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PHASE II REMEDIAL INVESTIGATION
PLANT NO.1
VAN DER HORST CORPORATION SITE
SITE NO. 9-05-008
OLEAN, CATTARAUGUS COUNTY

TEXT
VOLUME I OF II

MAY 1991

SUBMITTED TO:

DIVISION OF HAZARDOUS WASTE REMEDIATION
NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK 12233

SUBMITTED BY:

ERM-NORTHEAST, INC.
5500 MAIN STREET
WILLIAMSVILLE, NEW YORK 14221

TABLE OF CONTENTS

TABLE OF CONTENTS

Section Page No.

TABLE OF CONTENTS, cont'd.

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES, cont'd.

LIST OF APPENDICES

EXECUTIVE SUMMARY

This report summarizes the findings and conclusions of the Phase II RI study conducted at Van Der Horst Plant No. 1 between May 1990 and December 1990. Work done by ERM to develop the Phase II RI report included a field exploration program, and then a reduction and analysis of the data. Specifically, field work completed during the Phase II RI included installation of test borings/monitoring wells, water level monitoring, an aquifer drawdown pumping test, and sampling and testing from various media including soil, storm sewer water/sediment, surface water/sediment and ground water. Laboratory testing, to aid in the evaluation of site conditions, was performed by Recra Environmental, Inc. The major findings of the Phase II RI are summarized below.

Geologic Conditions

Ground water beneath Van Der Horst Plant No. 1 is present in two distinct and separate aquifers. Logs from shallow and deep monitoring wells indicate that the upper aquifer primarily consists of gravel and sand deposits with occasional cobbles. These deposits extend down to a depth of 90 feet.

The lower aquifer beneath the site was encountered during the drilling of monitoring well MW-5B. The lower aquifer is separated from the upper aquifer by a 19-foot thick layer (i.e., from 90 ft to 109 ft) of silty-clay. Lower aquifer sediments (i.e., > 109 ft) are typically composed of sand and gravel, based on the MW-5B well log. The top of the lower aquifer is at a depth of 109 feet, but the depth of the base of the aquifer is not presently known.

Ground Water Flow

Ground water flow in the shallow monitoring wells is primarily towards the southwest with an average lateral gradient of 0.0004. Ground water in the deep monitoring wells generally flows toward the southwest or west at an average lateral gradient of 0.0006. An average downward vertical (i.e., head difference between shallow and deep wells) gradient of -0.004 occurs within the uppermost aquifer southwest of the site.

The upper aquifer near Plant No. 1 behaves like a semi-confined aquifer during static and low pumping conditions. Regionally, the upper aquifer is believed to be unconfined; however, clay lenses have been shown to locally exist within this aquifer, and may explain the aquifer's semi-confined behavior. The lower aquifer (i.e., > 109 ft below land surface) is confined by a 19-foot thick layer of silty clay, and is hydraulically separate from the upper aquifer, based on an average static head difference of greater than 1.0 ft, and that the aquifer did not respond to pumping of the upper aquifer.

The following average aquifer characteristics have been calculated or estimated from slug test and aquifer test data:

Parameter	Method	Value
Transmissivity	Pumping Test	193 ft^2/min
Hydraulic Cond.	Pumping Test	1.4 cm/sec
Hydraulic Cond.	Shallow Well Slug Test	0.1 cm/sec
Hydraulic Cond.	Deep Well Slug Test	0.05 cm/sec
Hydraulic Cond.	Lower Aquifer Slug Test	0.06 cm/sec
Storativity	Pumping Test	0.017
Specific Yield	Estimated Range	0.15 - 0.25

Public Health Risk Assessment

The public health risk assessment concluded that under current conditions there are carcinogenic effects from chromium in fugitive dust emissions and arsenic in residential soil (incidental ingestion by children). Under future conditions, if no remedial action is taken, the carcinogenic effects include PCE in drinking water, chromium in fugitive dust emissions and arsenic in residential soil. Additionally, the risk assessment concluded that non-carcinogenic effects under future conditions include chromium and lead in groundwater.

Based on the environmental risk assessment, no adverse effects to sensitive environmental resources are expected to occur as a result of the site contaminants. However, several of the contaminants found in sediment and surface water samples collected from Olean Creek are above SCGs and may be impacting benthic and aquatic life in this creek.

Extent of Contamination

Based on surface soil samples collected during the Phase I and II RIs, it appears that the area of chromium contaminated surface soil (based on a 100 ppm clean-up level) includes the majority of the surface soil (i.e., soil from the ground surface to a depth of 2 feet) within the fenced-in area of the site and an area outside the fence (i.e., approximately 100 feet beyond the fence to the east and north).

Subsurface soil conditions near the MW-5 well cluster and the MW-3 well cluster were further evaluated during the Phase II RI program. In the area of MW-5 (location where the plant's chromic-acid filter formerly discharged backwash-water) the data indicate that the chromium concentrations are highest near the ground surface (i.e., 0 to 2') and near the top of ground water table (i.e., 16 to 20'). Chromium concentrations measured in subsurface soil samples collected in the area of MW-3 were less than 100 mg/Kg and similar to background concentrations. Chromium near MW-3 appears to be associated with specific surface deposits and does not appear to be present below approximately 2 feet from ground surface.

The sediment and water samples collected from the storm sewer system that runs from the east side of the site to the Brookview outfall indicate that this system contains elevated levels of chromium and lead. Based on Phase II data, it appears that the chromium concentrations are highest in water and sediment samples that were collected between the Van Der Horst Line and Keating Street.

Chromium concentrations in Olean Creek sediment appear to be the highest near the Brookview storm-sewer outfall; however, elevated chromium concentrations (i.e., chromium concentrations greater than 100 ppm) were measured in two of the bank-sediment samples downstream of the outfall. Based on a comparison of the chromium concentrations in sediment upstream and downstream of the outfall, it appears that this outfall was/is a source of the elevated chromium in Olean Creek.

Aluminum, iron and zinc were the only analytes detected above Class "C" surface water quality standards in surface water from

Olean Creek during the Phase II RI sampling program. Thus, it appears that the surface water in Olean Creek is not being significantly impacted by the Brookview outfall (i.e., contaminants associated with the subject site migrating through the storm sewer) or the creek sediments (i.e., through suspension of contaminated sediments) at the time of the Phase II sampling event.

Chromium and PCE have been determined to be the principle ground water contaminants. PCE levels in Phase I and II ground water samples indicate that PCE contamination primarily occurs within the shallow wells adjacent to the Plant No. 1 building. Chromium contamination within the shallow monitoring wells has predominantly migrated south of the site. The extent of the shallow chromium plume appears to lie within the existing network of shallow monitoring wells. Chromium contamination in the deep monitoring wells has been transported to the southwest and west beyond the Phase I and II wells.

Areas of Soil Contamination

The Phase II RI provided additional information regarding the two areas of soil contamination (i.e., one near MW-5 and the second near MW-3) located at the site which appear to be the result of past disposal/discharge activities at Plant No. 1. Both of these areas contain chromium contaminated soil at concentrations several orders of magnitude above background. There may be other areas of soil contamination beneath the plant building (i.e., the various dipping tanks) and outside the plant building (i.e., recently identified plating "wells") that were not sampled during the Phase I and II RIs.

Two off-site areas of soil/sediment contamination have been identified based on the Phase II RI. The first is the sediments in the storm sewer system that runs between the site and the Brookview outfall. The second off-site area is the Olean Creek sediments near the Brookview outfall. It appears that these Olean Creek sediments are in the immediate vicinity of the outfall, and do not extend across the entire stream channel at this location.

Recommendations for Phase III RI

Although the Phase II RI provided additional information regarding the physical characteristics of the study area and the contaminants of interest, some additional study will be required to further evaluate site conditions and collect the necessary data for a detailed FS. Some recommended studies for the Phase III RI are summarized below:

1) The horizontal extent of ground water contamination needs to be further delineated with additional monitoring wells southwest of the site. This work is necessary to

1.0 INTRODUCTION

This report summarizes the results and findings of ERM-Northeast's (ERM) Phase 2 Remedial Investigation (RI) for the New York State Department of Conservation (NYSDEC) at the Van Der Horst Plant No. 1 chrome plating facility in Olean, New York. The Phase 1 report has previously been submitted by ERM under a separate title. Several associated appendices are cited throughout the text when reference is made to the backup documentation.

1.1 Purpose of Phase 2 RI Study

The purpose of this RI study is to assess the nature, extent and potential source(s) of contamination at the site. Ultimately, it was the intent of the RI (through successive phases) to compile sufficient data so that cost-effective and environmentally sound long-term remedial actions can be developed during a Feasibility Study (FS). The Phase 2 RI did not involve any field work inside of the plant building because the USEPA was working inside of the plant performing an emergency removal of uncontained chemicals.

estimate the volume of ground water that is contaminated, so that treatment/disposal alternatives can be evaluated.

2) Wipe samples and asbestos samples should be collected from the plant building envelope to evaluate contamination within this structure.

3) A detailed ground water modeling effort is needed to evaluate various pump and treat remedial alternatives. This effort will include a simulation of the zone of influence that is created by different:

   - Recovery well numbers;
   - Locations for recovery wells; and
   - Recovery well pumping rates.

4) Subsurface sampling and testing in the interior portions of the plant are needed to identify source areas and remedial alternatives for this structure. We presently know very little about the potential for soil contamination to exist beneath the building, and do not know if additional source areas are present at this location.

5) The area of soil contamination near MW-5 should be further investigated to delineate its extent at the ground surface.

Remedial Action Objectives

The following remedial action objectives have been developed for this site based on the Phase I and II RIs:

* Remediate identified areas of contaminated surface soil to limit future migration of chromium and PCE;

* Remediate ground water to acceptable risk levels for chromium, lead and PCE;

* Remediate the storm sewer system (i.e. pipe between site and Olean Creek) of residual contamination that may be impacting benthic and aquatic life;

* Remediate the contaminated sediments in the vicinity of the Brookview outfall to Olean Creek; and

* Remediate on-site building structures (possibly including demolition of the plant building) if necessary.

1.2 Background

1.2.1 Present Status of Plant No. 1 RI/FS Program

The Van Der Horst Plant No. 1 Study has been divided into seven tasks which are to take place in a phased and integrated manner. The present status of each task, upon submission of this report, is listed in Table 1-1.

The Phase 2 RI, discussed herein, is Task V and included obtaining additional chemical and hydrological data at the site. The additional chemical data was generated from the sampling of on-site soil, off-site soil, sediment and surface water from nearby Olean Creek, ground water from twenty monitoring wells (seven of which were newly installed) and sediment and water samples from the adjacent storm sewer system. Additional hydrological data was generated by logging of subsurface conditions during the installation of the wells, by subsequent in-situ hydraulic conductivity testing and by conducting a ground water pumping test.

1.2.2 Site Description

The former Van Der Horst Corporation of America Plant No. 1 chrome-plating facility is located at 314 Pennsylvania

TABLE 1-1

PROJECT TASKS
VAN DER HORST PLANT NO. 1 RI/FS

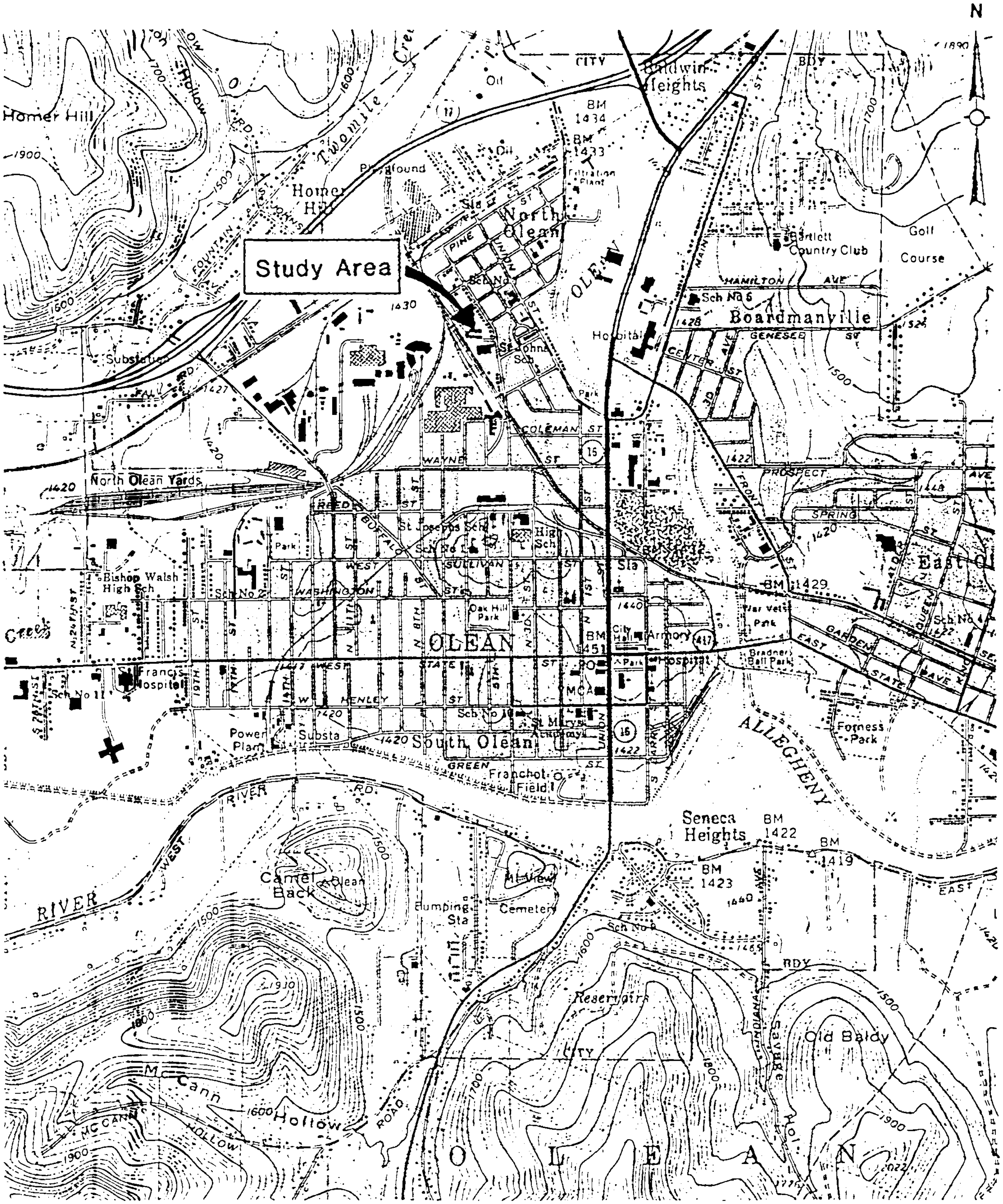
	TASK	STATUS
I.	Development of Work Plan	Completed Mar/Apr 1989
II.	Phase I Remedial Investigation	Completed Nov. 1989
III.	Phase I Feasibility Study (development of alternatives)	Completed Feb. 1990
IV.	Phase II Feasibility Study (initial screening of alternatives)	Completed Feb. 1990
V.	Phase II Remedial Investigation	
	Field Investigation	Completed Dec. 1990
	Baseline Risk Assessment	Completed Feb. 1991
	Phase I RI Report	Completed Feb. 1991
VI.	Phase III Feasibility Study (detailed analysis of alternatives)	in progress
VII.	Selected Remedial Action	not begun

Avenue in the northern section of the City of Olean, Cattaraugus County, New York (Figure 1-1). The subject site, defined for the purpose of this study as the fenced in area at Van Der Horst Plant No. 1, comprises approximately 2 acres in area and lies within the valley of the Allegheny River Basin. Bordering the site to the north, east, and south are several residential properties located along Pennsylvania Avenue, West Fourth Street, Spruce Street, and Vine Street (Figure 1-2). Two sets of Conrail tracks border the site to the west and southwest, thereby separating the plant from the main industrial area of Olean.

1.2.3 Site History

Dr. Hendrik Van Der Horst founded the Van Der Horst Corporation in 1940 to service the local oil field industry and railroad companies. His first manufacturing operations were located in Olean at Plant No. 1, and consisted of the electrolytic deposition of hard chrome plating on various types of customized metal parts. The corporation developed, patented, and utilized a specialized plating process called Porus-Krome™ during World War II. This process produced a "glass smooth, diamond hard, chromium-plated surface" that retained oil. It was initially used to repair the worn

FIGURE 1-1
Site Location Map - Van Der Horst Company
RI/FS Plant No.1



Source: U.S.G.S. Quadrangle Map, Olean, N.Y.

Scale: 1"-2000'

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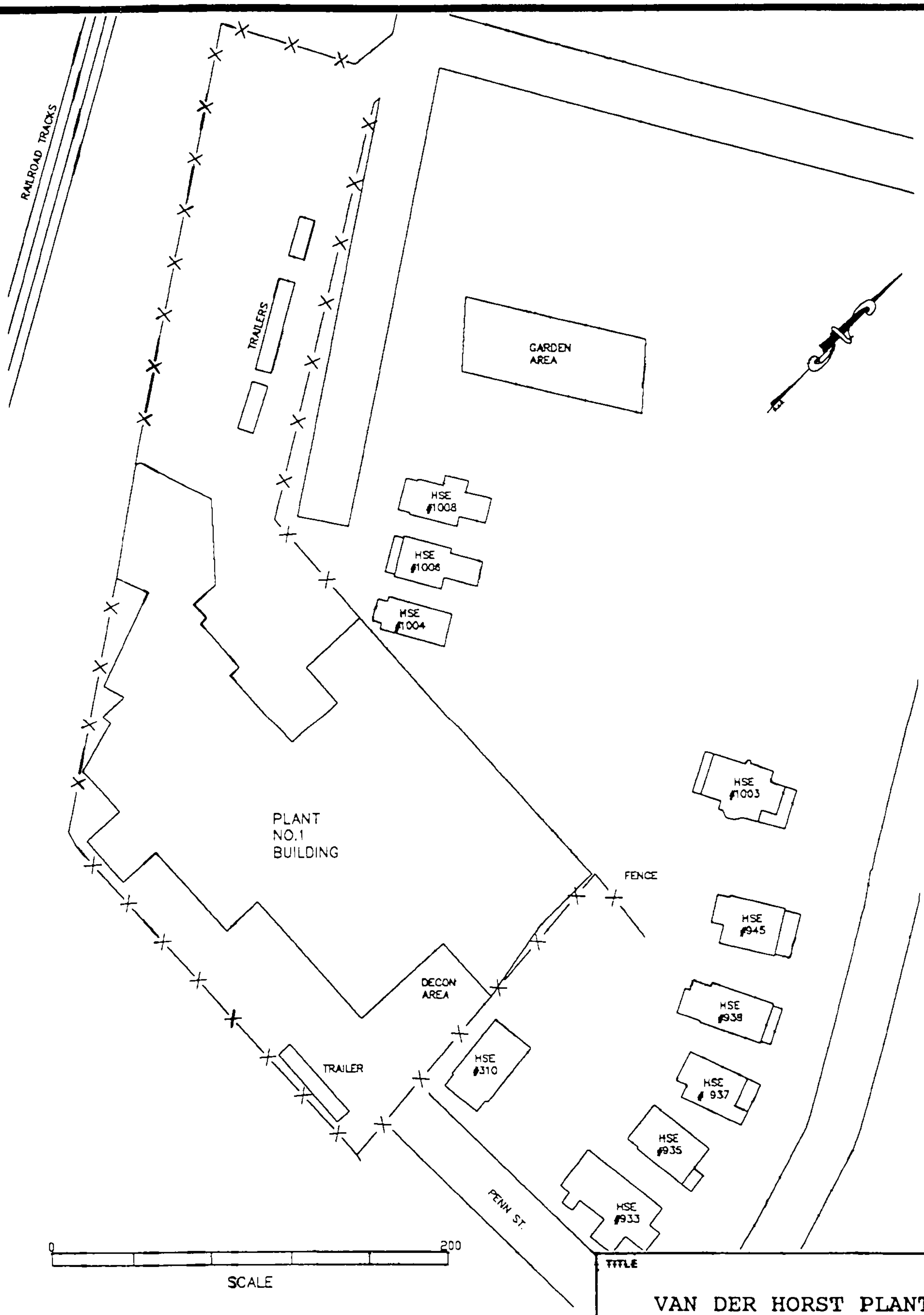

NOTES:

1) BASE MAP PROVIDED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

TITLE

VAN DER HORST PLANT NO. 1

FACILITY PLAN

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SCALE

DATE

FIGURE
1-2

cylinder linings in diesel engines of submarines, tugboats, and combat machines for the U.S. Navy.

The Van Der Horst Corporation opened a second plant (Plant No. 2) in 1951 on Connell Street in Olean. This plant was constructed to perform a new iron-plating process (Vanderloy M™) that was designed and patented by the corporation. The iron-plating process was used to repair and restore the worn surfaces of mobile components of machinery (i.e., cylinders, crankshafts, etc.) for a cost that was far less than that of purchasing new components.

In August, 1965, Plant No. 1 was responsible for an accidental discharge of 400 to 500 gallons of untreated chromic acid wastewater directly into the storm sewer system. This resulted in a substantial fish kill of over 10,000 fish near the sewer's outfall in Olean Creek. At that time, the plant routinely disposed of its chromic-acid waste through the storm sewer that led to the creek, and the standard operating procedure was to dilute and neutralize the pH of the waste prior to discharge. No residual chromium contamination was detected in Olean Creek after the fish kill; however, thereafter the plant was only allowed to dispose of its waste into the sanitary sewer system.

In 1967, an industrial well field owned by Felmont Oil and located 500 feet west of Plant No. 1 was found to contain elevated concentrations of chromium (8.36 mg/l total and 0.54 mg/l trivalent) after being in operation for a single year. The City of Olean and the CCDOH expressed considerable concern over this since 13,500 people lived within the city and were dependant upon the local water (private wells, municipal wells, and the Allegheny River) obtained within the Allegheny River Basin. At this time residents were cautioned by the CCDOH against the use of private supply wells for drinking purposes, and were encouraged to use only municipal water. The CCDOH also required the Van Der Horst Corporation to pretreat any chromic acid waste prior to discharge into the city's sanitary sewer system. In March, 1968, a "chrome destruct" unit was installed at Plant No. 1 by the corporation to treat waste in accordance with the effluent limitation for hexavalent chromium.

Several manufacturing operations at Plant No. 1 could have resulted in the chromium contamination found within the ground water. During the 1940's and 1950's, chromic acid waste had allegedly been discharged directly into the ground water via exterior plating "wells". These "wells" are 20-inch diameter steel casings that had PVC liners and concrete bottoms (approximately 20 below grade). The "wells" were used for refurbishing cannon barrels during World War II and the Korean War. Another potential source area inside of the building are several chromic-acid plating tanks that were located beneath the building floor (to depths of approximately 20 feet). Though the tanks were lined and reportedly checked daily for contents, these tanks were situated in permanent subsurface concrete vaults that received drippings when the plated objects were removed from the tanks.

There are two chromic-acid filters at the plant that are located along the plant's western wall. Each filter is cylindrical and is approximately 4 feet high and 2.5 feet in diameter. These filters were used to remove suspended solids from used chromic acid during recirculation from the plating tanks. Approximately twice a day the filters became clogged, and were backflushed (Gino Lorenzino, per. comm., 1991; Appendix A). The backflushing was performed under pressure, and chromic acid and filter cake were blown out of the plant (through fixed piping) to the west side of the plant building in the area were the MW-5 well cluster is presently installed.

In May, 1968, Van Der Horst Corporation of America was acquired by Unochrome to become a subsidiary of the largest chrome plating company in the world. However, the operations at Plant Nos. 1 and 2 remained essentially unchanged. Thereafter (in 1973), the Van Der Horst subsidiary was acquired by the R. G. Scott Corporation.

In 1984, the site was listed on the NYSDEC Registry of Suspected Hazardous Waste Sites. In response, the corporation installed emission control equipment. In 1986, Van Der Horst corporation received a proposed Order on Consent from the NYSDEC in reference to the facility's continued stack emissions. This consent order charged the corporation with "unreasonably interfering with the comfortable enjoyment of life and property". The action stemmed from the repeated complaints, and subsequent legal action, to the CCDOH by nearby residents that emissions from two points at Plant 1 were causing personal injury and property damages. In January, 1987, the corporation signed the consent order calling for a $5,000 fine, and modifications to the emission control equipment that would eliminate any future discharge of chromic acid into the air.

In June, 1987, Van Der Horst ceased all operations at their facilities after the employee's independent union rejected a contract proposal calling for benefit cuts and a 30% reduction in wages for all employees. The contract dispute was not settled and by October, 1987 the plant property was reportedly for sale. In August, 1988, the NYSDEC issued a proposed letter of consent to Van Der Horst Corporation for performing an RI/FS and in May, 1989 the corporation filed for bankruptcy.

The plant has been vacant since November 1988, and most of the production equipment has been removed from the interior of the building during salvage operations in 1988 and the Spring of 1989. The property is completely circumscribed by a chain-link fence, and numerous "keep out" signs have been posted. The three entrance gates, two on Penn Avenue and one on Vine Street, have been secured with chains and locks. An on-site project trailer is located adjacent to the Penn Avenue entrances. This trailer houses all support equipment, and contains a telephone for off-site communications.

The interior of the building had contained numerous containers and vats of chemicals that were left unsecured by the Van Der Horst Corporation. During the period from January

1990 to February 1991, the USEPA conducted a removal operation for these uncontained chemicals. Also removed during this operation were: 1) a small quantity of miscellaneous chemicals that were housed in a Research & Development (R & D) laboratory; and 2) waste materials (liquids and solids) that were already containerized in 55-gallon drums.

1.2.4 Current Situation

Presently, a USEPA Emergency Response Team is working at facility securing and removing containment vessels and other machinery left when the facility was abandoned. The remediation of the plant's interior, with respect to the containment and removal of chemicals, has been completed. To date no decision has been determined as to the future of the plant building structures.

To-date, numerous reports has been issued concerning the RI/FS project that is being conducted by ERM under contract with the NYSDEC. The Phase I RI report was submitted to the NYSDEC in December 1989. The Phase I and II FS report was submitted in February 1990. A Scope-of-Work for the Phase II

RI was submitted and approved in March 1990 and field activities for the Phase II commenced in June 1990.

A Phase III RI Work Plan was submitted to the NYSDEC in February 1991 for the purpose of investigating the subsurface conditions (soil and ground water) beneath the building interior. This is an important phase of the project because of the many potential source areas beneath the plant building, and this phase of the investigation could only recently begin because of the completion of USEPA's removal actions.

1.3 Report Organization

This RI report presents the findings of the (Phase II) RI study. Work was conducted in accordance with the NYSDEC and USEPA requirements and protocols, and the report format is also, in accordance with by "USEPA Guidance for Conducting RI/FS Under CERCLA." Table 3-3 EPA/540/G-89/004, October, 1988). The organization of this report is as follows:

Section 1.0 - Introduction
Section 2.0 - Phase II Drilling and Sampling Program
Section 3.0 - Aquifer Hydraulic Characteristics and Testing
Section 4.0 - Overview of Phase II Chemical Analyses
Section 5.0 - Public Health and Environmental Risk Assessment
Section 6.0 - Potential Sources and Extent of Plant No. 1 Contamination
Section 7.0 - Summary and Conclusions

Appendix A	- January 15, 1991 Site Walkthrough Notes
Appendix B	- Phase II QA/QC Laboratory Data Validation
Appendix C	- Project Field Notes
Appendix D	- Boring Logs
Appendix E	- Monitoring Well Installation Reports
Appendix F	- Ground Water Contour Maps
Appendix G	- Slug Test Data
Appendix H	- Pumping Test Data and Drawdown/Recovery Figures

2.0 PHASE II RI: POST-SCREENING FIELD INVESTIGATION (TASK V)

2.1 Project Overview

The objective of ERM's Phase II RI field investigation program was to further identify and delineate the extent of soil and ground water contamination outside of Van Der Horst Corporation's Plant No. 1 and to identify any residual contamination from the one time release of chromic acid to the storm-sewer system. Emphasis was placed on further identifying four environmental problems: 1) major on-site contaminant source areas; 2) the magnitude and extent of soil contamination in the local area adjacent to the Van Der Horst plant; 3) any residual contamination present in the storm sewer system and Olean Creek; and 4) the lateral and vertical extent of ground water contamination. To accomplish these goals, the Phase II RI included the following tasks:

- Preparation of a Base Map and Site Topographic Map
- Installation of Ground Water Wells and Test Borings
- Monitoring Well Development
- Sampling of Ground Water Monitoring Wells
- Aquifer Pumping Test
- Delineation of On-Site Soil Contamination
- Supplemental Evaluation of Off-Site Soils
- Additional Sampling at Olean Creek
- Sampling of Adjacent Storm-Sewer System
- Expanded Survey of Local Ground-Water Usage
- Final Risk Assessment

Field samples collected during Phase II were analyzed for chemical parameters that reflected the facility's manufacturing and discharging history, and the results of previous sampling by ERM, the CCDOH and NYSDEC. Analytical parameters for each matrix are summarized in Table 2-1. The laboratory data package for the Phase II RI is voluminous and was provided to the NYSDEC in December 1990. A QA/QC data review of the laboratory data is presented in Appendix B, where all of the sampling data is summarized and critiqued. A discussion of the sampling data is presented in Sections 4.0 and 6.0 of this report.

2.2 Health and Safety Monitoring

Health and safety monitoring was done during field activities in general accordance with the site-specific Health and Safety Plan (HASP). All site monitoring was conducted by, or under the supervision of the Site Safety Officer to provide the continued safety of workers and nearby residents. The monitoring involved air quality sampling at the locations of site operations and along the downwind perimeter of the site. The ambient air and breathing space of on-site workers was monitored for organic vapors using either a TIP II photoionization detector or a HNU; and for dust particulates using a Mini Ram (model PDM-3), a real-time particulate monitor. The instruments used during site activities

TABLE 2-1

SUMMARY OF PHASE II RI SAMPLING PROGRAM

	Sampling Location	Analyses
ON-SITE SOILS	SURFACE: OS-SS-1 Through OS-SS-10	Total chromium, arsenic and lead
	SUBSURFACE: SB-1 through SB-8 (3 samples/boring)	Total chromium, arsenic and lead.
	SUBSURFACE: SB-1 through SB-3 and SB-6 through SB-8 (8 samples)	TCLP for RCRA metals
OFF-SITE SOILS	SURFACE: BSS-1, BSS-2, RSS-1 and RSS-2.	Total TAL metals
GROUND WATER	Twenty monitoring wells (MW-1 through MW-14)	TCL Volatiles, TAL metals, hexavalent chromium.
OLEAN CREEK	GENERAL SURVEY: CR-SW-1 through CR-SW-7 and CR-SD-1 through CR-SD-6	TAL metals Hexavalent chromium (water only), pH (water only)
	OUTFALL: CR-BSD-1 through CR-BSD-6 and OS-OC-1 through OS-OC-4	TAL metals
	GENERAL: OS-OC-5 and OS-OC-6	TCLP for RCRA metals
STORM SEWER	WATER and SEDIMENT: ST-SEW-1 through ST-SEW-7	Total chromium, arsenic and lead, hexavalent chromium (water only) and pH (water only).
WASTE	DRUMMED DRILL CUTTINGS: 19 soil samples	TCLP for RCRA metals
	CONTAINERIZED PURGE WATER: 2 water samples	RCRA metals, hexavalent Cr, TCE and non-filterable residue.

NOTE: Analyses were conducted at the lowest practical detection limit.

met the established requirements set forth in OSHA, MSHA, and NIOSH.

No significantly elevated organic vapor instrument readings (i.e., above background) were measured during the field operations. Some elevated values were obtained from a few boreholes and soil samples during site activities; however, these were attributed to moisture and no elevated values were obtained when monitoring in the breathing zone. Documentation of health and safety monitoring is included in the field notes, which are contained in Appendix C.

To reduce the likelihood of releasing airborne particulates and the potentially associated contaminants, engineering and administrative controls were implemented during site activities. During field activities the following dust control measures were used:

- allowing only minimal disturbance of sampling areas by personnel and machinery;
- containerizing all development and purge water directly into storage vessels;
- placing all exhumed soil directly into 55-gallon drums, which were then covered and secured; and
- storing all exhumed soils and development water in a segregated area within the fenced-in confines of the facility.

2.3 Decontamination Procedures

A temporary equipment decontamination pad was constructed on the south side of the plant building, adjacent to the loading dock (See Figure 1-2). The USEPA had completely occupied the small lot on the north side of the plant building, and was intermittently using the only remaining lot (on the building's south side) for building access and for loading trucks during waste disposal. This decontamination pad had a central sump from which the spent water was pumped into above-grade holding tanks for storage.

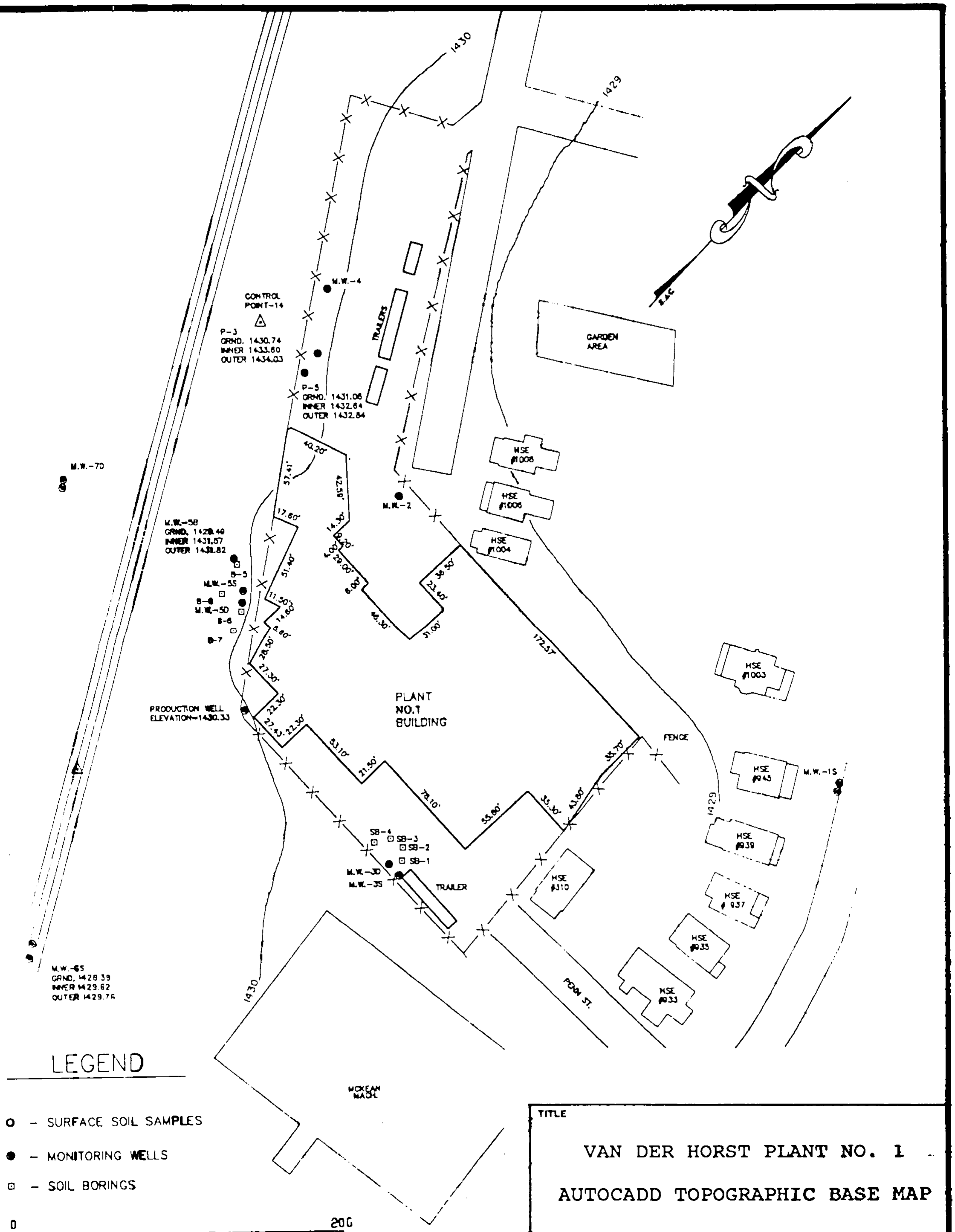
All water generated from the monitoring wells during development and purging was also stored on-site in plastic holding tanks. Three tanks were located adjacent to the decontamination pad, and one tank was sited next to the west fence at the northern end of the site. Water samples were collected from these tanks and the decontamination tanks and analyzed for POTW disposal parameters. Based on these sampling results, all containerized water was pumped into the sanitary sewer with approval from the Olean Department of Public Works and NYSDEC.

Precautions were taken to secure potentially contaminated material generated during the field activities. Excess soil and disposable safety apparel that were generated during drilling operations were stored on-site in 55 gallon metal drums. Drums were secured with bolt-tightened lids and labeled (as to contents) on the top and sides. The drums are presently kept on wooden pallets in a secure on-site area and covered by a tarp.

2.4 Preparation of a Base Map and a Site Topographic Map

A land surveyor, licensed in the State of New York, was contracted to prepare base map of the study area and a topographic map of the site area. The land surveyor used aerial photography and ground-control survey techniques to generate a site topographic map with a scale of one inch equals fifty feet, and with one-foot contour intervals.

The base map was generated at a scale of 1 in. = 200 ft. and included the study areas for both Van Der Horst Plant 1 and Plant 2. Cultural features on the base map include city streets, houses, railroad tracks, fences, etc. All Plant 1 and Plant 2 monitoring wells, piezometers and test borings were surveyed and plotted on the map, for the purpose of delineating the local and regional flow characteristics of the aquifer. Computer files (Autocadd Version 10) of the base map and the topographic map (Figure 2-1) were created to facilitate subsequent figure generation.



LEGEND

○ – SURFACE SOIL SAMPLES

● – MONITORING WELLS

⊡ – SOIL BORINGS

0 200
SCALE

NOTES:

1) BASE MAP PROVIDED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

TITLE

VAN DER HORST PLANT NO. 1

AUTOCADD TOPOGRAPHIC BASE MAP

PREPARED FOR

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
DATE	2-1

2.5 Installations of Monitoring Wells

2.5.1 Well Locations

Locations for seven monitoring wells and three piezometers are presented in Figure 2-2 and were selected for the Phase II RI based on the following rationale:

MW-5B: evaluate the vertical extent of the chromium contamination in the lower aquifer beneath a clay aquitard;

MW-10: evaluate the southern extent of the chromium contamination in the shallow upper aquifer;

MW-11S: evaluate the southwestern extent of chromium contamination in the shallow upper aquifer;

MW-11D: evaluate the southwestern extent of chromium contamination in the lower portion of the upper aquifer;

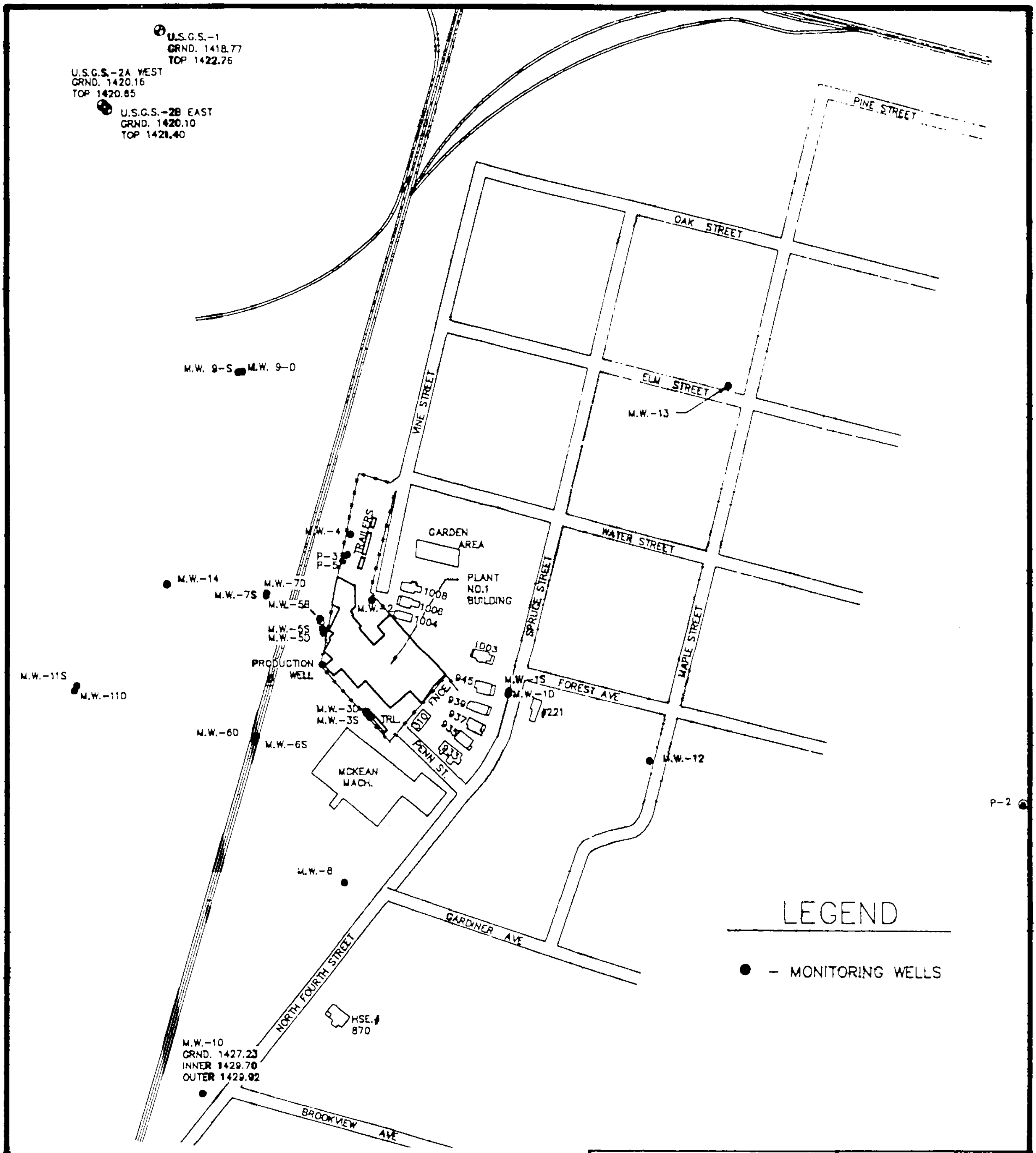
MW-12: evaluate the northeastern extent of chromium contamination in the shallow upper aquifer;

MW-13: evaluate the eastern extent of the chromium contamination in the shallow upper aquifer;

MW-14: replaced former shallow well MW-6S which was destroyed by others after the Phase I RI;

P-1,P-2: determine groundwater flow direction;

P-3: A six-inch I.D., PVC piezometer was installed for use during the pump test. This location provided information relative to the hydrogeologic properties of the aquifer without coming in contact with highly contaminated soil and groundwater at the site;



NOTES:

THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS & ENGINEERS, BUFFALO, NY, IN NOVEMBER, 1990.

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)
1 inch = 200 ft.

TITLE

VAN DER HORST PLANT NO. 1

MONITORING WELL LOCATIONS

PREPARED FOR

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
DATE	2-2

P-5: A second six-inch I.D., PVC piezometer was installed after P-3 did not yield sufficient water for the pumping test.

2.5.2 Shallow Monitoring Wells

All shallow wells were drilled using a CME-55 drilling rig outfitted with 4 1/4 -inch inside diameter (I.D.) hollow-stem augers. All drilling operations were monitored by an ERM-Northeast hydrogeologist. During the drilling, soil samples were collected at two-foot intervals for description of soil characteristics. These samples were collected using a 2-inch I.D. split-spoon sampler that was driven 2 feet beyond the augers by a 140-pound hammer free falling 30 inches. Descriptions of the soil samples were recorded on the boring logs, which are included in Appendix D.

Subsurface soil samples were collected at 5-ft intervals with a split-spoon sampler during the installation of the monitoring wells. The samples were used primarily for soil classification. At the clustered wells soil samples were only collected from the deep well.

In each shallow overburden well, a 15 or 20 foot section of slotted 2-inch I.D. PVC, NSF-approved well screen was installed. A riser casing of flush jointed, threaded, 2-inch

I.D. PVC, NSF-approved pipe was extended from the screen to ground surface. The top of the well screen was positioned between one and three feet above the top of the water table. A sand filter pack was placed around the well screen extending two feet above the screen. The sand pack was overlain by a two foot seal of hydrolyzed bentonite pellets. The remainder of the annular space was filled with a cement/bentonite grout of the following ratio: 12 lbs. of cement, 1 lb.of bentonite, and 1 gallon of potable water. Specific well installation information is provided for each well in Table 2-2. A Locking, protective outer casing was cemented in place over the PVC riser pipe to secure each well. The concrete was mounded around the protective casing to promote drainage away from the monitoring wells. Monitoring well installation reports for each of the wells are included in Appendix E.

2.5.3 Deep Monitoring Wells

Drilling procedures for monitoring well MW-11D was similar to that used for the shallow wells, although the construction of the well intake varied (see Table 2-2). The well screen consisted of a 5-foot section of 2-inch PVC slotted screen. Approximately 10 feet of sand filter pack was

TABLE 2-2

SUMMARY OF PLANT 1 MONITORING WELL DATA

Boring Number	Date Completed	Ground Surface Elevation (ft)	Monitoring Point Elevation (ft)	Depth of Boring (ft)	Bottom of Boring Elevation (ft)	Screened Interval Depth (ft)	Screened Interval Elevation (ft)	Sand Pack Depth (ft)	Sand Pack Elevation (ft)
				(Phase I Monitoring Wells)					
MW-1S	6-1-89	1427.76	1427.35	31.0	1396.76	15.0-30.0	1412.76-1397.76	12.6-31.0	1415.16-1396.76
MW-1D	6-2-89	1427.73	1427.38	60.0	1367.73	50.0-55.0	1377.73-1372.73	51.0-60.0	1377.73-1367.73
MW-2	5-8-89	1430.14	1432.20	32.0	1399.14	16.0-31.0	1414.14-1399.14	14.9-32.0	1415.24-1398.14
MW-3s	5-3-89	1427.37	1429.54	30.0	1397.37	12.0-27.0	1415.37-1400.37	9.2-30.0	1418.17-1397.37
MW-3D	5-16-89	1427.53	1429.84	58.0	1369.53	51.0-56.0	1376.53-1371.53	49.0-58.0	1378.53-1369.53
MW-4	5-4-89	1430.92	1433.26	32.0	1398.92	16.0-31.0	1414.92-1399.92	14.9-32.0	1416.02-1398.92
MW-5S	5-12-89	1429.34	1432.42	32.0	1397.34	16.0-31.0	1413.34-1398.34	15.0-32.0	1414.34-1397.34
MW-5D	5-11-89	1429.32	1432.44	54.0	1375.32	47.0-52.0	1382.32-1377.32	45.0-54.0	1384.32-1375.32
MW-6S	5-18-89	1428.50	1430.16	33.0	1395.50	16.0-31.0	1412.50-1397.50	12.4-33.0	1416.10-1395.50
MW-6D	5-17-89	1428.58	1430.89	62.0	1366.58	54.0-59.0	1374.58-1369.58	52.0-62.0	1376.58-1366.58
MW-7S	5-16-89	1429.10	1431.42	36.0	1393.10	18.0-33.0	1411.10-1396.10	15.0-36.0	1414.10-1393.10
MW-7D	5-16-89	1429.04	1431.40	57.0	1372.04	48.0-53.0	1381.04-1376.04	45.0-57.0	1384.04-1372.04
MW-8	5-9-89	1429.00	1428.47	32.0	1397.92	16.0-31.0	1413.00-1398.00	13.4-32.0	1415.60-1397.00
MW-9S	7-7-89	1429.92	1433.50	32.0	1397.92	15.0-30.0	1414.92-1399.92	12.0-32.0	1417.92-1397.92
MW-9D	7-6-89	1429.84	1433.36	63.0	1366.84	55.0-60.0	1374.84-1369.84	53.0-63.0	1376.84-1366.84
				(Phase II Monitoring Wells)					
MW-5B	08-7-90	1429.49	1431.57	118.9	1310.59	113.4-118.4	1315.09-1310.09	108.3-118.9	1299.99-1310.59
MW-10	07-7-90	1427.23	1429.70	35.0	1392.23	14.0-34.0	1413.23-1393.23	12.9-35.0	1414.33-1392.23
MW-11S	07-16-90	1428.92	1431.52	34.6	1394.32	18.6-33.6	1408.32-1393.32	18.5-34.6	1410.42-1394.32
MW-11D	7-13-90	1429.09	1431.58	60.0	1369.09	54.0-59.0	1373.09-1368.09	49.0-60.0	1380.09-1369.09
MW-13	7-18-90	1429.79	1429.81	33.0	1396.79	15.0-32.0	1412.79-1395.79	15.0-33.0	1414.79-1396.79
MW-14	7-17-90	1429.62	1431.47	34.0	1395.62	18.0-33.0	1411.62-1396.62	17.0-34.0	1413.62-1395.62
MW-12	7-26-90	1431.31	1431.24	34.0	1397.31	18.0-33.0	1413.31-1398.31	15.2-34.0	1416.11-1397.31
P-1	7-6-90	1428.54	1431.11	39.5	1389.04	23.5-38.5	1405.09-1390.04	20.5-39.5	1408.04-1389.04
P-2	7-19-90	1425.45	1425.51	44.7	1380.75	18.3-43.3	1407.15-1382.15	17.0-44.7	1408.45-1380.75
P-3	7-25-90	1430.74	1433.60	56.0	1374.74	15.0-55.0	1415.74-1375.74	10.0-56.0	1420.74-1374.74
P-5	11-5-90	1431.06	1432.64	60.0	1371.06	20.0-60.0	1411.06-1371.06	16.0-60.0	1415.06-1371.06

placed around the well screen and the 2-inch PVC riser pipe above the screen. A thick bentonite slurry was set immediately above the sand pack. The remainder of the well construction was similar to the shallow wells.

The installation of well MW-5B was somewhat different than other deep wells at the site. The screen and sand pack were set in the lower aquifer which lies beneath a 19-foot silt and clay aquitard. A 5-foot length of 2-inch I.D., slotted PVC screen was set at the bottom of the borehole. Two-inch I.D., flush joint, PVC riser pipe was connected to the screen and extended 2 feet above ground level. A 10-foot thickness of sand filter pack was set outside the screen and riser pipe. A thick bentonite slurry was placed above the sand pack. The rest of the well construction was similar to the shallow monitoring wells.

Well MW-5B was double cased to prevent the chromium-contaminated ground water from migrating through the aquitard. The well was initially drilled with 6 1/4-inch hollow-stem augers to a depth of 95 feet -- 5 feet below the <u>top</u> of the aquitard. The augers were filled with bentonite grout and 5-inch I.D. steel casing was seated in the aquitard. After the augers were removed from the borehole, the grout was allowed to set overnight. The following day, the 5-inch casing was flushed out with a tri-cone roller-bit. The borehole was advanced using a combination of 4-inch roller-bit drilling and 4-inch spin-casing drilling.

2.5.4 Piezometers

Piezometers P-1 and P-2 were constructed in the same manner as the shallow monitoring wells, although no split-spoon samples were collected during drilling for these two piezometers. These two wells were installed off-site to obtain water-level data for use in determining the ground water flow direction around the site.

Piezometers P-3 and P-5 were similarly installed to a depth of approximately 60 feet for the purpose of serving as pumping wells. Forty feet of 6-inch I.D., slotted PVC screen was set in the boring, with the top of the screen located above the top of the static water table. Riser pipe constructed of 6-inch I.D. schedule-40 PVC was then installed to 2.5 feet above ground surface. A sand filter (P-3) or gravel filter (P-5) was placed from total depth to approximately two feet above the screen and capped with a two foot bentonite seal. The remainder of the annular space was filled with grout to ground surface (see Table 2-2).

Piezometer P-5 was drilled and installed after preliminary pumping of P-3 yielded a maximum sustainable discharge of only 60 gpm. During 3 hours of pumping no drawdown was measured in MW-4, located 42 feet north of P-3. Subsequent well development did not measurably improve the maximum discharge of P-3; however, piezometer P-3 played a major role in the pumping test analyses in that it experienced the greatest amount of drawdown.

2.6 Monitoring Well Development

Following installation, monitoring wells were left undisturbed for several days to allow the well construction materials to stabilize. The wells were then developed by either pumping or bailing to ensure an effective hydraulic connection between the monitoring well and the aquifer. Most of the wells were initially bailed dry several times to remove silt from the well bottom and surrounding sand pack. Thereafter, the well screens were sufficiently transmissive to allow for sustained withdrawal using a centrifugal pump.

During development, samples of the discharged ground water were periodically collected and analyzed with a turbidity meter (portable nephelometer, Model 21PE, Monotek^R). All of the monitoring wells initially produced very turbid water, and well development was continued until the turbidity of the discharged water was visually sediment free and numerically less than 50 National Turbidity Units (NTU). The data collected during well development data is presented in Table 2-3.

All of the ground water removed from the monitoring wells during well development and pre-sample purging was containerized within 55-gallon drums and then transferred into several on-site holding tanks. These holding tanks were emptied, after municipal approval, into Olean's sanitary sewer system.

Well development equipment (PVC bailers, polyethylene suspension cord, and PVC hosing) was dedicated to each well. In instances were well development occurred over a several day period, the equipment was cleansed with a deionized water rinse and stored within the field trailer.

2.7 Ground Water Sampling

Following well development, unfiltered ground water samples were collected from all twenty monitoring wells using a bottom loading PVC bailer with a polypropylene suspension cord. The bailers, dedicated for each well, were laboratory cleaned (in accordance with the QA/QC plan) and wrapped in aluminum foil. Prior to well sampling, a minimum of three volumes of well water

TABLE 2-3

VAN DER HORST PLANT 1, PHASE II

MONITORING WELL SAMPLING INFORMATION

WELL	SAMPLING DATE	HEIGHT OF WATER (ft)	WATER PURGED (gal)	NTU	pH	CONDUCTIVITY	TEMPERATURE (C)
1S	8/15/90	11.80	107	50	8.6	940	14.0
1D	8/15/90	35.66	42	15	8.3	680	14.5
2	8/15/90	10.77	10	25	8.5	590	13.5
3S	8/14/90	10.73	93	45	7.8	870	14.0
3D	8/14/90	37.15	18	8.5	7.0	640	14.0
4	8/15/90	9.35	30	45	8.1	820	13.5
5S	8/14/90	11.37	6	45	8.4	520	13.0
5D	8/15/90	30.63	25	35	8.4	840	13.5
5B	8/14/90	94.94	70	10	8.8	370	14.0
7S	8/14/90	6.00	54	50	7.8	820	14.0
7D	8/14/90	33.39	37	35	7.6	660	15.0
8	8/15/90	12.45	137	33	8.2	920	14.0
9S	8/15/90	8.28	115	45	8.4	860	13.0
9D	8/15/90	38.72	31	<10	8.4	620	12.0
10	8/15/90	15.31	205	45	8.0	850	13.5
11S	8/16/90	13.88	175	40	8.8	690	15.0
11D	9/5/90	37.28	95	*	10.4	640	13.0
12	8/15/90	11.70	210	30	8.4	720	14.0
13	8/15/90	11.64	201	50	8.1	640	14.5
14	8/16/90	12.17	147	38	9.0	710	13.0

* turbidity of well water could not be lowered to 50 NTU

was pumped from each monitoring well with a centrifugal pump, using dedicated and previously unused PVC hosing. All ground water samples (except from MW-11D) were collected between August 14 and 16, 1990. Upon collection, the samples were immediately stored on ice in insulated coolers and daily delivered by ERM to the analytical laboratory (Recra Environmental, Inc.).

Samples of ground water were collected from MW-11D on September 5, 1990 due to difficulties encountered during well purging. This 60-foot well recovered very-slowly during purging and the expelled well water had a high turbidity. Several pumping and surging methods were performed on the well, but all techniques were unsuccessful in improving turbidity.

Samples from the twenty monitoring wells were analyzed for all TCL volatile organic compounds, TAL metals, hexavalent chromium, and pH. Sample analyses were performed at the lowest practical detection limit. Sampling results are discussed in detail within Section 4.0, while Appendix B contains a summary of all analytical data and an independent review of these data.

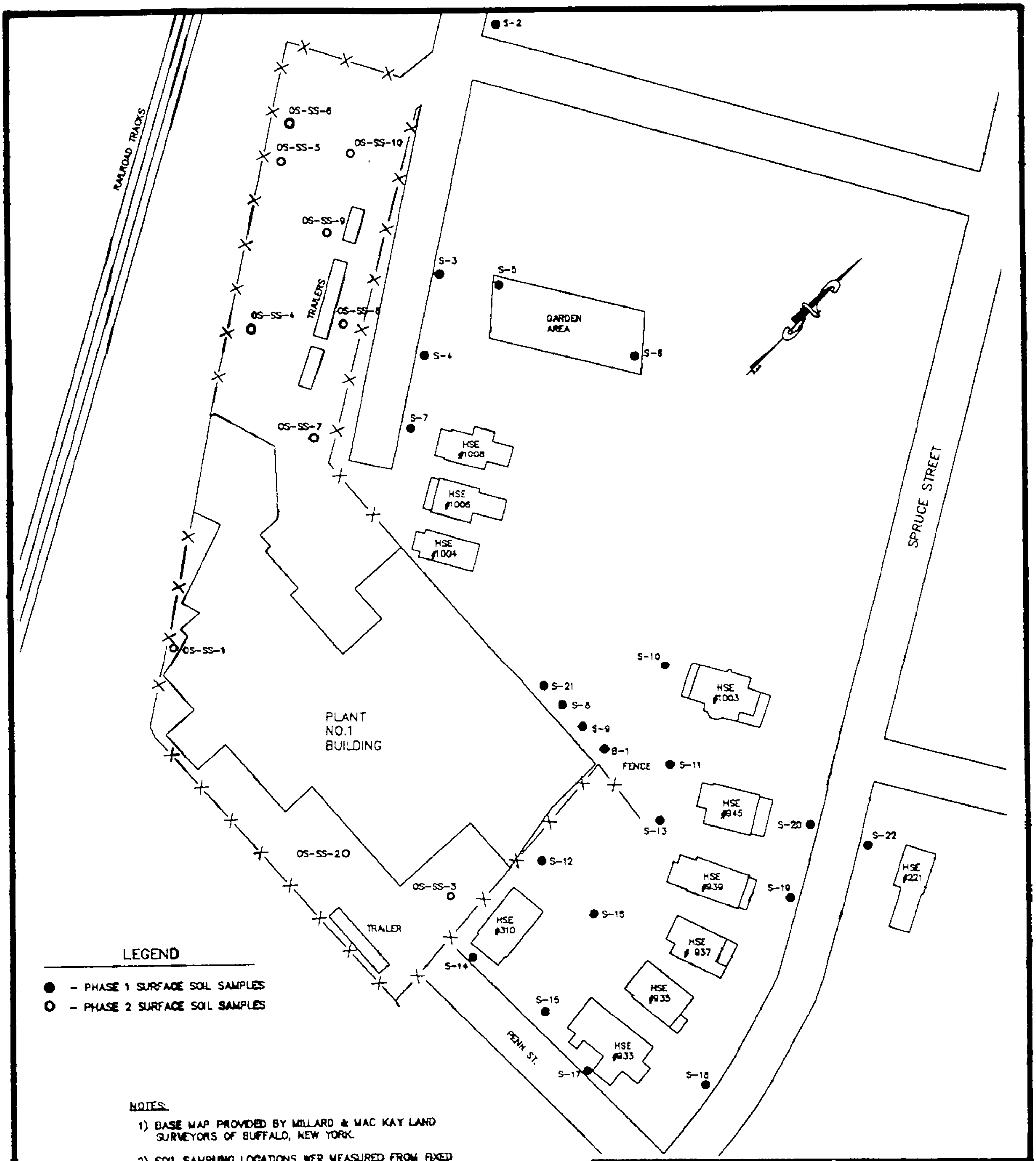
Two additional samples of ground water were collected from MW-11D (on October 19, 1990) to determine if the sample's high turbidity had effected chromium concentration (total and hexavalent). One aliquot of ground water was filtered (in the field) prior to preservation, while the other aliquot was not filtered.

2.8 Delineation of On-Site Soil Contamination

The soil sampling program for the Phase II RI served to delineate the extent of the chromium-contaminated soil areas (outside of the plant building) that were identified during the Phase I RI. To evaluate these areas of known chromium-contaminated soil, samples were collected at ten surface locations and from eight borings.

Surface soil samples were collected at 10 locations (OS-SS-1 through OS-SS-10, shown on Figure 2-3) and analyzed for total chromium, total arsenic, and total lead. Crushed stone (recently emplaced by the USEPA) covers the ground surface adjacent to MW-4. Consequently the surface soil sampling in this area took place below the stone, approximately three to five inches below grade.

Two additional samples of surface soil were collected adjacent to the area of chromium contamination along the site's westernperimeter. These samples were collected for grain size analyses so that the risks associated with fugitive dusts could be calculated.



LEGEND

● - PHASE 1 SURFACE SOIL SAMPLES

○ - PHASE 2 SURFACE SOIL SAMPLES

NOTES:

1) BASE MAP PROVIDED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

2) SOIL SAMPLING LOCATIONS WER MEASURED FROM FIXED LANDMARKS AND PLOTTED ON THE BASE MAP BY SCALING THE DISTANCES. THE LOCATIONS SHOULD BE CONSIDERED ACCURATE TO THE DEGREE IMPLIED BY THE METHOD USED.

0 200

SCALE

TITLE

VAN DER HORST PLANT NO. 1

SURFACE SOIL SAMPLE LOCATIONS

PREPARED FOR

ERM-Northeast
Environmental Resources Management

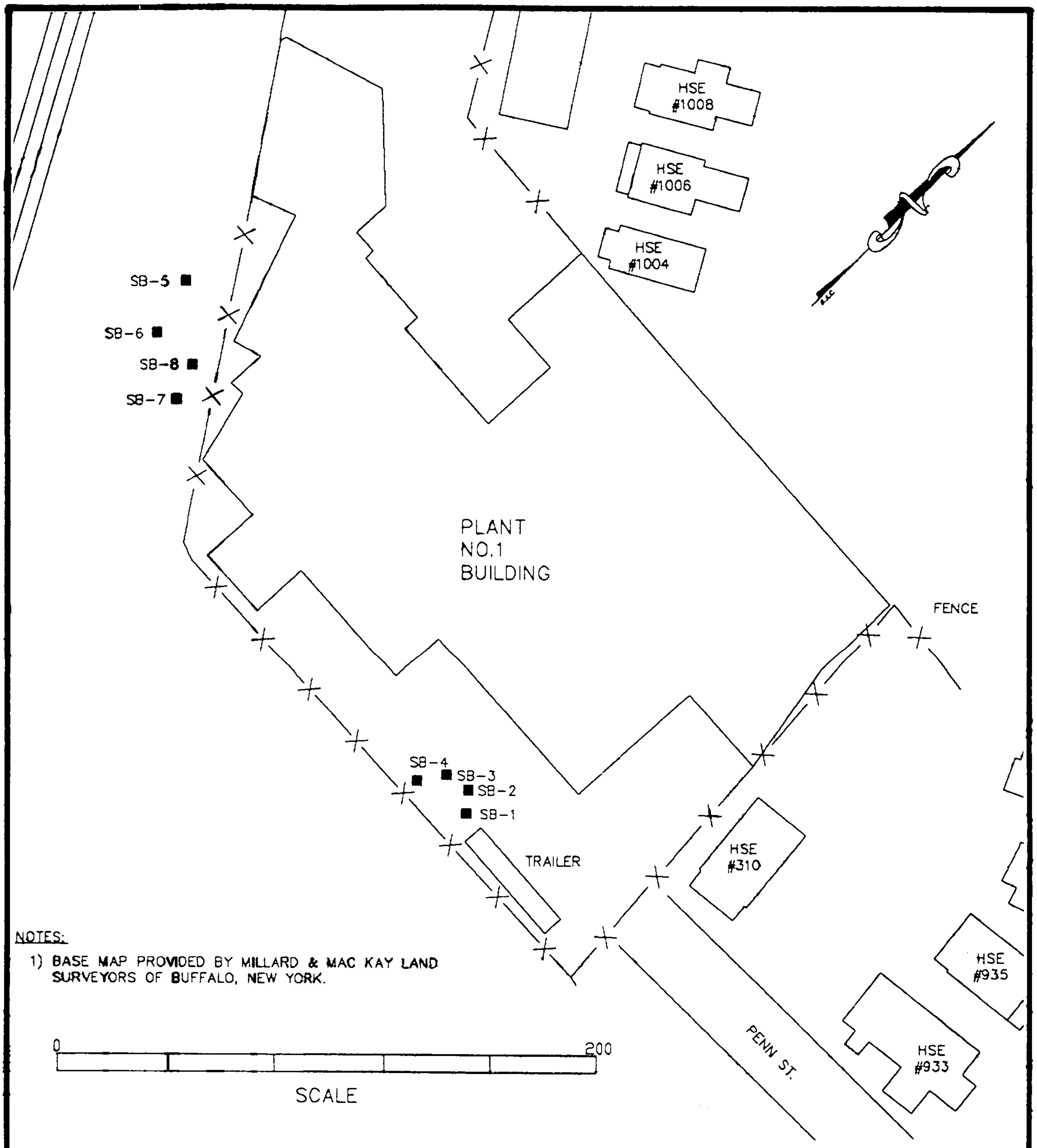
SCALE	FIGURE
DATE	2-3

139839

Samples of subsurface soil were collected for laboratory analyses during the drilling of eight test borings: SB-1 through SB-8 (Figure 2-4). Borings SB-1 through SB-4 were located on the southeast side of the property, while SB-5 through SB-8 were performed along the site's western perimeter. Seven of these borings were drilled to a depth of 10 feet, while SB-8 was drilled to the top of the water table (20 feet). Split-spoon samples were collected continuously while the borings were being drilled. Three samples from each shallow test boring were collected and analyzed for total chromium, arsenic, and lead. Ten samples were collected from SB-8 and analyzed for total chromium, arsenic, and lead. Six samples from the 8 test borings were also selected for TCLP metals analysis.

2.9 Supplemental Evaluation of Off-Site Soils

Four off-site samples of surface soil were collected for TAL metal analyses to further provide data for evaluation of the health risks associated with these soils (Figure 2-5). Surface soil sample BSS-1 was collected from an area away from the site to evaluate background concentrations, while the remaining three samples



NOTES:

1) BASE MAP PROVIDED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

LEGEND

■ - SOIL BORINGS

TITLE

VAN DER HORST PLANT NO. 1

SOIL BORING LOCATIONS

PREPARED FOR

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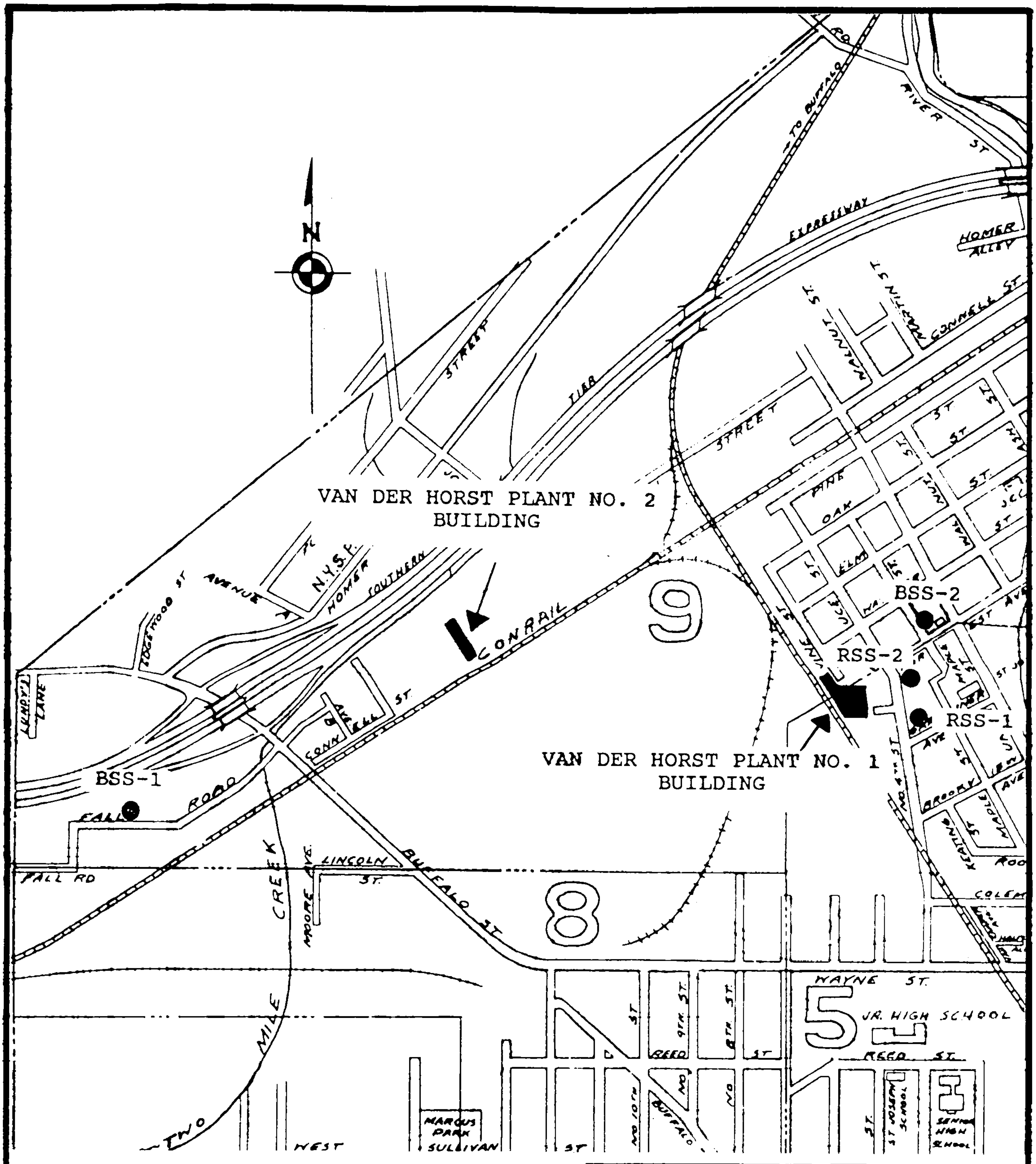
Environmental Resources Management

SCALE	FIGURE
DATE	2-4



TITLE

VAN DER HORST PLANT NO. 1

BACKGROUND AND RESIDENTIAL SOIL SAMPLE LOCATIONS

PREPARED FOR

ERM-Northeast
Environmental Resources Management

SCALE

DATE

FIGURE
2-5

Note: Sample BSS-1 is the upwind background sample.

(BSS-2, RSS-1 and RSS-2) were collected in residential areas to further delineate potential off-site chromium contamination. Background sample BSS-1 was collected several hundred yards west of Plant No. 1. Sample BSS-2 was collected from the playground of the North Hill School, two blocks east of the plant. Residential soil sample RSS-1 was collected near the intersection of North Fourth Street and Gardiner, while residential soil sample RSS-2 was collected in the backyard of 940 North Fourth Street.

For each sampling location, the upper one inch of sod was removed, and the sample was collected from 1 to 3 inches below grade. A dedicated stainless-steel trowel was used for each of the soil samples collected. Following soil sampling, the holes were backfilled potted soil and the sod was replaced. The results of the soil analysis are discussed in Section 4.0, while Appendix B contains a summary of all analytical data and an independent review of these data.

2.10 Additional Sampling at Olean Creek

Additional sampling of Olean Creek was performed to determine if residual chromium was present in the creek bed and banks, and if chromium contaminated sediment was being transported by the water. The specific sampling sites were selected based on the following criteria:

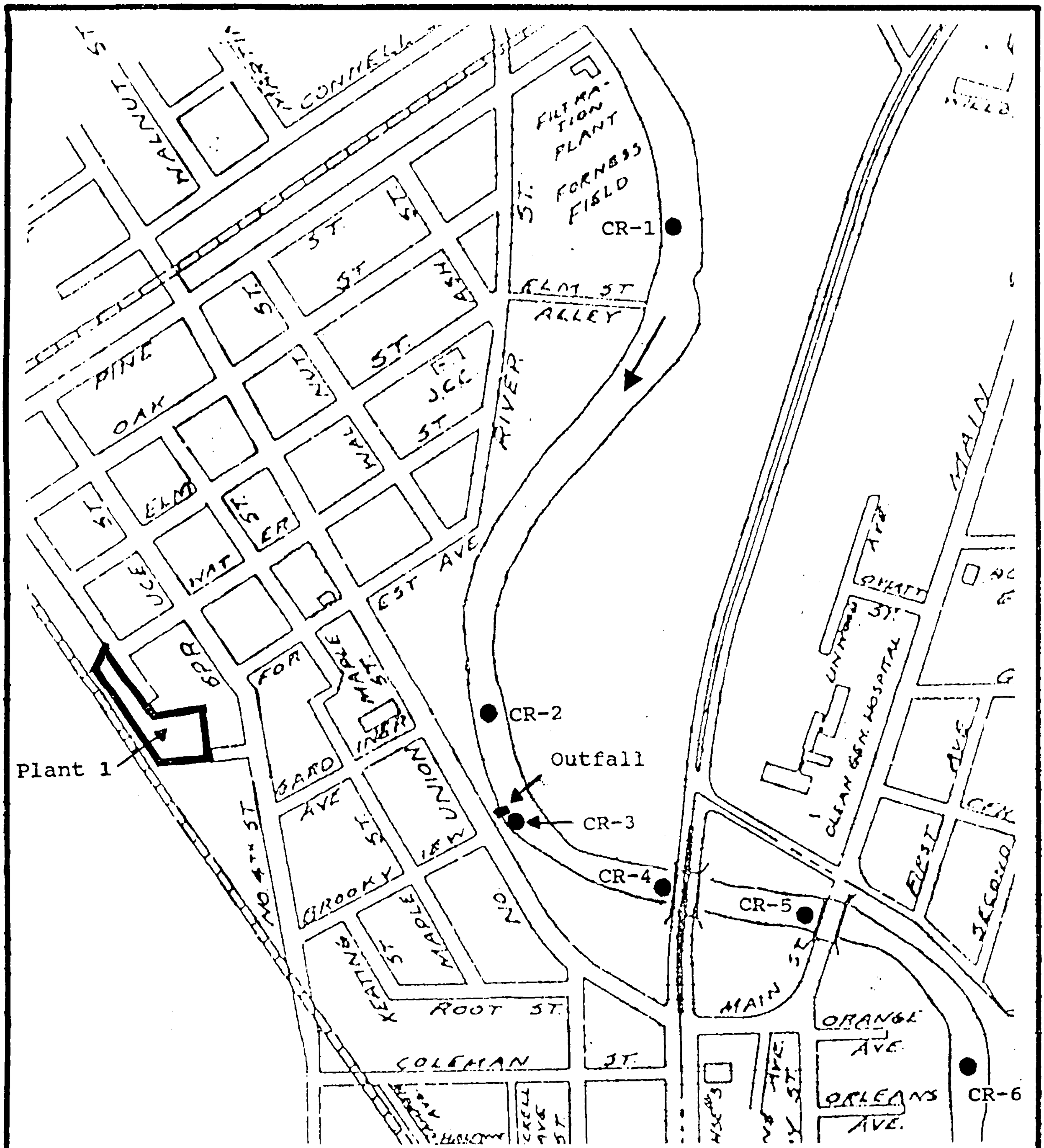
- Past and present stream morphology;
- Historical dredging activities;
- Potential areas of contaminant deposition; and
- Previous sampling locations within Olean Creek.

Based on this review, six locations away from the storm sewer outfalls were sampled for bank sediment (CR-BSD-1 through 6), creek-bed sediment (CR-SD-1 through 6), and surface water (CRSW-1 through 6). The sampling locations are shown on Figure 2-6. All surface water was tested for TAL metals, hexavalent chromium and pH. Sediment samples were tested for TAL metals.

In addition to these six locations, six additional sediment samples (OS-CC-1 through 6) were collected adjacent to the storm sewer outfall associated with the Van Der Horst Plant 1. Sample locations were adjacent to the sewer out-fall pipe, immediately upstream of the outfall, and immediately downstream of the outfall (Figure 2-7). Sediment samples were tested for TAL metals. Two of these samples were also tested for TCLP (RCRA metals) for comparison with landfill acceptance criteria.

2.11 Sampling of Adjacent Storm-Sewer System

Storm-sewer water and sediment samples were then collected from accessible manholes at seven locations during one non-storm



Sampling location ●

Note: Duplicate sample CR-7 was also collected at CR-3

TITLE

SURFACE WATER AND SEDIMENT LOCATIONS IN OLEAN CREEK

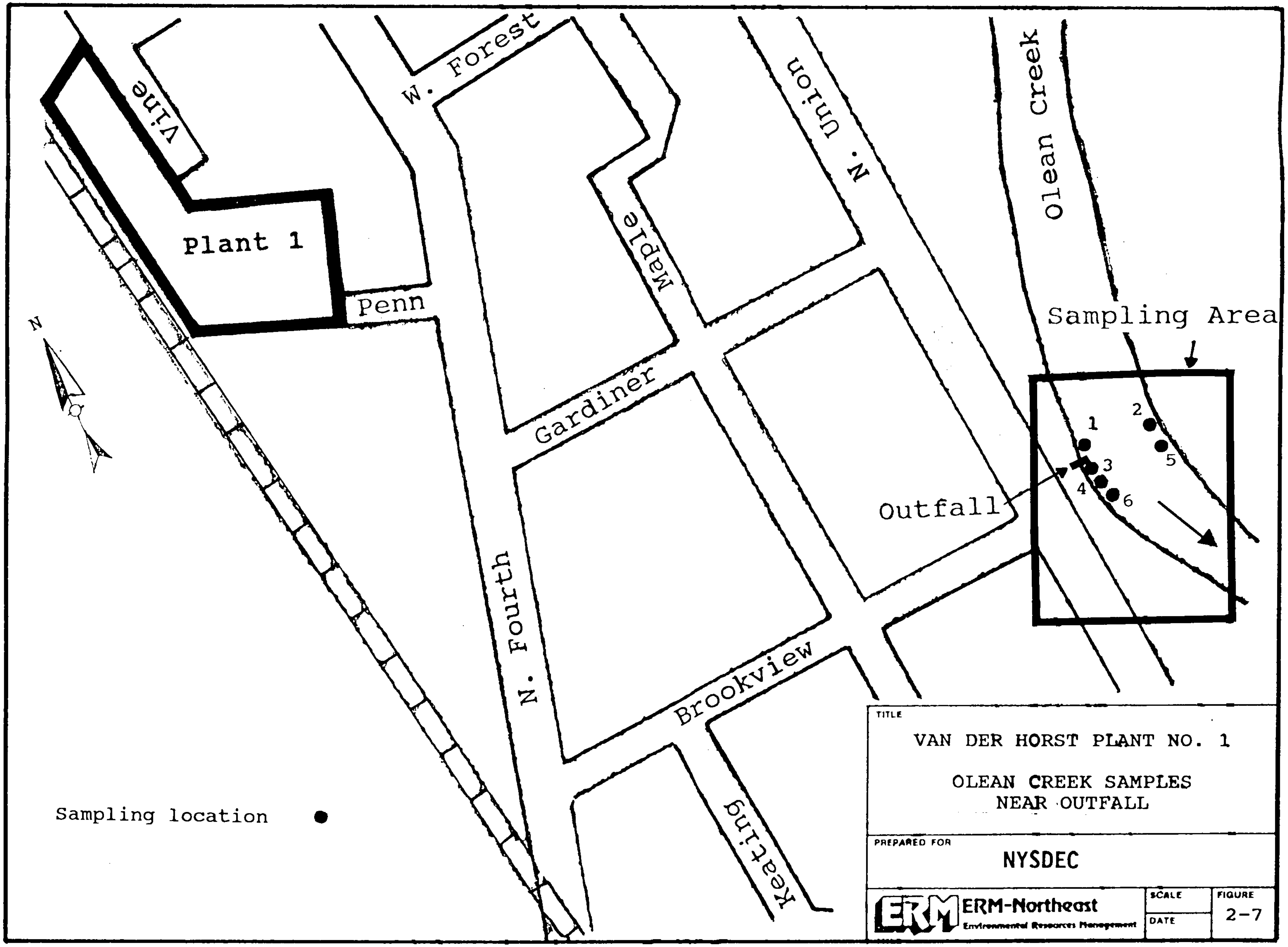
PREPARED FOR

NYSDEC

ERM **ERM-Northeast** Environmental Resources Management

SCALE	FIGURE
DATE	2-6

139839



TITLE

VAN DER HORST PLANT NO. 1

OLEAN CREEK SAMPLES
NEAR OUTFALL

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE

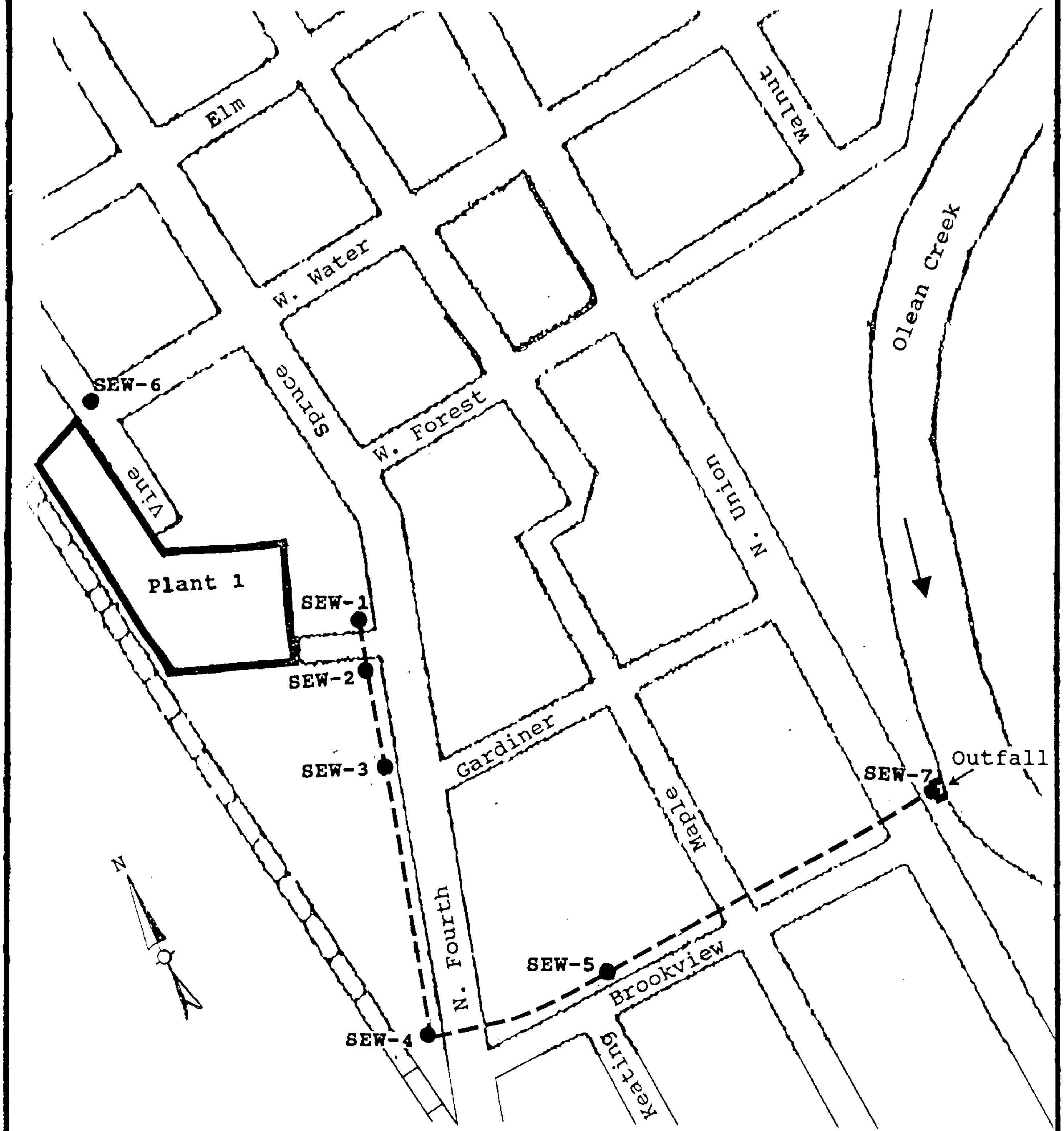
DATE

FIGURE
2-7

sampling event (Figure 2-8). Sample SEW-1 was collected at the manhole immediately upgradient of the Van Der Horst junction to the sewer, while five samples (SEW-2 through SEW-5, and SEW-7) were collected at locations in between the plant and the storm sewer's outfall. An additional storm sewer sample (SEW-6) was collected from another storm sewer north of the site (see Figure 2-8). This storm sewer discharges to an outfall north of the outfall shown on Figure 2-6. Storm-sewer sediment samples were analyzed for total chromium, arsenic, and lead, while the storm-sewer water samples were analyzed for the same three metals, plus hexavalent chromium and pH.

2.12 Expanded Survey of Local Ground-Water Usage

A water well survey was conducted to determine the type and amount of ground water use in the vicinity of the Plant 1 facility. This information, in combination with that obtained from the USGS Water-Resources Investigations Report 85-4082 and the USGS DESPOOL Ground Water Tables for Cattaraugus County indicate that there are numerous uses of the ground water resource within a 1 mile radius of the Plant 1 site. These uses include: 1) public/domestic uses, 2) commercial/industrial/institutional uses, and; 3) wells used for ground water observation. Locations of these wells are shown on the following Figures 2-9 through 2-11.



Sewer sampling location ●

Storm sewer line — — — —

TITLE

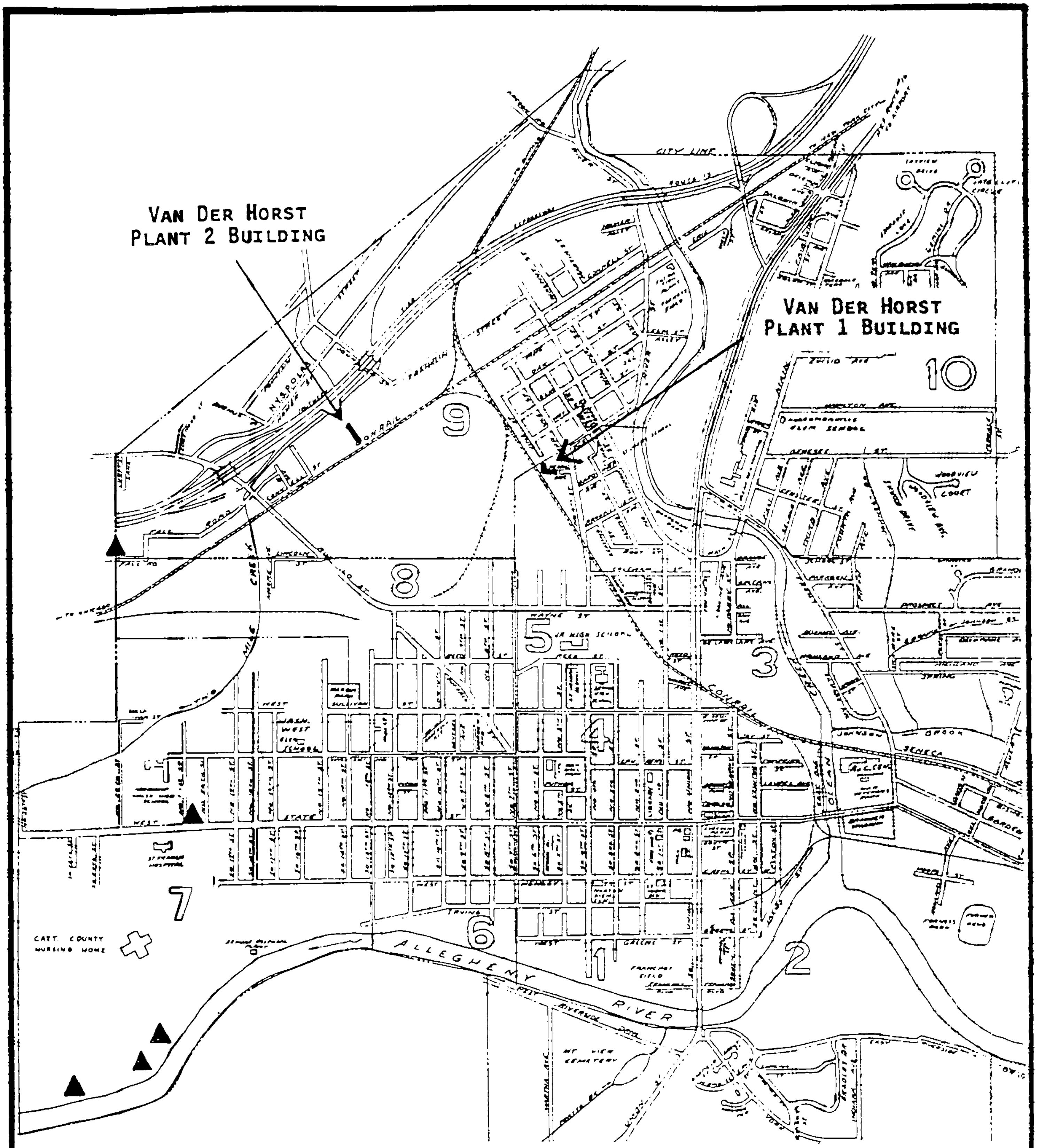
SEWER SAMPLE LOCATIONS

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

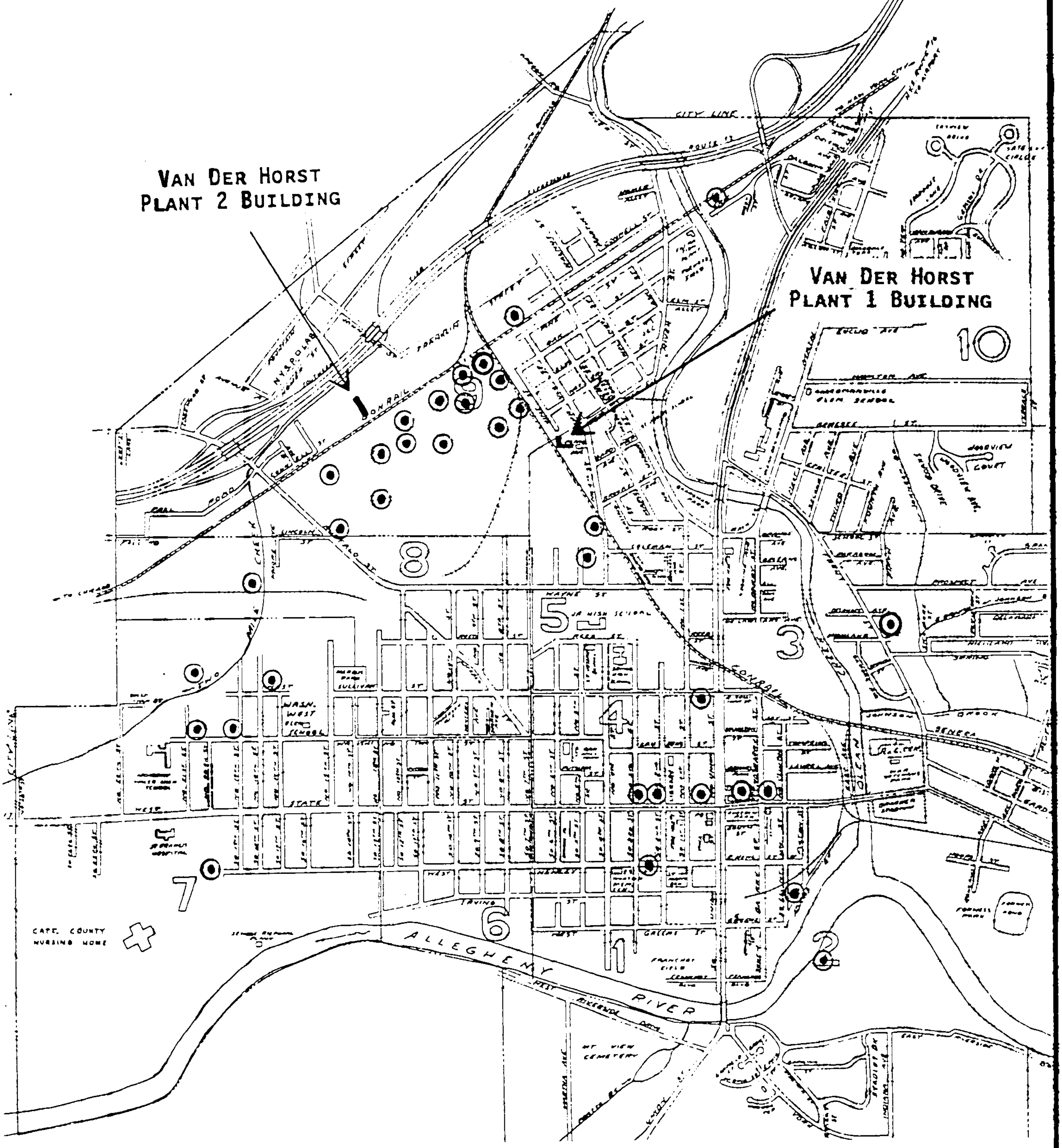
SCALE	FIGURE
DATE	2-8



▲ DENOTES PUBLIC/DOMESTIC SUPPLY WELL
LOCATION

SOURCES: USGS WATER-RESOURCES INVESTIGATIONS REPORT 85-4082, 1987; USGS DESPOOL GROUND WATER TABLES, CATTARAUGUS COUNTY, NEW YORK.

TITLE	LOCATION OF PUBLIC/DOMESTIC WELLS IN THE OLEAN AREA
PREPARED FOR	
ERM-Northeast Environmental Resources Management	SCALE
	DATE
FIGURE	2-9



◉ DENOTES INDUSTRIAL/COMMERCIAL/INSTITUTIONAL WELL LOCATION

SOURCES: USGS WATER-RESOURCES INVESTIGATIONS REPORT 85-4082, 1987; USGS DESPOOL GROUND WATER TABLES, CATTARAUGUS COUNTY, NEW YORK.

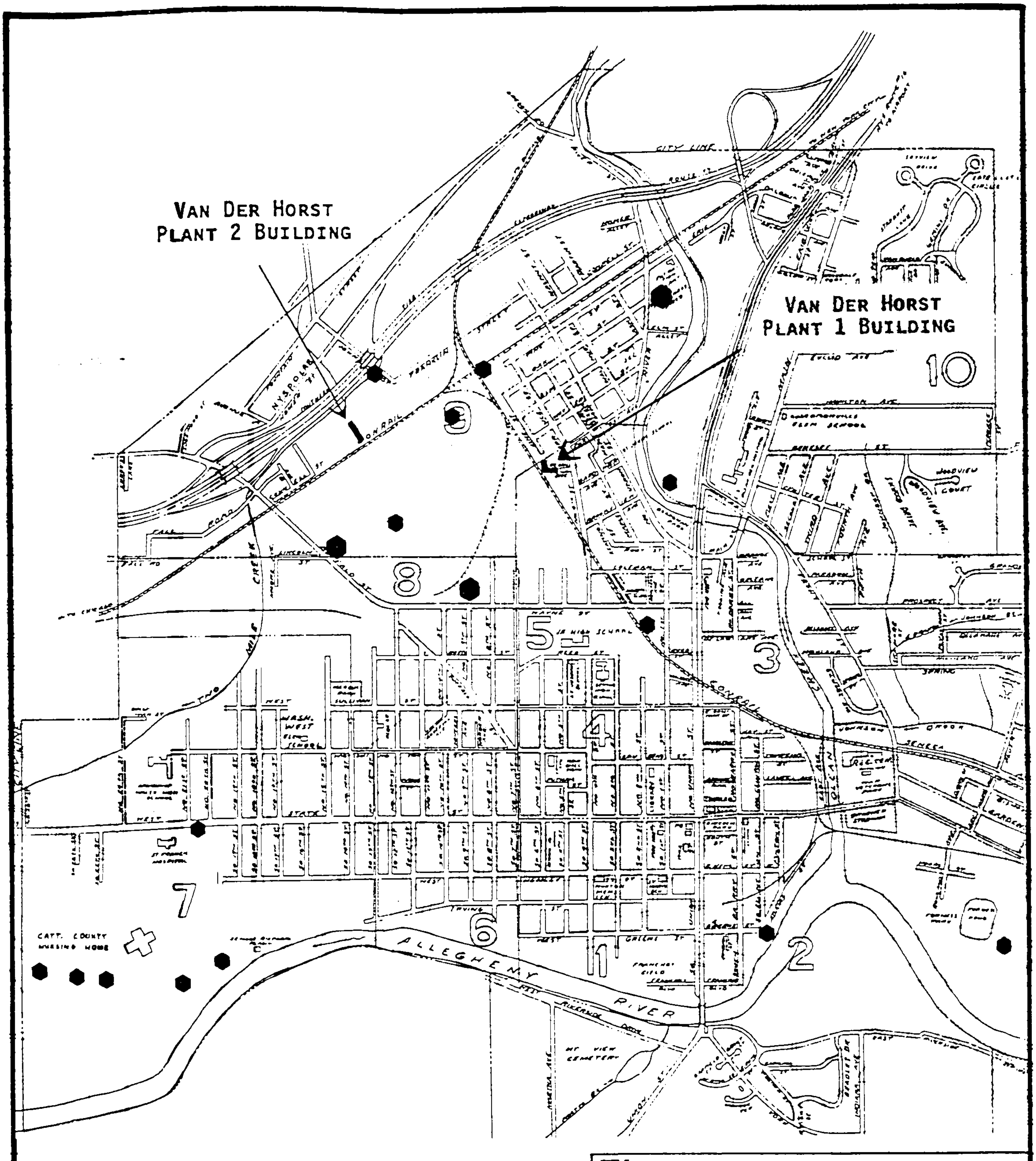
TITLE

LOCATION OF COMMERCIAL/
INDUSTRIAL/INSTITUTIONAL WELLS
IN THE OLEAN AREA

PREPARED FOR

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
DATE	2-10



● DENOTES USGS OBSERVATION WELL LOCATION

SOURCES: USGS WATER-RESOURCES INVESTIGATIONS REPORT 85-4082, 1987; USGS DESPOOL GROUND WATER TABLES, CATTARAUGUS COUNTY, NEW YORK.

TITLE

LOCATION OF OBSERVATION WELLS
IN THE OLEAN AREA

PREPARED FOR

ERM-Northeast Environmental Resources Management	SCALE	FIGURE 2-11
	DATE	

3.0 AQUIFER HYDRAULIC CHARACTERISTICS AND TESTING

3.1 Hydrogeology

3.1.1 Previous Studies

Previous studies have indicated that the uppermost aquifer near the site consists generally of 20 to 100 feet of coarse sand and outwash gravel that underlies the valleys of the Allegheny River and its tributaries. These deposits form an extensive and high yielding aquifer that has provided millions of gallons a day to industrial and municipal wells. At some locations within the valley, relatively thin lenses of silt and clay occur between 30 to 50 feet below land surface. These fine grained materials act as localized semi-confining beds that separates the aquifer into an upper and lower layer.

The United States Geological Survey (USGS) has monitored the water levels of 50 to 95 wells in the Olean area since the early 1970s. According to one study (Water Resources Investigation Report 87-4043, 1988), the upper 50 feet of the aquifer is more permeable than the lower 30 feet, and has yielded up to 500-1000 gal/min. The USGS recorded transmissivity values between 1,700 and 200,000 ft^2/day (1.2 and 140 ft^2/min), and the hydraulic conductivity is between 300 and 1500 feet/day (0.10 and 0.53 cm/sec) for the uppermost aquifer material at the Felmont Oil well field. The value of storativity was calculated to be 0.015.

In 1984, the ground water flow was to the south and southwest -- toward the Allegheny River, and radically toward cones of depression created by localized industrial pumping (USGS, 1985). The localized pumping included production wells at the Felmont-Oil well field (which were shut down in 1986) and a purge well at the Agway property. The pumping of these wells had created a cone of depression of up to 30 feet vertically and extending laterally to as far away as Olean Creek to the east.

Ground water is recharged by infiltration of precipitation and underflow from the Olean Creek and Allegheny River valleys. Recharge to the aquifers is estimated to be 19 inches per year (USGS, 1988) and is probably greater through induced infiltration in areas where pumping lowers water levels near surface-water bodies. The USGS estimated that when pumping was to cease at the Felmont well field the cone of depression would be lost after 4 to 8 months, after which static and natural ground water conditions would resume. The USGS also estimated that, if this should happen, ground water flow to the south-southwest would occur at a rate of 375 feet per year, making it approximately 6 years before the point source contamination would reach a potable well field located 1 mile to the south of Plant No. 1.

3.1.2 Phase I and II Results

Local hydrogeologic conditions at Plant No. 1 have been found to be somewhat different that those of earlier studies. The top of the upper aquifer at Plant No. 1 is at a depth of about 20 feet. The base of the upper aquifer occurs at a depth of 90 feet (well MW-5B), and lies above a 19-foot thick, silty clay aquitard. Beneath this aquitard is a semi-confined lower aquifer of unknown thickness. Both the upper and lower aquifers are within sand and gravel deposits.

The upper aquifer at the site behaves like a semi-confined aquifer however, no low permeability confining layer has been identified during drilling. Water levels in the upper aquifer fluctuate with changes in barometric pressure under static conditions or low-stress pumping. Water level changes of this nature are typical of a semi-confined aquifer.

On a regional scale, the upper aquifer is believed to be unconfined.

Static ground water levels were measured in the monitoring wells on seventeen events during the period of July 1989 through January 1991. Most of these measurements were collected on a monthly basis. Water level measurements from the complete Phase I and II monitoring well system were started in October 1990 and will continue during the duration of the RI/FS Project. Water levels in three USGS wells and the on-site production well were first measured in November 1990, and will likewise be continued. Water levels were measured to the nearest 0.01 feet with an electronic water level indicator and engineer's rule. The data are presented in Table 3-1.

Ground water elevations in Phase I monitoring wells are presented graphically in Figures 3-1, 3-2, and 3-3. The local water-table aquifer displayed a gradual lowering of approximately four feet between early July and late August (1989), and then stabilized in December (1989). Ground water levels rose until March (1990) and then declined until August (1990). Water levels rose in the fall of 1990 and reached the highest measured level in January (1991). The rising and

TABLE 3-1

VAN DER HORST PLANT NO. 1
GROUND WATER ELEVATIONS

LOCATION	MONITORING POINT ELEVATION (FEET)	PARAMETER	10-Jul-89	12-Jul-89	13-Jul-89	17-Jul-89	7-Aug-89	30-Aug-89	7-Dec-89	22-Jan-90	8-Mar-90	2-Apr-90	18-May-90	20-Jun-90	7-Aug-90	2-Oct-90	1-Nov-90	13-Dec-90	4-Jan-91
MW-1S	1427.35	Depth to Water (FT.)	14.75	15.05	15.15	15.67	17.35	18.65	18.78	17.70	15.69	16.42	15.94	16.87	17.98	17.27	15.29	16.11	14.03
		Static Water Level (FT)	1412.60	1412.30	1412.20	1411.68	1410.00	1408.70	1408.57	1409.65	1411.66	1410.93	1411.41	1410.48	1409.37	1410.08	1412.06	1411.24	1413.32
MW-1D	1427.38	Depth to Water (FT.)	14.80	15.11	15.25	15.73	17.42	18.71	18.86	17.77	15.77	16.50	16.02	16.94	18.06	17.34	15.36	16.18	14.10
		Static Water Level (FT)	1412.58	1412.27	1412.13	1411.65	1409.98	1408.67	1408.52	1409.61	1411.61	1410.88	1411.36	1410.44	1409.32	1410.04	1412.03	1411.20	1413.28
MW-2	1432.20	Depth to Water (FT.)	19.63	19.94	20.07	20.57	22.33	23.65	23.83	22.77	20.69	21.42	21.07	21.89	22.79	22.32	20.27	21.11	19.04
		Static Water Level (FT)	1412.57	1412.26	1412.13	1411.63	1409.87	1408.55	1408.37	1409.43	1411.51	1410.78	1411.13	1410.31	1409.41	1409.88	1411.93	1411.09	1413.16
MW-3S	1429.54	Depth to Water (FT.)	17.00	17.26	17.45	17.94	19.64	20.94	21.10	20.03	18.00	18.73	18.28	19.17	20.28	19.60	17.58	18.43	16.38
		Static Water Level (FT)	1412.54	1412.28	1412.09	1411.60	1409.90	1408.60	1408.44	1409.51	1411.64	1410.81	1411.26	1410.37	1409.26	1409.94	1411.96	1411.11	1413.16
MW-3D	1429.84	Depth to Water (FT.)		17.58	17.70	18.22	19.91	21.21	21.36	20.27	18.23	18.91	18.52	19.42	20.55	19.84	17.84	18.67	16.60
		Static Water Level (FT)		1412.26	1412.14	1411.62	1409.93	1408.63	1408.48	1409.57	1411.61	1410.93	1411.32	1410.42	1409.29	1410.00	1412.00	1411.17	1413.24
MW-4	1433.26	Depth to Water (FT.)	20.63	20.96	21.07	21.69	23.35	24.67	24.84	23.77	21.63	22.37	22.03	22.85	23.99	23.29	21.22	22.08	20.00
		Static Water Level (FT)	1412.63	1412.30	1412.19	1411.57	1409.91	1408.59	1408.42	1409.49	1411.83	1410.89	1411.23	1410.41	1409.27	1409.97	1412.04	1411.18	1413.26
MW-5S	1432.42	Depth to Water (FT.)	19.87	20.17	20.32	20.82	22.59	23.92	24.08	23.00	20.84	21.60	21.24	22.08	23.28	22.52	20.44	21.29	19.20
		Static Water Level (FT)	1412.55	1412.25	1412.10	1411.60	1409.83	1408.50	1408.34	1409.42	1411.58	1410.82	1411.18	1410.34	1409.18	1409.90	1411.98	1411.13	1413.22
MW-5D	1432.44	Depth to Water (FT.)	19.84	20.15	20.30	20.79	22.54	23.86	24.02	22.94	20.83	21.57	21.16	22.04	23.22	22.46	20.43	21.27	19.19
		Static Water Level (FT)	1412.60	1412.29	1412.14	1411.65	1409.90	1408.58	1408.42	1409.50	1411.61	1410.87	1411.28	1410.40	1409.22	1409.98	1412.01	1411.17	1413.25
MW-5B	1431.57	Depth to Water (FT.)													23.62	22.78	20.67	21.52	19.40
		Static Water Level (FT)													1407.95	1408.79	1410.90	1410.05	1412.17
MW-6S	1430.18 1429.82	Depth to Water (FT.)	17.71	18.05	18.15	18.51										19.76	17.72	18.59	16.47
		Static Water Level (FT)	1412.49	1412.13	1412.01	1411.55										1409.86	1411.90	1411.08	1413.15
MW-6D	1430.89 1429.46	Depth to Water (FT.)	18.40	18.70	18.80	19.33										19.53	17.47	18.32	16.24
		Static Water Level (FT)	1412.49	1412.19	1412.09	1411.56										1409.93	1411.99	1411.14	1413.22
MW-7S	1431.42	Depth to Water (FT.)	18.85	19.16	19.37	19.79	21.55	22.88	23.03	21.96	19.82	20.57	20.21	21.04	22.21	21.48	19.42	20.27	18.19
		Static Water Level (FT)	1412.57	1412.26	1412.05	1411.63	1409.87	1408.54	1408.39	1409.46	1411.60	1410.85	1411.21	1410.38	1409.21	1409.94	1412.00	1411.15	1413.23
MW-7D	1431.40	Depth to Water (FT.)	18.82		19.28	19.78	21.53	22.86	23.04	21.99	19.87	20.62	20.26	21.09	22.26	21.51	19.45	20.30	18.23
		Static Water Level (FT)	1412.58		1412.12	1411.62	1409.87	1408.54	1408.36	1409.41	1411.53	1410.78	1411.14	1410.31	1409.14	1409.89	1411.95	1411.10	1413.17
MW-8	1428.47	Depth to Water (FT.)		16.27	16.40	16.88	18.58	19.76	19.88	18.78	16.88	17.60	17.02	18.03	19.14	18.42	16.59	17.30	15.23
		Static Water Level (FT)		1412.20	1412.07	1411.59	1409.89	1408.71	1408.59	1409.69	1411.59	1410.87	1411.45	1410.44	1409.33	1410.05	1411.87	1411.17	1413.24
MW-9S	1433.50	Depth to Water (FT.)	20.84	21.26	21.37	20.90	23.72	25.09	25.10	24.19	21.93	22.69	22.44	23.19	24.39	23.66	21.53	22.43	20.32
		Static Water Level (FT)	1412.66	1412.24	1412.13	1412.60	1409.78	1408.41	1408.40	1409.31	1411.57	1410.81	1411.06	1410.31	1409.11	1409.84	1411.97	1411.07	1413.18
MW-9D	1433.36	Depth to Water (FT.)	20.75	21.11	21.24	21.75	23.57	24.92	25.27	24.03	21.77	22.53	22.28	23.03	24.23	23.51	21.36	22.25	20.16
		Static Water Level (FT)	1412.61	1412.25	1412.12	1411.61	1409.79	1408.44	1408.09	1409.33	1411.59	1410.83	1411.08	1410.33	1409.13	1409.85	1412.00	1411.11	1413.20
MW-10	1429.70	Depth to Water (FT.)													20.39	19.65	17.78	18.57	16.49
		Static Water Level (FT)													1409.31	1410.05	1411.92	1411.13	1413.21
MW-11S	1431.52	Depth to Water (FT.)													22.62	21.76	19.89	20.56	18.46
		Static Water Level (FT)													1409.90	1409.76	1411.63	1410.96	1413.06
MW-11D	1431.58	Depth to Water (FT.)													22.44	21.86	19.77	20.64	18.55
		Static Water Level (FT)													1409.14	1409.72	1411.81	1410.94	1413.03
MW-12	1431.24	Depth to Water (FT.)													21.40	21.10	19.17	19.97	17.89
		Static Water Level (FT)													1409.84	1410.14	1412.07	1411.27	1413.35
MW-13	1429.81	Depth to Water (FT.)													20.40	19.72	17.65	18.50	16.41
		Static Water Level (FT)													1409.41	1410.09	1412.16	1411.31	1413.40
MW-14	1431.47	Depth to Water (FT.)													22.33	21.58	19.60	20.37	18.28
		Static Water Level (FT)													1409.14	1409.89	1411.87	1411.10	1413.19
P-1	1431.11	Depth to Water (FT.)													19.54	19.26	16.94	17.62	16.13
		Static Water Level (FT)													1411.57	1411.85	1414.17	1413.49	1414.98
P-2	1425.51	Depth to Water (FT.)													15.53	14.95	13.30	14.00	11.97
		Static Water Level (FT)													1409.98	1410.56	1412.21	1411.51	1413.54
P-3	1433.60	Depth to Water (FT.)													24.08	23.64	21.56	22.41	20.33
		Static Water Level (FT)													1409.52	1409.96	1412.04	1411.19	1413.27
P-5	1432.64	Depth to Water (FT.)																21.53	19.44
		Static Water Level (FT)																1411.11	1413.20
USGS-1	1433.80	Depth to Water (FT.)															21.85	22.75	20.70
		Static Water Level (FT)															1411.95	1411.05	1413.10
USGS-2A	1432.44	Depth to Water (FT.)															20.49	21.33	19.31
		Static Water Level (FT)															1411.95	1411.11	1413.13
USGS 2B	1431.69	Depth to Water (FT.)															19.73	20.67	18.58
		Static Water Level (FT)															1411.96	1411.02	1413.11
VDH(PROD)	1430.33	Depth to Water (FT.)															16.56	19.41	17.33
		Static Water Level (FT)															1411.77	1410.92	1413.00

FIGURE 3-1

GROUND WATER ELEVATIONS FOR
MONITORING WELLS 1S, 1D, 2, 3S, 3D & 4

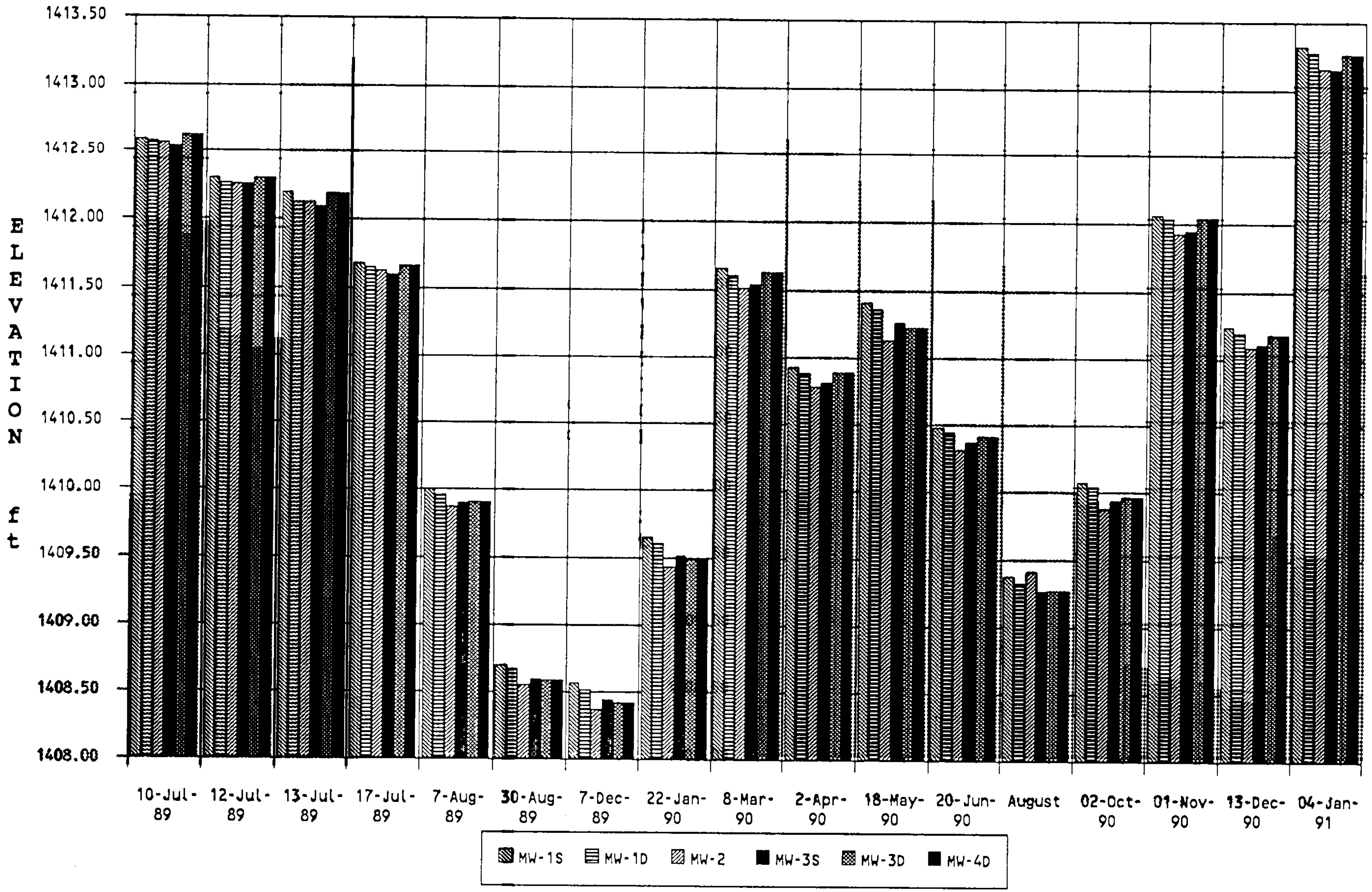


FIGURE 3-2

GROUND WATER LEVELS FOR
MONITORING WELLS 5S,5D 7S, 7D, & 8

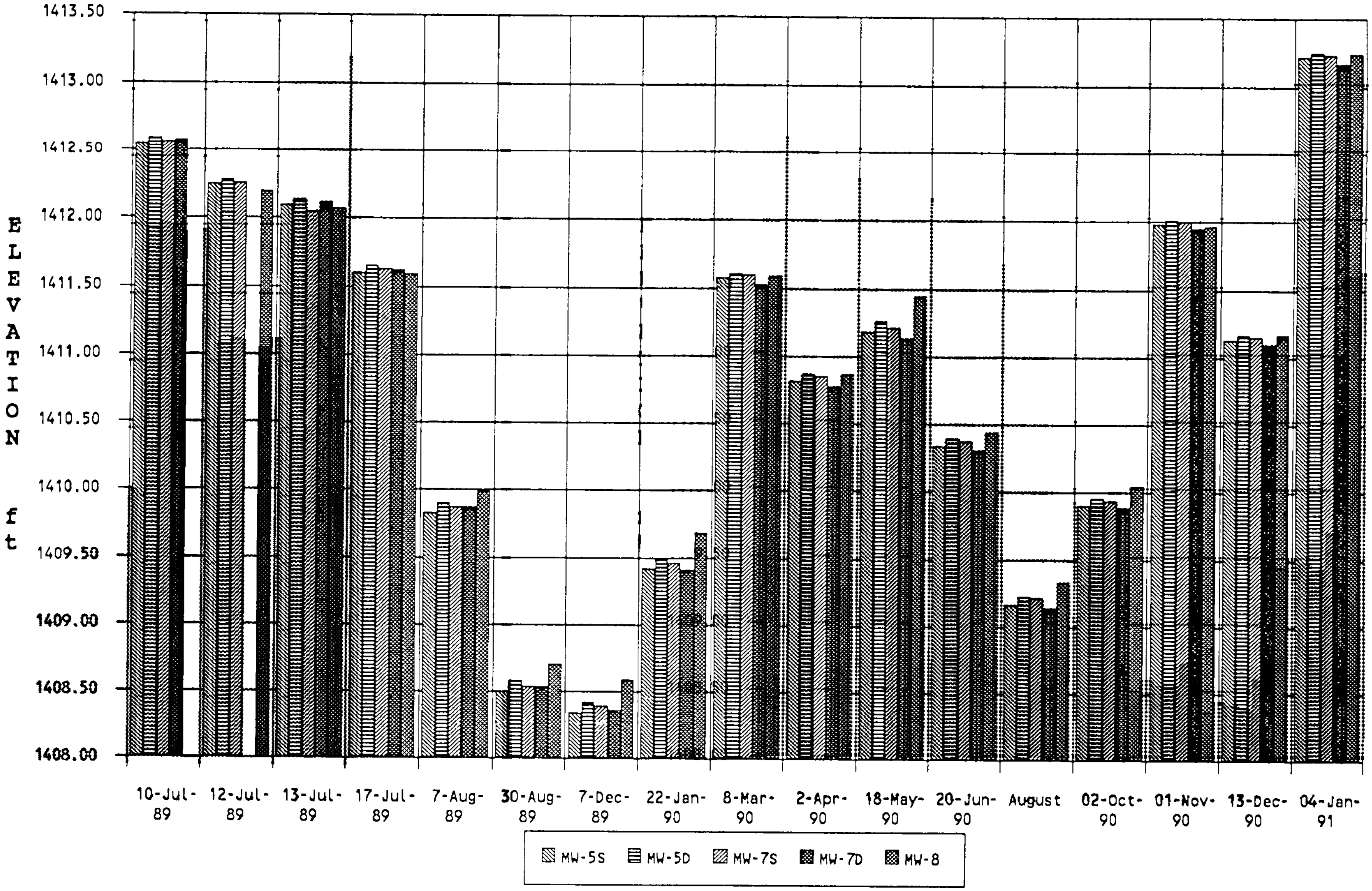
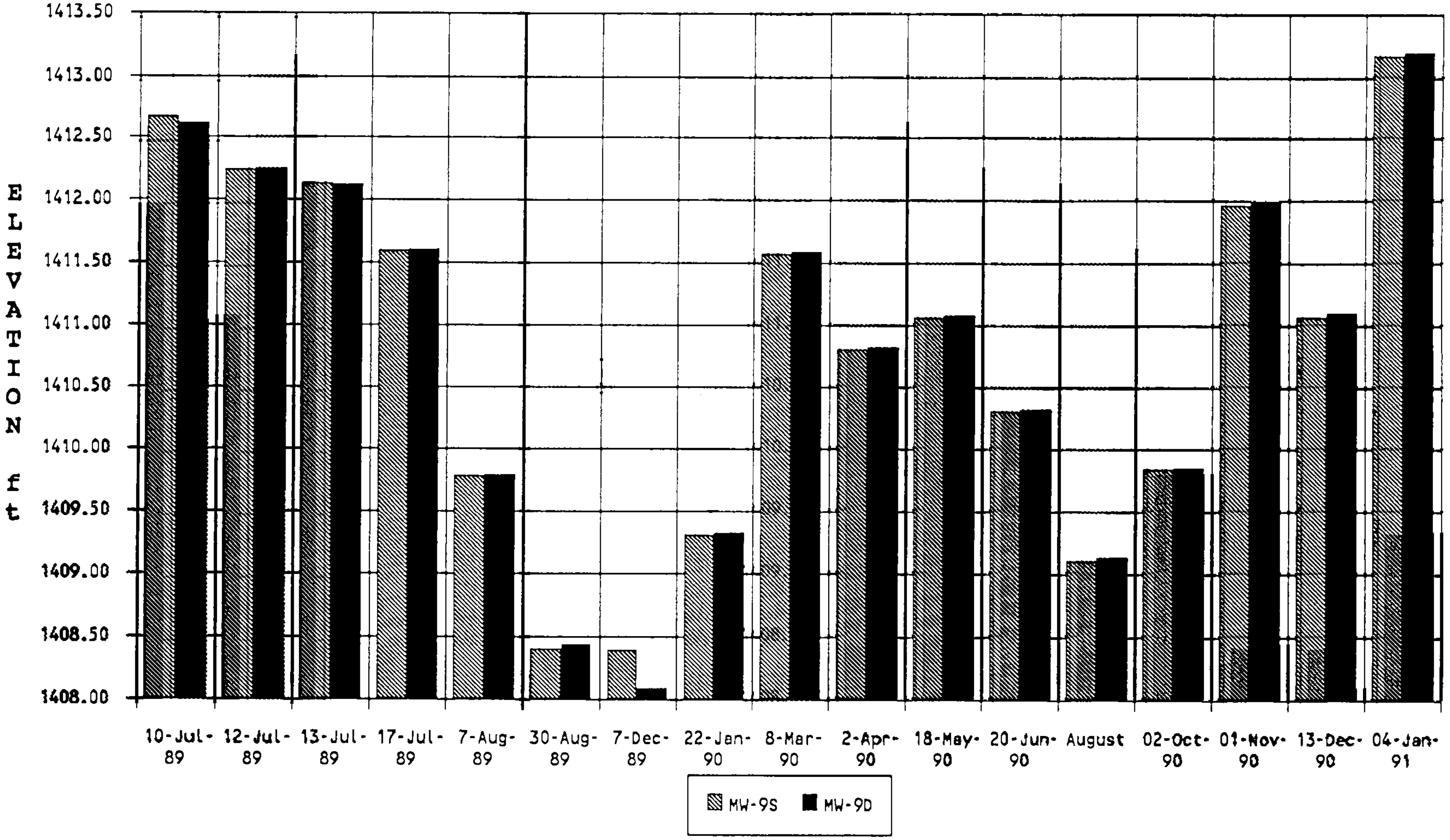


FIGURE 3-3

GROUND WATER LEVELS FOR
MONITORING WELLS 9S & 9D



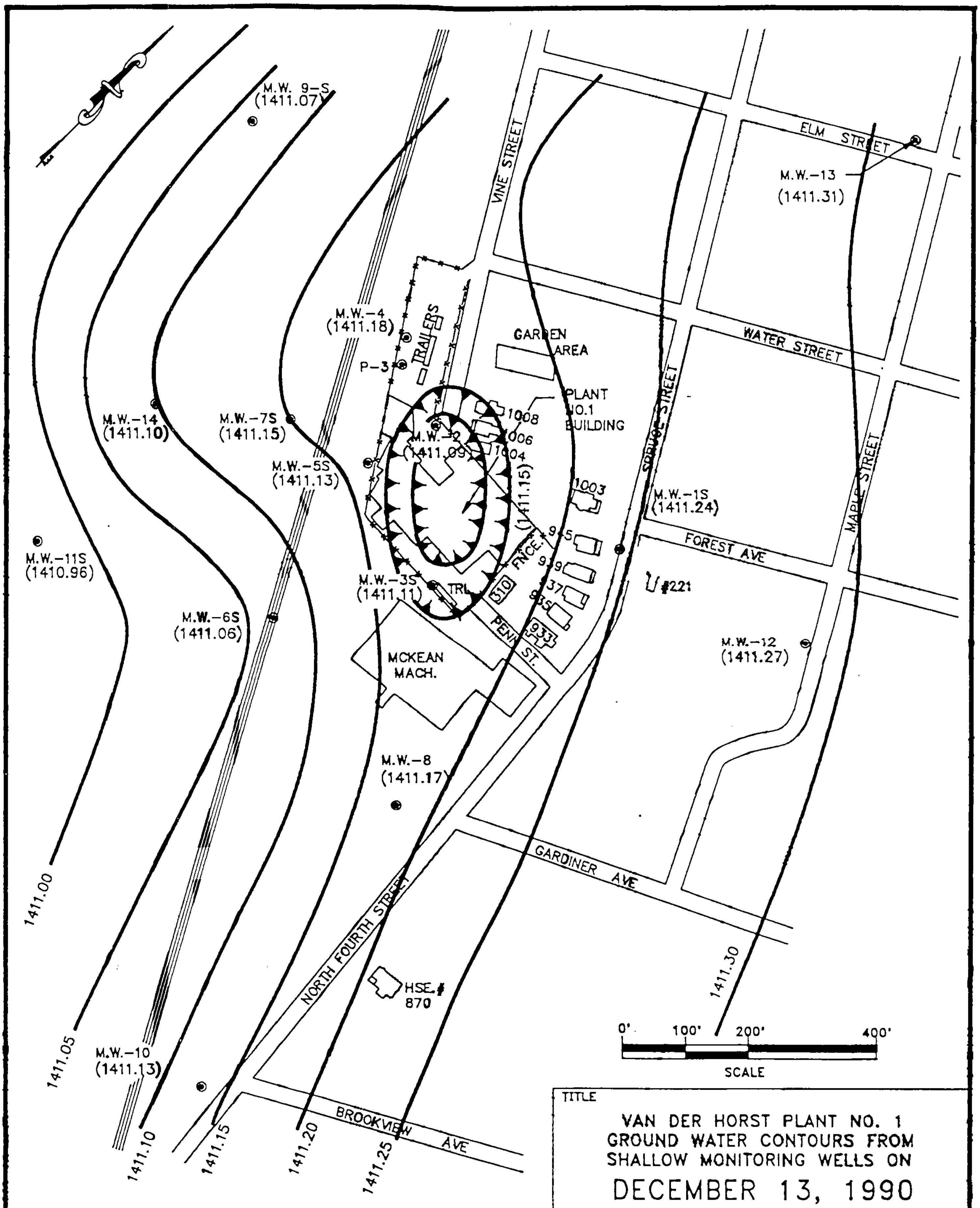
falling trends of the aquifer are believed to be in response to periods of increased precipitation (and above freezing temperatures in the winter). High water levels in July 1989 and January 1991 occurred because of heavy rainfall and or snowmelt in these months. Low levels in August 1989 and December 1989 resulted from little rainfall or snowmelt infiltrating down to the aquifer.

The range of ground water depth is presented in Table 3-2. The water table has been measured as shallow as 14.44 feet in MW-1S and as deep as 22.50 feet in MW-4. The maximum range of ground water fluctuation within each well has been to date, about 4.7 feet.

Water level data were plotted on the site base map and were used to generate monthly ground water contour maps. Ground water contours from shallow and deep monitoring wells on December 13, 1990 are presented in Figures 3-4 and 3-5. Ground water contour maps of shallow and deep wells at Plants No. 1 and No. 2 are illustrated in Figures 3-6 and 3-7. The contours in these figures are believed to be representative of the general pattern of ground water flow beneath the site. All ground water contour maps generated to date are presented in Appendix F.

TABLE 3-2

		Depth of Ground Water at Plant 1				
Monitoring Well	Ground Elevation (ft)	Ground Water Elevation (ft)		Depth Range (ft)		High - Low (ft)
		High January 1989	Low December 1989	High	Low	
MW-1S	1427.76	1413.32	1408.57	14.44	19.19	4.75
MW-2	1430.14	1413.16	1408.37	16.98	21.77	4.79
MW-3S	1427.37	1413.15	1408.44	14.22	18.93	4.71
MW-4	1430.92	1413.28	1408.42	17.64	22.50	4.86
MW-5S	1429.34	1413.22	1408.34	16.12	21.00	4.88
MW-6S	1428.50	1413.15	--	15.35	--	--
MW-7S	1429.10	1413.23	1408.39	15.87	20.71	4.84
MW-8	1429.00	1413.24	1408.59	15.76	20.41	4.65
MW-9S	1429.92	1413.18	1408.40	16.74	21.52	4.78



LEGEND

1411.00 —— GROUND WATER CONTOURS (FT.)

1410.95 ▲▲▲▲ GROUND WATER DEPRESSION CONTOURS (FT.)

(1410.88) GROUND WATER ELEVATIONS (FT.)

TITLE

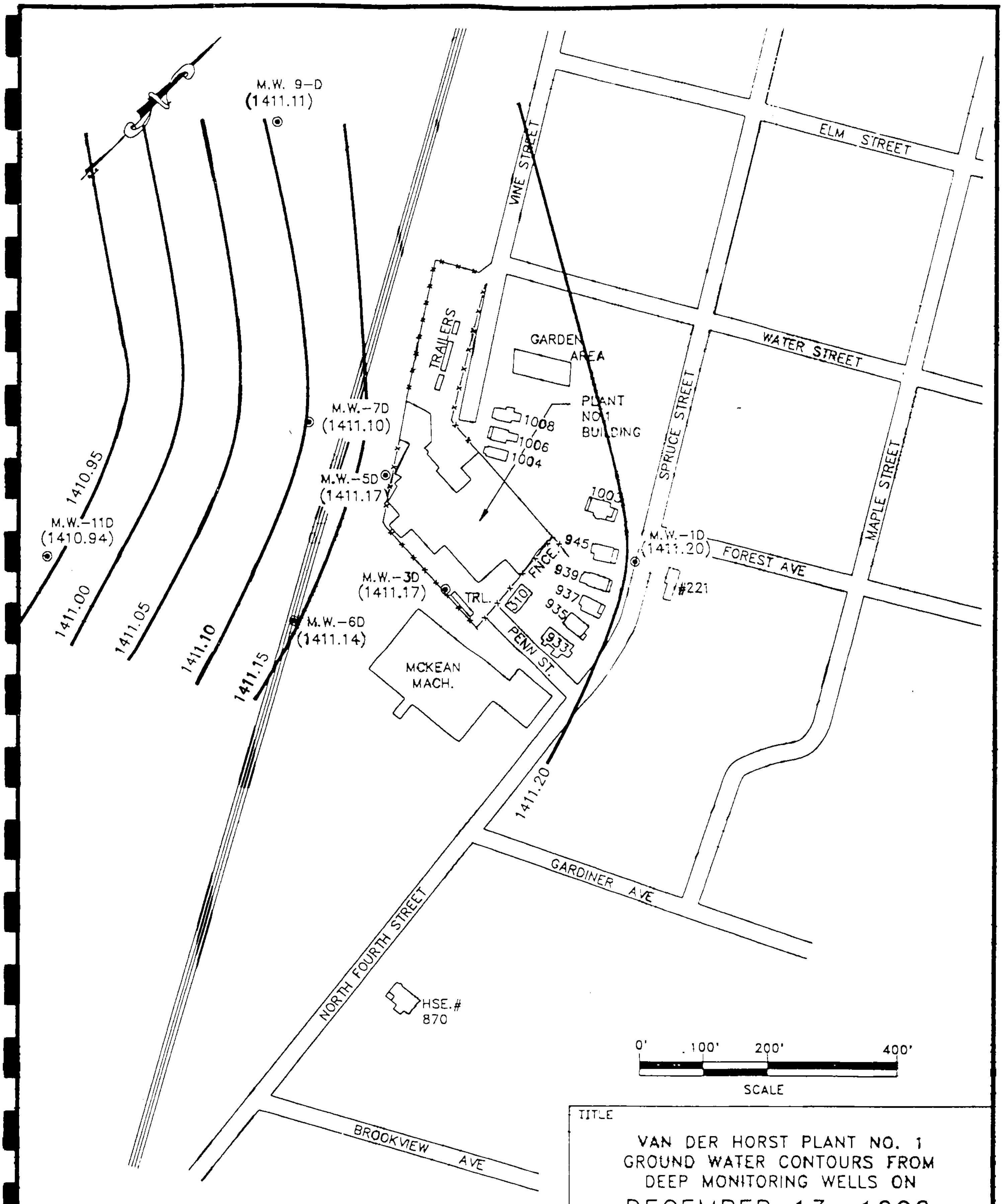
VAN DER HORST PLANT NO. 1
GROUND WATER CONTOURS FROM
SHALLOW MONITORING WELLS ON
DECEMBER 13, 1990

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
AS NOTED	3-4
DATE	



TITLE

VAN DER HORST PLANT NO. 1
GROUND WATER CONTOURS FROM
DEEP MONITORING WELLS ON
DECEMBER 13, 1990

PREPARED FOR

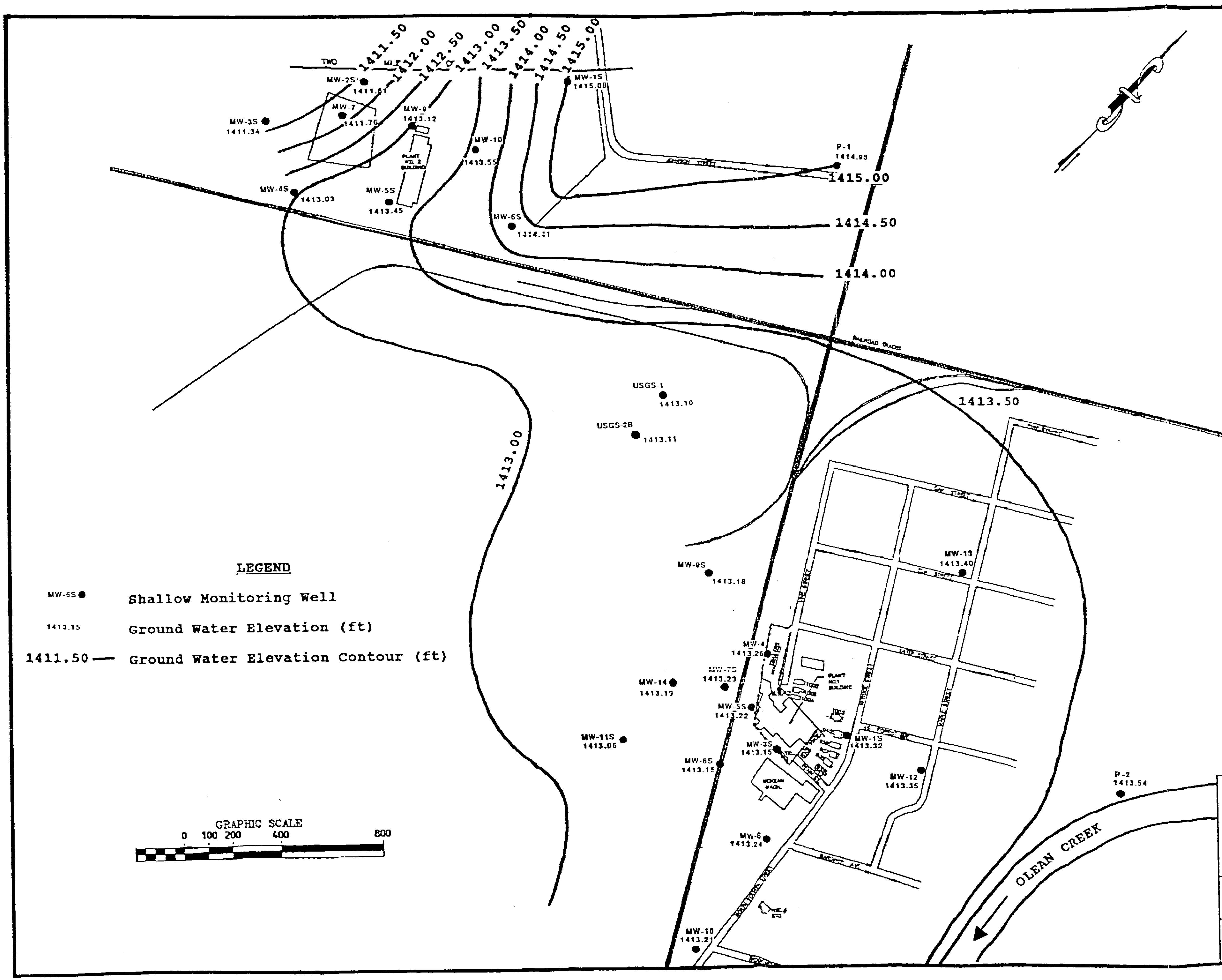
NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
AS NOTED	3-5
DATE	

LEGEND

1411.00 ——— GROUND WATER CONTOURS (FT.)
(1410.88) GROUND WATER ELEVATIONS (FT.)



TITLE

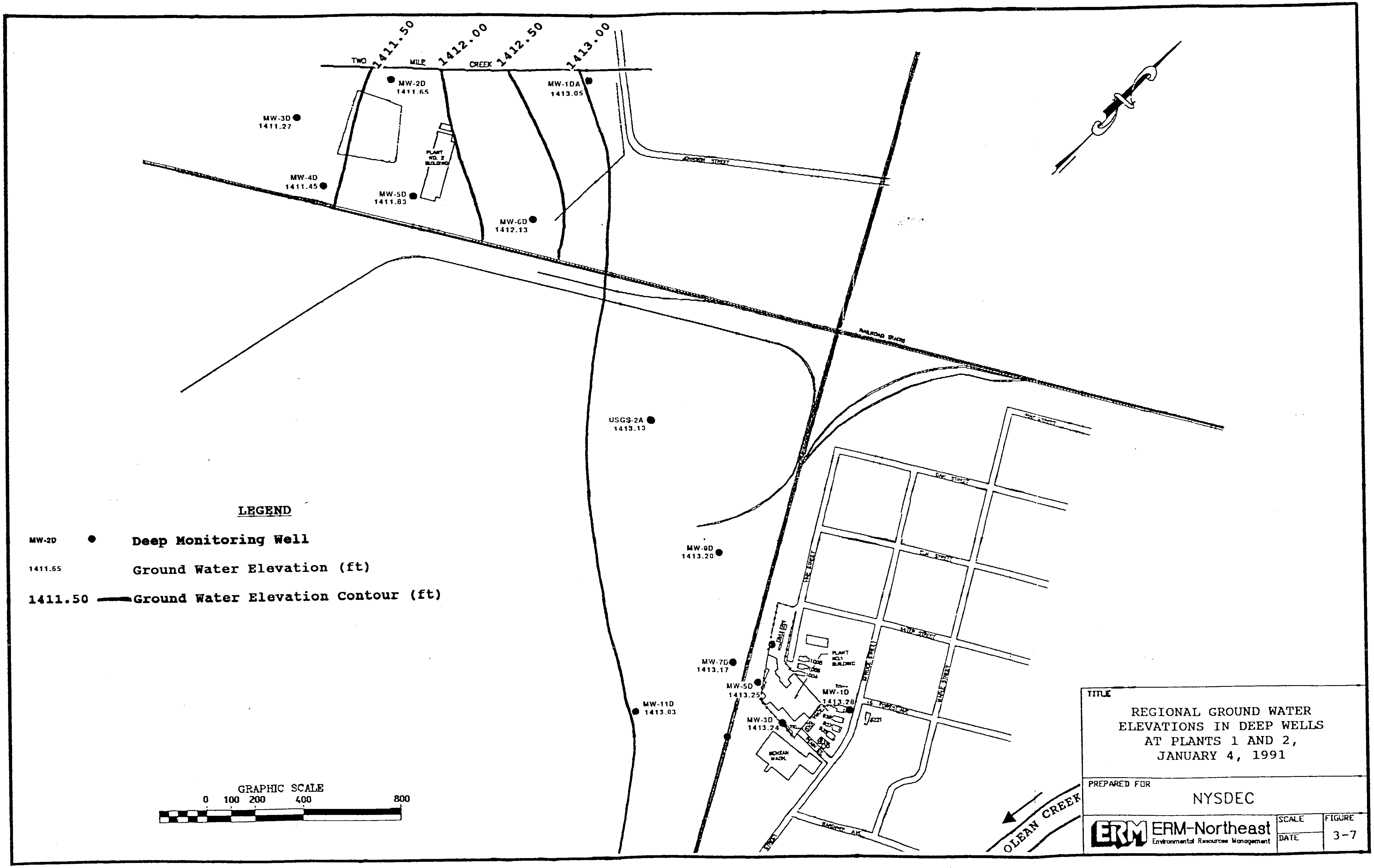
REGIONAL GROUND WATER
ELEVATIONS IN SHALLOW WELLS
AT PLANTS 1 AND 2,
JANUARY 4, 1991

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
DATE	3-6



TITLE

REGIONAL GROUND WATER
ELEVATIONS IN DEEP WELLS
AT PLANTS 1 AND 2,
JANUARY 4, 1991

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
DATE	3-7

The general direction of ground water flow in the shallow wells of the upper aquifer is to the southwest. Flow direction can range from due south to due west. The average horizontal hydraulic gradient in the shallow wells down-flow of the site is 0.0004 and, to date, the gradient has ranged from 0.0003 to 0.0006.

A depression in the potentiometric surface beneath part of the Plant No. 1 building and the area immediately north of the building, was found to occur on all shallow well ground water contour maps. The depth of the depression was very shallow and ranged from .05 to .10 feet. This depression may have resulted from localized decreased rainwater infiltration beneath the Plant No. 1 building.

The typical ground water flow direction in the deep wells of the upper aquifer is also towards the southwest however, the range of flow direction in the deep wells is greater than in the shallow wells. Flow direction can vary from southeast to northwest. The average horizontal hydraulic gradient down-flow of the site is 0.0006. The gradient was found to fluctuate between 0.0002 and 0.0010.

The ground water flow in shallow wells in the upper aquifer inclusive of both Van Der Horst Plants No. 1 and No. 2 (i.e., regional flow) is shown in Figure 3-6. The direction of flow downgradient of Plant No. 1 is towards the southwest. Ground water flow at Plant No. 2 is primarily to the west. Along the railroad tracks between Plants No. 1 and No. 2 the ground water flow direction is south. The hydraulic gradient at the two plants are markedly different. The gradient at Plant No. 1 is only 0.0002 whereas the Plant No. 2 gradient is 0.005.

Regional ground water flow in deep wells of the upper aquifer at Van Der Horst Plants No. 1 and No. 2 is illustrated in Figure 3-7. The flow direction at both sites is to the southwest. The hydraulic gradient is steeper at Plant No. 1 (0.001) than at Plant No. 2 (0.0003).

There are two reasons why the horizontal hydraulic gradient is very small at both Plants No. 1 and No. 2. First, the topography at both sites is relatively flat. The ground water surface generally follows the slope of the land. Secondly, the hydraulic conductivity of the aquifer is very high. Aquifers with high conductivity commonly have low horizontal gradients, since ground water flow requires less energy than in aquifers with low hydraulic conductivity.

Ground water within the upper aquifer also has a vertical flow component. The average vertical hydraulic gradient within the upper aquifer was calculated at each of the shallow and deep well pairs. Average vertical hydraulic gradient was calculated by dividing the average water level difference between the shallow and deep wells by the vertical distance between the bottom of the shallow well borehole and the top off the deep well sand pack. Negative values indicate a downward vertical gradient. Average vertical gradients are listed below for all monitoring well pairs:

Monitoring Wells	Average Water Level Difference Between Deep and Shallow Wells (ft)	Average Vertical Gradient
MW-1S & 1D	-0.04	-0.002
MW-3S & 3D	0.05	0.003
MW-5S & 5D	0.05	0.004
MW-6S & 6D	0.06	0.003
MW-7S & 7D	-0.04	-0.004
MW-9S & 9D	0.01	0.0005
MW-11S & 11D	-0.002	-0.002

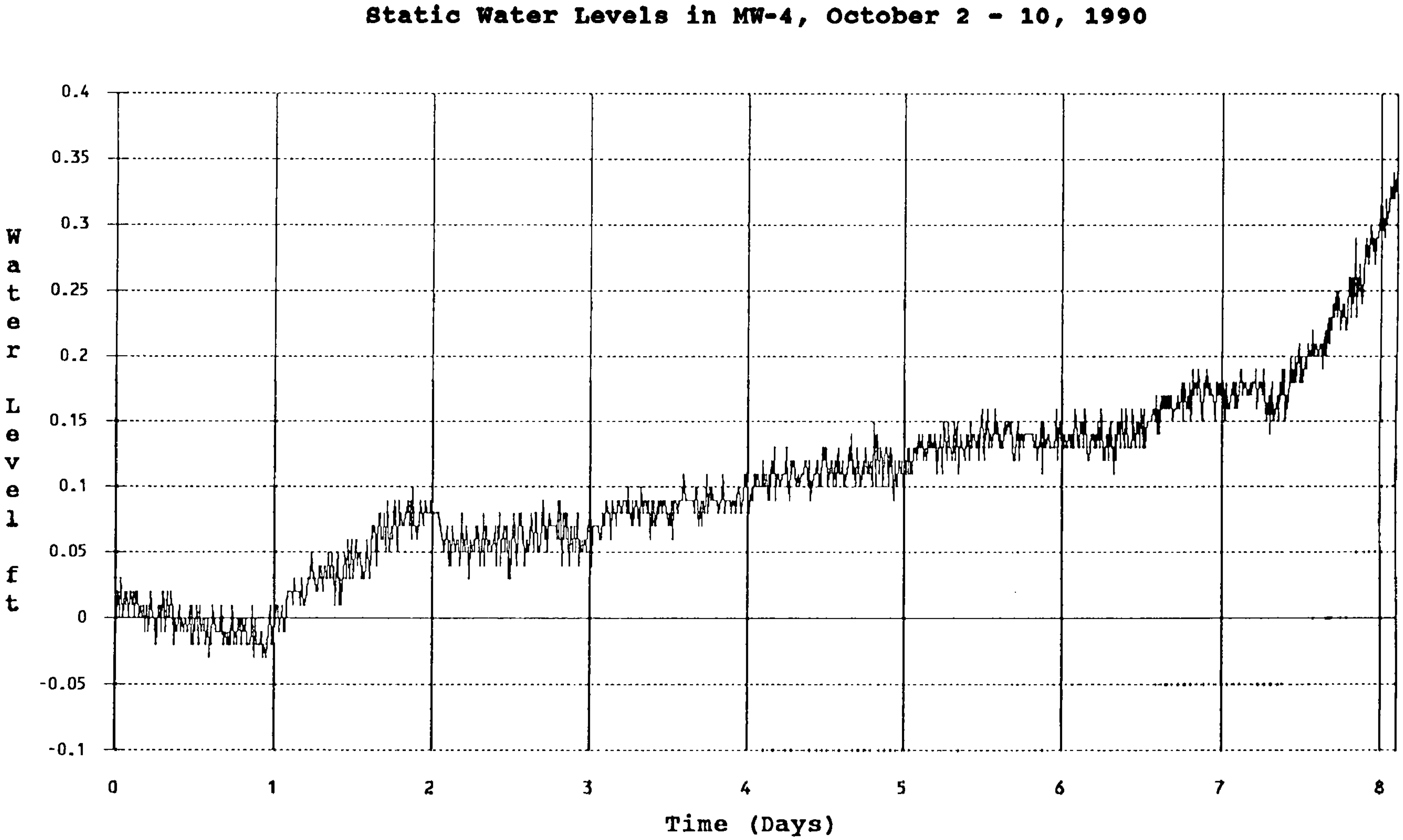
Although the vertical gradient is small within the upper, this component of ground water flow is significant at the

Plant No. 1 site. The vertical gradient is approximately 10 times greater than the horizontal gradient.

The average vertical hydraulic gradient was also calculated between the upper and lower aquifers beneath the site. Well MW-5B is the only well that penetrates the 19-foot thick aquitard. The average water level difference between MW-5B (1409.97) and MW-5D (1411.12 feet) was -1.15 feet. The vertical gradient between these two aquifers was -0.06.

The static water-level in monitoring well MW-4 was continuously measured between October 2 and October 10, 1990. Water levels were recorded by an SE-1000B data logger and transducer at 5-minute intervals during this time period. Figure 3-8 illustrates the ground-water trend during this 8-day period. The water level increase between days (0.15 feet) 1 and 7 is believed to result from ground water recharge of intermittent rainfall and barometric pressure fluctuations. The sharp increase (0.20 feet) between days 7 and 8 was produced by heavy rainfall. The continuous water level oscillations (about 0.02 feet in magnitude), which can be seen in Figure 3-8, probably resulted from variations in the transducer output signal and is an artifact from instrumentation.

FIGURE 3-8



Static Water Levels in MW-4, October 2 - 10, 1990
Water Level ft
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
0
1
2
3
4
5
6
7
8
Time (Days)

Phase I slug test results found an average hydraulic conductivity of 1 x 10^{-1} cm/sec in shallow wells and 5 x 10^{-2} cm/sec in deep wells in the upper aquifer. Phase II slug test results in the lower aquifer yielded an average hydraulic conductivity of 6 x 10^{-2} cm/sec (See Section 3.2).

Phase II pumping test data analysis (Section 3.3) generated the following hydraulic parameters for the upper aquifer:

average transmissivity	193 ft^2/min
average hydraulic conductivity	1.4 cm/sec
average storativity	0.017

The range of specific yield was estimated to be between 0.15 and 0.25, based on geological characteristics of the aquifer material (USGS Water-Supply Paper 1662-D, 1967; and USGS Open-File Report 78-304, 1978). Overall these characteristics are similar to those calculated by the USGS in earlier; however the USGS has not been able to locate the field data used in their calculations.

3.2 Slug Testing

Monitoring well MW-5B was field tested to estimate the hydraulic conductivity of the aquifer material surrounding the well screen in the lower aquifer. Water level fluctuations within the well were initiated by rapidly introducing a solid PVC slug into the water column and measuring the rate that the displaced well water fell and returned to equilibrium (falling head). The second step of the test was to remove the PVC slug and measure the rate at which the water level rose and returned to equilibrium (rising head).

The induced water level changes were recorded with an In-Situ Data Logger, Model SE-1000B in combination with a 15 psi pressure transducer. During the slug tests, water level readings were obtained at logarithmic increments which increased with time. Prior to testing the well, the transducer, cable and slug were all cleansed (potable water/detergent, potable water, and deionized water).

Slug test data were analyzed and plotted using the AQTESOLV™ program. The Bouwer and Rice slug test evaluation method (1976) was used in AQTESOLV™ since monitoring well MW-5B partially penetrates the lower aquifer. Computer plots and AQTESOLV™ data analysis equations are included in Appendix G.

Prior to analysis, slug test water levels (raw data) were converted into buildup data for the falling head test and drawdown data for the rising head test. Buildup and drawdown data were adjusted to give the pre-test water level a value of 0.00 ft (100.00 ft in the raw data). Raw and corrected data are also presented in Appendix G. No negative corrected data were used in the slug test analyses.

The hydraulic conductivity of the lower aquifer is estimated to be 6 x 10^{-2} cm/sec (Table 3-3). This value is quite similar to Phase I upper aquifer slug test results in deep monitoring wells (5 x 10^{-2} cm/sec). The MW-5B hydraulic conductivity is about half of the average value found in the shallow upper aquifer monitoring wells (1 x 10^{-1} cm/sec).

Since the upper aquifer has been found to have a high transmissivity and storativity, the lower aquifer has not been utilized as a water resource and very little information has been published on the aquifer hydraulics of the lower aquifer. Also, little information exists concerning the lateral extent of the aquitard found during the drilling of MW-5B.

TABLE 3-3

Hydraulic Conductivity from Slug Tests in MW-5B

Type of Test	Starting Time (min)	Hydraulic Conductivity (ft/min)	Hydraulic Conductivity (cm/sec)
Falling Head	12:48	0.1425	0.0724
Rising Head	12:50	0.0856	0.0435
Falling Head	12:56	0.1209	0.0614
Rising Head	12:57	0.5167	0.2626

Note: The final rising head test is considered erroneous given the similarity of the the previous three tests.

3.3 Pumping Test

3.3.1 Pumping Test Objectives

ERM conducted a pumping test at the Van Der Horst Plant No. 1 Site. Pumping well P-5 was pumped and then allowed to recover between the dates of December 5 and 7, 1990. A total of 17 monitoring wells were measured for water level fluctuations. The objectives of this testing were as follows:

- Calculate the hydraulic characteristics of the upper aquifer beneath the Plant No. 1 site for usage during ground water modeling;
- Determine the hydraulic relationship between the lower and upper aquifers;
- Estimate an optimum discharge for a contaminated ground water recovery well at Plant No. 1;
- Estimate if the on-site production well location could be acceptable for the recovery of contaminated ground water.

3.3.2 Equipment and Pumping Test Procedures

The pumping of P-5 was performed using a Grundfos Model SP45-225S50-2 pump; attached to a Franklin 5.0 hp, 230V, single phase electric motor. The motor was powered by a trailer-mounted 25KW, diesel generator.

Ground water was pumped through a discharge line, which was constructed of 3-inch, Schedule-40, PVC pipe. Pumped water was discharged directly into a sanitary sewer manhole located at the south end of Vine Street. A tap was installed in the discharge line near the well head for water sampling of hexavalent chromium, pH and specific conductivity during the pumping test.

The rate of discharge during the pumping test was measured using a flow meter. The flow meter consisted of a paddle-wheel sensor and rate meter. The sensor was installed within the discharge line and was connected to a digital rate meter which recorded instantaneous and total flow. During the pumping test, numerous digital readings were recorded by the field personnel monitoring the pumping test.

Water levels were measured in the monitoring wells before and during the P-5 pumping test. Water levels in wells MW-2, MW-4, MW-5S, MW-5D, MW-5B, P-3 and P-5 were monitored with pressure transducers connected to an 8-channel, Instrumentation Northwest data logger. An Insitu Model 1000B data logger was used to measure water levels in MW-7S and MW-7D so that the main set of transducer cables did not have to transverse actively used railroad tracks. Water levels in the remaining wells (MW-1S, MW-1D, MW-3S, MW-3D, MW-6S, MW-6D, MW-9S and MW-9D) were manually measured with an electronic water level indicator. All of the water level data collected during the pumping test are presented in Appendix H.

A preliminary pumping test was run on December 4, 1991 to check equipment performance and monitoring well response. At this time, well P-5 was pumped for 2 hours, and then measured for recovery for a period of 2 hours. Previous testing had established that the well could sustain continuous pumping. This latter testing was a check for the various instrumentation (transducers, data loggers, etc.) to be used during pumping.

The P-5 pumping test began at 8:30 AM on December 5, 1990. The well was pumped at a relatively constant average rate of 256 gpm, though there was some minor variation in the flow rate, as shown in Table 3-4. On December 6, at 8:30 AM the pump in P-5 was shut off due to an erroneous rise in drawdown (produced by a change in barometric pressure). Recover measurement was immediately initiated after the pump was turned off, and was continued until 8:30 AM on December 7.

TABLE 3-4

Discharge during P-5 Pumping Test

Date	Time hrs:min	Pumping Duration (min)	Discharge (gpm)	Volume of Pumped Water (gal)
5-Dec-90	8:31	1	257	257
"	8:32	2	258	515
"	8:33	3	258	773
"	8:34	4	257	1030
"	8:35	5	256	1286
"	8:36	6	255	1541
"	8:37	7	256	1797
"	8:38	8	255	2052
"	8:39	9	255	2307
"	8:40	10	255	2562
"	8:45	15	256	3842
"	8:50	20	256	5122
"	8:55	25	255	6397
"	9:00	30	256	7677
"	9:10	40	256	10237
"	9:20	50	256	12797
"	9:30	60	255	15347
"	9:40	70	256	17907
"	9:50	80	254	20447
"	10:00	90	253	22977
"	10:30	120	254	30597
"	11:00	150	257	38307
"	11:30	180	255	45957
"	12:00	210	255	53607
"	12:30	240	255	61257
"	13:30	300	255	76557
"	14:00	330	256	84237
"	14:30	360	256	91917
"	15:04	394	255	100587
"	15:42	432	256	110315
"	16:00	450	256	114923
"	17:00	510	255	130223
"	18:00	570	255	145523
"	18:55	625	255	159548
"	20:30	720	256	183868
"	22:47	857	257	219077
6-Dec-90	0:47	977	256	249797
"	2:46	1096	255	280142
"	4:47	1217	256	311118
"	6:45	1335	254	341090
	8:30	1440	256	367970

Pump turned on at 8:30 AM 5-Dec-90

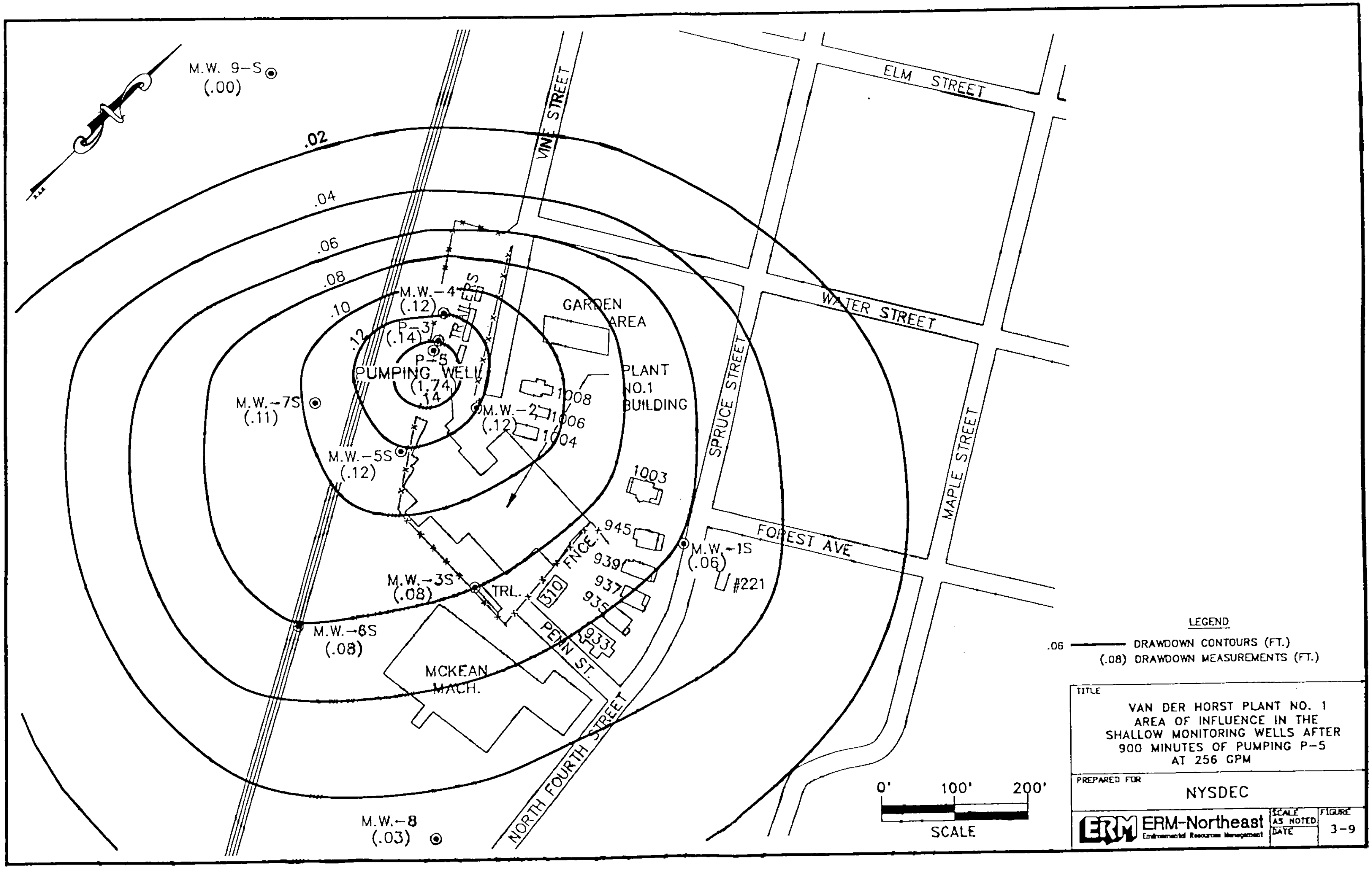
Pump shut off at 8:30 AM 6-Dec-90

3.3.3 Aquifer Response to Pumping (Area of Influence)

The area of influence is the lateral area where water levels in monitoring wells are lowered as a result of pumping. The area of influence in the shallow and deep monitoring wells after 900 minutes of pumping is illustrated on Figures 3-9 and 3-10. The area of influence was estimated by the measured drawdown in monitoring wells and by distance drawdown calculations. The distance-drawdown evaluation allowed for drawdown interpretation between, and extrapolation beyond measured water levels. Distance-Drawdown calculations are discussed in Section 3.3.6.

During the pumping test the area of influence was not concentric around pumping well P-5. Drawdown within the area of influence was greatest to the southeast and smallest to the northwest of P-5. In Figures 3-9 and 3-10, well P-5 is located near the northwestern end of the 0.14 ft drawdown contour. The non-concentric shape of the area of influence may have resulted from several possible factors, including:

- A ground water depression which occurs beneath part of the Plant No. 1 Building and Site during static conditions;
- Aquifer heterogeneity;
- Leakage from the sanitary sewer (where the water was discharged) to the aquifer;
- Natural direction of ground water flow



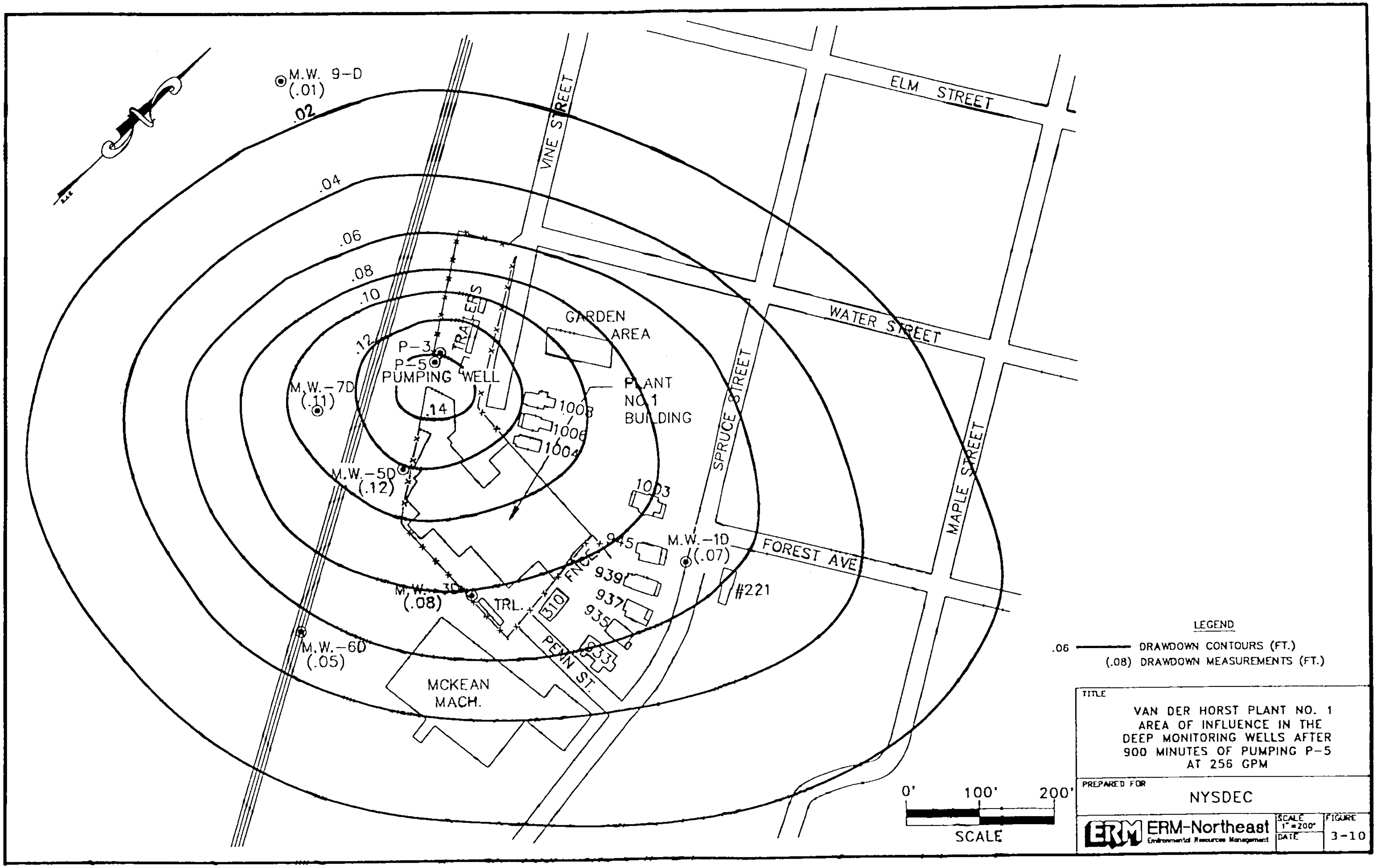
TITLE

VAN DER HORST PLANT NO. 1
AREA OF INFLUENCE IN THE
SHALLOW MONITORING WELLS AFTER
900 MINUTES OF PUMPING P-5
AT 256 GPM

PREPARED FOR

NYSDEC

FIGURE 3-9



LEGEND

.06 ——— DRAWDOWN CONTOURS (FT.)

(.08) DRAWDOWN MEASUREMENTS (FT.)

TITLE

VAN DER HORST PLANT NO. 1
AREA OF INFLUENCE IN THE
DEEP MONITORING WELLS AFTER
900 MINUTES OF PUMPING P-5
AT 256 GPM

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
1" = 200'	3-10
DATE	

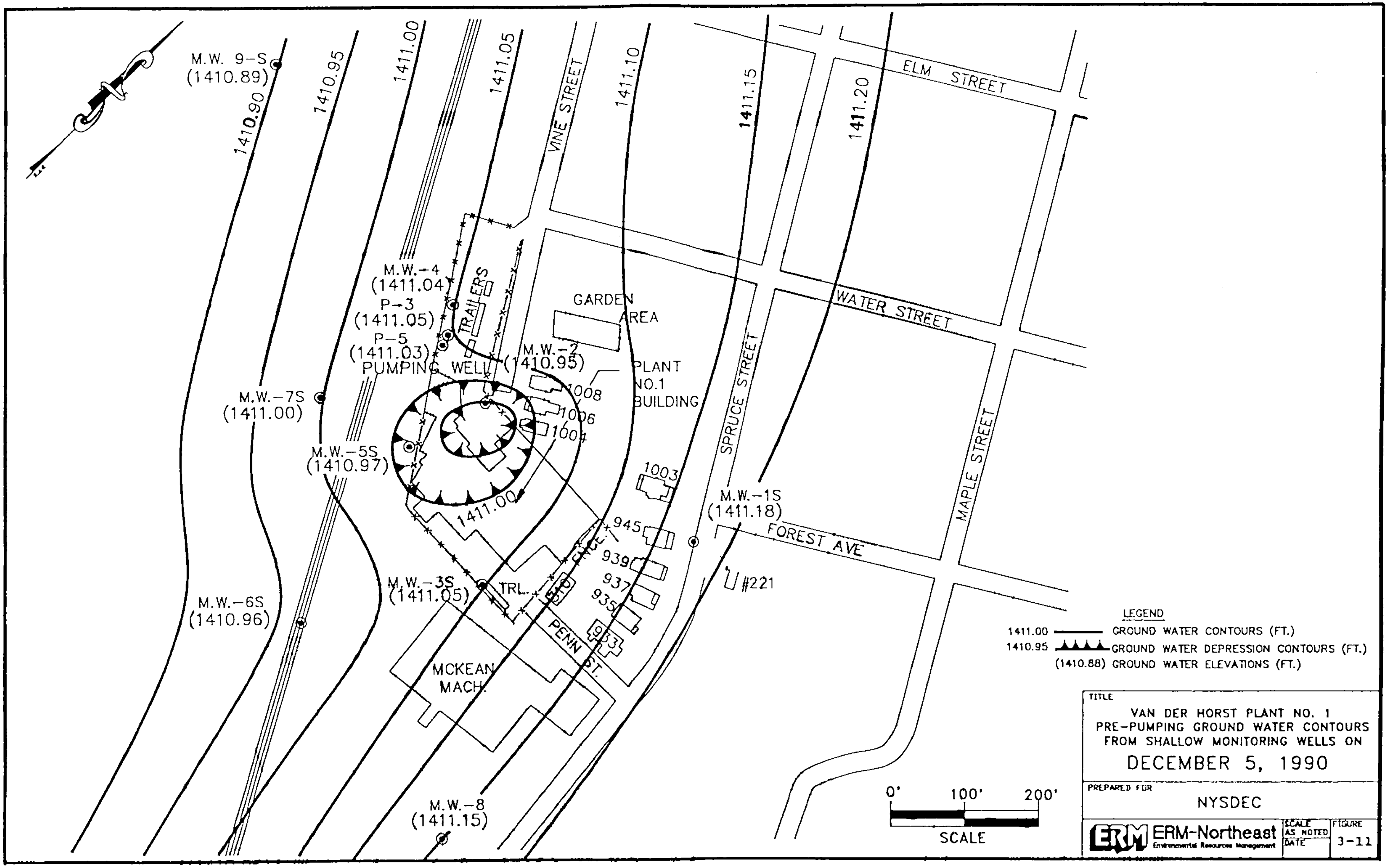
3.3.4 Factors Affecting Pumping Test Data

Aquifer test drawdown data were used to calculate the flow characteristics (transmissivity and average hydraulic conductivity) and the storage characteristics (storativity and specific yield) of the aquifer. The values obtained from these calculations are believed to be representative of the general characteristics of the aquifer; however, they do not account for the following factors which may have affected the data:

- Irregular slope of the water table;
- Partial penetration of P-5 in the aquifer; and
- Barometric pressure changes during the pumping test.

A ground water depression generally occurs beneath part of the Plant No. 1 Building and Site during static conditions (see Figure 3-11). This depression is believed to have been partially responsible for the non-concentric area of influence around pumping well P-5. Aquifer parameter calculations were probably not significantly affected by this factor.

Pumping well P-5 only partially penetrates the aquifer beneath Plant No. 1. Well P-5 has a depth of 60 feet and is screened in the upper 40 feet of the aquifer. Based on MW-5B drilling log data, the base of the upper aquifer beneath Plant



LEGEND

1411.00 ———	GROUND WATER CONTOURS (FT.)
1410.95 ▲▲▲▲	GROUND WATER DEPRESSION CONTOURS (FT.)
(1410.88)	GROUND WATER ELEVATIONS (FT.)

TITLE

VAN DER HORST PLANT NO. 1
PRE-PUMPING GROUND WATER CONTOURS
FROM SHALLOW MONITORING WELLS ON
DECEMBER 5, 1990

PREPARED FOR
NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE AS NOTED
DATE
FIGURE 3-11

No. 1 is at a depth of 90 feet and the saturated thickness of the aquifer is 70 feet.

During pumping, a partially penetrating well creates an upward, vertical component of flow within the aquifer. This vertical flow can decrease drawdown in monitoring wells which are less than one aquifer thickness away from the pumping well (ie. P-3 and MW-4). Partial penetration effects appear to have little influence on aquifer parameter calculations from wells P-3 or MW-4. The high average hydraulic conductivity of the aquifer and small drawdown during the pumping test may have minimized the partial penetration effects in these monitoring wells.

Barometric pressure changes are believed to have had a major effect on some of the pumping test drawdown and recovery data. In general, when the barometric pressure decreases, the water level in a monitoring well increases, and converse. Should there be a decrease in barometric pressure during a pumping test, then the impact would be a decrease in water level drawdown.

Barometric pressure data for the pumping test were obtained from the Bradford Airport, which is located approximately 23 miles southwest of the site. A drop in barometric pressure began about 630 minutes into the pumping test. Drawdown data began to decrease after 900 minutes of pumping. Because of the relative magnitude of the drawdown decrease (40% to 64% of the maximum drawdown), data later than 900 minutes were not analyzed. The length of pumping was shortened from 48 hours to 24 hours due to the drawdown decrease.

Pumping test recovery data were also affected by the barometric pressure drop. The low pressure at the start of recovery caused water levels to recover above the static water level prior to pumping. Theoretically, if the barometric pressure remained constant, the monitoring well water levels should recover to the static level.

3.3.5 Aquifer Parameter Calculation

Transmissivity, average hydraulic conductivity, storativity, and specific yield were calculated from pumping test drawdown and recovery data in seven monitoring wells at Plant No. 1. The Theis, Jacob, Distance-Drawdown, and Neuman methods were used to calculate these values from drawdown data. The Theis Recovery method was used to obtain transmissivity, average hydraulic conductivity, and storativity from recovery data. Aquifer parameters calculated from P-5 pumping test data are listed in Table 3-5. The time vs drawdown plots which were used to determine aquifer parameters are presented in Appendix H.

The Theis and Jacob methods are primarily designed for analysis of drawdown data from confined aquifers. Data analyzed by the Theis method were plotted on logarithmic paper and were matched to a type curve. Data analyzed by the Jacob method were plotted on semi-logarithmic paper and were matched with a best fit straight line.

The Neuman method is designed for analysis of drawdown data from unconfined aquifers. Data were plotted on logarithmic paper were matched to a type curve. The "B" parameter presented in Table 3-5 represents delayed drainage which can occur in an unconfined aquifer during pumping.

The Distance-Drawdown method assumes that steady-state conditions have been achieved during a pumping test in a confined aquifer. When this method was used, the monitoring well distance from the pumping well versus drawdown were

TABLE 3-5

Aquifer Parameters from the P-5 Pumping Test

Monitoring Well Transmissivity (sq ft/min)

Method	P-5	P-3	MW-2	MW-4	MW-5S	MW-5D	MW-7S
Theis	*****	200.3	202.1	203.7	154.3	277.8	153.1
Jacob	132.2	201.8	213.5	213.7	199.1	280.3	174.5
Neuman	4.17	194.0	200.0	201.0	74.8	198.5	135.0
Theis Recovery	198.7	231.1	239.9	246.2	220.7	273.5	*****

Monitoring Well Average Hydraulic Conductivity (cm/sec)

Method	P-5	P-3	MW-2	MW-4	MW-5S	MW-5D	MW-7S
Theis	*****	1.45	1.47	1.48	1.12	2.02	1.11
Jacob	0.96	1.46	1.55	1.55	1.44	2.03	1.27
Neuman	0.03	1.41	1.45	1.46	0.54	1.44	0.98
Theis Recovery	1.44	1.68	1.74	1.79	1.60	1.98	*****

Monitoring Well Storativity (dimensionless)

Method	P-5	P-3	MW-2	MW-4	MW-5S	MW-5D	MW-7S
Theis	*****	0.05909	0.0106	0.01403	0.01987	0.001025	0.004075
Jacob	*****	0.05544	0.007842	0.0105	0.009823	0.000951	0.002068
Neuman	*****	0.067	0.010	0.014	0.01731	0.001907	0.00613
Theis Recovery	*****	0.005876	0.001728	0.002996	*****	0.000743	*****

Neuman Specific Yield and B Values for Monitoring Wells (dimensionless)

Method	P-5	P-3	MW-2	MW-4	MW-5S	MW-5D	MW-7S
Neuman Sy	*****	0.25	0.20	0.20	0.30	0.03175	0.25
Neuman B	0.03	0.000001	0.00001	0.00001	0.06	0.001	0.00001

Distance Drawdown Values for Transmissivity and Storativity

Monitoring Wells	Transmissivity (sq ft/min)	Storativity (dimensionless)	Radius of Influence (ft)
1S,3S,5S,7S & 8	92.3	0.13	1200
4 & 9S	93.6	*****	450
1D,3D,5D,6D & 7D	97.6	0.112	1330
9D	93.6	*****	540

$$\text{Average hydraulic conductivity} = \frac{(\text{Transmissivity})\ (30.48\ \text{cm/ft})}{(60\ \text{sec/min})\ (70\ \text{ft aquifer thickness})}$$

***** Unrealistic value

plotted on a semi-logarithmic graph. These data were matched to a best-fit straight line and enable calculation of transmissivity and storativity. Distance-Drawdown data were also used to estimate the area of influence due to pumping.

The Theis Recovery method is generally used to evaluate pumping test recovery data in confined aquifers. Recovery time divided by total pumping test time versus water level recovery were plotted on a semi-logarithmic graph. A best-fit straight line was matched to these data for aquifer parameter calculation.

3.3.6 Interpretation of Aquifer Characteristics

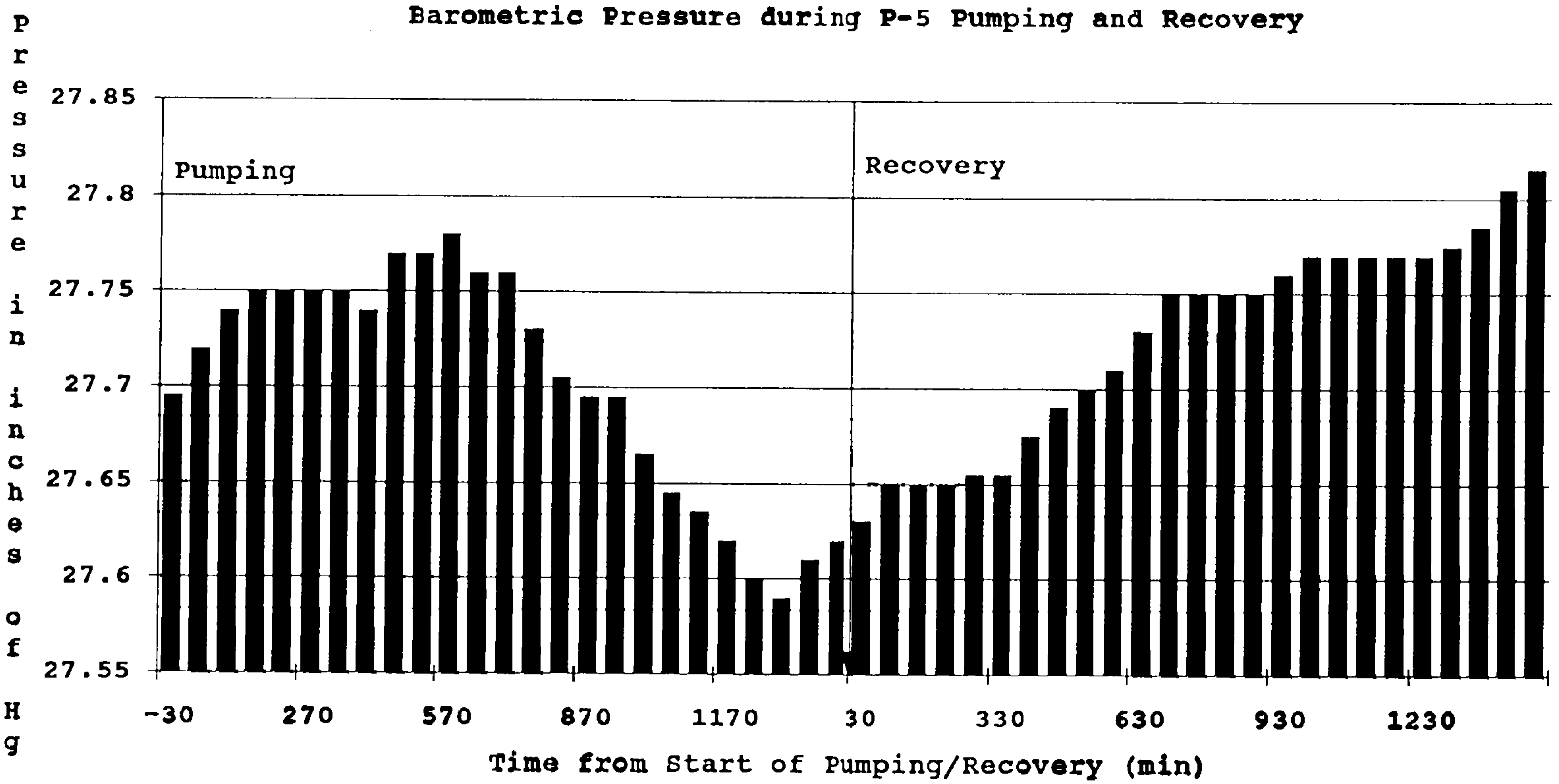
Drawdown data from the regionally unconfined upper aquifer beneath the Plant No. 1 site were much different than pumping test data from a typical unconfined aquifer. At most monitoring wells the data were quite similar to drawdown in a confined aquifer. This type of drawdown is believed to have resulted from the following characteristics of the upper aquifer:

- High transmissivity and hydraulic conductivity;
- Low delayed gravity drainage (Neuman "B" factor);
- Local semi-confined nature of the aquifer under static and low stress conditions.

Unconfined aquifers with high transmissivity and hydraulic conductivity generally behave like confined aquifers. Pumping tests in these types of unconfined aquifers result in only a small drawdown in the pumping well and in the adjacent monitoring wells; however, the lateral area of influence from pumping is large. Drawdown in these aquifers is not typically affected by delayed drainage from the dewatered portions of the aquifer; the high hydraulic conductivity of the aquifer media allows water to drain instantly from the dewatered aquifer (where drawdown has occurred) to the cone of depression (the surface of the water table during the pumping test). Small drawdown, large area of influence, and no delayed drainage are also characteristics of a highly transmissive, confined aquifer.

Although the upper aquifer is believed to be regionally unconfined, the aquifer appears to be semi-confined in the immediate vicinity of Plant No. 1. This conclusion is based on monitoring and pumping well response to changes in barometric pressure during the P-5 pumping test. Reductions in drawdown at the monitoring wells during the pumping test roughly paralleled decreases in barometric pressure (See Figure 3-12). Unconfined aquifers are relatively unaffected

FIGURE 3-12


Barometric Pressure during P-5 Pumping and Recovery
Pressure in inches of Hg
27.85
27.8
27.75
27.7
27.65
27.6
27.55
Pumping
Recovery
-30
270
570
870
1170
30
330
630
930
1230
Time from Start of Pumping/Recovery (min)

by barometric pressure; however, confined and semi-confined aquifers are influenced by barometric changes.

The interpretation of pumping test data reflect the above mentioned characteristics of the upper aquifer at the Plant No. 1 site. Results from aquifer test data analysis methods are presented in Table 3-5. In general, the Theis and Jacob confined aquifer analytical methods had the best match with the drawdown data and provided the best estimate of transmissivity. The Neuman unconfined aquifer method was also closely matched to the drawdown data, if a very small value of "B" was selected. When "B" is very small the Neuman method and the Theis methods are practically identical. The transmissivities obtained from the Theis Recovery method are not believed to be representative of the upper aquifer since most of the recovery data were effected by changes in barometric pressure. Distance-Drawdown transmissivity values are not considered to be typical of the upper aquifer because equilibrium drawdown conditions were not achieved during the test.

Average transmissivities for pumping test monitoring wells were calculated from the Theis, Jacob and Neuman methods. Transmissivities from P-3, MW-2 and MW-4 were averaged together since the results were relatively similar. Average transmissivity data are listed below:

Monitoring Well(s)	Transmissivity (ft^2/min)
P-3, MW-2 & MW-4	203
MW-5S	142
MW-5D	254
MW-7S	154

The average transmissivity calculated for MW-5D may not be representative of upper aquifer, since this well was screened at the bottom 10 feet of the pumped interval in P-5.

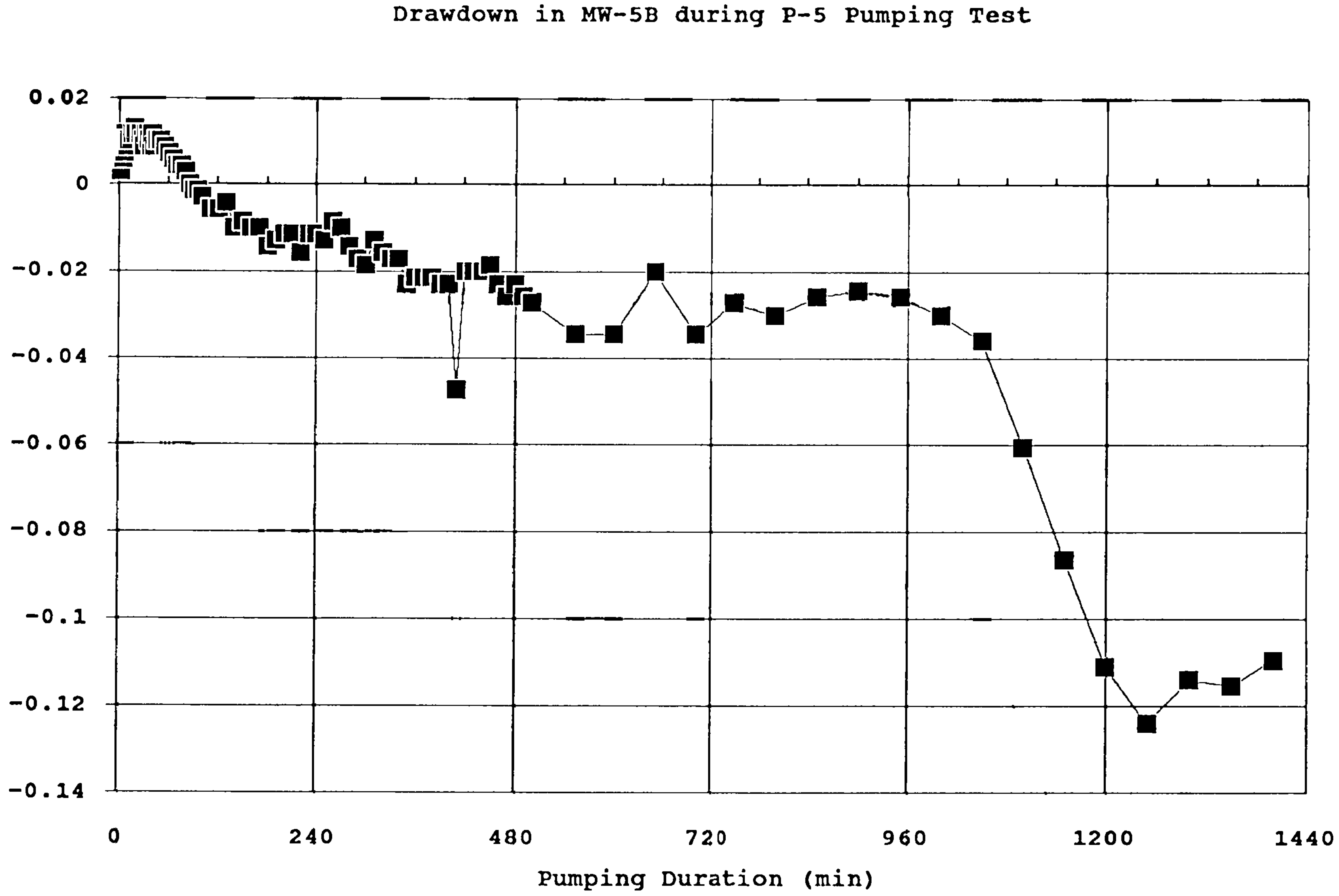
Aquifer storativity is related to the volume of water stored in a confined or semi-confined aquifer. Storativity values calculated from monitoring well drawdown data are also listed in Table 3-5. The range of storativity calculated from the Theis, Jacob and Neuman methods was 0.000951 to 0.059; and the average storativity was 0.017.

Specific yield is a parameter which can be used to determine the amount of water stored in an unconfined aquifer. Specific yield is obtained from the late drawdown data in an unconfined-aquifer pumping test. Although many of the calculated values of specific yield are within a realistic range for the upper aquifer, there were insufficient late drawdown data to determine an accurate estimate of specific yield. The length of pumping was shortened from 48 to 24 hours due to barometric pressure effects on drawdown data. Therefore, specific yield values calculated from the P-5 pumping test should not be used for aquifer water volume calculations. The specific yield of the upper aquifer is estimated to be between 0.15 and 0.25, based on the geological characteristics of the aquifer (USGS Water-Supply Paper 1662-D, 1967; and USGS Open-File Report 78-304, 1978).

Area of influence calculations for 900 minutes of pumping P-5 at 256 gpm are presented in Table 3-5. These data were obtained from Distance-Drawdown analysis of monitoring well data. Based on these results, the radius of influence northwest of the site (in the direction of MW-4, MW-9S and MW-9D) was between 450 and 540 feet from P-5. The radius of influence in other areas of the aquifer was approximately 1200 to 1330 feet from P-5.

The lower aquifer beneath Plant No. 1 appeared to be completely unaffected by the P-5 pumping test. Water level measurements from lower-aquifer monitoring well MW-5B rose (negative drawdown) throughout most of the pumping. Figure 3-13 presents water level measurements in well MW-5B during the pumping of well P-5. MW-5B water levels appear to be only affected by the lowering of barometric pressure during the

FIGURE 3-13


Drawdown in MW-5B during P-5 Pumping Test
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
-0.14
Drawdown ft
0
240
480
720
960
1200
1440
Pumping Duration (min)

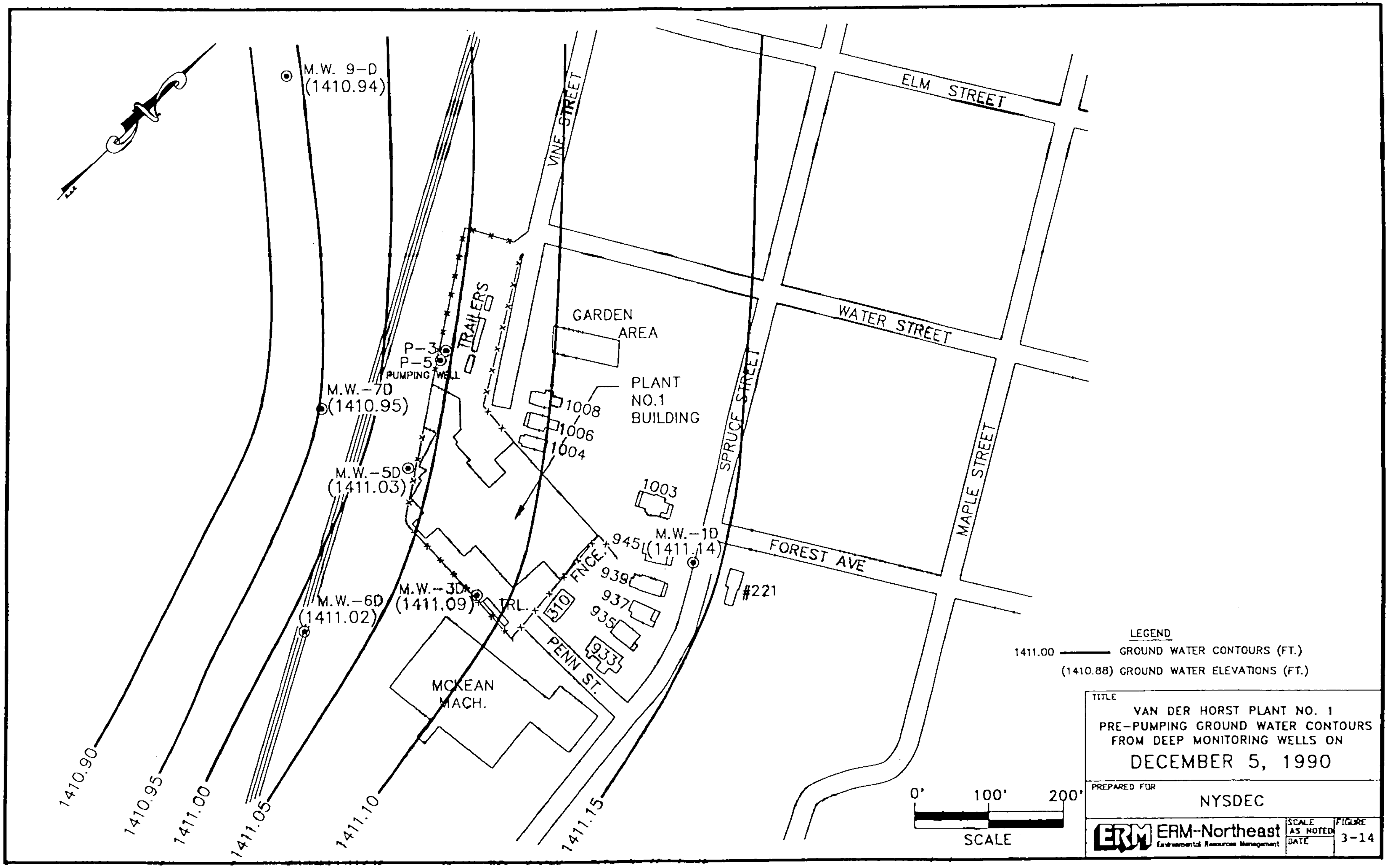
pumping test. The pattern of MW-5B water levels and the trend of barometric pressure during pumping (Figure 3-12) are quite similar. These data provide further evidence that the lower aquifer is confined or semi-confined beneath the Plant No. 1 site.

A comparison between hydraulic conductivity calculated from the pumping test and the slug tests indicate that pumping test results are about ten times higher (i.e. one order of magnitude). A pumping test transmissivity value of 203 ft^2/min is equal to a hydraulic conductivity of 1.5 cm/sec. The average hydraulic conductivity obtained from shallow well slug test analysis was 0.11 cm/sec. Slug tests generally have greater accuracy in aquifers with low and medium hydraulic conductivity than in highly conductive aquifers.

3.3.7 Ground Water Capture Area during Test

The ground water capture area for P-5 was evaluated after pumping 256 gpm for 900 minutes. The pumping time of 900 minutes was selected since this was the approximate time of maximum drawdown during the 24-hour pumping period. Both measured and estimated ground water elevations were used for capture area analysis. Estimated ground water elevations were calculated through a technique that utilized the pre-test ground water contours for the shallow and deep wells (Figures 3-11 and 3-14) and the shallow and deep well Area of Influence maps (Figures 3-9 and 3-10). The Area of Influence maps were superimposed on the pre-test ground water contour maps to obtain points of estimated ground water elevation during the pumping test. These estimated data were used as a guide for contouring areas between points of measured ground water elevation data. The resultant contour maps of ground water elevations at 900 minutes of pumping are provided in Figures 3-15 and 3-16. The ground water capture area is shaded on each of these figures.

It should be noted that the areas of influence due to pumping P-5 (Figures 3-9 and 3-10) are not equivalent to the ground water capture areas. The ground water capture area is only the area where ground water flows towards the pumping well, that is, where the ground water surface slopes toward the well. In areas where the ground water surface is naturally sloped, the area of influence will extend further downgradient beyond the capture area. Water levels in the aquifer will drop in these areas, even though ground water flow is away from the pumping well.



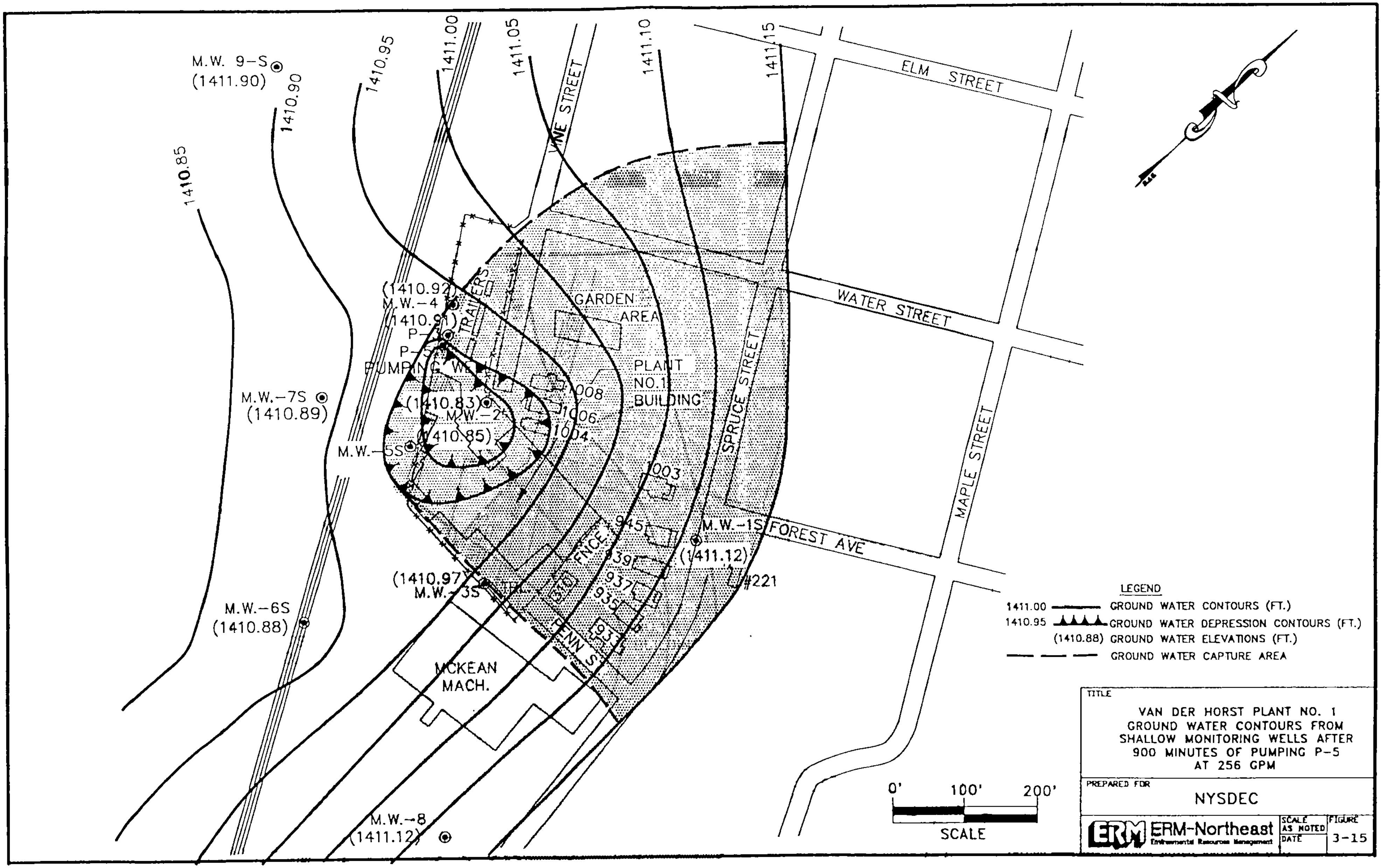
TITLE

VAN DER HORST PLANT NO. 1
PRE-PUMPING GROUND WATER CONTOURS
FROM DEEP MONITORING WELLS ON
DECEMBER 5, 1990

PREPARED FOR
NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE AS NOTED
DATE
FIGURE 3-14



LEGEND

1411.00 ——— GROUND WATER CONTOURS (FT.)

1410.95 ▲▲▲▲ GROUND WATER DEPRESSION CONTOURS (FT.)

(1410.88) GROUND WATER ELEVATIONS (FT.)

— — — GROUND WATER CAPTURE AREA

TITLE

VAN DER HORST PLANT NO. 1
GROUND WATER CONTOURS FROM
SHALLOW MONITORING WELLS AFTER
900 MINUTES OF PUMPING P-5
AT 256 GPM

PREPARED FOR

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Environmental Resources Management

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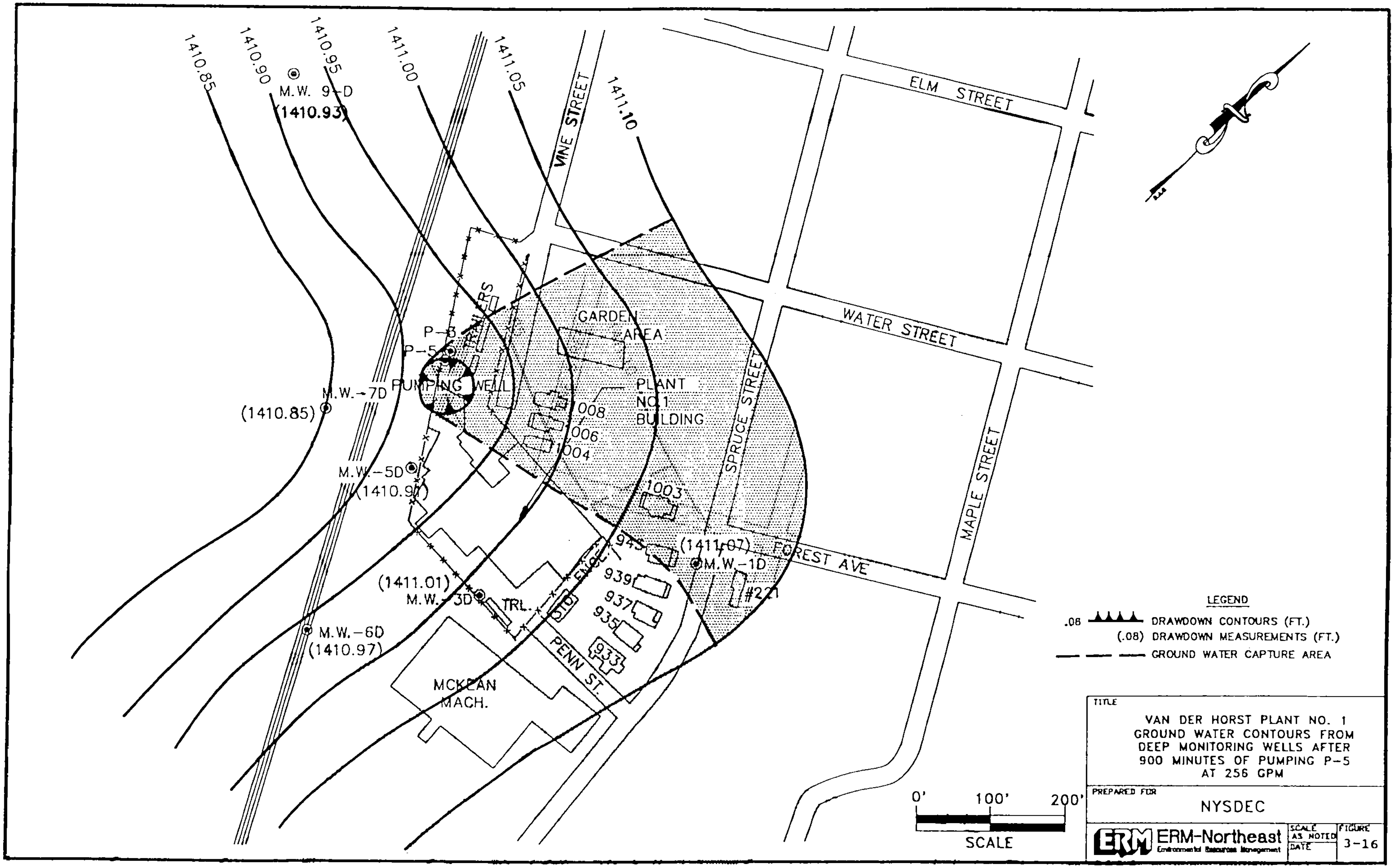
DATE

FIGURE 3-15



TITLE

VAN DER HORST PLANT NO. 1
GROUND WATER CONTOURS FROM
DEEP MONITORING WELLS AFTER
900 MINUTES OF PUMPING P-5
AT 256 GPM

PREPARED FOR

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Environmental Resources Management

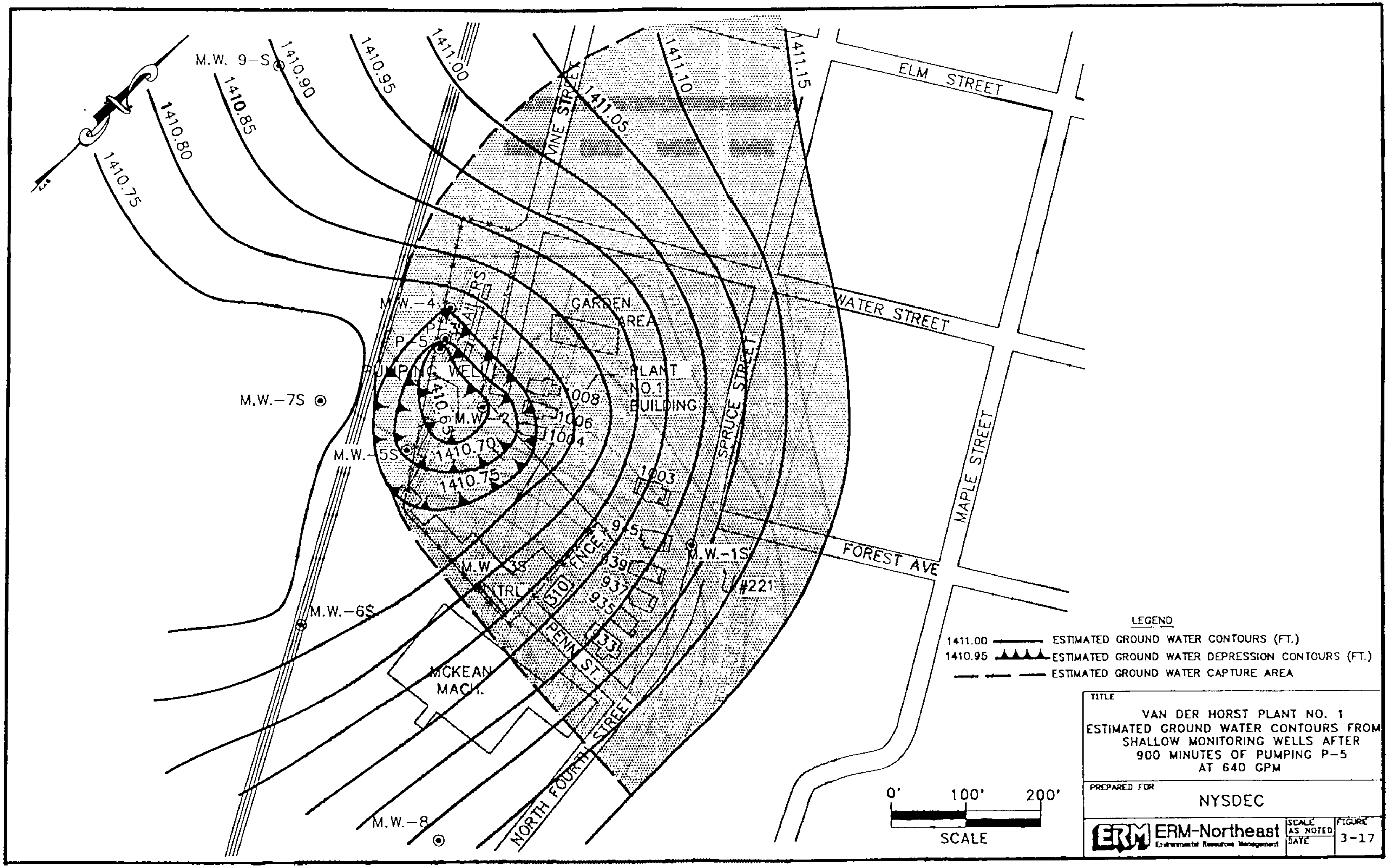
SCALE AS NOTED
DATE
FIGURE 3-16

3.3.8 Estimated Capture Area for Pumping P-5 at a Higher Rate

Ground water contours and capture area were also estimated for pumping P-5 at a rate of 640 gpm (2.5 times the discharge of the pumping test). Ground water elevations were calculated by assuming that drawdown was directly proportional to pumping discharge (Fetter, 1979). Observed drawdowns in each of the monitoring wells were multiplied by 2.5. The values of drawdown contour lines on area of influence Figures 3-9 and 3-10 were also multiplied by 2.5. The new area of influence figures were superimposed on the pre-pumping test ground water contour maps (Figure 3-11 and 3-14) in a similar manner as the data from the pumping test. From these data and the estimated ground water elevation data at the monitoring wells, ground water contour maps were generated for pumping P-5 at 640 gpm for 900 minutes (Figures 3-17 and 3-18). The ground water capture area is shaded in these figures.

3.3.9 Estimated Capture Area for Pumping the Production Well

One of the criteria for selecting the location of P-5 was to minimize the amount of hexavalent chromium contamination which would be pumped to the sanitary sewer. The Olean Department of Public Works required that hexavalent chromium



LEGEND

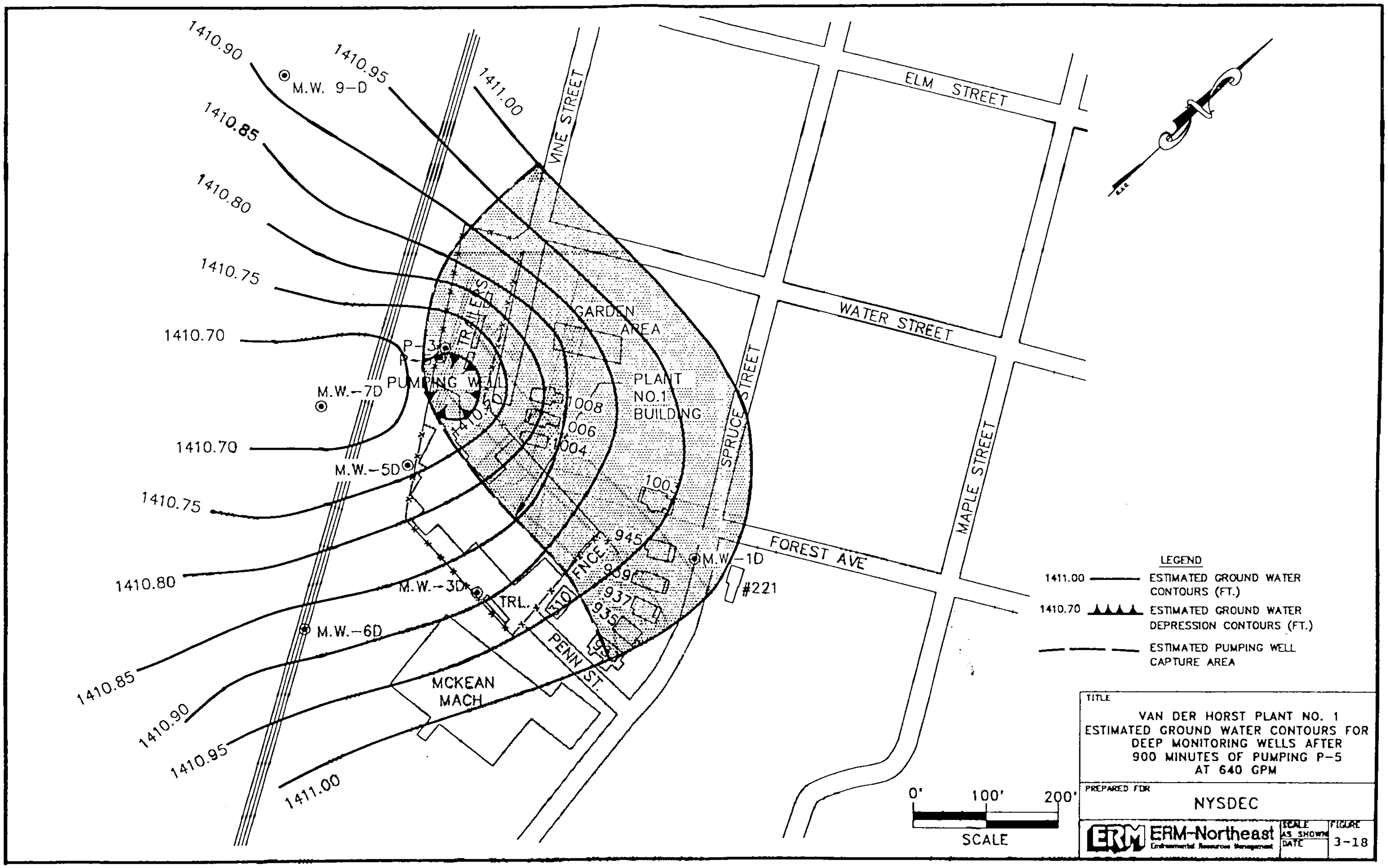
1411.00 ESTIMATED GROUND WATER CONTOURS (FT.)
1410.95 ESTIMATED GROUND WATER DEPRESSION CONTOURS (FT.)
ESTIMATED GROUND WATER CAPTURE AREA

TITLE
VAN DER HORST PLANT NO. 1
ESTIMATED GROUND WATER CONTOURS FROM
SHALLOW MONITORING WELLS AFTER
900 MINUTES OF PUMPING P-5
AT 640 GPM

PREPARED FOR
NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE AS NOTED
DATE
FIGURE 3-17



TITLE

VAN DER HORST PLANT NO. 1
ESTIMATED GROUND WATER CONTOURS FOR
DEEP MONITORING WELLS AFTER
900 MINUTES OF PUMPING P-5
AT 640 GPM

PREPARED FOR

NYSDEC

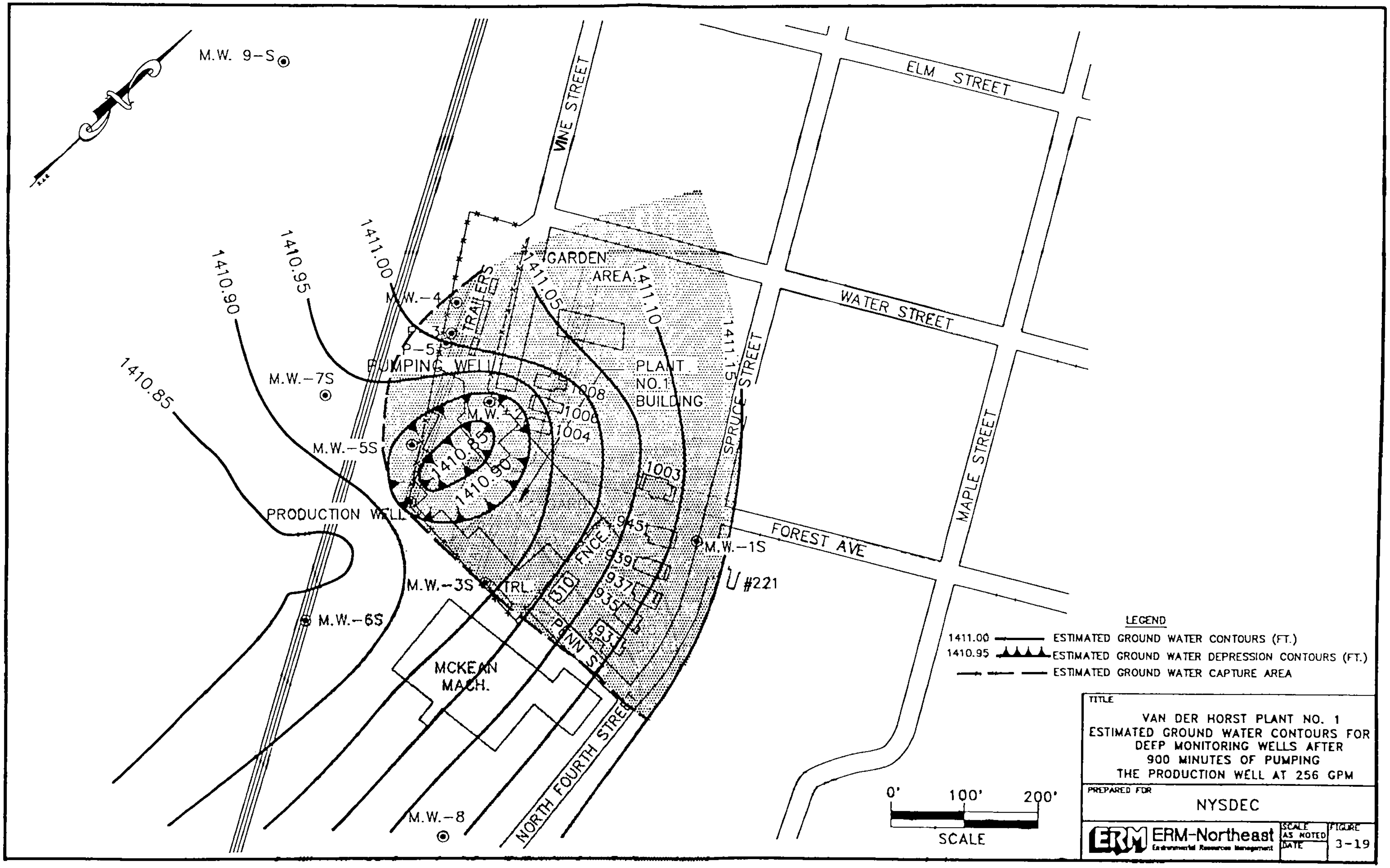
ERM-Northeast
Environmental Resources Management

SCALE AS SHOWN
DATE
FIGURE 3-18

levels in the discharge be less than 5.5 mg/L. The on-site production well, located near the southwest corner of the building, is at a location which is much more suitable for the recovery of contaminated ground water; however this well was shut down because of chromium contamination.

Ground water contours were estimated for pumping the production well at 256 gpm for 900 minutes. Drawdown contours in area of influence Figure 3-9 were shifted in a manner that would locate the production well in the same position as P-5 relative to the drawdown contours. The relocated drawdown contours were superimposed over the pre-pumping test ground water contours in a manner similar to the pumping test data. The resultant estimated ground water elevations were contoured in Figure 3-19.

A more elaborate simulation of production well pumping will be conducted during ground water modeling of the upper aquifer at Plant No. 1. The model will evaluate several different pumping rates for the production well, and will also examine different locations and pumping rates for other potential recovery wells.



LEGEND

1411.00 ——— ESTIMATED GROUND WATER CONTOURS (FT.)
1410.95 ▲▲▲▲ ESTIMATED GROUND WATER DEPRESSION CONTOURS (FT.)
— - — - — ESTIMATED GROUND WATER CAPTURE AREA

TITLE
VAN DER HORST PLANT NO. 1
ESTIMATED GROUND WATER CONTOURS FOR
DEEP MONITORING WELLS AFTER
900 MINUTES OF PUMPING
THE PRODUCTION WELL AT 256 GPM

PREPARED FOR
NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
AS NOTED	3-19
DATE	

3.3.10 Water Quality of P-5 Discharge

Prior to the start of the pumping test, ERM requested permission from the Olean Department of Public Works (ODPW) to discharge pumping test water to the sanitary sewer. The ODPW approved pumping test discharge to the sewer, provided that ERM collected discharge samples and performed field analyses for hexavalent chromium, specific conductivity and pH. Hexavalent chromium analysis was performed using a HACH 1834-00 color-disk test kit. The test kit method had an analysis range from 0 to 1.5 ppm and a precision of about +/- .05 ppm.

ERM agreed to stop pumping if the hexavalent chromium levels in the discharge water were 5.5 ppm or greater. Discharge results are presented in Table 3-6. At no time during the pump did the discharge water exceed the ODPW limit of 5.5 ppm for hexavalent chromium.

3.3.11 Conclusions

One of the primary objectives of the pumping test was to obtain aquifer parameters required for subsequent ground water modeling. Aquifer parameter values for transmissivity,

TABLE 3-6

Field Analysis of Discharge Water during the P-5 Pumping Test 12/5 - 12/6/90

Clock Time	Pumping Duration (min)	Specific Conductivity (umhos/cm)	pH	Hexavalent Chromium (mg/L)
8:40	10	500	8.18	ND
9:45	75	500	7.98	ND
10:30	120	500	7.95	ND
11:40	190	500	8.22	ND
12:30	240	485	7.92	0.10
13:30	300	485	7.95	0.10
14:30	360	480	8.07	0.14
15:42	432	485	8.00	0.14
16:30	480	485	7.93	0.10
21:06	756	480	7.90	0.10
22:56	866	476	8.01	0.13
0:57	987	474	7.92	0.11
2:58	1108	481	8.12	0.11
4:56	1226	483	8.05	0.11
6:54	1344	485	8.03	0.11

ND = Not Detected

storativity, and average hydraulic conductivity were able to be calculated from pumping test data. Specific yield could not be determined from pumping test data for the following reasons:

- The length of the pumping test was shortened due to water level fluctuation related to barometric pressure changes;
- The pumping test only mildly stressed the aquifer. Greater discharge was not possible due to the size restrictions on the diameter of the pump and the well;
- The drawdown data were not effected by delayed drainage from dewatered portions of the aquifer. Delayed drainage effects on drawdown are used to calculate specific yield.

Based on geological characteristics of the aquifer, the specific yield is estimated between 0.15 and 0.25 (USGS Water-Supply Paper 1662-D, 1967; and USGS Open-File Report 78-304, 1978).

The lower aquifer beneath the site appears to be confined or semi-confined. Water levels in MW-5B were unaffected by the pumping of P-5, but seemed to be directly influenced by barometric pressure changes.

The upper aquifer in the vicinity of Plant No. 1 behaves as a semi-confined aquifer during static and low stress pumping conditions. This conclusion is based on the response of ground water levels to barometric pressure changes during the pumping test. The upper aquifer is believed to be regionally unconfined.

A ground water discharge of 256 gpm may be an acceptable rate for a recover well at Plant No. 1. There appeared to be little difference in the size of the pumping test well capture area for 256 gpm (Figures 3-15 and 3-16) and the estimated capture area for a discharge of 640 gpm (Figures 3-17 and 3-18).

The on-site production well may be in a good location for a recovery well. The estimated ground water capture area in Figure 3-19 appears to encompass most of the upgradient high level ground water contamination in the aquifer.

The suitability (i.e. present condition) of the production well for an on-site recovery well has not yet been determined. Additional information about well construction and integrity will be required before this decision can be made. Down-hole geophysical logging of the production well may be necessary to determine well integrity.

4.0 OVERVIEW OF PHASE II CHEMICAL ANALYSIS

4.1 General

The following six media were sampled and tested during this Phase II RI study:

- On and off-site surface and subsurface soil;
- Surface water from Olean Creek;
- Sediment from Olean Creek;
- Ground water from on and off-site monitoring wells;
- Storm sewer sediment; and
- Storm sewer water

A summary of the samples collected and the associated analyses is shown on Table 2-1. Sampling locations are shown on Figures 2-2 through 2-8. These data were reviewed and validated by an ERM QA/QC validation specialist. A copy of ERM's QA/QC data validation is provided in Appendix B and has previously been submitted to the NYSDEC along with the entire Phase II package of CLP documentation.

This section presents a summary of the Phase II RI analytical sampling results. This summary is followed by a baseline risk assessment (Section 5.0) which used these data to evaluate risks to human health and the environment. Section 6.0 discusses the potential sources and extent of contamination (based on the Phase I and II RI data), and graphically shows the distribution of contaminants relative to Plant No. 1.

4.2 Off-site Surface Soils

Table 4-1 presents the analytical test results for the 4 surface soil samples collected at the nearby residences which were analyzed for TAL metals. Sample BSS-1 was collected outside the immediate vicinity of the site (i.e., several hundred feet upwind from the site boundary) and is considered to represent background conditions. Samples BSS-2, RSS-1 and RSS-2 were collected at residences downwind of the site boundary.

Eighteen (18) of the twenty-three (23) TAL metals were detected in the background off-site surface soil sample BSS-1 (see Table 4-2). The concentrations of lead and total chromium in this sample were 43.8 and 52.2 mg/Kg, respectively. The concentrations of lead and chromium in non-background off-site soil samples were respectively, 16.3 and 52.2 mg/Kg in BSS-2, 14 and 101 mg/Kg in RSS-1 and 24.8 and 460 mg/Kg in RSS-2. Arsenic was detected in all four off-site samples ranging from 10.3 mg/Kg (RSS-2) to 23.6 mg/Kg (BSS-1).

TABLE 4-1

Van Der Horst Plant 1 Phase 2
Off-Site Background and Residential Surface Soils
TAL Metals

SAMPLE NUMBER		BSS-1		BSS-1 MD		BSS-2		RSS-1		RSS-2	
MATRIX		Soil		Soil		Soil		Soil		Soil	
DATE ANALYZED		19-Jul-90		19-Jul-90		19-Jul-90		19-Jul-90		19-Jul-90	
% SOLIDS		78.80%		78.80%		75.70%		81.70%		79.40%	
UNITS		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
ANALYTE	**CAS Number**										
Aluminum	7429-90-5	13100	J	10100	J	14300	J	7370	J	9640	J
Antimony	7440-36-0	ND		ND		ND		ND		ND	
Arsenic	7440-38-2	23.6	J	17.5	J	15.1	J	18	J	10.3	J
Barium	7440-39-3	126	J	94.9	J	131	J	114	J	276	J
Beryllium	7440-41-7	0.7	J	0.5	J	ND		ND		ND	
Cadmium	7440-43-9	ND		0.5	J	ND		ND		ND	
Calcium	7440-70-2	1690		1630		4360		3530		4480	
Chromium	7440-47-3	13.8	J	11.6	J	16.3	J	14	J	24.8	J
Cobalt	7440-48-4	8.3	J	6.1	J	8.4	J	6.9	J	6.6	J
Copper	7440-50-8	43.8	J	33.1	J	44.7	J	59.2	J	64.7	J
Iron	7439-89-6	22600	J	16000	J	22300	J	19000	J	20000	J
Lead	7439-92-1	88.5	J	61.9	J	52.2	J	101	J	460	J
Magnesium	7439-95-4	1960		1610		2780		1520		1440	
Manganese	7439-96-5	494	J	359	J	973	J	633	J	552	J
Mercury	7439-97-6	ND		ND		ND		ND		0.2	
Nickel	7440-02-0	24	J	16.1	J	26.8	J	23.8	J	21.5	J
Potassium	7440-09-7	1070		829		1490		742		855	
Selenium	7782-49-2	ND		ND		ND		ND		ND	
Silver	7440-22-4	3.2	J	2.5	J	3.5	J	3	J	2.7	J
Sodium	7440-23-5	144	B	117		ND		125	B	176	B
Thallium	7440-28-0	ND		ND		ND		ND		ND	
Vanadium	7440-62-2	22.3	J	20.2	J	25.9	J	11	J	16.5	J
Zinc	7440-66-6	131	J	127	J	146	J	167	J	591	J

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

TABLE 4-2

Van Der Horst Plant 1 Phase 2
On-Site Surface Soils
Total Cr, As, Pb

SAMPLE NUMBER		OS-SS-1		OS-SS-2		OS-SS-3		OS-SS-4		OS-SS-4 MD		OS-SS-5	
MATRIX		Soil		Soil		Soil		Soil		Soil		Soil	
DATE ANALYZED		27-Jul-90		27-Jul-90		27-Jul-90		27-Jul-90		27-Jul-90		27-Jul-90	
% SOLIDS		81.10%		90.10%		92.70%		91.70%		91.70%			
UNITS		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
ANALYTE	**CAS Number**												
Arsenic	7440-38-2	24.5	J	14.8	J	24.1	J	6.6	J	8.3	J	7.1	J
Chromium	7440-47-3	3530	J	1000	J	461	J	63.6	J	99	J	24.8	J
Lead	7439-92-1	3900	J	53700	J	636	J	161	J	190	J	48.1	J

SAMPLE NUMBER		OS-SS-6		OS-SS-6,DUP		OS-SS-7		OS-SS-8		OS-SS-9		OS-SS-10	
MATRIX		Soil		Soil		Soil		Soil		Soil		Soil	
DATE ANALYZED		27-Jul-90		27-Jul-90		27-Jul-90		27-Jul-90		27-Jul-90		27-Jul-90	
% SOLIDS		93.00%		91.20%		83.20%		92.60%		93.50%		95.30%	
UNITS		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
ANALYTE	**CAS Number**												
Arsenic	7440-38-2	499	J	7.2	J	1.7	J	15.5	J	5.3	J	6.1	J
Chromium	7440-47-3	9.1	J	611	J	999	J	55.2	J	62.4	J	50.1	J
Lead	7439-92-1	359	J	500	J	868	J	115	J	81.6	J	73.1	J

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

4.3 On-site Surface Soils

Ten (10) surface soil samples (OS-SS-1 through OS-SS-10) were collected from various areas on-site to further delineate the extent of the chromium contamination on the ground surface and at potential source areas identified during the Phase I RI. Figures 2-3 and 2-4 present the Phase II RI on-site soil sampling locations and Table 4-2 summarizes the analytical results. These on-site surface soil samples were analyzed for total chromium, total arsenic, and total lead. Total arsenic concentrations ranged from 1.7 mg/Kg (OS-SS-7) to 499 mg/Kg (OS-SS-6), total chromium ranged from 9.1 mg/Kg (OS-SS-6) to 3530 mg/Kg (OS-SS-1) and total lead ranged from 48.1 mg/Kg (OS-SS-5) to 53,700 mg/Kg (OS-SS-2).

4.4 On-site Subsurface Soil

Forty-two (42) subsurface samples were collected from on-site soil borings during the Phase II RI. As shown on Table 4-3, 34 samples were analyzed for total chromium, total arsenic and total lead. The remaining eight samples were analyzed for TCLP Metals for comparison with waste disposal criteria.

For those samples collected from ground surface to 2 feet below grade, arsenic concentrations ranged from 6.2 mg/Kg (SB-3, 0-2) to 192 mg/Kg (SB-1, 0-2), chromium concentrations ranged from

TABLE 4-3

Van Der Horst Plant 1 Phase 2
On-Site Test Boring Soils
Total Cr, As, Pb

SAMPLE NUMBER		SB-1, 0'-2'	SB-1, 0'-2' DUP	SB-1, 4'-6'	SB-1, 8'-10'	SB-2, 0'-2'	SB-2, 0'-2' MD	SB-2, 4'-6'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE ANALYZED		13-Jul-90	13-Jul-90	13-Jul-90	13-Jul-90	13-Jul-90	13-Jul-90	13-Jul-90
% SOLIDS		93.90%	92.30%	91.40%	75.80%	93.50%	93.50%	90.90%
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**							
Arsenic	7440-38-2	192 J	9.5 J	6.9	7.2	8.2	7.1	7
Chromium	7440-47-3	179 J	139 J	35.2 J	121 J	496 J	302 J	75.6 J
Lead	7439-92-1	147 J	54.7 J	24.1 J	26.8 J	298 J	81.8 J	40.2 J

SAMPLE NUMBER		SB-2, 8'-10'	SB-3, 0'-2'	SB-3, 4'-6'	SB-3, 8'-10'	SB-4, 0'-2'	SB-4, 4'-6'	SB-4, 8'-10'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE ANALYZED		13-Jul-90	13-Jul-90	13-Jul-90	13-Jul-90	13-Jul-90	13-Jul-90	19-Jul-90
% SOLIDS		88.40%	95.90%	89.80%	94.70%	91.00%	91.10%	89.30%
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**							
Arsenic	**7440-38-2**	6.5	8.2	7.1	3.8	8.3	5.2	5.2 J
Chromium	**7440-47-3**	96.8 J	406 J	164 J	8.7 J	530 J	14.2 J	10.1 J
Lead	**7439-92-1**	45.2 J	116 J	50.6 J	12.2 J	137 J	21.4 J	5.2 J

Qualifier Codes:
B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.

TABLE 4-3 (continued)

Van Der Horst Plant 1 Phase 2
On-Site Test Boring Soils
Total Cr, As, Pb

SAMPLE NUMBER		SB-5, 0'-2'	SB-5, 0'-2'	SB-5, 4'-6'	SB-5, 8'-10'	SB-6, 0'-2'	SB-6, 4'-6'	SB-6, 8'-10'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE ANALYZED		19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90
% SOLIDS		63.90%	63.90%	87.20%	89.70%	81.80%	91.80%	
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**							
Arsenic	7440-38-2	43.7 J	41.8 J	11.2 J	5.8 J	27.7 J	8.7 J	18.5 J
Chromium	7440-47-3	15300 J	12900 J	68 J	208 J	5200 J	189 J	59.7 J
Lead	7439-92-1	11600 J	10100 J	16.2 J	17.9 J	2060 J	24.7 J	18.2 J

SAMPLE NUMBER		SB-7, 0'-2'	SB-7, 4'-6'	SB-7, 8'-10'	SB-8, 0'-2'	SB-8, 0'-2' MD	SB-8, 2'-4'	SB-8, 4'-6'	SB-8, 6'-8'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE ANALYZED		19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90
% SOLIDS		80.80%	86.40%	90.60%	67.40%	67.40%	85.30%	80.60%	88.40%
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**								
Arsenic	7440-38-2	16.7 J	8.3 J	3.9 J	28.1 J	45.5 J	6.5 J	6.9 J	5.6 J
Chromium	7440-47-3	4160 J	38.1 J	43.9 J	23200 J	12100 J	587 J	667 J	87.9 J
Lead	7439-92-1	1880 J	20 J	18.6 J	7490 J	2820 J	17 J	24.9 J	9 J

SAMPLE NUMBER		SB-8, 8'-10'	SB-8, 10'-12'	SB-8, 12'-14'	SB-8, 14'-16'	SB-8, 16'-18'	SB-8, 18'-20'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil
DATE ANALYZED		19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90
% SOLIDS		87.90%	90.90%	95.00%	93.40%	94.00%	94.30%
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**						
Arsenic	7440-38-2	7.6 J	5.8 J	4.9 J	4.1 J	6.2 J	7.8 J
Chromium	7440-47-3	203 J	95.3 J	56.1 J	156 J	693 J	1530 J
Lead	7439-92-1	7.9 J	5.4 J	12.4 J	18.9 J	12.2 J	22.3 J

Qualifier Codes:
B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.

TABLE 4-3 (continued)

Van Der Horst Plant 1 Phase 2
On-Site Test Boring Soils
TCLP Metals

SAMPLE NUMBER		SB-1, 0'-2'	SB-1, 0'-2' Dup	SB-2, 4'-6'	SB-3, 8'-10'	SB-6, 0'-2'	SB-8, 0'-2'	SB-8, 0'-2' MD	SB-8, 12'-14'
MATRIX		Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP
DATE ANALYZED		13-Jul-90	13-Jul-90	13-Jul-90	13-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90	19-Jul-90
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANALYTE	**EPA LIMITS FOR TCLP ANALYSIS (µg/L)**								
Aresenic	5000	ND	ND	ND	ND	ND	ND	ND	ND
Barium	100000	1380	ND	293	261	1220 J	2460 J	1920 J	328 J
Cadmium	1000	26	18	16	13	13 J	12 J	26 J	23 J
Chromium	5000	100	98	296 J	42	988 J	6030 J	9190 J	430 J
Copper	___	82 J	32 J	11 B	20 B	24 J	42 J	136 J	35 J
Lead	5000	100 J	170 J	ND	150	350 J	200 J	150 J	90 J
Mercury	200	ND	ND	ND	0.3	ND	ND	ND	ND
Nickel	___	100	80	60	90	ND	ND	ND	44
Selenium	1000	ND	ND	ND	ND	ND	ND	ND	ND
Silver	5000	35 J	ND	17	29	ND	ND	7	ND

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.
▨: This concentration exceeds EPA TCLP limits.

139 mg/Kg (SB-1, 0-2 DUP) to 23,200 mg/Kg (SB-8, 0-2) and lead concentrations ranged from 54.7 mg/Kg (SB-4, 0-2 DUP) to 11,600 mg/Kg (SB-5, 0-2). For those samples collected from 4 to 6 feet below grade, total arsenic ranged from 5.2 mg/Kg (SB-4, 4-6) to 11.2 mg/Kg (SB-5, 4-6), total chromium ranged from 14.2 mg/Kg (SB-4, 4-6) to 667 mg/Kg (SB-8, 4-6), and total lead ranged from 16.2 mg/Kg (SB-5, 4-6) to 50.6 mg/Kg (SB-3, 4-6). A summary of the high and low ranges of arsenic, chromium and lead detected in subsurface samples is presented in Table 4-4.

The TCLP analyses indicated that only one parameter (chromium) for one sample, SB-8 (0-2) exceeded the EPA TCLP limits (Table 4-3). As shown on Figure 2-4, this sample was collected near MW-5 where the backwash from the former chromic acid filtration system was reportedly discharged. The remainder of the TCLP analytical results were below the TCLP limits.

4.5 Storm Sewer Sediment and Water Samples

Seven storm sewer sediment and six storm water samples were obtained from the storm sewer system leading from the plant facility to Olean Creek (see Figure 2-8). The sediment samples were analyzed for arsenic, chromium, and lead. The analytical results are presented in Table 4-5. Arsenic concentrations for the sediment samples ranged from 4.5 mg/Kg (ST-SEW-7 SOIL) to 20.9

TABLE 4-4

Arsenic, Lead and Chromium Concentration Ranges in Soil Boring Samples

Depth (ft)	ARSENIC				LEAD				CHROMIUM			
	Boring	Low (ppm)	Boring	High (ppm)	Boring	Low (ppm)	Boring	High (ppm)	Boring	Low (ppm)	Boring	High (ppm)
0 - 2	SB-3	6.2	SB-1	192	SB-4	54.7	SB-5	11600	SB-1	139	SB-8	23200
4 - 6	SB-4	5.2	SB-5	11.2	SB-5	16.2	SB-3	50.6	SB-4	14.2	SB-8	667
8 - 10	SB-3	3.8	SB-6	18.5	SB-4	5.2	SB-2	45.2	SB-3	8.7	SB-5	205

TABLE 4-5

Van Der Horst Plant 1 Phase 2
Storm Sewer Sediment

TOTAL Cr, As, Pb:

SAMPLE NUMBER	ST-SEW-1	ST-SEW-2	ST-SEW-3	ST-SEW-3 MD	ST-SEW-4	ST-SEW-5	ST-SEW-6	ST-SEW-7
MATRIX	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE ANALYZED	27-Jul-90	27-Jul-90	27-Jul-90	27-Jul-90	27-Jul-90	27-Jul-90	27-Jul-90	27-Jul-90
% SOLIDS	63.90%	65.60%	63.30%	63.30%	68.30%	72.20%	84.70%	72.50%
UNITS	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE								
Arsenic	8.2 J	10.7 J	5.2 J	8.7 J	7.6 J	7 J	20.9 J	4.5 J
Chromium	76.2 J	2620 J	197 J	225 J	14800 J	12900 J	140 J	902 J
Lead	165 J	1460 J	97.1 J	127 J	3390 J	1210 J	99.4 J	402 J

pH (standard units): 7.2 7.39 7.33 ___ 7.82 7.58 8.44 7.35

Qualifier Codes:
B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.

mg/Kg (ST-SEW-6 SOIL), chromium ranged from 76.2 mg/Kg (ST-SEW-1 SOIL) to 14,800 mg/Kg (ST-SEW-4 SOIL), and lead ranged from 97.1 mg/Kg (ST-SEW-3 SOIL) to 3390 mg/Kg (ST-SEW-4 SOIL).

The six storm water samples were analyzed for arsenic, chromium, lead, hexavalent chromium, and pH. The results are presented on Table 4-6. Hexavalent chromium was only detected in ST-SEW-4 WATER, at a level of 47.0 ug/L. Arsenic concentrations ranged from not detected (ST-SEW-1, 4, 5, and 7) to 17 ug/L (ST-SEW-3). Total chromium ranged from 15 ug/L (ST-SEW-7 WATER) to 80,000 ug/L (ST-SEW-2 WATER). Lead ranged from 25 ug/L (ST-SEW-1 WATER) to 30,000 ug/L (ST-SEW-2 WATER).

4.6 Olean Creek Sampling

Analytical samples were collected from Olean Creek during two different sampling events. Surface water and sediment samples were collected at six locations on June 28, 1990 (see Figure 2-6). These locations were both upstream and downstream of the Brookview Avenue storm sewer outfall. Six additional Olean Creek sediment samples were collected adjacent to the outfall on July 20, 1990 (see Figure 2-7).

TABLE 4-6

Van Der Horst Plant 1 Phase 2
Storm Sewer Water

TOTAL Cr, As, Pb:

SAMPLE NUMBER	ST-SEW-1		ST-SEW-2		ST-SEW-3		ST-SEW-3,MD		ST-SEW-4		ST-SEW-5		ST-SEW-7	
MATRIX	Water		Water		Water		Water		Water		Water		Water	
DATE ANALYZED	19-Jul-90		19-Jul-90		19-Jul-90		19-Jul-90		19-Jul-90		19-Jul-90		19-Jul-90	
UNITS	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
ANALYTE														
Arsenic	ND		74	J	17	J	20	J	ND		ND		ND	
Chromium	18	J	80000	J	11100	J	8400	J	1450	J	1450	J	15	J
Lead	25		30000		3100		3300		250		310		220	

WET CHEMISTRY:

SAMPLE NUMBER	ST-SEW-1	ST-SEW-2	ST-SEW-3	ST-SEW-4	ST-SEW-5	ST-SEW-7
MATRIX	Water	Water	Water	Water	Water	Water
PARAMETER						
Hexavalent Chromiu	ND	ND	ND	47	ND	ND
pH (standard units)	7.32	7.56	7.45	7.21	7.34	10.08

QUALIFIER CODES
J: This result should be considered a quantitative estimate.
<: Indicates not detected above the indicated quantitation limit.
ND: This parameter was not detected.

Tables 4-7 through 4-8 list the analytical results for the Olean Creek surface water and sediment samples, respectively. Seven surface water samples were collected and analyzed for TAL metals and hexavalent chromium. Conductivity and pH were measured at the time of sampling for each sample. Analysis of the surface water samples detected 9 of the 23 TAL metals in all seven samples (see Table 4-7) at relatively low levels (i.e., near the analytical laboratory detection limit). Hexavalent chromium was not detected in these samples. Metal concentrations, pH and conductivity levels in these samples were below Class "C" surface water quality standards (NYSDOW Memorandum, September, 1990). Olean Creek has been ranked by NYSDEC as a Class "C" stream.

Sediment samples collected on June 28, 1990 were analyzed for TAL metals. The analysis of sediment samples CR-SD-1 through CR-SD-6 detected 17 of the 23 TAL metals (see Table 4-8). Arsenic levels ranged from 1.7 mg/Kg (CR-SD-5) to 8.4 mg/Kg (CR-SD-6). Chromium levels ranged from 11.7 mg/Kg (CR-SD-1) to 704 mg/Kg (CR-SD-3). Lead levels ranged from 7.1 mg/Kg (CR-SD-5) to 244 mg/Kg (CR-SD-3).

Creek-bank sediments were also analyzed for TAL metals. Analytical results for creek-bank samples CR-BSD-1 through CR-BSD-6 detected 19 of the 23 TAL metals (see Table 4-8). Arsenic ranged from 6.6 mg/Kg (CR-BSD-3 and CR-BSD-5) to 10.7 mg/Kg (CR-BSD-6).

TABLE 4-7

Van Der Horst Plant 1 Phase 2
Olean Creek Surface Water

TAL METALS:

SAMPLE NUMBER		CR-SW-1	CR-SW-2	CR-SW-3	CR-SW-4	CR-SW-5	CR-SW-5 MD	CR-SW-6	CR-SW-7
MATRIX		Water	Water	Water	Water	Water	Water	Water	Water
DATE ANALYZED		12-Jul-90	12-Jul-90	12-Jul-90	12-Jul-90	12-Jul-90	12-Jul-90	12-Jul-90	12-Jul-90
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANALYTE	NYS CLASS 'C' WATER QUALITY STANDARDS µg/L								
Aluminum	100	▨ 376	▨ 244	▨ 279	▨ 258	▨ 203	▨ 264	▨ 179 B	▨ 166 B
Antimony	___	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	190	ND	ND	ND	ND	ND	ND	ND	ND
Barium	___	68 B	62 B	60 B	62 B	64 B	62	63 B	65 B
Beryllium	11	ND	1	ND	1	1	1	ND	ND
Cadmium	___	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	___	37200 J	38500 J	37800 J	38500 J	38800 J	37600 J	39800 J	38000 J
Chromium	___	ND	11 J	ND	ND	ND	15	ND	ND
Cobalt	5	ND	ND	ND	ND	ND	ND	ND	ND
Copper	___	2 B	2 B	2	3 B	4 B	3	10 B	2 B
Iron	300	▨ 677 J	▨ 394 J	▨ 412 J	▨ 370 J	▨ 301 J	▨ 382 J	▨ 369 J	295 J
Lead	___	4.2	3.8	ND	ND	3.9	3.4	3	ND
Magnesium	___	7040 J	6780 J	6740 J	6820 J	6940 J	6870 J	6780 J	6700 J
Manganese	___	105	73	63	71	76	73	81	62
Mercury	0.2	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	___	ND	ND	ND	ND	18 B	ND	ND	ND
Potassium	___	1780 B	1740 B	1760 B	1790 B	1820 B	1810	1670 B	1660 B
Selenium	1	ND	ND	ND	ND	ND	ND	ND	ND
Silver	0.1	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	___	15000	14000	15000	14000	16000	15000	15000	14000
Thallium	8	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	14	ND	ND	ND	7 B	11 B	7	ND	6 B
Zinc	30	19 B	ND	17 B	5 B	18 B	19	▨ 97	8 B

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

▨: This result exceeds NYS Class 'C' water quality standards.

WET CHEMISTRY PARAMETERS:

SAMPLE NUMBER	CR-SW-1	CR-SW-2	CR-SW-3	CR-SW-4	CR-SW-5	CR-SW-5 MD	CR-SW-6	CR-SW-7
MATRIX	Water	Water	Water	Water	Water	Water	Water	Water
PARAMETER								
Hexavalent Chromium (µg/L)	ND	ND	ND	ND	ND	ND	ND	ND
pH (standard units)	8.32	8.73	8.46	8.87	8.85	8.89	8.71	8.93

QUALIFIER CODES:

J: This result should be considered a quantitative estimate.

<: Indicates not detected above the indicated quantitation limit.

ND: This parameter was not detected.

TABLE 4-8

Van Der Horst Plant 1 Phase 2
Olean Creek Sediment
TAL Metals

SAMPLE NUMBER		CR-SD-1		CR-SD-2		CR-SD-3		CR-SD-4		CR-SD-5		CR-SD-6	
MATRIX		Soil		Soil		Soil		Soil		Soil		Soil	
DATE ANALYZED		16-Jul-90		16-Jul-90		16-Jul-90		16-Jul-90		16-Jul-90		16-Jul-90	
% SOLIDS		70.80%		74.30%		75.80%		77.90%		78.90%		75.20%	
UNITS		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
ANALYTE	**CAS Number**												
Aluminum	7429-90-5	7710		5980		4820		3830		3340		5330	
Antimony	7440-36-0	ND		ND		ND		ND		ND		ND	
Arsenic	7440-38-2	6.3		6.9		3.6		4.4		1.7		8.4	
Barium	7440-39-3	42.2	J	123	J	62.9	J	44.1	J	42.5	J	42.5	J
Beryllium	7440-41-7	0.32	B	0.67		0.35	B	0.19	B	1.3		0.23	B
Cadmium	7440-43-9	1		0.81		1.3		1		ND		ND	
Calcium	7440-70-2	2230	J	3820	J	10700	J	1010	J	2590	J	2160	J
Chromium	7440-47-3	11.7	J	17.7	J	704	J	24.4	J	19.2	J	44	J
Cobalt	7440-48-4	6.8		9.4		3.3	B	3.7	B	3.6	B	4.6	B
Copper	7440-50-8	26.7	J	18.6	J	20.1	J	7.8	J	10.1	J	7.7	J
Iron	7439-89-6	13800	J	20600	J	11500	J	21900	J	14000	J	10700	J
Lead	7439-92-1	68		34.3	J	244	J	7.5	J	7.1	J	10.6	J
Magnesium	7439-95-4	1790		2920		2480		1020		1170		1530	
Manganese	7439-96-5	479		799		348		590		662		335	
Mercury	7439-97-6	ND		ND		0.14		ND		0.27		ND	
Nickel	7440-02-0	16		22.4		16		13.1		13.6		11.8	
Potassium	7440-09-7	646	B	500	B	580	B	306	B	390	B	681	J
Selenium	7782-49-2	ND		ND		ND		ND		ND		ND	
Silver	7440-22-4	1.8	J	1.9	B	2.6	J	2.4	J	1.6	J	2.5	J
Sodium	7440-23-5	128	B	121	B	188	B	170	B	148	B	155	B
Thallium	7440-28-0	ND		ND		ND		0.59		ND		0.61	
Vanadium	7440-62-2	11	J	19	J	9.1	J	7.7	J	5.9	B	10.4	J
Zinc	7440-66-6	129		83.3		141		79.3		35.9		44.8	

Qualifier Codes:
B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.

TABLE 4-8 (continued)

Van Der Horst Plant 1 Phase 2
Olean Creek Sediment
TAL Metals

SAMPLE NUMBER		CR-BSD-1		CR-BSD-2		CR-BSD-3		CR-BSD-3 MD		CR-BSD-4		CR-BSD-5		CR-BSD-6	
MATRIX		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
DATE ANALYZED		16-Jul-90		16-Jul-90		16-Jul-90		16-Jul-90		16-Jul-90		16-Jul-90		16-Jul-90	
% SOLIDS		80.50%		72.50%		59.80%		59.80%		71.30%		72.60%		69.90%	
UNITS		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
ANALYTE	**CAS Number**														
Aluminum	7429-90-5	16000		12900		12400		10300		15000		15400		17900	
Antimony	7440-36-0	ND		ND		ND		ND		ND		ND		ND	
Arsenic	7440-38-2	9		7		6.6		6.6		9.2		6.6		10.7	
Barium	7440-39-3	157	J	126	J	128	J	115	J	133	J	1.4	B	146	J
Beryllium	7440-41-7	0.81		0.68	B	0.68	B	0.4	B	0.6	B	0.7		0.79	
Cadmium	7440-43-9	0.87		0.83		0.69		0.2		0.7		1.3		ND	
Calcium	7440-70-2	2870	J	3910	J	3560	J	4810	J	3520	J	3000	J	3720	J
Chromium	7440-47-3	21.1	J	18.1	J	172	J	301	J	189	J	77.8	J	261	J
Cobalt	7440-48-4	1.2	B	9.6		8.9		9		10.1		9.9		11.5	B
Copper	7440-50-8	18.3	J	19	J	21.2	J	34.2	J	18.8	J	17.5	J	19.8	J
Iron	7439-89-6	26900	J	21100	J	19300	J	18000	J	22300	J	27400	J	26900	J
Lead	7439-92-1	8.9	J	35.1	J	72.9	J	182	J	38.5	J	60	J	19.8	J
Magnesium	7439-95-4	3670		2990		2820		3020		3240		3310		3800	
Manganese	7439-96-5	1110		895		654		692		965		1010		948	
Mercury	7439-97-6	ND		ND		0.53		0.5		ND		ND		ND	
Nickel	7440-02-0	34.9		29.6		25.8		25.8		30.9		29.5		33.4	
Potassium	7440-09-7	1840	J	1.4	J	1500	J	1140	J	1890	J	2310	J	2580	J
Selenium	7782-49-2	ND		ND		ND		0.7		ND		ND		ND	
Silver	7440-22-4	2.89	J	3.9	J	3.2	J	4.7	J	1.4	J	9.3	J	2.1	J
Sodium	7440-23-5	125	B	153	B	221	B	205	B	171	B	161	B	259	B
Thallium	7440-28-0	ND		ND		ND		ND		0.63		ND		ND	
Vanadium	7440-62-2	26	J	20.9	J	21	J	17.5	J	24.5	J	24.3	JJ	28.3	J
Zinc	7440-66-6	114		157		94.9		106		144		117		93	

Qualifier Codes:
B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.

TABLE 4-8 (continued)

Van Der Horst Plant 1 Phase 2
Olean Creek Sediment
TAL Metals

SAMPLE NUMBER		OS-OC-1		OS-OC-2		OS-OC-3		OS-OC-4		OS-OC-4 MD	
MATRIX		Soil		Soil		Soil		Soil		Soil	
DATE ANALYZED		30-Jul-90		30-Jul-90		30-Jul-90		30-Jul-90		30-Jul-90	
% SOLIDS		53.40%		73.00%		58.70%		53.90%		53.90%	
UNITS		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
ANALYTE	**CAS Number**										
Aluminum	7429-90-5	15100	J	10300	J	8900	J	6300	J	6700	J
Antimony	7440-36-0	ND		ND		ND		ND		ND	
Arsenic	7440-38-2	6.9	J	6.7	J	5.9	J	4.1	J	4.6	J
Barium	7440-39-3	129	J	77.4	J	468	J	81.6	J	76.5	J
Beryllium	7440-41-7	0.8	B	1.1		0.78	B	ND		ND	
Cadmium	7440-43-9	1.6		1.2		8.3		2.2		1.7	
Calcium	7440-70-2	3070	J	1450	J	18200	J	3760	J	-1.9	J
Chromium	7440-47-3	18.3	J	12.8	J	3600	J	3920	J	340	J
Cobalt	7440-48-4	9.2	B	6.3		8		8.8	B	5	
Copper	7440-50-8	17.6	J	16.2	J	218	J	238	J	26.2	J
Iron	7439-89-6	23800	J	14600	J	17600	J	19200	J	12000	J
Lead	7439-92-1	8.7	J	5.8	J	804	J	875	J	87.7	J
Magnesium	7439-95-4	3140	J	2380	J	4870	J	5310	J	1690	J
Manganese	7439-96-5	905	J	239	J	426	J	392	J	357	J
Mercury	7439-97-6	ND		ND		0.32		ND		ND	
Nickel	7440-02-0	32.4		18.1		28		17.2		16.4	
Potassium	7440-09-7	2210	J	1600	J	1020	J	904	B	1010	J
Selenium	7782-49-2	ND		ND		ND		ND		ND	
Silver	7440-22-4	3.4	J	2.2	J	1.8	J	2.1	J	1	J
Sodium	7440-23-5	274	B	146	B	478	B	257	B	329	B
Thallium	7440-28-0	ND		ND		ND		ND		ND	
Vanadium	7440-62-2	20.1		15.7		15.3		10.2		12	
Zinc	7440-66-6	104	J	64.8	J	227	J	69	J	88.7	J

Qualifier Codes:
B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.

TABLE 4-8 (continued)

Van Der Horst Plant 1 Phase 2
Olean Creek Sediment (near Outfall)
TCLP Metals

SAMPLE NUMBER		OS-OC-5	OS-OC-6
MATRIX		Soil/TCLP	Soil/TCLP
DATE ANALYZED		30-Jul-90	30-Jul-90
UNITS		µg/L	µg/L
ANALYTE	**EPA LIMITS FOR TCLP ANALYSIS (µg/L)**		
Arsenic	5000	ND	ND
Barium	100000	504	834
Cadmium	1000	ND	ND
Chromium	5000	10	28
Copper	—	NA	NA
Lead	5000	ND	94
Mercury	200	0.4	ND
Nickel	—	NA	NA
Selenium	1000	ND	ND
Silver	5000	7	13

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

NA: This analyte not analyzed for this sample.

▨: This result exceeds EPA TCLP limits.

Chromium ranged from 18.1 mg/Kg (CR-BSD-2) to 261 mg/Kg (CR-BSD-6). Lead ranged from 8.9 mg/Kg (CR-BSD-1) to 72.9 mg/Kg (CR-BSD-3).

4.7 Ground Water Samples

Table 4-9 includes the analytical results for the ground water samples tested during the Phase II RI study. Samples from all 20 ground water monitoring wells were tested for TCL volatile organics, TAL metals and hexavalent chromium (see Table 2-1). Table 4-10 presents a summary of analytes that exceeded NYS Ground Water Quality Standards. Conductivity and pH were measured in the field and are included with the well development and sampling parameters in Table 2-3.

The QA/QC samples and the waste samples (drummed drill cuttings and monitoring well purge water), are presented in Tables 4-11 and 4-12, respectively.

Samples were not collected from MW-6S and MW-6D during the Phase II sampling since the integrity of these wells is questionable. Both wells were damaged by an unknown cause after the Phase I sampling. The damage included: knocked over protective casings, broken inner PVC casings, and destructions

TABLE 4-9

Van Der Horst Plant 1 Phase 2
Ground Water

TAL Metals:

SAMPLE NUMBER		MW-1D	MW-1S	MW-2	MW-3D	MW-3S	MW-4	MW-5D
MATRIX		**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANALYTE	**NYSDEC GROUND WATER QUALITY STANDARDS (µg/L)**							
Aluminum	___	1460	5380	2680	1010	7980	4840	1460
Antimony	3	ND	ND	ND	86	26 B	ND	ND
Arsenic	25	ND	5 B	ND	ND	14	7 B	ND
Barium	1000	134 B	183 B	118 B	130 B	282	182 B	101 B
Beryllium	3	ND	ND	ND	ND	ND	ND	1 B
Cadmium	10	5	5	ND	ND	ND	ND	ND
Calcium	___	89600	110000	91600	89100	153000	108000	129000
Chromium	50	18	ND	2860	23	240	17	55700
Cobalt	___	ND	ND	ND	ND	11 B	ND	ND
Copper	200	9 B	20 B	25	7 B	37	26	17 B
Iron	300	2930	10300	8300	1830	10000	9910	3260
Lead	25	32	27	46	10	58.4	36	48
Magnesium	35000	13000	15800	12200	12900	35900	19100	15800
Manganese	300	159	487	889	71	870	707	323
Mercury	2	ND	ND	ND	ND	ND	ND	ND
Nickel	___	ND	ND	15 B	15 B	18 B	ND	ND
Potassium	___	3080 B	4720 B	2940 B	2800 B	5340	4960 B	2510 B
Selenium	20	ND	ND	ND	ND	ND	ND	ND
Silver	50	ND	7 B	ND	43	351	ND	13
Sodium	___	35200	62000	30300	29500	57800	47700	31100
Thallium	4	ND	ND	ND	ND	ND	ND	ND
Vanadium	___	60	60	ND	ND	6 B	ND	ND
Zinc	300	65	82	62	74	153	94	59
Hexavalent Chromium	50	ND	11	2880	ND	192	15	35900

TCL Volatiles:

		MW-1D	MW-1S	MW-2	MW-3D	MW-3S	MW-4	MW-5D
vinyl chloride	2	ND	ND	ND	ND	ND	ND	ND
acetone	50	ND	ND	28	ND	ND	ND	ND
carbon disulfide	50	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene(total)	5	ND	ND	6	ND	ND	ND	ND
chloroform	100	ND	0.7 J	7	ND	0.6 J	ND	ND
bromodichloromethane	50	ND	ND	ND	ND	ND	ND	ND
trichloroethene	5	ND	ND	20	ND	ND	ND	ND
tetrachloroethene	0.7	ND	ND	4 J	ND	ND	ND	0.8 J

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

▨: This result exceeds NYSDEC ground water quality standards.

TABLE 4-9 (continued)

Van Der Horst Plant 1 Phase 2
Ground Water

TAL Metals:

SAMPLE NUMBER		MW-5B	MW-5S	MW-7D	MW-7S	MW-8	MW-9D	MW-9S
MATRIX		**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANALYTE	**NYSDEC GROUND WATER QUALITY STANDARDS (µg/L)**							
Aluminum	___	352	930	2790	7390	7470	39100	15200
Antimony	3	58 B	88	47 B	29 B	ND	ND	ND
Arsenic	25	ND	ND	ND	7 B	7 B	110	58
Barium	1000	32 B	56 B	112 B	135 B	196 B	890	835
Beryllium	3	ND	ND	ND	ND	ND	2 B	1 B
Cadmium	10	ND	ND	5 B	ND	ND	ND	ND
Calcium	___	57300	82800	87300	134000	110000	413000	209000
Chromium	50	13	3920	5040	33	29	132	29
Cobalt	___	ND	ND	ND	ND	ND	35 B	8 B
Copper	200	3 B	16 B	13 B	29	19 B	318	107
Iron	300	512	2030	4600	13300	14500	115000	40200
Lead	25	18.3	11.3	27	26.8	43	570	88
Magnesium	35000	9490	9350	11500	20600	15000	43400	38800
Manganese	300	101	663	333	5360	649	4300	2870
Mercury	2	ND	ND	ND	0.3	ND	1.9	ND
Nickel	___	ND	16 B	ND	61	15 B	88	64
Potassium	___	1470 B	1500 B	2950 B	4860 B	5910	9550	6210
Selenium	20	ND	ND	ND	ND	ND	ND	ND
Silver	50	18	71	24	68	8 B	28	30
Sodium	___	13100	25100	24400	28400	63400	27800	21100
Thallium	4	ND	ND	ND	ND	ND	ND	ND
Vanadium	___	ND	ND	ND	ND	ND	140	50
Zinc	300	61	108	125	265	82	596	458
Hexavalent Chromium	50	27	7560	6300	32	26	70	16

TCL Volatiles:

vinyl chloride	2	ND	3 J	ND	ND	ND	ND	ND
acetone	50	ND	ND	ND	ND	ND	ND	6 J
carbon disulfide	50	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene(total)	5	ND	11	ND	ND	ND	ND	ND
chloroform	100	ND	ND	ND	ND	ND	ND	ND
bromodichloromethane	50	ND	ND	ND	ND	ND	ND	ND
trichloroethene	5	ND	2 J	ND	1 J	ND	ND	ND
tetrachloroethene	0.7	ND	8	ND	ND	ND	ND	ND

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

▨: This result exceeds NYSDEC ground water quality standards.

TABLE 4-9 (continued)

Van Der Horst Plant 1 Phase 2
Ground Water

TAL Metals:

SAMPLE NUMBER		MW-10		MW-11D		MW-11S		MW-12		MW-13		MW-14		MW-14 Dup	
MATRIX		**Water**		**Water**		**Water**		**Water**		**Water**		**Water**		**Water**	
UNITS		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
ANALYTE	**NYSDEC GROUND WATER QUALITY STANDARDS (µg/L)**														
Aluminum	---	5940		3760		5440		11000		4630		33700		34100	
Antimony	3	ND		ND		ND		ND		ND		ND		ND	
Arsenic	25	5	B	5	B	5	B	13		7	B	30	J	19	J
Barium	1000	148	B	164	B	139	B	284		18	B	440		428	
Beryllium	3	ND		1	B	1	B	1	B	ND		2	B	2	B
Cadmium	10	ND		8		ND		ND		ND		ND		ND	
Calcium	---	92400		99700		119000		10600		102000		305000		287000	
Chromium	50	13		1030		10		19		10		93		86	
Cobalt	---	ND		ND		ND		8	B	ND		27	B	24	B
Copper	200	31		144		23	B	39		26		126		121	
Iron	300	10400		9270		9390		24400		11500		68200		68000	
Lead	25	103		41		30		63		29		116	J	72	J
Magnesium	35000	12100		18000		21000		20000		18400		61000		58000	
Manganese	300	1060		909		565		649		904		4240		4000	
Mercury	2	ND		ND		ND		ND		ND		ND		ND	
Nickel	---	19	B	25	B	ND		37	B	27	B	106		91	
Potassium	---	6560		9170		3620	B	5910		5640		11400		11400	
Selenium	20	ND		ND		ND		ND		ND		ND		ND	
Silver	50	ND		ND		ND		10		ND		ND		ND	
Sodium	---	44400		29600		24400		54500		34300		35000		33800	
Thallium	4	ND		ND		ND		ND		ND		ND		ND	
Vanadium	---	ND		6	B	6	B	ND		ND		54		53	
Zinc	300	578		1030		88		115		105		404		371	
Hexavalent Chromium	50	ND		1030		ND		ND		ND		ND		ND	

TCL Volatiles:

		MW-10		MW-11D		MW-11S		MW-12		MW-13		MW-14		MW-14 Dup	
vinyl chloride	2	ND		ND		ND		ND		ND		ND		ND	
acetone	50	ND		10		ND		ND		ND		ND		ND	
carbon disulfide	50	ND		10		ND		ND		ND		ND		ND	
1,2-Dichloroethene(total)	5	ND		ND		ND		ND		ND		ND		ND	
chloroform	100	0.6	J	ND		ND		0.6	J	14		ND		ND	
bromodichloromethane	50	ND		ND		ND		ND		2	J	ND		ND	
trichloroethene	5	ND		ND		ND		ND		ND		ND		ND	
tetrachloroethene	0.7	ND		ND		ND		ND		ND		ND		ND	

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

░: This result exceeds NYSDEC ground water quality standards.

TABLE 4-10

Organics and Inorganics in Monitoring Wells Which Exceeded NYSDEC Ground Water Quality Standards

Analyte	NYSDEC Standard (ug/L)	Number of Wells Exceeding Standard	Concentration Range of Wells Exceeding Standard (ug/L)
VOLATILES			
1,2-Dichloroethene	5	2 of 20	6 - 7
Tetrachloroethane	0.7	3 of 20	0.8 - 8
Trichloroethene	5	1 of 20	20
Vinyl Chloride	2	1 of 20	3
METALS			
Antimony	3	6 of 20	26 - 88
Arsenic	25	3 of 20	30 - 110
Total Chromium	50	8 of 20	86 - 55000
Hex Chromium	50	7 of 20	70 - 35000
Copper	200	1 of 20	318
Iron	300	20 of 20	512 - 115000
Lead	25	18 of 20	26.8 - 570
Magnesium	35000	5 of 20	35900 - 61000
Manganese	300	18 of 20	323 - 5360
Silver	50	3 of 20	69 - 351
Zinc	300	6 of 20	371 - 1030

TABLE 4-11

QA/QC Samples
Van Der Horst Plant 1 Phase 2
Field Blanks
Wet Chemistry Parameters

SAMPLE NUMBER	FB-3	FB-GW-1
MATRIX	Water	Water
PARAMETER		
Hexavalent Chromium (µg/L)	NA	ND
Chloride (mg/L)	NA	NA
Nitrate (mg N03-N/L)	NA	NA
pH (standard units)	6.57	NA
Total Recoverable Phenolics (mg/L)	NA	NA
Sulfate (mg/L)	NA	NA

QUALIFIER CODES
J: This result should be considered a quantitative estimate.
<: Indicates not detected above the indicated quantitation limit.
NA: This parameter not analyzed for this sample.
ND: This parameter was not detected.

TABLE 4-11 (continued)

QA/QC Samples
Van der Horst Plant 1 Phase 2
Field Blanks
Volatile TICs

SAMPLE NUMBER	FB-GW-1
MATRIX	Water
DATE ANALYZED	15-Aug-90
UNITS	µg/L
TENTATIVELY IDENTIFIED VOLATILE COMPOUNDS	
UNKNOWN	6 J

Qualifier Codes:

B: This result is qualitatively invalid because the compound was also detecte in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This compound was not detected.

TABLE 4-11 (continued)

QA/QC Samples
Van Der Horst Plant 1 Phase 2
Field Blanks
Total Cr, As, Pb

SAMPLE NUMBER		SB-FB-1	FB-2	FB-3
MATRIX		Water	Water	Water
DATE ANALYZED		13-Jul-90	19-Jul-90	19-Jul-90
UNITS		µg/L	µg/L	µg/L
ANALYTE	**CAS Number**			
Arsenic	7440-38-2	5	ND	ND
Chromium	7440-47-3	14	ND	ND
Lead	7439-92-1	5	ND	ND

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

TABLE 4-11 (continued)

QA/QC Samples
Van Der Horst Plant 1 Phase 2
Field Blanks
TCL Volatiles

SAMPLE NUMBER		FB-GW-1
MATRIX		Water
DATE ANALYZED		15-Aug-90
UNITS		µg/L
COMPOUND	**CAS Number**	
chloromethane	74-87-3	ND
bromomethane	74-83-9	ND
vinyl chloride	75-01-4	ND
chloroethane	75-00-3	ND
methylene chloride	75-09-2	ND
acetone	67-64-1	ND
carbon disulfide	75-15-0	ND
1,1-Dichloroethene	75-35-4	ND
1,1-Dichloroethane	75-34-3	ND
1,2-Dichloroethene(total)	540-59-0	ND
chloroform	67-66-3	ND
1,2-Dichloroethane	107-06-2	ND
2-Butanone	78-93-3	ND
1,1,1-trichloroethane	71-55-6	ND
carbon tetrachloride	56-23-5	ND
vinyl acetate	108-05-4	ND
bromodichloromethane	75-27-4	ND
1,2-dichloropropane	78-87-5	ND
cis-1,3-Dichloropropene	10061-01-5	ND
trichloroethene	79-01-6	ND
dibromochloromethane	124-48-1	ND
1,1,2-Trichloroethane	79-00-5	ND
benzene	71-43-2	ND
trans-1,3-Dichloropropene	10061-02-6	ND
bromoform	75-25-2	ND
4-Methyl-2-Pentanone	108-10-1	ND
2-Hexanone	591-78-6	ND
tetrachloroethene	127-18-4	ND
1,1,2,2-Tetrachloroethane	79-34-5	ND
toluene	108-88-3	ND
chlorobenzene	108-90-7	ND
ethylbenzene	100-41-4	ND
styrene	100-42-5	ND
total xylenes	1330-20-7	ND

Qualifier Codes:
B: This result is qualitatively invalid because the compound was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This compound was not detected.

TABLE 4-11 (continued)

QA/QC Samples
Van Der Horst Plant 1 Phase 2
Field Blanks
TAL Metals

SAMPLE NUMBER		FB-1		FB-GW-1	
MATRIX		Water		Water	
DATE ANALYZED		19-Jul-90		16-Aug-90	
UNITS		µg/L		µg/L	
ANALYTE	**CAS Number**				
Aluminum	7429-90-5	230		56	B
Antimony	7440-36-0	ND		24	B
Arsenic	7440-38-2	ND		ND	
Barium	7440-39-3	ND		ND	
Beryllium	7440-41-7	ND		ND	
Cadmium	7440-43-9	ND		ND	
Calcium	7440-70-2	1230	B	1100	B
Chromium	7440-47-3	ND		ND	
Cobalt	7440-48-4	ND		ND	
Copper	7440-50-8	ND		1	B
Iron	7439-89-6	204		21	B
Lead	7439-92-1	ND		5	
Magnesium	7439-95-4	ND		ND	
Manganese	7439-96-5	ND		ND	
Mercury	7439-97-6	ND		ND	
Nickel	7440-02-0	ND		ND	
Potassium	7440-09-7	ND		ND	
Selenium	7782-49-2	ND		ND	
Silver	7440-22-4	ND		32	
Sodium	7440-23-5	ND		464	B
Thallium	7440-28-0	ND		ND	
Vanadium	7440-62-2	ND		ND	
Zinc	7440-66-6	14		44	

Qualifier Codes:
B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.

TABLE 4-11 (continued)

QA/QC Samples
Van der Horst Plant 1 Phase 2
Trip Blanks
Volatile TICs

SAMPLE NUMBER	TB-GW-1		TB-GW-4	
MATRIX	Water		Water	
DATE ANALYZED	15-Aug-90		7-Sep-90	
UNITS	µg/L		µg/L	
TENTATIVELY IDENTIFIED VOLATILE COMPOUNDS				
ALKYL SUBSTITUTED COMPOUND	9	J	6	BJ

Qualifier Codes:
B: This result is qualitatively invalid because the compound was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This compound was not detected.

TABLE 4-11 (continued)

QA/QC Samples
Van Der Horst Plant 1 Phase 2
Trip Blanks
TCL Volatiles

SAMPLE NUMBER		TB-GW-1	TB-GW-2	TB-GW-3	TB-GW-4
MATRIX		Water	Water	Water	Water
DATE ANALYZED		15-Aug-90	21-Aug-90	20-Aug-90	7-Sep-90
UNITS		µg/L	µg/L	µg/L	µg/L
COMPOUND	**CAS Number**				
methylene chloride	75-09-2	ND	86	410 E	ND
acetone	67-64-1	ND	56 B	320 E	ND

Qualifier Codes:
B: This result is qualitatively invalid because the compound was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This compound was not detected.
E: Compound whose concentration exceeds the calibration range of the GC/MS instrument for that specific analysis.

TABLE 4-12

Van Der Horst Plant 1 Phase 2
Drummed Drill Cuttings
TCLP Metals

SAMPLE NUMBER		D-P-1	D-P-2	D-P-3	D-P-3 MD	D-SB-1-4	D-SB-5-8	D-UNK
MATRIX		Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP
DATE ANALYZED		30-Jul-90	30-Jul-90	18-Sep-90	18-Sep-90	30-Jul-90	30-Jul-90	30-Jul-90
UNITS		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L
ANALYTE	**EPA LIMITS FOR TCLP ANALYSIS (μg/L)**							
Arsenic	5000	ND	ND	ND	ND	ND	ND	ND
Barium	100000	859	885	586	590	2810	2620	628
Cadmium	1000	ND	ND	ND	ND	ND	27	5
Chromium	5000	ND	ND	17	11	153	1800	ND
Lead	5000	ND	185	ND	ND	ND	403	50
Mercury	200	ND	ND	ND	ND	ND	ND	ND
Selenium	1000	ND	ND	ND	ND	ND	ND	ND
Silver	5000	7 B	7 B	ND	ND	7 B	7 B	7 B

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

TABLE 4-12 (continued)

Van Der Horst Plant 1 Phase 2
Drummed Drill Cuttings
TCLP Metals

SAMPLE NUMBER		D-MW-1	D-MW-2	D-MW-3	D-MW-4	D-MW-5	D-MW-5B	D-MW-6	D-MW-6 MD
MATRIX		Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP
DATE ANALYZED		30-Jul-90	30-Jul-90	30-Jul-90	30-Jul-90	30-Jul-90	4-Jan-91	30-Jul-90	30-Jul-90
UNITS		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L
ANALYTE	EPA LIMITS FOR TCLP ANALYSIS (μg/L)								
Arsenic	5000	ND	ND	ND	ND	5	ND	ND	ND
Barium	100000	616	907	746	641	2660	530	584	587
Cadmium	1000	5	13	ND	ND	21	ND	ND	ND
Chromium	5000	11	40	32	ND	697	150	ND	ND
Lead	5000	ND	292	ND	ND	2120	250	ND	ND
Mercury	200	0.2	ND	ND	ND	ND	ND	ND	ND
Selenium	1000	ND	ND	ND	ND	ND	ND	ND	ND
Silver	5000	9 B	9 B	10	11	8 B	ND	5 B	7

Qualifier Codes:
B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.

TABLE 4-12 (continued)

Van Der Horst Plant 1Phase 2
Drummed Drill Cuttings
TCLP Metals

SAMPLE NUMBER		D-MW-7	D-MW-8	D-MW-9	D-MW-10	D-MW-11	D-MW-12	D-MW-13
MATRIX		Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP	Soil/TCLP
DATE ANALYZED		30-Jul-90	30-Jul-90	30-Jul-90	30-Jul-90	4-Jan-91	4-Jan-91	30-Jul-90
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANALYTE	EPA LIMITS FOR TCLP ANALYSIS (µg/L)							
Arsenic	5000	ND	ND	ND	ND	ND	ND	ND
Barium	100000	585	598	853	897	410	770	823
Cadmium	1000	ND	ND	ND	6	ND	ND	ND
Chromium	5000	ND	ND	ND	ND	12	12	13
Lead	5000	ND	ND	269	ND	5	ND	ND
Mercury	200	ND	ND	ND	ND	ND	ND	ND
Selenium	1000	ND	ND	ND	ND	ND	ND	ND
Silver	5000	18	7 B	13	6 B	ND	ND	10

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

within the PVC casings. During the Phase II investigation the damage was repaired so that water levels could be taken.

4.7.1 Background Samples

Analytical results from monitoring wells MW-12 and MW-13 represent background conditions. Both of the wells are upgradient of Van Der Horst Plant 1 and are not believed to be affected by contamination from the site. Three metals (iron, lead and manganese) were detected at concentrations greater than NYSDEC ground water quality standards in the background samples. These metals are believed to occur naturally within the aquifer.

Low levels of chloroform were also detected in wells MW-12 (0.6 ug/L) and MW-13 (14 ug/L). Bromodichloromethane was found in MW-13 at a concentration of 2 ug/L. These levels are considerably below NYSDEC ground water standards (100 ug/L for chloroform and 50 ug/L for bromodichloromethane).

4.7.2 Volatile Organics

TCL volatile organics detected in the ground water samples include acetone, trichloroethene (TCE), tetrachloroethene (PCE), total-1,2-dichloroethene, chloroform, vinyl chloride, carbon disulfide and bromodichloromethane. Only four volatile organics were detected at concentrations greater than NYSDEC ground water quality standards. TCE was found at 20 ug/L in MW-2. The NYSDEC standard for TCE is 5 ug/L. PCE was detected in MW-2 (4 ug/L), MW-5 (0.8 ug/L) and MW-5S (8 ug/L). The NYSDEC standard for PCE is 0.7 ug/L. 1,2-Dichloroethene was observed in MW-2 at 6 ug/L. The NYSDEC standard for 1,2-dichloroethene is 5 ug/L. Vinyl chloride was found in MW-5S at a concentration of 3 ug/L. The NYSDEC standard for vinyl chloride is 2 ug/L.

Several other tentatively identified volatile organics and unknowns were detected in the samples which are summarized on Table 4-10. The majority of these tentatively identified volatile organics were found in samples from MW-9S and MW-9D which are located off-site at the Felmont Oil facility.

4.7.3 Metals

Metals were detected in all ground water samples collected at Van Der Horst Plant 1. Metals found at concentrations exceeding NYSDEC ground water quality standards include (see Table 4-11): 1) Antimony, ranging from 26 ug/L in MW-3S to 88 ug/L in MW-5S; 2) Arsenic, ranging from 30 ug/L in MW-14 to 110 ug/L in MW-9D; 3) Total Chromium, ranging from 86 ug/L in MW-14 to 55,000 ug/L in MW-5D; 4) Hexavalent Chromium, ranging from 70 ug/L in MW-9D to 35,000 ug/L in MW-5D; 5) Iron, ranging from 512 in MW-5B to 115,000 in MW-9D; 6) Lead, ranging from 26.8 ug/L in MW-7S to 570 ug/L in MW-9D; 7) Magnesium, ranging from 35900 in MW-3S to 61,000 in MW-14; 8) Manganese, ranging from 323 ug/L in MW-5D to 5,360 ug/L in MW-7S; 9) Silver, ranging from 69 ug/L in MW-7S to 351 ug/L in MW-3S; 10) Copper, at 318 ug/L in MW-9D; and 11) Zinc, ranging from 371 ug/L in MW-14 to 1030 ug/L in MW-11D.

5.0 PUBLIC HEALTH AND ENVIRONMENTAL RISK ASSESSMENT

A complete public health and environmental risk assessment was conducted as part of the Phase I investigation. The purpose of the Phase II investigation was to collect additional field data required to complete the delineation of contamination at the site and to provide information necessary for the feasibility study. As described in Chapters 2 and 4, the Phase II investigation involved additional sampling of soils, ground water, Olean Creek surface water and sediments, and the adjacent storm sewer system. Furthermore, additional information on ground water flow direction and local usage of ground water was compiled. In this section, the additional data are reviewed in terms of the previously conducted risk assessment to determine if any of the conclusions reached in the earlier study are no longer valid or require further evaluation. A summary of the conclusions of the Phase I risk assessment is provided in Table 5-1.

This evaluation is divided into four sections:

- review of new soil data (Section 5.1);
- review of new ground water data (Section 5.2);
- review of new Olean Creek and storm sewer data with respect to impacts to human health (Section 5.3); and
- review of new Olean Creek and storm sewer data with respect to impacts to aquatic life (Section 5.4).

TABLE 5-1

SUMMARY OF CHEMICALS FOR WHICH PROJECTED INTAKES EXCEED ACCEPTABLE INTAKES - PHASE I

	Noncarcinogenic Effects	Carcinogenic Effects
Current Conditions	o No adverse effects	o Chromium in fugitive dust emissions o Arsenic in residential soils (incidental ingestion by children)
Future Conditions	o Chromium in ground water o Lead in ground water	o Chromium in fugitive dust emissions o Arsenic in residential soils (incidental ingestion by children) o Tetrachloroethene in ground water

5.1 Review of Phase II Soil Data

5.1.1 Phase II Background Soil Data

A total of four new off-site background soil samples were collected in the Phase II investigation and analyzed for metals (BSS-1, BSS-2, RSS-1, RSS-2). These data were compared to the previously collected background samples to see if any additions or deletions to the list of indicator chemicals in soil were required. The Phase II background soil data are consistent with the Phase I background soil data. Therefore, no modification to the list of indicator chemicals for soils is required based on the Phase II data.

5.1.2 Phase II On-Site Soil Data

A total of 42 additional on-site soil samples were collected in the Phase II investigation. Each sample was analyzed for arsenic, chromium, and lead. Potential exposures involving inorganics in soil identified and evaluated in the Phase I risk assessment include: (1) inhalation of fugitive dust emissions by nearby residents; and (2) direct contact with soil by hypothetical future on-site landscapers or construction workers. Each of these exposure routes was reevaluated based on the new data.

5.1.2.1 Fugitive Dust Emissions

In the previous study, fugitive dust emissions arising from unpaved areas of the site due to contamination in surface soils was quantitatively evaluated for each of the chemicals of concern. As indicated in Table 5-1, the presence of chromium in surface soils was found to present unacceptable risks to human health. In the Phase II investigation, an additional 18 near surface samples (surface samples plus samples from 0 to 2 feet) were collected and analyzed for arsenic, chromium, and lead. Because analyses based on the previous data have already demonstrated that chromium poses unacceptable risks due to inhalation of fugitive dust, no further evaluation of that chemical was necessary. Analysis of the Phase II arsenic and lead results is provided below.

The average concentrations of arsenic and lead in Phase II surface soil samples were calculated and compared to the average concentrations reported in the Phase I study to see if there were any significant differences. The average concentrations of arsenic in Phase I and Phase II samples were essentially the same (32 mg/kg and 33 mg/kg, respectively). Therefore, based on the results of the previous investigation, the presence of arsenic in fugitive dust emissions from on-site surface soils is not expected to pose any unacceptable risk to human health. The average concentration of lead in Phase II surface soil samples (4,649 mg/kg) is, however, significantly higher than the average concentration in Phase I samples (1,982 mg/kg). Therefore, exposure by nearby residents to lead in fugitive dust emissions based on the Phase II data was quantitatively evaluated, as described below.

The concentration of lead in air at the site resulting from fugitive dust emissions was calculated based on the Phase II soil data using the same methodology used in the previous report. Table 5-2 presents the results of the analyses based on data from both the Phase I and Phase II studies. The estimated ambient concentration of lead in the site vicinity due to fugitive dust emissions based on the Phase II soil data are 3.79×10^{-3} ug/m^3. This concentration is well below the National Ambient Air Quality Standard of 1.5 ug/m^3. The resulting hazard index is less than 1.0 (0.0025). Therefore, although the surface soil concentrations of lead from the Phase II investigation were higher than those in the Phase I study, the resulting ambient concentrations in fugitive dust still do not pose a risk to human health.

TABLE 5-2

EVALUATION OF EXPOSURE TO LEAD IN FUGITIVE DUST BASED ON PHASE I AND PHASE II SAMPLING RESULTS

	Average Concentration in Surface soils (mg/kg)	Projected Concentration in Air (ug/m^3)	Projected Average Daily Intake (mg/kg/day)	Acceptable Daily Intake[1] (Rfd) (mg/kg/day)	Hazard Index
Phase I	1,982	1.61×10^{-3}	4.62×10^{-7}	4.3×10^{-4}	0.0011
Phase II	4,649	3.79×10^{-3}	1.08×10^{-6}	4.3×10^{-4}	0.0025

(1) Source: U.S. EPA, 1986

5.1.2.2 Incidental Soil Ingestion

In the previous study, incidental soil ingestion resulting from direct contact with on-site soils by hypothetical future short-term landscapers or construction workers was quantitatively evaluated as a potential route of concern. As is the case with fugitive dust emissions, this evaluation was based on chemical concentrations in the top two feet of soil. The results of the Phase I investigation indicated no adverse health effects are expected to result from direct contact with on-site soils. As described above, Phase II on-site soil samples were analyzed for arsenic, chromium and lead. The average concentration of arsenic in the Phase II study was essentially equal to the average concentration in the Phase I study. The average concentration of chromium in surface soils in the Phase II investigation (3,111 mg/kg) was significantly less than the average concentration in Phase I (48,643 mg/kg). Therefore, no further evaluation of these two chemicals was required and neither is expected to pose a significant risk to future landscapers or construction workers due to direct contact. The average concentration of lead in the Phase II samples (4,649 mg/kg) was significantly higher than in the Phase I samples (1,982 mg/kg). Therefore, potential exposures resulting from direct contact with site soils based on the Phase II lead results were quantitatively evaluated.

The average daily intake of lead by landscapers or construction workers resulting from incidental soil ingestion was calculated based on the Phase II sampling results using the same methodology presented in the previous report. Table 5-3 presents the results of the analyses based on Phase I and Phase II data. As indicated in this table, the hazard indices are less than 1.0 for both the Phase I and the Phase II sampling results. Therefore, although the surface soil lead concentrations from the Phase II investigation were higher than those in the Phase I study, the resulting average daily intake by construction workers due to incidental soil ingestion still does not pose a risk to human health.

5.2 Review of Phase II Ground Water Data

The Phase II ground water data were initially reviewed to determine if any additions to the list of indicator chemicals were required. A total of 21 wells were sampled in the Phase II investigation. These wells include all of the wells installed in the Phase I and II investigations with the exception of wells MW-6S and MW-6D which were structurally damaged prior to Phase II sampling. Based on a comparison of the Phase I and Phase II data,

TABLE 5-3

EVALUATION OF EXPOSURE TO LEAD RESULTING FROM INCIDENTAL INGESTION OF SOILS BY HYPOTHETICAL FUTURE CONSTRUCTION WORKERS (PHASE I AND PHASE II RESULTS)

	Average Concentration in Surface Soils (mg/kg)	Projected Average Daily Intake (mg/kg/day)	Acceptable Daily Intake(1) (RfD) (mg/kg/day)	Hazard Index
Phase I	1,982	9.31 x 10-5	1.40 x 10-3	0.067
Phase II	4,649	2.18 x 10-4	1.40 x 10-3	0.16

(1) Source: U.S. EPA, 1986

with particular emphasis on on-site wells, no new chemicals of concern were identified in the Phase II study.

Table 5-4 presents the average concentrations of each of the chemicals of concern in on-site wells in the Phase I and Phase II investigations; as well as applicable federal and New York State standards and guidelines. As indicated in this table, the average concentrations of most of the chemicals in the Phase II study were essentially the same as or less than their respective concentrations in the Phase I investigation (barium, cadmium, copper, nickel, and trichloroethene). Since none of these chemicals posed a significant risk to human health based on the Phase I results, no further evaluation of these chemicals was necessary.

The presence of silver in ground water did not pose an unacceptable health risk based on the Phase I sampling data. However, the average concentration of silver in the Phase II study is higher than in the Phase I study. Therefore, the more recent higher values were quantitatively evaluated to determine if they present a risk to human health.

As indicated in Table 5-1, concentrations of chromium, lead, and tetrachloroethene in Phase I samples resulted in unacceptable risks to human health. The average concentration of chromium in

TABLE 5-4

COMPARISON OF AVERAGE ON-SITE CONCENTRATIONS OF THE CHEMICALS OF CONCERN IN GROUND WATER WITH RELEVANT STANDARDS AND GUIDANCE VALUES

			Federal Standards and Guidance Values				
Chemical	Phase I - Average On-site Concentration (mg/l)	Phase II - Average On-site Concentration (mg/l)	MCL (mg/l)	MCLG (mg/l)	PROPOSED MCL (mg/l)	PROPOSED MCLG (mg/l)	NYS AWQSV(1) (mg/l)
Barium	0.12	0.13	1		5	5	1
Cadmium	0.015	ND	0.01		0.005	0.005	0.01
Chromium - Total	3.45	7.54	0.05		0.1	0.1	0.05
Chromium - Hexavalent	1.30	5.85					0.05
Copper	0.057	0.019			1.3	1.3	0.200
Lead	0.12	0.031	0.05		0.005	Zero	0.025
Nickel	0.063	0.017					
Silver	0.0041	0.065	0.05		0.1(2)	0.1(2)	0.05
Tetrachloroethylene	0.0084	0.0031			0.005	Zero	0.005
Trichloroethylene	0.0022	0.0042	0.005	Zero			0.005

Note: ND = not detected.

(1) Ambient Water Quality Standards and Guidance Values for the Protection of Human Health for Class GA waters (incorporates subpart 5-1 MCLs and Part 170 standards of the Department of Health). Revised September 25, 1990.

(2) Tentative value.

the Phase II study is higher than in the Phase I study. Therefore, no further evaluation of these chemicals is required. Chromium continues to pose a threat to human health if ground water in the site vicinity is used as a source of drinking water. The average concentrations of lead and tetrachloroethene were lower in the Phase II study than in the Phase I study. Therefore, in order to determine if these lower concentrations also pose a threat to human health, the Phase II concentrations are quantitatively evaluated, along with silver, below.

The average daily intakes of lead, silver, and tetrachloroethene resulting from ingestion of ground water in the site vicinity were calculated using the Phase II sampling results and the same methodology as was used in the previous report. As described in that report, there are currently no potable wells reported in the site vicinity. However, in order to evaluate the extent of ground water contamination, it was hypothetically assumed that a well would be installed in the site vicinity in the future. Table 5-5 compares the results of the analyses based on Phase I and Phase II data. As indicated in this table, the average concentration of lead in the Phase II investigation, in contrast to the results from the Phase I investigation, does not result in an unacceptable risk to human health (hazard index less than 1.0). Although the average concentration of silver in the Phase II study was higher than that reported in the Phase I study, the hazard

TABLE 5-5
EVALUATION OF RISK ASSOCIATED WITH INGESTION OF LEAD, SILVER AND TETRACHLOROETHENE IN GROUND WATER BASED ON PHASE I AND PHASE II RESULTS

	Phase I				**Phase II**			
Noncarcinogens	Average Concentration in On-Site Ground Water (mg/l)	Projected Average Daily Intake (mg/kg/day)	Acceptable Daily Intake (Rfd) (mg/kg/day)	Hazard Index	Average Concentration in On-Site Ground Water (mg/l)	Projected Average Daily Intake (mg/kg/day)	Acceptable Daily Intake (Rfd) (mg/kg/day)	Hazard Index
Lead	0.12	3.34 x 10-3	1.40 x 10-3	2.4	0.031	8.80 x 10-4	1.40 x 10-3	0.62
Silver	0.0041	1.17 x 10-4	3.00 x 10-3	0.039	0.065	1.87 x 10-3	3.00 x 10-3	0.62

	Phase I				**Phase II**			
Carcinogens	Average Concentration in On-Site Ground Water (mg/l)	Projected Average Daily Intake (mg/kg/day)	Potency Factor (mg/kg/day)-1	Risk	Average Concentration in On-Site Ground Water (mg/l)	Projected Average Daily Intake (mg/kg/day)	Potency Factor (mg/kg/day)-1	Risk
Tetrachloroethene	0.0084	9.60 x 10-5	5.1 x 10-2	4.9 x 10-6	0.0031	3.54 x 10-5	5.1 x 10-2	1.8 x 10-6

index is still less than 1.0, which indicates no adverse health impacts are expected. The average concentration of tetrachloroethene in Phase II samples, while lower than in Phase 1 samples, still results in a marginally unacceptable risk (1.8 x 10^{-6}). Therefore, based on the results of the Phase II investigation, chromium and tetrachloroethene in ground water pose significant risks to human health.

5.3 Review of Phase II Olean Creek Data with Respect to Impacts to Human Health

The only potential human exposure route for contamination in Olean Creek, as described in the Phase I investigation, is consumption of fish caught in the creek. A total of 6 new samples were collected in the Phase II investigation to evaluate Olean Creek surface water (CRSW1 - CRSW6). The only chemicals detected in significantly higher concentrations in downstream samples than in upstream samples were copper, vanadium, and zinc. Since the concentrations of these three inorganics reported in the Phase II study were essentially the same as or less than their respective concentrations in the Phase I study, and because the Phase I study did not reveal any significant risk associated with ingestion of fish from Olean Creek for any of the chemicals of concern, no additional evaluation was required. Based on the results of both the Phase I and Phase II data, ingestion of fish from Olean Creek does not pose a significant risk to human health.

Table 5-6 presents a summary of the conclusions of the Phase I and Phase II investigation with respect to impacts to human health. As indicated in this table, the only significant difference is that concentrations of lead in ground water were above acceptable levels in Phase I but within acceptable levels in Phase II (as indicated by the hazard index).

5.4 Review of Phase II Olean Creek and Storm Sewer Data with Respect to Impacts to Aquatic Life

5.4.1 Surface Water

As described in Section 5.3, only three inorganic chemicals (copper, vanadium, and zinc) were detected at higher concentrations in downstream than in upstream samples collected during the Phase II investigation. Table 5-7 compares the concentrations detected in downstream samples in the Phase I and Phase II investigations to relevant standards for the protection of aquatic life. All three inorganics were detected in excess of relevant guidelines in the Phase I investigation. As indicated in Table 5-7, the concentrations detected in the Phase II investigation were generally lower

TABLE 5-6

SUMMARY OF CHEMICALS FOR WHICH PROJECTED INTAKES EXCEED ACCEPTABLE INTAKES - PHASE I AND PHASE II

	Noncarcinogenic Effects	Carcinogenic Effects
Current Conditions	o No adverse effects	o Chromium in fugitive dust emissions o Arsenic in residential soils (incidental ingestion by children) - (not evaluated in Phase II)
Future Conditions	o Chromium in ground water o Lead in ground water (Phase I only)	o Chromium in fugitive dust emissions o Arsenic in residential soils (incidental ingestion by children) - (not evaluated in Phase II) o Tetrachloroethene in ground water

TABLE 5-7
COMPARISON OF CONCENTRATIONS DETECTED IN OLEAN CREEK WATERS IN PHASE I AND PHASE II TO RELEVANT GUIDELINES

	Phase I - Range of Concentrations Detected in Downstream Samples (ug/l)	Phase II - Range of Concentrations Detected in Downstream Samples (ug/l)	NYS AWQSGV (1) (ug/l)	U.S. EPA AWQC (2) (ug/l)
Copper	23 - 42	2 - 10	6.9 (3,4)	6.9 (3,4)
Vanadium	110 - 140	<5 - 11	14 (4)	---
Zinc	65 - 91	5 - 97	30 (4)	61 (3,4)

(1) New York State Ambient Water Quality Standards and Guidance Values for the protection of aquatic life (Class A, A-S, AA, AA-S, B, and C waters).

(2) Ambient Water Quality Criteria for the protection of aquatic life (chronic exposure).

(3) Standard is hardness dependent. The average hardness of 53 mg/l based on three in-stream samples was used in calculating the standard.

(4) Standard applies to the acid-soluble form of the chemical.

than those reported in the Phase I investigation. However, the relevant guidelines for copper and zinc were still exceeded in the Phase II investigation. As described in the Phase I report, the site's contribution to the elevated levels of these chemicals is uncertain. Neither vanadium nor zinc was identified as a chemical of concern in site soils or ground water. The sewer system which discharges to Olean Creek is an active storm drain which collects runoff from the town of Olean. The presence of common inorganics in stormwater runoff from urban/residential areas is not unexpected.

The Phase I study concluded that the presence of hexavalent chromium in Olean Creek waters may pose some risk to aquatic life and that its presence was in all likelihood due, at least in part, to activities at the site. However, hexavalent chromium was not detected in any Olean Creek surface water samples in Phase II. In addition, total chromium was only detected in one upstream sample (CRSW2), and in none of the downstream samples. It should be noted, however, that both total chromium and hexavalent chromium were detected in excess of the New York State Ambient Water Quality Standards and Guidance Values for the protection of aquatic life in the sewer water samples.

5.4.2 Sediments

A number of inorganic chemicals were detected in the Phase II investigation at higher concentrations in one or more downstream sediment samples than in upstream samples (barium, cadmium, calcium, chromium, copper, lead, mercury, magnesium, silver, sodium and zinc). In most cases, the elevated concentrations were from samples OS-OC-3 or CR-3, which are immediately downstream of the outfall. With the exception of chromium and lead, the site's contribution to this contamination is uncertain. As described above, the sewer system which discharges to Olean Creek is an active storm drain which collects runoff from the town of Olean. The presence of common inorganics in stormwater runoff from urban/residential area is not unexpected.

The results of the Phase I investigation indicated that the presence of chromium and lead in sediments may pose a threat to aquatic life. The results of the Phase II study are consistent with this conclusion. Table 5-8 compares the results of the two sampling phases. As indicated in this table, one or more of the relevant guidelines listed are exceeded for both of chromium and lead in Phase II samples. Furthermore, the results of on-site sampling as well as sewer

TABLE 5-8
COMPARISON OF PHASE I AND PHASE II SEDIMENT SAMPLING RESULTS WITH RELEVANT GUIDELINES

	Phase I		Phase II		Guidelines			
Metal	Upstream Sample (ppm)	Downstream Samples (ppm)	Upstream Samples (ppm)	Downstream Samples (ppm)	NYSDEC (1) Background (ppm)	NYSDEC (1) Proposed Criterion (ppm)	NYSDEC (1) Limit of Tolerance (ppm)	U.S. EPA (2) Threshold Concentration (ppm)
Chromium	14.7J	35.7J - 511J	12 - 21	13 - 3920	75	26	111	---
Lead	71.4J	55.7-378	8.9 - 68	5.8 - 875	55	27	250	132

Notes: J = Quantitative Estimate
(1) Source: NYSDEC, 1989
(2) Source: U.S. EPA, 1986

sediment and water sampling suggest that the presence of these two chemicals in Olean Creek is site-related.

6.0 EXTENT AND POTENTIAL SOURCES OF CONTAMINATION

6.1 Introduction

This section summarizes the extent of contamination and the potential source areas at the site, based on the Phase I and II RI data. Although this discussion focuses on the Phase II RI data, the Phase I RI analytical results were used to aid in the delineation of the extent of contamination in soil/sediment and ground water.

The baseline Risk Assessment identified sixteen (16) separate indicator chemicals found in either the soil/sediment, ground water or surface water during the Phase I and II RIs. These indicator chemicals were selected based on their concentrations, toxicity, mobility and frequency of occurrence in the study area. Of these 16 indicator chemicals, the following four were identified as posing a risk to human health or the environment: chromium, lead, arsenic and PCE.

Based on the past activities at Van Der Horst Plant No. 1 and the on-site sampling data, it appears that the chromium measured in the study area is: 1) the result of past disposal/discharge activities at the site; and 2) the inorganic indicator chemical detected most frequently above background concentrations. PCE is the organic indicator chemical that appears to be the result of past site activities and was measured most frequently above background concentrations. The petroleum hydrocarbons and various other VOC and semi-VOC indicator chemicals encountered off-site in the area of the MW-9 monitoring well cluster appear to be confined to the Felmont Oil facility and are not associated with past operations at the Van Der Horst Plant. Additionally, arsenic, although identified in Section 5.0 as an indicator chemical of concern, does not appear to be associated with past operations at the plant. Lead was generally found above background levels at the same locations where elevated chromium concentrations were encountered. Thus, this section addresses the extent of contamination and the identification of potential sources at Plant No. 1, based primarily on the chromium and PCE concentrations measured in the study area.

6.2 Extent of Contamination

This section summarizes the extent of the contamination observed during the Phase I and II RIs in: 1) on and off-site soil; 2) the storm sewer system surface water and sediment; 3) Olean Creek surface water and sediment; and 4) groundwater in the study area. The analytical data discussed in this section are presented in Tables 4-1 through 4-12. The extent of contamination in the on-site structures (e.g., Plant No.1 building) was not evaluated during the Phase II RI, due to access restrictions imposed by USEPA. It is our intent to evaluate these building interior conditions during a pending Phase III RI.

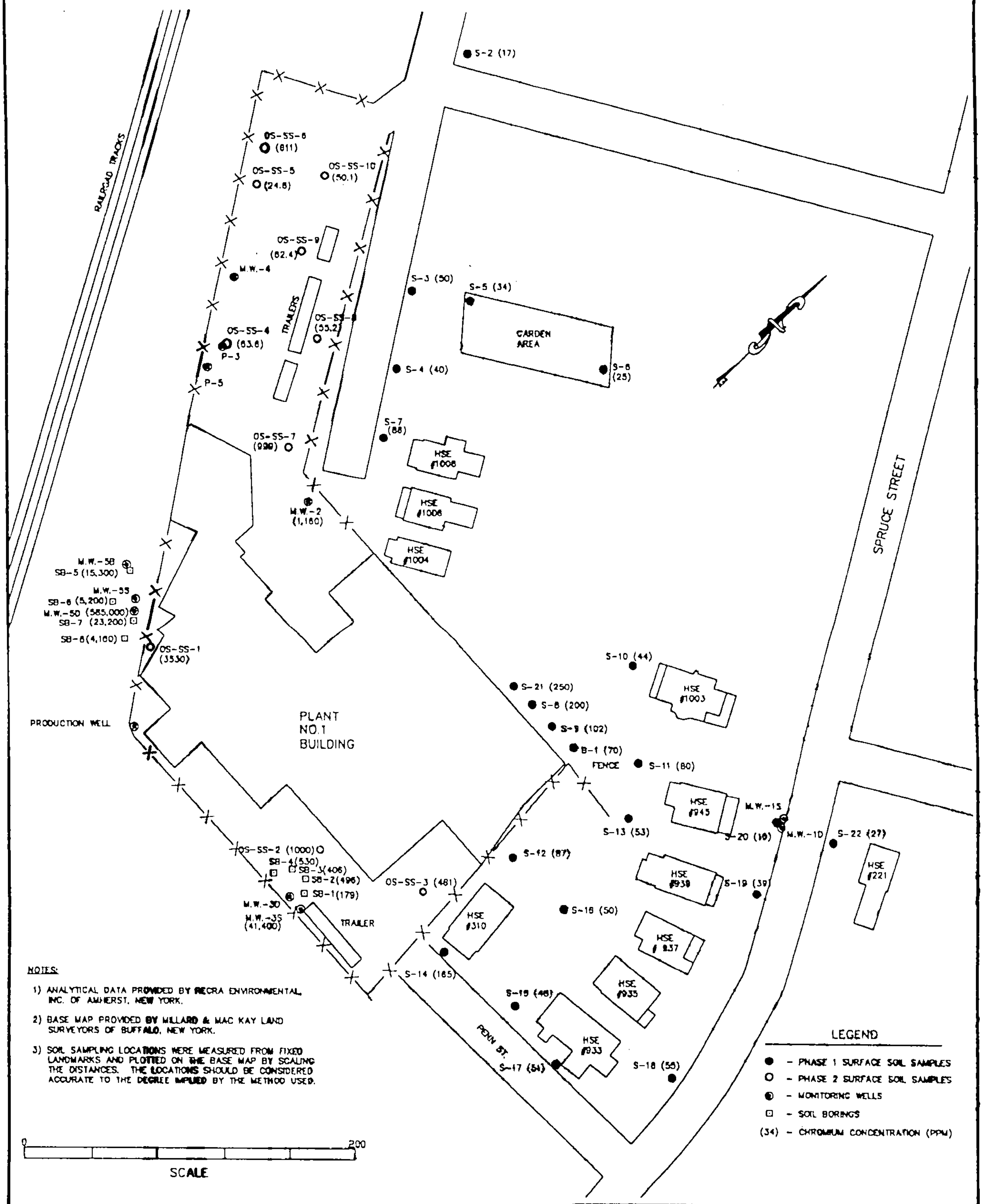
Additional study (i.e., primarily to the southwest of the site) is necessary to delineate the extent of ground water contamination; however, for the purpose of this discussion we have attempted to approximate the area associated with the primary contaminants of concern (i.e. chromium and PCE). The Phase II RI data indicate the existence of a ground water plume and that the concentrations diminish away from the site. However, ground water samples collected from the perimeter wells along the southwestern side of the study area contained contaminants above drinking water standards, so that the southwestern extent of ground water contamination presently remains unknown.

Although specific clean-up levels for chromium will not be designated for this project until completion of the Phase III FS, a soil/sediment clean-up level of 100 ppm has been used to tentatively delineate the extent of contamination. This level was selected based on soil standards used at other NYSDEC sites (e.g., Union Road Site, Site No. 9-15-128) since health risk based chromium clean-up standards have not been developed for New York State. Additionally, a ground water clean-up level of 50 ppb for hexavalent and total chromium has been selected to delineate the extent of ground water contamination, based on New York State Ground Water Quality standards, and a surface water clean-up level of 11 ppb for hexavalent and total chromium has been selected to delineate the extent of surface water contamination, based on New York State Class "C" Surface Water Quality standards.

6.2.1 Surface Soil

The objective of the Phase II RI surface soil sampling program was to delineate the extent of surficial chromium, lead and arsenic concentrations within the fenced area of the site. The parameters selected for analysis and the surface soil sampling locations were chosen based on data needs identified by the Phase I RI.

Figure 6-1 presents the total chromium concentrations measured in the surface soil samples collected during the Phase I and II RIs. Based on this figure, it appears that the area of surface soil chromium contamination (based on a 100 ppm clean-up level) includes the majority of the soil



NOTES:

1) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC. OF AMHERST, NEW YORK.

2) BASE MAP PROVIDED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

3) SOIL SAMPLING LOCATIONS WERE MEASURED FROM FIXED LANDMARKS AND PLOTTED ON THE BASE MAP BY SCALING THE DISTANCES. THE LOCATIONS SHOULD BE CONSIDERED ACCURATE TO THE DEGREE IMPLIED BY THE METHOD USED.

TITLE

PHASE 1 AND 2 RI
TOTAL CHROMIUM CONCENTRATIONS
IN SURFACE SOIL SAMPLES

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
DATE	6-1

within the fenced-in area of the site and an area outside the fence (i.e., approximately 100 feet beyond the fence to the east and north).

The extent of surface soil contamination to the south and west was not delineated by the Phase I and II sampling programs. Surface soil samples have not been collected (with the exception of the area near MW-5) from the Conrail property (west of the site) or McKean Machinery property (south of the site) because the operations at these two facilities have in all likelihood released metals to the surface soil. Thus, if chromium or lead concentrations were measured in samples from these areas, they could be attributed to one or all of three sources (i.e., Van Der Horst Plant #1, McKean or Conrail).

Additionally, the lateral limits of the chromium contamination at the surface in the area of MW-5 was not identified by the Phase II RI because all four 0-2' surface soil samples from the four Phase II borings had elevated levels of chromium. This area of chromium contamination may extend beyond the southwest corner of the site, based on the slope of the ground surface in this area of the site.

Lead concentrations measured in the on-site surface soil samples were in a number of cases higher than the concentrations measured in the background samples. Additionally, elevated lead concentrations (see Tables 4-2 and 4-3) in the surface soil samples appear to correspond with the occurrence of the elevated chromium concentrations (i.e., where the lead concentrations are above background levels the chromium concentrations are also generally above background levels). Therefore, elevated lead concentrations appear to be a result of the former on-site activities and are associated with the areas of surface soil chromium contamination.

Arsenic concentrations measured in the ten (10) surface soil samples were below the arsenic concentrations in the background soil sample BSS-1 (23.6 mg/kg), with the exception of OS-SS-1 (24.5 mg/kg), OS-SS-3 (24.1 mg/kg) and OS-SS-6 (499 mg/kg). Additional sampling will be necessary to determine if the arsenic in OS-SS-6 originated from Plant No. 1 operations, or whether it is simply a localized surface deposit. There are many commonly used products that contain arsenic and could have resulted in localized contamination (e.g., rat poison, paint, leather goods, insecticides, weed killers, etc.).

6.2.2 Subsurface Soil

Subsurface soil conditions near the MW-5 well cluster and the MW-3 well cluster were further evaluated during the Phase

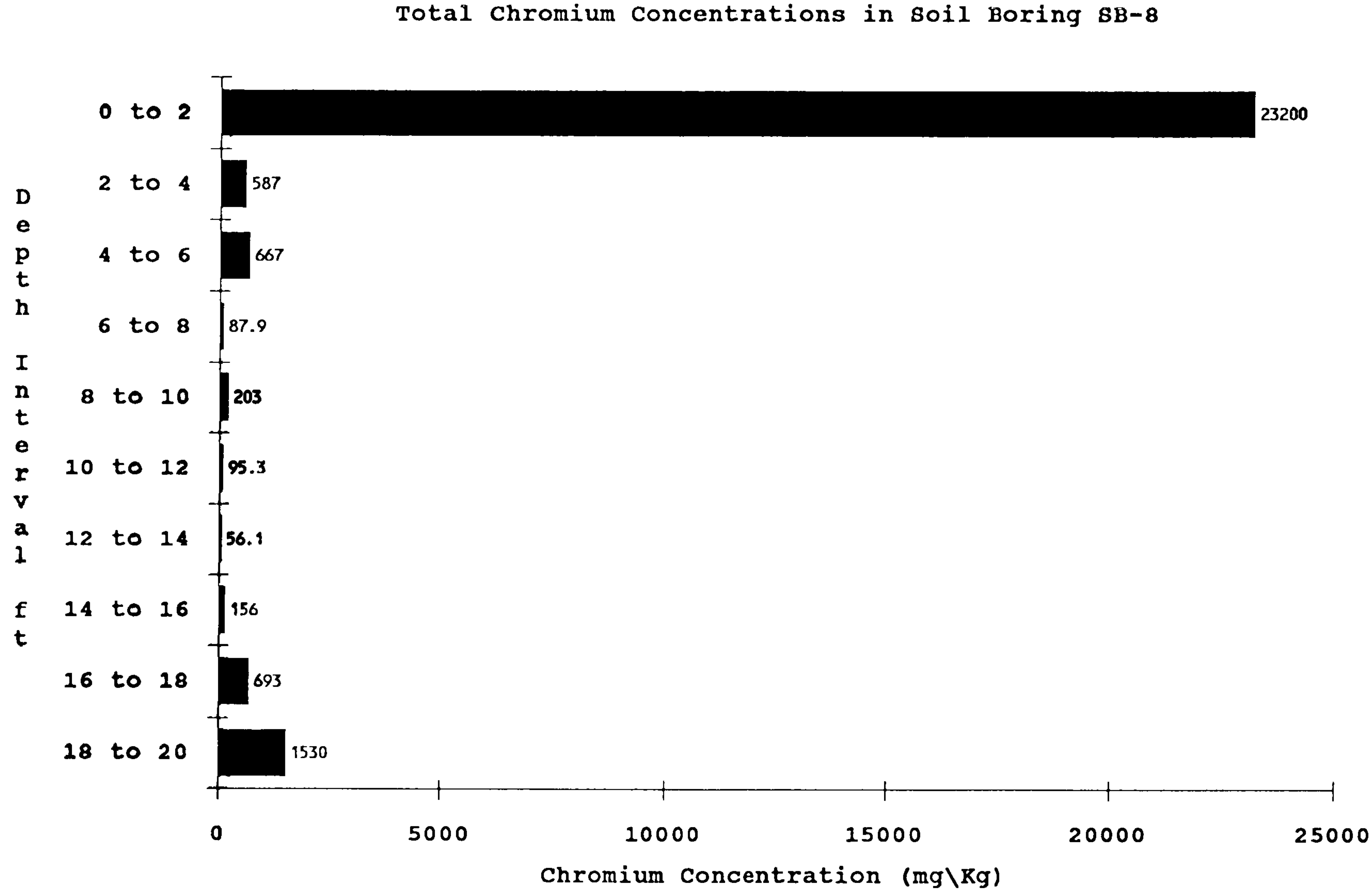
II RI program. In the area of MW-5 (the location where the plant formerly discharged backwash-water from their chromic acid filtration system) the data indicate that the chromium concentrations are highest near the ground surface (i.e., 0 to 2') and near the top of ground water table (i.e., 16 to 20'). This trend is graphically shown on Figure 6-2 which presents the total chromium concentrations from subsurface soil samples collected during the drilling of SB-8. Based upon these data, it appears that the chromium contamination in this area of the site is the result of two possible scenarios:

1) The chromium has migrated downward from the surface source and reconcentrated at the former high water levels; or

2) The chromium has been released from two source areas, one at the ground surface outside the plant that has resulted in the surface soil contamination near MW-5 and one within the plant building that has resulted in downgradient subsurface contamination at the ground water table near MW-5.

These possibilities will be further evaluated during the Phase II RI (i.e., plant building interior investigation).

FIGURE 6-2

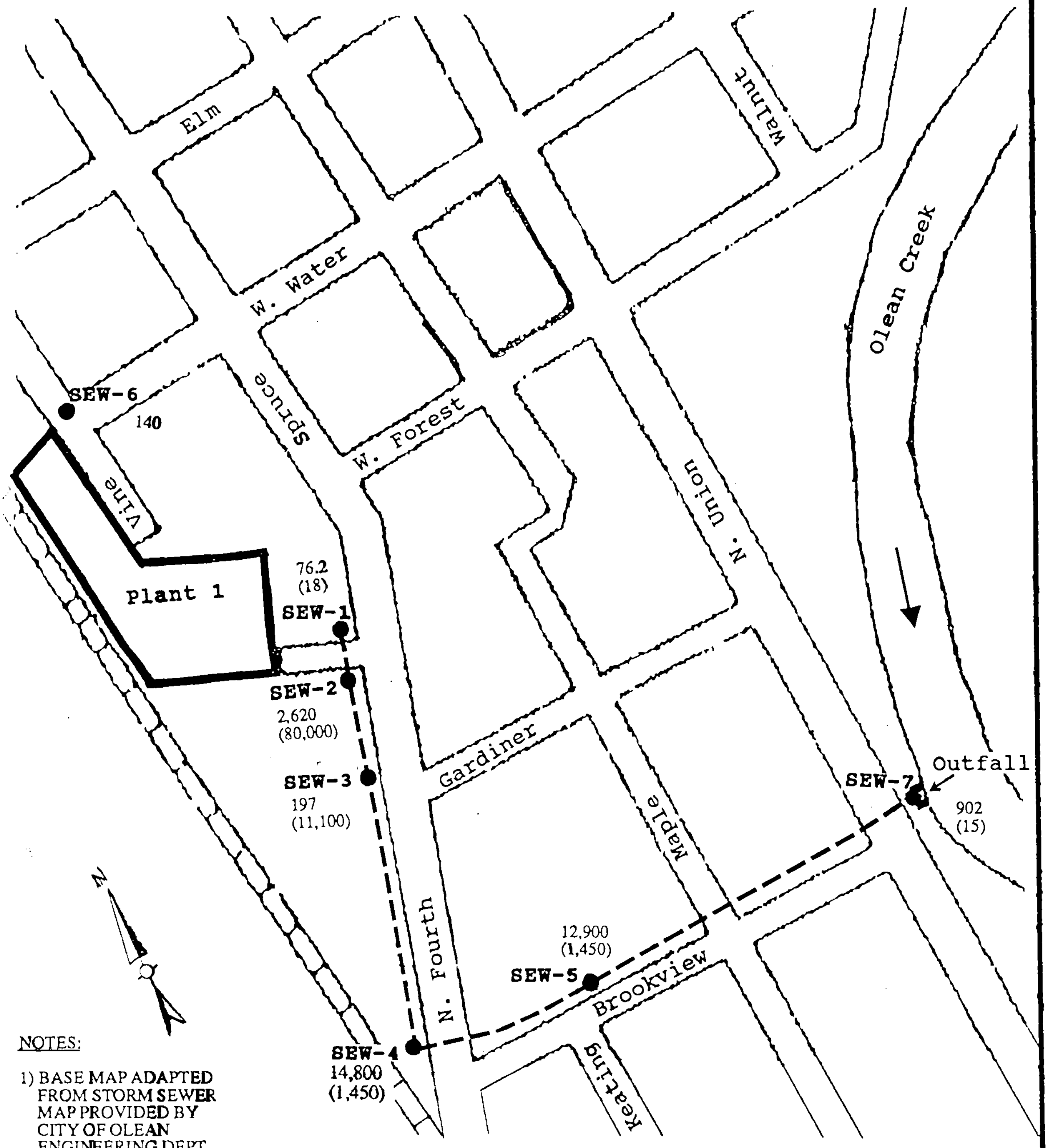

Total Chromium Concentrations in Soil Boring SB-8
Depth Interval ft
0 to 2
2 to 4
4 to 6
6 to 8
8 to 10
10 to 12
12 to 14
14 to 16
16 to 18
18 to 20
23200
587
667
87.9
203
95.3
56.1
156
693
1530
0
5000
10000
15000
20000
25000
Chromium Concentration (mg\Kg)

Chromium concentrations measured in subsurface soil samples collected in the area of MW-3 were less than those measured in the subsurface samples collected near MW-5. In most cases the chromium concentrations measured in the subsurface soil samples from the MW-3 area, at depths greater than 2 feet, were near background levels. Elevated chromium concentrations near MW-3 appear to be associated with specific surface deposits and does not appear to be present below approximately 2 feet from ground surface.

The TCLP analysis of the subsurface soils at the MW-3 and MW-5 areas indicated that these soils were non-hazardous. However, as previously mentioned, one surface soil sample (SB-8, 0-2') failed the TCLP criteria.

6.2.3 Storm Sewer System

The concentrations measured in the sediment and water samples collected from the storm sewer system that runs from the east side of the site to the Brookview outfall indicate that this system contains elevated levels (i.e., above background levels) of chromium and lead (Figure 6-3). Based on these data, it appears that the chromium concentrations are highest, in both water and sediment, between SEW-2 and SEW-5. The highest sediment concentration was measured in the sample from SEW-4 which was collected from the junction manhole for



NOTES:

1) BASE MAP ADAPTED FROM STORM SEWER MAP PROVIDED BY CITY OF OLEAN ENGINEERING DEPT.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

LEGEND:

● SEWER SAMPLING LOCATION

— — — STORM SEWER LINE

12,900 TOTAL CHROMIUM CONCENTRATION IN SEDIMENT (mg/Kg)

(1,450) TOTAL CHROMIUM CONCENTRATION IN WATER (ug/L)

TITLE

TOTAL CHROMIUM CONCENTRATIONS IN STORM SEWER SYSTEM

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE

FIGURE

DATE

6-3

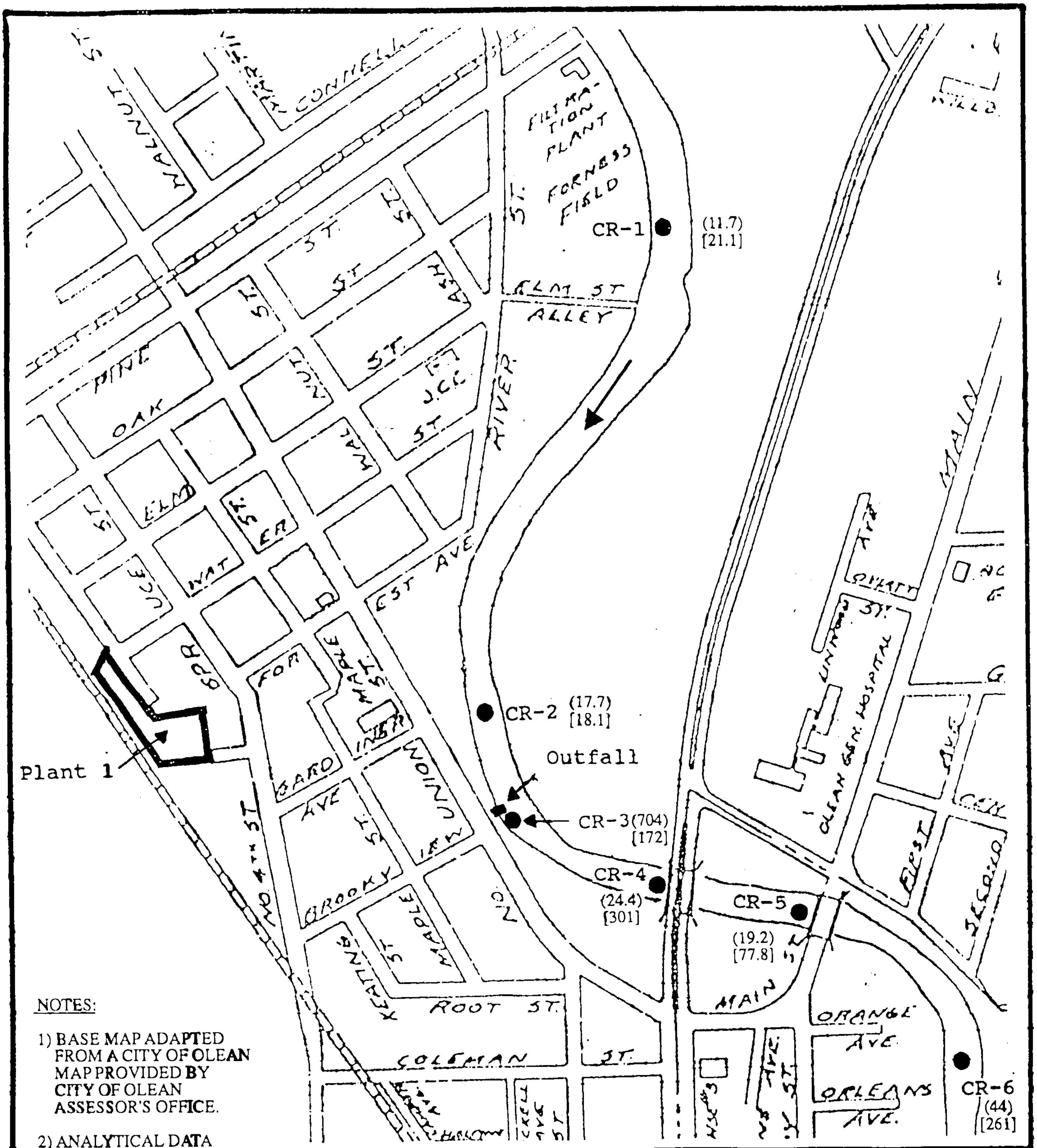
flow coming from the south and the north. Thus, the chromium detected at and downstream of SEW-4 is not necessarily from the subject site, and could instead be from other industries (former and present) that discharged into the storm sewer. The highest chromium concentration in water was measured in the sample from SEW-2, which is approximately 300 feet downgradient of the site.

6.2.4 Olean Creek

Sediment

Figure 6-4 presents the chromium concentrations in sediment samples collected from the banks and channel bottom of Olean Creek. Chromium concentrations in sediment appear to be the highest near the Brookview storm sewer outfall; however, elevated chromium concentrations (i.e., chromium concentrations greater than 100 ppm) were measured in two bank samples (i.e., CR-4 and CR-6) downstream of the outfall.

Based on a comparison of the chromium concentrations in sediment upstream and downstream of the outfall, it appears that this outfall was/is a source of the chromium in Olean Creek. This trend is further indicated by the fact that the chromium concentrations in sediment samples collected immediately downstream of the Brookview outfall (OS-OC-3 and



NOTES:

1) BASE MAP ADAPTED FROM A CITY OF OLEAN MAP PROVIDED BY CITY OF OLEAN ASSESSOR'S OFFICE.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

LEGEND:

● SEDIMENT SAMPLING LOCATION

(11.7) TOTAL CHROMIUM CONCENTRATION IN THE CREEK SEDIMENT (mg/Kg)

[21.1] TOTAL CHROMIUM CONCENTRATION IN THE BANK SEDIMENT (mg/Kg)

TITLE

CHROMIUM CONCENTRATIONS IN OLEAN CREEK SEDIMENT

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE

DATE

FIGURE
6-4

OS-OC-4; see Figure 2-7) are over 100 times higher than the concentrations in sediment samples collected immediately upstream of the outfall (OS-OC-1 and OS-OC-2).

Surface Water

Aluminum, iron and zinc were the only analytes detected above Class "C" surface water quality standards during the Phase II RI sampling program. Aluminum and iron were detected at higher concentrations upstream of the Brookview outfall than they were downstream of this outfall, and zinc was detected at only one location. Hexavalent chromium was not detected in any of the surface water samples and total chromium was not detected above surface water quality standards for this analyte. Based on these comparisons, it appears that the surface water in Olean creek was not being significantly impacted by the Brookview outfall (i.e., contaminants associated with the subject site migrating through the storm sewer) or the creek sediments (i.e., through suspension of contaminated sediments) at the time of the Phase II sampling event.

6.2.5 Ground Water

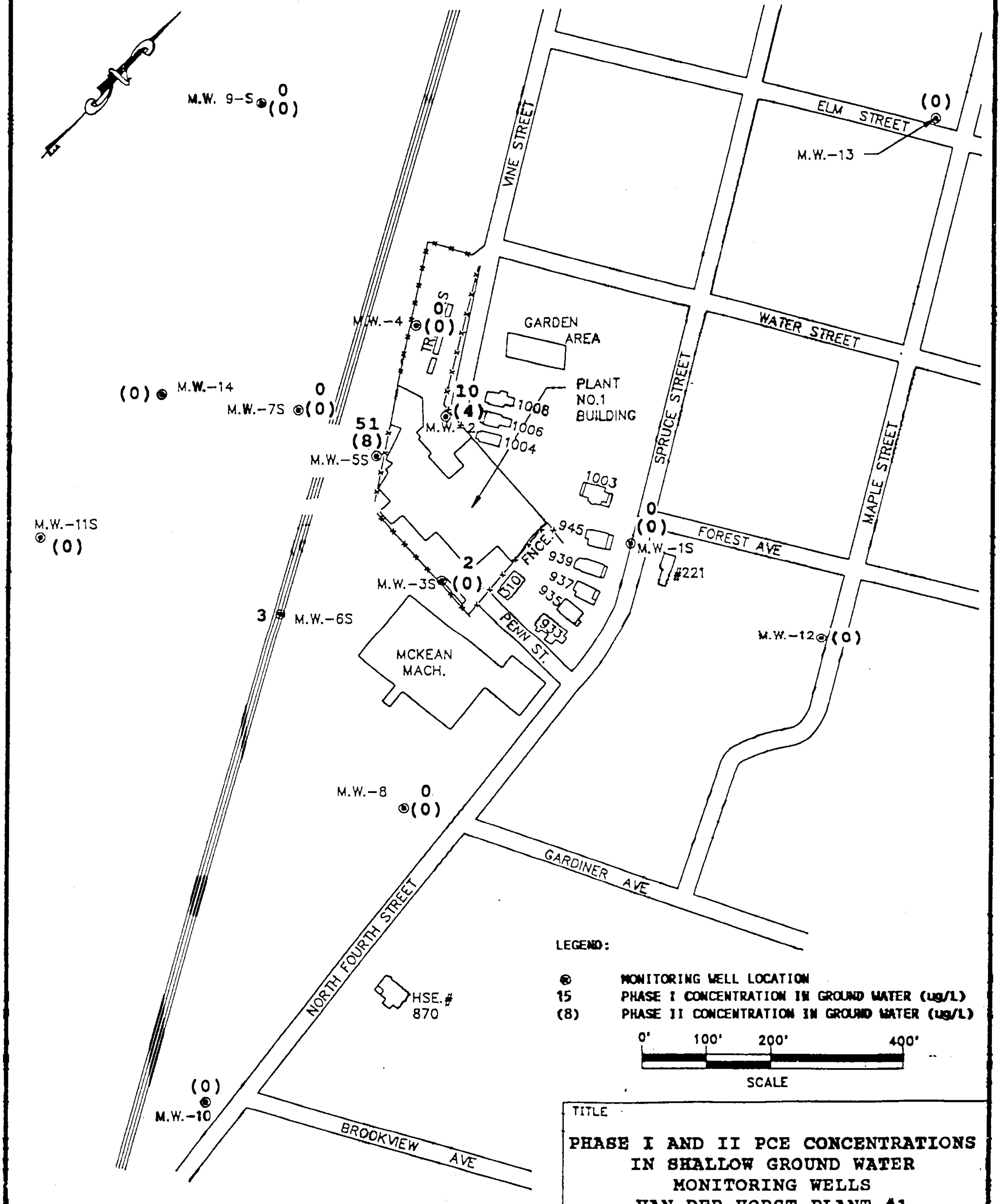
Phase II Sampling and Analysis

The objective of the Phase II ground water sampling was to further delineate the extent and concentration of on-site and off-site ground water contamination. Five (5) additional shallow monitoring wells (MW-10, MW-11S, MW-12, MW-13, and MW-14); one (1) additional deep monitoring well (MW-11D); and one (1) lower aquifer monitoring well (MW-5B) were installed and sampled during Phase II. Ground water samples were analyzed for TCL volatile organics, TAL metals and hexavalent chromium.

Volatile Organics

Only two TCL Volatile Organics (PCE and TCE) were detected above NYSDEC ground water standards in the Phase II samples (see Table 4-9). PCE concentrations will be discussed in this section since PCE was the only volatile organic identified in the baseline Risk Assessment (Section 5.0) as posing a risk to human health or the environment.

The Phase I and II PCE concentrations in shallow monitoring well ground water samples are illustrated in Figure 6-5. PCE was detected in only four (4) of the shallow wells



LEGEND:

●	MONITORING WELL LOCATION
15	PHASE I CONCENTRATION IN GROUND WATER (ug/L)
(8)	PHASE II CONCENTRATION IN GROUND WATER (ug/L)

NOTES:

1) THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

3) CONCENTRATION CONTOURS WERE DEVELOPED USING INTERPOLATION OF CONCENTRATIONS MEASURED IN GROUND WATER SAMPLES COLLECTED AT WIDELY SPACED SAMPLING LOCATIONS. THE ACTUAL EXTENT AND DELINIATION OF THE CONCENTRATION CONTOUR LINES MAY VARY FROM THE LOCATIONS SHOWN.

TITLE

PHASE I AND II PCE CONCENTRATIONS
IN SHALLOW GROUND WATER
MONITORING WELLS
VAN DER HORST PLANT #1

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE AS NOTED
DATE 2/91
FIGURE 6-5

(MW-2, MW-3S, MW-5S, and MW-6S) at concentrations ranging from 51 ug/L (MW-5S, Phase I) to 2 ug/L (MW-3S, Phase I). PCE was also detected in MW-5D (18 ug/L in Phase I and 0.8 ug/L in Phase II) but was not found in any other deeper wells within the upper aquifer. The NYSDEC limit for PCE in ground water is 0.7 ug/L. Phase I PCE levels are higher than concentrations detected during Phase II; however both Phase I and II results indicate that the extent of PCE contamination is relatively small. PCE contamination appears to be limited to the area beneath and surrounding the Plant 1 building.

Metals

The following metals were detected above NYSDEC ground water standards in Phase II samples at Plant No. 1:

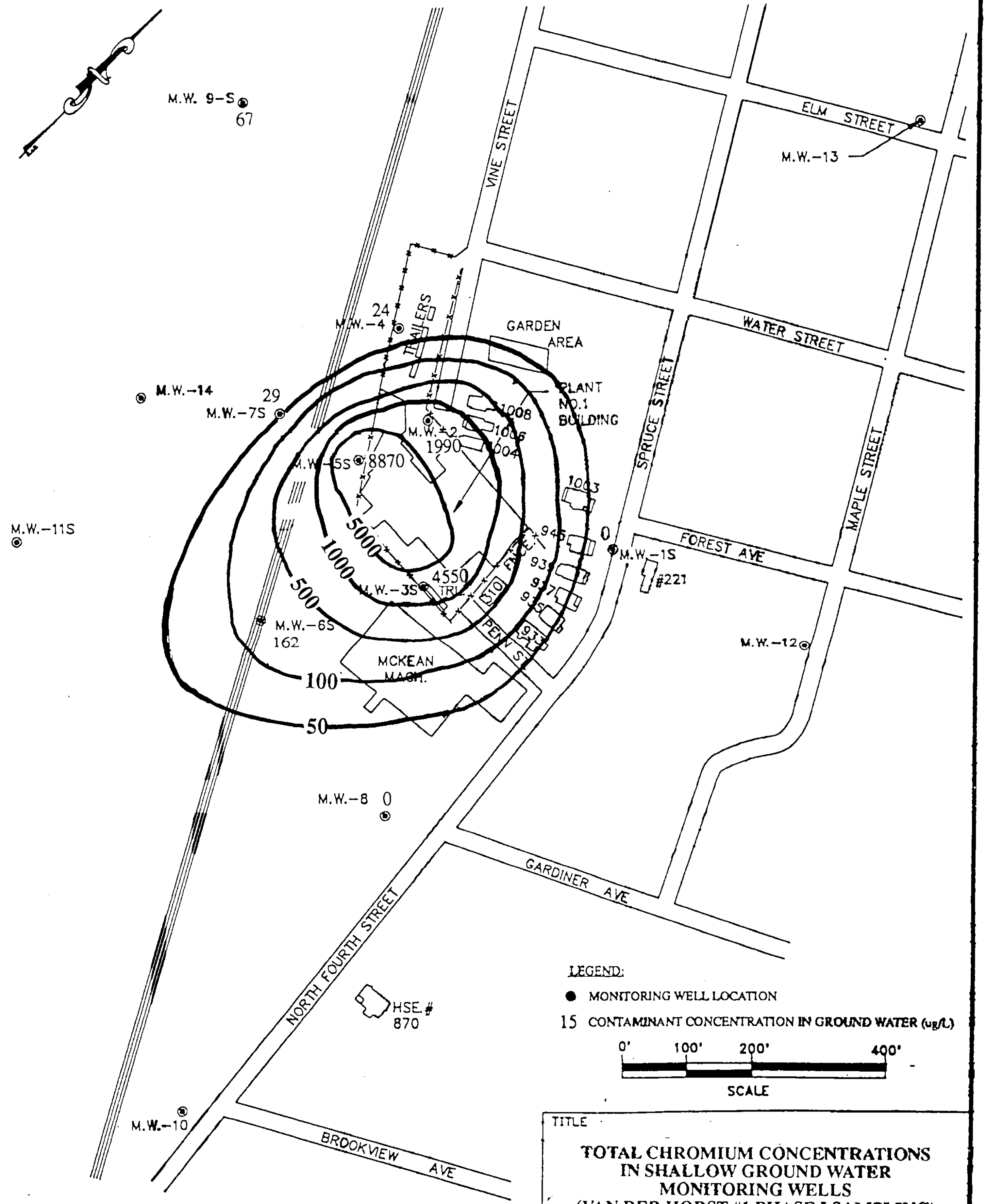
> antimony, arsenic, total chromium, hexavalent chromium, iron, lead, magnesium, manganese, and silver.

Total chromium and hexavalent chromium were the only two metals which have been identified to pose a significant potential health or environment risk in the ground water (see Section 5.0). Elevated levels of the other metals were not considered to be significant risk for the following reasons:

- Lead, iron and manganese exceeded ground water standards in background wells and were not believed to originate from on-site sources.
- Magnesium was high in background wells.
- Antimony and arsenic could not be directly linked to previous site activities.
- Phase II elevated silver concentrations in MW-3S (351 ug/L), MW-5S (71 ug/L), and MW-7S (69 ug/L) appeared to occur within a limited area at the site. No silver levels in Phase I samples were not detected above the NYSDEC ground water standard of 50 ug/L.

The most significant ground water contaminants associated with Plant No. 1 were total and hexavalent chromium. Estimated areas of total and hexavalent chromium in ground water during the Phase I and II sampling are illustrated in Figures 6-6 to 6-13. The 50 ug/L contour was used to estimate the outermost limits of the ground water contaminant-plume, since this concentration is the NYSDEC ground water standard for total and hexavalent chromium.

Figures 6-6, 6-8, 6-10, and 6-12 present the distribution of hexavalent or total chromium in the shallow monitoring wells. Figures 6-6, 6-10, and 6-12 show a fairly similar area of ground water contamination. The primary axis of the contamination plume runs north to south. The principle directions of chromium migration are south and southwest of the Plant No. 1 building.



TITLE

TOTAL CHROMIUM CONCENTRATIONS IN SHALLOW GROUND WATER MONITORING WELLS (VAN DER HORST #1 PHASE I SAMPLING)

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

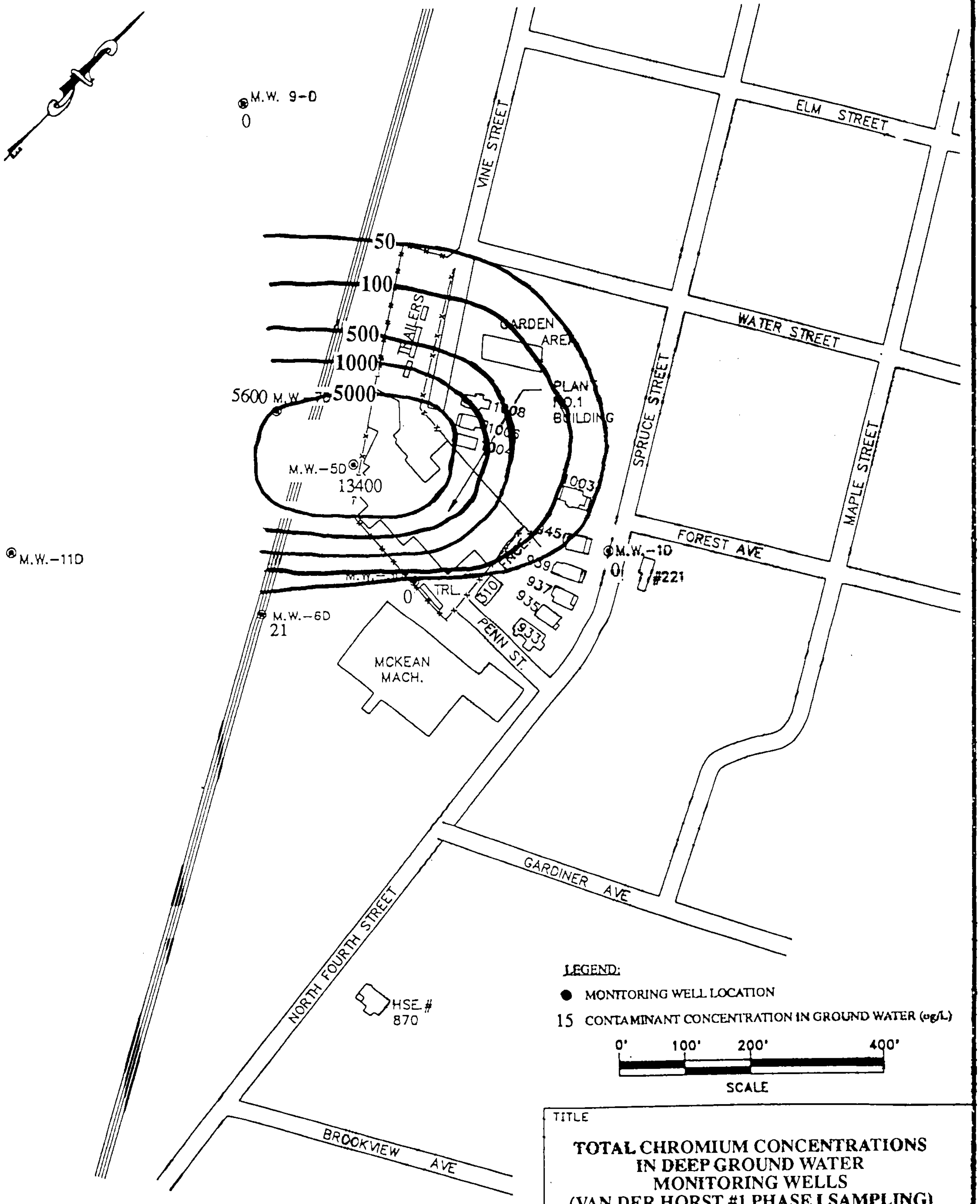
SCALE	FIGURE
AS NOTED	6-6
DATE 2/91	

NOTES:

1) THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

3) CONCENTRATION CONTOURS WERE DEVELOPED USING INTERPOLATION OF CONCENTRATIONS MEASURED IN GROUND WATER SAMPLES COLLECTED AT WIDELY SPACED SAMPLING LOCATIONS. THE ACTUAL EXTENT AND DELINIATION OF THE CONCENTRATION CONTOUR LINES MAY VARY FROM THE LOCATIONS SHOWN.



LEGEND:

● MONITORING WELL LOCATION

15 CONTAMINANT CONCENTRATION IN GROUND WATER (ug/L)

0' 100' 200' 400'

SCALE

TITLE

TOTAL CHROMIUM CONCENTRATIONS IN DEEP GROUND WATER MONITORING WELLS (VAN DER HORST #1 PHASE I SAMPLING)

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

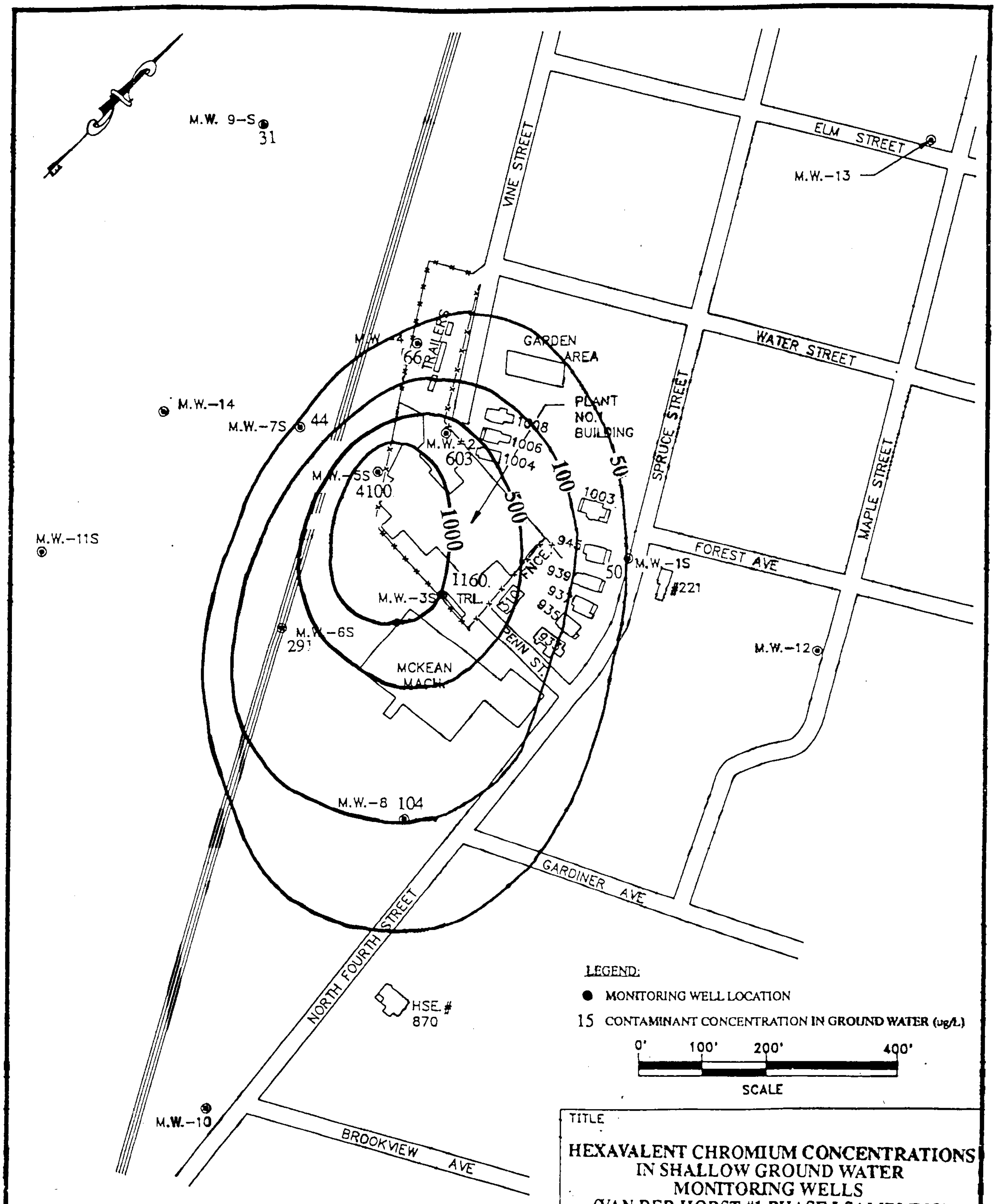
SCALE	FIGURE
AS NOTED	6-7
DATE 2/91	

NOTES:

1) THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

3) CONCENTRATION CONTOURS WERE DEVELOPED USING INTERPOLATION OF CONCENTRATIONS MEASURED IN GROUND WATER SAMPLES COLLECTED AT WIDELY SPACED SAMPLING LOCATIONS. THE ACTUAL EXTENT AND DELINIATION OF THE CONCENTRATION CONTOUR LINES MAY VARY FROM THE LOCATIONS SHOWN.



LEGEND:

- ● MONITORING WELL LOCATION
- 15 CONTAMINANT CONCENTRATION IN GROUND WATER (ug/L)

NOTES:

1) THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

3) CONCENTRATION CONTOURS WERE DEVELOPED USING INTERPOLATION OF CONCENTRATIONS MEASURED IN GROUND WATER SAMPLES COLLECTED AT WIDELY SPACED SAMPLING LOCATIONS. THE ACTUAL EXTENT AND DELINIATION OF THE CONCENTRATION CONTOUR LINES MAY VARY FROM THE LOCATIONS SHOWN.

TITLE

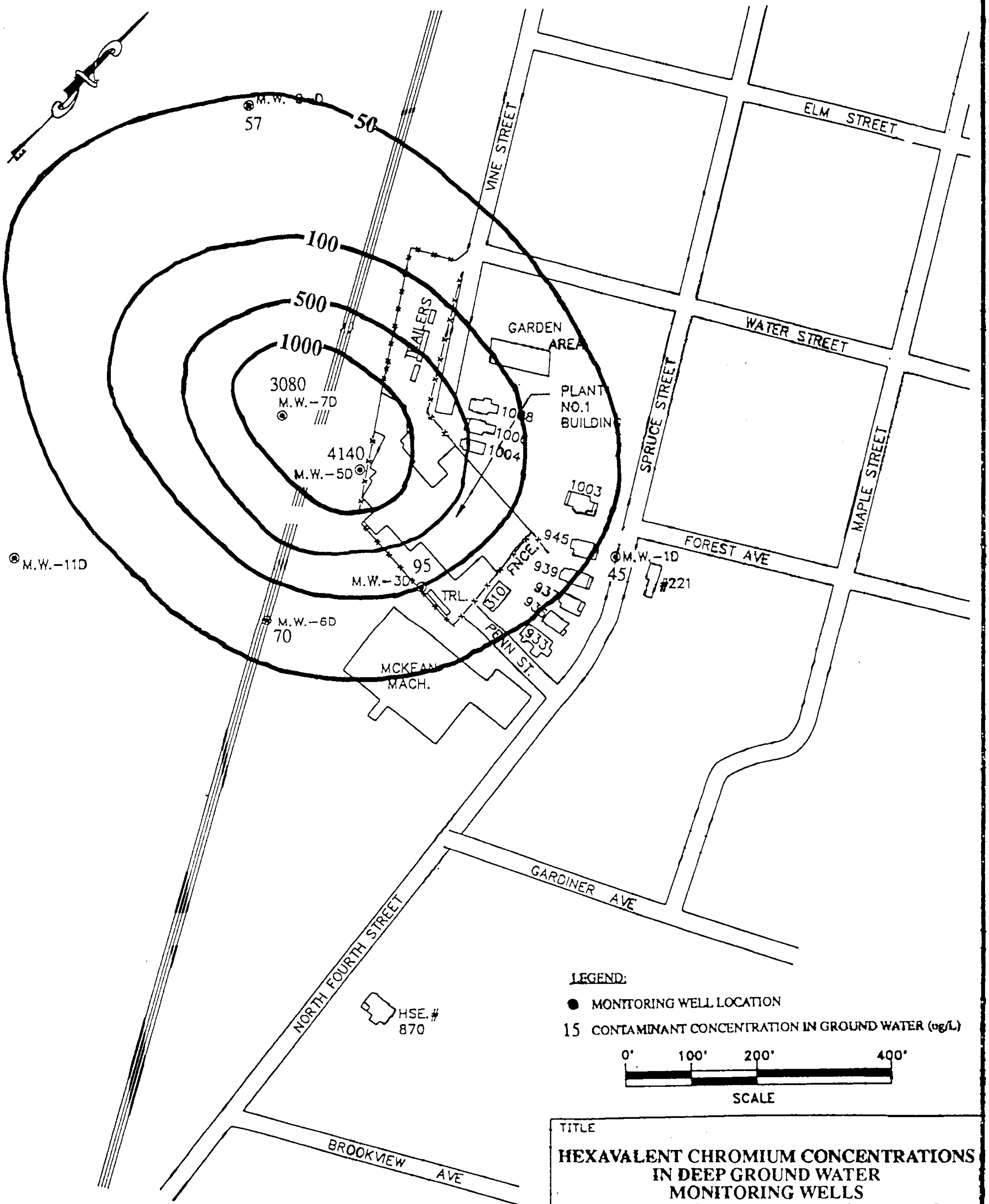
HEXAVALENT CHROMIUM CONCENTRATIONS IN SHALLOW GROUND WATER MONITORING WELLS (VAN DER HORST #1 PHASE I SAMPLING)

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
AS NOTED	6-8
DATE 2/91	



LEGEND:

- ● MONITORING WELL LOCATION
- 15 CONTAMINANT CONCENTRATION IN GROUND WATER (ug/L)

NOTES:

1) THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

3) CONCENTRATION CONTOURS WERE DEVELOPED USING INTERPOLATION OF CONCENTRATIONS MEASURED IN GROUND WATER SAMPLES COLLECTED AT WIDELY SPACED SAMPLING LOCATIONS. THE ACTUAL EXTENT AND DELINIATION OF THE CONCENTRATION CONTOUR LINES MAY VARY FROM THE LOCATIONS SHOWN.

TITLE

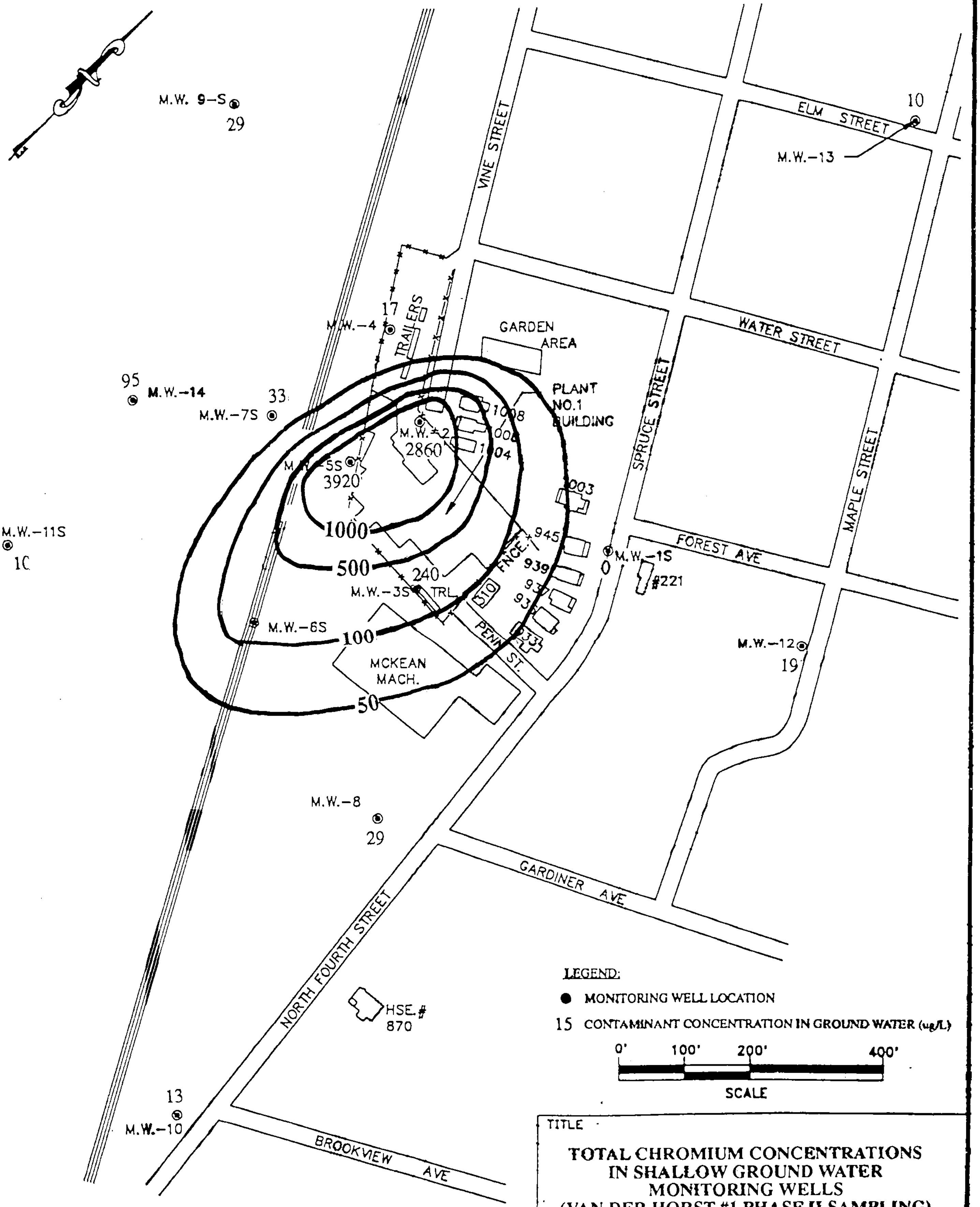
HEXAVALENT CHROMIUM CONCENTRATIONS IN DEEP GROUND WATER MONITORING WELLS (VAN DER HORST #1 PHASE I SAMPLING)

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
AS NOTED	6-9
DATE 2/91	



TITLE

**TOTAL CHROMIUM CONCENTRATIONS
IN SHALLOW GROUND WATER
MONITORING WELLS
(VAN DER HORST #1 PHASE II SAMPLING)**

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

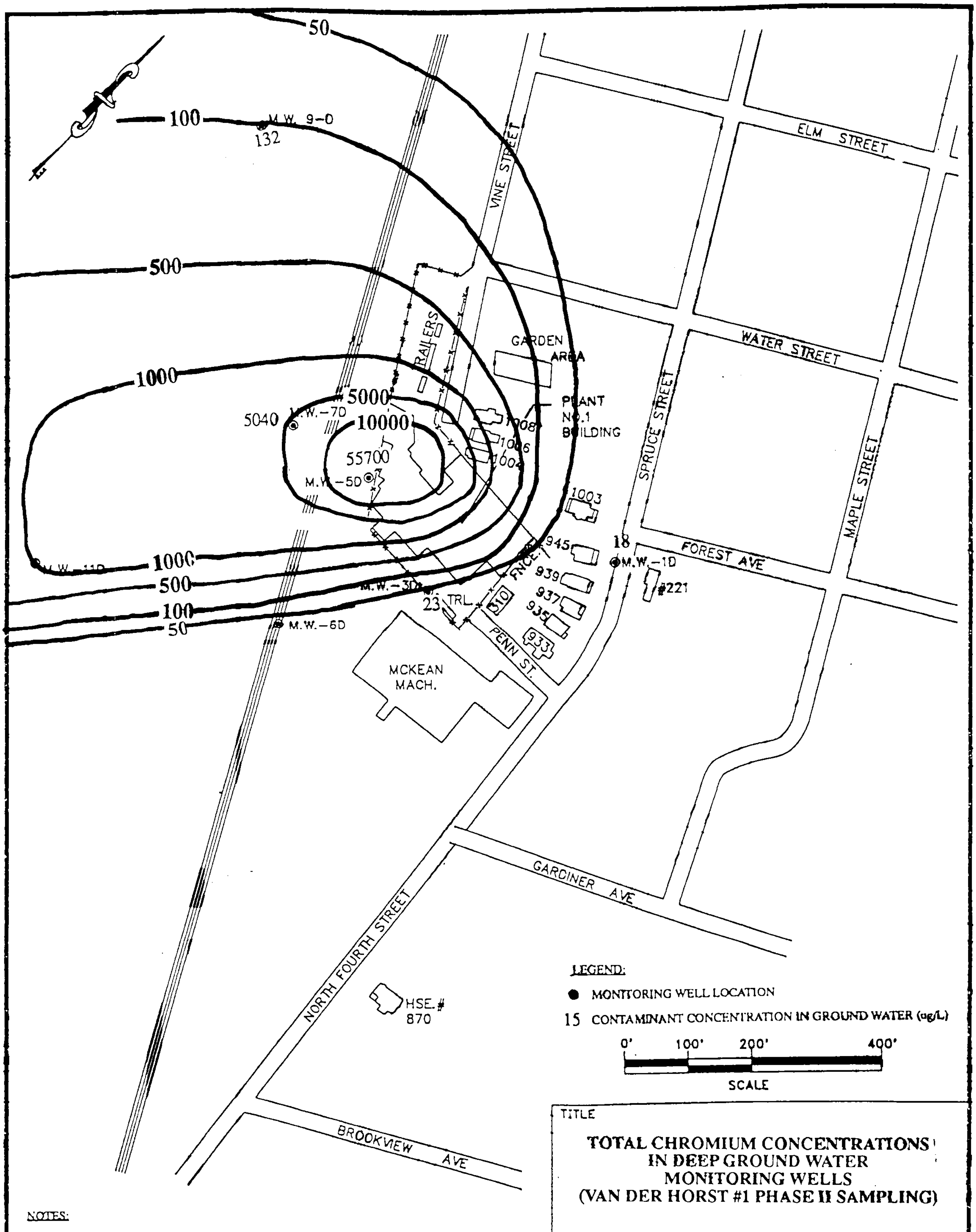
SCALE	FIGURE
AS NOTED	6-10
DATE 2/91	

NOTES:

1) THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

3) CONCENTRATION CONTOURS WERE DEVELOPED USING INTERPOLATION OF CONCENTRATIONS MEASURED IN GROUND WATER SAMPLES COLLECTED AT WIDELY SPACED SAMPLING LOCATIONS. THE ACTUAL EXTENT AND DELINIATION OF THE CONCENTRATION CONTOUR LINES MAY VARY FROM THE LOCATIONS SHOWN.



TITLE

TOTAL CHROMIUM CONCENTRATIONS IN DEEP GROUND WATER MONITORING WELLS (VAN DER HORST #1 PHASE II SAMPLING)

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

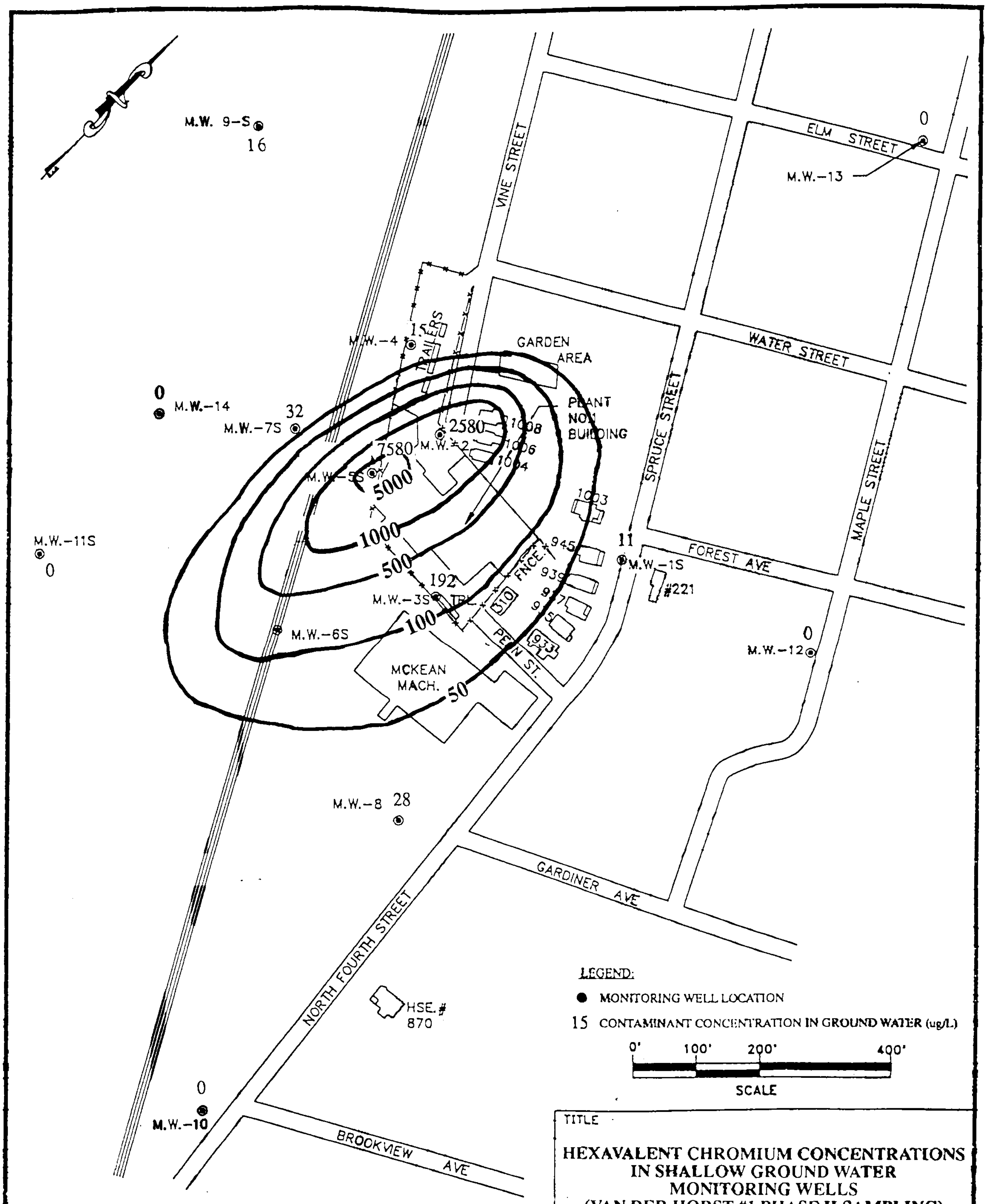
SCALE	FIGURE
AS NOTED	6-11
DATE 2/91	

NOTES:

1) THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

3) CONCENTRATION CONTOURS WERE DEVELOPED USING INTERPOLATION OF CONCENTRATIONS MEASURED IN GROUND WATER SAMPLES COLLECTED AT WIDELY SPACED SAMPLING LOCATIONS. THE ACTUAL EXTENT AND DELINIATION OF THE CONCENTRATION CONTOUR LINES MAY VARY FROM THE LOCATIONS SHOWN.



TITLE

HEXAVALENT CHROMIUM CONCENTRATIONS IN SHALLOW GROUND WATER MONITORING WELLS (VAN DER HORST #1 PHASE II SAMPLING)

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

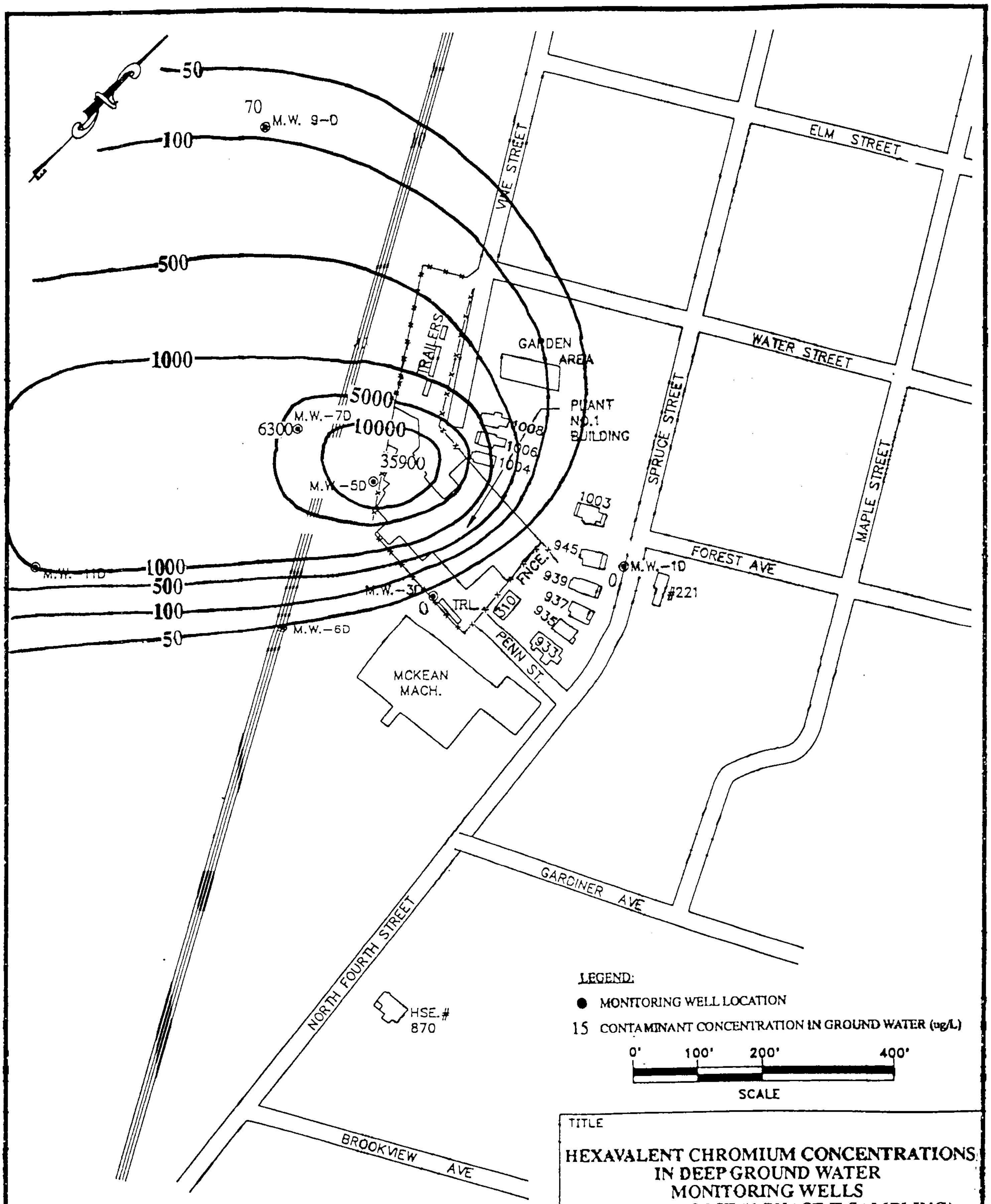
SCALE	FIGURE
AS NOTED	6-12
DATE 2/91	

NOTES:

1) THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

3) CONCENTRATION CONTOURS WERE DEVELOPED USING INTERPOLATION OF CONCENTRATIONS MEASURED IN GROUND WATER SAMPLES COLLECTED AT WIDELY SPACED SAMPLING LOCATIONS. THE ACTUAL EXTENT AND DELINIATION OF THE CONCENTRATION CONTOUR LINES MAY VARY FROM THE LOCATIONS SHOWN.



LEGEND:

● MONITORING WELL LOCATION

15 CONTAMINANT CONCENTRATION IN GROUND WATER (ug/L)

TITLE

HEXAVALENT CHROMIUM CONCENTRATIONS IN DEEP GROUND WATER MONITORING WELLS (VAN DER HORST #1 PHASE II SAMPLING)

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
AS NOTED	6-13
DATE 2/91	

NOTES:

1) THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

3) CONCENTRATION CONTOURS WERE DEVELOPED USING INTERPOLATION OF CONCENTRATIONS MEASURED IN GROUND WATER SAMPLES COLLECTED AT WIDELY SPACED SAMPLING LOCATIONS. THE ACTUAL EXTENT AND DELINIATION OF THE CONCENTRATION CONTOUR LINES MAY VARY FROM THE LOCATIONS SHOWN.

Ground water contamination contours in Figure 6-8 depict a greater area of hexavalent chromium contamination in the shallow wells. The axis of this plume lies in a northwest-southeast direction, and the major direction of contaminant transport is towards the south.

The hexavalent chromium concentration of MW-8 during the Phase I sampling (104 ug/L) is the primary reason why the contaminant plume shown in Figure 6-8 is so much larger than that shown in Figures 6-6, 6-10 and 6-12. No total chromium was detected in MW-8 during Phase I sampling, and no total or hexavalent chromium were found during Phase II. Excessive laboratory holding times for the Phase I hexavalent chromium samples may have produced an erroneous concentration in MW-8. Therefore, the extent of total and hexavalent chromium ground water plume is probably best estimated by the areas encircled by the 50 ug/L concentration contours in Figures 6-6, 6-10 and 6-12.

Figures 6-7, 6-9, 6-11, and 6-13 portray hexavalent and total chromium ground water contamination in deep monitoring wells during Phase I and II sampling. The axis of the contamination plume (total chromium) is northeast to southwest in Figures 6-7, 6-11 and 6-13. The major directions of total chromium migration are apparently southwest and west. The plume axis of the hexavalent chromium plume during Phase I sampling (Figure 6-9) runs east to west. The principle contaminant transport direction is to the west.

The limits of total and hexavalent chromium contamination at Plant No. 1 have not been defined for ground water in the deep monitoring wells. Figures 6-9, 6-11 and 6-13 show concentration contours which are open ended to the southwest and west. Hexavalent and total chromium levels in Phase II monitoring well MW-11D (both 1030 ug/L) indicate that a significant amount of contamination has migrated beyond the Phase I and II deep monitoring wells. Phase II analytical data in Figures 6-11 and 6-13 appear to provide the best estimate for delineating the chromium plume to the north, south and east of the site. Additional monitoring well installation and sampling will be required to define the plume west and southwest of Plant No. 1.

A single well (MW-5B) was installed in the lower aquifer beneath Plant No. 1 to determine if ground water contamination had reached the lower aquifer. Well MW-5B was positioned adjacent to the highest known area of ground water contamination at the site. The lower aquifer at MW-5B is separated from the upper aquifer by a 19-foot thick, silty-clay aquitard. Hexavalent and total chromium levels in well

MW-5B (27 and 13 ug/L, respectively) were below NYSDEC ground water limits. Consequently, chromium contamination is not believed to have significantly affected water quality in the lower aquifer beneath Plant No. 1.

The distribution of chromium contamination in the shallow and deep monitoring wells (Figures 6-6 to 6-13) appears to be fairly consistent with the ground water flow direction within the upper aquifer. The primary direction of chromium transport in the shallow wells is towards the south. Ground water flow has been shown, on occasion, to have a southern trend in the shallow wells; however the primary flow direction is apparently to the southwest. Chromium contamination in the deep monitoring wells appears to be moving in a southwest and west direction. The principle ground water flow directions in the deep wells are southwest and west.

The extent of ground water contamination within the shallow monitoring wells appears to be fairly well defined by Phase I and II analytical results. The contaminant plume in the deep monitoring wells extends beyond the well network and will require additional well installation and sampling before the plume is adequately delineated; however, the present data suggest that the concentrations of chromium diminish to the south/southwest. The downward hydraulic gradient in the upper aquifer southwest of Plant No. 1 may have been the cause for the greater areal extent of the deep well contaminant-plume. The downward hydraulic gradient within the upper aquifer can be up to 10 times more than the horizontal gradient. Contamination in the shallow wells appears to have moved downward within the aquifer (towards the deep wells) as it was transported southwest of the site.

A comparison of ground water analytical data for Phase I and II chromium samples is graphically presented in Figures 6-14 to 6-16. This comparison has revealed the following major differences between Phase I and II results:

- The total chromium concentration in MW-3S decreased from 4,550 to 240 ug/L;
- The total chromium concentration in MW-5D increased from 13,400 to 55,700 ug/L;
- The hexavalent chromium concentration in MW-2D increased from 603 to 2,860 ug/L;
- The hexavalent chromium concentration in MW-3S decreased from 1,160 to 240 ug/L; and
- The hexavalent chromium concentration in MW-5D increased from 4,140 to 35,900 ug/L;

The wide variance in some of the hexavalent chromium data may have resulted from excessive laboratory holding for hexavalent chromium samples during Phase I analysis. The reasons for

Figure 6-14

Phase I and II Chromium Concentrations in Ground Water

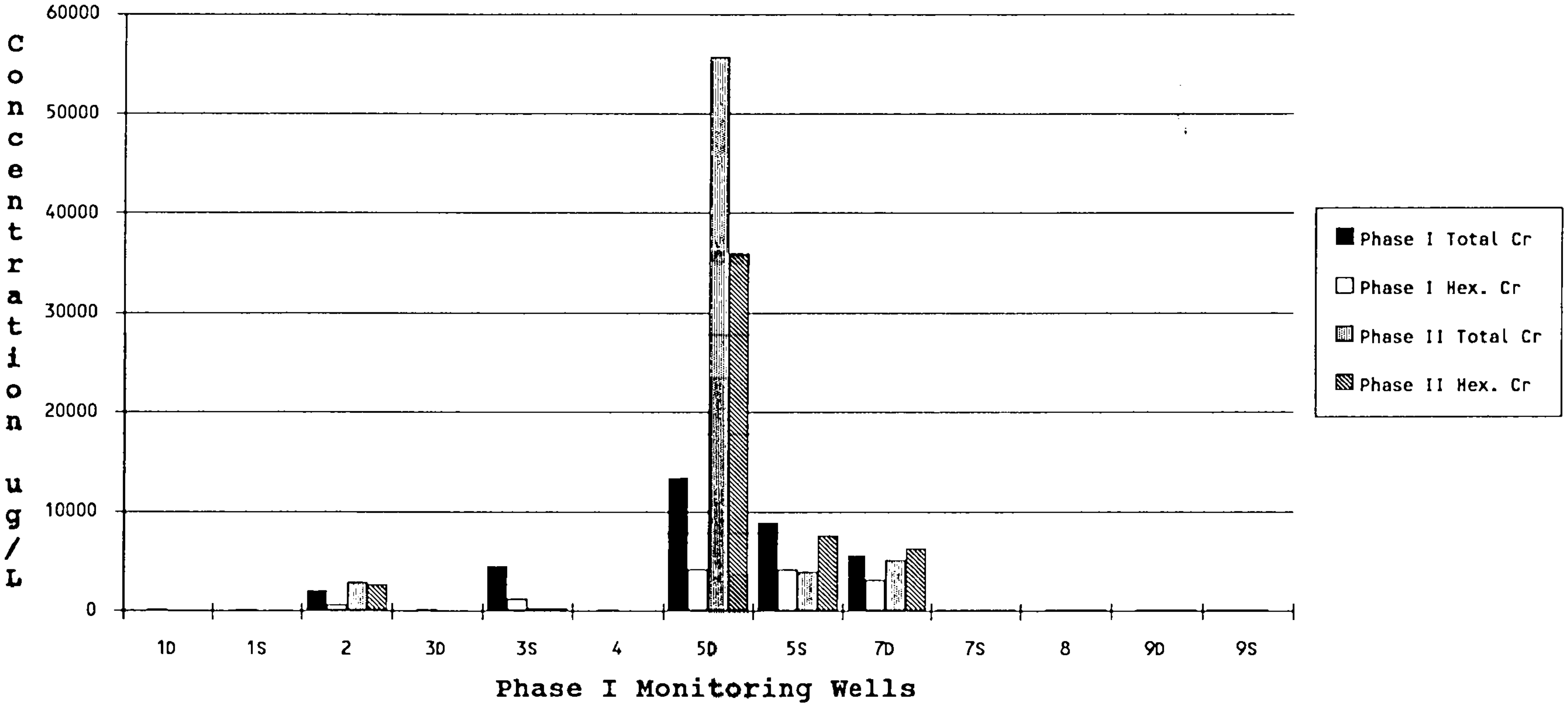


Figure 6-15

Phase I and II Chromium Concentrations in Shallow Monitoring Wells

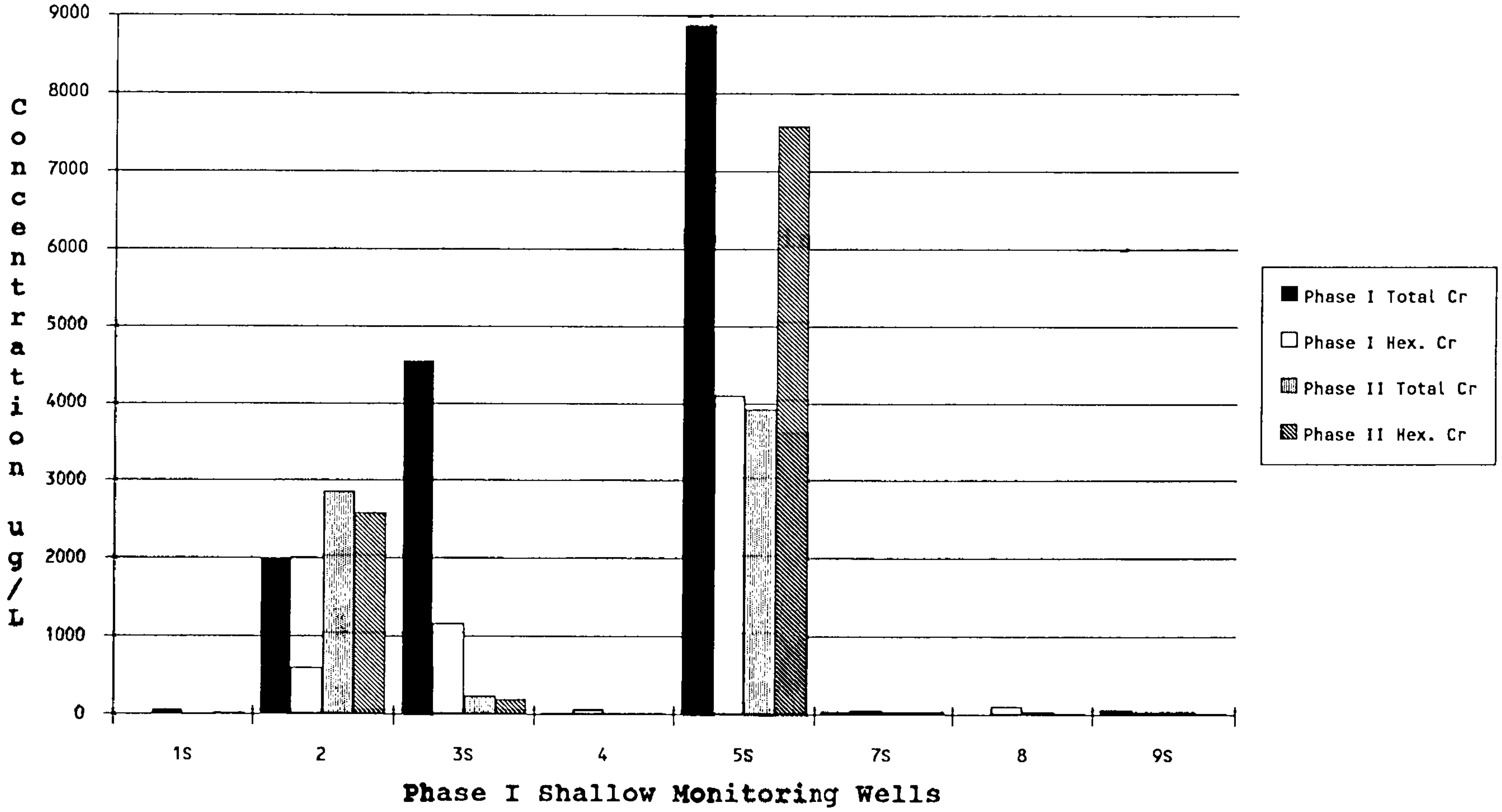
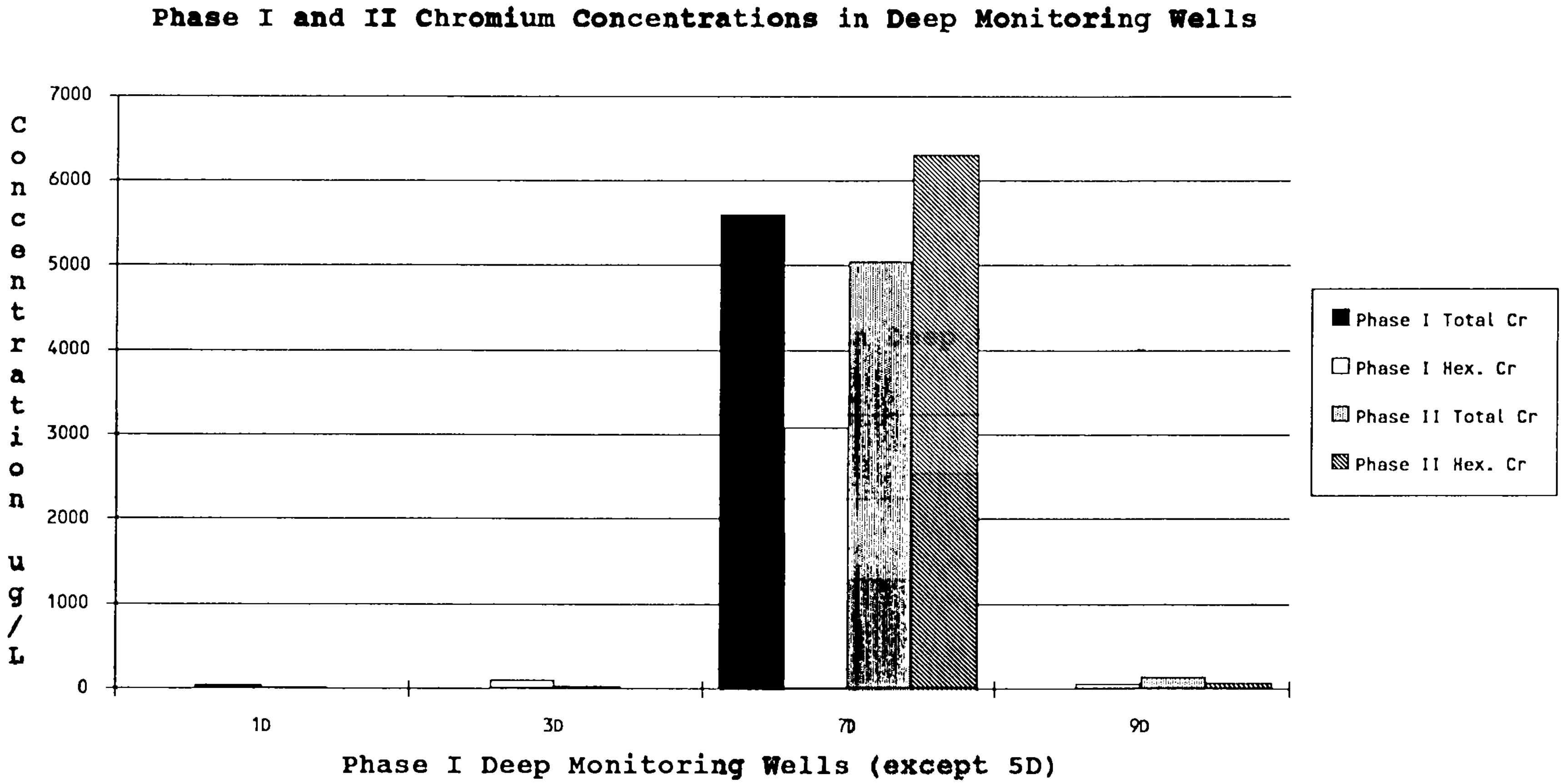


Figure 6-16


Phase I and II Chromium Concentrations in Deep Monitoring Wells
Concentration ug/L
7000
6000
5000
4000
3000
2000
1000
0
1D
3D
7D
9D
Phase I Deep Monitoring Wells (except 5D)
■ Phase I Total Cr
☐ Phase I Hex. Cr
▦ Phase II Total Cr
▨ Phase II Hex. Cr

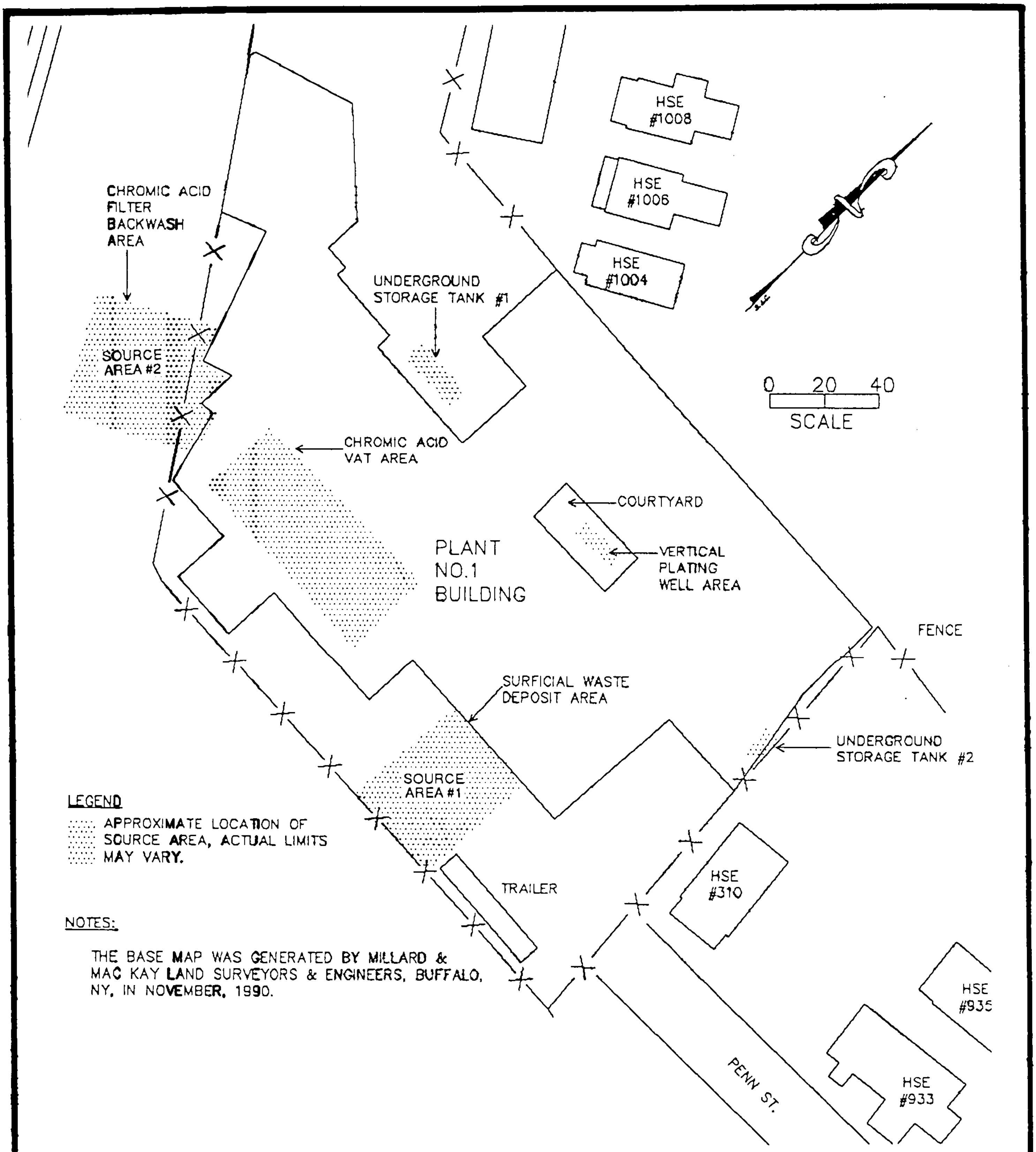
discrepancies between Phase I and Phase II total chromium data are not known. Additional sampling will be required to determine which data are most representative of water quality associated with the Plant No. 1 site.

6.3 Potential Sources of Contamination

On-site Sources

In the context of this discussion, a source area is a deposit of contaminated soil, sediment or waste that has the potential to be a source of contamination to either the ground water, surface water or air, and is an area where one or more of the indicator chemicals was measured at a concentration several orders of magnitude above background. Based on this definition of a source and the analytical data from soil and groundwater samples collected during the Phase I and II RIs, two potential on-site contaminant source areas have been identified, one confined within the fenced in area at Plant No. 1 and one on the west side of the Plant building, extending outside the fenced area. These potential source areas are shown on Figure 6-17.

Note that there may be other source areas within the plant building (i.e., the various dipping tanks) and outside the plant



LEGEND

░ APPROXIMATE LOCATION OF SOURCE AREA, ACTUAL LIMITS MAY VARY.

NOTES:

THE BASE MAP WAS GENERATED BY MILLARD & MAC KAY LAND SURVEYORS & ENGINEERS, BUFFALO, NY, IN NOVEMBER, 1990.

TITLE		
POTENTIAL SOURCE AREA MAP		
PREPARED FOR NYSDEC		
ERM-Northeast Environmental Resources Management	SCALE	FIGURE
	DATE	6-17

building that were not sampled during the Phase I and II RIs. Based on ERM's recent conversations with the former plant maintenance manager and a plant building interior walk-through, these suspected interior source areas include: 1) the chromic acid vats; 2) the vertical plating wells in the courtyard area; and 3) the two reported underground storage tanks (Figure 6-17). These suspected sources will be further evaluated during the Phase III RI.

Source No. 1 (see Figure 6-17) is approximately 5,000 to 20,000 square feet in surface area (i.e., based on surface soil data and visually observed staining) near the southeast corner of the plant building near the MW-3 well cluster. The chromium concentration in surface soil sample MW-3 (collected from this source area during the Phase 1 RI) was 41,400 ppm. However, chromium concentrations measured in samples collected below ground surface at this source area, during the Phase I and II RIs, were approximately equal to background levels. Thus, it appears that the chromium at this source area is concentrated at the ground surface (i.e. ground surface to a depth of 2 feet). Additionally, the chromium concentrations measured in the Phase II RI surface soil samples from this area indicate that Source No. 1 is comprised of individual deposits of high chromium contaminated soil (i.e., concentrations several orders of magnitude above background) and not one large deposit. PCE was also measured at a concentration of

2 ppb in a ground water sample from MW-3s during Phase I; however, was not detected in the samples from MW-3S or MW-3D during Phase II.

Source No. 2 (see Figure 6-17) is approximately 1,000 to 5,000 square feet in surface area (i.e., based on surface soil data and visual observations) near the southwest corner of the plant building near the MW-5 well cluster. This area is reportedly where the chromic acid filtration system backwash-water was discharged prior to the installation of the on-site chromium water treatment system in 1965.

The chromium concentration measured in sample MW-5A (0-2'), collected from source area No. 2 from 0 to 2 feet below ground surface, was 585,000 ppm. This concentration represents the highest chromium concentration measured in any soil sample collected during the Phase I and II RIs. Chromium concentrations measured in Phase II surface and subsurface soil samples from this area were also several orders of magnitude above background levels. PCE was detected in ground water samples from MW-5S and MW-5D during the Phase II RI and in one subsurface soil sample collected from this area during the Phase I RI. These data suggest that this area may also be a source of the solvents (i.e., PCE and TCE) in the ground water.

Off-site Sources

Two off-site sources have been identified based on the Phase II RI. The first is the sediments in the storm sewer system that runs between the site and the Brookview outfall. Specifically, the reach between SEW-2 and SEW-5 (see Figure 6-3) appears to be a source area to the sediment and surface water of Olean Creek.

The second off-site source area is the Olean Creek sediments near the Brookview outfall. Although the dimensions of this source area have not been clearly defined, it appears that the contaminated sediments are in the immediate vicinity of the outfall, and doe not extend across the entire stream channel at this location.

7.0 SUMMARY AND CONCLUSIONS

7.1 Summary

This section summarizes the results of the Phase II RI. Additionally, the Phase I RI data are discussed since data from both studies have been collectively used in delineating the extent of soil/ storm sewer water/sediment, surface water/sediment and ground water contamination. Specifically, this section focusses on the results presented in Sections 5.0 and 6.0, since these sections provide the findings and interpretations of the study, and are based on the data presented in preceding sections (i.e. Sections 1.0 through 4.0).

7.1.1 Risk Assessment

The public health risk assessment concluded that under current conditions there are carcinogenic effects from chromium in fugitive dust emissions and arsenic in residential soil (incidental ingestion by children). Under future conditions, if no remedial action is taken, the carcinogenic effects include PCE in drinking water, chromium in fugitive dust emissions and arsenic in residential soil. Additionally, the risk assessment concluded that non-carcinogenic effects under future conditions include chromium and lead in groundwater. Noncarcinogenic effects under future conditions for lead in ground water were only significant in the Phase I data.

Based on the environmental risk assessment, no adverse effects to sensitive environmental resources are expected to occur as a result of the site contaminants. However, several of the contaminants found in sediment and surface water samples collected from Olean Creek are above SCGs, and may be impacting benthic and aquatic life in this creek.

7.1.2 Extent of Contamination and Potential Sources

Surface Soil

Based on surface soil samples collected during the Phase I and II RIs, it appears that the area of chromium contaminated surface soil (based on a 100 ppm clean-up level) includes the majority of the surface soil (i.e., soil from the ground surface to a depth of 2 feet) within the fenced-in area of the site and an area outside the fence (i.e., approximately 100 feet beyond the fence to the east and north). The extent of surface soil contamination to the south and west was not clearly delineated by the Phase I and II sampling programs.

Subsurface Soil

Subsurface soil conditions near the MW-5 well cluster and the MW-3 well cluster were further evaluated during the Phase II RI program. In the area of MW-5 (location where the plant's chromic-acid filter formerly discharged backwash-water) the data indicate that the chromium concentrations are highest near the ground surface (i.e., 0 to 2') and near the top of ground water table (i.e., 16 to 20'). Chromium contamination is present between these intervals, though at lesser concentrations.

Chromium concentrations measured in subsurface soil samples (i.e., greater than 2 feet) collected in the area of MW-3 were less than 100 mg/Kg and similar to local background concentrations. Chromium near MW-3 appears to be associated with specific surface deposits and does not appear to be present below approximately 2 feet from ground surface.

Storm Sewer

The sediment and water samples collected from the storm-sewer system that runs from the east side of the site to the

Brookview outfall indicate that this system contains elevated levels of chromium and lead. Based on Phase II data, it appears that the chromium concentrations are highest in water and sediment samples that were collected between the Van Der Horst line and Keating Street.

Creek Sediment

Chromium concentrations in sediment appear to be the highest near the Brookview storm-sewer outfall; however, elevated chromium concentrations (i.e., chromium concentrations greater than 100 ppm) were measured in two of the bank-sediment samples downstream of the outfall. Based on a comparison of the chromium concentrations in sediment upstream and downstream of the outfall, it appears that this outfall was/is a source of the elevated chromium in Olean Creek.

Surface Water

Aluminum, iron and zinc were the only analytes detected above Class "C" surface water quality standards in surface water from Olean Creek during the Phase II RI sampling program. Thus, it appears that the surface water in Olean Creek is not being significantly impacted by the Brookview outfall (i.e., contaminants associated with the subject site migrating through the storm sewer) or the creek sediments (i.e., through suspension of contaminated sediments) at the time of the Phase II sampling event.

Ground Water

Chromium and PCE have been determined to be the principle ground water contaminants. PCE levels in ground water samples indicate that PCE contamination primarily occurs within the shallow monitoring wells adjacent to the Plant No. 1 building. Chromium contamination within the shallow monitoring wells, has predominately migrated south of Plant No. 1. The extent of the chromium plume in the shallow monitoring wells appears to lie within the existing monitoring well network. The plume limits were defined by the NYSDEC ground water limit of 50 ug/L.

Chromium contamination in the deep monitoring wells has been transported to the southwest and west beyond the Phase I and II wells. Additional well installation and ground water sampling will be required to delineate the chromium ground water plume in the deep monitoring wells.

Areas of Soil Contamination

The Phase II RI provided additional information regarding the two areas of soil contamination located at the site which appear to be the result of past disposal/discharge activities at Plant No. 1. Both of these areas contain chromium contaminated soil at concentrations several orders of magnitude above background. There may be other areas of soil contamination beneath the plant building (i.e., the various dipping tanks) and outside the plant building (i.e., recently identified plating "wells") that were not sampled during the Phase I and II RIs.

Two off-site areas of soil/sediment contamination have been identified based on the Phase II RI. The first is the sediments in the storm sewer system that runs between the site and the Brookview outfall. The second off-site area is the Olean Creek sediments near the Brookview outfall. It appears that these sediments are in the immediate vicinity of the outfall, and do not extend across the entire stream channel at this location.

7.2 Conclusions

This section summarizes: 1) the limitations; 2) recommendations for the Phase III RI; and 3) recommended remedial action objectives for the Phase III FS. The conclusions presented with regard to these three items are based upon the information presented in previous sections.

7.2.1 Limitations

The findings of this study are based upon explorations, field measurements and analyses which are subject to certain limitations. These limitations are summarized below:

Explorations and Measurements

The geologic profiles presented and described herein are intended to convey trends in subsurface conditions. The boundaries between strata are approximate and have been developed by interpretations of widely spaced explorations.

Ground water level readings have been made in the monitoring wells at times and under conditions stated on the field reports. These data have been reviewed and interpretations have been made. However, note that fluctuations in the ground water level will occur due to variations in rainfall and other factors occurring at the time of measurement.

Surveying (elevation of test borings/monitoring wells) was done by others using optical survey techniques. These data were used in developing conclusions made in this report. Should variations become evident, it will be necessary to reevaluate the findings of this report.

Analyses

The analyses and conclusions submitted in this report are based in part on samples tested by others, and are contingent upon their validity. Fluctuations of contaminant levels, types and migration paths may occur due to seasonal fluctuations, temperature variations, ground water fluctuations and other factors.

Use of Report

This report was prepared exclusively for the NYSDEC for specific application to the Van Der Horst Plant No. 1 site in accordance with generally accepted engineering practice. No other warranty, expressed or implied, is made.

7.2.2 Recommendations for Future Work

Although the Phase II RI provided additional information regarding the physical characteristics of the study area and the contaminants of interest, some additional study will be required to further evaluate site conditions and collect the necessary data for a detailed FS. Some recommended studies for the Phase III RI are summarized below:

1) The horizontal extent of ground water contamination needs to be further delineated with additional monitoring wells southwest of the site. This work is necessary to estimate the volume of ground water that is contaminated, so that treatment/disposal alternatives can be evaluated.

2) Wipe samples and asbestos samples should be collected from the plant building envelope to evaluate contamination within this structure.

3) A detailed ground water modeling effort is needed to evaluate various pump and treat remedial alternatives. This effort will include ground water flow simulations which will be designed to optimize the recovery of contaminated ground water. The following factors will be evaluated during modeling:

    - Numbers of recovery wells;
    - Recovery well locations; and
    - Recovery well pumping rates.

4) Sub-surface sampling and testing in the interior portions of the plant are needed to identify source areas and remedial alternatives for this structure. We presently know very little about the potential for soil contamination to exist beneath the building, and don't know if additional source areas are present at this location.

5) The area of soil contamination near MW-5 should be further investigated to delineate its extent at the ground surface.

7.2.3 Recommended Remedial Action Objectives

The remedial action objectives are contingent upon current and future use of ground water by local residents and the potential for contaminant migration to public supply wells. This information has, in part, been collected by the NYSDOH during their residential well survey and the results, combined with the USGS records, are not conclusive that there is no active local withdrawal of ground water. However, assuming that there is some future exposure path for the contaminated ground water, the following remedial action objectives have been developed:

* Remediate identified areas of contaminated surface soil to limit future migration of chromium and PCE;
* Remediate ground water to acceptable risk levels for chromium, lead and PCE;
* Remediate the storm sewer system (i.e. pipe between site and Olean Creek) of residual contamination that may be impacting benthic and aquatic life;
* Remediate the contaminated sediments in the vicinity of the Brookview outfall to Olean Creek; and
* Remediate on-site building structures (possibly including demolition of the plant building) if necessary.

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