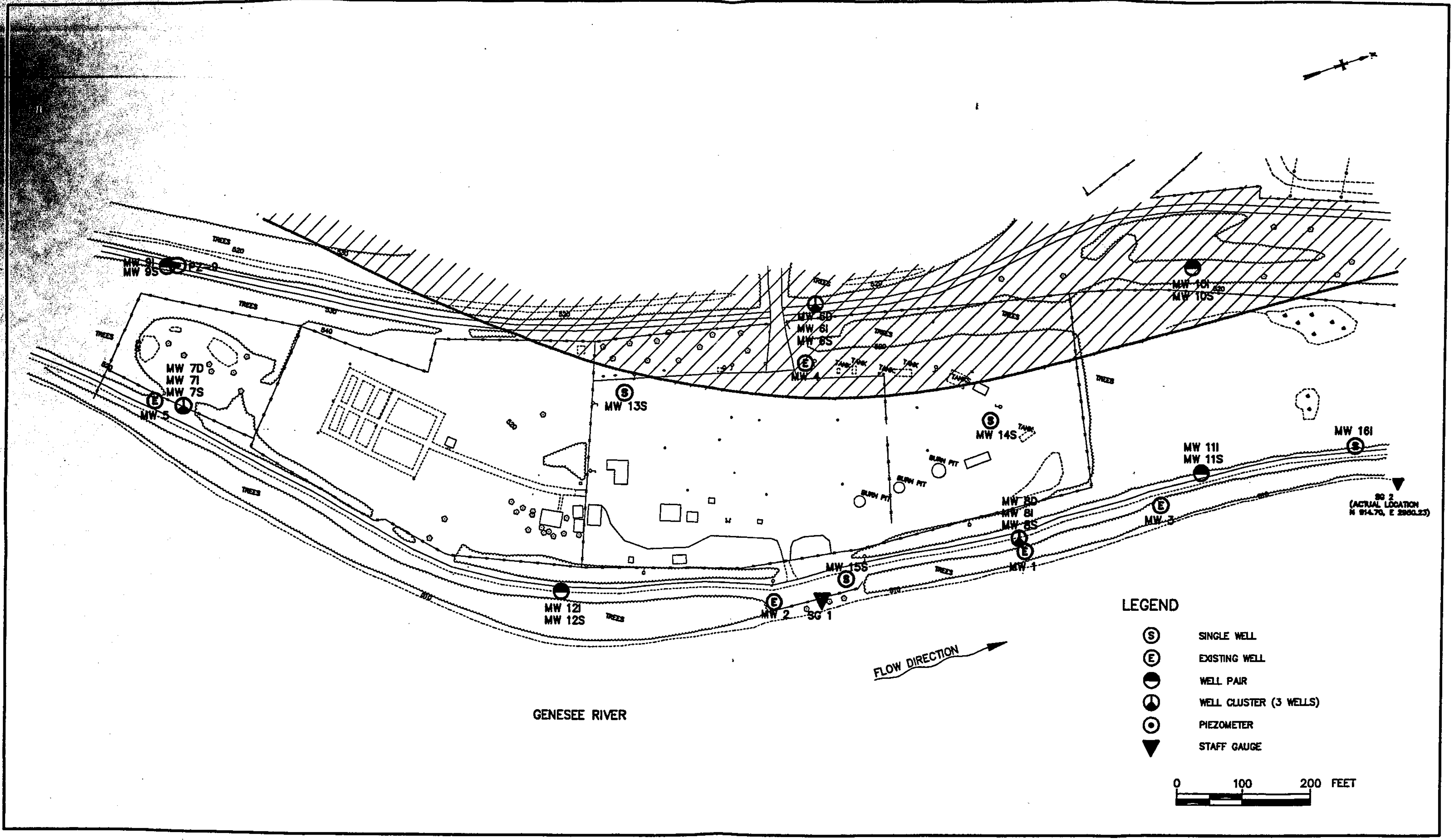
5.4.2 Overburden Water-Bearing Zone

The overburden water-bearing zone at the Fire Academy site occurs within some areas of the fill material and within the alluvial deposits. Ground water in this zone occurs under unconfined (water table) conditions. In the western portion of the site, the gray clayey silt restricts vertical flow and may be considered a semi-confining unit. Figure 5-11 shows the approximate extent of the gray clayey silt which acts as a semi-confining unit.

During the first round of ground water sampling, May 1990, the average depth to this zone was 2.1 feet below ground surface. During the second round of ground water sampling, August 1990, the average depth to this zone was 5.7 feet below ground surface. Hydraulic head distribution within this zone for the two sampling events are depicted in isopotential maps presented as Figures 5-12 and 5-13. Shallow ground water movement at the site is to the east towards the Genesee River in the direction of decreasing hydraulic head. Recharge to the water-bearing zone occurs principally through the infiltration of precipitation. Additionally, recharge occurs from the ponded water in the former Genesee Valley Canal located along the western site boundary.

Horizontal hydraulic gradients for the overburden water-bearing zone are generally low for all areas of the site and are reflective of the low topographic relief at the site. A summary of the horizontal hydraulic gradient across the site is presented in Table 5-7. As indicated in Table 5-7, horizontal hydraulic gradients were greater during the May 1990 sampling even than the August 1990 event. This increase is primarily attributable to greater precipitation volume in the spring relative to the late summer of the study period.

Vertical hydraulic gradients measured in monitoring well couplets triplets and are presented in Table 5-8. During the May 1990 sampling event, hydraulic gradients were vertically downward between the shallow water-bearing zone and the bedrock aquifer. The vertical gradients were less in wells closest to the Genesee River compared with wells located further away from the Genesee River. During the August 1990 sampling event period, hydraulic gradients were vertically downward between the shallow water-bearing



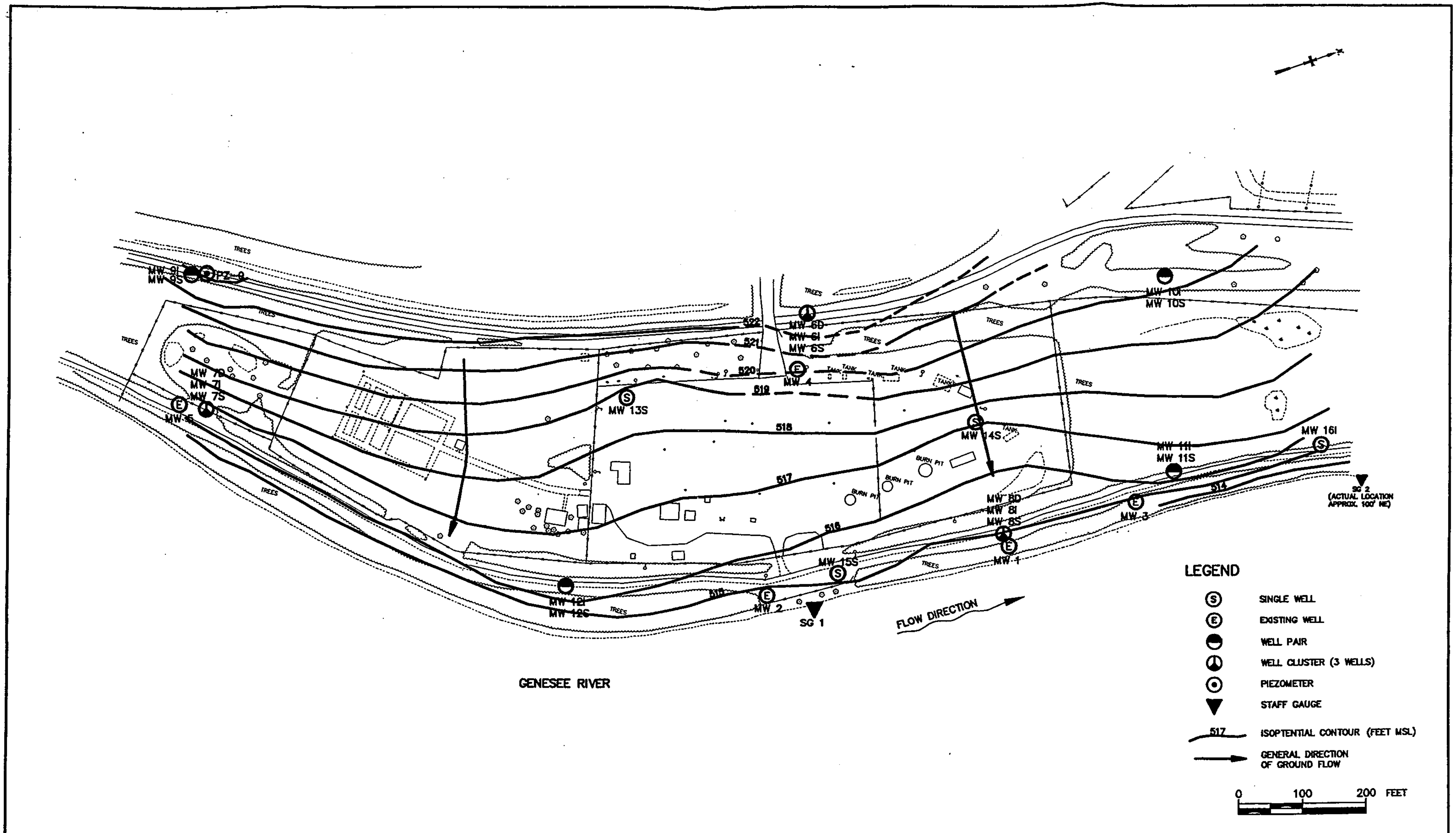
MALCOLM PIRNIE

ROC-04-FG1

ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS
APPROXIMATE EXTENT OF
SEMICONFINING UNIT

CITY OF ROCHESTER

MARCH 1991

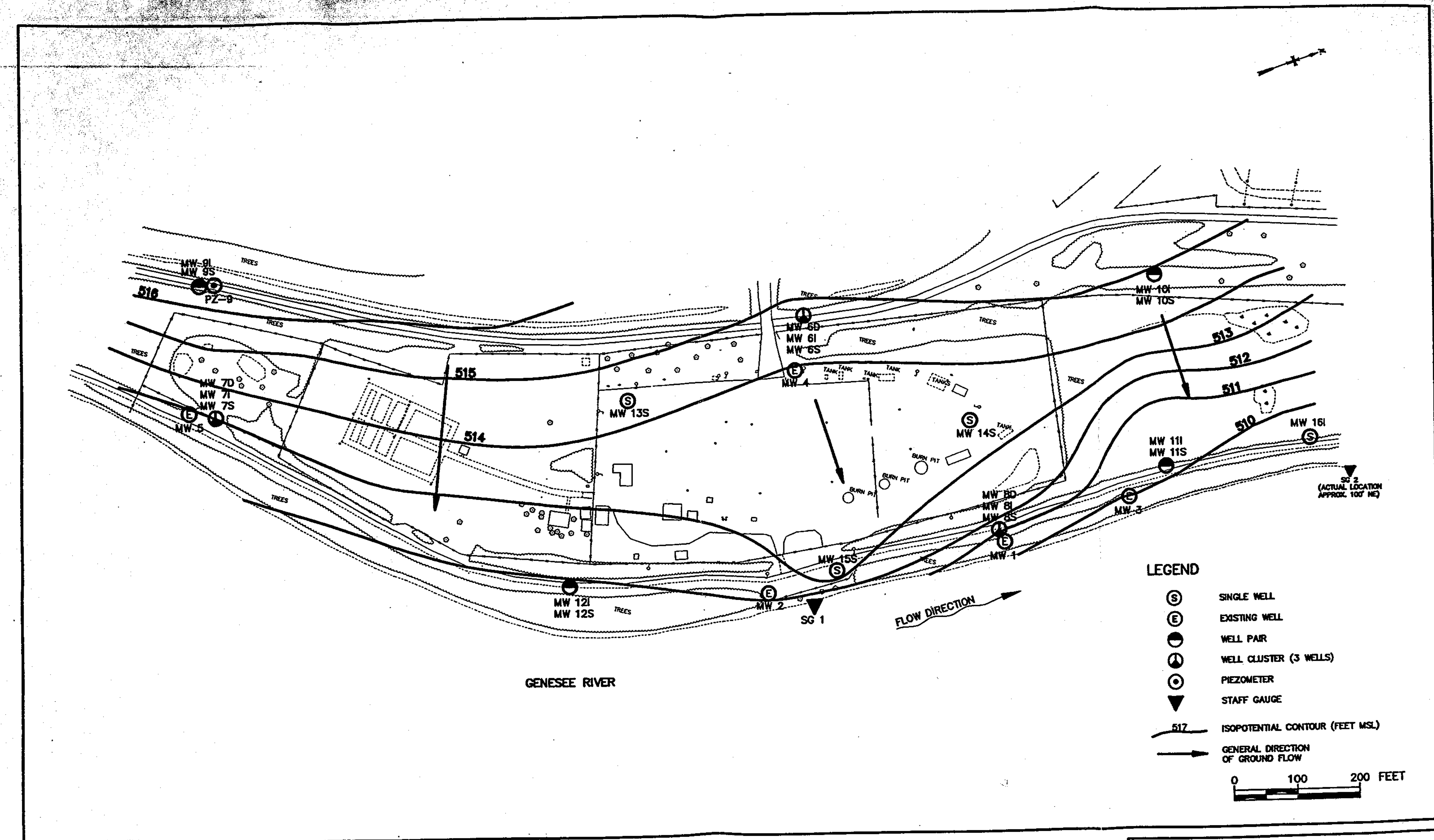


MALCOLM PIRNIE

ROC-04-IPM

ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS
ISOPOTENTIAL MAP FOR THE
OVERBURDEN WATER-BEARING ZONE (5/21/90)

CITY OF ROCHESTER MARCH 1991



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ROC-04-F12

ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS
ISOPOTENTIAL MAP FOR THE
OVERBURDEN WATER-BEARING ZONE (8/27/90)

CITY OF ROCHESTER MARCH 1991

TABLE 5-7
ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF HORIZONTAL HYDRAULIC GRADIENTS

HYDROSTRATIGRAPHIC UNIT	AREA	MONITORING WELLS	5/21/90 (1) GRADIENT (ft/ft)	8/27/90 (1) GRADIENT (ft/ft)
	SOUTH DISPOSAL	9S/7S	0.023	0.019
		13S/15S	0.006	0.003
OVERBURDEN WATER-BEARING ZONE	TRAINING GROUNDS	4/15S	0.008	0.002
		6S/15S	(2) 0.016	0.004
	NORTH DISPOSAL	10S/11S	0.012	0.018
BEDROCK AQUIFER (3)				
	SOUTH DISPOSAL	9I/7I	0.003	0.001
SHALLOW BEDROCK (0-10 ft)	TRAINING GROUNDS	6I/8I	0.006	0.003
	NORTH DISPOSAL	10I/11I	0.004	0.002
DEEPER BEDROCK (10-20 ft)	TRAINING GROUNDS	6D/8D	0.005	0.001

NOTES:

(1) Ground water monitoring date

(2) MW-6S was not fully recovered. Water level was estimated at 522.7 ft based on nearby wells and the Genesee Canal.

(3) Shallow bedrock zone includes wells screened in the upper 10 feet of rock.

Deeper bedrock zone includes wells screened from 10 to 20 feet below the top of rock.

TABLE 5-8
ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF VERTICAL HYDRAULIC GRADIENTS

HYDROSTRATIGRAPHIC UNIT	MONITORING WELLS	5/21/90 (1) GRADIENT (ft/ft)	8/27/90 (1) GRADIENT (ft/ft)
Upper/Lower Overburden Water-Bearing Zone	PZ-9/9S	-0.129	-0.069
Lower Overburden Water-Bearing Zone/ Shallow Bedrock	PZ-9/9I	-0.246	-0.126
Overburden Water-Bearing Zone/ Shallow Bedrock	6S/6I	* -0.161	-0.032
	7S/7I	-0.015	+0.022
	8S/8I	-0.054	+0.036
	9S/9I	-0.169	-0.126
	10S/10I	-0.278	-0.115
	11S/11I	-0.180	+0.106
	12S/12I	-0.128	+0.012
Shallow Bedrock/Deeper Bedrock	6I/6D	-0.089	-0.104
	7I/7D	-0.014	0.0
	8I/8D	-0.001	+0.113

NOTES:

(1) Ground water monitoring date

'-' Negative sign indicates downward vertical gradient.

'+' Positive sign indicates upward vertical gradient.

* MW-6S not fully recovered. Water level was estimated at 522.7 ft based on water levels in nearby wells and the Genesee Canal.

zone and the bedrock aquifer in wells removed from the river and upward in wells closest to the Genesee River.

Ground water flow rates for the overburden water-bearing zone were determined for the site using in-situ hydraulic conductivity testing data described in Section 5.1.4. The hydraulic conductivity testing results are summarized in Table 5-9 and the supporting data is presented in Appendix C.5.2. Hydraulic conductivity values ranged from 1.9 x 10^{-8} cm/s (MW-6S) to 2.7 x 10^{-3} cm/s (MW-9S). The lower limit of this range was several orders of magnitude lower than other values for this zone. It is believed that smearing of the borehole wall occurred at MW-6S during borehole drilling of the clayey silt material creating a low permeability "skin" around the screened portion of the borehole. The "skin" effect was not diminished during well development. The average hydraulic conductivity value for the shallow wells screened in the overburden water-bearing zone, excluding the value obtained from MW-6S, is 5.0 x 10^{-4} cm/s.

A hydraulic conductivity value of 3.2 x 10^{-3} cm/s was obtained for the piezometer (PZ-9) screened in the lower portion of this zone. This higher hydraulic conductivity value reflects the increase in permeability due to the coarser grain size associated with the sand and gravel deposits.

Ground water flow rates for the overburden water-bearing zone for different areas of the site were calculated using the horizontal gradients (from the May 1990 sampling period) and hydraulic conductivity values determined for the site. Effective porosity values used in the velocity calculations were selected from a range of values presented in the hydrogeologic literature for each of the geologic materials described (Freeze and Cherry, 1979). These flow rates, in addition to other ground water flow properties and physical properties of the overburden water-bearing zone, are summarized in Table 5-10.

5.4.3 Bedrock Aquifer

The upper portion of the bedrock beneath the site (Lockport Group) is water-bearing. Bedding-plane fractures, vertical fractures and solution voids are the principal water-bearing openings within the dolostone bedrock. The average depth to this aquifer is 28.7 feet below the ground surface. Ground water flow conditions during the May and August sampling periods within the upper weathered portion of the bedrock are shown in isopotential maps in Figures 5-14 through 5-17. Figures 5-14 and 5-15 present hydraulic head distribution in

TABLE 5-9
ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF HYDRAULIC CONDUCTIVITY

WELL #	MATERIAL SCREENED	SOIL TESTING RESULTS (cm/s)	PACKER TEST RESULTS (cm/s)
MW-6S	Brown Clayey Silt	1.9E-08	
MW-6I	Shallow Bedrock	3.4E-02	> 8.8E-04
MW-6D	Deeper Bedrock	3.7E-03	2.1E-05
MW-7S	Mottled Brown/Gray Sand	1.2E-04	
MW-7I	Shallow Bedrock	1.4E-02	(1)
MW-7D	Deeper Bedrock	3.3E-03	6.5E-04
MW-8S	Mottled Brown/Gray Sand	9.5E-04	
MW-8I	Shallow Bedrock	1.4E-02	> 1.2E-03
MW-8D	Deeper Bedrock	2.1E-03	9.2E-05
PZ-9	Brown Sand and Gravel	3.2E-03	
MW-9S	Brown Clayey Silt	2.7E-03	
MW-9I	Shallow Bedrock	4.1E-02	
MW-10S	Mottled Brown/Gray Silt	9.0E-05	
MW-10I	Shallow Bedrock	1.4E-02	
MW-11S	Mottled Brown/Gray Silt	8.2E-05	
MW-11I	Shallow Bedrock	2.1E-02	
MW-12S	Mottled Brown/Gray Silt	1.8E-04	
MW-12I	Shallow Bedrock	9.2E-03	
MW-13S	Brown Clayey Silt	2.9E-05	
MW-14S	Mottled Brown/Gray Sand	3.1E-04	
MW-15S	Mottled Brown/Gray Sand	7.6E-05	
MW-16I	Shallow Bedrock	2.1E-02	

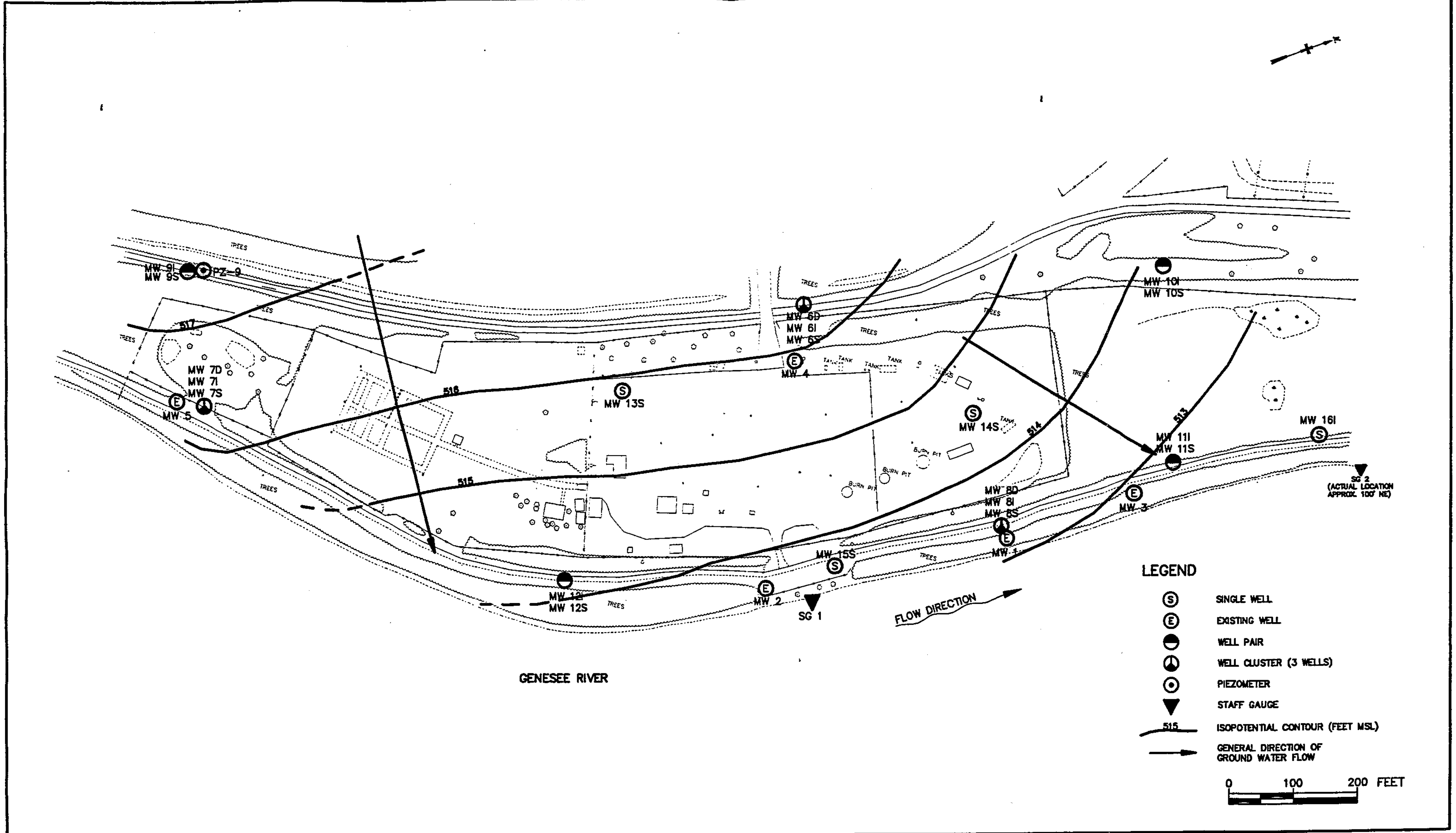
STATISTICS	Mean (cm/s)	Std Dev (cm/s)	Min (cm/s)	Max (cm/s)	# of Wells
'S' series wells (shallow overburden) (2)	5.0E-04	8.4E-04	1.9E-08	2.7E-03	9
'PZ' piezometer (deep overburden)	3.2E-03	-	3.2E-03	3.2E-03	1
'I' series wells (upper bedrock)	2.1E-02	1.1E-02	9.2E-03	4.1E-02	8
'D' series wells (deeper bedrock)	3.0E-03	8.3E-04	2.1E-03	3.7E-03	3

(1) Not tested due to borehole collapse
(2) Mean value excludes MW-6S

TABLE 5–10
ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF HYDROGEOLOGY

HYDROSTATIGRAPHIC UNIT	GEOLOGIC UNIT(S)	PHYSICAL PROPERTIES			GROUND WATER FLOW PROPERTIES		
		SATURATED THICKNESS (2) (ft)	HYDRAULIC CONDUCTIVITY (cm/s)	EFFECTIVE POROSITY (4)	PRINCIPAL FLOW DIRECTION	HORIZONTAL GRADIENT (2) (ft/ft)	FLOW VELOCITY (3) (ft/day)
OVERBURDEN WATER-BEARING ZONE							
SOUTH DISPOSAL	FILL, ALLUVIAL DEPOSITS	32.2	1.4E-03	0.20	EAST	0.023	0.46
TRAINING GROUNDS	FILL, ALLUVIAL DEPOSITS	25.9	* 4.3E-04	0.20	EAST	0.009	0.06
NORTH DISPOSAL	FILL, ALLUVIAL DEPOSITS	25.3	8.9E-05	0.20	EAST	0.012	0.02
BEDROCK AQUIFER							
UPPER (0-10 ft)							
SOUTH DISPOSAL	DOLOSTONE	approx. 20 (1)	2.8E-02	0.05	NORTHEAST	0.003	4.8
TRAINING GROUNDS	DOLOSTONE	approx. 20 (1)	1.9E-02	0.05	NORTHEAST	0.006	6.5
NORTH DISPOSAL	DOLOSTONE	approx. 20 (1)	1.9E-02	0.05	NORTHEAST	0.004	4.3
LOWER (10-20 ft)	DOLOSTONE	approx. 20 (1)	3.0E-03	0.01	NORTHEAST	0.004	0.68

NOTES:
(1) Most bedrock flow through upper 20 feet of fractured rock.
(2) Ground water level data from 5/21/90
(3) Flow velocities for the lower portion of the overburden water-bearing zone are expected to be higher than the reported values.
(4) Porosity values are estimated from a range of values provided in the geologic literatue (Freeze and Cherry, 1979 and Fetter, 1980). Bedrock porosity values are fracture porosity values.
* Average excludes MW-6S



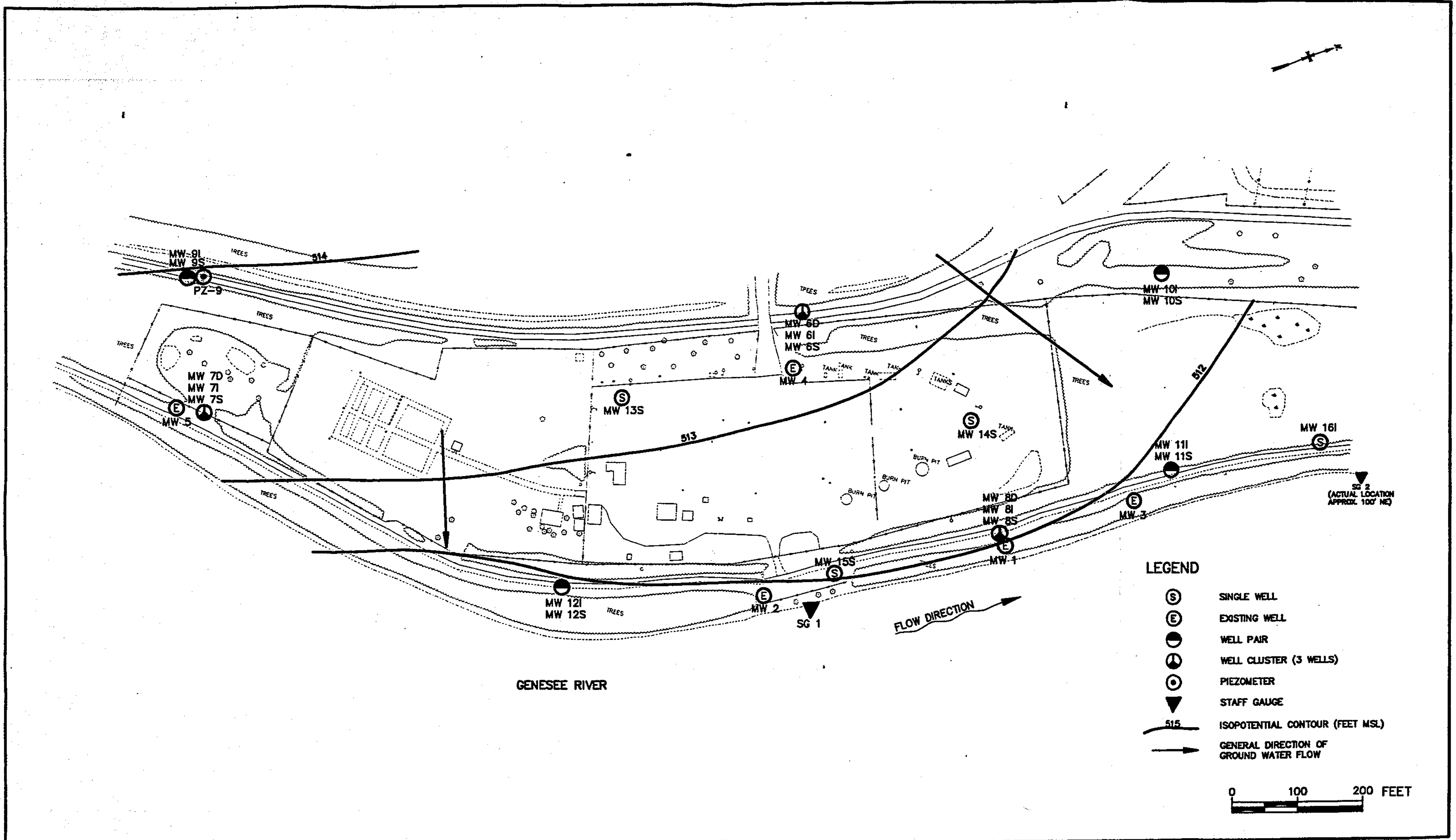
MALCOLM PIRNIE

ROC-04-AIW

ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS
ISOPOTENTIAL MAP FOR THE UPPER PORTION OF THE BEDROCK AQUIFER – INTERMEDIATE WELLS
(5/21/90)

CITY OF ROCHESTER

MARCH 1991



MALCOLM PIRNIE

ROC-04-F14

ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS
ISOPOTENTIAL MAP FOR THE UPPER PORTION OF THE BEDROCK AQUIFER – INTERMEDIATE WELLS (8/27/90)

CITY OF ROCHESTER

MARCH 1991

ground water and flow directions for the May 1990 and August 1990 sampling events, in the upper 10-feet of the bedrock where the occurrence of water-bearing openings are most frequent. Figures 5-16 and 5-17 show hydraulic head distribution and flow directions for the same sampling events at a slightly deeper depth within the aquifer where the presence of water bearing openings are less frequent (10 to 20 feet below the top of the aquifer) . The general direction of ground water flow in the upper portion of the bedrock aquifer during both sampling periods was northeast.

Horizontal hydraulic gradients for the bedrock aquifer, as determined from monitoring well data, are summarized in Table 5-7. Horizontal hydraulic gradients in the bedrock aquifer are generally low and are consistent across the site. Vertical hydraulic gradients within the bedrock aquifer near the Genesee River vary from downward under high water level conditions (May 1990) to upward following water levels decline (August 1990). As suggested by the upward vertical gradients in the bedrock, the bedrock aquifer is discharging to the Genesee River. These vertical gradients are summarized in Table 5-8.

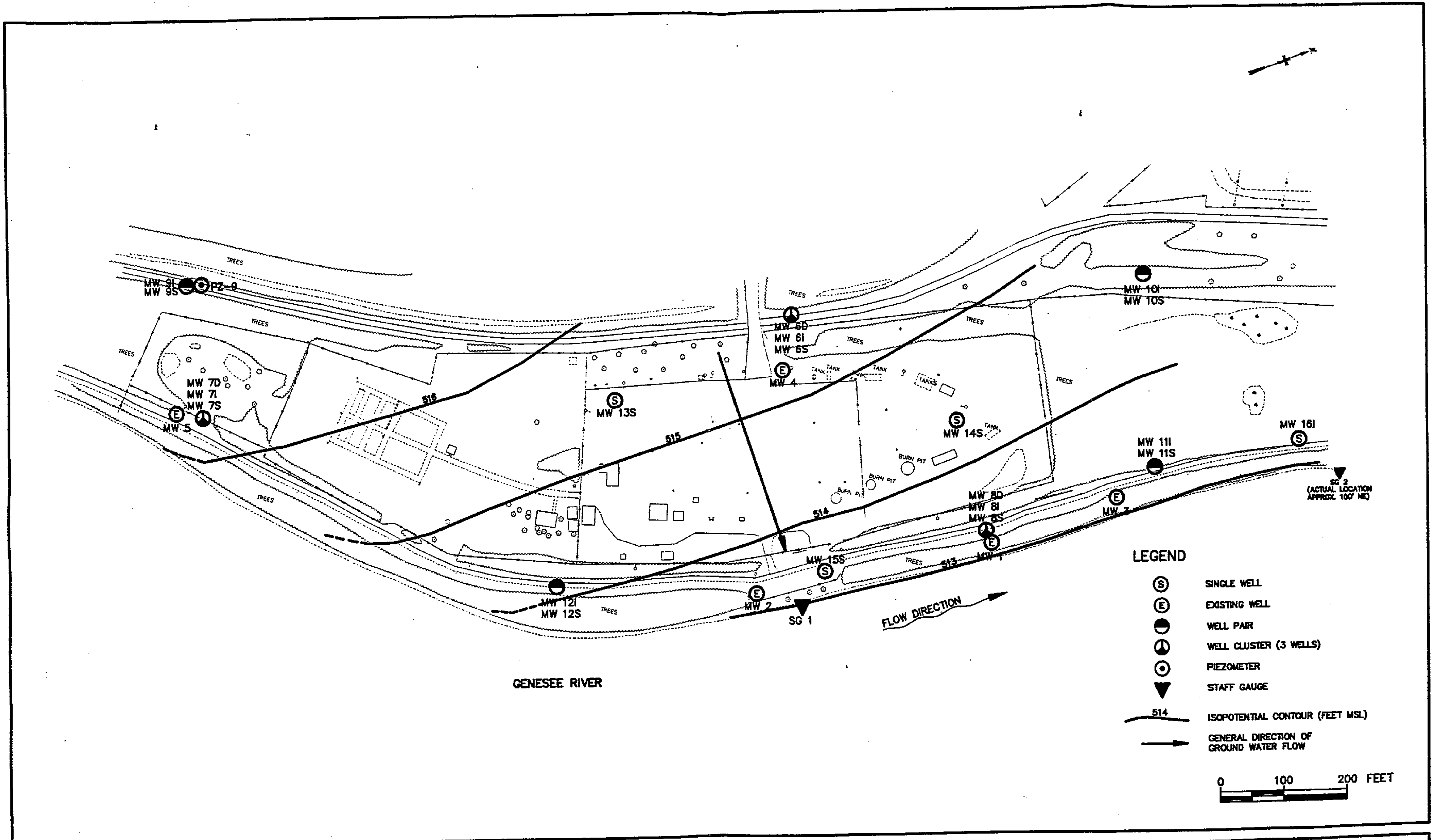
Ground water flow rates in the bedrock aquifer were determined using the horizontal hydraulic gradients calculated for the May 1990 sampling period and hydraulic conductivity data presented in Tables 5-7 and 5-9, respectively. Porosity values used in the velocity calculations are secondary porosity values selected from the midpoint of a range of values presented in the literature for carbonate rocks (Freeze and Cherry, 1979). Porosity values are variable and are dependent upon fracture properties. Therefore, calculated horizontal flow velocities are only approximate values. The calculated flow rates are presented in Table 5-10. The greater flow velocity in the South Disposal Area is primarily due to a steeper hydraulic gradient.

5.4.4 Summary of Hydrogeologic Properties of the Hydrostratigraphic Units

1. The overburden water-bearing zone consists of fill material and alluvial deposits.

2. The general direction of ground water flow within the overburden water-bearing zone is east toward the Genesee River.

3. Ground water in the overburden water-bearing zone discharges to the Genesee River as well as recharges the bedrock aquifer during seasonally high water levels.



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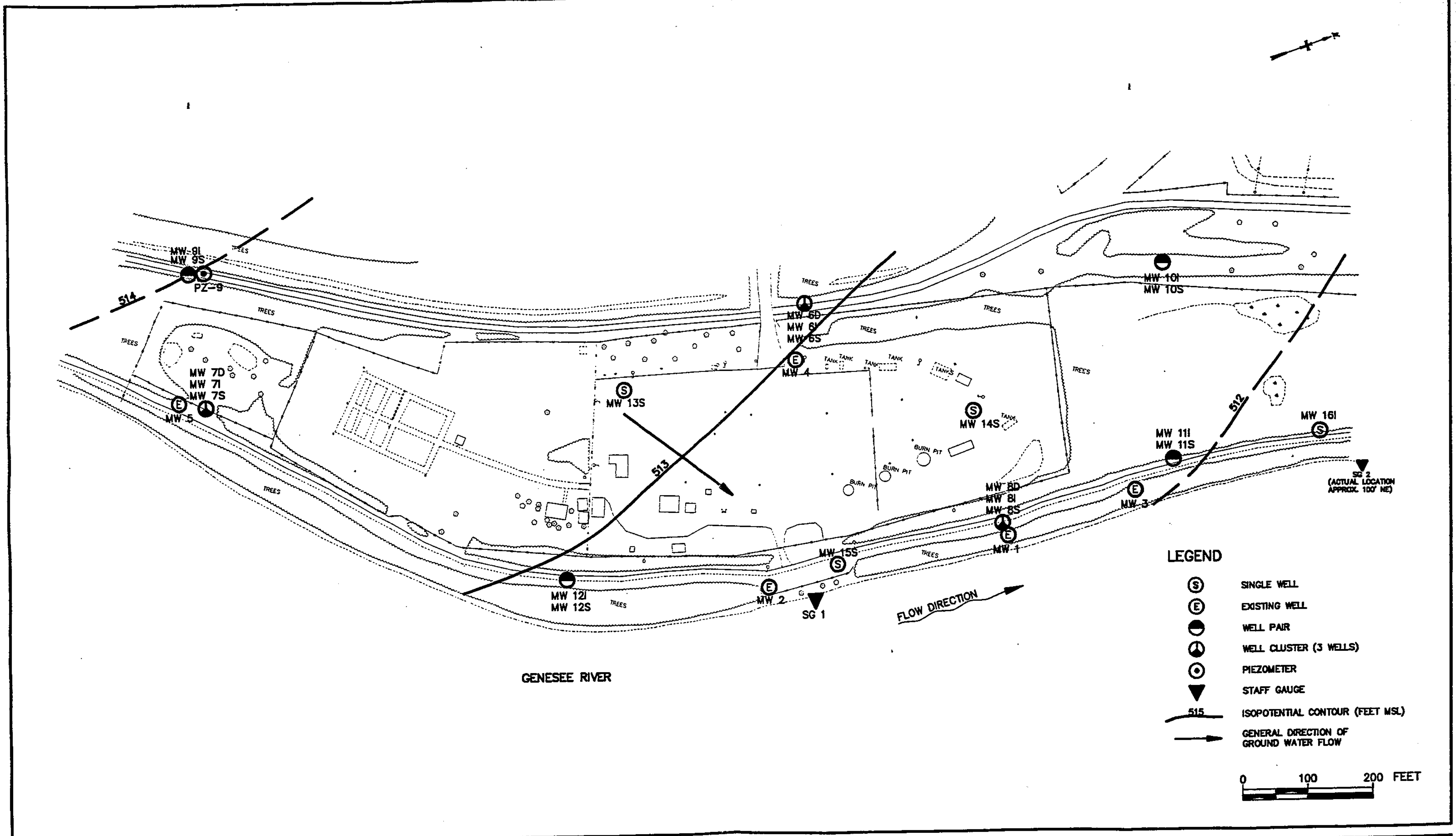
ROC-04-ADW

ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS
ISOPOTENTIAL MAP FOR THE BEDROCK AQUIFER – DEEP WELLS (5/21/90)

CITY OF ROCHESTER

MARCH 1991



MALCOLM PIRNIE

ROC-04-F16

ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS
ISOPOTENTIAL MAP FOR THE BEDROCK AQUIFIER – DEEP WELLS (8/27/90)

CITY OF ROCHESTER MARCH 1991

4. Horizontal flow velocities within the overburden water-bearing zone are 0.46, 0.06 and 0.02 ft/day for the South Disposal Area, Training Grounds Area, and the North Disposal Area, respectively. The relatively greater flow velocity in the South Disposal Area is attributable to the higher hydraulic gradient in this area.

5. The bedrock aquifer consists of dolostone bedrock of the Lockport Group. The occurrence of ground water is primarily in bedding plane fractures and interconnected solution voids.

6. The frequency of water-bearing openings in the bedrock decreases with depth.

7. The general direction of ground water flow within the bedrock aquifer is to the northeast.

8. Horizontal flow velocities within the extreme upper portion of the bedrock aquifer ranges from 4.3 to 6.5 ft/day. Flow velocities decrease at depth within the bedrock aquifer.

9. The bedrock aquifer discharges to the Genesee River.

A summary of hydrogeologic properties and the hydrostratigraphic units is presented in Table 5-10.

6.0 HYDROLOGY

6.1 WATER BALANCE

A water balance was performed for each of the areas of concern at the Rochester Fire Academy Site. These areas include the South Disposal Area, the North Disposal Area and the Training Grounds Area. This water balance was used to partition quantities of water which factor into the hydrologic recharge/discharge relationship that exists for each area. Recharge is defined as all water entering the site either in the form of infiltration from precipitation falling on the site and ground water inflow along the western upgradient boundary of the site. Discharge, defined as all water leaving the site, includes ground water discharge to the Genesee River (downgradient) and the downward leakance of ground water in the shallow water-bearing zone into the bedrock aquifer (during Spring conditions). The average annual water balance can be expressed mathematically as:

$$Q_I + Q_{GI} = Q_{GO} + Q_{LD} \pm \Delta S$$

where:

Q_I = average annual infiltration (precipitation),

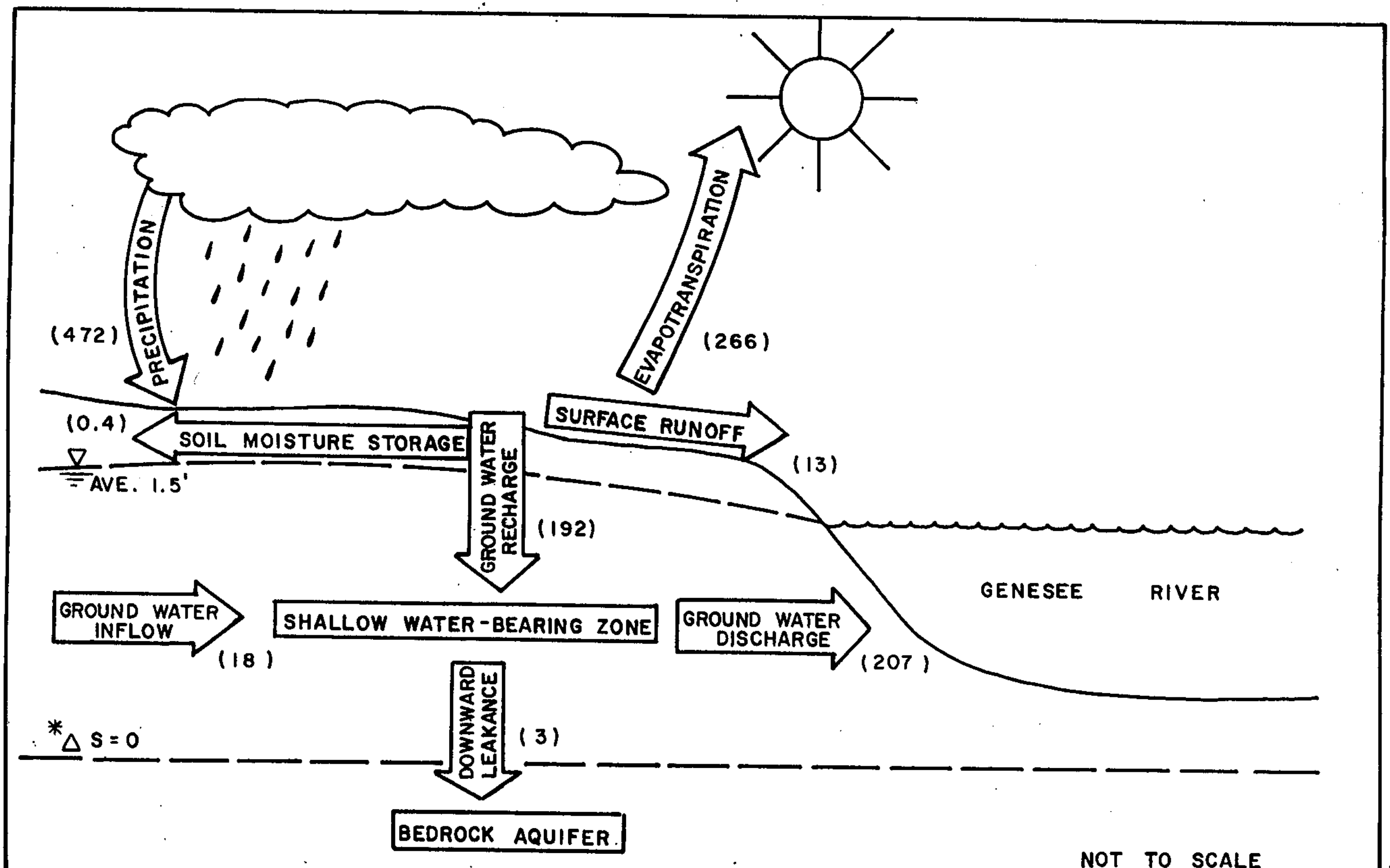
Q_{LD} = average annual downward leakance,

Q_{GI} = average annual ground water inflow,

Q_{GO} = average annual ground water outflow to the Genesee River, and

ΔS = annual change in ground water storage.

It should be recognized that this water balance equation provides only a general approximation of the hydrologic budget. This approximation does, however, provide an indication of the relative importance of the various component parameters to the overall budget. Figures 6-1 through 6-3 are provided to schematically illustrate the following discussion of the various component parameters.



NOTE: (VALUE) - VOLUMES ARE AVERAGE ANNUAL VALUES EXPRESSED IN CUBIC FEET/DAY.
* CHANGE IN STORAGE = 0 STEADY STATE CONDITIONS ASSUMED.

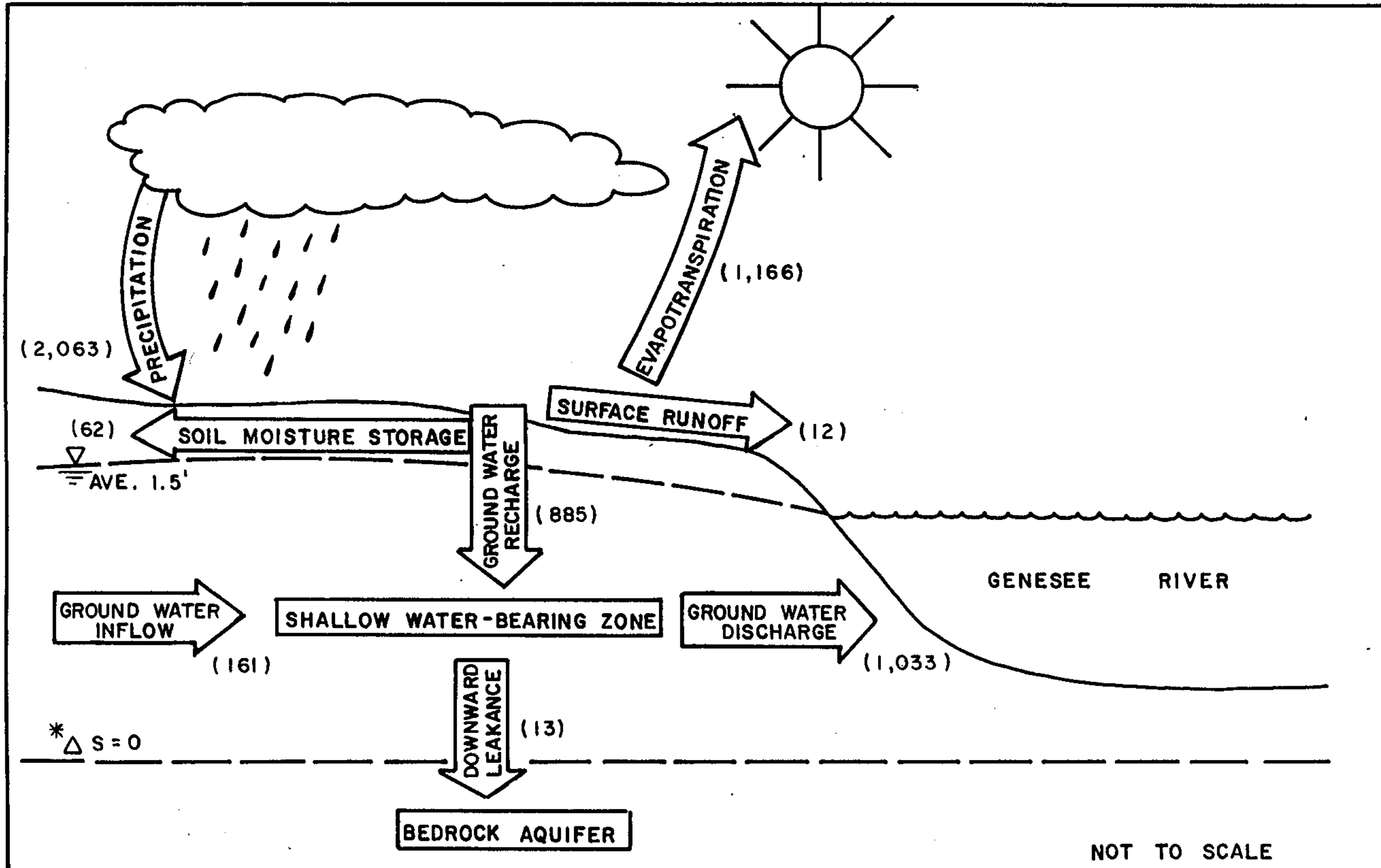
MALCOLM PIRNIE

ROC - 04

ROCHESTER FIRE ACADEMY
RI / FS
NORTH DISPOSAL AREA
WATER BALANCE

CITY OF ROCHESTER, NEW YORK — JULY 1990

FIGURE 6-1



NOTE: (VALUE) - VOLUMES ARE AVERAGE ANNUAL VALUES EXPRESSED IN CUBIC FEET/DAY.
* CHANGE IN STORAGE = 0 STEADY STATE CONDITIONS ASSUMED.

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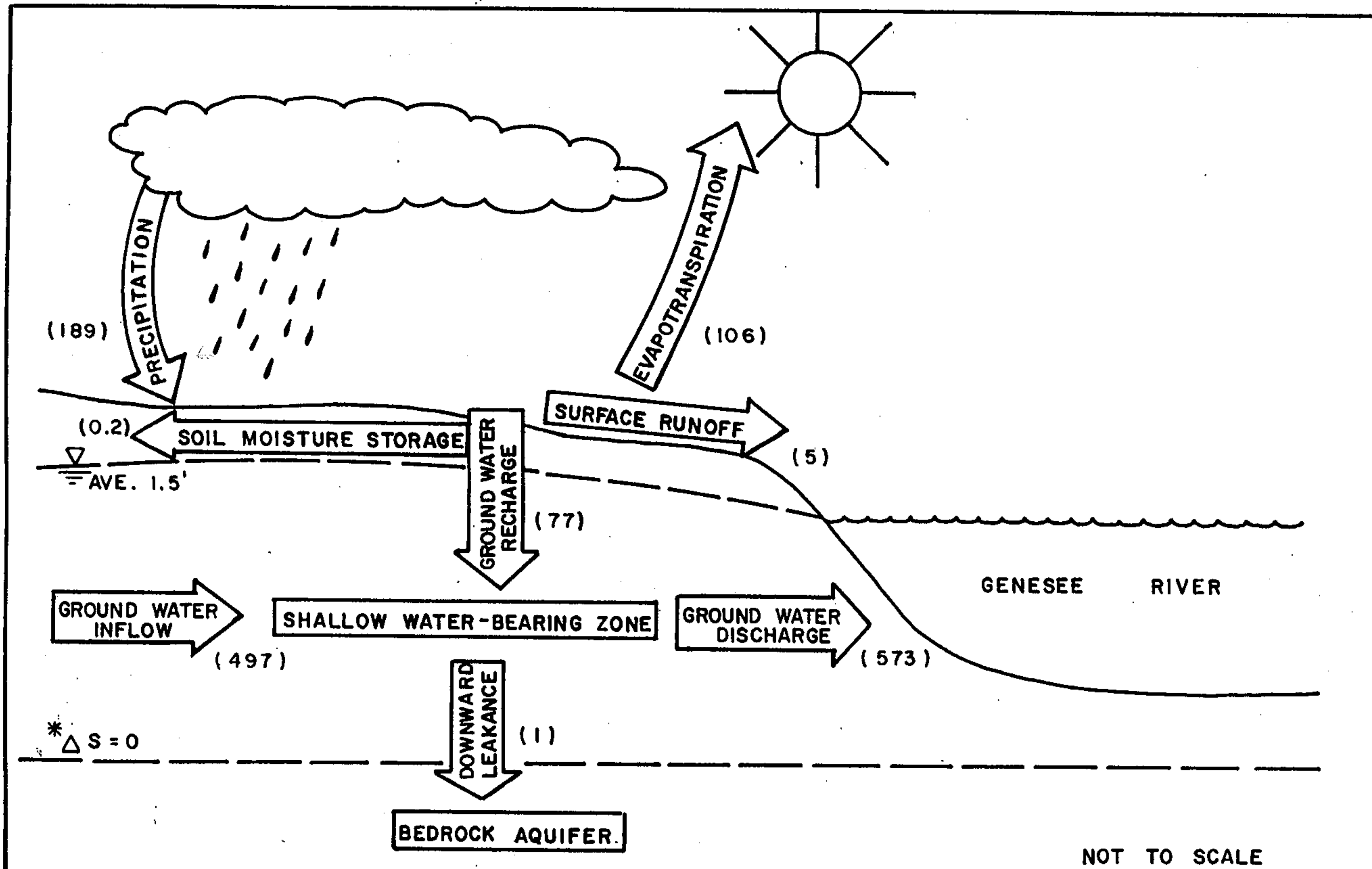
ROCHESTER FIRE ACADEMY
RI / FS
TRAINING GROUNDS AREA
WATER BALANCE

CITY OF ROCHESTER, NEW YORK JULY 1990

FIGURE 6-2



NOTE: (VALUE) - VOLUMES ARE AVERAGE ANNUAL VALUES EXPRESSED IN CUBIC FEET/DAY.
* CHANGE IN STORAGE = 0 STEADY STATE CONDITIONS ASSUMED.

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RI / FS
SOUTH DISPOSAL AREA
WATER BALANCE

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FIGURE 6-3

6.1.1 Recharge

Infiltration - The Hydrologic Evaluation of Landfill Performance (HELP) computer model developed by Schroeder et.al. (1988), was employed to simulate the movement of precipitation (i.e., runoff, evapotranspiration, and infiltration (groundwater recharge) for each of the areas of concern. The HELP model uses climatologic and soil input data which is either specified by the user or selected from an extensive data bases stored within the model. The sources of the input parameters used during the simulations (viz., for existing or open condition) are identified below:

Climatologic Data	Source
Monthly mean temperature and precipitation	Weather observation station at the Greater Rochester International Airport
Daily precipitation, solar radiation values, leaf area indices, and winter cover factors	Model default data for Buffalo NY

Soil Characteristics	Source
Hydraulic conductivity, porosity, field capacity, wilting point, and evaporation coefficient.	Model Default Data for Similar Site Soil Type

For purposes of simulating actual field conditions, it was assumed that the site consists of a fill layer with either a non-vegetative surface (i.e., Training Grounds Area) or a vegetated surface (i.e., North and South Disposal Areas). Additional design and soil data inputs are summarized below:

Total Disposal Surface Area:

North Disposal Area	60,000 sq. ft.
South Disposal Area	24,000 sq. ft.
Training Grounds	262,500 sq. ft.
Unsaturated Fill Thickness	1.5 ft.
Permeability of Unsaturated Zone (fill)	2.9×10^{-2} cm/sec
Porosity	0.42 vol/vol
Field Capacity	0.045 vol/vol
Wilting Point	0.02 vol/vol

Potential Run Off Fraction:

North Disposal Area	0.2 (unitless)
South Disposal Area	0.2 (unitless)
Training Grounds	0.1 (unitless)

Evaporative Zone Depth — 8 inches

The model outputs are presented in Appendix D. Figures 6-1 through 6-3 show resulting ground water recharge volumes for each area after average annual volumes of precipitation, surface runoff, soil moisture storage and evapotranspiration occur.

Ground Water Inflow - Ground water inflow across the western (upgradient) boundary of the site was estimated by Darcy's Law which is expressed as:

$$Q = K\,i\,A$$

where:

K = average hydraulic conductivity,

i = horizontal hydraulic gradient, and

A = cross sectional area of the overburden water-bearing zone

The hydraulic conductivity values used in the calculation are the actual values determined by slug test analysis for the overburden water-bearing zone in each area. The hydraulic gradient and saturated cross sectional area were based upon the areas of concern (viz., South Area, North Area, and Training Grounds Area). Using data collected during

May 1990, the various input parameters and the calculated ground water inflow are summarized below:

PARAMETER	UNITS	NORTH DISPOSAL AREA	SOUTH DISPOSAL AREA	TRAINING GROUNDS
Hydraulic Conductivity	ft/day	0.24	3.97	0.85 ft/day
Hydraulic Gradient	ft/ft	0.012	0.023	0.009 ft/ft
Cross sectional Area	ft^2	6,160	5,440	21,000 ft^2
Ground Water Inflow	ft^3/day	18	497	161 ft^3/day

6.1.2 Discharge

Downward Leakance

Downward leakance from the shallow water-bearing zone into the bedrock aquifer was estimated for each of the areas of concern using an average vertical hydraulic conductivity of 3.5 10^{-4} ft/day, an average vertical hydraulic gradient of 0.141 ft/ft and the total surface area of each area. The calculated leakance is 3, 1 and 13 ft^3/day for the North Disposal Area, South Disposal Area and Training Grounds, respectively.

Ground Water Outflow - Ground water leaves the site through the shallow water-bearing zone into the bedrock aquifer and the Genesee River. Outflow was calculated to be equal to the sum of infiltration and ground water inflow less the downward leakance. Input parameters and the calculated ground water outflow to the Genesee River from each of the areas for average water table (i.e., steady state) conditions are presented below:

AREA	GROUND WATER OUTFLOW TO RIVER (Q_{GO})
North Disposal Area	207 ft^3/day
South Disposal Area	573 ft^3/day
Training Grounds	1,033 ft^3/day

Ground Water Storage

The change in storage parameter is generally disregarded where the water balance is averaged over several years. This assumes that steady state conditions exist over the site, and consequently, that the change in ground water levels is negligible.

6.2 DRAINAGE BASIN CHARACTERISTICS

The Fire Training Academy Site is located adjacent to the Genesee River within the Genesee River Drainage Basin. This drainage basin, the fourth largest water shed in the state, covers 2,479 mi^2 and is shown in Figure 6-4. The drainage basin may be divided into two separate regions: the upper basin extending from Mt. Morris, NY southward to its headwaters; and the lower Basin extending northward from the Mt. Morris Dam (used for flood control) to Lake Ontario. The lower basin of the Genesee River Valley is a broad alluvial flood plan that extends up to three miles across in some areas (U.S. Army Corps, 1969).

In an average year the Genesee River transports approximately 1.2 million tons of sediment past the Avon gaging station (located approximately 25 miles upstream from the Fire Academy Site) (U.S. Army Corps, 1969). The erosion of stream banks is the major cause of this large volume of sediment.

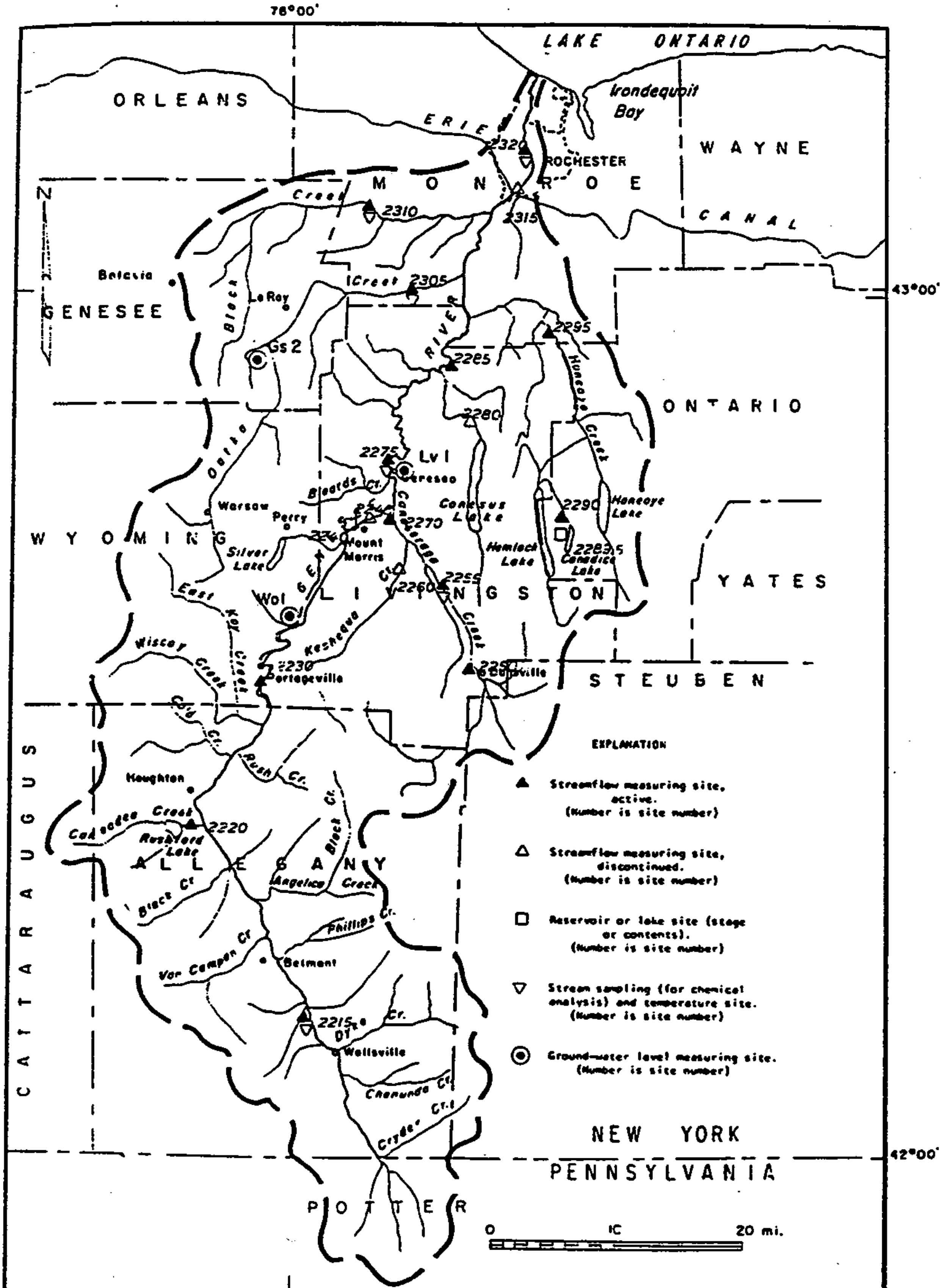
The Genesee River receives approximately 90% of the drainage basin's municipal and industrial waste loads (Genesee River Basin Planning Board, 1976).

6.3 FLOOD PLAIN

The Mount Morris Dam was constructed on the Genesee River from 1947-1952 for flood protection. Since the construction of the dam, peak river discharges downstream from the dam have been reduced by over 50% (U.S. Army Corps, 1973). Figure 6-5 graphically demonstrates the dam's effectiveness for downstream flood control. Flood controls are also present within the City of Rochester downstream from the site.

The Federal Emergency Management Agency (FEMA) conducted hydrologic analyses of peak discharge frequency and peak elevation frequency relationships in order to determine the 10-, 50-, and 100-year flood profiles of the Genesee River at various locations. However, an analysis of the flood plain in the vicinity of the Rochester Fire Academy Site

FIGURE 6 - 4



NOTE: FROM GILBERT & KRAMMERER, 1965

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RI / FS
THE GENESEE VALLEY RIVER BASIN

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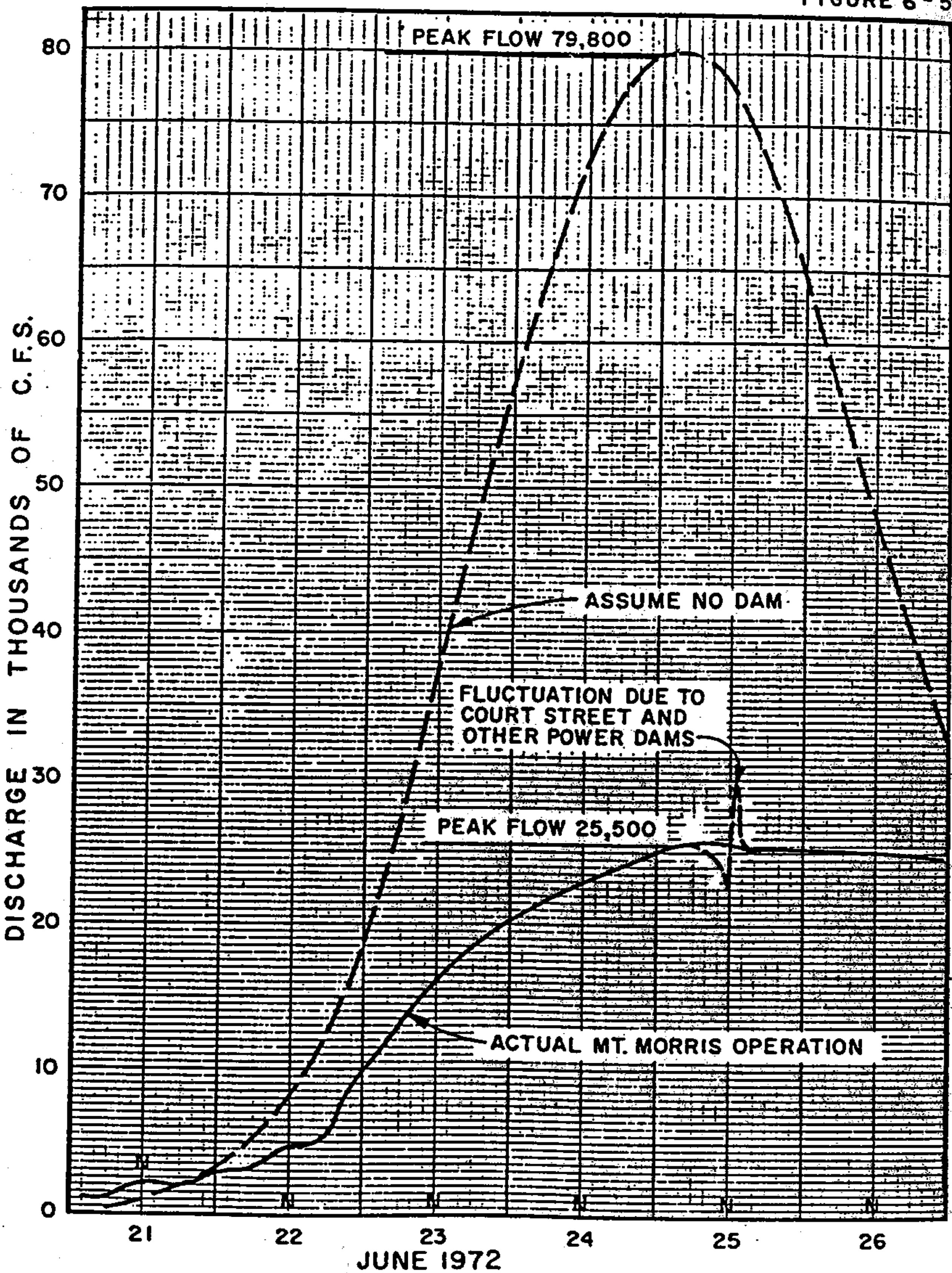

NOTE: FROM U.S. ARMY ENGINEER DISTRICT, BUFFALO; AUGUST, 1973

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ROCHESTER FIRE ACADEMY
RI/FS
FLOOD CONTROL OF THE MT. MORRIS DAM

CITY OF ROCHESTER, NEW YORK JULY 1990

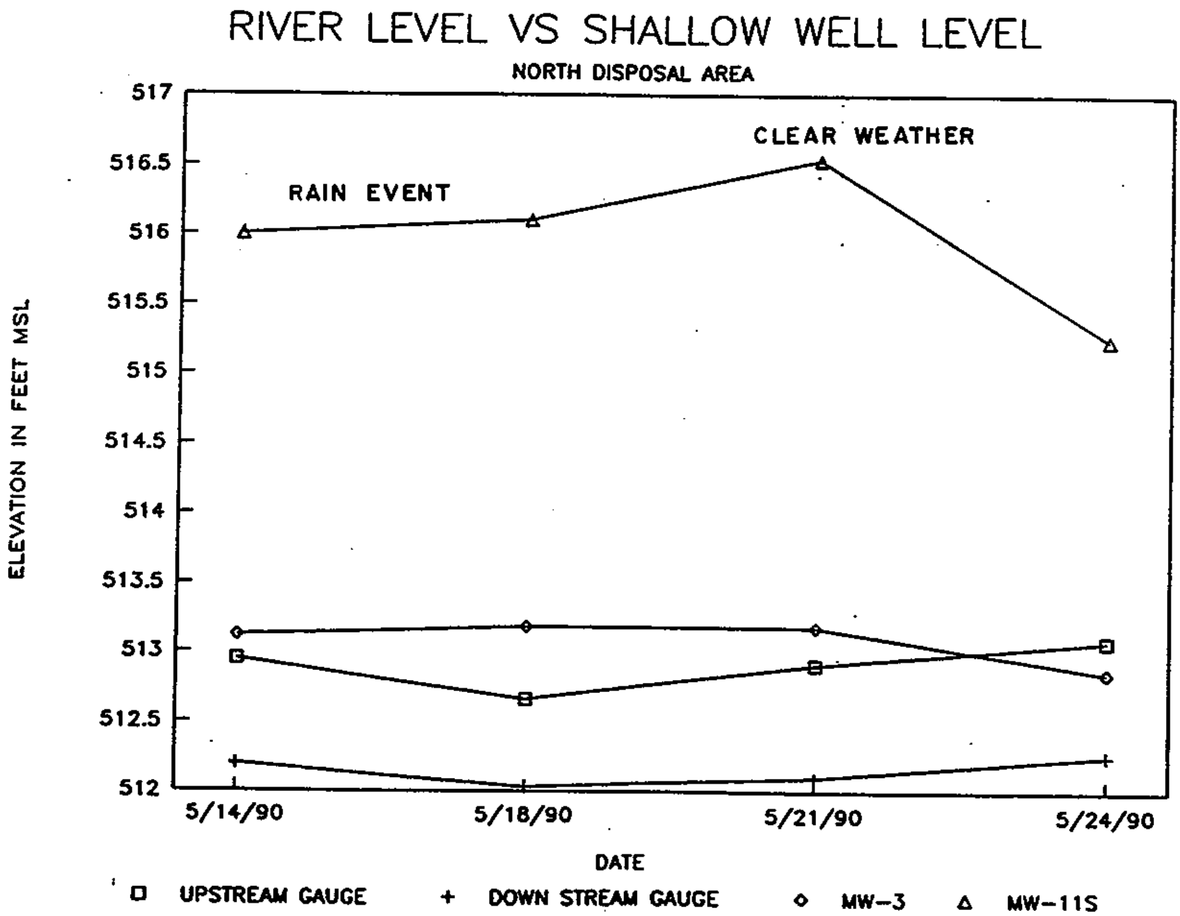
was not included in the FEMA Study. The Army Corps of Engineers has conducted flood plain studies in this area which included the limits of 100 year flood. According to this study, the limits of the 100 year flood plain in the vicinity of the site is at an elevation of 519 feet above sea level (Per. Comm., Buffalo Army Corps). This level would place a large portion of the site under water during a 100-year flood.

6.4 RELATIONSHIP BETWEEN RIVER LEVEL AND OVERBURDEN WATER-BEARING ZONE

As described in Section 5.1.5, water levels were recorded in monitoring wells and at two river staff gauges. Figures 6-6 through 6-8 graphically displays ground water elevations in the shallow wells adjacent to the river and river levels with time. A chronology of site climatic conditions over the period of measurement follows:

- May 16, 1990 and May 17, 1990, periods of heavy rain; and
- generally clear from May 18, 1990 to May 24, 1990.

As depicted in the figures, recharge from precipitation increased the water levels in the shallow wells soon after the precipitation event occurred. However, a lag time is associated with the river level response to the same precipitation events. Water levels generally declined in the monitoring wells after May 21, 1990 while levels in the river continued to rise. During the period of monitoring, it appears that a positive correlation exists between recharge from precipitation events and the water level in the overburden water-bearing zone. Water levels in the overburden water-bearing zone are minimally influenced by water levels in the adjacent regulated river.



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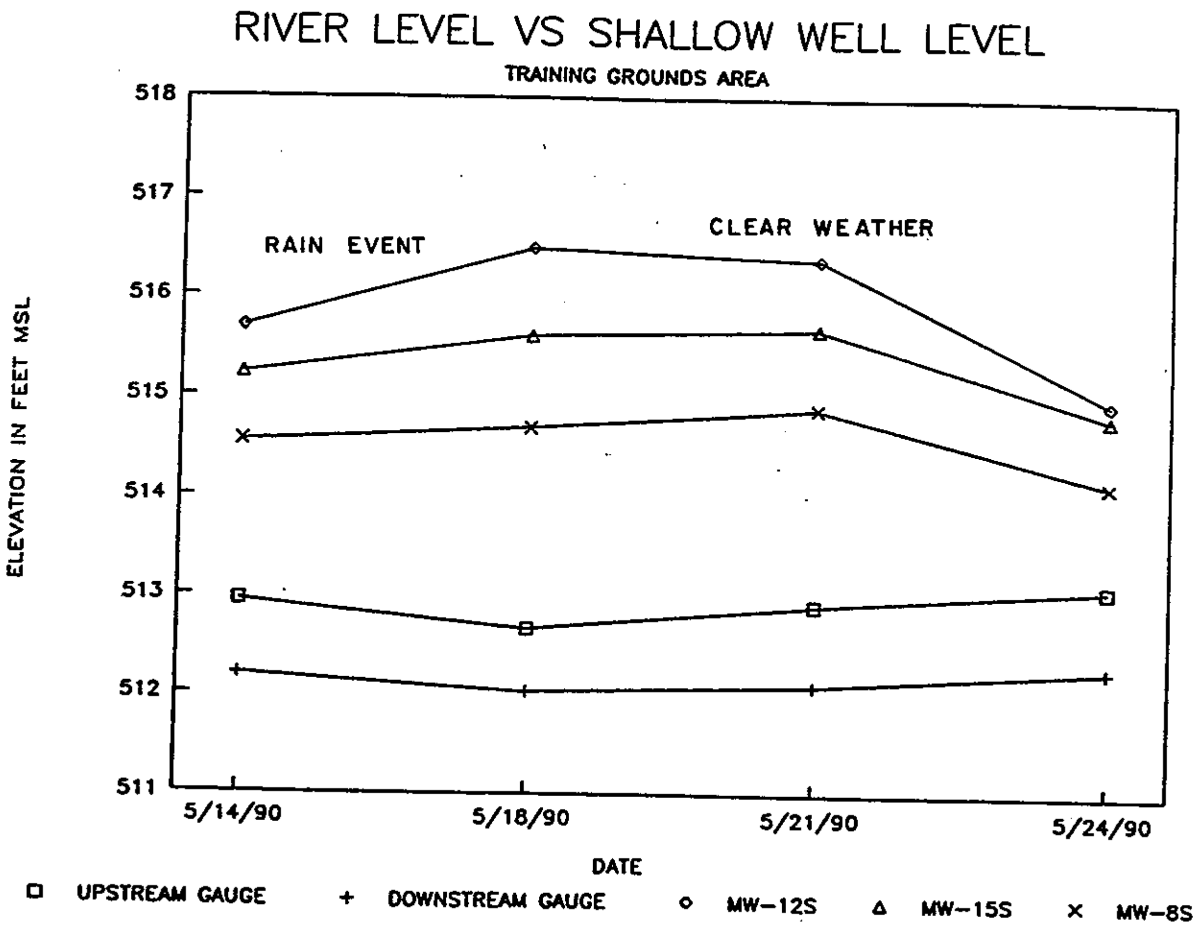
ROCHESTER FIRE ACADEMY
RI/FS
WATER LEVELS IN GENESEE RIVER AND WELLS NEAR THE NORTH DISPOSAL AREA

CITY OF ROCHESTER, NEW YORK　　OCTOBER 1990



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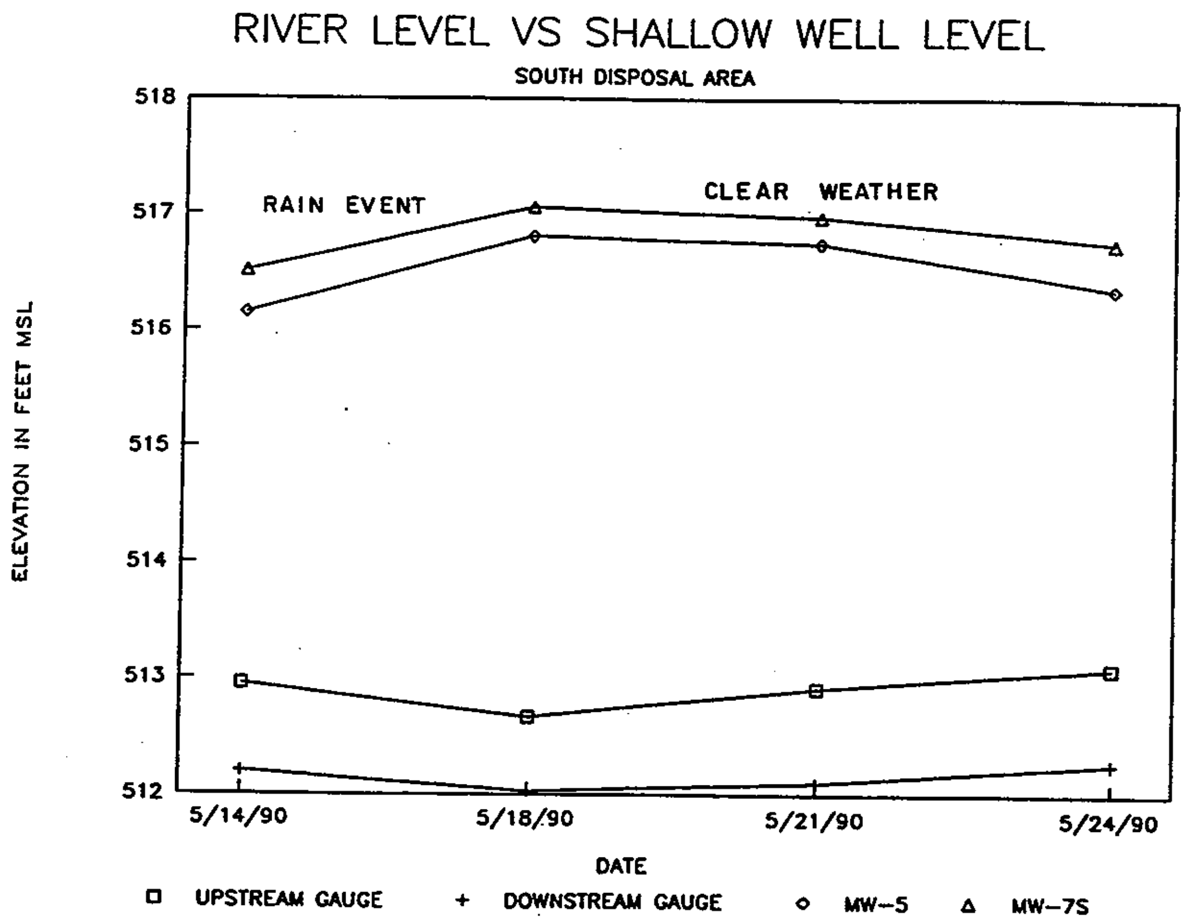
ROCHESTER FIRE ACADEMY
RI/FS
WATER LEVELS IN GENESEE RIVER AND WELLS NEAR TRAINING GROUNDS AREA

CITY OF ROCHESTER, NEW YORK OCTOBER 1990



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ROCHESTER FIRE ACADEMY
RI/FS
WATER LEVELS IN GENESEE RIVER AND WELLS NEAR THE SOUTH DISPOSAL AREA

CITY OF ROCHESTER, NEW YORK OCTOBER 1990

7.0 SITE CONTAMINATION CHARACTERIZATION

7.1 RI SAMPLING AND ANALYSIS PROGRAM

The characterization of site contamination was accomplished by analysis of soil, sediment, surface water, and ground water samples. Samples were collected during the period of April - October 1990. Documentation of the sampling procedures and rationale has been presented in the RI Work Plan dated June 1988, in the Preliminary Survey report dated February 1990 and in the chronology of work scope modifications in Appendix B.1.

All final soil sampling locations and water monitoring well locations were determined on the basis of preliminary non-intrusive surveys (radiological, electromagnetic (EM) terrain conductivity, and soil gas surveys) conducted in November 1989. The preliminary surveys were performed on a surveyed grid established across the site. Sampling locations were selected at locations of discrete survey anomalies, which indicated a possibility of contaminated soil or fill. No radiologic survey anomalies were identified; therefore, final sampling locations were selected on the basis of the EM and soil gas surveys alone. Grid coordinates of survey anomalies are presented in Table 4-1.

Samples collected for the Rochester Fire Academy RI were analyzed for the parameters listed in Table 7-1. Sampling events are categorized as Rounds 1, 2, or 3 based on the analytical protocols and parameter list that were established for each sampling event by agreement with NYSDEC. As shown in Table 7-1, all environmental samples collected during Round 1 were analyzed for parameters included on the 1987 New York State Contract Laboratory Protocol Target Compound List. Analytical parameters that were detected at elevated concentrations during Round 1 sampling were selected as parameters of interest and analyzed for in Round 2 samples. Analytical methods for Round 2 were modified from Round 1 to obtain a lower detection limit (by GC methods) for the parameters of interest. Round 3 was conducted at the request of NYSDEC to confirm specific analytical results obtained during Round 1 and Round 2.

Analysis of the samples collected during the RI program was performed by the following laboratories (see Table 7-1):

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TABLE 7-1

ROCHESTER FIRE ACADEMY
ANALYTICAL METHODS AND PARAMETERS

Sampling Round	Parameters	Methodology	Laboratory[5]
Round 1	TCL Volatile Organics	NYS CLP	GTC
	TCL Semi-Volatile Organics	NYS CLP	GTC
	TCL Pesticides/PCBs	NYS CLP	GTC
	TCL Metals	NYS CLP	E_3I
	2,3,7,8 TCDD (Dioxin)	[2]	CCI
	Remediation Assessment Parameters	[1]	TOX
Round 2	Halogenated Volatile Organics	8010[3]	GTC
	Aromatic Volatile Organics	8020[3]	GTC
	PCBs	8080[3]	GTC
	Acid Extractable Organics	8270[3]	GTC
	Select Total Metals	[4]	E_3I
	Remediation Assessment Parameters	[1]	TOX

(continued)

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TABLE 7-1

ROCHESTER FIRE ACADEMY
ANALYTICAL METHODS AND PARAMETERS

Sampling Round	Parameters	Methodology	Laboratory[5]
Round 3	TCL Volatile Organics	NYS CLP	GTC
	TCL Semi-Volatile Organics	NYS CLP	GTC
	TCL PCBs	NYS CLP	GTC

NOTES:
NYS-CLP: 1987 New York State Contract Laboratory Protocols
TCL: NYS-CLP Target Compound List

(1) Ground water samples only analyzed for alkalinity, bicarbonate, hardness, TKN, NH_3, phosphate, SO_4, sulfide, COD, TOC, Oil and Grease, TDS, pH, and specific conductivity in accordance with Methods of Chemical Analysis for Water and Wastes. USEPA, Cincinnati, Ohio, EPA 600/4-79-020, Revised March 1983.

(2) Method presented in laboratory report. Only soil sample nos. SS-6, SS-7, SS-10, SS-12, MW-15S and BKGD were analyzed for Dioxin.

(3) From Test Methods for Evaluation of Solid Waste USEPA-OSWER SW-846, Third Edition, Nov. 1986.

(4) SW-846 Protocol using ICP or AA.

(5) GTC - General Testing Corp. E_3I - Energy & Environmental Engineering, Inc.
TOX - Toxicon, Inc. CCI - Compuchem, Inc.

LABORATORY	ANALYSES PERFORMED
General Testing Corp.	TCL Organics
Energy & Environmental Engineering, Inc.	Metals
Toxikon	Remediation Assessment Parameters
Chemwest Analytical Labs, Inc.	2,3,7,8 TCDD

The analytical results are summarized and discussed in this section of the RI report. The detailed laboratory reports of analytical results and documentation packages are provided as Appendix E. In addition, a report of the results of an analytical data validation, performed to assess the data quality, is presented as Appendix F.

The organic analytical data packages, generated from soil samples collected during the first round of sampling, failed to comply with the requirements of the 1987 NYSDEC CLP. Specifically, contractual requirements for initial and continuing calibrations were not met and contract required quantitation limits (CRQLs) were not calculated in the manner required by the 1987 NYSDEC CLP. Therefore, quantitation of detected analytes is questionable and the organic data for soil samples has been accepted by the NYSDEC as screening level data.

The following subsections discuss the sampling program for a) soil sampling at survey anomalies (including test pit, surficial soil, and shallow boring sampling), b) sediment sampling, c) ground water sampling, and d) surface water sampling. A summary of RI sampling program showing the number and type of samples for each sampling event is presented in Table 7-2.

7.1.1 Soil Sampling at Survey Anomalies

The preliminary non-intrusive surveys identified 29 areas of elevated volatile organic vapor concentrations and 21 unidentified EM anomalies, which are representative of either soil types, contaminated soil/fill, or buried metallic objects. A total of 41 discrete survey anomalies were selected for further investigation by environmental sampling. The remaining anomalies were attributable to either buried utilities or conductive soil conditions in the Police Obstacle Course and Firing Range Area where no waste disposal is known to have occurred. The sampling program at survey anomalies, which included the sampling of test pit excavations, surficial soil, and shallow soil borings, is described below.

7.1.1.1 Test Pit Excavation/Sampling

A total of eleven (11) test pits (designated TP-1 to TP-11) were excavated at locations where geophysical anomalies attributed to buried metallic debris had been detected. Test pit locations are shown in Figure 7-1. The intended location for TP-9 was

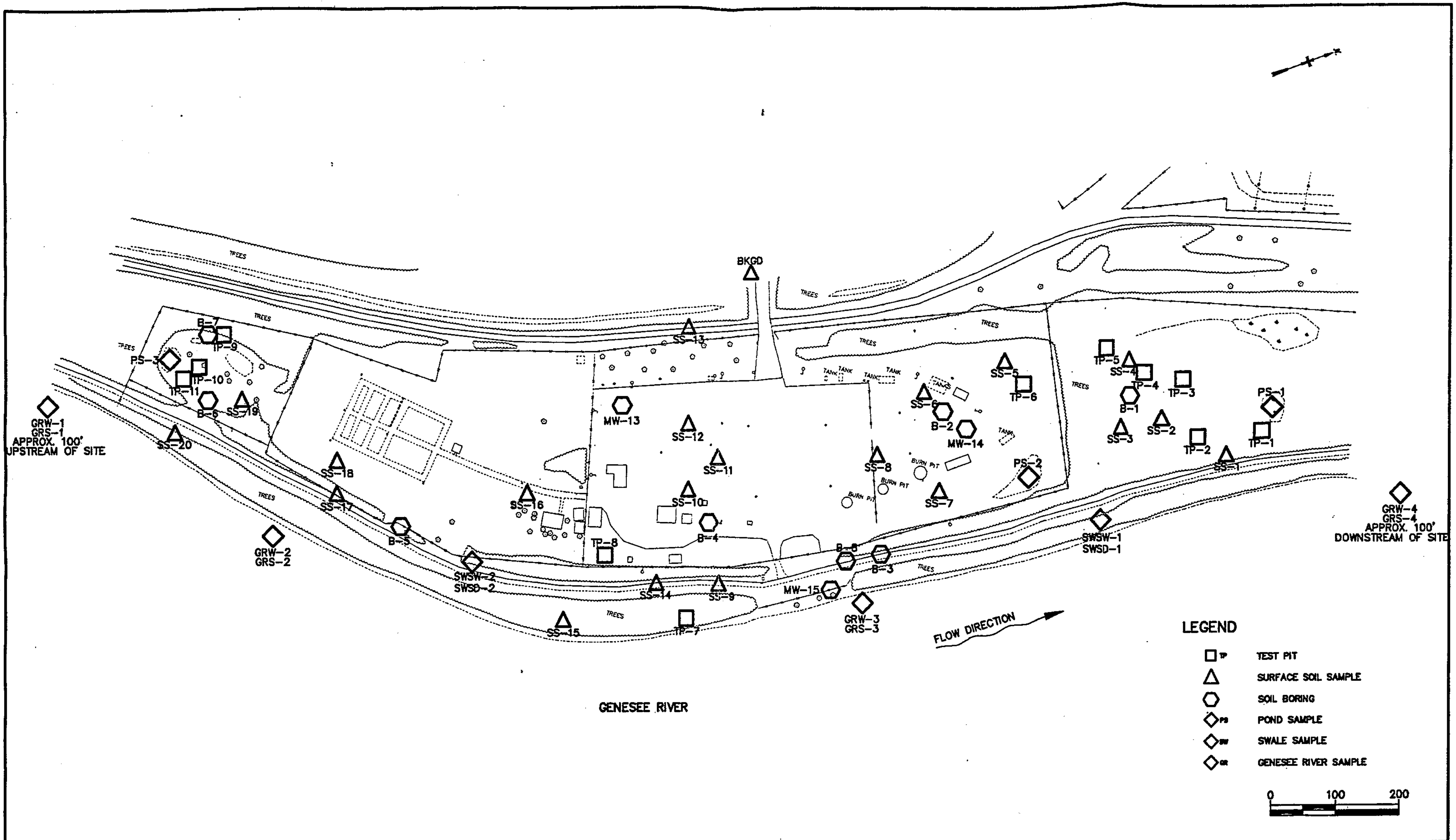
TABLE 7-2

ROCHESTER FIRE ACADEMY
SUMMARY OF ENVIRONMENTAL SAMPLING EVENTS[1]

Sampling Point	Analytical Protocol[2]	Sampling Event	Soil	Sediment	Surface Water	Ground Water
Test Pits	Round 1	4/90	11			
Shallow Borings	Round 1	4/90	8			
Surficial Soil	Round 1	4/90	21			
Monitoring Wells	Round 1	4/90	3			
Monitoring Wells	Round 1	5/90				21
Monitoring Wells	Round 2	8/90				21
Monitoring Wells	Round 3	10/90				10
On-Site Ponds	Round 1	5/90			3	
Drainage Swales	Round 1	5/90		2	2	
Genesee River	Round 1	5/90		4	4	
Genesee River	Round 2	8/90		4		
TOTAL			43	10	9	52

NOTE:

1. Number of samples per matrix per sampling event.
2. Analytical protocol for each round is shown in Table 7-1.



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ROC-04-71

ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS

SOIL & SURFACE WATER SAMPLING LOCATIONS

CITY OF ROCHESTER

NOVEMBER 1990

inaccessible due to ponded water, therefore, TP-9 was relocated to an area of disturbed fill. The test pits were excavated until either the object causing the anomaly was discovered or the water table was encountered. Test pit completion depths ranged from 2 to 6 feet below ground surface. Visual observations made during test pit excavations are summarized in Table 7-3. Test pit description logs are presented in Appendix C-7.

With the exception of TP-7, samples were collected above the water table from the walls of each test pit. TP-7 was excavated near the storm sewer outfall pipe down-gradient of the Training Grounds area. The purpose of this test pit was to examine and sample the bedding material adjacent to the outfall pipe. Although bedding material was not present at that location, a sample of the soil adjacent to the pipe was collected and submitted for analysis for the parameters identified in Table 7-1. Test pits were excavated in accordance with the procedures described in the Preliminary Surveys Report (February 1990).

7.1.1.2 Surficial Soil Sampling

Surficial soil samples were collected from areas of elevated volatile organic vapor concentrations detected during the soil gas survey. A total of 20 surficial soil samples (designated SS-1 to SS-20) were collected at the locations shown in Figure 7-1 and submitted for analysis for the parameters listed in Table 7-1. One additional surficial sample (designated BKGD) was collected from an off-site location and analyzed for priority pollutant metals and 2,3,7,8 TCDD (Dioxin) to establish background soil metals and dioxin concentrations. Sample descriptions and collection methods are summarized in Table 7-4.

7.1.1.3 Shallow Soil Boring/Sampling

Eight (8) soil borings (designated B-1 to B-8) were advanced to the top of the saturated zone using 24-inch split spoon samplers or hollow stem augers and split spoon samplers. Borehole depths ranged from 2 to 4 feet below ground surface. An additional three (3) soil borings (designated MW-13S, MW-14S, and MW-15S) were advanced into the saturated zone and completed as shallow overburden monitoring wells.

A total of 11 soil samples were submitted for analysis. All samples were collected from the unsaturated zone, which, as indicated on Table 7-5, ranged from 2 to 4 feet in thickness at the time of sample collection. Samples submitted for inorganic, semi-volatiles, and PCB analysis from borings greater than two feet in depth were composited in the field,

TABLE 7-3

ROCHESTER FIRE ACADEMY
TEST PIT EXCAVATION SUMMARY

Test Pit #	Test Pit Location	Date	Type of Survey Anomaly	Observation
TP-01	E2700, N975	4/3/90	Low conductive soil	Native soil
TP-02	E2600, N970	4/3/90	Buried Metal	C and D debris
TP-03[2]	E2575, N1075	4/3/90	Buried Metal	Decomposing drums with slag-like material
TB-3A	E2575-N1075	5/4/90	see TP-3	see TP-3
TP-04	E2520, N1080	4/3/90	Buried Metal	C and D debris
TP-05	E2460, N1125	4/3/90	Buried metal	Empty decomposing drum
TP-06	E2320, N1060	4/3/90	Buried metal	Empty 25 gal barrel VOC's present
TP-07	E1795, N708	4/4/90	Storm sewer outfall	Concrete sewer pipe; no bedding material encountered
TP-08	E1660, N820	4/4/90	Buried metal	Native soil; buried tree stump
TP-09	E1075, N1150	4/4/90	Metallic object at surface; (1) excavation moved 25 feet west to fill area	Drum in pond; VOCs present in fill

(continued)

TABLE 7-3

ROCHESTER FIRE ACADEMY
TEST PIT EXCAVATION SUMMARY

Test Pit #	Test Pit Location	Date	Type of Survey Anomaly	Observation
TP-10[2]	E1030, N1100	4/4/90	Buried metal	Black cinders and ash with VOCs and oily sheen
TP-10A	E1030, N1100	5/4/90	see TP-10	see TP-10
TP-11[2]	E1010, N1075	4/4/90	Buried metal/conductive anomaly	Metallic debris in black cinders and ash
TP-11A	E1010, N1075	5/4/90	see TP-11	see TP-11

NOTES:
(1) Original location at E1075, N1125
(2) Sample VOA holding time exceeded by laboratory; resampled with split spoon sampler on 5/4/90.

TABLE 7-4

ROCHESTER FIRE ACADEMY
SURFACE SOIL SAMPLE SUMMARY

Sample	Location	Date	Description	Collection Method(1)	Type of Survey Anomaly
SS-01	E2650, N950	4/5/90	Brown silt and fine sand	S.S.G.S.	No anomaly - location beyond limits of fill
SS-02	E2550, N1000	4/5/90	Black silty fine sand with organic-rich fill	S.S.G.S.	TOVs (0.9 ppm)
SS-03	E2480, N975	4/5/90	C and D black fill adjacent to drum	S.S.G.S.	Exposed drums
SS-04	E2500, N1100	4/5/90	Brown medium sand (foundry sand)	S.S.G.S	TOVs (0.9 ppm)
SS-05	E2300, N1100	4/5/90	Black gravel and silt fill	S.S.G.S.	TOVs (10 ppm)
SS-06(2)	E2175, N1050	4/6/90	Black gravel and oily fill	S.S.G.S.	TOVs (70 ppm)
SS-07(2)	E2200, N900	4/6/90	Black gravel fill	S.S.G.S.	TOVs (3.0 ppm)
SS-08	E2100, N950	4/6/90	Saturated black gravel fill	S.S.G.S.	TOVs (1.1 ppm)
SS-09(3)	E1900, N750	4/6/90	Saturated gray/brown silt	S.S.G.S.	TOVs (0.8 ppm)
SS-10(2), (3)	E1800, N900	5/3/90	Firm brown silt, some gravel	S.S.	TOVs (15 ppm)
SS-11	E1850, N950	5/3/90	Dense brown silt, fine sand, gravel	S.S.	TOVs (22 ppm)
SS-12(2)	E1800, N1000	5/3/90	Gray gravel fill with some fine sand, diesel fuel odor	S.S.	TOVs (3.0 ppm)
SS-13	E1800, N1150	5/3/90	Railroad ballast material, black cindery material, some coal, fragments, dry, no odor	S.S.	TOVs (0.8 ppm)
SS-14	E1750, N750	5/3/90	Dark brown silt, sand gravel, moist	S.S.	TOVs (0.8 ppm)
SS-15(3)	E1600, N700	5/7/90	Organic-rich, dark brown silt	S.S.G.S.	TOVs (5.0 ppm)
SS-16	E1550, N900	5/3/90	Dense, black, gravely, asphalt-like material, dry	S.S.	TOVs (2.0 ppm)

(continued)

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TABLE 7-4

ROCHESTER FIRE ACADEMY
SURFACE SOIL SAMPLE SUMMARY

Sample	Location	Date	Description	Collection Method(1)	Type of Survey Anomaly
SS-17	E1250, N900	5/7/90	Organic rich, dark brown silt	S.S.G.S.	TOVs (1.2 ppm)
SS-18	E1300, N950	5/3/90	Firm brown, silt, trace clay, moist	S.S.	TOVs (0.6 ppm)
SS-19	E1100, N1050	5/4/90	Brown firm silt	S.S.	TOVs (4.4 pm)
SS-20	E1000, N1000	5/4/90	Brown fine sand	S.S.	TOVs (2.5 ppm)
BKGD(4)	E1244, N1905	5/3/90	Brown silt	S.S.G.S.	No anomaly, background samples

NOTES:

TOVs: Elevated organic vapors detected during soil gas survey.
(1) Collection method:
S.S.G.S. - Stainless steel grab sampler and stainless spoon.
S.S. - Split spoon sampler
(2) 2,3,7,8 tetrachlorodibenzo-p-dioxin sample also collected.
(3) MS and MSD samples collected.
(4) Background value for metals and 2,3,7,8 tetrachlorodibenzo-p-dioxin only.

TABLE 7-5

ROCHESTER FIRE ACADEMY
SOIL BORING SAMPLE SUMMARY

Boring No.	Location	Depth to Saturated Zone	Head Space Analysis Max HNu Reading	Description	Sample Collection Date	Type of Survey Anomaly
B-1	E2500, N1050	4.0	1.4	Organic rich fill	5/1/90	TOVs (5.1 ppm)
B-2	E2200, N1025	2.0	500	Black gravelly, oily fill	5/2/90	TOVs (300 ppm)
B-3	E2100, N800	3.2	45	Gray brown sandy fill	5/2/90	TOVs
B-4	E1850, N850	2.0	50	Black gravelly oily fill	5/2/90	TOVs (17 ppm)
B-5	E1350, N850	2.2	BKGD	Organic rich dark brown silt	5/4/90	Conductive Soil/Fill
B-6	E1050, N1050	2.2	20	Black cindery material	5/4/90	TOVs (13 ppm)
B-7	E1050, N1150	2.3	1.4	Brown silt fill	5/4/90	TOVs (5.4 ppm)
B-8	E2036, N797	4.0	8.0	Brown silt/fine sand; some black staining	5/2/90	TOVs and discoloration of surficial soil
MW-13S	E1700, N1038	2.2	1.8	Black ash; gravel fill	5/1/90	TOVs (8 ppm)
MW-14S	E2249, N1001	4.0	200	Gravel fill; hydrocarbon odor	4/30/90	TOVs (90 ppm)
MW-15S	E2038, N768	4.0	1.8	Gray/brown sand	5/1/90	see B-8

NOTE:
BKGD - Background Value
TOVs - Elevated total organic vapors detected during soil gas survey.

in accordance with the procedure given in the Work Plan prior to submittal for chemical analysis. However, each sample submitted for volatile organic analysis was from the discrete split spoon sample, which exhibited the highest reading on an HNu photoionizing detector. A summary of soil boring information is presented in Table 7-5. Soil boring locations are shown in Figure 7-1.

7.1.2 Sediment Sampling

A total of 10 sediment samples were analyzed for the parameters identified in Table 7-1. Two (2) sediment samples were collected from on-site drainage swales. One swale originates in the North Disposal area (sample SWSD-1). This sediment is described as a brown organic rich silt. A second swale originates in the South Disposal area (sample SWSD-2). This sediment is described as a brown, silty fine sand, with a trace of organic matter.

Four (4) Genesee River sediment samples were collected during each of two (2) sampling rounds at four (4) sampling stations (designated GRS-1 to GRS-4). These include an upstream and downstream sampling stations and two (2) stations immediately adjacent to the study area (intermediate stations) all within five (5) feet of the shoreline. River sediment samples consisted of a fine to medium sand with a trace of admixed organic matter. Sediment sampling stations are shown in Figure 7-1. River sediment samples were collected with a stainless steel Ponar Grab Dredge in accordance with the protocols described in the RI Work Plan. Table 7-6 summarizes sediment sampling information.

7.1.3 Ground Water Sampling

The 21 monitoring wells installed during the RI were sampled on two (2) occasions, May 1990, and August 1990. Monitoring parameters for the May and August sampling rounds are listed in Table 7-1. After performance of a data validation, the NYSDEC required confirmation of organic analytical data and requested that 10 monitoring wells be resampled exclusively for the Round 3 parameters listed in Table 7-1. The supplemental sampling event was conducted in October 1990 at wells MW-6I, MW-7S and MW-7-I, MW-8S and MW-8I, MW-11S and MW-11I, MW-12S and MW-12I, MW-15S.

TABLE 7-6

CITY OF ROCHESTER
ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF SURFACE WATER/SEDIMENT SAMPLES

Sample No.	Location	Description
SEDIMENT SAMPLES		
SWSD-1	E2450, N850	Swale sediment from north disposal area.
SWSD-2	E1465, N800	Swale sediment along bike path.
GRS-1	Offsite upstream	Genesee River sediment
GRS-2	E1150, N805	Genesee River sediment
GRS-3	E2060, N830	Genesee River sediment
GRS-4[(1)]	Offsite downstream	Genesee River sediment
SURFACE WATER SAMPLES		
SWSW-1	E2450, N850	Swale surface water from North Disposal Area
SWSW-2	E1465, N800	Swale surface water along bike path from South Disposal Area
PS-1	E2720, N1010	Pond sample of North Disposal Area
PS-2	E2320, N900	Pond sample from Training Water Grounds
PS-3	E990, N1100	Pond sample from South Disposal Area
GRW-1	Off-site upstream	Genesee River water
GRW-2	E1150, N805	Genesee River water
GRW-3	E2060, N750	Genesee River water
GRW-4[(1)]	Offsite downstream	Genesee River water

NOTE: [(1)] MS and MSD sample collected.

Well locations are shown in Figure 7-2 . The screened interval for each well is discussed in Section 5.1.1. Each well was purged and sampled in accordance with procedures identified in the RI Work Plan.

7.1.4 Surface Water Sampling

A total of nine (9) surface water samples were collected during the May 1990 sampling event. Five (5) surface water samples were collected from three (3) on-site ponds and two (2) drainage swales. On-site pond sampling locations include a) a surface depression approximately 125 feet north of the North Disposal area (sample PS-1), b) the drainage retention basin in the Training Grounds area (sample PS-2), and c) the southernmost pond in the South Disposal area (sample PS-3). It should be noted that PS-1 also receives surface runoff from the Rochester Greater International Airport across Scottsville Road via a stormwater sewer.

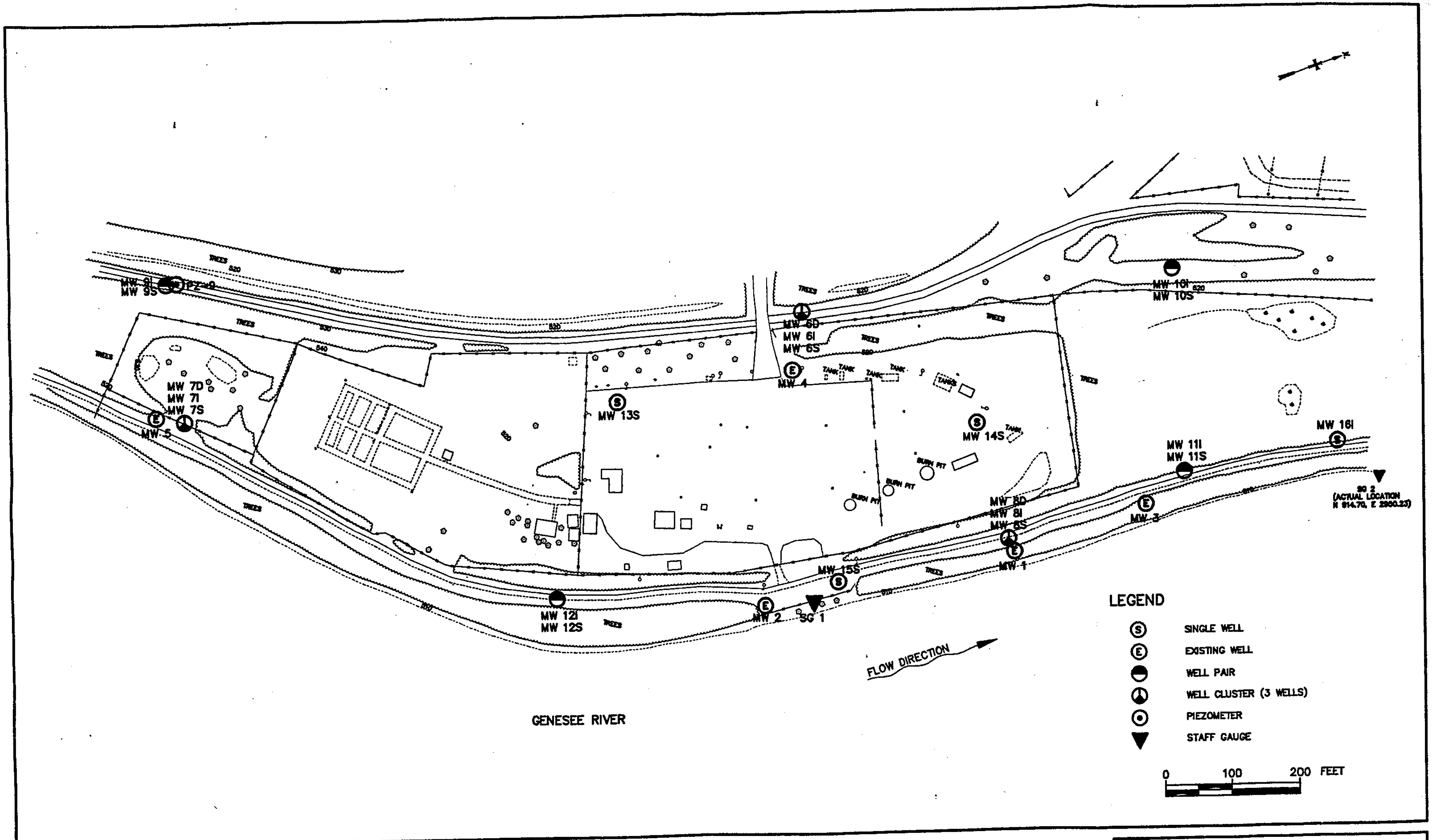
Two (2) surface water drainage samples were collected during the May 1990 sampling event at swale sediment sampling locations SWSD-1 and SWSD-2 (water samples designated SWSW-1, and SWSW-2, respectively). Both drainage swales were dry during the August sampling event.

A total of four (4) surface water samples (designated GRW-1 to GRW-4) were collected from the Genesee River at river sediment sampling locations GRS-1 to GRS-4 during the May 1990 sampling event.

Surface water sampling locations are shown in Figure 7-1. All samples were analyzed for the parameters identified in Table 7-1. Surface water samples are summarized in Table 7-6.

7.2 ANALYTICAL RESULTS FOR SOIL/FILL

The soil/fill analytical results for those parameters detected above analytical detection limits are presented in Tables 7-7 to 7-17. A discussion of the character and magnitude of contamination found in each area is presented below. The soil/fill sampling locations in each of these areas are shown on Figure 7-1. For the purpose of this discussion,



ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS
MONITORING WELL
LOCATIONS

CITY OF ROCHESTER

MARCH 1991

MALCOLM PIRNIE

ROC-04-F72

the Rochester Fire Academy site has been divided into the following areas:

- North Disposal Area
- Training Grounds Area
- Firing Range Area
- South Disposal Area
- Genesee Valley Park Area
- Genesee Valley Canal Area.

7.2.1 North Disposal Area

Surficial soil samples SS-1 to SS-4, test pit samples TP-1 to TP-5, and shallow boring sample B-1 were collected in the North Disposal Area. Analytical results for these locations are summarized on Table 7-7.

Within the North Disposal Area is an approximately 1.4-acre area of fill. A distinct berm is present along the west side of this fill, where empty rusting drums are exposed. As illustrated on Figure 7-3, fill thickness thins to less than 1 foot along the east and north sides. Based on observations made during sampling, fill material in the North Disposal Area is comprised of 2 to 3 feet of construction and demolition debris, metal drums (currently empty, crushed and/or decomposed), foundry sand, refractory bricks, and admixed soil material. Exclusive of TP-1 and SS-1, all samples were collected from the fill material. TP-1 and SS-1 were collected from native soil at locations beyond the visual boundary of the fill.

The magnitude of inorganic contamination in the North Disposal Area is the highest of the six (6) areas investigated. Organic contamination, however, is present at only low to trace concentrations.

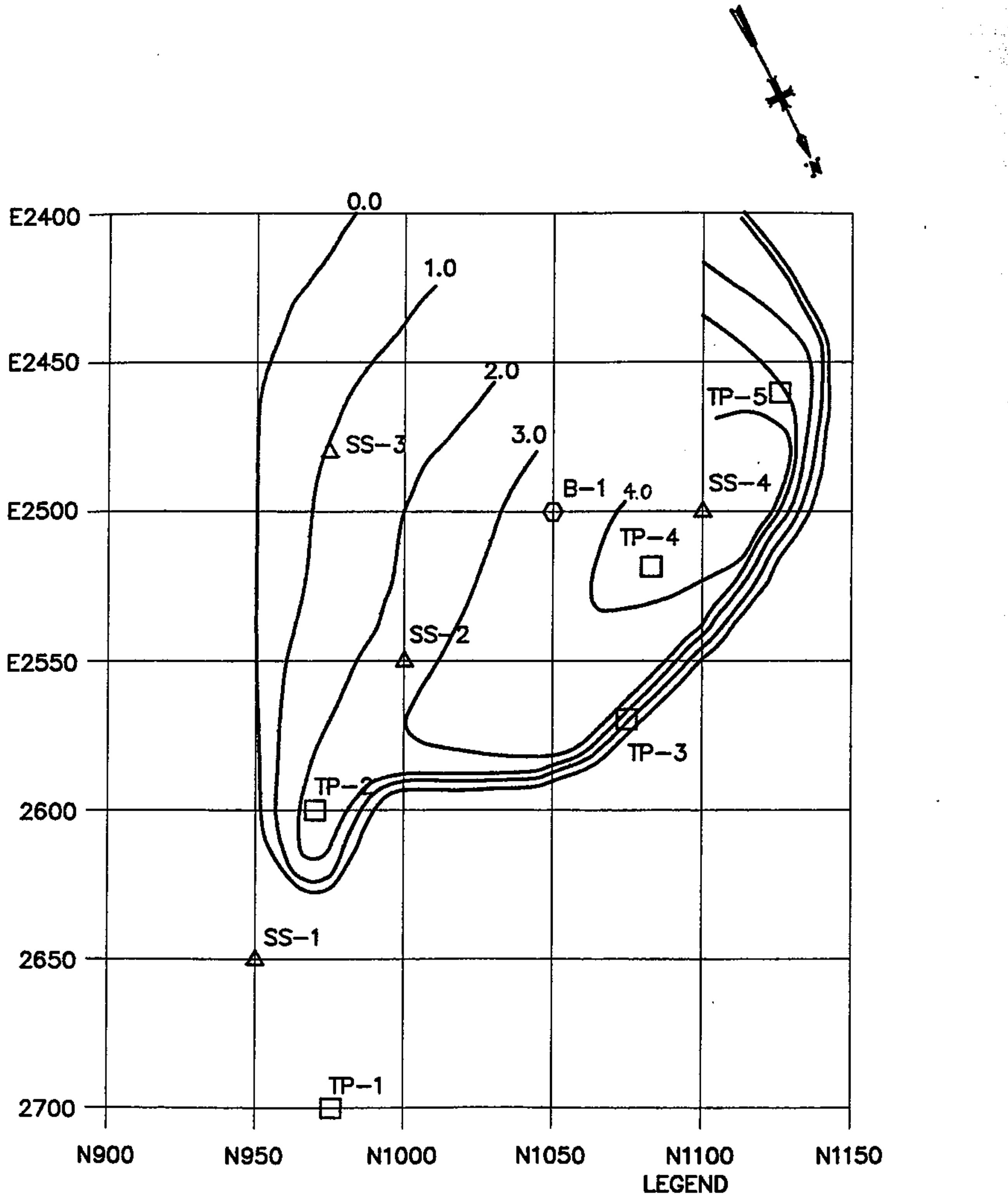
Organic Parameters - Low to trace concentrations of volatile organics, PAHs, phthalates, and PCBs appear to occur throughout the fill material. Organic contamination detected in samples from the fill material in the North Disposal Area are summarized on the following table as total volatile organics (TVO), total polycyclic aromatic hydrocarbons (PAHs), total phthalate esters (PHTHALs), phenolic compounds (ACIDs), and other semi-volatile organics (OTHERs), in mg/Kg (dry weight basis). The term trace (tr) is used where the sum of all specific compounds in a category is less than 1 mg/kg.

TABLE 7-7
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
SUMMARY OF ANALYTES DETECTED IN SURFICAL AND SUBSURFACE SOILS OF NORTH DISPOSAL AREA

SAMPLE NUMBER	SS-1	SS-2	SS-3	SS-4	TP-1	TP-2	TP-3	TP-3A	TP-4	TP-5	B-1
SAMPLE DEPTH (1)	0-.5'	0-.3'	0-.4'	0-.3'	1.5'	2.5'	2'	2'	1.4'	2'	0-4'
PARAMETER (2) (3) (4)											
Volatiles (mg/kg)											
Methylene Chloride	0.006 B	0.007 B	0.007 B	0.006 B	0.013 B	0.017 B	0.013 B	0.031 B	0.023 B	0.026 B	0.006 B
Acetone	0.012 B	0.013 B	0.013 B	0.012 B	0.018 B	0.020 B	0.030 B	0.011 B	0.050 B	0.014 B	0.017 B
1,1-Dichloroethane	0.010								0.002 J		
1,2-Dichloroethene (total)	0.041						0.002 J				0.005 J
Chloroform									0.002 J		
1,2-Dichloroethane	0.001 J										
1,1,1-Trichloroethane	0.004 J					0.002 J	0.001 J		0.006 J	0.002 J	
Trichloroethene			0.004 J	0.014		0.042	0.063	0.020	0.021	0.009	0.019
Benzene											
Tetrachloroethene	0.005 J		0.007 J	0.006 J		0.036	0.10	0.039	0.004 J	0.012	0.004 J
1,1,2,2-Tetrachloroethane						0.001 J	0.001 J				
Toluene	0.002 J					0.002 J				0.012	0.003 J
Chlorobenzene						0.001 J					
Semi-Volatiles (mg/kg)											
bis(2-chloroisopropyl)ether						0.12 J	0.28 J			0.34 J	
Isophorone										0.17 J	
Benzoic Acid					0.25 J	0.20 J					
Naphthalene						0.18 J	0.30 J	0.035 J		0.41 J	
2-Methylnaphthalene				0.26 J		0.17 J	0.61 J	0.053 J		1.7	
Dimethylphthalate				0.15 J							
4-Nitrophenol						0.16 J					
Diethylphthalate				0.094 J		0.23 J		0.54 J			0.040 J
Phenanthrene		0.19 J	0.10 J	0.22 J		0.94		0.32		0.42 J	
Anthracene				0.24 J		0.15					
Di-n-butylphthalate				0.64		3.0		0.26 J	0.12 J		0.39 B
Fluoranthene		0.42 J	0.20 J	0.27 J		0.88					
Pyrene		0.31 J	0.13 J	0.29 J		1.2				0.13 J	
Butylbenzylphthalate				0.68	0.11 J	1.3		0.54 J			
Benzo(a)anthracene		0.21 J		0.14 J							
Chrysene		0.26 J	0.10 J	0.21 J		0.59					
Bis(2-ethylhexyl)phthalate	0.43 B	0.49 B	0.47 B	2.1	0.41 B	7.3		1.5 B	0.57 B	0.98 B	0.39 B
Di-n-octylphthalate										0.15 J	
Benzo(b)fluoranthene				0.16		0.24 J					
Benzo(k)fluoranthene				0.20 J		0.50					
Benzo(a)pyrene		0.17 J				0.50					

TABLE 7-7 (cont)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
SUMMARY OF ANALYTES DETECTED IN SURFICAL AND SUBSURFACE SOILS OF NORTH DISPOSAL AREA

SAMPLE NUMBER	SS-1	SS-2	SS-3	SS-4	TP-1	TP-2	TP-3	TP-3A	TP-4	TP-5	B-1
SAMPLE DEPTH (1)	0-.5'	0-.3'	0-.4'	0-.3'	1.5'	2.5'	2'	2'	1.4'	2'	0-4'
PARAMETER (2) (3) (4)											
Pesticide/PCBs (mg/kg)											
Aroclor-1254				10							
Aroclor-1260		0.162				7.4	4.1	9.7			0.49
Inorganic Elements (mg/kg)											
Aluminum	15300	7950	11200	4280	12800	9310	3430		8750	11000	13900
Antimony				12		22.8 J					17 J
Arsenic	5.9	12.4	15.5	41.9	5.8	14.6	8.3		50	69	18.6
Barium	75.4	1220	4160	490	49.9	1170	286		1690	787	581 J
Beryllium	0.54 J		412		0.50 J					0.41 J	0.48 J
Cadmium	0.33	2.6 J	5.1 J	19.7 J		20.1 J	3.6 J		3.8 J	3.2 J	9.4
Calcium	2080	49200	54300	32600	761 J	59600	27900		67900	36800	25000
Chromium	17	36.1	37.5	340	15.1	227	105		42.2	41.4	46.8
Cobalt	11.3 J	7.7 J	50	5.80 J	11.3 J	9.7 J	4.2 J		8.50 J	9.1 J	21
Copper	14.7	426	51700	56	12.7	14000	29.8		167	110	156
Iron	23700 J	32000 J	26100 J	10300 J	21900 J	38800 J	8540 J		19800 J	22800 J	106000
Lead	16.2	3220	7860	3080		4260	830		4310	3160	1470.
Magnesium	3740	11500	13200	11700	3680	16000	6800		14400	12200	7090
Manganese	384 J	443 J	449 J	248 J	381 J	624 J	287 J		443 J	664 J	1070 J
Mercury	0.43	0.39	0.30	0.49	0.12	1.6	0.16		0.73	0.30	0.66 J
Nickel	20.8	15.9	28.9	10.3	20.4	48.4	8.5		26	22.8	46
Potassium	1090 J	1300 J	1650	894 J	951 J	874 J	659 J		1700	1450	1950
Selenium		1.0	3.2	8.1		4.90 J	1.0 J		0.62 J		1.1
Silver			47.6	5.3		2.4 J	3.1				1.30 J
Sodium	67.9 J	349 J	537 J	123 J	52.3 J	308 J	99 J		345 J	258 J	180 J
Thallium									0.55 J		
Vanadium	23.8	24	34.4	11 J	20.7	25.1	10.6		32.8	33.1	31.7
Zinc	68 J	1690 J	6190 J	470 J	54.4 J	3750 J	246 J		2020 J	1000 J	672 J



LEGEND

- □ TEST PIT
- △ SURFICIAL SOIL SAMPLE
- ○ SOIL BORING
- 1.0—— APPROXIMATE FILL THICKNESS CONTOUR

SCALE 1"=50'

MALCOLM PIRNIE

ROC-04-F73

ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS
FILL THICKNESS IN THE NORTH DISPOSAL AREA

CITY OF ROCHESTER

MARCH 1991

Location	TVO	PAHs	PHTHALs	PCBs	Others
SS-2		1.6		tr	
SS-3	tr	tr			
SS-4	tr	2.0	3.7	10	
TP-3	tr	tr		4.1	tr
TP-3A	tr	tr	1.3	9.7	
TP-4	tr		tr		
TP-5	tr	2.7	tr		tr
B-1	tr		tr	tr	

Organic contamination detected in samples of native soil from beyond the limits of the fill are summarized in the following table:

Location	TVO	PAHs	PHTHALs	PCBs	OTHERs
SS-1	tr				
TP-1			tr		tr

Trace concentrations (maximum 0.063 mg/Kg) of volatile organics (most notably tetrachloroethene and trichloroethene) were found at all soil/fill sampling locations except SS-2 and TP-1. Sampling results for the native soil at SS-1 indicate that volatile organics may be present at trace concentrations beyond the limits of the fill. Sample location SS-1 is approximately 25 feet from the fill limits (see Figure 7-3). The occurrence of only trace concentrations of volatile organics in the fill in this Area is in agreement with the findings of the soil gas survey, which indicated low to nondetectable concentrations (ND to 5.1 ppm) of total organic vapors.

Trace to low concentrations of eleven polycyclic aromatic hydrocarbons (PAHs) were detected in six of eight sampling locations in the fill material. The highest PAH concentrations (1.2 mg/Kg pyrene, and 1.7 mg/Kg 2-methylnapthalene) occurred in TP-2 and TP-5, respectively. Trace to low concentrations of six (6) phthalate esters were detected including a maximum phthalate concentration of 7.3 mg/Kg bis(2-ethylhexyl)phthalate at TP-2.

Trace to low concentrations of PCB Aroclor 1254 (not detected above 10 mg/Kg) and Aroclor 1260 (0.16 to 9.7 mg/Kg) were found in six of eight samples from the fill material.

Inorganic Parameters - Metal concentrations in the soil/fill samples from the North Disposal Area are compared in Table 7-8 to concentrations occurring in off-site background soil (at BKGD), and also to the range of naturally occurring concentrations of metals in soils reported in the literature. Mean values of cadmium, copper, lead, and silver in fill samples from the North Disposal Area sampling locations are relative to mean concentrations reported in the literature by a factor greater than 100. Mean concentrations of arsenic, barium, beryllium, cobalt, mercury, selenium, and zinc are elevated relative to the literature means by factors ranging from 1.7 to 32. In addition, chromium, and nickel are also elevated above the offsite background concentrations, but not above literature values. A substantial iron concentration of 10.6% was detected in the fill material at B-1.

The distribution of metals throughout the North Disposal Area is highly variable with only cadmium, lead,and zinc being detected at elevated concentrations at every sampling location within the fill material.

However, sampling results indicate that inorganic contamination may be limited to the extent of the fill, which is shown on Figure 7-3. Evidence of this is based upon the sampling results at sampling locations SS-1 and TP-1, where only native soil was encountered. The concentrations of inorganics in these latter samples are similar to background concentrations determined at sampling location BKGD.

7.2.2 Training Grounds Area

The Training Grounds Area encompasses approximately 6 acres. A large portion of the Area has been used for fire fighting training purposes involving the controlled burning of a variety of fuel oils. The north end of the Area is occupied by fuel oil storage tanks and burn pits. The burn pits are supplied with fuel from the storage tanks via an underground transmission line. Water used in training exercises at the burn pits is currently collected in the retention pond at PS-2. Based on historic aerial photography, past practices allowed water to drain out of the Training Grounds to the Genesee River in the vicinity of MW-15S. Surficial soil samples SS-6, SS-7, SS-8, shallow boring samples B-2 and MW-14S were

TABLE 7-8

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

COMPARISON OF INORGANIC CONCENTRATIONS TO NATURAL SOILS, NORTH DISPOSAL AREA

	CONCENTRATIONS OF INORGANIC PARMETERS DETECTED ON-SITE (mg/kg)				CONCENTRATIONS OF INORGANICS IN NATURAL SOILS (mg/kg) (1)		
PARAMETER	CONCENTRATION RANGE	MEAN	BACKGROUND CONCENTRATION	# OF OCCURENCES ABOVE BKGD. / # OF SAMPLES	COMMON RANGE	COMMON MEAN	RATIO OF ON-SITE MEAN TO LITERATURE MEAN
Inorganic Elements							
Aluminum	3430 - 15300	9792	18500	0/11	10000 - 300000	71000	.1
Antimony	BDL - 22.8	17	<11	3/11	<1 - 8.8 (2)	0.8	
Arsenic	5.8 - 69	24	2.8	10/11	1 - 50	5	4.8
Barium	49.9 - 4160	1051	120	8/11	100 - 3000	430	2.4
Beryllium	0.41 - 412	42	0.58	1/11	0.1 - 40	6	6.9
Cadmium	0.33 - 20.1	7.5	<0.21	9/11	0.01 - 0.7	0.06	136
Calcium	761 - 67900	35164	40400	4/11			
Chromium	15.1 - 340	91	24.6	8/11	1 - 1000	100	.9
Cobalt	4.2 - 50	14	10.4	4/11	1 - 40	8	1.7
Copper	12.7 - 51700	6667	13.1	9/11	2 - 100	30	222
Iron	8540 - 106000	30994	25500	4/11			
Lead	16.2 - 7860	2821	<6.7	9/11	2 - 200	10	282
Magnesium	3680 - 16000	10031	11000	6/11	600 - 6000	5000	2
Manganese	248 - 1070	499	451	3/11	20 - 3000	600	.8
Mercury	0.12 - 1.6	0.52	<0.11	10/11	0.01 - 3.4 (2)	0.12	4.0
Nickel	8.5 - 48.4	25	21.7	5/11	5 - 500	40	.6
Potassium	659 - 1950	1259	3800	0/11			
Selenium	0.62 - 8.1	2.1	<0.42	7/11	0.1 - 2	0.3	7.1
Silver	1.3 - 47.6	12	<0.67	5/11	0.01 - 5	0.05	126
Sodium	52.3 - 537	232	229	5/11			
Thallium	BDL - 0.55	0.55	<0.42	1/11	2.2 - 23 (2)	8.6 (2)	.01
Vanadium	10.6 - 34	25	37.8	0/11	20 - 500	100	.3
Zinc	54.4 - 6190	1616	54.7	9/11	10 - 300	50	32

NOTES:

BDL - BELOW DETECTION LIMITS

(1) USEPA OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, HAZARDOUS WASTE LAND TREATMENT, SW-874 (APRIL, 1983).

(2) SHACKLETTE AND BOERNGEN (1984)

collected from this portion of the Training Grounds Area. Sample locations SS-5 and TP-6 are northwest of the storage tanks, near the boundary with the North Disposal Area.

The central portion of the Area is open and unoccupied. No notable anomalies were detected in the middle portion of the Training Grounds Area during the preliminary surveys.

The southern portion of the Area is occupied by 1 and 2 story structures used for burning during training exercises. Surficial soil samples SS-11 and SS-12 are located in an open area at soil gas survey anomalies with no apparent relationship to the training structures. Sample locations SS-10 and B-4 are in the vicinity of the frequently burned structures. Shallow boring MW-13S is located at a former offloading area for fuel oil drums. Test pit TP-8 encountered native soil on the periphery of the Training Grounds Area.

Currently, the Training Grounds Area is covered with approximately 3 to 6 inches of crushed stone. Potential sources of contamination include spills; leakage from oil storage tanks, drums or underground pipes; and the release of combustion by-products and discharge from the burn pits to the ground surface.

Materials underlying the crushed stone are described as a compact gravelly silt fill, which commonly exhibits a black discoloration (see Tables 7-3, 7-4, 7-5). A black, oily gravel fill was observed at locations SS-6, B-2, and B-4. All samples were collected from 0 - 6 inches or 0 - 12 inches beneath the base of the crushed stone layer.

The magnitude of the volatile organic, semi-volatile organic, and PCB contamination detected in soil samples collected in the Training Grounds Area, especially in the area of the fuel storage tanks, underground transmission line, and burn pits, is high relative to the other five (5) Areas investigated, with only the South Disposal Area exhibiting organic contamination of an equal or greater magnitude. Inorganic contamination consists principally of lead and cadmium. Analytical results for samples from the Training Grounds Area are summarized on Table 7-9.

Organic Parameters - The greatest magnitude of organic contamination was detected near the fuel storage tanks and the underground transmission line in the north portion of the Area. The contaminants detected in this vicinity are summarized below as total volatile organics (TVO), total polycyclic aromatic hydrocarbons (PAHs), total phthalate esters (PHTHALs), phenolic compounds (ACIDs), and other semi-volatile organics (OTHERs) in mg/Kg (dry weight basis):

[redacted]ABLE 7-9
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
SUMMARY OF ANALYTES DETECTED IN SURFICAL AND SUBSURFACE SOILS OF TRAINING GROUNDS

SAMPLE NUMBER	SS-5	SS-6	SS-7	SS-8	SS-10	SS-11	SS-12	TP-6	TP-8	B-2	B-4	MW-13S*	MW-14S*
SAMPLE DEPTH (1)	0-.3'	0-.3'	0-.3'	0-.3'	0-1'	0-1'	0-1'	0-2'	0-3'	0-2'	0-2'	0-2'	0-4'
PARAMETER (2) (3) (4)													
[redacted]latiles (mg/kg)													
[redacted]ethylene Chloride	0.006 B	1.6 B	0.006 B	0.10 B	0.011 B	0.006 B	0.010 B	0.023 B	0.007 B	7.0 B	0.79 B		1.9 B
Acetone	0.013 B		0.013 B		0.031 B	0.096 B	0.012 B	0.055 B		14.0 B		0.029 B	
1,1-Dichloroethane			0.019										
[redacted]2-Dichloroethene (total)			0.007										
[redacted]loroform			0.002 J										
2-Butanone						0.011 J			0.01 J				
Trichloroethene						0.001 J							
[redacted]enzene		0.89 J											
[redacted]etrachloroethene							0.001 J						
Toluene		210					0.001 J	0.006 J		350			13
[redacted]lorobenzene								0.005 J					
[redacted]hylbenzene		3.2								26			5
Total Xylenes		210								173	0.78 J		35
[redacted]mi-Volatiles (mg/kg)													
[redacted]-Methylphenol										13 J			
Isophorone								0.27 J					
2-Nitrophenol								0.12 J					
[redacted]enzoic Acid			0.12 J										
[redacted]aphthalene		2.2 J								100			
2-Methylnaphthalene		4.6 J								150	4.4		0.42
[redacted]imethylphthalate											0.091 J		
[redacted]cenapthylene							9.4 J				0.43 J		
Acenaphthene											2.0 J		
Dibenzofuran											0.46 J		
[redacted]ethylphthalate		1.4 J					8.0 J	0.21		29	0.32 J		
[redacted]uorene										11	2.3		
4-Nitroaniline											1.1 J		
4,6-Dinitro-2-Methylphenol											2.4 J		
[redacted]-nitrosodiphenylamine								0.043 J					
[redacted]entachlorophenol					0.18 J	1.4 J							
Phenanthrene	0.39 J	1.2 J	0.096 J		0.036 J	0.064 J	7.6 J		0.38 J	38	4.6		0.22 J
[redacted]thracene	0.086 J									110			
[redacted]-n-butylphthalate	0.046 J	3.2 J	0.12 J		0.37 B	0.35 B	9.7 J	0.098 J		77	0.42 B		0.15 J
Fluoranthene	0.86		0.13 J						0.42 J				0.11 J
Pyrene	0.77	0.79 J	0.31 J				4.6 J		0.40 J				0.10 J
[redacted]tylbenzylphthalate		19	0.087 J							120			0.17 J
[redacted]3'-Dichlorobenzidine			0.44										
Benzo(a)anthracene	0.55								0.17 J				
Chrysene	0.62								0.22 J				
[redacted]s(2-ethylhexyl)phthalate	0.43 B	53	1.2 B	0.37 B	0.37 B	0.35 B		0.47 B	0.48 B	720	1.3 B	0.39 B	5.7
[redacted]enzo(b)fluoranthene	0.63												
Benzo(k)fluoranthene	0.54												
[redacted]enzo(a)pyrene	0.63												
[redacted]deno(1,2,3-cd)pyrene	0.47												
Dibenz(a,h)anthracene	0.17 J												
Benzo(g,h,i)perylene	0.58												

TABLE 7-9 (cont)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
SUMMARY OF ANALYTES DETECTED IN SURFICAL AND SUBSURFACE SOILS OF TRAINING GROUNDS

SAMPLE NUMBER	SS-5	SS-6	SS-7	SS-8	SS-10	SS-11	SS-12	TP-6	TP-8	B-2	B-4	MW-13S*	MW-14S*
SAMPLE DEPTH (1)	0-.3'	0-.3'	0-.3'	0-.3'	0-1'	0-1'	0-1'	0-2'	0-3'	0-2'	0-2'	0-2'	0-4'
PARAMETER (2) (3) (4)													
Pesticide/PCBs (mg/kg)													
Aroclor-1254										10			21
Aroclor-1260			31	0.30	0.11	0.024	1.7	2.4			0.14		
Inorganic Elements (mg/kg)													
Aluminum	8050	3640	5350	2270	10400	10600	4310	4610	11900	3760	4990	6470	7840
Antimony		12.5 J					12.8 J						12.3 J
Arsenic	4.1	3.9	3.5	3.8	6.2	4.7	4.0	6.7	8.3	3.6	3.9	3.6	8.8
Barium	55.3	63.5	75.5	12.1 J	49.5	45 J	18.3 J	38.5 J	56.9	55.9 J	64.6 J	19.5 J	47.6 J
Beryllium	0.28 J				0.39 J	0.40 J	0.24 J		0.35 B		0.22 J	0.24 J	0.32 J
Cadmium	0.74 J	2.5 J	5.0 J	0.73 J	0.28 J	0.42 J	1.3	11.9 J		0.62 J	0.22 J		0.26 J
Calcium	39600	106000	112000	156000	78700	65300	153000	93800	5250	149000	105000	48100	89700
Chromium	11.5	42.6	62.1	6.3	14.1	14.1	7.7	12.2	14.8	27.1	17.6	8.1	12.2
Cobalt	5.5 J	3.2 J	31.3		6.2 J	6.90 J	3.30 J	4.8 J	9.1 J	3.9 J	4.4 J	6.7 J	5.2 J
Copper	22.8	55.6	29.8	13.8	11.8	8.0	6.6	66.6	14.9	17.4	188	14.3	32.1
Iron	12600 J	7610 J	9970 J	5990 J	17700	14400	8100 J	10900 J	20900 J	7750 J	11300 J	13200 J	16200 J
Lead	73.5	384	555	46	19.5	8.4	19.9	136	16.2	202	107	8.4	42.6
Magnesium	13700	51500	31200	80200	39800	25400	63500	49900	4660	61800	43200	16300	40400
Manganese	353 J	204 J	228 J	229 J	380	300 J	239 J	264 J	336 J	245 J	250 J	166 J	326 J
Mercury	0.2							0.23	0.21				
Nickel	7.5 B	7.1 B	11.5		14.3	10.4	5.8 B	14.4	18.9	4.2 B	42	10.1	12.1
Potassium	1290	1700	1740	1300	2020	2270	1690	2030	1560	1580	2150	988 J	1820
Selenium		0.47						0.78 J					
Silver													
Sodium	108 J	122 J	169 J	167 J	221 J	167 J	152 J	146 J	81.2 J	156 J	212 J	92.4 J	148 J
Thallium						0.53 J		0.78 J					
Vanadium	18.4	8.0 J	15.4	7.1 B	20.7	20	10.2 J	9.5 J	24	8.1 J	7.1 J		14.7
Zinc	114 J	118 J	165 J	33.1 J	47.8 J	33.3 J	36.7 J	97.5 J	58.5 J	53 J	224 J	36.5 J	53.5 J

NOTES:

(1) Depth below ground surface
(2) Only those analytes found above analytical detection limits at a minimum of one location are presented.
(3) Laboratory Qualifers: B - Estimated detection limit due to blank contamination,
J - Estimated value due to limitations identified during the quality control review.
(4) All results based on mg/kg dry weight of soil
* Soil samples collected before monitoring well installation.

Location	TVO	PAHs	PHTHALs	PCBs	ACIDs	OTHERs
SS-6	424	8.8	77			
B-2	549	409	946	10	13	
MW-14S	53		6	21		

At these locations the volatile organics were benzene, toluene, ethylbenzene, and total xylenes, which comprise the volatile fraction of gasoline and other fuels. An occurrence of free product containing aromatic and chlorinated hydrocarbons and PCBs was sampled from the well installed in boring MW-14S (see Section 7.3.1.2). The soil contamination appears to be principally associated with spills near the fuel storage tanks and leakage from the underground transmission line that services the burn pits.

Location SS-7, which receives water discharged from the burn pits, exhibited PCBs (31 mg/Kg Aroclor 1260) and trace concentrations of several chlorinated hydrocarbons. No organic contaminants were detected at SS-8, which is up-slope from the burn pits.

Locations SS-5 and TP-6, which are northwest of the fuel storage area, exhibited low concentrations of PAHs and chlorinated hydrocarbons. Field evidence of contamination at these locations include blackened gravel fill, a partially buried drum, and total organic vapors above background.

The sum of the organic contaminants in the south portion of the Training Grounds Area are summarized below (in mg/Kg, dry weight basis). The term "trace" (tr) is used where the sum of all specific compounds in a category is less than 1 mg/Kg.

Location	TVO	PAHs	PHTHALs	PCBs	ACIDs	OTHERs
SS-10		tr		tr	tr	
SS-11	tr			tr	1.4	
SS-12	tr	22	18	tr		
B-4	tr	14	tr	tr	2.4	1.6
MW-13S						
TP-8	tr	1.7				

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The volatile organics detected in the southern portion of the Area consist of trace concentrations of chlorinated hydrocarbons and total xylenes. Dibenzofuran and 4-nitroaniline were detected at concentrations below 1 mg/Kg. PAHs, phthalates, and PCBs are widespread, but occur only at low concentrations. No organic parameters were detected at boring MW-13S, which encountered a black ash over a gravel fill; and only low concentrations were detected at TP-8, which encountered native soil.

Surficial soils were analyzed for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) at SS-6, SS-7, SS-10, SS-12. Surficial soils at MW-15S and BKGD (outside of the Training Grounds Area) were also sampled for TCDD. No TCDD was detected in any sample at the detection limits reported in Table 7-10.

The most substantial concentrations of volatile organic, PAH, phthalate ester, and PCB contamination of soil/fill in the Training Grounds Area were found at three (3) sampling locations (SS-6, B-2, and MW-14S), which are in close proximity to the free product identified in monitoring well MW-14S.

Inorganic Parameters - Table 7-11 compares metal concentrations detected in Training Grounds soil/fill to off-site background levels and to literature values. Mean cadmium and lead concentrations are elevated above the mean of literature values. Cadmium concentrations greater than 1 mg/Kg were detected in SS-6, SS-7, SS-12, and TP-6. Lead concentrations greater than 200 mg/Kg were detected at SS-6, SS-7, and B-2. The concentrations of antimony detected at SS-6, SS-12, and MW-14S exceed the off-site background level and common range cited in the literature.

Inorganic contamination in the Training Grounds Area occurs at a lower magnitude than does the organic contaminants, however the organic and inorganic contamination occurs in association at the same sampling locations.

7.2.3 Police Obstacle Course and Firing Range Area

Surficial soil samples SS-16, and SS-18 were collected in the Firing Range Area. A summary of analytical results is presented on Table 7-12.

The Firing Range Area is in use as a police firing range and obstacle course. There is no documented history of waste disposal or fuel burning within the Area. Surficial soil samples were collected at two (2) low level soil gas survey anomalies (see Table 7-4).

TABLE 7-10
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF 2,3,7,8 Tetrachlorodibenzo-p-dioxin

SAMPLE NO.	CONCENTRATION (ug/kg)	DETECTION LIMIT (ug/kg)
SS-6	ND	0.074
SS-7	ND	0.13
SS-10	ND	0.035
SS-12	ND	0.035
MW-15S	ND	0.042
BKGD	ND	0.048

ND-NOT DETECTED

TABLE 7–11

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

COMPARISON OF INORGANIC CONCENTRATIONS TO NATURAL SOILS, TRAINING GROUND AREA

PARAMETER	CONCENTRATIONS OF INORGANIC PARMETERS DETECTED ON-SITE (mg/kg)				CONCENTRATIONS OF INORGANICS IN NATURAL SOILS (mg/kg) (1)		
	CONCENTRATION RANGE	MEAN	BACKGROUND CONCENTRATION	# OF OCCURENCES ABOVE BKGD. / # OF SAMPLES	COMMON RANGE	COMMON MEAN	RATIO OF ON-SITE MEAN TO LITERATURE MEAN
Inorganic Elements							
Aluminum	2270 - 11900	6476	18500	0/13	10000 - 300000	71000	.4
Antimony	BDL - 12.8	13	<11	3/13	<1 - 8.8 (2)	0.8	
Arsenic	3.5 - 8.8	5	2.8	13/13	1 - 50	5	1
Barium	12.1 - 64.6	46	120	0/13	100 - 3000	430	.1
Beryllium	0.22 - 0.40	0.27	0.58	0/13	0.1 - 40	6	.05
Cadmium	0.22 - 11.9	1.9	<0.21	11/13	0.01 - 0.7	0.06	31
Calcium	5250 - 156000	92419	40400	11/13			
Chromium	6.3 - 62.1	19	24.6	3/13	1 - 1000	100	.2
Cobalt	3.2 - 31.3	7.5	10.4	1/13	1 - 40	8	.9
Copper	6.6 - 188	37	13.1	11/13	2 - 100	30	1.2
Iron	5990 - 20900	12048	25500	0/13			
Lead	8.4 - 555	125	<6.7	13/13	2 - 200	10	13
Magnesium	4660 - 80200	40120	11000	12/13	600 - 6000	5000	8
Manganese	166 - 353	271	451	0/13	20 - 3000	600	.5
Mercury	BDL - 0.23	0.13	<0.11	3/13	0.01 - 3.4 (2)	0.12	1
Nickel	BDL - 42	12	21.7	1/13	5 - 500	40	.3
Potassium	988 - 2270	1703	3800	0/13			
Selenium	BDL - 0.78	0.49	<0.42	2/13	0.1 - 2	0.3	1.6
Silver	BDL		<0.67	0/13	0.01 - 5	0.05	
Sodium	92.4 - 221	149	229	0/13			
Thallium	BDL - 0.78	0.52	<0.42	2/13	2.2 - 23 (2)	8.6 (2)	.06
Vanadium	BDL - 24	13	37.8	0/13	20 - 500	100	.13
Zinc	33.1 - 224	83	54.7	6/13	10 - 300	50	1.7

NOTES:

BDL – BELOW DETECTION LIMITS

(1) USEPA OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, HAZARDOUS WASTE LAND TREATMENT, SW–874 (APRIL, 1983).

(2) SHACKLETTE AND BOERNGEN (1984)

TABLE 7–12
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
SUMMARY OF ANALYTES DETECTED IN SURFICAL AND SUBSURFACE SOILS
OF POLICE OBSTACLE COURSE AND FIRING RANGE AREA AND OFFSITE LOCATION*

SAMPLE NUMBER	SS–16	SS–18	SS–13	BKGD
SAMPLE DEPTH (1)	0–1'	0–1'	0–1'	0–1.2'
PARAMETER (2) (3) (4)				
Volatiles (mg/kg)				
Methylene Chloride	0.026 B	0.010 B	0.015 B	
Acetone	0.092 B	0.060 B	0.013 B	
2–Butanone	0.006 J			
Tetrachloroethene	0.001 J			
Toluene	0.006 J			
Semi–Volatiles (mg/kg)				
Naphthalene			0.85 J	
2–Methylnaphthalene			1.0 J	
Dibenzofuran			0.52 J	
Phenanthrene			2.6 J	
Anthracene			0.77 J	
Di–n–butylphthalate		0.38 B		
Fluoranthene	0.22 J		3.9	
Pyrene	0.29 J		3.4 J	
Benzo(a)anthracene			2.2 J	
Chrysene			4.1	
Bis(2–ethylhexyl)phthalate		0.38 B		
Benzo(b)fluoranthene			4.3	
Benzo(k)fluoranthene			3.9	
Benzo(a)pyrene			2.5 J	

* SS–13 collected in Genesee Valley Canal Area and BKGD sample collected off–site near entrance gate to Training Grounds (see Figure 7–1).

TABLE 7-12 (cont)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
SUMMARY OF ANALYTES DETECTED IN SURFICAL AND SUBSURFACE SOILS
OF POLICE OBSTACLE COURSE AND FIRING RANGE AREA AND OFFSITE LOCATION

SAMPLE NUMBER	SS-16	SS-18	SS-13	BKGD
SAMPLE DEPTH (1)	0-1'	0-1'	0-1'	0-1.2'
PARAMETER (2) (3) (4)				
Pesticide/PCBs (mg/kg)				
Aroclor-1254				
Aroclor-1260	0.56			
Inorganic Elements (mg/kg)				
Aluminum	3610	12800	2880	18500
Antimony			15.8 B	
Arsenic	2.6	4.7	11.9	2.8
Barium	18.1 J	69.9 J	48.4	102 J
Beryllium		0.33 J	0.30 J	0.58 J
Cadmium	0.30 J		0.25	
Calcium	161000	49100	18300	40400
Chromium	6.4	16	8.5	24.6
Cobalt	3.2 J	11.4	7.3	10.4 J
Copper	6.9	10.9	66	13.1
Iron	7470 J	21600 J	32100 J	25500 J
Lead	17.1		72.4	
Magnesium	26100	12300	9350	11000
Manganese	222 J	530 J	344 J	451 J
Mercury			0.12 J	
Nickel	7.6 J	21.6	11.4	21.7
Potassium	1270	2460	557 J	3800
Selenium				
Silver				
Sodium	134 J	176 J	79.2 J	229 J
Thallium			0.54 J	
Vanadium	12.4	30.8	10.1 J	37.8
Zinc	23.2 J	43.2 J	45.2 J	54.7 J

NOTES:

(1) Depth below ground surface

(2) Only those analytes found above analytical detection limits at a minimum of one location are presented.

(3) Laborartory Qualifers: B- Estimated detection limit due to blank contamination,
J- Estmated value due to limitions identified during the quality control review.

(4) All results based on mg/kg dry weight of soil

Organic Parameters - There were no organic contaminants detected at SS-18, which is located near the earthen berm constructed for the firing range. Sampling location SS-16, which is located near the obstacle course, exhibited trace concentrations of volatile organics (total concentration of 0.013 mg/Kg), PAHs (total PAH concentration of 0.51 mg/Kg), and PCBs (0.56 mg/Kg Aroclor 1260). The magnitude and character of organic contamination at the Police Obstacle Course is similar to the contamination detected in the south portion of the Training Grounds Area.

Inorganic Parameters - As shown in Table 7-13, metal concentrations detected in the Firing Range Area were not substantially above background concentrations as determined on the basis of a surficial soil sample collected off-site near the Training Grounds entrance gate (see Figure 7-1).

7.2.4 South Disposal Area

Surficial soil sample SS-19, test pit samples TP-9, TP-10/TP-10A, and TP-11/TP-11A; and shallow soil borings B-6 and B-7 were collected in the South Disposal Area. Analytical results are summarized on Table 7-14.

Approximately 0.6 acres of the South Disposal Area were formerly used for the open air incineration of waste materials. Sampling locations TP-10/10A, TP-11/11A, and B-6 are comprised primarily of incineration residue (cinders and ash). The underlying native soil is covered to a depth of one to three feet with this residue and noncombustible residue (glass, nails, springs, wire). Sampling locations SS-19, TP-9, and B-7 are comprised of native brown silt that has been previously excavated from within the South Disposal Area and now occurs in piles that are separate from the incineration residue. These samples exhibited soil gas survey anomalies.

Substantial concentrations of organic and inorganic contaminants were detected in samples from the South Disposal Area.

Organic Parameters - Organic contaminants detected in samples from the incineration residue at the South Disposal Area are summarized below as total volatile organics (TVO), total polycyclic aromatic hydrocarbons (PAHs), total phthalate esters (PHTHALs), phenolic compounds (ACIDs), and other semi-volatile organics (OTHERs)

TABLE 7-13

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

COMPARISON OF INORGANIC CONCENTRATIONS IN THE FIRING RANGE AREA TO NATURAL SOILS

PARAMETER	CONCENTRATIONS OF INORGANIC PARMETERS DETECTED ON-SITE (mg/kg)				CONCENTRATIONS OF INORGANICS IN NATURAL SOILS (mg/kg) (1)		RATIO OF ON-SITE MEAN TO LITERATURE MEAN
	CONCENTRATION RANGE	MEAN	BACKGROUND CONCENTRATION	# OF OCCURENCES ABOVE BKGD. / # OF SAMPLES	COMMON RANGE	COMMON MEAN	
Inorganic Elements							
Aluminum	3610 - 12800	8205	18500	0/2	10000 - 300000	71000	0.1
Antimony	BDL	-	<11	0/2	<1 - 8.8 (2)	0.8	
Arsenic	2.6 - 4.7	3.7	2.8	1/2	1 - 50	5	0.7
Barium	18.1 - 69.9	44	120	0/2	100 - 3000	430	0.1
Beryllium	BDL - 0.33	0.32	0.58	0/2	0.1 - 40	6	0.05
Cadmium	BDL - 0.30	0.27	<0.21	1/2	0.01 - 0.7	0.06	4.5
Calcium	49100 - 161000	105050	40400	2/2			
Chromium	6.4 - 16	11	24.6	0/2	1 - 1000	100	0.1
Cobalt	3.2 - 11.4	7.3	10.4	1/2	1 - 40	8	0.9
Copper	6.9 - 10.9	8.9	13.1	0/2	2 - 100	30	0.3
Iron	7470 - 21600	14535	25500	0/2			
Lead	BDL - 17.1	11.5	<6.7	1/2	2 - 200	10	1.1
Magnesium	12300 - 26100	19200	11000	2/2	600 - 6000	5000	3.8
Manganese	222 - 530	376	451	1/2	20 - 3000	600	0.6
Mercury	BDL	-	<0.11	0/2	0.01 - 3.4 (2)	0.12	
Nickel	7.6 - 21.6	14.6	21.7	0/2	5 - 500	40	0.4
Potassium	1270 - 2460	1865	3800	0/2			
Selenium	BDL	-	<0.42	0/2	0.1 - 2	0.3	
Silver	BDL	-	<0.67	0/2	0.01 - 5	0.05	
Sodium	134 - 176	155	229	0/2			
Thallium	BDL	-	<0.42	0/2	2.2 - 23 (2)	8.6 (2)	
Vanadium	12.4 - 30.8	21.6	37.8	0/2	20 - 500	100	0.2
Zinc	23.2 - 43.2	33.2	54.7	0/2	10 - 300	50	0.7

NOTES:

BDL - BELOW DETECTION LIMITS

(1) USEPA OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, HAZARDOUS WASTE LAND TREATMENT, SW-874 (APRIL, 1983).

(2) SHACKLETTE AND BOERNGEN (1984)

TABLE 7-14
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
SUMMARY OF ANALYTES DETECTED IN SURFICAL AND SUBSURFACE SOILS
OF SOUTH DISPOSAL AREA

SAMPLE NUMBER	SS-19	TP-9	TP-10A	TP-10	TP-11A	TP-11	B-6	B-7
SAMPLE DEPTH (1)	0-1'	0-6'	0-2'	0-2'	0-1'	0-1'	0-2'	0-2'
PARAMETER (2) (3) (4)								
Volatiles (mg/kg)								
Vinyl Chloride		0.061			3.0 B	0.23 J	0.27	
Chloroethane							0.11	
Methylene Chloride	0.024 B	0.006 B	2.3 B	0.83 B		1.4 B	0.76 B	0.009 B
Acetone	0.014 B	0.057 B				5.2	17	0.013 B
1,1-Dichloroethene		0.020					0.017 J	
1,1-Dichloroethane		0.16	7.5	1.3	26	4.2	1.3	
1,2-Dichloroethene (total)		0.091	44	12	250	14	0.33	
Chloroform		0.005 J	0.51 J				0.031	
1,2-Dichlorethane		0.043			1.6 J	0.53 J	0.19 J	
2-Butanone		0.018				4.9	7.9	
1,1,1-Trichloroethane		0.055		3.1	14	8.0	0.22	
Trichloroethene	0.015	0.006 J	110	12	58	7.1	0.019 J	
1,1,2-Trichloroethane		0.014						
Benzene		0.001 J					0.009 J	
4-Methyl-2-pentanone				2.8		2.6	3.5	
Tetrachloroethene	0.002 J	0.072	140	1.5	0.92 J		0.05	
1,1,2,2-Tetrachloroethane			1.5 J		1.3 J	3.5		
Toluene		0.023	1.4 J	5.3	4.3		0.41	
Ethylbenzene		0.006 J			0.82 J	0.28 J	0.16	
Total Xylenes		0.040		2.4	8.7 J	1.5 J	1.31	
Semi-Volatiles (mg/kg)								
Phenol						3.0	3.3	
4-Methylphenol								
Isophorone								
2-Nitrophenol								
Benzoic Acid						0.69 J	0.83 J	
Naphthalene								
2-Methylnaphthalene								
Dimethylphthalate								
Acenapthylene								
Acenaphthene								
Dibenzofuran								
Diethylphthalate	0.43		9.7 J	17	51	23	4.9	
Fluorene								
4-Nitroaniline								
4-,6-Dinitro-2-Methylphenol								
N-nitrosodiphenylamine								
Pentachlorophenol								
Phenanthrene						0.37 J		
Anthracene								
Di-n-butylphthalate	0.22 J		3.7 J	1.0 J		2.1 J	0.56	0.42
Fluoranthene						0.28 J		
Pyrene								
Butylbenzylphthalate								
3,3'-Dichlorobenzidine								
Benzo(a)anthracene								
Chrysene								
Bis(2-ethylhexyl)phthalate	0.54 B		53	4.9 B	37	9.1 B	0.99 B	0.42 B
di-n-octyphthalate							0.15 J	
Benzo(b)fluoranthene								
Benzo(k)fluoranthene								
Benzo(a)pyrene								
Indeno(1,2,3-cd)pyrene								
Dibenz(a,h)anthracene								
Benzo(g,h,i)perylene								

TABLE 7-14 (cont)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
SUMMARY OF ANALYTES DETECTED IN SURFICAL AND SUBSURFACE SOILS
OF SOUTH DISPOSAL AREA

SAMPLE NUMBER	SS-19	TP-9	TP-10A	TP-10	TP-11A	TP-11	B-6	B-7
SAMPLE DEPTH (1)	0-1'	0-6'	0-2'	0-2'	0-1'	0-1'	0-2'	0-2'
PARAMETER (2) (3) (4)								
Pesticide/PCBs (mg/kg)								
Aroclor-1254	3.3				190	61	108	
Aroclor-1260			330	29				
Inorganic Elements (mg/kg)								
Aluminum	6710	11900		20400		16400	16900	14300
Antimony				55.3 J		23 J		
Arsenic	16.3	4.4		46.5		52.5	7.5	5.3
Barium	52.5	77.2		2170		2000	229	92.8
Beryllium	0.24 J	0.33 J					0.49 J	0.47 J
Cadmium	1.3 J			111 J		151 J	33.9 J	
Calcium	42400	68500		11200		30400	6780	53800
Chromium	10.7	17.2		664		417	52.9	19.9
Cobalt	7.20 J	10.4 J		71.3		17	13.4	11.2
Copper	26.3	13		7330		13300	4240	13.8
Iron	15400	20200 J		203000 J		65300 J	28500	25200
Lead	721 J			4460		4880	382 J	
Magnesium	10800	15100		23500		26800	6720	12200
Manganese	393	561 J		2910 J		1020 J	1010	498
Mercury				3.20		1.4	0.27	0.23
Nickel	15.7	16.3		494		672	683	31.3
Potassium	1080	2970		634 J		949 J	2650	2410
Selenium				6.3		7.1	0.70 J	
Silver						50.5		
Sodium	156 J	237 J		903 J		612 J	332 J	184 J
Thallium		0.53 J		1.2 J				
Vanadium	19.7	29.9		56.8		14.4 J	35.9	31.4
Zinc	62.8 J	39.5 J		6760 J		4720 J	1430 J	49.4 J

NOTES:

(1) Depth below ground surface

(2) Only those analytes found above analytical detection limits at a minimum of one location are presented.

(3) Laboratory Qualifers: B - Estimated detection limit due to blank contamination,
J - Estimated value due to limitations identified during the quality control review.

(4) All results based on mg/kg dry weight of soil

in mg/Kg (dry weight basis). The term trace (tr) is used where the sum of all specific compounds in a category is less than 1 mg/Kg.

Location	TVO	PAHs	PHTHALs	PCBs	ACIDs	OTHERs
TP-10	40		18	29		
TP-10A	305		66	330		
TP-11	52	tr	25	61	3.0	tr
TP-11A	366		88	190		
B-6	33		5.6	108	3.3	tr

Test pits TP-10 and TP-11 were resampled (as TP-10A and TP-11A) for organic parameters because holding times for the first round volatile organic samples had been exceeded. Although the same compounds were detected during the resampling, there was a substantial increase in the concentrations of organics. Since resampling was conducted at the same location, it is apparent that the volatile organic results for TP-10 and TP-11 may not be representative of actual concentrations at those locations.

Organic contaminants detected in the soil/fill material at the South Disposal Area are summarized as follows (in mg/Kg, dry weight basis):

Location	TVO	PAHs	PHTHALs	PCBs	ACIDs	OTHERs
SS-19	tr		tr	3.3		
TP-9	tr					
B-7			tr			

Total volatile organics in the incineration residue samples were comprised of up to ten different chlorinated hydrocarbons, and four (4) aromatic hydrocarbons. The maximum concentrations of chlorinated hydrocarbons were as follows:

140 mg/Kg tetrachloroethene
110 mg/Kg trichloroethene
250 mg/Kg 1,2-dichloroethene

Aromatic hydrocarbons (benzene, toluene, ethylbenzene, and total xylenes) were detected at low concentrations in all samples of incineration residue. The maximum aromatic hydrocarbon detected was 8.7 mg/Kg total xylenes.

Acetone, 2-butanone, and 4-methyl-2-pentanone were detected at low concentrations in four (4) samples. Although these compounds are common laboratory contaminants and were also found in the blanks, each occurs in the sample at concentrations at least 10 times greater than the blank concentration. Therefore, the analytical results for these compounds were accepted as valid during the data validation procedure.

Phthalate compounds detected in the incineration residue were principally diethylphthalate, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate.

PCBs occur in substantial concentrations in samples from the incineration residue. Aroclor 1260 was consistently identified at TP-10/10A, and Aroclor 1254 at TP-11/11A. PCBs were detected in only one soil/fill sample (3.3 mg/Kg Aroclor 1254 at SS-19).

Inorganic Parameters - Metal concentrations from samples of the incineration residue collected from the South Disposal Area are compared in Table 7-15a to concentrations occurring in off-site background soil, and also to the common range of concentrations reported in the literature. As indicated, values of cadmium, copper, lead, and silver are elevated with respect to mean concentrations reported in the literature by a factor of greater than 100. Mean concentrations of antimony, arsenic, barium, chromium, cobalt, mercury, nickel, selenium, and zinc are elevated with respect to the literature means by factors ranging from 3.4 to 86. A substantial iron concentration of 20.3% was detected in the incineration residue at TP-10.

As shown in Table 7-15b metal concentrations for the soil/fill samples from the South Disposal Area are substantially lower than for the incineration residue. Lead, at SS-19 (721 mg/Kg), is the only metal detected at an elevated concentration in the soil/fill material.

The sampling results indicate that inorganic contamination in the South Disposal Area is primarily associated with the incineration residue. The cinders and ash at both TP-10 and TP-11 contain 11 different metal parameters at elevated concentrations.

TABLE 7-15a

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

COMPARISON OF INORGANIC CONCENTRATIONS IN SOUTH DISPOSAL AREA INCINERATION RESIDUE TO NATURAL SOILS*

	CONCENTRATIONS OF INORGANIC PARMETERS DETECTED ON-SITE (mg/kg)				CONCENTRATIONS OF INORGANICS IN NATURAL SOILS (mg/kg) (1)		
PARAMETER	CONCENTRATION RANGE	MEAN	BACKGROUND CONCENTRATION	# OF OCCURENCES ABOVE BKGD. / # OF SAMPLES	COMMON RANGE	COMMON MEAN	RATIO OF ON-SITE MEAN TO LITERATURE MEAN
Inorganic Elements							
Aluminum	16400 -20400	17900	18500	1/3	10000 - 300000	71000	.2
Antimony	BDL - 55.3	13	<11	2/3	<1 - 8.8 (2)	0.8	
Arsenic	7.5 - 52.5	36	2.8	3/3	1 - 50	5	7.2
Barium	229 -2170	1466	120	3/3	100 - 3000	430	3.4
Beryllium	0.24 - 0.49	0.26	0.58	0/3	0.1 - 40	6	.04
Cadmium	34 - 151	99	<0.21	3/3	0.01 - 0.7	0.06	1650
Calcium	6780 - 30400	16127	40400	0/3			
Chromium	53 - 664	378	24.6	3/3	1 - 1000	100	3.8
Cobalt	13.4 - 71.3	34	10.4	3/3	1 - 40	8	4.3
Copper	4240 - 13300	8300	13.1	3/3	2 - 100	30	277
Iron	28500 - 203000	98000	25500	3/3			
Lead	382 - 4880	3240	<6.7	3/3	2 - 200	10	324
Magnesium	6720 - 26800	19007	11000	2/3	600 - 6000	5000	3.8
Manganese	1010 - 2910	1647	451	3/3	20 - 3000	600	2.7
Mercury	0.27 - 3.2	1.62	<0.11	3/3	0.01 - 3.4 (2)	0.12	14
Nickel	494 - 683	616	21.7	3/3	5 - 500	40	15
Potassium	634 - 2650	1411	3800	0/3			
Selenium	0.70 - 7.1	4.7	<0.42	3/3	0.1 - 2	0.3	16
Silver	BDL - 50.5	17.5	<0.67	1/3	0.01 - 5	0.05	350
Sodium	332 - 903	616	229	3/3			
Thallium	BDL - 1.2	0.29	<0.42	1/3	2.2 - 23 (2)	8.6 (2)	.03
Vanadium	14.4 - 56.8	36	37.8	1/3	20 - 500	100	.3
Zinc	1430 - 6760	4300	54.7	3/3	10 - 300	50	86

NOTES:

* Incineration residue samples TP10/10A, TP11/11A and B-6.

BDL - BELOW DETECTION LIMITS

(1) USEPA OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, HAZARDOUS WASTE LAND TREATMENT,SW-874 (APRIL,1983).

(2) SHACKLETTE AND BOERNGEN (1984)

TABLE 7-15b

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

COMPARISON OF INORGANIC CONCENTRATIONS IN SOUTH DISPOSAL AREA SOIL/FILL TO NATURAL SOILS*

	CONCENTRATIONS OF INORGANIC PARMETERS DETECTED ON-SITE (mg/kg)				CONCENTRATIONS OF INORGANICS IN NATURAL SOILS (mg/kg) (1)		
PARAMETER	CONCENTRATION RANGE	MEAN	BACKGROUND CONCENTRATION	# OF OCCURENCES ABOVE BKGD. / # OF SAMPLES	COMMON RANGE	COMMON MEAN	RATIO OF ON-SITE MEAN TO LITERATURE MEAN
Inorganic Elements							
Aluminum	6710 - 14300	10970	18500	1/6	10000 - 300000	71000	.1
Antimony	BDL	-	<11	2/6	<1 - 8.8 (2)	0.8	
Arsenic	4.4 - 16.3	8.7	2.8	6/6	1 - 50	5	1.7
Barium	52.5 - 92.8	74	120	3/6	100 - 3000	430	0.2
Beryllium	0.24 - 0.47	0.35	0.58	0/6	0.1 - 40	6	0.05
Cadmium	BDL - 1.3		<0.21	4/6	0.01 - 0.7	0.06	
Calcium	42400 - 68500	54900	40400	3/6			
Chromium	10.7 - 19.9	16	24.6	3/6	1 - 1000	100	0.1
Cobalt	7.2 - 11.2	9.6	10.4	4/6	1 - 40	8	1.2
Copper	13 - 26.3	18	13.1	4/6	2 - 100	30	0.6
Iron	15400 - 25200	20267	25500	3/6			
Lead	BDL - 721	241	<6.7	4/6	2 - 200	10	24
Magnesium	10800 - 15100	12700	11000	4/6	600 - 6000	5000	2.5
Manganese	393 - 561	484	451	5/6	20 - 3000	600	0.8
Mercury	BDL - 0.23		<0.11	4/6	0.01 - 3.4 (2)	0.12	0.5
Nickel	15.7 - 31.3	21	21.7	4/6	5 - 500	40	0.5
Potassium	1080 - 2970	2153	3800	0/6			
Selenium	BDL	-	<0.42	3/6	0.1 - 2	0.3	
Silver	BDL	-	<0.67	1/6	0.01 - 5	0.05	
Sodium	156 - 237	192	229	4/6			
Thallium	BDL - 0.53		<0.42	2/6	2.2 - 23 (2)	8.6 (2)	.01
Vanadium	19.7 - 31.4	27	37.8	1/6	20 - 500	100	.3
Zinc	39.5 - 62.8	51	54.7	3/6	10 - 300	50	1

NOTES:

BDL – BELOW DETECTION LIMITS

* Soil/fill samples include SS-19, TP-9 and B-7.

(1) USEPA OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, HAZARDOUS WASTE LAND TREATMENT, SW-874 (APRIL, 1983).

(2) SHACKLETTE AND BOERNGEN (1984)

7.2.5 Genesee Valley Park Area

Surficial soil samples SS-9, SS-14, SS-15, SS-17, and SS-20; test pit TP-7; and soil borings B-3, B-5, B-8, and MW-15S were collected in the Genesee Valley Park Area. Analytical results are summarized on Table 7-16.

The Genesee Valley Park Area is a 100-foot wide area, which is situated between the eastern boundary of the site and the Genesee River. This portion of the Park has been developed as a recreational bicycle path, which follows the western riverbank. Soil sampling was conducted along the bicycle path to determine if contamination extends off-site into a potential public-use area. The bicycle path is currently closed to use by the public.

Samples were collected in this area primarily at locations of soil gas survey anomalies, although these anomalies were organic vapor readings that were only slightly over background (0.8 to 5.0 ppm on an HNU meter). Discolored soil and a softening of the asphalt surface of the bicycle path at sampling location B-8 was the only visible evidence of contamination in the Area. A storm sewer, which drains the Training Grounds Area, crosses the Bicycle path, and discharges to the Genesee River. The pipe backfill was excavated and sampled at TP-7.

Organic Parameters - Organic contaminants detected in surficial soil samples from the Genesee Valley Park Area are summarized below as total volatile organics (TVO), total polycyclic aromatic hydrocarbons (PAHs), total phthalate esters (PHTHALs), phenolic compounds (ACIDs), and other semi-volatile organics (OTHERs) in mg/Kg (dry weight basis). The term trace (tr) is used where the sum of all specific compounds in a category is less than 1 mg/Kg.

Location	TVO	PAHs	PHTHALs	PCBs	ACIDs	OTHERs
SS-20	1.3	tr	tr	5.3		
SS-17	tr		tr	1.3		
SS-15						
SS-14		tr		tr	tr	tr
SS-9	tr			2.5		

Organic contaminants detected in shallow subsurface samples (from borings and test pits) are summarized as follows (in mg/Kg):

Location	TVO	PAHs	PHTHALs	PCBs	ACIDs	OTHERs
TP-7						
B-5	tr		tr	tr		
MW-15S	tr			tr		
B-8		tr	tr	1.4	tr	2.5
B-3	tr			tr		

All surficial soil samples that were collected along the bicycle path (including SS-20, SS-17, SS-14, and SS-9) exhibit low to trace concentrations of organic contaminants. The bicycle path between the gate from the Training Grounds Area (near SS-9) and the gate to the South Disposal Area (near SS-20) was formerly used as a road to transport waste material for incineration (in the South Disposal Area). The organic contamination detected in this area may have occurred as minor spillage during the transport of wastes to the South Disposal Area.

The organic contamination detected at sample locations SS-17 and B-5 is adjacent to (but outside of) the drainage swale that drains the South Disposal Area. The source of this contamination may be either contaminated sediment or contaminated surface water from the South Disposal Area that overflows the swale during high flow events.

Subsurface samples from shallow borings also exhibit low to trace concentrations of organic contaminants. Location B-8, situated at an area of discolored soil and softened asphalt, exhibits low concentrations of six (6) PAHs, two (2) phthalates, and five (5) other semi-volatile organics, including:

- nitroaniline 1.9 mg/Kg
- 4-chlorophenol-phenylether 0.38 mg/Kg
- isophorone 0.20 mg/Kg
- 2-nitrophenol 0.07 mg/Kg
- dibenzofuran 0.012 mg/Kg

Historic aerial photography shows discolored soil marking a surface drainage route that led from the burn pits to the Genesee River through the vicinity of shallow boring locations B-8

TABLE 7-16

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN SURFICAL AND SUBSURFACE SOILS OF THE GENESEE VALLEY PARK AREA

SAMPLE NUMBER	SS-9	SS-14	SS-15	SS-17	SS-20	TP-7	B-3	B-5	B-8	MW-15S*
SAMPLE DEPTH (1)	0-.4'	0-1'	0-1'	0-1'	0-.3'	5'	0-1.5'	0-2.3'	0-4'	0-4'
PARAMETER (2) (3) (4)										
Volatiles (mg/kg)										
Methylene Chloride	0.010 B	0.015 B	0.006 B	0.009 B	0.018 B	0.006 B	0.006 B	0.012 B	0.006 B	0.005 B
Acetone	0.015 B	0.016 B	0.012 B	0.16	0.076 B	0.013 B	0.11 B	0.036 B	0.086 B	0.082 B
1,1-Dichloroethene					0.003 J					
1,1-Dichloroethane					0.003 J					
1,2-Dichloroethene (total)					0.19			0.002 J		
Chloroform							0.002 J			
2-Butanone							0.011 J			0.013
1,1,1-Trichloroethane					0.17					
Trichloroethene	0.002 J				0.52			0.002 J		
Benzene										
4-Methyl-2-pentanone				0.003 J	0.43					
Tetrachloroethene								0.002 J		
Toluene								0.002 J		0.001 J
Semi-Volatiles (mg/kg)										
4-Methylphenol										
Isophorone									0.20 J	
2-Nitrophenol									0.07 J	
Benzoic Acid										
Naphthalene										
2-Methylnaphthalene		0.027 J							0.059	
Dimethylphthalate										
Acenapthylene									0.038	
Acenaphthene									0.025 J	
Dibenzofuran									0.012 J	
Diethylphthalate				0.13 J	0.29 J			0.10 J		
Fluorene										
4-Nitroaniline										
4-.6-Dinitro-2-Methylphenol										
N-nitrosodiphenylamine										
Pentachlorophenol		0.80 J								
Phenanthrene		0.16 J							0.059 J	
Anthracene									0.38	
Di-n-butylphthalate		0.39 B			0.17 J		0.41 B		0.38 B	0.35 B
Fluoranthene		0.24 J			0.089 J					
Pyrene		0.23 J							0.051 J	
Butylbenzylphthalate									0.059 J	
3,3'-Dichlorobenzidine										
Benzo(a)anthracene		0.14 J								
Chrysene		0.15 J								
Bis(2-ethylhexyl)phthalate	0.47 B	0.39 B	0.46 B	0.49 B	0.50 B	0.42 B	0.41 B	0.40 B	2.0 B	0.35 B
Benzo(b)fluoranthene										
Benzo(k)fluoranthene										
Benzo(a)pyrene										
Indeno(1,2,3-cd)pyrene										
Dibenz(a,h)anthracene										
Benzo(g,h,i)perylene										
1,4 Dichlorobenzene		0.046 J								
3-Nitroaniline									1.9	
4-Chlorophenyl-phenylether									0.38	
Di-n-Octyl phthalate									0.038 J	

TABLE 7-16 (cont)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF ANALYTES DETECTED IN SURFICAL AND SUBSURFACE SOILS OF
THE GENESEE VALLEY PARK AREA

SAMPLE NUMBER	SS-9	SS-14	SS-15	SS-17	SS-20	TP-7	B-3	B-5	B-8	MW-15S*
SAMPLE DEPTH (1)	0-.4'	0-1'	0-1'	0-1'	0-.3'	5'	0-1.5'	0-2.3'	0-4'	0-4'
PARAMETER (2) (3) (4)										
Pesticide/PCBs (mg/kg)										
Aroclor-1254				1.3	5.3				1.4	
Aroclor-1260	2.5	0.329					0.74	0.059		0.52
Inorganic Elements (mg/kg)										
Aluminum	7070	6930	7760	6960	9150	9090	11100	13500	9250	5510
Antimony										
Arsenic	4.3	6.0	8.8	6.1	6.5	7.1	5.0	5.3	3.5	4.8
Barium	53.6 J	63.5 J	48.9	40.5 J	51.3	49	50.9 J	79.4	48.3	28.1 J
Beryllium	0.32 J	0.25 J		0.25 J	0.36 J	0.32 J	0.35 J	0.44 J	0.29 J	0.24 J
Cadmium	9.1 J	15.5	0.31 J	12.6 J				0.66 J		
Calcium	73100	29900	3290	40900	1980	2390	938 J	40400	5680	88600
Chromium	7.8	9.2	10.3	10.7	12.1	12.3	13.7	18.5	11.4	8.2
Cobalt	3.5 J	6.4 J	8.10 J	6.5 J	8.20 J	9.1 J	8.0 J	10.3	5.0	3.3
Copper	26.3	30.7	16	30.8	11.3	13.9	13.2	18	9.7	10.3
Iron	16000 J	16200 J	17300	14100	18500	20000 J	18100 J	22900	14400 J	11200 J
Lead	50.5	49.5	19 J	34.5 J		21.9	9.8		9.7	25.5
Magnesium	38300	15800	3030	23200	3120	3380	2830	10600	4320	38500
Manganese	299 J	181 J	363	333	363	370	208 J	456	181 J	250 J
Mercury			0.13 J	0.14	0.10 J			0.11	0.25 J	
Nickel	8.8 J	12.4	17.4	16.4	21.8	19.3	15.9	23.90	11.4	8.5 J
Potassium	1400	993 J	1270	919 J	1080	1150 J	810 J	2060	881 J	1870
Selenium		0.51 J	0.57 J	0.93 J	0.52 J			0.57 J		
Silver		0.74 J								
Sodium	252 J	105 J	41.7 J	85.6 J	74 J	75.7 J	73.2 J	160 J	83.1 J	139 J
Thallium		0.52 J								
Vanadium	14	15.1	14.6	16.2	17.6	18.9	18.2	28.7	16.0	10.9
Zinc	60.5 J	99 J	70.3 J	76.9 J	54 J	55.6	47.3 J	57.8 J	41.5 J	36.2 J

NOTES:

(1) Depth below ground surface

(2) Only those analytes found above analytical detection limits at a minimum of one location are presented.

(3) Laboratory Qualifers: B - Estimated dectection limit due to blank contamination,
J - Estimated value due to limitations identified during the quality control review.

(4) All results based on mg/kg dry weight of soil

* Soil sample collected before monitoring well installation.

and MW-15S. Currently, the majority of surface drainage from the burn pits is directed to a retention pond. However, during the RI it was observed that some overflow from the burn pits flowed toward the Area boundary near B-8.

No contaminants were detected in the bedding of the storm water sewer at TP-7.

Inorganic Parameters - As shown on Table 7-17, cadmium is the only inorganic parameter that was detected in this area at elevated concentration in comparison to off-site background concentration and common literature values. Cadmium concentrations range from 9.1 to 15.5 mg/Kg in surficial soil at SS-9, SS-14, and SS-17. Sampling location SS-17 is next to a swale that drains the South Disposal Area, where elevated cadmium concentrations were identified. The source of cadmium at sampling locations SS-9 and SS-14 may be spills that occurred during the transportation of waste material to the South Disposal Area.

7.2.6 Genesee Valley Canal Area

Surficial sample SS-13 was collected along a former railroad right-of-way, which is adjacent to the former Genesee Valley Canal. Analytical results are summarized in Table 7-12.

The railroad right-of-way is situated on an elevated berm that defines the east side of the former Genesee Valley Canal. Based on soil sampling at locations MW-6 and MW-9 (see Figure 7-2), the berm is comprised of 1 to 6 feet of railroad ballast (black cinders and coal fragments), which is underlain by a red brown silty clay. The sample at SS-13 consists of railroad ballast material.

Organic Parameters - No volatile organic compounds were detected at location SS-13. Eleven (11) PAHs were identified at SS-13, with concentrations ranging from 0.77 mg/Kg anthracene to 4.3 mg/Kg Benzo(b)fluoranthene. The sum of all PAHS concentrations is 30 mg/Kg. The occurrence of low concentrations of PAHs at SS-13 may be related to former railroad activities rather than to the site waste disposal history.

Inorganic Parameters - No substantially elevated concentrations of metals were detected at sampling location SS-13.

TABLE 7–17

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

COMPARISON OF INORGANIC CONCENTRATIONS IN GENESEE VALLEY PARK AREA TO NATURAL SOILS

PARAMETER	CONCENTRATIONS OF INORGANIC PARMETERS DETECTED ON-SITE (mg/kg)				CONCENTRATIONS OF INORGANICS IN NATURAL SOILS (mg/kg) (1)		RATIO OF ON-SITE MEAN TO LITERATURE MEAN
	CONCENTRATION RANGE	MEAN	BACKGROUND CONCENTRATION	# OF OCCURENCES ABOVE BKGD. / # OF SAMPLES	COMMON RANGE	COMMON MEAN	
Inorganic Elements							
Aluminum	5510 - 13500	9002	18500	0/12	10000 - 300000	71000	.1
Antimony	BDL	-	<11	0/12	<1 - 8.8	0.8	
Arsenic	3.5 - 8.8	5.9	2.8	12/12	1 - 50	5	1.2
Barium	28.1 - 75.4	54	120	0/12	100 - 3000	430	.1
Beryllium	BDL - 0.44	0.29	0.58	0/12	0.1 - 40	6	0.05
Cadmium	BDL - 15.5	4.0	<0.21	7/12	0.01 - 0.7	0.06	66
Calcium	4000 - 88600	24682	40400	3/12			
Chromium	7.8 - 30.7	13	24.6	1/12	1 - 1000	100	0.1
Cobalt	3.3 - 10.3	7.1	10.4	0/12	1 - 40	8	0.9
Copper	9.7 - 30.8	19	13.1	7/12	2 - 100	30	0.6
Iron	11200 - 22900	16875	25500	0/12			
Lead	BDL - 50.5	23	<6.7	10/12	2 - 200	0	2.3
Magnesium	2740 - 38500	12234	11000	4/12	600 - 6000	5000	2.5
Manganese	181 - 456	294	451	1/12	20 - 3000	600	0.5
Mercury	BDL - 0.25	0.12	<0.11	5/12	0.01 - 3.4 (2)	0.12	1
Nickel	8.5 - 23.9	16	21.7	2/12	5 - 500	40	0.4
Potassium	810 - 2060	1323	3800	0/12			
Selenium	BDL - 0.93	0.56	<0.42	6/12	0.1 - 2	0.3	1.9
Silver	BDL - 1.6	0.70	<0.67	2/12	0.01 - 5	0.05	14
Sodium	41.7 -252	108	229	1/12			
Thallium	BDL - 0.52	0.50	<0.42	1/12	2.2 - 23 (2)	8.6 (2)	0.06
Vanadium	10.9 - 28.7	18	37.8	0/12	20 - 500	100	0.2
Zinc	36.2 - 328	85	54.7	8/12	10 - 300	50	1.7

NOTES:

BDL – BELOW DETECTION LIMITS

(1) USEPA OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, HAZARDOUS WASTE LAND TREATMENT, SW-874 (APRIL, 1983).

(2) SHACKLETTE AND BOERNGEN (1984)

7.2.7 Summary

Soil/fill sampling and analysis at the Rochester Fire Academy site has demonstrated that inorganic and organic contamination occurs at many of the survey anomalies identified during the Preliminary Investigation. Table 7-18 presents the frequency of detection and maximum concentration of all organic and inorganic contaminant in soil/fill samples that were detected above analytical detection limits at least once.

Contamination in the North Disposal Area is primarily inorganic in nature and appears to be limited to the visual extent of fill material. The fill exhibits substantial concentrations of iron, cadmium, copper, lead, and silver. Organic contamination consists of chlorinated hydrocarbons, PAHs, phthalate esters, and PCBs at low to trace concentrations.

A substantial amount of the contamination identified in soil/fill of the Training Grounds Area is associated with historic spills and leaks of various types of fuels that have been used in the northern portion of the Area. Maximum concentrations of volatile organics, PAHs, phthalate esters, and PCBs occur in soil/fill in the vicinity of the fuel storage tanks and fuel transmission line. An accumulation of free product in the vicinity of MW-14S contributes to soil contamination by direct contact with unsaturated soils. The extent of the free product has not been defined. It is also apparent, however, that lower levels of volatile organics, PAHs, phthalates, and PCBs are present at portions of the Area that are removed from the storage tanks and fuel transmission line. Cadmium, lead, and antimony have been detected at elevated concentrations.

The Firing Range has little organic or inorganic contamination at the locations sampled.

Organic contamination in the South Disposal Area consists primarily of chlorinated hydrocarbons and PCBs. However, a large variety of additional organic compounds were identified at low concentrations. Inorganic contamination is primarily iron, cadmium, copper, lead, and silver. Sampling results to date indicate that both organic and inorganic contamination is closely associated with the incineration residue.

Low to trace concentrations of volatile organics occur at one location within the Genesee Valley Park Area. The contaminant of principle concern identified in the Area is cadmium, which occurs locally.

TABLE 7-18
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
FREQUENCY OF ANALYTE DETECTION IN SURFICIAL AND SUBSURFACE SOIL (1)

	NORTH DISPOSAL AREA (2)			TRAINING GROUNDS AREA (3)			SOUTH DISPOSAL AREA (4)			GENESEE VALLEY PARK (5)			FIRING RANGE AREA (6)			GENESEE VALLEY CANAL (7)		
ANALYTE (mg/Kg)	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX
Volatiles																		
Vinyl Chloride							3	0.27	B-6									
Chloroethane							1	0.11	B-6									
Methylene Chloride																		
Acetone							2	17	B-6									
1,1-Dichloroethene							2	0.020	TP-9	1	0.003	SS-20						
1,1-Dichloroethane	2	0.010	SS-1	1	0.019	SS-7	6	26	TP-11A	1	0.003	SS-20						
1,2-Dichloroethene (total)	3	0.041	SS-1	1	0.007	SS-7	6	250	TP-11A	2	0.19	SS-20						
Chloroform	1	0.002	TP-4	1	0.002	SS-7	3	0.51	TP-10A	1	0.002	B-3						
1,2-Dichlorethane	1	0.001	SS-1				4	1.6	TP-11A									
2-Butanone				2	0.011	SS-11	3	7.9	B-6	2	0.013	MW-15S	1	0.006	SS-16			
1,1,1-Trichloroethane	5	0.006	TP-4				5	14	TP-11A	1	0.17	SS-20						
Trichloroethene	8	0.063	TP-3	1	0.001	SS-11	7	110	TP-10A	3	0.52	SS-20						
1,1,2-Trichloroethane							1	0.014	TP-9									
Benzene				1	0.89	SS-6	2	0.009	B-6									
4-Methyl-2-pentanone							3	3.5	B-6	2	0.43	SS-20						
Tetrachloroethene	9	0.10	TP-3	1	0.001	SS-12	6	140	TP-10A	1	0.002	B-5	1	0.001	SS-16			
1,1,2,2-Tetrachloroethane	2	0.001	TP-2/3				3	3.5	TP-11									
Toluene	4	0.012	TP-5	5	350	B-2	5	5.3	TP-10	2	0.002	B-5	1	0.006	SS-16			
Chlorobenzene	1	0.001	TP-2	1	0.005	TP-6												
Ethylbenzene				3	26	B-2	4	0.82	TP-11A									
Total Xylenes				4	210	SS-6	5	8.7	TP-11A									
Semi-Volatiles (mg/kg)																		
bis(2-chloroisopropyl)ether	3	0.34	TP-5															
Phenol							2	3.3	B-6									
4-Methylphenol				1	13	B-2												
Isophorone	1	0.17	TP-5	1	0.27	TP-6				1	0.20	B-8						
2-Nitrophenol				1	0.12	TP-6				1	0.07	B-8						
4-Nitrophenol	1	0.16	TP-2															
Benzoic Acid	2	0.25	TP-1	1	0.12	SS-6												

NOTES:

(1) Number of detections above detection limit.

(2) Total number of 11 samples collected.

(3) Total number of 13 samples collected.

(4) Total number of 7 samples collected.

(5) Total number of 10 samples collected.

(6) Total number of 2 samples collected.

(7) Total number of 1 sample collected.

TABLE 7–18 (cont'd)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
FREQUENCY OF ANALYTE DETECTION IN SURFICIAL AND SUBSURFACE SOIL (1)

	NORTH DISPOSAL AREA (2)			TRAINING GROUNDS AREA (3)			SOUTH DISPOSAL AREA (4)			GENESEE VALLEY PARK (5)			FIRING RANGE AREA (6)			GENESEE VALLEY CANAL (7)		
ANALYTE (mg/Kg)	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX
Semi–Volatiles																		
Naphthalene	4	0.41	TP–5	2	100	B–2	2	0.83	B–6							1	0.85	SS–13
2–Methylnaphthalene	5	1.7	TP–5	4	150	B–2				2	0.059	B–8				1	1.0	SS–13
Dimethylphthalate	1	0.15	SS–4	1	0.091	B–4												
Acenapthylene				2	9.4	SS–12				1	0.038	B–8						
Acenaphthene				1	2.0	B–4				1	0.025	B–8						
Dibenzofuran				1	0.46	B–4				1	0.012	B–8						
Diethylphthalate	4	0.54	TP–3A	5	29	B–2	6	51	TP–11A	3	0.29	SS–20				1	0.52	SS–13
Fluorene				2	11	B–2												
4–Nitroaniline				1	1.1	B–4												
4–6–Dinitro–2–Methylphenol				1	2.4	B–4												
N–nitrosodiphenylamine				1	0.043	TP–6												
Pentachlorophenol				2	1.4	SS–11				1	0.80	SS–14						
Phenanthrene	6	0.94	TP–2	10	38	B–2	1	0.37	TP–11	2	0.16	SS–14				1	2.6	SS–13
Anthracene	2	0.24	SS–4	2	110	B–2				1	0.38	B–8				1	0.77	SS–13
Di–n–butylphthalate	5	3.0	TP–2	7	77	B–2	6	3.7	TP–10A	1	0.17	SS–20						
Fluoranthene	4	0.88	TP–2	4	0.86	SS–5	1	0.28	TP–11	2	0.24	SS–20	1	0.22	SS–16	1	3.9	SS–13
Pyrene	5	1.2	TP–2	6	4.6	SS–12				2	0.24	SS–14	1	0.29	SS–16	1	3.4	SS–13
Butylbenzylphthalate	4	1.3	TP–2	4	120	B–2				1	0.059	B–8						
3,3'–Dichlorobenzidine				1	0.44	SS–7												
Benzo(a)anthracene	2	0.21	SS–2	2	0.55	SS–5				1	0.14	SS–14				1	2.2	SS–13
Chrysene	4	0.59	TP–2	2	0.62	SS–5				1	0.15	SS–14				1	4.1	SS–13
Bis(2–ethylhexyl)phthalate	2	7.3	TP–2	3	720	B–2	2	53	TP–10A									
di–n–octyphthalate	1	0.15	TP–5				1	0.15	B–6	1	0.038	B–8						
Benzo(b)fluoranthene	2	0.24	TP–2	1	0.63	SS–5										1	4.3	SS–13
Benzo(k)fluoranthene	2	0.50	TP–2	1	0.54	SS–5										1	3.9	SS–13
Benzo(a)pyrene	2	0.50	TP–2	1	0.63	SS–5										1	2.5	SS–13
Indeno(1,2,3–cd)pyrene				1	0.47	SS–5												
Dibenz(a,h)anthracene				1	0.17	SS–5												
Benzo(g,h,i)perylene				1	0.58	SS–5												
1,4 Dichlorobenzene										1	0.046	SS–14						
3–Nitroaniline										1	1.9	B–8						
4–Chlorophenyl–phenylether										1	0.38	B–8						

NOTES:

(1) Number of detections above detection limit.

(2) Total number of 11 samples collected.

(3) Total number of 13 samples collected.

(4) Total number of 7 samples collected.

(5) Total number of 10 samples collected.

(6) Total number of 2 samples collected.

(7) Total number of 1 sample collected.

TABLE 7-18 (cont'd)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
FREQUENCY OF ANALYTE DETECTION IN SURFICIAL AND SUBSURFACE SOILS (1)

	NORTH DISPOSAL AREA (2)			TRAINING GROUNDS AREA (3)			SOUTH DISPOSAL AREA (4)			GENESEE VALLEY PARK (5)			FIRING RANGE AREA (6)			GENESEE VALLEY CANAL (7)		
ANALYTE (mg/Kg)	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX
Pesticide/PCBs																		
Aroclor-1254	1	10	SS-4	2	21	MW-14S	4	190	TP-11A	3	5.3	SS-20						
Aroclor-1260	5	9.7	TP-3	7	31	SS-7	2	330	TP-10A	5	2.5	SS-9	1	0.56	SS-16			
Inorganic Elements																		
Aluminum	10	15300	SS-1	13	11900	TP-8	6	20400	TP-10	10	13500	B-5	2	12800	SS-18	1	2880	SS-13
Antimony	3	23	TP-2	3	13	SS-12	2	55	TP-10									
Arsenic	10	69	TP-5	13	8.8	MW-14S	6	53	TP-11	10	8.8	SS-15	2	4.7	SS-18	1	12	SS-13
Barium	10	4160	SS-3	13	76	SS-7	6	2170	TP-10	10	79	B-5	2	70	SS-18	1	48	SS-13
Beryllium	5	412	SS-3	8	0.40	SS-11	4	0.49	B-6	9	0.44	B-5	1	0.33	SS-18	1	0.30	SS-13
Cadmium	9	20	TP-2	11	12	TP-6	4	151	TP-11	5	13	SS-17	1	0.30	SS-18	1	0.25	SS-13
Calcium	10	67900	TP-4	13	156000	SS-8	6	68500	TP-9	10	88600	MW-15S	2	161000	SS-16	1	18300	SS-13
Chromium	10	340	SS-4	13	62	SS-7	6	684	TP-10	10	19	B-5	2	16	SS-18	1	8.5	SS-13
Cobalt	10	50	SS-3	12	31	SS-7	6	71	TP-10	10	10	B-5	2	11	SS-18	1	7.3	SS-13
Copper	10	51700	SS-3	13	188	B-4	6	13300	TP-11	10	31	SS-14	2	11	SS-18	1	66	SS-13
Iron	10	38800	TP-2	13	20900	TP-8	6	203000	TP-10	10	22900	B-5	2	21600	SS-18	1	32100	SS-13
Lead	9	7860	SS-3	13	555	SS-7	4	4880	TP-11	8	51	SS-9	1	17	SS-16	1	72	SS-13
Magnesium	10	16000	TP-2	13	80200	SS-8	6	26800	TP-11	10	38500	MW-15S	2	12300	SS-18	1	9350	SS-13
Manganese	10	1070	B-1	13	380	SS-10	6	2910	TP-10	10	370	TP-7	2	530	SS-18	1	344	SS-13
Mercury	10	1.6	TP-2	3	0.23	TP-6	4	3.2	TP-10	5	0.25	B-8	0	-	-	1	0.12	SS-13
Nickel	10	48	TP-2	12	42	B-4	6	683	B-6	10	24	B-5	2	22	SS-18	1	11	SS-13
Potassium	10	1950	B-1	13	2270	SS-11	6	2970	TP-9	10	2060	B-5	2	2460	SS-18	1	557	SS-13
Selenium	7	8.1	SS-4	2	0.78	TP-6	3	7.1	TP-11	5	0.93	SS-17	0	-	-	0	-	-
Silver	5	48	SS-3	0	-	-	1	51	TP-11	1	0.74	SS-14	0	-	-	0	-	-
Sodium	10	537	SS-3	13	221	SS-10	6	903	TP-10	10	252	SS-9	2	176	SS-18	1	79	SS-13
Thallium	1	0.55	TP-4	2	0.78	TP-6	2	1.2	TP-10	1	0.52	SS-14	0	-	-	1	0.54	SS-13
Vanadium	10	34	SS-3	12	21	SS-10	6	57	TP-10	10	29	B-5	2	31	SS-18	1	10	SS-13
Zinc	10	6190	SS-3	13	224	B-4	6	6760	TP-10	10	99	SS-14	2	43	SS-18	1	45	SS-13

NOTES:

(1) Number of detections above detection limit.

(2) Total number of 11 samples collected.

(3) Total number of 13 samples collected.

(4) Total number of 7 samples collected.

(5) Total number of 10 samples collected.

(6) Total number of 2 samples collected.

(7) Total number of 1 sample collected.

Contamination in the Genesee Valley Canal Area is characterized by low concentrations of PAHs, which are likely associated with the bedding material of the railroad formerly located in this area.

7.3 ANALYTICAL RESULTS FOR GROUND WATER

For the purpose of discussing the nature and extent of contamination in ground water, the Rochester Fire Academy site has been divided into the following areas:

- North Disposal Area
- Training Grounds Area
- South Disposal Area.

The analytical results for those parameters having at least one occurrence above the analytical detection limit in ground water are summarized in Tables 7-19 to 7-28. Analytical results are discussed separately below for the overburden and bedrock water bearing zones.

As discussed in Section 7.1.3, three (3) rounds of ground water sampling were conducted during the RI. All wells installed during the RI were sampled in Round 1 and Round 2. Round 3 was conducted only to confirm prior sampling results from selected wells, therefore, only MW-6I, MW-7S/7I, MW-8S/8I, MW-11S/11I, MW-12S/12I, and MW-15S were sampled during Round 3.

7.3.1 Overburden Water Bearing Zone

The monitoring interval for each well installed in this zone is summarized as follows:

- At the Water Table

North Disposal Area -	MW-10S and MW-11S
Training Grounds Area -	MW-6S, MW-8S, MW-12S, MW-13S, MW-14S, MW-15S
South Disposal Area -	MW-7S and MW-9S

- Base of the Overburden Water Bearing Zone

North Disposal Area -	PZ-9.

During the May sampling event, ground water elevations were higher than in the August sampling event, and were either at or above the top of the sand pack of each water table well. Ground water elevations had fallen to within the screened interval of these wells by the August sampling event.

Piezometer PZ-9 was installed to monitor water levels only and, therefore, was not sampled.

Hydrogeologic conditions in the overburden are discussed in Section 5.4.2. Field measurements and field observations recorded during sampling are presented with the summary of remediation assessment parameters results in Tables 7-19 to 7-21. Well locations are shown on Figure 7-2.

Overburden ground water samples are bicarbonate-sulfate water with high to very high hardness (300 to 900 mg/l). This is a regional water quality characteristic imparted to ground water by the dolomitic bedrock.

Oxidation-reduction conditions within the overburden ground water appear to have changed between the May and August sampling events. Relatively oxidized conditions prevailed in May, while relatively reducing conditions prevailed in August. The change is indicated throughout the site by an August decrease in sulfate, an August increase in iron and manganese, and an August increase in the ratio of reduced nitrogen species to oxidized nitrogen species. This trend is especially apparent in certain downgradient wells, but also occurs to a lesser degree in the upgradient wells.

High concentrations of iron are widespread throughout the overburden water bearing zone. The source of dissolved iron is most likely the reduction and dissolution of ferric hydroxides in the aquifer matrix due to changing oxidation-reduction conditions within the aquifer. Overburden ground water at the site may develop a reducing potential due to the oxidation of organic materials. Although alluvial sediment at the site most likely contains naturally occurring organic matter, petroleum hydrocarbons may be an additional source of oxidizable material within the site and at downgradient locations.

7.3.1.1 North Disposal Area

This Area has one (1) upgradient well (MW-10S) and one (1) downgradient well (MW-11S). Analytical results are summarized in Table 7-22.

TABLE 7-19

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY. RI/FS

SUMMARY OF REMEDIATION ASSESSMENT AND FIELD PARAMETERS,NORTH DISPOSAL AREA

	OVERBURDEN WATER-BEARING ZONE				BEDROCK AQUIFER					
	UPGRADIENT		DOWNGRADIENT		UPGRADIENT		DOWNGRADIENT			
	MW-10S		MW-11S		MW-10I		MW-11I		MW-16I*	
PARAMETERS (1) (mg/l)	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND
Acidity										
Alkalinity	320	470	284	270	338	410	340	370	358	370
Bicarbonate	320	470	284	270	338	410	340	370	358	370
Chloride	12	16	15.5	28	44	44	40.9	46	43.1	44
COD			64	28			40		37	34
Total Hardness	404	740	520	860	480	500	600	580	660	660
Nitrate	0.22	0.36	0.35		0.22	0.13		0.13		0.1
Nitrogen Ammonia			0.05	0.3	0.05	0.66	0.05	0.20	0.05	0.06
Nitrogen Kjeldahl, Total	0.05	0.62	0.11	0.68	0.11	0.22	0.09	0.28	0.11	0.38
Oil and Grease			1.44				3.13		2.34	
Total Phosphate		0.31		0.11						
Sulfate	140	20	440	280	17	84	311	154	198	94
Sulfide								0.69		
Total Dissolved Solids	342	428	400	544	420	492	388	536	402	388
TOC	4.0	3.8	9.2	11.3	4.0	3.4	2.5	3.6		3.3

	MW-10S		MW-11S			MW-10I		MW-11I			MW-16I*	
FIELD PARAMETERS	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND
pH	7.08	7.44	6.42	6.40	6.23	7.09	7.50	7.00	7.40	6.80	6.97	7.28
Temperature (2)	16	16	14	15	12.5	14.5	18	14	17	14	13	15
Specific Conductance (3)	893	710	1240	1210	990	1100	750	1313	910	880	1215	850
Turbidity (4)	55	9	35	38	6	11	16	22	20	31	67	29
Appearance	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear
Odor	none	none	none	none	none	sulfide	sulfide	sulfide	sulfide	sulfide	sulfide	none

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Degrees centigrade

(3) umhos

(4) NTU

* Well is monitoring ground water North of North Disposal Area.

TABLE 7-20

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY. RI/FS

SUMMARY OF REMEDIATION ASSESSMENT AND FIELD PARAMETERS,TRAINING GROUNDS

	OVERBURDEN WATER-BEARING ZONE											
	UPGRADIENT		DOWNGRADIENT									
	MW-6S		MW-8S		MW-12S		MW-13S		MW-14S		MW-15S	
PARAMETERS (1) (mg/l)	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND
Acidity												
Alkalinity	416	400	90	180	186	290	280	330	574	540	196	240
Bicarbonate	416	400	90	180	186	290	280	330	574	540	196	240
Chloride	48	56	5.5	8	17.7	26	24	28	79.6	78	22.1	16
COD		46	44						70	107	60	40
Total Hardness	840	900	130	300	268	320	756	920	732	600	8.0	400
Nitrate							0.12				0.45	
Nitrogen Ammonia	0.06	0.07	0.05	0.14			0.05		0.07		0.12	0.22
Nitrogen Kjeldahl, Total	0.16	0.38	0.2	0.50		0.56	0.11	0.32	0.11	1.12	0.13	0.56
Oil and Grease			1.41						1.20	142	3.49	1.0
Total Phosphate										0.20		
Sulfate	295	460	272	24	21	64	600	250	95	28	426	46
Sulfide												
Total Dissolved Solids	752	628	148	152	1860	284	714	568	1805	508	204	308
TOC	1.5	3.5	4.0	5.0	3.0	3.6	3.6	4.2	12.5	15.2	7.4	9.0

	MW-6S		MW-8S			MW-12S			MW-13S		MW-14S		MW-15S		
FIELD PARAMETERS	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
pH	7.00	7.22	6.22	7.01	6.15	6.24	6.50	6.31	7.17	7.5	6.63		6.24	6.95	6.57
Temperature (2)	10	18.5	14	17	14	13	15	13	15	18	16		15	19	13.5
Specific Conductance (3)	1835	1050	285	335	252	688	550	530	1540	1200	1825		698	480	460
Turbidity (4)	4	2.5	11	24	8	46	20	8	12	11	65	free	12	16	6
Appearance	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear	product	clear	clear	clear
Odor	none	none	none	none	sulfur	sulfide	none	none	none	none	fuel	fuel	none	none	none

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Degrees centigrade

(3) umhos

(4) NTU

TABLE 7-20 (cont)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY. RI/FS
SUMMARY OF REMEDIATION ASSESSMENT AND FIELD PARAMETERS,TRAINING GROUNDS

	BEDROCK AQUIFER									
	UPGRADIENT				DOWNGRADIENT					
	MW-6I		MW-6D		MW-8D		MW-8I		MW-12I	
PARAMETERS (1) (mg/l)	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND
Acidity										
Alkalinity	314	260	332	370	228	250	336	350	516	600
Bicarbonate	314	260	332	370	228	250	336	350	516	600
Chloride	50	38	32	22	16.6	54	36.5	44	50.9	38
COD			27	46	50	31	37			34
Total Hardness	430	600	430	900	1560	2200	540	600	652	660
Nitrate										
Nitrogen Ammonia	0.10	0.11	0.08		0.07	0.11	0.14	0.35		0.17
Nitrogen Kjeldahl, Total	0.19	0.50	0.18	0.56	0.12	0.50	0.16	0.72	0.28	0.44
Oil and Grease							1.05			
Total Phosphate										
Sulfate	56	34	86	34	208	580	46	92	237	54
Sulfide					30		0.88			
Total Dissolved Solids	412	362	420	434	208	1048	376	462	738	482
TOC	1.9	2.7	1.9	17.1		2.2	2.4	3.6	5.7	7.2

	MW-6I			MW-6D		MW-8D		MW-8I			MW-12I		
FIELD PARAMETERS	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
pH	7.81	8.28	8.04	7.55	7.69	7.07	7.20	7.21	7.62	6.97	6.61	7.01	6.49
Temperature (2)	11	15	15	11	16	15	19.5	15	19	15.5	12	18	12.5
Specific Conductance (3)	1073	625	580	1063	750	2850	2200	1155	900	800	1495	905	960
Turbidity (4)	72	62	29	>100	25	9	6	61	40	28	>100	90	72
Appearance	cloudy	turbid	clear	turbid	clear	clear	clear	clear	turbid	clear	turbid	turbid	clear
Odor	sulfide	sulfide	none	sulfide	sulfide	sulfide	sulfide	none	none	sulfur	sulfide	none	sulfur

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Degrees centigrade

(3) umhos

(4) NTU

TABLE 7-21

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY. RI/FS

SUMMARY OF REMEDIATION ASSESSMENT AND FIELD PARAMETERS,SOUTH DISPOSAL AREA

	OVERBURDEN WATER-BEARING ZONE				BEDROCK AQUIFER					
	UPGRADIENT		DOWNGRADIENT		UPGRADIENT		DOWNGRADIENT			
	MW-9S		MW-7S		MW-9I		MW-7I		MW-7D	
PARAMETERS (1) (mg/l)	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND
Acidity										
Alkalinity	308	310	380	480	340	420	334	400	358	320
Bicarbonate	308	310	380	480	340	420	334	400	358	320
Chloride	8.0	6.0	74.1	98	24	26	90.7	74	38.7	28
COD			140	140			70			31
Total Hardness	332	660	588	680	448	480	862	640	740	760
Nitrate	0.22	0.08								
Nitrogen Ammonia		0.08		0.15	0.05	0.05		0.09		0.11
Nitrogen Kjeldahl, Total		0.32	0.35	2.68	0.22	0.50		0.68		0.44
Oil and Grease		1.0	4.6	3.0					1.12	
Total Phosphate		0.47	0.4	0.29						
Sulfate	260	56	22		242	20	974	72	784	340
Sulfide									16	6.79
Total Dissolved Solids	306	424	3000	494	386	402	1895	512	2100	684
TOC	2.4	2.4	38	50.9	1.2	2.0	11.5	3.6	2.4	3.3

	MW-9S		MW-7S			MW-9I		MW-7I			MW-7D	
FIELD PARAMETERS	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND
pH	6.85	7.40	6.80	7.08	6.91	7.06	7.60	7.26	7.43	7.20	7.00	7.41
Temperature (2)	14	15	14.5	20	13	14	14	15	18	13	16	20
Specific Conductance (3)	715	650	1165	1050	795	913	625	1343	900	850	1733	1400
Turbidity (4)	7	>100	>100	>100	34	67	>100	46	45	16	15	6
Appearance	clear	turbid	turbid	turbid	clear	clear	turbid	clear	clear	clear	clear	clear
Odor	none	none	solvent	solvent	solvent	sulfide	none	none	solvent	none	sulfide	sulfide

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Degrees centigrade

(3) umhos

(4) NTU

TABLE 7-22

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN OVERBURDEN WATER-BEARING ZONE, NORTH DISPOSAL AREA

PARAMETER (1) (2)	UPGRADIENT MW-10S		DOWN GRADIENT MW-11S		
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
Volatiles (mg/l)	ND	ND	ND	ND	
1,2-Dichloroethane					
Trichloroethene					
Methylene Chloride					0.013B
Vinyl Chloride					
1,2-Dichloroethene(total)					
Semi-Volatiles (mg/l)		ND	ND	ND	
Bis(2-ethylhexyl)phthalate	0.01 B				0.013
Di-n-butylphthalate					0.001JB
PCBs (mg/l)					
Aroclor-1254					

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - October sampling event; analysis for organic compounds only.

TABLE 7-22 (cont.)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF ANALYTES DETECTED IN OVERBURDEN WATER-BEARING ZONE, NORTH DISPOSAL AREA

PARAMETER (1) (2)	UPGRADIENT MW-10S		DOWN GRADIENT MW-11S		
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
Inorganic Elements (mg/l)					
Aluminum			12		
Arsenic	0.002 J		0.007	0.005B	
Barium	0.051 J		0.070J		
Beryllium					
Cadmium					
Calcium	87		100		
Chromium			0.017		
Cobalt			0.014 J		
Copper	0.007 B		0.015 J		
Iron	2.69	7.82	18	14.1	
Lead					
Magnesium	48.6		81.2		
Manganese	0.117	0.258	0.633	1.77	
Mercury					
Nickel			0.026 J		
Potassium	0.861		1.01 J		
Selenium					
Sodium	6.63		21.3		
Vanadium			0.018 J		
Zinc	0.012		0.065		

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs; Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - October sampling event; analysis for organic compounds only.

Organic Parameters - A single occurrence of bis(2-ethylhexyl)phthalate (0.013 mg/l) was the only organic contaminant detected in shallow ground water from the North Disposal Area. This result is similar to the sampling results for the soil/fill material in the North Disposal Area, which indicated the presence of only trace concentrations of organic contaminants.

Inorganic Parameters - Aluminum, iron, and manganese exhibit substantially elevated concentrations in downgradient well MW-11S with respect to upgradient well MW-6S. Iron and manganese exceed the 6 NYCRR Part 703 ground water standards in MW-11S and (for iron only) MW-6S.

7.3.1.2 Training Grounds Area

This Area has one (1) upgradient well (MW-6S); three (3) downgradient wells (MW-8S, MW-12S, and MW-15S); and two (2) wells (MW-13S and MW-14S), which are located within the Training Grounds. Analytical results are summarized in Tables 7-23 and 7-24.

Organic Parameters - The upgradient well (MW-6S) exhibited a trace concentration of 1,1 dichloroethene (0.003 mg/l) on one (1) sampling occasion. Organic contamination was not detected in wells in the southern portion of the Training Grounds Area (MW-12S and MW-13S).

A free product, described as a yellow kerosene, was observed at MW-14S during the August sampling event. (Kerosene has been used as a fuel for the burn pits since 1981). A strong organic odor was noted at MW-14S during both the May and August sampling events. However, neither free-product nor dissolved organics were detected during the May sampling event. Water levels at MW-14S were above the sand pack in May; therefore, the product, if present, may have been unable to enter the well. The water and product levels in August were measured with an oil-water interface meter. Depth to product from the top of the riser (TOR) was 6.61 feet; depth to water was 8.15 (TOR), yielding a product thickness in the well of 1.54 feet. Product thickness outside the well would be less than 1.5 feet due to capillary fringe effects. The areal extent of free-product is uncertain.

TABLE 7-23

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN OVERBURDEN WATER-BEARING ZONE, TRAINING GROUNDS AREA

	UPGRADIENT		DOWNGRADIENT												
PARAMETER (1) (2)	MW-6S		MW-8S			MW-12S			MW-13S		MW-14S		MW-15S		
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
Volatiles (mg/l)															
1,2-Dichloroethene (total)													0.009		
1,2-Dichloroethane													0.005	0.004	0.002J
1,1-Dichloroethene (total)		0.003		0.013								3.2		0.008	0.032
1,1-Dichloroethane												0.062			
Trichloroethane													0.007		
Trichloroethene												0.10		0.003	0.002J
Acetone														0.026J	
Methylene Chloride					0.002J			0.006B				0.046B			0.011B
Benzene												0.12		0.074	0.008
Toluene												0.30			
Ethylbenzene												0.16			
Total Xylene(o,m,p)												0.49			
Vinyl Chloride				0.027								1.9		0.008	
Semi-Volatiles (mg/l)															
Bis(2-ethylhexyl)phthalate	0.01 B				0.005J	0.01 B			0.01 B		0.01 B		0.01 B		
Di-n-butylphthalate					0.001JB				0.01 B						
PCBs (mg/l)															
Aroclor-1254												0.0049			

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - October sampling event; analysis for organic compounds only.

TABLE 7-23 (cont.)

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN OVERBURDEN WATER-BEARING ZONE, TRAINING GROUNDS AREA

PARAMETER (1) (2)	UPGRADIENT		DOWNGRADIENT												
	MW-6S		MW-8S			MW-12S			MW-13S		MW-14S		MW-15S		
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
<u>Inorganic Elements (mg/l)</u>															
Aluminum	0.519		1.73			5.33			2.29		31.2		3.22		
Antimony															
Arsenic	0.002 J	0.003B	0.0024 J	0.003B		0.0022	0.006B		0.002		0.007	0.011		0.004B	
Barium	0.019 J					0.058 J			0.03 J		0.196 J		0.045 J		
Beryllium											0.001 J				
Cadmium						0.001 J			0.001 J		0.002				
Calcium	160		26.5			51.1			208		182		49.8		
Chromium	0.009					0.008					0.042				
Cobalt											0.030 J		0.009 J		
Copper	0.009		0.007			0.015							0.009 J		
Iron	1.21	0.684	3.10	9.27		8.50	11.4		3.15	2.87	71.1	28.7	6.06	4.59	
Lead				0.039J							0.040				
Magnesium	111		13.3			30.9			83.8		92.2		33.6		
Manganese	1.37	1.3	1.28	1.85		0.373	1.73		0.712	0.522	5.04	3.54	7.69	7.28	
Mercury							0.0002B								
Nickel						0.0257 J					0.064				
Potassium	3.88 J		0.531 J			1.16 J			2.59 J		4.7 J		1.03 J		
Selenium															
Silver															
Sodium	71.5		11.8			20			41.6		54.2		21.7		
Thallium															
Vanadium											0.054				
Zinc	0.0589		0.0107 J			0.0322 J			0.016 J		0.223		0.0197 J		

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - October sampling event; analysis for organic compounds only.

TABLE 7-24

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN FREE-PRODUCT, TRAINING GROUNDS AREA

PARAMETER (1) (2)	MW-14S
Volatiles (mg/l)	
1,2-Dichloroethene (total)	140
1,2-Dichloroethane	
1,1-Dichloroethene (total)	
1,1-Dichloroethane	
Trichloroethane	
Trichloroethene	56
Acetone	
Methylene Chloride	79B
Benzene	
Toluene	390
Ethylbenzene	640
Total Xylene(o,m,p)	2400
Vinyl Chloride	
Semi-Volatiles (mg/l)	
Bis(2-ethylhexyl)phthalate	
Di-n-butylphthalate	
PCBs (mg/l)	
Aroclor-1254	2.9

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

From second round - August sampling event.

TABLE 7-24 (cont.)

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN FREE-PRODUCT, TRAINING GROUNDS AREA

PARAMETER (1) (2)	MW-14S
Inorganic Elements (mg/l)	
Aluminum	1.07
Antimony	
Arsenic	
Barium	20B
Beryllium	
Cadmium	
Calcium	12.5
Chromium	0.006B
Cobalt	
Copper	0.0076B
Iron	2.58
Lead	0.44
Magnesium	6.45
Manganese	5.07
Mercury	
Nickel	
Potassium	0.342B
Selenium	0.036
Silver	
Sodium	3.17B
Thallium	
Vanadium	0.01B
Zinc	0.043

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

From second round - August sampling event.

The organics detected in the ground water at MW-14S were comprised of four (4) chlorinated hydrocarbons, predominantly 1,1 dichloroethene (3.2 mg/l) and vinyl chloride (1.9 mg/l); and four (4) aromatic hydrocarbons, specifically, benzene, toluene, ethylbenzene, and total xylenes at concentrations of less than 0.49 mg/l. A PCB (Aroclor-1254) was present at 0.0049 mg/l.

Based on an analysis presented on Table 7-24, the free-product contains 3626 mg/l of the same (or related) volatile organics found in the ground water. A PCB (2.9 mg/l Aroclor-1254) was also detected in the product. These results indicate that the kerosene has been contaminated with chlorinated hydrocarbons, PCBs and possibly to some degree, with aromatic hydrocarbons (which are a minor component of kerosene). The source of these contaminants may be direct contact with contaminated soil after leakage, or with contaminated fuel or sludge in the storage tanks.

Well MW-8S is approximately 180 feet downgradient from MW-14S. Ground water from MW-8S exhibited low concentrations of 1,1 dichloroethene (0.013 mg/l) and vinyl chloride (0.027 mg/l) during the August sampling round. No organic parameters were detected at MW-8S in May.

Well MW-15S is located downgradient of the central portion of the Training Grounds Area. Trace concentrations of six (6) chlorinated hydrocarbons (0.021 mg/l to 0.037 mg/l TVO) were detected during the three sampling rounds. Benzene was detected at low concentrations during the second and third sampling rounds.

Inorganic Parameters - Iron and manganese concentrations are elevated above background concentrations at upgradient well MW-6S, and in all wells within and downgradient of the Training Grounds Area. Iron concentrations in MW-14S ranged from 29 to 71 mg/l; and manganese from 3.5 to 5.0 mg/l. These values reflect the reduced oxidation state of ground water due to oxidation of the free product at MW-14S. Elevated concentrations of iron and manganese at other locations probably occur at lower concentrations due to relatively less reducing conditions. Inorganic parameters that occur at elevated concentrations in ground water in this area are summarized as follows:

aluminum	1.7 - 31 mg/l
iron	2.7 - 71 mg/l
manganese	0.37 - 7.7 mg/l
lead	ND - 0.040 mg/l.

7.3.1.3 South Disposal Area

The South Disposal Area has two (2) upgradient wells (MW-9S and PZ-9) and one (1) downgradient well (MW-7S) in the overburden water bearing zone. PZ-9 was monitored for water levels only. Analytical results are summarized on Table 7-25.

Organic Parameters - No organic contaminants were detected in upgradient well MW-9S. However, the same suite of organic contaminants present in the soil/fill of the South Disposal Area (see Section 7.2.4) were also detected in the downgradient well (MW-7S).

Chlorinated hydrocarbons detected at MW-7S include the following:

1,1 dichloroethene	0.12 mg/l
1,1 dichloroethane	0.21 - 0.69 mg/l
1,2 dichloroethene	11 - 30 mg/l
1,2 dichloroethane	ND - 0.021 mg/l
vinyl chloride	ND - 0.084 mg/l
1,1,1 trichloroethane	5.3 - 7.9 mg/l
trichloroethene	0.46 - 0.94 mg/l
tetrachloroethene	ND - 0.088 mg/l

The aromatic hydrocarbons (benzene, toluene, chlorobenzene, ethylbenzene, and total xylenes) were detected at concentrations up to 1.8 mg/l total xylenes and 0.91 mg/l toluene. Toluene and total xylenes were detected during all three (3) sampling events. Acetone, 2-butanone, and 4-methyl-2-pentanone were detected in the first sampling event at concentrations up to 1.5 mg/l (acetone). All volatile organics detected in downgradient overburden ground water were also detected in the soil/fill at the South Disposal Area.

Low concentrations of phenolic compounds were detected during each of the May, August, and October sampling events at MW-7S. The maximum concentration was 0.050 mg/l 4-methylphenol. PCBs were detected in MW-7S on two sampling rounds at

TABLE 7-25

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN OVERBURDEN WATER-BEARING ZONE, SOUTH DISPOSAL AREA

PARAMETER (1) (2)	UPGRADIENT		DOWNGRADIENT		
	MW-9S		MW-7S		
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
Volatiles (mg/l)					
1,1-Dichloroethene			0.12 J		
1,1-Dichloroethane			0.21 J	0.69	0.28J
1,2-Dichloroethene (total)			11.0	30	12*
Chloroform			0.008 B		
1,2-Dichloroethane			0.021		
Vinyl Chloride			0.084		
Acetone			1.6		
Methylene Chloride				0.45B	0.58
2-Butanone			0.15		
1,1,1-Trichloroethane			6.7	7.9	5.3
Bromodichloromethane			0.009		
Trichloroethene			0.94	0.46	
Benzene			0.009		
4-Methyl-2-pentanone			0.16		
Tetrachloroethene			0.088		
Toluene			0.89	0.91	0.62
Chlorobenzene			0.008		
Ethylbenzene			0.17 J		0.34J
Total Xylenes			0.86 J	2.3	1.81

* cis isomer

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - November sampling event; analysis for organic compounds only.

TABLE 7-25 (cont.)

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN OVERBURDEN WATER-BEARING ZONE, SOUTH DISPOSAL AREA

PARAMETER (1) (2)	UPGRADIENT		DOWNGRADIENT		
	MW-9S		MW-7S		
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
Semi-Volatiles (mg/l)					
Phenol			0.015 J	0.017J	0.005J
2-Methylphenol			0.010 J	0.010J	0.005J
4-Methylphenol			0.027 J	0.050J	0.02
2,4-Dimethylphenol			0.004 J	0.014J	0.012
Pentachlorophenol				0.001J	
Benzoic Acid				0.012J	
Naphthalene					
2-Methylnaphthalene					
Diethylphthalate			0.083		0.05
N-nitrosodiphenylamine					
Di-n-butylphthalate			0.01 B		0.002JB
Bis(2-ethylhexyl)phthalate	0.01 B		0.01 B		0.006J
PCBs (mg/l)					
Aroclor-1254				0.0026	0.005

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - November sampling event; analysis for organic compounds only.

TABLE 7-25 (cont.)

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN OVERBURDEN WATER-BEARING ZONE, SOUTH DISPOSAL AREA

PARAMETER (1) (2)	UPGRADIENT MW-9S		DOWNGRADIENT MW-7S		
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
Inorganic Elements (mg/l)					
Aluminum	2.11		3.8		
Arsenic			0.0002	0.010	
Barium	0.059 J		0.146 J		
Beryllium					
Cadmium			0.0023 J		
Calcium	105		124		
Chromium			0.00134		
Cobalt					
Copper	0.0112 J		0.0189 J		
Iron	3.72	8.21	18.3	13.9	
Lead				0.059J	
Magnesium	25.8		70.1		
Manganese	0.0718	0.407	1.86	1.65	
Mercury					
Nickel					
Potassium	2.92 J		2.28 J		
Selenium			0.0023		
Sodium	4.67 J		18.5		
Vanadium					
Zinc	0.0107 J		0.0819		

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - November sampling event; analysis for organic compounds only.

concentrations of 0.0026 mg/l and 0.005 mg/l Aroclor 1254. PCBs and phenol were also detected in the soil/fill samples collected in this area.

Inorganic Parameters - Several metals were detected in MW-7S at concentrations substantially greater than at the upgradient well MW-9S. These included three (3) metals that exceeded 6 NYCRR Part 703 ground water standards as follows:

Iron	14 - 18 mg/l
Manganese	1.7 - 1.9 mg/l
Lead	ND - 0.059 mg/l

The downgradient increase in iron and other trace metals is consistent with a change in the oxidation-reduction properties of the overburden water bearing zone to more reducing conditions.

7.3.2 Bedrock Water Bearing Zone

The monitoring interval for each bedrock well is as follows:

- Upper Bedrock

  North Disposal Area - MW-10I, MW-11I, MW-16I

  Training Grounds Area - MW-6I, MW-8I, MW-12I

  South Disposal Area - MW-9I and MW-7I

- Deep Bedrock

  Training Grounds Area - MW-6D and MW-8D

  South Disposal Area - MW-7D.

Hydrogeologic conditions in the bedrock aquifer are discussed in Section 5.4.3. Field measurements and field observations recorded during sampling are presented in the summaries of the remediation assessment parameters (Tables 7-18 to 7-20). Well locations are shown in Figure 7-2. As discussed in Section 5.4, the bedrock aquifer discharges into the Genesee River, which is most likely a regional ground water discharge zone.

All bedrock ground water samples are bicarbonate-sulfate water with high hardness (400 - 2200 mg/l). These characteristics are consistent with the occurrence of dolomitic bedrock.

An increase in reduced nitrogen species and, locally, a reduction in sulfate concentrations indicate that oxidation-reduction conditions within the bedrock aquifer became relatively more reducing between the May and August sampling events. Based on the detection of hydrogen sulfide or a hydrogen sulfide odor in 10 of 11 bedrock wells during at least one sampling event, the bedrock aquifer appears to be relatively more reducing than the overburden aquifer. Overall, iron concentrations in the bedrock aquifer are less than in the overburden ground water. Dissolved iron content in the bedrock ground water may be controlled by the precipitation of iron sulfides. The highest concentrations of hydrogen sulfide were detected in the deep bedrock wells (30 mg/l in MW-8D, and 15 mg/l in MW-7D), indicating that the bedrock becomes more reducing with depth.

7.3.2.1 North Disposal Area

This area has one (1) upgradient bedrock well (MW-10I), and two (2) downgradient bedrock wells (MW-11I and MW-16I). All bedrock wells are screened in the upper ten feet of bedrock in the upper bedrock zone. Analytical results are summarized on Table 7-26.

Organic Parameters - A trace concentration of 1,2 dichloroethane was detected on one occasion at upgradient well MW-10I. The concentrations of chlorinated hydrocarbons detected at downgradient wells MW-11I and MW-16I are as follows:

1,2-dichloroethane	0.003 - 0.006 mg/l
1,1 dichloroethane	ND - 0.075 mg/l
vinyl chloride	ND - 0.055 mg/l

Since the overburden well at MW-11S exhibited no organic contaminants and the soil/fill in the North Disposal Area exhibits only trace concentrations of volatile organics, these concentrations may be the result of contaminant migration via bedrock flow from the shallow ground water contamination identified within the Training Grounds Area.

TABLE 7-26

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN BEDROCK AQUIFER, NORTH DISPOSAL AREA AND AREA TO NORTH

PARAMETER (1) (2)	UPGRADIENT		DOWNGRADIENT			NORTH OF NORTH DISPOSAL AREA	
	MW-10I		MW-11I			MW-16I	
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND
Volatiles (mg/l)							
1,2-Dichloroethane	0.004					0.006	0.003
Trichloroethene							
Methylene Chloride		0.002B			0.011B		
Vinyl Chloride					0.055		
1,2-Dichloroethene(total)							
1,1-Dichloroethene(total)					0.075		
Semi-Volatiles (mg/l)							
Bis(2-ethylhexyl)phthalate	0.01 B				0.005J		
Di-n-butylphthalate					0.001JB		
PCBs (mg/l)							
Aroclor-1254							

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - October sampling event; analysis for organic compounds only.

TABLE 7-26 (cont.)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF ANALYTES DETECTED IN BEDROCK AQUIFER, NORTH DISPOSAL AREA AND AREA TO NORTH

PARAMETER (1) (2)	UPGRADIENT		DOWNGRADIENT			NORTH OF NORTH DISPOSAL AREA	
	MW-10I		MW-11I			MW-16I	
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND
Inorganic Elements (mg/l)							
Aluminum	0.133 J					0.868	
Arsenic	0.001 J			0.005B			
Barium	0.135		0.022 J			0.104 B	
Beryllium							
Cadmium	0.0012 J						
Calcium	114		155			146	
Chromium							
Cobalt						0.128 J	
Copper							
Iron	0.116	0.230	0.197	14.1		1.37	1.20
Lead						0.032	
Magnesium	51.8		45.4			63.8	
Manganese	0.012	0.012B	0.012	1.77		0.061	0.053
Mercury							
Nickel							
Potassium	1.83		1.4			2.74 J	
Selenium							
Sodium	25.9		26.2			30.6	
Vanadium							
Zinc			0.006			0.064	

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.
J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - October sampling event; analysis for organic compounds only.

Inorganic Parameters - Downgradient wells exhibited elevated concentrations of iron (14 mg/L) and manganese (1.8 mg/L) with respect to the upgradient well. In addition, cobalt (0.128 mg/L) and lead (0.032 mg/L) were detected in MW-16I.

7.3.2.2 Training Grounds Area

This Area has one (1) upgradient upper bedrock well (MW-6I), and two (2) downgradient upper bedrock wells (MW-8I and MW-12I). In addition, the upgradient deep bedrock well (MW-6D), and one (1) downgradient deep bedrock well (MW-8D) are in the Training Grounds Area. Analytical results are summarized on Table 7-27.

Organic Parameters - The upgradient wells in the upper and deep bedrock both exhibit trace concentrations of chlorinated hydrocarbons, as follows:

1,2 dichloroethene	ND - 0.018 mg/l
1,1 dichloroethene	0.009 - 0.023 mg/l
tetrachloroethene	ND - 0.002 mg/l

One or more of these compounds were detected in MW-6I or MW-6D during each sampling round. The persistent occurrence of these chlorinated hydrocarbons in the upgradient well suggests that a source of contamination may be present at a further upgradient location.

Downgradient bedrock wells at MW-8I and MW-12I exhibited one or more of the following chlorinated hydrocarbons:

1,2-dichloroethene	0.020 - 4.7 mg/l
1,1-dichloroethene	0.020 - 0.030 mg/l
tetrachloroethene	ND - 0.001 mg/l
1,1-dichloroethane	ND - 0.003 mg/l
trichloroethene	0.010 - 0.022 mg/l
vinyl chloride	0.17 - 4.5 mg/l

The source of organic contamination at MW-8I (and possibly MW-11I) may be the shallow ground water contamination detected near the storage tanks and burn pits in the Training Grounds Area. This relationship would require that the contaminated ground water within the Training Grounds follows a downward hydraulic gradient in the overburden water-bearing zone and then preferentially follows the highly permeable upper bedrock zone towards the river.

TABLE 7-27

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN BEDROCK AQUIFER, TRAINING GROUNDS AREA

PARAMETER (1) (2)	UPGRADIENT MW-6I			UPGRADIENT MW-6D		DOWNGRADIENT MW-8I			DOWNGRADIENT MW-8D		DOWNGRADIENT MW-12I		
	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
<u>Volatiles (mg/l)</u>													
1,2-Dichloroethene (total)	0.018					0.20					4.7		
1,2-Dichloroethane													
1,1-Dichloroethene (total)			0.023	0.009	0.011		0.20	0.30					
Tetrachloroethene				0.002J		0.001J							
1,1-Dichloroethane							0.003						
Trichloroethane													
Trichloroethene						0.01	0.01	0.022					
Acetone									0.079B				
Methylene Chloride							0.002B	0.003JB		0.001B			0.006B
Benzene													
Toluene													
Ethylbenzene													
Total Xylene(o,m,p)													
Vinyl Chloride						0.17	0.027	0.23			4.5		
<u>Semi-Volatiles (mg/l)</u>													
Benzyl Alcohol											0.002J		
Nitrobenzene											0.001J	–	
Bis(2-chloroethoxy)methane											0.002J		
2-Methylnaphthalene											0.004J		
Bis(2-ethylhexyl)phthalate	0.01B			0.01B		0.01B		0.01	0.01B		0.01B		0.004J
Di-n-butylphthalate			0.001JB			0.01B							
<u>PCBs (mg/l)</u>													
Aroclor-1254													

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - October sampling event; analysis for organic compounds only.

TABLE 7-27 (cont.)

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

SUMMARY OF ANALYTES DETECTED IN BEDROCK AQUIFER, TRAINING GROUNDS AREA

PARAMETER (1) (2)	UPGRADIENT					DOWNGRADIENT							
	MW-6I			MW-6D		MW-8I			MW-8D		MW-12I		
	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND
<u>Inorganic Elements (mg/l)</u>													
Aluminum	0.393 B			1.39		0.512					2.25		
Antimony													
Arsenic	0.001 J					0.001 J					0.003 J		
Barium	0.107 J			0.116 J		0.070 J			0.014 J		0.206		
Beryllium													
Cadmium									0.001 J				
Calcium	99.8			162		137			445		183		
Chromium											0.010		
Cobalt													
Copper	0.005 J			0.006							0.007		
Iron	0.418	0.967		2.07	0.268	0.752	0.875		0.05J	0.187	6.85	7.55	
Lead													
Magnesium	37.0			55.9		61.0			96.6		55.1		
Manganese	0.043	0.047		0.101	0.031	0.048	0.046		0.012J	0.008B	0.406	0.416	
Mercury							0.0002						
Nickel													
Potassium	2.53 J			2.68 J		3.76 J			1.63 J		2.65 J		
Selenium													
Silver													
Sodium	30.1			25.1		26.8			17.8		81.2		
Thallium													
Vanadium													
Zinc	0.021			0.128		0.022			0.004 J		0.081		

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.

J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - October sampling event; analysis for organic compounds only.

The source of volatile organic compound (VOC) contamination at MW-12I is questionable. As discussed in Section 7.2, only a low magnitude of contamination was detected in areas that are upgradient of MW-12I (the Firing Range Area and the southern portion of the Training Grounds). Well MW-12I is cross-gradient from both MW-7I and MW-7S, and is not likely to be influenced by contamination originating from the South Disposal Area. Therefore, there is no apparent source for the contamination detected in MW-12I. Furthermore, volatile organics were detected only during the May sampling event. A review of field sampling forms for the May sampling event indicates that well cluster MW-12S/12I was sampled immediately following the collection of samples at well cluster MW-7S/7I/7D in the South Disposal Area, which exhibited high concentrations of VOCs. Therefore, the VOCs detected at MW-12I during the May sampling event may be attributable to cross-contamination which could have occurred during the sampling procedure.

No organic contamination was detected in the deep bedrock well at MW-8D. It should be noted that the upper bedrock is more highly contaminated with volatile organics than is the shallow overburden at the downgradient ground water monitoring locations in this area. This is also true in the North Disposal Area.

Inorganic Parameters - Iron occurs at elevated concentrations in MW-12I (6.9 to 7.6 mg/l) and in MW-6D (2.1 mg/l). Otherwise inorganic contamination is absent in the bedrock aquifer beneath the Training Grounds Area. Iron sulfide precipitation, which is indicated by the local occurrence of iron and hydrogen sulfide in ground water, may be limiting the concentrations of iron and other trace metals in the bedrock aquifer.

7.3.2.3 South Disposal Area

This Area has one (1) upgradient well (MW-9I), and one (1) downgradient well (MW-7I) in the upper bedrock. A downgradient deep bedrock well is located at MW-7D. Analytical results are summarized on Table 7-28.

Organic Parameters - The upgradient ground water exhibits one occurrence of volatile organics (1,1 dichloroethene at 0.047 mg/l). The downgradient upper bedrock well (MW-7I) exhibits a TVO ranging from 1.5 to 13 mg/l. The TVO in the deep bedrock at

TABLE 7-28

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF ANALYTES DETECTED IN BEDROCK AQUIFER, SOUTH DISPOSAL AREA

PARAMETER (1) (2)	UPGRADIENT MW-9I		DOWNGRADIENT MW-7I			DOWNGRADIENT MW-7D	
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND
Volatiles (mg/l)							
1,1-Dichloroethene		0.047	0.077	0.14	0.25		
1,1-Dichloroethane			0.53	0.11	0.59	0.011	0.004
1,2-Dichloroethene (total)							
Chloroform			0.008 B				
1,2-Dichloroethane			0.013		0.008J		
Vinyl Chloride			0.053		0.17		
Acetone			0.13		0.48J	0.024 B	
Methylene Chloride				0.007B	0.041B		
2-Butanone			0.037				
1,1,1-Trichloroethane			2.6	0.56	0.39	0.039	0.004
Bromodichloromethane			0.003 J				
Trichloroethene			2.6	0.70	0.48	0.039	0.010
Benzene							
4-Methyl-2-pentanone			0.03		0.89		
Tetrachloroethene			0.038	0.023			0.003
Toluene			0.035		10J		
Ethylbenzene			0.006				
Total Xylenes			0.038				
Semi-Volatiles (mg/l)							
Diethylphthalate			0.010 J		0.003J		
Di-n-butylphthalate					0.001JB		
Bis(2-ethylhexyl)phthalate	0.01 B		0.01 B		0.022		
PCBs (mg/l)							
Aroclor-1254					0.003		

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.
J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - November sampling event; analysis for organic compounds only.

TABLE 7-28 (cont)

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS
SUMMARY OF ANALYTES DETECTED IN BEDROCK AQUIFER, SOUTH DISPOSAL AREA

PARAMETER (1) (2)	UPGRADIENT		DOWNGRADIENT				
	MW-9I		MW-7I			MW-7D	
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	THIRD ROUND	FIRST ROUND	SECOND ROUND
Inorganic Elements (mg/l)							
Aluminum	0.789		0.395			0.147 J	
Arsenic				0.010		0.0052 J	
Barium	0.152 J		0.155 J			0.018 J	
Beryllium							
Cadmium							
Calcium	142		147			226	
Chromium	0.0083 J						
Cobalt							
Copper	0.006 J					0.0073 J	
Iron	1.64	3.77	0.474	0.777		0.165	0.178
Lead		0.060J					
Magnesium	50		45.1			59.4	
Manganese	0.086	0.123	0.0674	0.092		0.0131 J	0.0088
Mercury							
Nickel							
Potassium	1.38 J		2.31 J			1.46 J	
Selenium							
Sodium	17.2		47.1			18.4	
Vanadium							
Zinc	0.115		0.0248			0.0062 J	

NOTE:

(1) - Analytes detected above quantification limits.

(2) - Laboratory qualifiers: B - Estimated detection limit due to blank contamination.
J - Estimated value due to limitations identified during QC review.

First Round - May sampling event.

Second Round - August sampling event; analysis for VOCs, Acid Extractables, PCBs, As, Cd, Fe, Pb, Mn and Hg.

Third Round - November sampling event; analysis for organic compounds only.

MW-7D is substantially less (0.021 to 0.089 mg/l). It should be noted that the TVO in the overburden well (MW-7S) is somewhat higher (21 to 42 mg/l). One or more of the following chlorinated hydrocarbons were detected in the downgradient bedrock wells:

1,1 dichloroethene	0.077 - 0.25 mg/l
1,1 dichloroethane	0.004 - 0.59 mg/l
1,2 dichloroethane	0.008 - 0.013 mg/l
vinyl chloride	0.17 - 0.053 mg/l
1,1,1 trichloroethane	0.004 - 2.6 mg/l
trichloroethene	0.010 - 2.6 mg/l
tetrachloroethene	0.003 - 0.038 mg/l

Toluene, ethylbenzene, and total xylenes occur at concentrations up to 10 mg/l. Acetone, 2-butanone, and 4-methyl-2-pentanone were also detected in the upper bedrock well. All organic contaminants detected in the bedrock ground water were also detected in the overburden ground water at MW-7S, and in the soil/fill in the North Disposal Area.

Inorganic Parameters - Concentrations of iron and lead were detected at the upgradient bedrock well MW-9I in excess of NYCRR Part 703 ground water standards. No inorganic contamination was detected in the downgradient wells.

7.3.3 Summary of Ground Water Results

Ground water sampling and analysis at the Rochester Fire Academy site has demonstrated that organic and, to a lesser extent, inorganic contamination occurs in the overburden and bedrock ground water. Organic contamination in ground water reflects the nature and extent of organic contamination present in the soil/fill material overlying the aquifer.

Organic contaminants have been identified in all upgradient bedrock wells. Therefore, an upgradient source of chlorinated hydrocarbons may be present.

Iron and manganese are the most widespread inorganic contaminants that have been identified in ground water. The source of the metals is most likely the mobilization of naturally occurring iron and manganese from the aquifer matrix due to anaerobic conditions in the ground water. Former waste disposal practices have indirectly influenced metal concentrations in ground water by providing organic material that contributes to the anaerobic (reducing) conditions. Other trace metals, in particular lead, also occur locally at elevated concentrations.

The frequency of detection, and maximum concentration of all organic and inorganic contaminants that were detected in ground water above analytical detection limits at least once are presented in Table 7-29 for overburden ground water and Table 7-30 for bedrock ground water.

North Disposal Area - Organic contamination is absent in the overburden ground water, but low concentrations of chlorinated hydrocarbons occur in the upper bedrock. Based on ground water flow patterns, the source of these contaminants is probably the northern portion of the Training Grounds Area.

Training Grounds Area - Contaminated soil/fill material near the storage tanks, the burn pits and throughout much of the southern portion of the Training Grounds Area are contributing organic contaminants to the ground water due to the leaching of contaminated soil by infiltrating precipitation during periods of low ground water levels, and by direct contact between ground water and contaminated soils during periods of high ground water levels. Since the upper bedrock ground water is more highly contaminated than the shallow overburden ground water, organic contaminants are most likely migrating to the upper bedrock due to a downward hydraulic gradient at source area locations. Contaminant migration than occurs preferentially through the highly permeable upper bedrock zone. There is also potential for chlorinated and aromatic hydrocarbons to enter the ground water from a free product plume, which may act as a continuous source of dissolved organics.

South Disposal Area - The leaching of organic contaminants from the soil/fill material contributes moderate to high concentrations of chlorinated hydrocarbons and low concentrations of phenolic compounds and PCBs to the overburden and bedrock ground water. In contrast to the vertical distribution of contaminants in the Training Grounds and North Disposal Areas, which increase in concentration with depth, ground water contaminant concentrations decrease in the South Disposal Area with depth. This is probably due to the close proximity of well cluster MW-7S/7I/7D to the source of contamination.

TABLE 7-29
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS
FREQUENCY OF ANALYTE DETECTION IN OVERBURDEN GROUND WATER (1)

PARAMETER	NORTH DISPOSAL AREA (2)			TRAINING GROUNDS AREA (3)			SOUTH DISPOSAL AREA (4)		
	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX
Volatiles (mg/l)									
1,1-Dichloroethene				5	3.2	MW-14S	3	0.12	MW-7S
1,1-Dichloroethane				1	0.062	MW-14S	3	0.69	MW-7S
1,2-Dichloroethene (total				1	0.009	MW-15S	1	30	MW-7S
Chloroform									
1,2-Dichloroethane				3	0.005	MW-15S	1	0.021	MW-7S
Vinyl Chloride				2	1.9	MW-14S	1	0.084	MW-7S
Acetone				1	0.026	MW-15S	1	1.6	MW-7S
Methylene Chloride				1	0.002	MW-8S	1	0.58	MW-7S
2-Butanone							1	0.15	MW-7S
Trichloroethane				1	0.007	MW-15S			
1,1,1-Trichloroethane							3	7.9	MW-7S
Bromodichloromethane							1	0.009	MW-7S
Trichloroethene				3	0.10	MW-14S	2	0.46	MW-7S
Benzene				3	0.12	MW-14S	2	0.009	MW-7S
4-Methyl-2-pentanone							1	0.16	MW-7S
Tetrachloroethene							1	0.088	MW-7S
Toluene				1	0.30	MW-14S	3	0.91	MW-7S
Chlorobenzene							1	0.008	MW-7S
Ethylbenzene				1	0.16	MW-14S	2	0.34	MW-7S
Total Xylenes				1	0.49	MW-14S	3	2.3	MW-7S
Semi-Volatiles (mg/l)									
Phenol							3	0.017	MW-7S
2-Methylphenol							3	0.010	MW-7S
4-Methylphenol							3	0.050	MW-7S
2,4-Dimethylphenol							3	0.014	MW-7S
Pentachlorophenol							1	0.001	MW-7S
Benzoic Acid							1	0.012	MW-7S
Diethylphthalate							2	0.063	MW-7S
Di-n-butylphthalate									
Bis(2-ethylhexyl)phthalat	1	0.013	MW-11S	1	0.005	MW-8S	3	0.006	MW-7S

NOTE:

(1) Number of detections above detection limit.

(2) Total number of 5 samples collected.

(3) Total number of 15 samples collected.

(4) Total number of 5 samples collected.

TABLE 7-29 (Cont'd)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS
FREQUENCY OF ANALYTE DETECTION IN OVERBURDEN GROUND WATER (1)

	NORTH DISPOSAL AREA (2)			TRAINING GROUNDS AREA (3)			SOUTH DISPOSAL AREA (4)		
PARAMETER	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX
PCBs (mg/l)									
Aroclor-1254				1	0.0049		2	0.005	MW-7S
Inorganic Elements (mg/l)									
Aluminum	1	12	MW-11S	6	31	MW-14S	2	3.8	MW-7S
Antimony									
Arsenic	2	0.007	MW-11S	10	0.011	MW-14S	2	0.010	MW-7S
Barium	2	0.070	MW-11S	5	0.20	MW-14S	2	0.15	MW-7S
Beryllium				1	0.001	MW-14S			
Cadmium				1	0.002	MW-14S	1	0.002	MW-7S
Calcium	2	100	MW-11S	6	208	MW-13S	2	124	MW-7S
Chromium	1	0.017	MW-11S	3	0.042	MW-14S	1	0.001	MW-7S
Cobalt	1	0.014	MW-11S	2	0.030	MW-14S			
Copper	2	0.015	MW-11S	4	0.015	MW-12S	2	0.019	MW-7S
Iron	4	18	MW-11S	12	71	MW-14S	4	18	MW-7S
Lead				2	0.40	MW-14S	1	0.059	MW-7S
Magnesium	2	81	MW-11S	6	111	MW-6S	2	70	MW-7S
Manganese	4	1.8	MW-11S	12	7.7	MW-15S	4	1.9	MW-7S
Mercury									
Nickel	1	0.026	MW-11S	2	0.064	MW-14S			
Potassium	2	1.0	MW-11S	6	4.7	MW-14S	2	2.9	MW-9S
Selenium							1	0.002	MW-7S
Silver									
Sodium	2	21	MW-11S	6	71.5	MW-6S	2	18.5	MW-7S
Thallium									
Vanadium	1	0.018	MW-11S	1	0.054	MW-14S			
Zinc	2	0.065	MW-11S	6	0.22	MW-14S	2	0.082	MW-7S

NOTE:

(1) Number of detections above detection limit.

(2) Total number of 5 samples collected.

(3) Total number of 15 samples collected.

(4) Total number of 5 samples collected.

TABLE 7-30

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS

FREQUENCY OF ANALYTE DETECTION IN BEDROCK GROUND WATER (1)

	NORTH DISPOSAL AREA (2)			TRAINING GROUNDS AREA (3)			SOUTH DISPOSAL AREA (4)		
PARAMETER	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX
<u>Volatiles (mg/l)</u>									
1,1-Dichloroethene				5	0.30	MW-8I	4	0.25	MW-7I
1,1-Dichloroethane				1	0.003	MW-8I	5	0.59	MW-7I
1,2-Dichloroethene (total)	1	0.075	MW-11I	3	4.7	MW-12I			
Chloroform									
1,2-Dichloroethane	3	0.006	MW-16I				1	0.013	MW-7I
Vinyl Chloride	1	0.055	MW-11I	4	4.5	MW-12I	2	0.17	MW-7I
Acetone							2	0.48	MW-7I
Methylene Chloride									
2-Butanone							1	0.037	MW-7I
1,1,1-Trichloroethane							5	2.6	MW-7I
Bromodichloromethane							1	0.003	MW-7I
Trichloroethene				3	0.022	MW-8I	5	2.6	MW-7I
Benzene									
4-Methyl-2-pentanone							2	0.89	MW-7I
Tetrachloroethene				2	0.002	MW-6D	3	0.038	MW-7I
Toluene							2	10	MW-7I
Chlorobenzene									
Ethylbenzene							1	0.006	MW-7I
Total Xylenes							1	0.038	MW-7I
<u>Semi-Volatiles (mg/l)</u>									
Phenol									
2-Methylphenol									
4-Methylphenol									
2,4-Dimethylphenol									
Pentachlorophenol									
Benzoic Acid									
Benzyl Alcohol				1	0.002	MW-12I			
Nitrobenzene				1	0.001	MW-12I			
Naphthalene									
2-Methylnaphthalene				1	0.004	MW-12I			
Diethylphthalate							2	0.010	MW-7I
N-nitrosodiphenylamine									
Di-n-butylphthalate									
Bis(2-ethylhexyl)phthalate	1	0.005	MW-11I	2	0.01	MW-8I	1	0.022	MW-7I
Bis(2-chloroethoxy)methane				1	0.002	MW-12I			

NOTE:

(1) Number of detections above detection limits.

(2) Total number of 7 samples collected.

(3) Total number of 13 samples collected.

(4) Total number of 7 samples collected.

TABLE 7-30 (Cont'd)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY RI/FS
FREQUENCY OF ANALYTE DETECTION IN BEDROCK GROUND WATER (1)

	NORTH DISPOSAL AREA (2)			TRAINING GROUNDS AREA (			SOUTH DISPOSAL AREA (4)		
PARAMETER	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX	NO. OF DETECT.	MAX CONC.	LOC. OF MAX
<u>PCBs (mg/l)</u>									
Aroclor-1254							1	0.003	MW-7I
<u>Inorganic Elements (mg/l)</u>									
Aluminum	2	0.87	MW-16I	4	2.25	MW-12I	3	0.79	MW-9I
Antimony									
Arsenic	2	0.001	MW-10I	3	0.003	MW-12I	2	0.010	MW-7I
Barium	3	0.135	MW-10I	5	0.21	MW-12I	3	0.155	MW-7I
Beryllium									
Cadmium	1	0.001	MW-10I	1	0.001	MW-8D			
Calcium	3	155	MW-11I	5	445	MW-8D	3	226	MW-7D
Chromium				1	0.010	MW12I	1	0.008	MW-9I
Cobalt	1	0.13	MW-16I						
Copper				3	0.007	MW-12I	2	0.007	MW-7D
Iron	6	14.1	MW-11I	10	7.6	MW-12I	6	3.8	MW-9I
Lead	1	0.032	MW-16I				1	0.060	MW-91
Magnesium	3	53.8	MW-16I	5	97	MW-8D	3	59	MW-7D
Manganese		1.8	MW-11I	10	0.42	MW-12I	6	0.12	MW-9I
Mercury				1	0.0002	MW-8I			
Nickel									
Potassium	3	2.7	MW-16I	5	3.8	MW-8I	3	2.3	MW-7I
Selenium									
Silver									
Sodium	3	31	MW-16I	5	81	MW-12I	3	47	MW-7I
Thallium									
Vanadium									
Zinc	2	0.064	MW-16I	5	0.13	MW-8D	3	0.12	MW-9I

NOTE:

(1) Number of detections above detection limits.

(2) Total number of 7 samples collected.

(3) Total number of 13 samples collected.

(4) Total number of 7 samples collected.

7.4 ANALYTICAL RESULTS FOR SURFACE WATER

7.4.1 On-site Ponds and Drainage Swales

Three (3) on-site ponds and two (2) drainage swales were sampled on one (1) occasion. Analytical results are presented on Tables 7-31 and 7-32.

Organic Parameters - Low concentrations of 10 volatile organic contamination (TVO: 2.1 mg/l) was detected at pond sampling location PS-3 in the South Disposal Area. With the exception of trace concentrations of chloroform and carbon tetrachloride, all volatile organics detected at PS-3 were also found in the soil/fill and ground water samples collected in the South Disposal Area.

Trace concentrations of acid extractable organics (maximum concentration 0.003 mg/l phenol) and diethylphthalate (0.003 mg/l) were also detected at PS-3.

No other organic contamination was detected at on-site ponds or drainage swales.

Inorganic Parameters - Lead was detected at concentrations ranging from 0.044 to 0.145 mg/l at PS-1, PS-2, PS-3, and SWSW-2.

7.4.2 Genesee River

The Genesee River was sampled at one upstream, one downstream, and two locations immediately adjacent to the site (intermediate stations). Analytical results are presented on Tables 7-33 and 7-34.

Organic Parameters - No organic contaminants were detected in water samples from the Genesee River.

Inorganic Parameters - In comparison to upstream and downstream sampling locations, a slight increase in nearly all metals was detected at intermediate sampling location GRW-2 (immediately downstream from the South Disposal Area).

TABLE 7-31

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY. RI/FS
SUMMARY OF ANALYTES DETECTED IN ON SITE SURFACE WATER

PARAMETER (1) (2)	POND			DRAINAGE SWALE	
	PS-1	PS-2	PS-3	SWSW-1	SWSW-2
Volatiles (mg/l)					
Acetone	0.010 B	0.010 B			
Vinyl Chloride			0.026 J		
1,1-Dichloroethane			0.25		
total-1,2-Dichloroethene			0.71		
Chloroform			0.016 J		
1,2-Dichloroethane			0.30		
1,1,1-Trichloroethane			0.48		
Carbon Tetrachloride			0.039		
Trichloroethene			0.26		
Tetrachloroethene			0.014 J		
Toluene			0.028		
Semi-Volatiles (mg/l)					
Bis(2-Ethylhexyl)Phthalate	0.013 B	0.011 B	0.010 B	0.010 B	0.010 B
Phenol			0.003 J		
2-Methylphenol			0.002 J		
4-Methylphenol			0.003 J		
2,4-Dimethylphenol			0.001 J		
Diethylphthalate			0.003 J		

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Laboratory Qualifers: B- Estimated detection limit due to blank contamination,
J- Estimated value due to limitations identified during the quality control review.

TABLE 7-31 (cont.)
CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY. RI/FS
SUMMARY OF ANALYTES DETECTED IN ON SITE SURFACE WATER

PARAMETER (1) (2)	POND			DRAINAGE SWALE	
	PS-1	PS-2	PS-3	SWSW-1	SWSW-2
Inorganic Elements (mg/l)					
Aluminum	5.2	1.56	0.767	7.62	1.49
Arsenic	0.005 J	0.003 J	0.003 J	0.010 J	0.002 J
Barium	0.108 J	0.056 J	0.237	0.116 J	0.029 J
Beryllium					
Cadmium		0.001 J	0.001 J	0.001 J	
Calcium	36.2	44.6	71.2	35	47.5
Chromium	0.011	0.012	0.02	0.018	0.018
Cobalt		0.025 J	0.009 J	0.014	
Copper	0.028	0.020 J	1.76	0.042	0.009 J
Iron	9.55	3.96	11.1	13.8	1.98
Lead	0.044	0.103	0.145	0.062	
Magnesium	13.8	12.3	16.4	10.5	9.97
Manganese	0.286	0.468	0.988	0.326	0.077
Mercury				0.0002 J	0.0002
Nickel			0.015 J		
Potassium	4.08 J	1.98 J	6.09	4.0 J	2.6 J
Selenium					
Silver			0.003 J	0.004 J	
Sodium	2.96 J	3.14 J	4.32 J	2.1 J	8.64
Vanadium	0.013 J	0.006 J		0.012 J	0.005 J
Zinc	0.089	0.126	1.22	0.179	0.086

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Laboratory Qualifers: B- Estimated detection limit due to blank contamination,
J- Estimated value due to limitations identified during the quality control review.

TABLE 7-32

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY. RI/FS
SUMMARY OF REMEDIATION ASSESSMENT AND FIELD PARAMETERS,ON-SITE SURFACE WATER

REMEDIATION ASSESSMENT	POND			DRAINAGE SWALE	
PARAMETERS (1) (2) (mg/l)	PS-1	PS-2	PS-3	SWSW-1	SWSW-2
Acidity					
Alkalinity	92	118	166	74	134
Bicarbonate	92	118	166	74	134
Chloride	4.0	4.0	38	4.0	4.0
COD	27	20	34	99	68
Total Hardness	108	116	216	104	152
Nitrate					
Nitrogen Ammonia	0.05	0.17	0.71	0.05	0.07
Nitrogen Kjeldahl, Total	0.16	0.17	1.62	0.26	0.24
Oil and Grease					
Total Phosphate				0.17	0.13
Sulfate	12	12	8.1	9.0	32
Sulfide					
Total Dissolved Solids	100	200	138	120	152
TOC	12.9	15.2	10.7	11.7	9.0
FIELD PARAMETERS					
pH	7.20	7.50	7.31	6.87	7.02
Specific Conductance (uhmos)	182	189	316	175	291
Turbidity (ntu)	>100	4	22	>100	53
Appearance	Turbid, Brown	Clear	Clear	Turbid, Brown	Clear

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Surface water samples collected on 5/17/90

TABLE 7-33

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY, RI/FS
SUMMARY OF ANALYTES DETECTED IN GENESEE RIVER SURFACE WATER

PARAMETER (1) (2)	UP STREAM	MIDSTREAM		DOWN STREAM
Volatiles (mg/l)	GRW-1	GRW-2	GRW-3	GRW-4
Acetone	0.010 B			
Semi-Volatiles (mg/l)				
Bis(2-Ethylhexyl)Phthalate	0.010 B	0.011 B	0.010 B	0.010 B
Inorganic Elements (mg/l)				
Aluminum	3.35	4.03	3.02	3.09
Arsenic	0.001 J	0.002 J	0.001 J	0.001 J
Barium	0.053 J	0.064 J	0.048	0.049 J
Beryllium				
Cadmium				
Calcium	53.6	69.9	50.9	54
Chromium	0.013	0.011	0.01	
Cobalt	0.016 J		0.011 J	
Copper	0.007 J	0.013 J	0.007 J	0.004 J
Iron	5.3	7.1	5.6	5.54
Lead				
Magnesium	12.4	16.2	11.7	12.5
Manganese	0.109	0.154	0.126	0.115
Nickel				
Potassium	3.21 J	3.68 J	2.83 J	2.57 J
Selenium				
Sodium	25.2	34.2	25.4	26.1
Vanadium	0.005 J		0.007 J	
Zinc	0.032	0.466	0.036	0.032

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Laboratory Qualifers: B - Estimated detection limit due to blank contamination,
J - Estimated value due to limitations identified during the quality control review.

TABLE 7-34

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY. RI/FS
SUMMARY OF REMEDIATION ASSESSMENT AND FIELD PARAMETERS, GENESEE RIVER

REMEDIATION ASSESSMENT	UP STREAM	MIDSTREAM		DOWN STREAM
PARAMETERS (1) (mg/l)	GRW-1	GRW-2	GRW-3	GRW-4
Acidity				
Alkalinity	120	112	123	126
Bicarbonate	120	112	123	126
Chloride	40	40	40	40
COD	35	38	50	53
Total Hardness	180	184	182	186
Nitrate	0.89	0.91	0.91	0.91
Nitrogen Ammonia	0.12	0.11	0.11	0.12
Nitrogen Kjeldahl, Total	0.28	0.27	0.23	0.22
Oil and Grease	10.8			
Total Phosphate				
Sulfate	25	34	24	44
Sulfide				
Total Dissolved Solids	198	188	194	192
TOC		5.3	5.3	5.2
FIELD PARAMETERS				
pH	7.70	7.80	7.80	7.80
Specific Conductance (uhmos)	550	550	550	550
Turbidity	62	53	60	47
Appearance	Clear	Clear	Clear	Clear

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Surface water samples collected on 5/16/90.

7.5 ANALYTICAL RESULTS FOR SEDIMENT SAMPLING

Sediment was collected at the four (4) river sampling locations, and two (2) on-site drainage swale locations. Analytical results are presented on Table 7-35.

7.5.1 Swale Sediment

Organic Parameters - Trace concentrations of 2-butanone, trichloroethene, tetrachloroethene, and toluene (maximum concentration 0.029 mg/Kg 2-butanone) were detected in swale sediment at SWSD-2. PCB (11 mg/Kg - Aroclor 1254) was also detected. This swale received drainage from the South Disposal Area and from the Firing Range Area. However, the portion of the swale that was sampled drains only the South Disposal Area. The occurrence of these same contaminants within the fill of the South Disposal Area indicates that contaminated sediment may be migrating along the swale from the South Disposal Area.

Inorganic Parameters - Cadmium (4.3 mg/Kg) and zinc (328 mg/Kg) are present at elevated concentrations at swale SWSD-2. Lead (49.0 and 46.9 mg/Kg, SWSD-1 and SWSD-2, respectively) is present at elevated concentrations in both on-site swales.

7.5.2 Genesee River Sediment

Organic Parameters - Toluene was detected at low concentrations in all river sediment samples, including the upstream sample. However, the downstream concentration at GRS-4 (0.049 mg/Kg) was elevated relative to the upstream and intermediate samples (0.001 to 0.002 mg/Kg).

Inorganic Parameters - Metals were not elevated in river sediment.

TABLE 7-35

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY. RI/FS

SUMMARY OF ANALYTES DETECTED IN GENESEE RIVER AND ON SITE SWALE SEDIMENT

PARAMETER (1) (2)	UPSTREAM STATION		INTERMEDIATE STATIONS			
	GRS-1		GRS-2		GRS-3	
	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND	FIRST ROUND	SECOND ROUND
Volatiles (mg/kg)						
Methylene Chloride	0.006 B	0.018 B	0.008 B	0.017 B	0.007 B	0.014 B
Acetone	0.015 B		0.016 B		0.014 B	
2-Butanone (MEK)	0.013 B					
Trichloroethene						
Tetrachloroethene						
Toluene	0.001 J		0.001 J		0.002 J	
Semi-Volatiles (mg/kg)		ND		ND		ND
Bis(2-Ethylhexyl)Phthalate	0.43 B		0.51 B		0.46 B	
Phenanthrene			0.12 J			
Fluoranthene			0.16 J			
Pesticide/PCBs (mg/kg)						
Aroclor - 1254						
Aroclor - 1260						
Inorganic Elements (mg/kg)						
Aluminum	11000		9450		9970	
Arsenic	7.9	6.8	7.9	4.3	7.9	6.3
Barium	66.7		52.2		64.1 J	
Beryllium	0.46 J		0.38 J		0.45 J	
Cadmium						
Calcium	11200		9490		10500	
Chromium	14.2 J		12.1 J		14.6 J	
Cobalt	10.4 J		9.2 J		9.7 J	
Copper	20.1		16		20.4	
Iron	22500	18900	19300	13600	21500	19500
Lead	17.9 J	20.8	12.7 J	16.6	22.4 J	18.3
Magnesium	6010		5350		5740	
Manganese	527	344	462	221	541	446
Mercury				0.17		
Nickel	22		20.2		20.6	
Potassium	1440		1050 J		1210 J	
Selenium						
Silver					1.0 J	
Sodium	104 J		105 J		123 J	
Vanadium	18.8		16.6		18.1	
Zinc	71.2		59.6		67.5	

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Laboratory Qualifers: B - Estimated detection limit due to blank contamination,

J - Estimated value due to limitations identified during the quality control review.

TABLE 7-35 (cont.)

CITY OF ROCHESTER, ROCHESTER FIRE ACADEMY. RI/FS

SUMMARY OF ANALYTES DETECTED IN GENESEE RIVER AND ON SITE SWALE SEDIMENT

PARAMETER (1) (2)	DOWN STREAM STATION GRS-4		SWSD-1	SWSD-2
	FIRST ROUND	SECOND ROUND		
Volatiles (mg/kg)				
Methylene Chloride	0.007 B	0.015 B	0.008B	0.009B
Acetone	0.014 B		0.052B	0.082B
2-Butanone (MEK)				0.029
Trichloroethene				0.002J
Tetrachloroethene				0.003J
Toluene	0.049			0.001J
Semi-Volatiles (mg/kg)		ND		
Bis(2-Ethylhexyl)Phthalate	0.48 B			0.61B
Phenanthrene				
Fluoranthene				0.13J
Pesticide/PCBs (mg/kg)				
Aroclor - 1254				11
Aroclor - 1260				
Inorganic Elements (mg/kg)				
Aluminum	11700		10500	11200
Arsenic	8.5	7.9	7.6	5.2
Barium	61.3 J		75.4	57.6J
Beryllium	0.45 J		0.37J	0.34J
Cadmium		0.35 B	0.38J	4.3
Calcium	10700		4000	5010
Chromium	17.9 J		12.5	30.7
Cobalt	12.3 J		7.9J	9.0J
Copper	18.1		22.4	27.3
Iron	21900	20300	17400	16400
Lead		29.9	49	46.9
Magnesium	5870		2740	2990
Manganese	490	492	343	182
Mercury				
Nickel	21.1		18.1	13.4
Potassium	1630		1570	1870
Selenium			0.70J	
Silver	1.2 J		1.6J	
Sodium	148 J		87.3J	119J
Vanadium	19		22.5	24.6
Zinc	67		93.9	328

NOTES:

(1) Only those analytes found above detection limits at a minimum of one location are presented.

(2) Laboratory Qualifers: B - Estimated detection limit due to blank contamination,

J - Estimated value due to limitations identified during the quality control review.

8.0 CONTAMINANT MIGRATION

8.1 CONTAMINANT PATHWAYS

Field investigations of the Rochester Fire Academy site indicate that contaminated ground water, generated as a result of dissolution of chemical constituents of the waste fill and contaminated soil, is moving off-site. Figure 8-1 schematically illustrates contaminant migration pathways for the Rochester Fire Academy site as identified during field investigations. Identified pathways include:

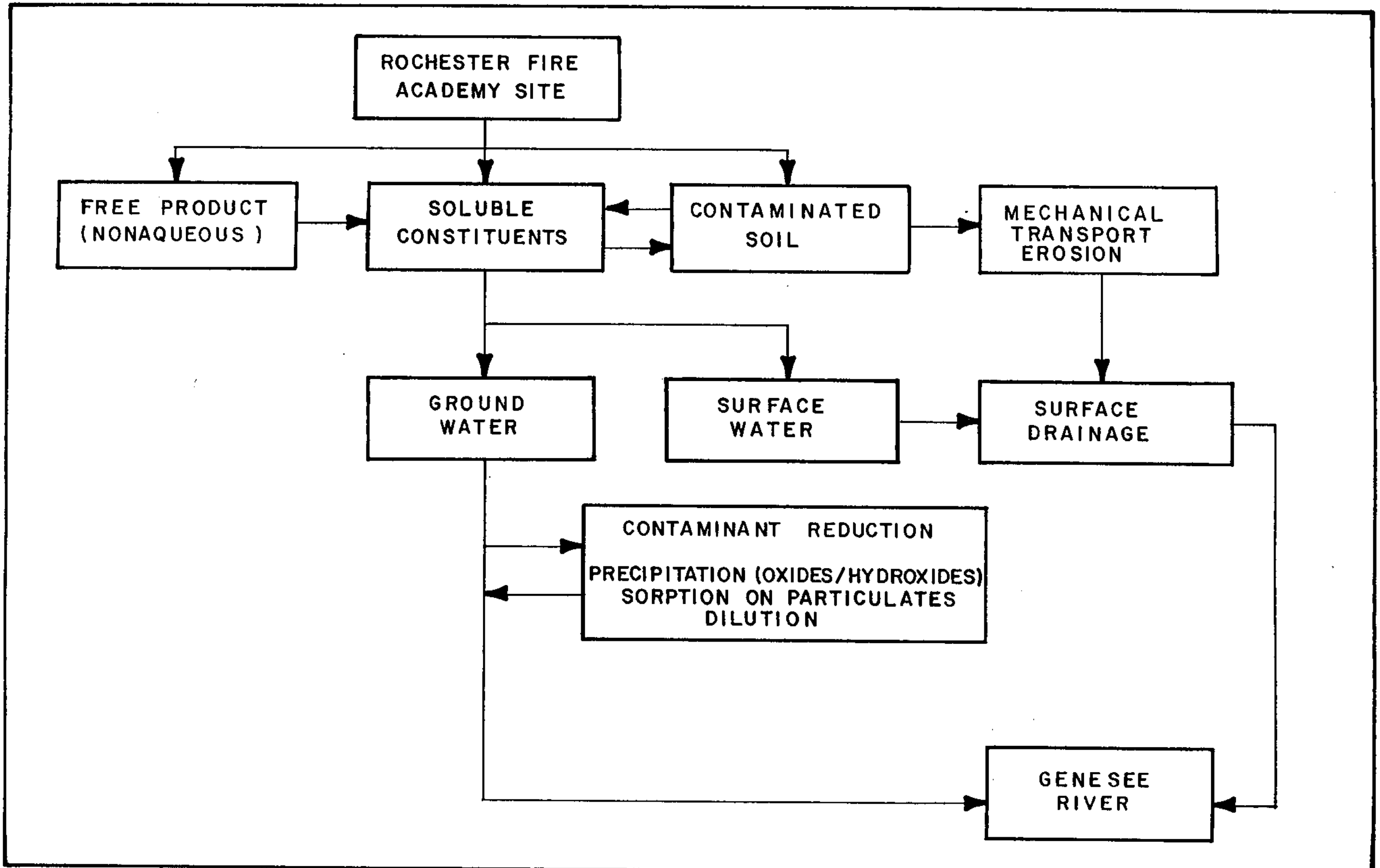
- overland runoff and mechanical transport of contaminated soil/fill material;
- continuous release of soluble constituents of the non-aqueous phase liquid located in the area of MW-14S to ground water within the shallow overburden;
- migration of solubilized contaminants in the soil/fill into ground water due to infiltration of precipitation and/or contact with ground water; and
- lateral movement of contaminated ground water through the shallow overburden, with ultimate discharge to the Genesee River.

A visual inspection of the site was also performed to determine the presence of underground utilities which might also act as a migration pathway. Each of these pathways is discussed in more detail in the following sections.

8.2 ASSESSMENT METHODOLOGY

8.2.1 Free-Product (Well M-14S)

A slightly viscous golden-colored free-phase product was observed in MW-14S. The thickness of the free-product, as measured in the well using an oil-water level indicator, is an apparent thickness rather than a true thickness (Testa et al. 1989). The difference between the true and apparent thickness is attributed to both the contrast in specific gravity between the free-product and water and the fact that free-product is immiscible in water. This results in the free-product perching on the capillary fringe above the actual water table. With penetration of the capillary fringe by the monitoring well, free-product migrates into



MALCOLM PIRNIE

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ROCHESTER FIRE ACADEMY
RI / FS
SCHEMATIC OF POLLUTANT MIGRATION (PATHWAYS / FATE)

CITY OF ROCHESTER, NEW YORK MARCH 1991

FIGURE 8-1

the well bore. The water surface within the well is lower than the top of the surrounding capillary fringe, thus allowing product to flow into the well. This in turn depresses the water level in the well until density equilibrium is attained. Therefore, a greater apparent product thickness is measured in the well than actually exists in the formation (Testa et al. 1989).

During the field investigation, approximately 1.5 feet of free-product was measured in MW-14S. The immiscible product will remain perched on the water table and will migrate in the direction of ground water flow. The same free-product was not observed in any of the other nearby wells or borings completed in the shallow water-bearing zone; however, the nearest monitor location is greater than 150 feet away from MW-14S.

8.2.2 Overland Flow/Mechanical Transport

Mechanical transport of contaminated soil or fill particles by overland flow is expected to be minor due to the relatively flat topographic relief of the site. This expectation is further supported by the site water balance (see Section 6.1.1) which indicates that surface runoff is only approximately 1% of the water leaving the South Disposal Area and the Training Grounds Area, and approximately 6% at the North Disposal Area.

Furthermore the City has implemented surface drainage control measures that tend to limit the mechanical transport of soil/fill particles from the site. The Training Grounds Area is covered by approximately 3-6 inches of crushed stone, and water in the vicinity of the burn pits is drained into a retention pond in the northeast corner of the Area. A swale has been constructed that collects surface runoff from the South Disposal Area, the Firing Range Area, and the southeastern portion of the Training Grounds Area. This swale also traps sediment that may be transported.

Sampling and analysis of surficial soil and sediment in the Genesee Valley Park Area (see Section 7.2.5) has demonstrated that low concentrations of contaminants occur locally along the bicycle path. It is believed that the occurrence of this contamination is due to one or more of the following practices:

- surface drainage from the burn pit area during training exercises. Historic aerial photos show stained surficial soils leading from the burn pit vicinity toward the River in the vicinity of locations B-8 and MW-15S.
- the generation of overland flow that encroaches on the bicycle path during fire training exercises at the multi-story structures.

- previous use of the route currently occupied by the bicycle path to transport waste material to the South Disposal Area for burning or disposal. Some of the low level contamination detected along the bicycle path may have originated as spills during waste transport.

- the channeling of surface runoff and sediment into swales. This restricts the migration of contaminated particles to the swale.

There is insufficient data to assess the contaminant migration that may have or will occur due to these practices. The low concentrations and localized occurrence of the contamination detected in the Genesee Valley Park Area during the RI suggest that the mechanical transport of contaminated soil/fill particles is not a significant migration pathway. Therefore, actual contaminant loadings to the river via this pathway were not assessed.

8.2.3 Ground Water

Contaminant loadings to the Genesee River via the ground water pathway were calculated for the North Disposal Area, the Training Grounds Area, and the South Disposal Area using site water balance data presented in Section 6.1.1 and contaminant concentration data presented in Section 7.0. Consideration made in these calculations included:

- ground water from the overburden water bearing zone is the primary source of contaminant loading to the river. An estimate of loading from the upper bedrock zone was also performed because the bedrock ground water most likely discharges directly to the river.

- the quantity of contaminants in the overburden zone was not corrected for potential background sources (viz. hydraulically upgradient of the site); and

- loading calculations were made for the following groups of parameters:

    - total volatile organics,
    - total semi-volatile organics,
    - total PCBs,
    - total iron and manganese,
    - total metals (viz. As, Ba, Be, Cd, Cr, Cu, Pb, Hg, Ni, Sb, Se, Ag, Tl, and Zn) excluding Fe and Mn.

All data collected during the RI from monitoring wells located along the Genesee River (viz. MW-11S in the North Disposal Area; MW-8S, MW-12S, MW-15S in the Training Grounds

Area; and MW-7S in the South Disposal Area) were utilized to calculate separate average concentrations of the above-specified groups of contaminants for each study Area as shown in Table 8-1. Contaminant loadings to the Genesee River were calculated using an estimated ground water outflow of 207 ft^3/day for the North Disposal Area; 1,033 ft^3/day for the Training grounds Area; and 573 ft^3/day for the South Disposal Area (see Section 6.1.1) and the average ground water concentrations as described above.

An identical calculation was performed for the upper bedrock zone assuming a saturated thickness of 10 feet (the thickness of the monitoring interval). Average concentrations were determined from all analyses at upper bedrock wells located along the River (viz. MW-11I and MW-16I in the North Disposal Area; MW-8I and MW-12I in the Training Grounds Area; and MW-7I in the South Disposal Area) as shown in Table 8-2. Ground water contaminant loadings were calculated using estimated ground water outflows of 431 ft^3/day for the North Disposal Area; 2392 ft^3/day for the Training Grounds; and 476 ft^3 day for the South Disposal Area (see Appendix G).

8.2.4 Underground Utilities Investigation

Underground utilities that were identified on-site include a) a stormwater drain (see Figure 3.3), and b) a fuel line (see Figure 8-2), both in the Training Grounds Area. The stormwater drain carries stormwater from an area east of the site to an outfall located along the Genesee River. During the RI, water generated during the training exercises was observed being pumped from the training structures to the stormwater drain. An oily sheen was observed to be discharging from the stormwater drain outfall to the Genesee River. Test pit TP-7 was excavated in order to examine the bedding material beneath the sewer. However, only recompacted soil was observed indicating that there is little potential for contaminant migration in the subsurface along the pipe.

The fuel line carries fuel oil from a storage tank via a pump house to four (4) burn pits used for training exercises (see Figure 8-1). Based on observations at MW-14S, it is known that free product has leaked to the water table. The cause of the problem is most likely a leak in the pipe rather than the tank, because the pipe reportedly drains between uses and three (3) shut-off valves are used to isolate the pipe from the tank. After recognizing the problem, the City closed all valves back to the tank and discontinued the use

TABLE 8-1

ROCHESTER FIRE ACADEMY RI
GROUND WATER LOADING THROUGH THE OVERBURDEN

Parameter	NORTH DISPOSAL AREA		TRAINING GROUNDS AREA		SOUTH DISPOSAL AREA		Total Kg/yr
	Average Concentration[2] mg/L	Load to River Kg/yr	Average Concentration[3] mg/L	Load to River Kg/yr	Average Concentration[4] mg/L	Load to River Kg/Yr	
Total Volatile Organics	0	0	0.026	0.28	28.7	170	170
Total Semi-Volatile Organics	0.013	0.028	0.005	0.05	0.114	0.67	0.71
Total PCBs	0	0	0	0	0.004	0.02	0.02
Total Iron and Manganese	17.2	37	10.4	111	17.8	105	253
Total Trace Metals[1]	0.167	0.36	0.081	0.86	0.254	1.5	2.7

NOTES:
1. Total Trace Metals include: Ba, Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn.
2. Average of all analyses at MW-11S.
3. Average of all analyses at MW-8S, MW-12S.
4. Average of all analyses at MW-7S.
5. Sample calculation for Total Volatile Organics: $28.7 \frac{mg}{L} \times 28.3 \frac{L}{ft^3} \times 573 \frac{ft^3}{day} \times 10^{-6} \frac{Kg}{mg} \times 365 \frac{day}{yr} = 170 \frac{Kg}{year}$

MALCOLM PIRNIE

TABLE 8-2

ROCHESTER FIRE ACADEMY RI
GROUND WATER LOADING THROUGH THE UPPER BEDROCK

Parameter	NORTH DISPOSAL AREA		TRAINING GROUNDS AREA		SOUTH DISPOSAL AREA		Total Kg/yr
	Average Concentration[2] mg/L	Load to River Kg/yr	Average Concentration[3] mg/L	Load to River Kg/yr	Average Concentration[4] mg/L	Load to River Kg/Yr	
Total Volatile Organics	0.028	0.12	1.73	43	7.0	34	77
Total Semi-Volatile Organics	0.001	0.004	0.004	0.10	0.012	0.06	0.16
Total PCBs	0	0	0	0	0.001	0.005	.005
Total Iron and Manganese	4.7	21	3.4	84	0.35	1.7	107
Total Trace Metals[1]	0.14	0.62	0.14	3.5	0	0	4.1

NOTES:
1. Total Trace Metals include: Ba, Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn.
2. Average of all analyses at MW-11I and MW-16I.
3. Average of all analyses at MW-8I, MW-12I.
4. Average of all analyses at MW-7I.

of the fuel line. The City is presently pursuing the removal and disposal of fuel from the tanks.

A search was undertaken for additional outfalls along the River bank, but no other outfalls were observed.

8.3 CONTAMINANT LOADINGS

8.3.1 Free Product Migration

Soil gas survey results in the vicinity of the fuel line are shown on Figure 8-2. High readings near the fuel tank are attributed to spillage during the transferred fuel to the tanks. The high reading at MW-14S is attributed to free-product. Due to ponded water at the time of the survey, soil gas readings were not obtained from the vicinity of the fuel line along the burn pit.

The free phase product appears to be localized near MW-14S, which is located within approximately 10 feet of the reported route of the fuel line (see Figure 8-2). Soil gas survey results indicate that organic vapor concentrations were elevated near the tank and near MW-14S. However, at the time of the soil gas survey, vapor levels decreased substantially at distances of 25 feet from the location of MW-14S. Therefore, based on soil gas survey results, the occurrence of free product at MW-14S appears to be localized.

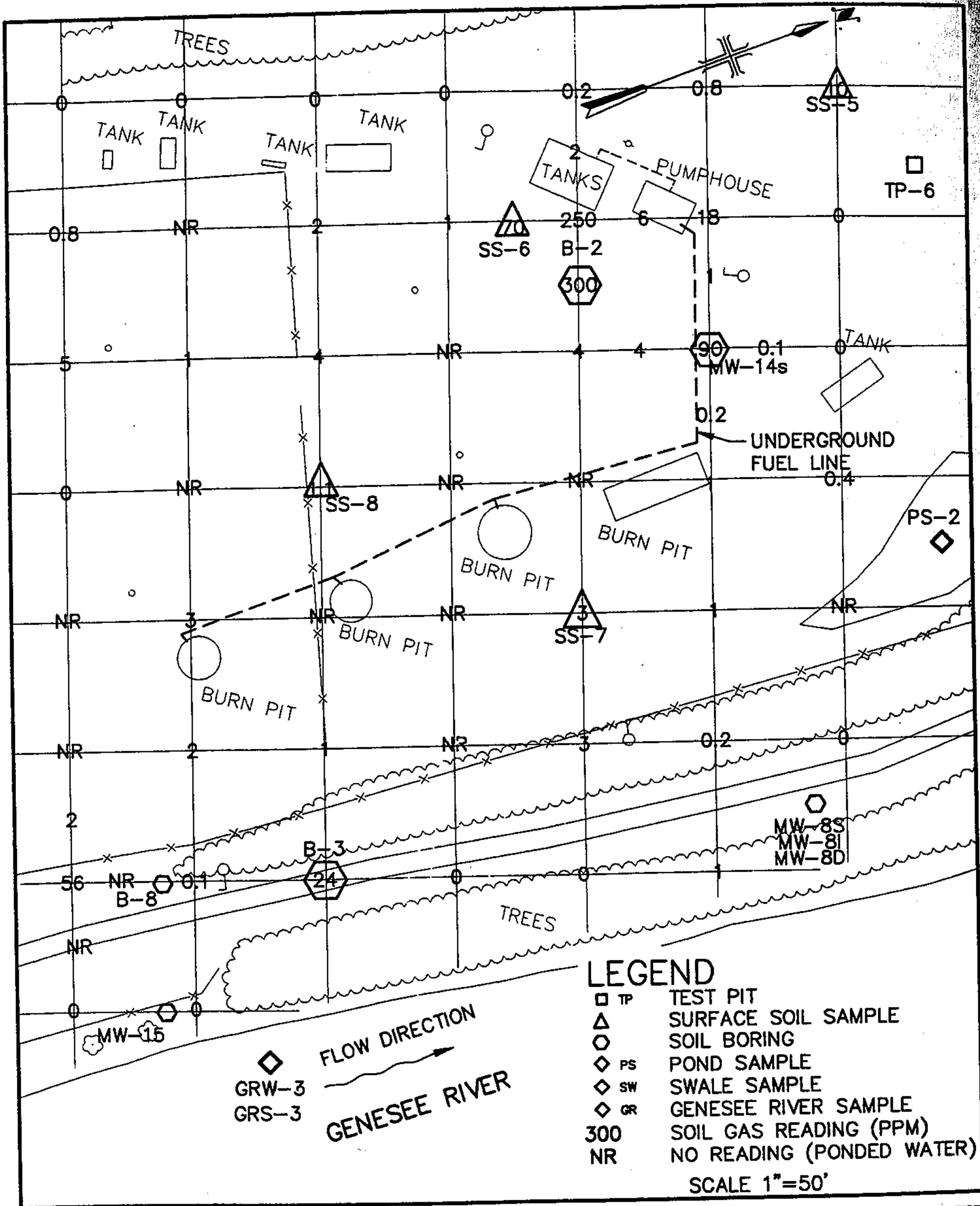
8.3.2 Ground Water Migration

Calculated contaminant loadings to the Genesee River from the Rochester Fire Academy site via the ground water pathway are summarized in Tables 8-1 and 8-2. Examination of the data in Table 8-1 for the overburden water bearing zone indicates that the yearly loading of semi-volatile organics, PCBs, and total trace metals is very low. Total volatile organics (170 Kg per year) and total iron/manganese (253 Kg per year) are the primary contaminants migrating off-site via shallow ground water to the river.

Examination of Table 8-2 shows that loading from the upper bedrock aquifer is somewhat lower than loading from the overburden water bearing zone.

The primary source of ground water contamination in the Training Grounds Area appears to be the leaching of contaminated soil by the infiltration of precipitation, and by ground water that comes into direct contact with contaminated soil during periods of high

FIGURE 8-2



ROCHESTER FIRE ACADEMY
REMEDIAL INVESTIGATIONS
SOIL GAS SURVEY RESULTS
NEAR MW-14S

MALCOLM PIRNIE

ROC-04-F82

CITY OF ROCHESTER

MARCH 1991

ground water levels (two to three feet BGS). Soluble constituents of the free phase product may also contribute to the organic load. Dissolved phase consitutents are conservatively assumed to move at the same rate as groundwater flow. The dissolved organic plume might be expected to migrate in an easterly direction at a rate of approximately 22 feet per year, based on a hydraulic gradient of 0.009 ft/ft, a hydraulic conductivity of 4.3 x 10^{-4} cm/s (1.2 ft/day), and a porosity of 0.20. Organic contamination is absent in the overburden well at MW-8S, which is 160 feet downgradient from MW-14S, but the age of the fuel oil leak is unknown.

Organic contamination is present at the upper bedrock well at MW-8I. The source of the organic contamination in the upper bedrock at MW-8I may be the fuel oil spill, since a) a downward hydraulic gradient exists between the overburden and bedrock (at least seasonally), b) there is no confining layer known to underlie the Training Grounds at MW-14S, and c) the rate of ground water flow in the upper bedrock is comparatively high. For example, based on a hydraulic gradient of 0.006 ft/ft, a hydraulic conductivity of 1.9 x 10^{-2} cm/s (53.9 ft/day), and a porosity of 0.05, the ground water flow rate in the upper bedrock would be 6.5 ft/day or nearly 2400 feet per year.

In contrast to the Training Grounds Area, the overburden ground water in the South Disposal Area exhibits higher concentrations of organic contaminants than does the bedrock aquifer. This probably results from the close proximity of the monitoring well cluster (MW-7S/7I/7D) to the source of contamination.

8.4 SUMMARY

The major pathway of contaminant migration from the Rochester Fire Academy Site is ground water flow to the Genesee River. The primary contaminants migrating to the River are volatile organics with a total loading of 250 Kg/year, and total iron and manganese with a total loading of 360 Kg/year. Volatile organics originate from the leaching of contaminated soil/fill material and, locally, from the solubilization of free phase product. Total iron/manganese loading is produced from the mobilization of naturally occurring metals, which results in part from the release of waste oils and oxidizable materials to the shallow ground water. Trace metals, if present in the aquifer matrix or the waste materials, are not being mobilized, under the existing conditions, to a degree that would contribute a substantial load to the river.

9.0 PUBLIC HEALTH AND ENVIRONMENTAL CONCERNS

Following agency review of the analytical results presented within this report, it was determined that further sampling and analysis was necessary to better define the lateral and vertical extent of soil contamination. In addition, in order to address the contamination present in the ground water, pump testing was determined to be necessary to better establish the hydraulic characteristics of the aquifer and to provide ground water for treatability evaluations. This new data will be evaluated in conjunction with the data presented herein to fully define the contamination present at the site in a supplemental report. Therefore, the public health and environmental concern will be presented in the Supplemental RI report taking into account all data collected during both investigations.

MALCOLM PIRNIE

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