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OCCIDENTAL CHEMICAL CORPORATION

Durez Division

North Tonawanda, N.Y.

Remedial Alternatives Assessment for The Durez Site

Prepared by

Dunn Geoscience Corporation

December 1986

REMEDIAL ALTERNATIVES ASSESSMENT

For

The Durez Site

Prepared for

Occidental Chemical Corporation
Durez Division

North Tonawanda,
New York

Prepared by

Dunn Geoscience Corporation

December 31, 1986

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EXECUTIVE SUMMARY

The Occidental Chemical Corporation, Durez Molding Materials Division has been in continuous operation since 1926, manufacturing chemicals and plastics for use by industry. Over time, there have been accidental spills, and some wastes were disposed of at various locations on the plant property.

Since 1979, continuing field investigations have focused on characterizing conditions at the plant property and adjacent properties as a unit in order to define possible pathways for exposure to chemicals. These studies have included defining the extent of migration of groundwater that contains chemicals, analyzing surface water and soil in non-vegetated areas and other surface areas on the plant property, and examining adjacent properties for the presence of materials which may have originated at Durez. Later studies included investigation of the thick, impermeable clay and the bedrock groundwater beneath the plant. A total of 123 borings were drilled, and 116 monitoring wells were installed in 15 phases of investigation. Finally, studies focused on the City of North Tonawanda storm and sanitary sewers, including the Pettit Creek Flume (PCF) box culvert and its outlet near the Little Niagara River, referred to herein as the "inlet".

Concentrations of organic chemicals from Durez have been found in the shallow, unconsolidated zone groundwater beneath the plant property, and in some North Tonawanda storm sewers. Bedrock groundwater is effectively isolated from the overlying shallow unconsolidated zone groundwater by a thick impermeable layer of clay.

The components of remediation for the Durez plant property and affected North Tonawanda sewers and the various alternatives considered and evaluated are listed below.

Groundwater - Unconsolidated Zone at the Durez property

- No Action
- Groundwater Monitoring
- Groundwater Pumping
- Groundwater Pumping and Recharge
- Impermeable Barriers
- Impermeable Barrier and Groundwater Recovery
- Subsurface Drain

Bedrock Groundwater at the Durez Property

- No Action
- Sealing Wells
- Sealing and Monitoring Well Casing Extraction

Plant Sanitary Sewers

- No Action
- Disconnection/Plugging

Plant Storm Sewers

- No Action
- Disconnection
- Sediment Removal
- Sealing

Panhandle Surface Areas

- No Action
- Cover
- Removal of Surface Material

Panhandle Railroad Ditch

- No Action
- Fencing
- Cover
- Culvert Installation
- Removal of Surface Soils

Treatment of Groundwater from the Durez Property

- Activated Carbon Adsorption System
- Distillation
- Solvent Extraction
- Thermal Incineration
- Bio-Treatment

Disposition of Soil Material Excavated at Durez property

- Reuse
- Off-Site Disposal
- Disposal on Durez Plant Property

Sanitary Sewers Located in the Vicinity of the Durez Plant

- No Action
- Sediment Removal

Pettit Creek Flume Storm Sewer

- No Action
- Sediment Storage in Place
- Sediment Removal
- Partial Sediment Removal

Other Storm Sewers in the Vicinity of the Durez Plant

- No Action
- Sediment Removal

Inlet

- No Action
- Containment and Sediment Storage in Place
- Sediment Removal
- Site Restoration

Disposition of Sediment Removed from Sewers and Inlet

- Off-Site Treatment
- Off-Site Disposal
- Storage Adjacent to Inlet
- Interim Storage at the Durez Plant
- Treatment at the Durez Plant

Treatment and Disposal of Water from Sewers and Inlet

- Discharge Without Treatment
- Suspended Solids Removal
- Suspended Solids Removal and Carbon Treatment

Developing Treatment Technologies for Dioxin - Containing Sediment

- Rotary Kiln Incineration
- Shirco Infrared System
- Electric Pyrolysis
- Chemical Dechlorination
- Insitu Vitrification
- Solvent Extraction
- Biological Treatment

The purpose of the evaluations is to allow selection of the alternative that will achieve the project objectives, and will adequately protect the public health and the environment in a cost effective manner.

Evaluation criteria are assessed qualitatively and include technical feasibility, performance, effectiveness, useful life, operation and maintenance requirements, reliability at similar sites, implementability, construction safety, potential for public exposure and cost effectiveness. Information used for making the assessments is derived from numerous sources including USEPA and National Contingency Plan (NCP) guidelines; State and Federal regulations; remedial assessments/feasibility studies conducted at other sites; discussions with contractors, vendors, research institute personnel and government agencies; and the best engineering judgement and experience of OCC and DGC personnel.

Proposals for remediation at the Durez plant property include sealing all existing bedrock wells; encircling the property with a groundwater collection system to prevent migration of chemicals from the property; treatment of collected groundwater by carbon filtration to remove dissolved organic chemicals; diversion of selected plant storm sewers to the proposed carbon treatment system; disconnecting plant sanitary sewer lines that are no longer in service; and covering non-vegetated areas of the Panhandle portion of the plant property.

Proposals for remediation in the North Tonawanda storm sewers include removing sediment from selected storm sewer segments to facilitate diversion of flow to the Meadow Drive interceptor, and securing and storing in place sediment in the inlet. Some of the removed sediment would be disposed of at a commercial hazardous waste disposal facility. The remaining sediment would be placed in an interim bulk storage cell on the Durez property, pending the availability of a technically suitable, commercially available treatment or disposal technology. Upon future completion of sediment removal from the inlet, an investigation would be conducted to determine if organic chemicals may be present near the City of Lockport's buried water intake line at the inlet.

1.0 INTRODUCTION

The Occidental Chemical Corporation (OCC) Durez Molding Materials Division (Durez) plant in North Tonawanda, New York has been in continuous operation since 1926, manufacturing chemicals and plastics for use by industry.

In the 60 years the plant has been in operation, there have been accidental spills associated with the handling and storage of chemicals. Some wastes, ranging from debris from the demolition of buildings, to chemicals, were disposed of at various locations on the plant property. Based upon often conflicting anecdotal recollections of present and former employees, and fragmentary plant records, a profile of plant spill and disposal areas and practices was developed. This information is contained in a 1979 report by the Interagency Task Force.

From their inception in 1979, field investigations have focused on characterizing conditions at the plant site and adjacent properties as a unit in order to define possible pathways for exposure to chemicals. These studies included defining the extent of migration of groundwater that contains chemicals, analyses of surface waters and soil from non-vegetated and other surface areas on the plant property, and examining adjacent properties for the presence of materials which may have originated at the plant. Later studies focused on determining whether chemicals had migrated from the unconsolidated zone groundwater to the deeper, bedrock groundwater and assessing the depth, integrity, and impermeability of the clay beneath the shallow unconsolidated zone. Finally, studies focused on the City of North Tonawanda storm and sanitary sewers as possible pathways for migration. The sewers investigated include the Pettit Creek Flume (PCF), several storm sewer laterals that discharge into the PCF, and the inlet adjacent to the Little Niagara River where the PCF outlet is located (referred to herein as the "inlet"), and the City sanitary sewers in the vicinity of the Durez plant.

Currently, only storm water runoff and non-contact cooling water discharge to plant storm sewers, and only boiler blow-down, toilets, sinks and showers discharge to plant sanitary sewers. There is, however, infiltration of groundwater that may contain chemicals to the plant site storm and sanitary sewers, which discharge to the City's storm and sanitary sewer systems.

1.1 Purpose

The purpose of this Remedial Alternatives Assessment (RAA) is to present an evaluation of remedial action alternatives considered for the Occidental Chemical Corporation Durez Division plant property and adjacent area and the affected North Tonawanda storm and sanitary sewers. This evaluation utilizes the results of extensive investigations that have been conducted in and around the plant since 1979.

1.2 Legal Considerations For Setting Objectives

Dunn Geoscience Corporation has been advised by counsel for OCC that the following legal considerations should govern the selection of alternatives.

Congress has adopted amendments to the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA"), sometimes referred to as Superfund. These amendments were enacted October 17, 1986 in Public Law No. 99-499, which is referred to as the Superfund Amendments and Reauthorization Act of 1986 (SARA). It is uncertain which of SARA's provisions apply where a State, rather than the Federal government, is pursuing an action for injunctive relief and damages. In the Federal Court action involving Durez, the State is proceeding as well for abatement of an alleged public nuisance, but it is not clear what the standards for selecting remedial options are. In the light of these uncertainties, OCC and its counsel have directed Dunn Geoscience Corporation to proceed to prepare this report on the assumptions stated below, subject to the ultimate determination of the appropriate standards, either by agreement among the parties or the determination of the Federal courts.

The remedial alternatives should assure protection of public health and the environment. Among alternatives which do so, the most cost effective is to be recommended. If a remedial alternative will provide adequate protection for public health and the environment, it should not be rejected in favor of another alternative which is more expensive even though it is more protective of public health and the environment.

These conclusions are based upon the following:

Section 121(a) of SARA provides that remedial programs shall be selected in accordance with the clean-up standards provided by that section and "to the extent practicable, the national contingency plan, and provide for cost-effective response".

The Congressional Conference Report on this provision explained it as follows:

> The provision that actions under both sections 104 and 106 must be cost-effective is a recognition of EPA's existing policy as embodied in the National Contingency Plan. The term "cost-effective" means that in determining the appropriate level of cleanup, the President first determines the appropriate level of environmental and health protection to be achieved and then selects the cost-efficient means of achieving that goal. Only after the President determines, by selection of applicable or relevant and appropriate requirements, that adequate protection of human health and the environment will be achieved, is it appropriate to consider cost effectiveness.

EPA, in issuing the current National Contingency Plan, pointed out that a remedial alternative need not be selected if it is more expensive merely because it is "more protective". In the Preamble to the National Contingency Plan, EPA stated:

> The approach embodied in today's rule is to select a cost-effective alternative from a range of remedies that protects the public health and welfare and the environment. First, it is clear that if all the remedies examined are equally feasible, reliable and provide the same level of protection, the lead agency will select the least expensive remedy. Second, where all factors are not equal, the lead agency must evaluate the cost, level of protection and reliability of each alternative...Finally, the lead agency would not always select the most protective option, regardless of cost. The lead agency would instead consider costs, technology, reliability, administrative and other concerns, and their effects on public health and welfare and the environment. This allows selection of an alternative that is most appropriate for the specific site in question. (50 Fed. Reg. 47921 (November 20, 1985)). (Emphasis supplied).

1.3 Objectives

Based upon the foregoing, OCC has directed Dunn Geoscience Corporation (DGC) to prepare this Remedial Alternatives Assessment to evaluate alternatives which would provide for the following objectives:

- o Reduce or eliminate the flow of groundwater from the Durez plant property via subsurface soils, sewers, sewer bedding, etc. and the treatment of such groundwater prior to discharge regardless of whether or not a "no action" alternative may adequately protect public health and the environment.

- o Consider the need for reduction or elimination of potential exposure to chemicals in the Panhandle area of the Durez plant that may contain materials originating at Durez.

- o Reduce or eliminate the potential for public exposure to sediment that may contain chemicals originating from the Durez plant in the City's sanitary and storm sewers, and in the inlet.

- o If sediment is removed from the sewers or inlet, provide for the permanent disposition of the sediment using commercially available and cost-effective technology.

- o If permanent solutions are not available for disposal of sediment containing chemicals, evaluate available interim alternatives, including storage in place, and storage at the Durez plant.

- o Identify the need for additional data to assess further, conditions in the inlet, including the area around the City of Lockport water intake pipe beneath the inlet.

1.4 Scope

This document presents a summary of remedial investigations conducted from 1979 to 1986 (reports for which have been submitted previously to New York State) and their findings and conclusions; identification of considered remedial alternatives; technical assessments of the alternatives; and, recommendations for remedial action or further investigations.

2.0 SUMMARY OF REMEDIAL INVESTIGATIONS AND FINDINGS

This section contains a summary of the remedial investigations performed by OCC and its consultants in and around the Durez Division plant property and in the City of North Tonawanda's storm and sanitary sewers beginning in April, 1979. For each major study area (e.g., groundwater, Panhandle surface water, sewers) there is a description of the purpose, scope of work, methodology and major findings. Data Tables 1 to 28, and Figures 2.1 to 6.9 have been adapted from the reports of the investigations and are presented at the end of Section 6.0. Tables 2.1 to 2.3, which summarize all the investigations, are presented in this section. Table 2.1 contains a list of the investigation reports and shows the reference codes that are used throughout the RAA.

The State of New York has participated in all investigations that have been conducted at Durez. In addition to participation in discussions on the scope of studies and reviewing all protocols, State personnel have observed sampling and other field activities and have been offered splits of all samples taken.

2.1 Groundwater

2.1.1 Unconsolidated Deposit Groundwater Zone

Monitoring of the shallow unconfined groundwater zone was conducted using a network of monitoring wells screened in the uppermost unconfined saturated zone. A total of 116 monitoring wells were installed in 15 separate phases, both on and in the vicinity of the plant site. Figure 2.1 shows well locations. The typical water table configuration at the site is shown in the groundwater level contour map in Figure 2.2. Table 2.2 lists a summary of boring installation dates, and references the

TABLE 2.1

REPORTS SUMMARY

1. Hydrogeologic Investigation
   Durez Division
   Hooker Chemicals and Plastics Corp.
   Walck Road, North Tonawanda
   Niagara County, New York
   1980

   Prepared by: Recra Research Inc. and Wehran Engineering, P.C., October 1980 (RECRA 80)

2. Subsurface Investigation Report on Shallow Piezometers and Wellpoints
   Hooker Durez Division
   North Tonawanda, New York

   Prepared by: Empire Soils Investigations, Inc., November 1981 (EMPIRE 81)

3. Report of Continuing Field Investigations - Summer 1982

   Section I: Introduction, Summary and Conclusions
   Section II: Hydrogeology
   Section III: Sampling and Analytical Chemistry

   Prepared by: Occidental Chemical Corporation, November 1982 (SUMR 82)

4. Report of Continuing Field Investigations and Exposure Assessment - 1983

   Section I: Introduction, Summary and Conclusions
   Section II: Hydrogeology
   Section III: Sampling and Analytical Chemistry

   Prepared by: Occidental Chemical Corporation, January 1984 (CONT INV 83)

5. Report of Continuing Field Investigations and Exposure Assessment - 1983

   New York State Comments and Requests for Clarification
   OCC Response

   Prepared by: Occidental Chemical Corporation, March 1984 (RESPONSE)

6. Report of Continuing Field Investigations and Exposure Assessment - 1984

Section I: Introduction, Conclusions, Exposure Assessment and Site Operations
Section II: Hydrogeology
Section III: Sampling and Analytical Chemistry

Prepared by: Occidental Chemical Corporation, July 1984 (CONT INV 84)

7. Report of Continuing Field Investigations and Exposure Assessment

   Site Operation Plan
   Clay Integrity Report

   Prepared by: Dunn Geoscience Corporation, August 1984 (CLAY INTG 84)

8. Report of Continuing Field Investigations and Exposure Assessment

   Site Operation Plan
   Clay Integrity
   Final Report

   Prepared by: Dunn Geoscience Corporation, November 1984 (CLAY FINAL 84)

9. Site Remediation Program and Alternatives Considered for 889 Lee Avenue

   Prepared by: Dunn Geoscience Corporation, March 1985 (889 LEE)

10. Site Operations Plan
    Investigation of the Durez Area
    Storm and Sanitary Sewers

    Prepared by: Dunn Geoscience Corporation, October 1985 Revised November 1985 (SOP SEW 85)

11. Report of Continuing Field Investigations
    Report on Site Operations Plan - Summer 1984

    Bedrock Aquifer
    Off-Site Soil Survey
    Panhandle Surface Investigation
    889 Lee Avenue

    Prepared by: Occidental Chemical Corporation and Dunn Geoscience Corporation, February 1986 (SOP 86)

12. Report of Continuing Field Investigations
    North Panhandle Hydrogeologic/Analytical Program

Prepared by: Occidental Chemical Corporation, June 1986 (PAN 86)

13. Report of Continuing Field Investigations
Phase 1 Report/Durez Area Sewer Investigation

Prepared by: Occidental Chemical Corporation, July 1986 (PH 1 SEW 86)

14. Report of Continuing Field Investigations
Phase 2 Report/Durez Area Sewer Investigation

Prepared by: Occidental Chemical Corporation, September 1986 (PH 2 SEW 86)

15. Report of Continuing Field Investigations
Video Inspection of the Pettit Creek Flume

Prepared by: Occidental Chemical Corporation, Draft

TABLE 2.2

BORING INSTALLATION SUMMARY

SYMBOL IDENTIFICATION	WELL NOS.	INSTALLATION DATES (REFERENCE)*
Shallow Wells	P-1 thru P-30	Dec. 1979 - Jan. 1980 (RECRA 80)
Shallow Wells	P-31 thru P-36	Nov. 1981 (EMPIRE 81)
	P-3S, P-11S, P-15S, P-18S	Dec. 1982 (CONT INV 83)
	P-6A, P-7S, P-8S	Apr. 1983 (CONT INV 83)
Shallow Piezometers	NP-1 thru NP-11	May - June 1982 (SUMR 82)
	NP-12 thru NP-23	Dec. 1982 (CONT INV 83)
	NP-24 thru NP-29	Feb. 1983 (CONT INV 83)
	NP-30 thru NP-36	Apr. 1983 (CONT INV 83)
	NP-37 thru NP-38	Sept. 1983 (CONT INV 83)
	NP-39 thru NP-40	Jan. 1984 (PAN 86)
	NP-41 thru NP-45	Apr. 1985 (PAN 86)
	NP-46 thru NP-51	Sept. 1985 (PAN 86)
Deep (Bedrock) Wells	Nos. W-7, W-12, W-16 (renovated)	Jan. - Feb. 1980 (RECRA 80)
	No. W-17	Jan. 1980 (RECRA 80)
Well Points to Sewer Bedding	Nos. 7 thru 9	Nov. 1981 (EMPIRE 81)
	Nos. 10 thru 20	Aug. - Sept. 1983 (CONT INV 83)
New York State Piezometers	SP-1	Nov. 1982
	SP-2 thru SP-7	Oct. 1983
Sewer Bedding Wells	SB-1 thru SB-3	Oct. 1983
Shallow Wells	WP-4, WP-5	Jan. 1979
Durez Borings	DB-1 thru DB-7	June 1984 (CLAY INTG 84)

*References are described in the ENVIRONMENTAL CHEMICAL AND HYDROGEOLOGIC ANALYSES/DATA INDEX found in Appendix A.

TABLE 2.3 (Continued)

WATER SAMPLING AND ANALYSIS

SYMBOL IDENTIFICATION	WELL NOS.	SAMPLE COLLECTION DATES (REFERENCE)*
Well Points to Sewer Bedding	Nos. 7 thru 9	
	Nos. 10 thru 20	September 1983 (CONT INV 83)
New York State Piezometers	SP-1	July 1983 (CONT INV 83)
	SP-2 thru SP-7	
Sewer Bedding Wells	SB-1 thru SB-3	
Shallow Wells	WP-4, WP-5	

*References are described in the ENVIRONMENTAL CHEMICAL AND HYDROGEOLOGIC ANALYSIS/DATA INDEX found in Appendix A.

appropriate reports where specific details are found.

Table 2.3 presents a summary of sample collection dates and appropriate report references where details of sampling and analytical protocols can be found. Tables 1 through 7 present summaries of the analytical data obtained through unconsolidated zone groundwater monitoring and clay boring analyses.

Results from the Recra Research, Inc. (RECRA 1980) investigation performed for OCC indicated that with some exceptions the groundwater generally exhibited a pH within the commonly encountered range from 6.5 to 8.5, specific conductance varied from 425 to 10,300 umhos/cm and phenolics were detected (>10 ug/l) in all of the monitoring wells which were sampled (Table 1).

Results of the OCC 1982 study (SUMR 82) indicated that the pH of all water samples was between 6.2 and 7.7 and that total dissolved solids, conductance and chloride levels varied considerably among the wells (Table 2). These parameters did not correlate with the presence of any organic components detected (SUMR 82).

Only four wells (P-11, -14, -24, and -26) consistently showed chemical concentrations above the detection limits, confirming the previous study (RECRA 1980) results, indicating that the majority of organic compounds occurs in two areas on the plant property; one in the southwest-central region, and the other in the eastern region (SUMR 82).

For the OCC 1983 study (CONT INV 83) comparison of results for total dissolved solids, conductance and chloride for wells sampled in both 1982 and 1983 showed no significant change with time (Table 3). The values of these parameters in the new wells were in the same range as the previously sampled wells (CONT INV 83).

Only eight wells contained quantities of organic compounds significantly above the detection limit. Quantities close to the detection limit were detected in only four other wells (CONT INV 83). Gas chromatography/mass spectrometry (GC/MS) confirmation of the identity of the organic compounds observed by GC was performed for many of the well water samples. In several cases, GC identifications of chlorophenols were not confirmed by GC/MS.

Because a localized depression in the clay surface in the area of monitoring well P-6 collected a non-aqueous phase liquid (NAPL) by gravity flow, P-6 was pumped on a periodic basis to remove this fluid for off-site disposal.

The supplementary sampling of Panhandle waters (CONT INV 84) showed that the same organic compounds found in NP-15 in 1983 were still present in 1984 and in roughly similar concentrations (Table 4). None of the other wells in the vicinity of NP-15 showed the presence of any of the compounds found in NP-15.

Studies (Tables 5 and 6) indicate that some organics have been detected in sites north of monitoring well NP-15 both on and off the plant property (PAN 86). These studies also determined the extent of the migration north of the Panhandle.

Soil Borings

The purpose of all soil borings, regardless of whether or not they were converted to groundwater monitoring wells, was to provide a description of the geologic stratigraphy underlying the site. Table 2.2 lists the appropriate sources where boring logs can be found. In several instances, soil was collected from borings in Shelby tubes for permeability testing or in split-spoon samplers for visual observation and/or chemical analysis. A contour map for the top of the glaciolacustrine clay is shown in Figure 2.3. The surface of the sand and gravel layer at the site is shown in Figure 2.4 and the thickness of this layer is shown in Figure 2.5.

In addition to the extensive split-spoon sampling program during the RECRA 1980 study, undisturbed Shelby tube samples were collected to define the permeability in the glaciolacustrine clay stratum underlying the entire site. Based on tube conditions and recoveries, samples from borings P-8 and P-18 (both recovered in the 13 to 15 foot interval below grade) were tested for permeability and index properties. Permeability results were 1.6 x 10^{-8} and 2.4 x 10^{-8} centimeters per second, respectively (RECRA 80).

During the OCC 1982 studies (Table 2), 16 locations in the overburden soil were sampled and analyzed for tetrachlorodibenzo-p-dioxins (TCDD). Of these, 2,3,7,8-TCDD was detected at two locations. At both locations the results were below 1 ug/l (ppb).

Three soil borings off plant property and three soil borings on plant property were analyzed for TCDD (Table 3) during the OCC 1983 investigation. TCDD was not detected in the off plant borings. One on plant boring (NP-19) showed 0.036 ng/g (ppb) TCDD. Study of the isomer pattern showed that two TCDD isomers (1,3,6,8- and 1,3,7,9-TCDD) were present in the sample. 2,3,7,8-TCDD was not detected in any of these six borings (CONT INV 83).

TABLE 2.3

SUMMARY OF WATER SAMPLING AND ANALYSIS

SYMBOL IDENTIFICATION	WELL NOS.	SAMPLE COLLECTION DATES (REFERENCE)*
Shallow Wells	P-1 thru P-30	April & June 1980 (RECRA 80); June & July 1982 (SUMR 82); June & July 1983 (CONT INV 83); February 1984 (CONT INV 84)
Shallow Wells	P-31 thru P-36	July 1982 (SUMR 82); July 1983 (CONT INV 83); February 1984 (CONT INV 84)
Shallow Piezometers	NP-1 thru NP-11	June & July 1982 (SUMR 82); June & July 1983 (CONT INV 83); February 1984 (CONT INV 84)
	NP-12 thru NP-23	June & July 1983 (CONT INV 83); February 1984 (CONT INV 84); May 1985 (PAN 86)
	NP-24 thru NP-29	June & July 1983 (CONT INV 83)
	NP-30 thru NP-36	June & July 1983 (CONT INV 83); February 1984 (CONT INV 84)
	NP-37 thru NP-38	
	NP-39 thru NP-40	May & December 1985 (PAN 86)
	NP-41 thru NP-45	May & December 1985 (PAN 86)
	NP-46 thru NP-51	December 1985 (PAN 86)
Deep (Bedrock) Wells	Nos. W-7, W-12, W-16	April & June 1980 (RECRA 80); July 1982 (SUMR 82); July 1983 (CONT INV 83); January-July 1985 (CONT INV 85)
	No. W-17	April & June 1980 (RECRA 80); July 1982 (SUMR 82); July 1983 (CONT INV 83); January-July 1985 (CONT INV 85)

To determine further that an adequate layer of clay exists beneath the site, five soil borings (DB-1 to DB-5) were drilled during June, 1984, and split-spoon and Shelby tube samples were collected as part of a clay integrity study. The specific vertical intervals of clay extraction are found in CLAY FINAL 84. Fourteen of the sixteen Shelby tubes collected were of satisfactory quality to test for permeability. A crimped tube, DB-3 (sampled at 8 to 10 feet) was archived. DB-3 was redrilled as DB-9.

Individual hydraulic conductivity values ranged from 4.06×10^{-8} to 8.80×10^{-9} cm/sec at 4 psi and 3.99×10^{-8} to 8.74×10^{-9} cm/sec at 8 psi with mean values of 2.12×10^{-8} cm/sec at 4 psi and 2.01×10^{-8} cm/sec at 8 psi (CLAY FINAL 84).

Two samples of clay taken at 5 to 7 feet (DB-4), and 7 to 9 feet (DB-9) within the clay layer beneath the two areas of highest known chemical concentrations, were analyzed for 8 specific chlorophenol and 6 chlorobenzene compounds (Table 7), none of which were detected in the two samples.

The final part of the clay integrity study consisted of excavation of a trench on the Durez property to a depth of five feet below the top of clay, for the purpose of direct observation of the clay. The trench was observed by OCC and NYS geologists; geologic logs and a photographic record of the observations were made. Results are reported in <u>Site Operation Plan</u>, <u>Clay Integrity</u>, <u>Final Report</u>, November 1984 (CLAY FINAL 84). The investigation confirmed earlier determinations that the clay underlying the site is an effective impermeable barrier to migration beneath the site.

2.1.2 Bedrock Groundwater Zone

Monitoring of the bedrock groundwater zone was conducted using three former production wells reconstructed as monitoring wells and a newer bedrock monitoring well installed in 1980. Figure 2.1 shows the well locations. Table 2.2 lists the boring installation dates and references the appropriate report where specific boring details may be found.

Table 2.3 presents a summary of sample collection dates and appropriate report references where details of sampling and analytical protocols can be found. Tables 8-11 present summaries of the analytical data obtained through bedrock groundwater monitoring.

The RECRA 1980 study (Table 8) showed that bedrock water quality was typical of the non-potable groundwater within the Camillus Shale Formation which is known to exhibit high conductivities. Phenolics were not detected in monitoring well W-17 (RECRA 1980). Detectable concentrations (>10 ug/l (ppb)) of phenolics were identified in monitoring wells W-7 and W-12 on April 3 and June 12, 1980, and in monitoring well W-16 on only April 3. (Bedrock wells W-7, W-12, W-16 and W-17 are subsequently referred to as DW-7, DW-12, DW-16 and DW-17).

Results of both the OCC 1982 and 1983 monitoring (Tables 9 and 10) indicated that although a few of the organic parameters were detected in the deep wells, concentrations were low and close to the method detection limit in most cases.

As part of continuing field investigations, OCC subsequently conducted an expanded bedrock groundwater monitoring program at the Durez facility to establish the extent to which chemicals may have migrated from the overburden into the bedrock groundwater, to provide a basis for determining whether remedial measures were required, and, if so, what those measures would be, and whether further monitoring of bedrock groundwater would be conducted (SOP 86).

The program consisted of pumping bedrock wells DW-7, DW-16 and DW-17 continuously for six months beginning on January 29, 1985. The wells were sampled weekly for the first nine weeks followed by four monthly sampling events.

Results from this 1985 bedrock groundwater study (Tables 11a and 11b) showed that no organic chemicals were detected in DW-16. Only one compound, toluene, was detected in the initial sampling event in DW-7 and that was only at a 4 ug/l (ppb) level. No organic chemicals were detected in the last 12 sampling events (25 weeks) of DW-7 (SOP 86).

Monochlorobenzene was the only detected organic chemical in DW-17 of the 17 parameters tested for. It was found in all 13 samples at low ppb levels.

The naturally occurring chlorides, total dissolved solids, pH and specific conductance are all high in the bedrock groundwater, which is typical of the non-potable groundwater within the Camillus shaly dolomite rock unit. The formation contains some natural evaporite minerals that dissolve in the groundwater.

The total dissolved solids, conductance and chloride concentrations decreased significantly from the first to ninth week. Also, the range of each of these parameters in the final four monthly results was much narrower than the initial nine weeks (SOP 86).

The last four monthly samples represented much more uniform flow from the bedrock fractures in the vicinity of the well. Earlier results represented a mixing of groundwater readily available in fractures above, adjacent to and below the open portion of the rock well. Therefore, the average of the last four months' results should represent the general characteristics of the bedrock groundwater in the vicinity of the pumping well (SOP 86).

2.2 Panhandle

2.2.1 Surface Water

To determine if surface water on the Panhandle is a route of chemical migration during times of heavy rain or rapidly melting snow, five surface water sites (A-F; C was not sampled) on and adjacent to the Panhandle were sampled during June, 1984. Figure 2.6 shows these sampling locations. Details of the sampling plan and analytical results are found in SOP 86.

Results of these analyses indicate that surface water on, and adjacent to, the area is not contaminated and therefore, significant concentrations of organic chemicals do not leave the site dissolved in surface water (SOP 86).

2.2.2 Surface Soil

During August, 1983, OCC collected soil samples to determine the presence of chemicals in Panhandle surface soil. Near-surface soil samples were collected from a drainage ditch between the Penn Central railroad line and the eastern edge of the site and analyzed for TCDD, chlorophenols and chlorobenzenes (CONT INV 84). Figure 2.7 shows the sampling locations.

The sixteen near-surface soil samples analyzed (Table 13) for various parameters during the OCC August 1983 study showed that chlorophenols were found only at sites SS2 and SS2A. No chlorobenzenes were found at sites SS8, 9, 14 and 15; the other sites had various amounts of some or all of the chlorobenzenes tested. The highest concentrations were found near site SS2 with the concentrations generally decreasing with increasing distance from the SS2 area (CONT INV 84).

The highest concentrations of chlorinated organic compounds found in soil samples taken from the ditch (Figure 2.7) near the railroad were found in the bottom of the ditch at SS-2 and -2A. The concentrations decrease as the distance from this location increases both along the bottom of the ditch and up its side walls. The concentrations at site SS-2F (near the railroad tracks) are, however, higher than at sites SS-2C and SS-2E, both of which are closer to the bottom of the ditch (CONT INV 84).

Fifteen samples were analyzed for 2,3,7,8- TCDD and coeluting compounds (Table 14). None exceeded the 1 ppb (ng/g) level of concern for soil in residential areas established by the U.S. Government Centers for Disease Control.

During June 1984 seven surface soil samples from the Panhandle area were collected and analyzed (SOP 86). Figure 2.8 shows the sampling locations. Results for these seven surface soils (Table 15) analyzed during the Panhandle study found no presence of chlorophenols, but all samples were found to contain low levels of chlorobenzenes (SOP 86).

2.2.3 Non-Vegetated Areas

During November 1984, non-vegetated areas representing limited areas located in the central region of the Panhandle (SOP 86) as shown in Figure 2.9 were found and mapped. Sixty sites were located where vegetative cover was missing or disturbed. These sixty sites were classified into eight groups (Table 16b) based on the types of materials observed. A total of eleven samples (Table 16b) was selected with State concurrence to represent the materials present on the surface (SOP 86).

Chlorophenols were not found (Table 16a) in any of the samples. Samples 4 and 10 showed no chlorobenzenes. The remaining samples showed low levels of chlorobenzenes. Sample 2, a tar-like material occupying a small area near the north boundary of the Panhandle, showed the highest levels of chlorobenzenes.

2.3 Off Plant Property

After being informed of the possibility of suspected Durez materials in the backyard at 889 Lee Avenue (North Tonawanda, New York) by the homeowner, the existence of spent catalyst pellets was confirmed by sampling and analysis conducted by OCC during June and August 1984. Analysis of aerial photographs taken in October, 1951 indicate that soil removed without authorization from the Durez Panhandle probably was used for fill at the present site of 889 Lee Avenue. Analytical results and recommended remedial action were presented in an OCC report entitled Site Remediation Program and Alternatives Considered for 889 Lee Avenue, May 1985 (889 LEE). Remedial action has been completed at 889 Lee Avenue (SOP 86).

During the fall of 1984, discussions were conducted between Occidental and New York State regarding the alleged presence of Durez materials at other off plant property locations besides 889 Lee Avenue. When the State's records concerning alleged Durez material were examined, only two allegations were found and no physical evidence could be located. This was followed by an extensive examination of aerial photographs and a ground reconnaissance in the vicinity of the plant. Although no physical or other evidence of Durez materials was found, twelve (12) sites were selected for the soil survey, including the above mentioned locations. Details of the soil sampling plan and analytical results are found in SOP 86.

None of the fourteen (14) chlorinated benzenes and chlorinated phenols analyzed were detected in soils off plant property (Table 17). With the exception of 889 Lee Avenue, there is no evidence of Durez materials off plant property, and soil in the residential areas near the plant does not contain Durez chemicals (SOP 86).

2.4 Preliminary Sewer Investigations

Water samples were collected from storm sewers both on and off the plant property during the summer of 1980 (RECRA 80) and the summer of 1982 (SUMR 82) and analyzed for a variety of parameters (Tables 18 and 19). The water contained concentrations of organic chemicals consistent with SPDES discharge limits. Analyses of suspended sediments carried in the sewer water (Table 20) showed the absence of chemicals that were analyzed for (SUMR 82).

Well points in the sewer bedding were used to assess groundwater for water quality, flow rate and flow direction (EMPIRE 81 and CONT INV 83). Chemical analyses (Table 21) indicated that organic chemicals were present in storm sewer bedding on Walck Road and in the sanitary sewer bedding on Walck Road and Wilson Avenue. A detailed analysis of the Walck Road storm sewer bedding revealed that groundwater flow was toward the nearest sewer joint and indicates the sewer bedding is not a conduit for migration of contaminants or groundwater except to the sewer itself (CONT INV 83).

2.5 Phase 1 Sewer Investigation

During the winter and spring of 1986, North Tonawanda storm and sanitary sewers were investigated to determine the nature and extent of sediment within the sewers in the vicinity of the OCC Durez facility.

2.5.1 Storm Sewers

Figure 2.10 shows the thirty manholes and six segments of the storm sewer system which were sampled and inspected during the Phase 1 investigation, conducted in January 1986. All work was conducted in accordance with the Site Operation Plan (S.O.P.) dated November 22, 1985 (SOP SEW 85 and PH 1 SEW 86).

Storm sewer sediment samples were composited and split with New York State at the OCC Laboratory at Grand Island, New York. Tables 22 and 23 list a summary of the results of chemical analyses of composite sewer samples. Details of the investigation, including sampling techniques, sampling locations and sediment volumes are found in the OCC Report of Continuing Field Investigations, Phase 1 Report, Durez Area Sewer Investigation, July 1986.

There are estimated to be approximately 788 cubic yards (c.y.) of sediment present in the 8975 lineal feet (l.f.) of storm sewers investigated during Phase 1. Approximately 594 c.y. of this sediment are estimated to be in the Pettit Creek Flume (PCF) between Meadow Drive and Rosebrock Avenue near Treichler Street. These are revised estimates based on data from the video inspection of the PCF (Section 2.7) conducted after completion of the Phase 2 investigation. (See Table 28).

The storm sewers on Wilson Avenue and Walck Road appeared to be in good physical condition. In the Pettit Creek Flume there was evidence at several locations of cracked and/or spalled concrete, and exposed and rusted reinforcing steel in the walls and ceilings.

The total concentration of chemicals in the storm sewer sediment ranged from 0.6 percent in the PCF north of Wilson Avenue to 7.6 percent in the Walck Road storm sewer east of Nash Road.

In addition to the analyses agreed upon in the S.O.P., additional analyses were performed:

- o The northern-most PCF sample (sample number Z163-4 taken from the manhole at the junction between the 4 by 5-foot PCF and the 48-inch circular section sewer to the north) was analyzed for selected parameters. Data are reported in Table 22.

- o The six composite samples were later analyzed for TCDD; these results were presented in the Phase 2 Sewer Report which is discussed below. Results are presented in Table 26.

2.5.2 Sanitary Sewers

Figure 2.11 shows the 16 sanitary sewer manholes which were sampled and the three sewer segments which were inspected using a remote video camera. Sampling and video inspection were done in March 1986. Sanitary sewer sediment samples were split with NYS at the OCC laboratory at Grand Island, NY. Table 24a provides a summary of results of chemical analyses of these sewer sediment samples; Table 24b provides a list of sampling locations correlated to sample numbers. Table 28 shows estimated sediment volumes for the sanitary sewers.

No chlorophenols were detected in any sediment samples. Benzene and styrene were not detected in any of the samples. Dichlorobenzenes were found in all the sanitary sewer sediments. 2-Chlorotoluene was found in 12 of the samples; two of these were at the 2 ug/g (ppm) detection limit. Monochlorobenzene was found in nine of the samples and toluene was found in one sample (Z206) at the 2 ug/g (ppm) detection limit. Phenol was found in sediment sample Z215 at a concentration of 11 ug/g (ppm) and in Z216 at 6 ug/g (ppm).

Video inspection of the sanitary sewers indicated that all lines are in good condition with some indications of infiltration at joints, occasional sags in pipe grade and other minor inefficiences. Generally, there was little accumulation of sediment observed in the sanitary sewers. Sediment accumulation as deep as one-half of pipe diameter was encountered at two locations; at one location this condition prevented passage of the camera.

2.6 Phase 2 Storm Sewer Investigation

Based on Phase 1 results (PH 1 SEW 86), OCC proposed and NYS agreed on a program for further investigation of the storm sewers. The Phase 2 program included sampling and inspection of additional storm sewer segments and laterals and the collection of samples in the inlet. OCC's report on the Phase 2 investigation was submitted to NYS on September 23, 1986.

2.6.1 Storm Sewers

Figure 2.12 shows twelve locations at which the storm sewer system was sampled and inspected during the Phase 2 investigation, conducted in June 1986. Storm sewer sediment samples were split with NYS at the OCC Laboratory at Grand

Island, New York. Table 25a lists a summary of the results of these chemical analyses; Table 25b provides a list of sampling locations correlated to sample numbers. One inlet sample from Phase 2 and six sewer samples from Phase 1 were analyzed for TCDD; results are presented in Table 26.

Of the four samples taken upstream from the Durez plant, two had no chemicals detected and two showed low levels of chemicals.

Total chemical concentrations in the Pettit Creek Flume decreased from 784 mg/kg (ppm) at Gilmore Avenue and Fifth Avenue, to 20 mg/kg (ppm) at River Road.

No chemicals were detected in two (Zimmerman Street and Eggert Drive) of the five small diameter laterals to the PCF. Samples from the remaining three laterals (Prospect Avenue, Euclid Avenue, and Esther Drive) each contained less than 5 mg/kg (ppm) total chemicals.

Four of the six composite samples obtained during the Phase 1 investigation contained 2,3,7,8-TCDD above a concentration of 1 ng/g (ppb). See Table 26.

Based on data from the video inspection of the PCF (Section 2.7), there are estimated to be approximately 92 cubic yards of sediment present in the 5023 lineal feet of the PCF between Rosebrock Avenue (Manhole No. 15) near Treichler Street and the PCF discharge at the Niagara River (See Table 28).

2.6.2 Inlet

On June 30 and July 1, 1986, bottom sediments (relatively soft or loose, recent soil deposits overlying natural, glacial clay) were sampled at ten locations in the inlet (See Figure 2.13).

Samples were composited and split at Durez by OCC and NYS. Detailed information about sampling and analysis, and sediment thickness, depth and volume is presented in the OCC Report of Continuing Field Investigations, Phase 2 Report, Durez Area Sewer Investigation, September 1986.

Sediment volume has been estimated from the maximum and minimum sediment depths measured. The estimated maximum and minimum sediment volumes are 4300 and 2500 cubic yards, respectively.

Chlorobenzenes were found in inlet sediment samples in concentrations varying from 2.3 to 0.003 percent (Table 27). The results indicate the presence of widely varying amounts of the chemicals of interest.

At the 0 to 6-inch depth, concentrations at sites along the south side of the inlet (sites 2, 5, and 8) are generally low (0.7, 0.003 and 0.04 percent, respectively). The sites along the north side (sites 3, 6, and 9) are generally higher (2.3, 0.2 and 0.4 percent, respectively) than those on the south side. The center line samples (sites 1, 4, 7 and 10) vary over a wide range (0.7, 0.1, 0.4 and 1.2 percent, respectively) some being higher than south side samples and some lower than the north side samples. Site 4 is lower than most of the surrounding sites.

The comparison of the 0 to 6-inch depth with the 6-inch to 2 foot depth at sites 1, 4, 7 and 10 show significant variations of concentrations with depth. At sites 4 and 7 the deeper samples have significantly higher concentrations, while at sites 1 and 10, the reverse is true. An explanation for the variation of chemical concentrations may be the uneven deposition of new sediment in the inlet.

The 0 to 6-inch sample at site 10 contained 2,3,7,8-TCDD at a concentration of 15 ng/g (ppb). See Table 26.

2.7 Video Inspection of the Pettit Creek Flume

The inspection of the PCF consisted of a continuous visual and video (black and white) examination of the interior of the PCF with sediment measurements made approximately every 100 feet along the flume bottom. Details of this investigation are presented in the OCC report entitled Video Inspection of the Pettit Creek Flume, North Tonawanda, New York.

Table 28 presents estimates of sediment volumes in PCF segments and other storm sewers, as well as the sanitary sewer sediment volume estimates.

3.0 SUMMARY OF REMEDIAL INVESTIGATION CONCLUSIONS

This section contains a summary of the conclusions of the remedial investigations performed by OCC and its consultants in and around the Durez Division plant property and in the City of North Tonawanda storm and sanitary sewers, including the inlet.

3.1 Groundwater

Unconsolidated Groundwater Zone

The investigation of the unconsolidated groundwater zone included hydrogeologic flow and water quality aspects. Shallow observation wells were constructed especially to monitor groundwater at the perimeter of the plant property.

Groundwater elevations were measured monthly through January 1986 in all existing monitoring wells and have been measured quarterly since April 1986. Contour maps have been prepared from the groundwater elevation data every month from September 1982 to January 1986 and quarterly since April 1986; and hydrographs have been completed for many wells for the 1983-1984 water year. All groundwater elevations are referenced to an assumed plant datum of 101.08 feet.

Water samples taken from many of these wells have been analyzed for representative Durez compounds and other materials and conclusions have been reached about the quality of the water in this area.

Interpretation of the groundwater elevation data and boring logs suggests the following:

- o Potential for groundwater movement off plant property is low.
- o Most groundwater flow from the developed portion of the property is intercepted by existing storm sewers.
- o There is no net groundwater flow from the plant property to locations south of Walck Road.
- o Groundwater movement at the eastern property line is to the south where it is either intercepted by the Walck Road storm sewer, or is limited by low hydraulic gradients and the absence of aquifer material.
- o Any groundwater movement west of Farnsworth Avenue, in the northern portion of the property, is limited by the thinness of the water bearing zone and by the fact that, during dry months, areas of the zone become dry.
- o Groundwater in the northwest portion of the property flows toward the Harding Avenue storm drain. Groundwater flow in the Panhandle region during the relatively high level groundwater months is to the north and northeast.
- o Groundwater movement toward the residential properties west of the plant is precluded most of the time by a north-south groundwater mound at the west property line. During the drier months, groundwater movement is limited by the thinness of the water bearing zone or by the fact that areas of the zone become dry.

- Since 1982, the water table has continued to exhibit the same characteristic features, which are as follows: low water levels in the principal plant area are surrounded by three groundwater mounds on the east, west, and south. A fourth groundwater mound is located in the northeast portion of the site.

The groundwater quality has remained consistent, as indicated below.

- Comparison of the results for monitoring wells sampled in 1982, 1983, and 1984 showed no significant change in chemical composition or concentration.

- Of those wells located south of Walck Road, only one showed organic compounds present. This well, P-32, is on the plant property; wells farther to the south showed no organic compounds.

- Four wells along the western periphery of the facility showed organic compounds; wells NP-31 and NP-28 located just west of the property line and wells NP-13 and NP-20 located on the plant property. Wells farther west showed no organic compounds.

- On the eastern periphery of the plant, four wells contained organic chemicals; P-26 had the highest level of total organics detected at 15.3 mg/l (ppm).

- To the north, in the Panhandle area, organic compounds have been detected in wells NP-15, -40, -43, -44 and -45, but none of the 17 organic chemicals analyzed for were detected in the outermost line of wells. Organic compounds detected in well NP-15 were absent in wells located to the west, east, and south.

- There is no groundwater in the unconsolidated materials in the area between the Panhandle and the Meadow Drive sanitary sewer extension during the relatively low groundwater months. This condition is principally controlled by evapotranspiration. Chemical concentrations in this area are close to the plant property and are very low because of the seasonal absence of groundwater in the unconsolidated zone and the very low concentrations of contaminants during the relatively high groundwater months.

- Remediation should be considered to prevent groundwater containing chemicals from leaving the Panhandle area and to capture contaminated groundwater which has migrated north of the property line.

Other conclusions have been drawn regarding the geology of the Durez property, as follows:

- The configuration of the surface of the clay layer and the clay's impermeability, the limited presence of fluvial sand east of the Niagara Mohawk power line, and intermittent seasonal nature of groundwater flow through the shallow zone make conditions favorable to conventional remedial measures.

- The geotechnical investigation of the clay confirmed the integrity and impermeability of the confining clay layer beneath plant property.

<u>Bedrock Groundwater</u>

Water in the bedrock is isolated from the chemicals in the shallow, unconsolidated groundwater by a thick, continuous layer of clay.

Confirmatory studies regarding the integrity and permeability of the clay, chemical analyses of the clay and characteristics of the clay observed in a clay exploration trench, confirm findings of the CLAY INTG 84 series borings, the laboratory permeability test program and previous site clay boring data. These results indicate that the 16 to 23 feet thick clay layer is continuous and impermeable, and thus is a confining layer for the property (CLAY FINAL 84).

The most likely source of the monochlorobenzene in monitoring well DW-17 was the non-aqueous phase liquid chemicals which occurred in the low area on top of the clay in the vicinity of wells P-6 and DW-17. The heavier-than-water, single-phase chemicals most likely migrated down the outside of the well casing. There are no other known potential paths of migration of chemicals into the bedrock. Remediation should be considered to prevent the future migration of chemicals from the unconsolidated water bearing zone to the bedrock via the existing bedrock wells.

The absence of potential routes of migration, the low concentration of one organic chemical compound in one well, and the high natural concentrations of chlorides and dissolved solids in the bedrock groundwater zone eliminate a need for further monitoring.

3.2 <u>Panhandle</u>

<u>Surface Water</u>

The surface water on and adjacent to the Panhandle area is not contaminated with organic chemicals and therefore, organic chemicals do not leave the plant property dissolved in surface water.

Panhandle surface water does not require remediation.

Surface Soil

Surface soil in some areas of the Panhandle contains low levels of chlorobenzenes. There is limited potential for contact or migration. The Panhandle is surrounded by a fence which significantly decreases any risk of exposure to members of the community. The Panhandle area is isolated from the main plant property.

Areas that contain surface soils that have been considered for remediation are included in areas shown in Figures 2.7 and 2.8.

Non-Vegetated Areas

Chlorobenzenes are present in limited areas located in the central region of the Panhandle. As in the case of the surface soils, the surrounding fence significantly reduces any risk of exposure to members of the community.

Non-vegetated areas that have been considered for remediation are shown in Figure 2.9.

Railroad Ditch

Low levels of chlorinated benzenes and TCDD were found in surface soils forming the bottom of the ditch. No soil samples exceeded the 2,3,7,8-TCDD level of concern for soils in residential areas used by the US Government Centers for Disease Control. Concentrations of all chemicals of concern diminished rapidly at higher elevations within the ditch.

3.3 Off Plant Property

Materials suspected of originating at Durez have been removed as reported in the May 1985 Site Remediation Program and Alternatives Considered for 889 Lee Avenue and the February 1986 Report of Continuing Field Investigations, section on 889 Lee Avenue.

Other locations off plant property that were surveyed and/or sampled showed no evidence of materials originating from Durez, and analytical results showed no organic chemicals in soil.

There are no surface areas off the plant property in the vicinity of the plant that require remediation.

3.4 Sanitary Sewers

- Video inspection of the sanitary sewers indicates that all lines are in good condition with some indications of infiltration at joints, occasional sags in pipe grade and other minor inefficiencies. Sediment accumulation as deep as one-half of pipe diameter were encountered at only two locations.

- There are estimated to be approximately 42 cubic yards of sediment present in the approximately 5100 lineal feet of sanitary sewer investigated.

- The chemical constituents and quantity of sanitary sewer sediment have been sufficiently determined. No further investigations are necessary.

3.5 Storm Sewers

- There are estimated to be approximately 936 cubic yards of sediment in the North Tonawanda storm sewers which were examined during the Phase 1 and 2 sewer investigations. Approximately 686 cubic yards of this total are estimated to be in the Pettit Creek Flume (PCF); 92 cubic yards between Rosebrock at Treichler and the PCF discharge (5023 lineal feet), and 594 cubic yards upstream of Rosebrock at Treichler (4630 lineal feet).

- Total chemical concentrations in the downstream portion of the Pettit Creek Flume at Gilmore and Fifth were twenty five times lower than the concentrations found in the upstream section from Nash to Rosebrock at Treichler. Chemical concentrations further decreased by a factor of forty between Gilmore and Fifth, and River Road.

- The chemical constituents and quantity of storm sewer sediment have been sufficiently determined. No further investigations are necessary.

- The storm sewers on Wilson Avenue and Walck Road appear to be in good physical condition. In the Pettit Creek Flume there is evidence of cracked and/or spalled concrete, and exposed and rusted reinforcing steel in the walls and ceilings.

- While area residents are not exposed to the sediment, they may sometimes detect a chemical odor from the storm sewers, those odors are detectable at concentrations many times lower than concentrations which would pose health concerns (See Table 23).

3.6 Inlet

- The average thickness of sediment overlying natural clay in the inlet ranges from 3.0 to 5.8 feet.

- The total concentrations of chemicals analyzed in the inlet sediment range from 0.003 percent to 2.3 percent.

- The one inlet sediment sample that was analyzed for dioxin contained 2,3,7,8-TCDD at a concentration of 15 ng/g (ppb).

3.7 Video Inspection of the Pettit Creek Flume

The Pettit Creek Flume is generally in fair to good structural condition. OCC's inspecting contractor has reported areas of possible structural weakness. That information has been given to the City of North Tonawanda and DPW personnel have viewed a video tape from the PCF inspection.

Large-size construction debris, bends between manholes, deviations from the standard box culvert section, lateral and overhead obstructions, and various direct and indirect openings to the atmosphere were observed within the PCF and will affect the selection and sequence of possible sediment remediation techiques.

The volume of sediment in the PCF is estimated to be approximately 686 cubic yards. Approximately 87 percent of this quantity is upstream of Manhole No. 15 at Rosebrock Avenue and Treichler Street, including approximately 29 percent upstream of Wilson Avenue. The sediments appear to be predominantly a mixture of sand, gravel, and silt. The silt content appears to increase in the upstream sections where the sediment thickness is the greatest.

Numerous street laterals and other connections are present in the Pettit Creek Flume. They appear to be in good structural condition and range in size from 2 to 48 inches in diameter, with the larger ones usually near the floor of the PCF. Approximately one-half contain varying amounts of sediment, and approximately two-fifths were discharging water during the inspection.

4.0 IDENTIFICATION OF REMEDIAL ALTERNATIVES

This section identifies various remedial alternatives for the Durez Plant and the affected North Tonawanda sewers. The alternatives presented here for assessment are the result of technical screening of available remedial technologies. These alternatives are normally considered to be technically feasible and generically applicable in dealing with chemicals in soil, sediment, sewers and groundwater.

The investigations summarized in Section 2.0 have demonstrated that Panhandle surface water and soils off plant property (described in Section 2.2.) contain no chemicals of concern and need not be addressed further. Presented below are the remedial alternatives that will be assessed in this document. The areas of consideration at the Durez plant include the following:

- Groundwater
    - Unconsolidated zone
    - Bedrock wells
- Plant Sewers
    - Storm
    - Sanitary
- Panhandle Surface Areas
    - Surface soil
    - Non-vegetated areas
    - Panhandle railroad ditch
- Related issues for the Durez Plant include
    - Groundwater treatment
    - Disposition of excavated material

The areas of consideration for the affected North Tonawanda sewers include the following:

- Sanitary Sewers

  Wilson Avenue
  Nash Road - Walck to Wilson
  Walck Road - Penn Central RR to Nash Road
            - Nash Road to Jesella Drive

- Storm Sewers

  Pettit Creek Flume (PCF)
  Other storm sewers
  - Nash Road-North of PCF to Meadow Drive
  - Wilson Avenue
  - Walck Road - Penn Central Railroad to Jesella Drive
  - Other street laterals
  - Other connections

- PCF Outfall at the Inlet

  Sewer sediment discharged from the PCF
  Natural clay underlying the sewer sediment
  City of Lockport 48-inch water intake pipe

- Related issues for the affected North Tonawanda Sewers include:

  Temporary diversion of storm sewer flows during remediation
  Disposition of removed sediment
  Treatment and disposal of water removed from sediment

4.1 Groundwater

Previous investigations have shown that two areas for remedial evaluation are the shallow, unconfined, soil zone underlying the plant, and the existing bedrock wells. The remedial alternatives normally considered feasible for these areas are listed below:

Unconsolidated Zone

No Action
Groundwater Monitoring
Groundwater Pumping
Groundwater Pumping and Recharge
Impermeable Barrier
Impermeable Barrier and Groundwater Recovery
Subsurface Drain

Bedrock Wells

No Action
Sealing
Casing Extraction and Sealing

4.2 Plant Sewers

Plant storm and sanitary sewers may require remedial action to reduce or prevent the infiltration of groundwater that may contain chemicals. No process chemicals are discharged to plant sewers. Considered remedial alternatives include:

- No Action
- Disconnect Sewers
- Cleaning
- Sealing/Plugging Leaks

4.3 Panhandle

4.3.1 Panhandle Surface Areas

The areas for remediation here are surface soils and non-vegetated areas. The remedial alternatives considered for these areas are listed below.

Surface Soils	Non-vegetated Areas
No Action	No Action
Cover	Cover
Removal of Surface Materials	Removal of Surface Materials

4.3.2 Panhandle Railroad Ditch

The remedial alternatives considered for the railroad ditch are as follows:

- No Action
- Fencing
- Cover
- Removal of Surface Material
- Culvert Installation

4.4 Groundwater Treatment

The alternatives considered for treatment of collected groundwater include carbon adsorption, distillation, solvent extraction, thermal incineration and biological treatment.

4.5 Disposition of Excavated Materials

Several options exist for the disposal of materials that may be excavated or removed during the implementation of remedial actions. These fall into two general categories; disposal off plant property and disposal on plant property.

4.6 Sanitary Sewers

The affected North Tonawanda sanitary sewers contain a limited quantity of sediment that exhibits very low levels of chlorobenzenes in comparison to levels in the storm sewers. The alternatives considered for remediation include the following.

- No Action

- Sediment Removal by:
  - Mechanical removal of sediment
  - Hydraulic flushing followed by vacuum or hydraulic removal of sediment

4.7 Storm Sewers

The affected North Tonawanda storm sewers will be separated into three components for the purposes of listing and assessing remedial alternatives: the Pettit Creek Flume, all other storm sewers, and the inlet.

4.7.1 Pettit Creek Flume

The PCF differs from other North Tonawanda storm sewers in several ways: it is a concrete box culvert of rectangular cross-section, typically ranging from 4 to 5 feet high and 5 to 8 feet wide; it contains most of the sediment encountered in the storm sewer system during previous investigations; and, it discharges to surface water at the inlet (See Figure 2.13). Alternatives considered for remedial action at the PCF include the following.

- No Action

- Sediment Storage in Place (in the PCF)

- Sediment Removal by:
  - Conventional methods (hydraulic, mechanical, vacuum, combined)
  - Innovative methods applying mining and dredging technologies

4.7.2 Other Storm Sewers

Other North Tonawanda storm sewers have a circular cross section, up to 48 inches in diameter. They include street laterals and other connections intersecting with the PCF and observed during the video inspection of the PCF. Street laterals are defined as large diameter (12+ inches) pipes shown on the City sewer maps and usually located in the bottom half of the PCF. They drain streets. Other connections are defined as the remaining smaller diameter pipes, usually located in the upper half of the PCF, and with uncertain origin. The alternatives considered for their remediation include the following.

- No Action

- Sediment Removal by:
  - Hydraulic methods
  - Mechanical methods
  - Vacuum methods
  - Combined methods

4.8 Inlet

4.8.1 Sewer Sediment

The inlet contains sediment which comes from the PCF and surrounding land surface areas. The sediment contains varying levels of organic chemicals. Alternatives considered for remediation of the inlet include the following.

- No Action
- Containment and Sediment Storage in Place
- Sediment Removal by:
  - Hydraulic dredging
  - Mechanical dredging
  - Dewatering and excavation

4.8.2 Underlying Natural Clay

The Phase 2 Sewer Investigation did not provide samples suitable for determination of the presence or absence of organic chemicals in clay underlying the sediments in the inlet. NYS has requested that the physical, and possibly the chemical, condition of this clay be determined, after sewer sediment has been removed from the inlet. This issue is addressed further in Section 6.13.

4.8.3 City of Lockport 48-inch Water Intake Pipe

In 1907, the City of Lockport constructed a 48-inch diameter water intake pipe, extending from the Niagara River, west of Tonawanda Island, to a pumping station east of the inlet, approximately at the location of the present Lockport pumping station. The 48-inch pipe passes under the south side of the inlet. In 1977, a polyethylene liner was installed in the pipe.

NYS has requested that, as part of further investigation of the inlet clay, OCC determine the presence or absence of chemicals near the Lockport water intake pipe. This issue is addressed further in Section 6.13.

4.9 Diversion of Storm Sewer Flows

The remedial alternatives under consideration for the affected North Tonawanda storm sewers will require varying degrees of temporary diversion of storm sewer water. Several aspects of flow diversion are presented for consideration in Section 5.13.

4.10 Disposition of Removed Sediment

The alternatives considered for disposition of sediment removed during remediation fall into five categories.

- o Off-site treatment
- o Off-site disposal
- o Storage adjacent to the inlet
- o Interim storage at the Durez Plant
- o Treatment at the Durez Plant

Various options in each of these categories are considered in Section 5.12.

4.11 Water Treatment and Disposal

Sediment removal and sewer cleaning operations may generate water containing organic chemicals. Options are presented in Section 5.14 for the treatment and disposal of this water, including:

- o Discharge without treatment;
- o Suspended solids removal prior to discharge;
- o Suspended solids removal and carbon filtration prior to discharge.

4.12 Regulatory Constraints

The evaluation of remedial alternatives is substantially complicated by the regulatory hurdles imposed by Federal and State statutes, regulations and practice. This section explores some of the bases for dispensing with governmental permits and other formal regulatory requirements for remedial alternatives and then describes the permit and other regulatory requirements which would complicate and delay remediation if those formal requirements cannot be dispensed with. This Section 4.12 has been prepared by counsel for OCC.

4.12.1 Waiver of Permits

a. Federal Waiver

This section identifies the extent and the authority for waiver of the state and federal permit requirements. If permits are required for the on-site remedial activity, EPA estimates that the implementation of the remedial plan is likely to be delayed for 10 to 12 months (50 Fed. Reg. 47912). Because the permit procedure in New York State includes an adjudicatory hearing as compared to the federal legislative hearing process, the delay could be even more substantial. In recognition of the potential for delay and the possibility that federal, state and local permits could thwart an on-site remedial program, Congress enacted section 121 (e)(1) of SARA which provides as follows:

> No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely on-site, where such remedial action is carried out in compliance with this section.

The rationale for not requiring permits is that the procedure and standards established by section 121 of SARA and the NCP ensures compliance with the substantive regulations of applicable and relevant and appropriate requirements. In addition, the RI/FS process provides adequate scrutiny to ensure that proper storage, treatment and disposal will be achieved. Because the permit requirements could add significant and unwarranted delay and could obstruct removals that are necessary to protect pubic health and the environment, Congress chose to waive federal, state and local permits for the portion of the remedial program conducted entirely on-site where such remedial programs are carried out in compliance with standards set forth in section 121 of SARA.

EPA officials have, for now, interpreted section 121(e)(1) of SARA as applicable only to federally approved remedial programs. It does not include privately-funded remedial programs (though consistent with section 121) that are not approved by EPA. The basis for this interpretation is that section 121 defines the standards applicable to remedial programs "required or agreed to by President" (See SARA Section 121(c)(1)) and provides a mechanism to ensure that the states have an opportunity to participate in the selection process.

Because section 121 (e)(1) waives permits only for those programs selected and carried out in accordance with section 121, EPA officials take the position, for now, that permits are waived only for those remedial programs "required or agreed to" by EPA.

In addition to its authority to waive permits under Section 121 (e) (1), EPA has authority to issue emergency permits (See 40 CFR 270.61) where there is no other realistically available management facility (See 50 Fed. Reg. 1986). In the preamble to the dioxin-containing waste rule, EPA stated: For example, if no management capacity is available following a dioxin waste clean up, an emergency permit could be issued to a facility if the alternative is to leave the waste in place in an unsecured setting. (50 Fed. Reg. 1986).

The need for EPA's approval of the remedial program is more critical where federal permits are needed to implement the remedial alternative. As shown herein, the remedial alternatives could require federal permits from the U.S. Army Corps of Engineers and from USEPA as well as State permits. As shown below, New York State has authority to waive state permits, but absent federal court intervention, it does not have authority to waive federal permits.

b. State Waiver

In the past, it has been "the New York State Department of Environmental Conservation's practice to require a defendant to meet the substantive requirements of permit regulations which would normally apply to activity undertaken, but not to require obtaining the permits themselves." (See Memorandum from Langdon Marsh, Executive Deputy Commissioner, to Norman Nosenchuck, dated July 13, 1984). The Department asserts prosecutorial discretion as its authority for waiving permits. (See, NYSDEC

Declaratory Ruling, 72-3; See also Gaybor v Rockfeller, 15 NY2d 120, 131, 132 (1965); ECL 71-0507 (1) (c) and Executive Law 63(15)). The Department is currently reviewing this policy to determine whether it should be continued, limited or expanded.

In addition to waiving permits, under 6 NYCRR 617.2 (m)(1), actions taken pursuant to or as a result of an enforcement actions are exempt from the requirements of the State Environmental Quality Review Act which requires an applicant to prepare an environmental impact statement for action which may have a significant effect on the environment.

c. Judicial Power

Finally, the federal district court, through its power in equity, has the authority to require the implementation of remedial activity without federal, state and local permits if the court determines that such action is necessary to protect human health and the environment and the delay attributable to the permit process will impede that objective. United States v First National Bank, 379 U.S. 378; See Also, Consent Decree in New York State v Mercury Refining Co., Inc., 83 CV 1054 (U.S.D.C.N.D.N.Y.) as amended on September 18, 1985.

4.12.2 Possible Permit Requirements

This section identifies the major state and federal permit and other formal requirements applicable to the various remedial alternatives unless dispensed with. It does not identify any local permits, right of ways or easements that are or may be required.

a. Classification of Removed Sediment Under the Hazardous Waste Regulations

A critical issue to identifying the applicable and relevant permit requirement is the classification of the sediment as a hazardous or non-hazardous waste. For the sediment to be a hazardous waste, the sediment must possess either one of the characteristics of hazardous waste under 6 NYCRR 371.3 (i.e., ignitable, corrosive, reactive, or E.P. toxic) or be a wastestream listed in 6 NYCRR 371.4 or be mixed with a wastestream listed on 6 NYCRR 371.4. Additionally, the waste must not be excluded from classification under 6 NYCRR 371.1 (e).

The first step is to determine whether the sediment is exempt from classification as a hazardous waste under section 371.1(e). If the answer is "yes", the analyses end here - the sediment is not a hazardous waste. All or a portion of the sediment is excluded from classification as a hazardous waste under section 371.1(e)(1)(b) (i.e., excludes any mixture of domestic sewage and other wastes that passes through a sewer system) and under section 371.1(e)(1)(ii) (excludes industrial wastewater discharges that are surface water point source discharges regulated under Article 17 of the ECL).

For the sediment, if any, that is not excluded from classification as a hazardous waste under the foregoing exclusions, the next step is to determine whether that sediment possesses any of the characteristics identified in section 371.3 (i.e., ignitability, corrosivity, reactivity and E.P. toxic). The sediment is not expected to possess any of those characteristics.

The last and final step is to determine whether the sediment is listed in section 371.4 or is mixed with a wastestream listed in section 371.4. Sewer sediment itself is not listed in section 371.4. Though some hazardous chemicals have been detected in the sediment, none of the wastestreams listed in Section 371.4

are the suspected source of those chemicals in the sediment. By way of example, as previously noted, low levels of dioxin have been detected in portions of the sediment. For the sediment to be classified as a hazardous waste, it must, however, contain or have been mixed with one of the wastestreams identified in F020 through F028. The process, however, that is suspected to have resulted in the formation of dioxin is no longer performed and is not listed in F020 through F028.

Similarly, some solvent-type chemicals (e.g., chlorobenzene) have been detected in some portions of the sediment, but those chemicals are not suspected to have resulted from any of the wastestreams listed in F001 through F005. The wastestream listed in F001 through F005 include only processes where the chemicals were used as solvents and do not include manufacturing waste where these chemicals were used as a chemical intermediate or as feedstock.

In summary, the classification of the sediment as a hazardous waste is far from certain. Major portions of the sediment appear to be excluded from classification as a hazardous waste. There is insufficient clarity in the regulations and the circumstances relating to the source of the chemicals in the sediment to conclude that the sediment is a listed hazardous waste or a hazardous waste mixture. Nonetheless, for purposes of the remainder of the permit discussion, it is assumed that the sediment is classified as a hazardous waste. The hazardous waste permit requirements applicable to the proposed remedial alternatives are discussed in more detail below.

b. Transportation of Removed Sediment

The transportation of a hazardous waste or a solid waste generally requires a state permit to transport pursuant to 6 NYCRR Part 364. Section 364.1 of 6 NYCRR specifically exempts from the permit requirements of Part 364 the transportation of dredge and fill material. Accordingly, a permit pursuant to 6 NYCRR Part 364 may not be required for the transportation of the sediment from the inlet but a transporter permit may be required for the transportation of the sediment cleaned from the storm and sanitary sewers.

If the sediment is a hazardous waste, the hazardous waste manifest requirements of 6 NYCRR 372 will be applicable.

c. Storage of Removed Sediment

If the sediment is a hazardous waste, the storage of the sediment once it is removed from the sewers or inlet requires a hazardous waste storage permit pursuant to 6 NYCRR Part 373. If the sediment is classified as a dioxin waste (i.e., F020, F021, F023, F026, and F027), the special requirements for the storage of such wastes are applicable (See 6 NYCRR 373-2.10 (i), 373-2.11 (i), 373-2.12 (i)). These requirements are enforceable by both NYSDEC and USEPA (See, 40 CFR 271.1 (j)).

The only storage of hazardous waste that is allowed without a permit is the storage at the site of generation in containers or tanks for less than 90 days and the storage in the transport vehicle prior to the unloading. It is also possible that some short term storage at the site of generation that is a necessary part of the removal operation would be allowed without a storage permit pursuant to 6 NYCRR Part 373 because it will be deemed a part of the cleaning and dredging process (i.e., the generation process) and not storage. The long term storage of hazardous waste either on-site or off-site requires a hazardous waste storage permit pursuant to 6 NYCRR Part 373.

The storage of sediments containing greater than one percent of F001 through F005 spent solvents cannot be stored in or on the land (i.e., surface impoundments or waste piles) unless certain treatment standards are met pursuant to the federal land burial restrictions of 40 CFR Part 268. The treatment standards are identified in 40 CFR 268.41. There are exemptions from this prohibition for (1) generators that can satisfactorily demonstrate that there will be no migration of hazardous contituents from the unit for so long as the waste remains hazardous pursuant to 40 CFR Part 268.6; (2) for generators that can demonstrate a lack of available treatment technology pursuant to 40 CFR Part 268.5; and, (3) for solvent waste generated from any response action taken under CERCLA. The latter exemption is only available until November 8, 1988 and EPA interprets the latter exemption as being limited only to EPA approved response actions.

Similarly, after November 8, 1988, the storage of all sediments classified as a hazardous waste under F001 through F005 (i.e., the spent solvent wastes) or classified as a hazardous waste under F020, F021, F023, F026, F027 and F028 (i.e. the dioxin waste) cannot be stored on land unless certain treatment standards (i.e., concentration levels) are met. The treatment standards are identified in 40 CFR 268.41. The two exemptions described above in 40 CFR 268.5 and 268.6 are also applicable to this land burial restriction.

d. Treatment of Removed Sediment

The treatment of the sediment (including dewatering, incineration, detoxification, stabilization, extraction and volume reduction) both on and off the site of generation may require a hazardous waste treatment or disposal permit pursuant to 6 NYCRR Part 373.

The treatment of sediments containing greater than one percent of F001 through F005 spent solvents in surface impoundments will not be allowed unless such treatment is in accordance with the requirements of 40 CFR 268.4. That section specifies some minimum design requirements for new and existing impoundments and requires that the treatment residue not meeting the treatment standards of 40 CFR 268.41 be removed annually. The two exemptions from the land burial restrictions described in 40 CFR 268.5 and 268.6 are also applicable to this restriction.

After November 8, 1988, the treatment restrictions applicable to surface impoundments will include all sediments classified as a hazardous waste under F001 through F005 (i.e., the spent solvents) or classified as a hazardous waste under F020, F021, F023, F026 and F028 (i.e., dioxin waste).

To incinerate dioxin waste classified under F020, F021, F023, F026 and F028, the facility must have demonstrated a destruction and removal efficiency of 99.9999 percent in accordance with 6 NYCRR 373-2.15 (d)(1)(ii) and 373-3.15. Nationally, no facility has yet received a permit to incinerate dioxin waste.

e. Land Burial Ban

The land burial or land disposal of the sediment either on or off the site of generation requires a permit pursuant to 6 NYCRR Part 373. Under 40 CFR Part 268, the land burial of sediment containing greater than one percent of F001 through F005 spent solvents will not be allowed unless the treatment standards of 40 CFR 268.41 are met. After November 8, 1988, the land disposal ban will be applicable to all sediment classified as a hazardous waste under F001 through F005 (i.e., the spent solvents) or classified as a hazardous waste under F020, F023, F026, F027 and F028 (i.e., the dioxin waste). The two exemptions to the land burial restrictions set forth in 40 CFR 268.5 and 268.6 are also applicable to this restriction.

Any dioxin waste or solvent waste disposed of on land prior to November 8, 1988 is not subject to the land disposal restriction as long as it is not removed after that date.

In addition, the land burial of the dioxin waste listed in F020 through F028 is also subject to the special requirements of 6 NYCRR 373-2.14 (m). These requirements are subject to both federal and state enforcements. Those provisions require the submission of a management plan for handling of dioxin waste. To date, USEPA has never published any guidelines for the preparation of such plans and no facility in the United States has submitted such plans.

On April 30, 1984, New York State initiated phased reduction of the land burial of certain hazardous organic wastes. The ban was implemented through modifications to the permits issued to CECOS and SCA. Portions of this sediment may be subject to this burial ban. Currently, the following hazardous wastes, inter alia, are banned from land disposal in New York State if they contain greater than two percent by weight of the following:

1. Halogenated, nitrogenated or aromatic chemicals;

2. Low molecular weight organic chemicals, i.e., those that are non-solid in the pure state at 25°C;

3. Any of the organic constituents identified in 40 CFR 261.33 (e) and (f),

4. The hazardous constituents listed under the following EPA waste codes:

F-001	K-010	K-018	K-029	K-042	K-096
F-002	K-015	K-019	K-030	K-073	K-097
K-001	K-016	K-020	K-033	K-085	K-098
K-009	K-017	K-021	K-034	K-095	K-105

The ban provides for a waiver for up to 18 months if it can adequately be demonstrated that practical alternative high technology facilities that can manage the specific waste do not exist. The decisions on waiver are typically made by the Region 9 Office of NYSDEC on a case-by-case basis. No waivers have been issued since August, 1985.

4.12.3 Removal of Sediment from the Inlet

State and federal permits may be required for the excavation done in the inlet at the Little Niagara River.

a. State Permits

Under section 15-0501 of the ECL, any person modifying or disturbing a stream must obtain a permit to do so. Similarly, under section 15-0505 of the ECL, any person excavating or placing fill below the mean high water level in any navigable waters of the State of New York must obtain a permit to do so. "Navigable water" includes waters used, or able to be used, in their natural and ordinary condition, as a highway for commerce over which trade and travel were or might be conducted. If the work constitutes disturbance of a stream bed under section 15-0501 and excavation or fill of navigable waters under section 15-0505, only one permit application is required.

b. Federal Permits

Under the Rivers and Harbors Act of 1899, any dredging or excavation affecting navigable waters of United States requires a permit from the U.S. Army Corps of Engineers. The determination of "navigable waters" is made on a case-by-case basis by the Corps of Engineers and includes waters presently used or that have been used or may be susceptible for use in interstate transport or foreign commerce. The permits are issued pursuant to 33 CFR Part 322.

In addition to dredging permits, section 1344 of 33 USC requires a permit for the discharge of fill material into navigable waters. The discharge permits are issued pursuant to 33 CFR Part 323.

The Department of the Army has developed a "nationwide permits" program. This program authorizes certain activities that otherwise would be subject to the individual permit requirement. The activity must be listed in the regulation and specified conditions must be met. One of the activities is as follows:

> Structures, work and discharge for the containment and cleanup of oil and hazardous substances which are subject to the National Oil and Hazardous Substances Pollution Contingency Plan provided the Regional Response Team which is activated under the Plan concurs with the proposed containment and cleanup action (33 CFR 330.5 (a) (207)).

The nationwide permit program is applicable to both dredging permits pursuant to 33 CFR Part 322 and to discharge permits pursuant to 33 CFR Part 323. The applicability of the nationwide permit to the remedial work that may take place in the inlet will depend on the involvement of USEPA in the approval of the remedial plan.

If a permit is required from the Army Corp of Engineers, the Commissioner of Environmental Conservation must certify under section 401 of Clean Water Act that the proposed activity will not cause a contravention of New York State water quality standards.

4.12.4 Water Treatment and Disposal

The water generated by the sediment removal (including dewatering the sludge) and sewer cleaning may contain organic chemicals. As a result, it can not be discharged into the State surface waters or to the local POTW without the required permits under ECL, Article 17 or authorization from the POTW. Such regulations and approvals may require the treatment of such water prior to discharge.

The Durez plant has had for many years a SPDES permit for discharge of wastewater to the City storm sewers. Counsel for OCC advises that presumably this permit was issued pursuant to ECL Article 17 Title 8 and the Clean Water Act, Section 402 because the storm sewers ultimately flow into the Niagara River. If a SPDES permit is required, it would also be required with respect to the discharges to the storm sewers from any proposed wastewater treatment system. Complications have been posed by the State's stated intention to impose "corrective action" requirements on the Durez plant under the asserted authority of a SPDES permit during the pendency of State of New York v. Occidental Chemical Corp., 83 CV 0552 C (U.S.D.C.W.D.N.Y.). The corrective actions and the lawsuit both seek remedial action with respect to chemicals in groundwater resulting from past plant activities. OCC has taken the position that the State cannot simultaneously in two different forums seek remedies for the same alleged conditions.

4.12.5 State Environmental Quality Review Act ("SEQRA")

Under Article 8 of the ECL (i.e., SEQRA), prior to issuing any permit that may have a significant adverse effect on the environment, the state agency issuing the permit must require that an environmental impact statement be prepared. Because the overall impact of the remedial program is positive, not adverse, no impact statement should be required. In any event, actions taken pursuant to or as a result of an enforcement action are exempt from the impact statement requirements (See 6 NYCRR Section 617.2 (m) (l)).

5.0 EVALUATION OF ALTERNATIVES

In this section the remedial alternatives presented in Section 4.0 are evaluated to identify remedial alternatives for the Durez plant and affected North Tonawanda sewers which adequately protect public health and the environment. The National Contingency Plan (NCP; 40 CFR 300.68 G,H) and Guidance on Feasibility Studies under CERCLA, US EPA, April, 1985, have been used to guide the selection process and to identify appropriate factors for evaluating alternatives.

The alternatives presented here for assessment are the result of technical screening of available remedial technologies. The purpose of the screening was to focus the evaluation and selection process on the remedial technologies that are normally considered to be technically feasible and generically applicable in dealing with chemicals in soil, sediment, sewers and groundwater.

To achieve the general objectives of Section 1.0, the primary factors used to evaluate alternatives and technologies are technical feasibility, risk of public exposure, and cost. Technical feasibility of the alternatives includes performance, reliability, implementability and construction safety. The performance evaluation includes effectiveness and useful life. Effectiveness refers to whether an action is adequate to protect public health and the environment. The useful life is the length of time this level of effectiveness can be maintained.

The reliability evaluation of alternatives is based on their operation and maintenance requirements and their reliability at similar sites. Implementability is defined as the relative ease of installation (constructability), and the time required to achieve a given level of response or results.

Costs for various alternatives have not been quantified. Rather, alternatives were evaluated on the basis of cost in a relative sense using best engineering judgement and experience. Detailed discussions of costs are therefore not included in this document.

Exposure or contact with a chemical substance is essential before it can produce an adverse effect on man or other living organisms. A first step in an assessment of the potential for an adverse effect on human health or the environment is to determine the potential for exposure to the chemicals of concern. An effort has been made qualitatively to assess the risk of exposure associated with the remedial alternatives that appear to be technically appropriate. As with costs, the exposure assessment is based largely on engineering judgment and experience with the various alternatives.

5.1 Groundwater - Unconsolidated Zone

This section addresses the alternatives for remediating groundwater flow containing chemicals, from the Durez property.

5.1.1 No Action

The low levels of chemicals identified within the groundwater, and the lack of potential pathways of human exposure to groundwater in the unconsolidated zone would make the no action alternative appropriate for evaluation. However, OCC has directed this study not to consider this alternative in the interest of settlement and because it does not achieve the stated OCC objective of intercepting groundwater flow from areas of the plant being remediated.

5.1.2 Groundwater Monitoring Only

While the groundwater monitoring only alternative may be acceptable for the reasons stated in Section 5.1.1, OCC has directed this study to pursue other remedial alternatives in the interest of settlement and to achieve the objective of intercepting groundwater flow from areas of the plant being consisdered for remediation. Groundwater monitoring alone is therefore not considered a viable alternative. However, groundwater monitoring used in conjunction with other remedial technologies is essential in assessing the performance of the selected alternative.

5.1.3 Groundwater Pumping

Groundwater pumping from well points is normally an alternative for the removal and containment of groundwater containing chemicals. This method of groundwater pumping has been used successfully for construction dewatering and for some aquifer remediation programs.

Well point dewatering systems are relatively straightforward to implement and operate and are a proven remedial alternative for certain hydrologic conditions. This system would include a suction lift pump connected to several closely spaced, vertical wells or well points.

The success of this system is dependent upon aquifer thickness, transmissivity of the saturated zone and well point spacing.

Well yields often decrease with time due to silting or encrustation of the well points. The water quality associated with the Durez property does not indicate encrustation to be a significant problem. However, the fine grained nature of the water-bearing materials, identified through visual observation of site soil and grain size analyses, suggest siltation of the wells may be a potential problem even with proper well design. In order to maintain well yields, a well rehabilitation program may need to be implemented on a regular basis.

The saturated thickness of the water-bearing unconsolidated zone is generally less than 7 feet, which would also limit well yields. Very close well spacings would be required to capture all groundwater flow off plant property to compensate for these hydrologic conditions.

For these reasons, groundwater pumping is not considered a technically appropriate remedial alternative at the Durez plant.

Infiltration Gallery

The construction of infiltration galleries to capture groundwater flow is normally an alternative remedial technique.

In a thin water-bearing zone, such as that found beneath Durez, vertical wells are basically ineffective tools for dewatering the aquifer. However, infiltration galleries which consist of one or more subsurface horizontal well screens, connected to a suction lift pumping system, can sometimes effectively dewater the soil or capture groundwater.

The materials and equipment for the construction of such a system are readily available in most areas. However, the effectiveness of the infiltration gallery could be significantly reduced due to siltation of the screen. Although proper design of the screen's filter pack could alleviate or reduce the problem, the fine grained nature of the unconsolidated material at Durez suggests that siltation may be a problem, and that periodic infiltration gallery rehabilitation may be necessary to maintain the system's effectiveness. For these reasons, an infiltration gallery is not considered a technically appropriate remedial alternative at the Durez plant.

5.1.4 Groundwater Pumping and Recharge

Groundwater pumping with recharge is normally an alternative to remove and contain groundwater in certain situations. A pumping system with recharge wells, basins or ditches can be used to return treated groundwater to the water bearing material, as well as flush residual chemicals from the unconsolidated material. The materials and equipment for construction of such a network are readily available. Groundwater pumping and recharge has been used for controlling groundwater contamination and salt water intrusion, for solution mining and for oil production.

The success of a groundwater pumping and recharge system is dependent, however, on the pumping well placement and the recharge capacity of the water bearing material. Details concerning groundwater pumping were outlined in Section 5.1.3. Recharge can be accomplished with wells, recharge basins or ditches. Recharge wells would not be appropriate at the Durez facility because of the shallowness and limited saturated thickness of the water bearing zone. Recharge basins would not be appropriate because of space limitations, the low hydraulic heads that could be developed and the relatively low permeability of the surficial soils. Recharge ditches would be filled with gravel and would need to be located centrally between lines of pumping wells to maximize flushing. The primary limitation of such a ditch system is the ability of the water bearing zone to receive the recharge water.

The addition of a central ditch recharge component to the groundwater pumping alternative would increase groundwater levels, flow rates and pumping rates, without any major enhancement to the remediation program. Groundwater recharge in ditches along the property boundaries in an attempt to prohibit flow from plant property would cause plant groundwater levels to rise which would require increased pumping rates without any added benefit. Thus, groundwater pumping with recharge is not considered a technically appropriate remedial technology because of the limited recharge capability of the aquifer, and space restrictions at the plant.

5.1.5 Impermeable Barriers

An impermeable barrier is a remedial alternative that can prevent groundwater from flowing off the Durez property. Impermeable barriers are passive systems that require minimal maintenance. Their construction is relatively straightforward, although specialty contractors are required. An impermeable barrier is not considered an appropriate remedial action for Durez because it does not remediate groundwater which may have already migrated from plant property. Also, it does not improve the groundwater quality on plant property. Plant storm and sanitary sewers and other utilities would penetrate the barrier and could compromise its integrity. An impermeable barrier would also capture water infiltrating on the property, raising water table elevations and possibly cause surface ponding.

5.1.6 Impermeable Barrier and Groundwater Recovery

The combination of an impermeable barrier and groundwater recovery is an alternative that can eliminate groundwater flow off the Durez plant and remediate groundwater on plant property containing chemicals. Details concerning impermeable barriers have been discussed. Groundwater recovery within the barrier would be useful for collecting and treating groundwater in addition to maintaining the groundwater level within the plant required to keep the gradient and flow toward, rather than away from, the property. However, as with the impermeable barrier alone, groundwater containing chemicals which may have already migrated off plant property would not be remediated. Plant storm and sanitary sewers would have to pass through the barrier resulting in a possible compromise to the barrier's integrity. For these reasons, the impermeable barrier and groundwater recovery remedial technology is not considered an appropriate alternative for the Durez property.

5.1.7 Subsurface Drain

A subsurface interceptor drain is an attractive remedial alternative since the shallow unconsolidated groundwater aquifer underlying the Durez property is well suited for drain operation and installation. In general, for shallow remedial applications, drains can be as effective as pumping, particularly in strata with low or variable hydraulic conductivity. Under these conditions, it would be more difficult to design, build and operate a pumping system to maintain a continuous hydraulic boundary.

Interceptor drains passively create a continuous discharge zone toward which groundwater flows from both sides of the drain. Thus, with minimal maintenance, drains placed along the perimeter of the plant property would eliminate any movement of groundwater off plant property, and would collect groundwater both on and off plant property. Because of the reduced groundwater flow rates into a drain system when compared to a pumping system, siltation should not be a significant factor for maintenance. There would be no problems with utilities crossing the interceptor drain, as flow in any utility trench/bedding would be collected in the drain.

Subsurface drains utilize proven and reliable technology; the constructability of such drains is straightforward and well established. An interceptor drain could be constructed in the shallow deposits on this property by an experienced local contractor using basic heavy construction equipment. All excavated material would be disposed of properly as discussed in Section 5.7.

A subsurface interceptor drain is considered the most appropriate remedial technology for the Durez facility because it would eliminate the movement of groundwater off the Durez property, it would capture groundwater on plant property as well as groundwater containing chemicals that may have already migrated to adjacent areas, and it is particularly well suited for shallow, laterally extensive remedial applications. Because the drain will collect for treatment groundwater containing chemicals, it will permanently reduce the volume of chemicals on the plant and adjacent properties.

5.2 Bedrock Groundwater

This section addresses the remedial alternatives for preventing degradation of bedrock groundwater quality, especially by migration of chemicals downward along the well casing at bedrock well DW-17. Well DW-17 was installed at the request of New York State to provide an additional sampling/observation point for the Durez bedrock groundwater assessment. It has been in place since January, 1980.

5.2.1 No Action

While no action is an alternative that is protective of public health and the environment because of the very low concentration of only one organic chemical in only one well (based on data from the six-month pumping program) and the naturally non-potable quality of bedrock groundwater, OCC has directed this study to evaluate sealing the bedrock wells. Two alternative methods are presented below to seal the bedrock wells to prevent future migration of chemicals into the bedrock aquifer.

5.2.2 Sealing

While no organic chemicals were detected in DW-7, DW-12 and DW-16 during the six-month pumping program, sealing of the bedrock wells is considered an appropriate remedial technology to eliminate the potential for any future migration of chemicals into the bedrock groundwater via the existing bedrock wells, and to prevent the unauthorized disposal of chemicals into these wells, however unlikely this possibility may be.

To eliminate any potential of additional chemicals reaching the bedrock via the well casing, the bedrock wells DW-7, DW-12, DW-16 could be plugged with cement grout. Sealing a well or boring with grout is a proven and reliable technology and the resources for implementation are readily available.

The most likely source of the monochlorobenzene in DW-17 is the non-aqueous phase liquid chemicals which occurred in the top of the clay depression in the vicinity of wells P-6 and DW-17. The most probable explanation is that heavier-than-water chemicals slowly migrated down the outside of the well casing. The removal of these separate phase chemicals by pumping from well P-6 has removed the source. There are no other known potential paths of migration of chemicals into the bedrock groundwater.

At DW-17 the earth material in contact with the casing could be pressure grouted from the surface down to the bottom of the well's 12-inch diameter outer steel casing, approximately seven feet below the top of the clay layer. In addition, the interior of the casing could be sealed, in the same way as the other bedrock wells.

Because of the problems observed at well DW-17, the internal sealing and external pressure grouting alternative is the desired remedial action at this location.

Sealing these four wells would be protective of public health and the environment because it would reduce the mobility of chemicals by preventing their entry to, or migration in, bedrock.

5.2.3 Sealing and Casing Extraction

Another alternative to prevent migration of contaminants down the exterior of the bedrock well casing at DW-17 would involve the extraction of the well casing and sealing the remaining hole by pressure grouting. Pressure grouting would first be performed within the bedrock to provide a preliminary seal. The well casing would then be extracted, probably by overcoring techniques and hydraulic jacking, before the grout has hardened. The vacated borehole would be pressure grouted during actual extraction of the casing and drill stem.

Extraction may present some risk of further movement of chemicals downward from the unconsolidated zone into the clay and/or bedrock, because of the disruptive nature of casing extraction methods. Accordingly, this alternative is considered technically not appropriate.

5.3 Plant Sewers

5.3.1 Plant Sanitary Sewers

See Figure 5.1 for the locations of Durez plant sanitary sewers.

The no action alternative could be considered protective of public health and the environment for plant sanitary sewers for several reasons:

- There are no process discharges to plant sanitary sewers. Only boiler blow-down, toilets, sinks and showers discharge to the sanitary sewers.

- Sanitary sewer discharges are eventually treated at the North Tonawanda waste water treatment plant (WWTP) before final discharge to the Niagara River. Treatment at the WWTP includes carbon filtration to remove dissolved organic chemicals from the plant's final effluent.

- While groundwater infiltrating to the sanitary sewers at the Durez plant may contain dissolved organic chemicals, sampling and inspection of the North Tonawanda sanitary sewers in the vicinity of Durez do not indicate that high concentrations of organic chemicals have been discharged to the city sanitary sewer system.

Nevertheless, OCC has previously stated its intention to disconnect or plug existing plant sanitary sewers in the western part of the plant that are no longer in service. This will help reduce the infiltration of plant groundwater to the NT sanitary sewer system and WWTP.

5.3.2 Plant Storm Sewers

See Figure 5.2 for the locations of Durez plant storm sewers.

No action is considered to be an appropriate alternative for some but not all plant storm sewers. While there are no longer any process discharges to plant storm sewers, there is infiltration of groundwater that may contain organic chemicals. Storm sewers in areas shown to contain little or no subsurface or groundwater chemicals will require no remedial action, and will satisfy the objectives stated in Section 1.0.

Disconnection of plant storm sewer outfalls from the City storm sewer system, and diversion of those outfalls to the proposed groundwater collection and treatment system is considered to be an appropriate alternative for those sewers in areas shown to contain the highest levels of chemicals in groundwater. OCC has directed that plant outfalls 001, 005, 006 and 008 be disconnected and diverted to the treatment system in the interest of settlement and for further attainment of objectives stated in Section 1.0.

It is anticipated that sediment will be removed from all plant storm sewers remaining in service as part of the sediment removal program that is under consideration for the North Tonawanda storm sewers in the vicinity of Durez. Removal of sediment from the plant storm sewers that may contain organic chemicals will prevent the future migration of that sediment into the City storm sewers.

Sealing storm sewer lines and/or manholes can reduce the infiltration of groundwater to the sewer system, while allowing the sewers to remain in service. Once outfalls 001, 005, 006 and 008 are disconnected, the discharge of groundwater containing organic chemicals will be substantially reduced. Only the remaining outfalls will discharge to the City storm sewers. Since these reduced discharge levels are within the proposed limits of the Durez plant's proposed SPDES permit, sealing plant storm sewers to reduce groundwater infiltration is considered not necessary.

5.4 Panhandle Surface Areas

This section addresses remedial alternatives for the Panhandle surface areas, including surface soil and non-vegetated areas.

5.4.1 No Action

The level of chemicals in the soil in Panhandle surface areas is low and does not present a significant risk of exposure. Occidental has restricted access to the property by the installation of a seven-foot high chain link fence. While no action may be an acceptable alternative, OCC has directed that additional remedial measures be implemented in order further to minimize exposure to the low level of chemicals in soil, and in the interest of settlement.

5.4.2 Cover

This alternative considers the covering of Panhandle areas, where chemicals in soil have been detected, with soil capable of sustaining plant growth, and the application of fertilizer, seed and mulch as appropriate to establish durable vegetative cover.

Adding topsoil to presently non-vegetated areas would be straightforward, requiring little or no preparation of existing surfaces. Adding soil cover to existing vegetated areas would require the clearing of existing vegetation and removal of some soil prior to placement of the cover. Similarly, in drainageways or ditches some soil would be removed in order for the new cover to conform to existing grades. A large-scale covering operation would require the stripping, clearing and regrading of many acres of the Panhandle surface.

The useful life of the proposed cover could be unlimited if good vegetative growth is maintained to prevent erosion by wind and water.

The construction of soil cover and establishment of vegetative cover are basic construction operations with documented success and reliability.

This alternative is considered not appropriate for existing vegetated Panhandle surface areas or ditches and drainageways because the potential for exposure is already insignificant in those areas. It would not reduce the levels of chemicals in soil in the Panhandle, but it would disturb large portions of Panhandle surface areas.

However, in existing non-vegetated areas cover could more readily be applied without disturbing in-place soil. A four to six-inch thick layer of topsoil could be placed over the barren areas and feathered at the edges to meet existing grade and vegetation. The areas could then be fertilized, seeded with a hardy local grass and/or wildflower mix, and covered with a straw mulch. Some early watering may be necessary to ensure successful growth. Such cover would further reduce potential for exposure to the low chemical concentrations in non-vegetated areas and would further reduce the potential for movement of chemical containing sediments.

This alternative for existing non-vegetated areas in the Panhandle would further reduce the potential for exposure to the low levels of chemicals in soil in these areas, by reducing the mobility of the chemicals and would be protective of public health and the environment.

5.4.3 Removal of Surface Material

Where necessary or helpful to establish and maintain good vegetative cover, limited removal of surface soil could be done in non-vegetated areas. This alternative would consist of removal and proper disposal of removed materials. Excavated areas would be filled and/or regraded and vegetative cover established as necessary to prevent erosion.

In certain instances, limited removal of surface soil in non-vegetative areas may be necessary or helpful to establish good vegetative cover. This alternative would be effective in reducing the potential for future exposure to chemicals in soil in the Panhandle, and in reducing the levels of chemicals in Panhandle surface materials.

The constructability of this option is simple and well established; the desired results would be achieved immediately upon completion of construction, and operation and maintenance requirements would be eliminated.

The use of standard, good construction practices to prevent dust and erosion, and limiting excavation to necessary areas can keep the risk of exposure to a minimum. This option could present some risk for construction workers and the surrounding community because of the potential for wind- or water-borne transport of chemicals in soil during construction; it would also present some potential for exposure during transportation of excavated materials, especially if off-site disposal was required.

This alternative is considered only for limited Panhandle surface areas, where exposed wastes or chemicals in soil may adversely affect the application of cover or future vegetative growth. This alternative is not necessary for protection of public health and the environment, but may be selected during remedial construction, by OCC's Supervising Engineer, to facilitate establishment of good, vegetative cover. Excavated or removed materials would be disposed of as discussed in Section 5.7 below.

5.5 Panhandle Railroad Ditch

The railroad ditch is not within the existing fenced Panhandle area and is, therefore, considered here as a separate subject.

If, during installation of the groundwater collector trench, the surface soil of concern in the railroad ditch is removed, then the need for the proposed culvert, which is discussed below, would be eliminated.

5.5.1 No Action

Although the concentrations of chemicals in soil are low in the drainage ditch adjacent and parallel to the slightly elevated railroad line, OCC has directed that additional remedial action be taken since the ditch is not within the Panhandle fenced area.

5.5.2 Fencing

Additional fencing to restrict access to the drainage ditch was considered, but was determined to be impractical relative to the use of the railroad right-of-way, and the site configuration. The fence would have to be placed immediately contiguous to the railroad track to prevent access to the ditch. Such a placement is not feasible because of the daily railroad operation. The fence alternative is not acceptable.

5.5.3 Cover

This alternative would provide for covering the areas containing chemicals in soil in the drainage ditch to minimize exposure. Such an action would decrease exposure. However, since it is essential to maintain grade elevations within the drainageway to promote drainage from the area, the addition of soil cover without removal of the equivalent amount of material would block the existing surface drainageways. Therefore, this alternative is not acceptable.

5.5.4 Culvert Installation

The installation of a culvert in the railroad ditch would include grading to prepare a bed for the culvert; installation of 300 to 400 lineal feet of culvert pipe; covering the pipe with clean backfill, thus filling in the ditch; final grading for surface drainage; and application of fertilizer, seed and mulch. The culvert design would include features to preclude the movement of soil and sediment into the pipe, including the use of filter fabric pipe wrap. Surface drainage would enter the culvert through one or more inlet structures.

This alternative would be effective in providing for the isolation of chemicals in soil in the railroad ditch, would eliminate the potential for exposure to those chemicals, would significantly reduce the potential for mobility of those chemicals, and would protect public health and the environment.

Culvert installation is a straightforward and readily available technology. Construction costs would be low, as would operation and maintenance costs. The desired results would be achieved immediately upon completion of construction. The installation of a culvert is considered to be an appropriate and effective remedial alternative for the railroad ditch.

5.5.5 Removal of Surface Soils

Removal of surface soil in the ditch would consist of excavating approximately 300 to 400 lineal feet of the ditch for a depth of 12 inches. The resulting excavation would be refilled and graded for positive drainage to the storm sewer on Walck Road. Excavated material would be disposed of properly as discussed in Section 5.7.

Removal of surface soil is a straightforward and readily available technology. The desired results would be achieved immediately upon completion of construction. This alternative for the railroad ditch would significantly reduce the potential for mobility of the chemicals in the soil, and would protect public health and the environment. Construction removal costs would be low; however, temporary storage, disposal and treatment would be moderate to high.

5.6 Groundwater Treatment

5.6.1 Activated Carbon Adsorption System

Activated carbon adsorption of organic compounds has been successfully used for both waste and process streams. Static and dynamic adsorption studies conducted on water samples from the Durez plant establish the feasibility of carbon adsorption as a treatment method. Results from these studies are reported in two reports: Calgon Validation Report No. R1-PB-1018 dated September 5, 1979 and Hooker Chemical Report Adsorption Isotherm Studies on Durez Effluents dated March 28, 1979.

The process of adsorption onto activated carbon involves contacting the contaminated groundwater with the carbon, usually by flow through a series of packed bed reactors. The activated carbon selectively adsorbs constituents by physical and chemical attraction, in which organic molecules are attracted to the surface of the carbon granules. The more hydrophobic (insoluble) a molecule is, the more readily the compound is adsorbed. Carbon adsorption is the best available technology for treating this groundwater. It is especially well suited for the removal of the mixed organic compounds found in the groundwater at Durez.

5.6.2 Distillation

The distillation process is usually used to separate or purify liquid organic products. Several distillation processes exist which involve heating the waste stream to drive off volatile chemicals. These vapors are then condensed and collected. Large energy sources are required for these processes. This treatment method is more applicable at primary and secondary treatment levels where contaminant concentrations are in the hundreds or thousands of parts per million (ppm) range. At Durez, the contaminants are at levels less than 10 mg/l (ppm) and distillation is not a feasible process for groundwater remediation.

5.6.3 Solvent Extraction

Liquid-liquid solvent extraction is the removal of chemical constituents by contact with an immiscible liquid. Solvent extraction rarely produces an effluent which can be discharged without subsequent treatment. This method is more applicable to higher pollutant concentrations. This method is not well suited for a wide range of chemical contaminants because no one solvent can effectively remove many contaminant solutes. This process is not a feasible method for groundwater remediation at Durez for this reason.

5.6.4 Thermal Incineration

Thermal incineration is a process in which high temperature thermal oxidation is used to convert a waste product. A liquid injection incinerator would not be applicable to the groundwater contaminant problem at Durez. Large quantities of energy required to operate this system render this process infeasible for the long-term treatment of groundwater at Durez because of the high water content and low chemical content of the groundwater, and the necessity for storage of groundwater until enough was available for incineration. EPA has not identified thermal incineration as one of the recommended technologies for solvent/waste water mixtures (51 Fed. Reg. 40613).

5.6.5 Bio-Treatment

Biological oxidation is considered to be a secondary rather than a tertiary treatment method. When considered for Durez groundwater treatment, concerns are:

- This technique is not capable of reducing chemical concentrations to the levels that are achieved with other available technologies such as carbon adsorption.

- Due to the low level of chemicals in the groundwater, chemical loading to a biological treatment system would be insufficient to sustain biological activity necessary to effect chemical reduction.

Bio-treatment is considered not to be applicable for treatment of groundwater at Durez because of the reasons stated above.

5.7 Disposition of Excavated Material

Several of the alternative remedial actions considered above include the removal of surface soil or deeper excavation of soil, and will result in the need to dispose of excess excavated materials, most of which will be clean, but some of which may contain chemicals.

5.7.1 Quantities and Physical Characteristics

A subsurface drain or slurry wall would vary in depth from 10 feet to 13 feet below the surface; it would be approximately 3 feet to 5 feet wide. The length of the subsurface drain proposed by OCC is approximately 8300 lineal feet. Based on calculations made from a preliminary centerline profile and cross-section of the drain, the total volume of material excavated from this trench would be approximately 13,000 cubic yards or 13,000 tons.

Once excavated, the trench would be backfilled with a free-draining gravel pack, unclassified backfill and topsoil. It is anticipated that the gravel pack and topsoil would be imported from a local borrow source, and that the unclassified backfill would consist of material excavated from the trench.

It is anticipated that approximately 6500 of the 13,000 cubic yards of soil excavated from the proposed trench would be left over for disposal or reuse upon completion of the construction of the groundwater interceptor system.

Based on available subsurface information from numerous soil borings it is estimated that the soil excavated from the trench would have the following average characteristics: 50 percent fine and medium sand, and silt; 17 percent medium and coarse sand, and 33 percent silty clay. A pre-construction soil sampling program would be conducted along the proposed trench centerline, to provide an opportunity for developing geotechnical and chemical data on trench soil.

5.7.2 Reuse of Excavated Material

Any soil, regardless of chemical content, could be replaced in the subsurface drain, which is designed to collect contaminated groundwater, for subsequent treatment for removal of chemicals.

Excess soil not required for trench backfill would be characterized, based upon the pre-construction soil sampling program described in Section 5.7.1, into soils appropriate for grading and fill material. Excess soil that cannot be used for grading would be disposed of in accordance with one of the disposal alternatives.

5.7.3 Off-Site Disposal

Off-site disposal of excess excavated material is subject to land disposal ban conditions discussed above in Section 4.12. Nevertheless, off-site disposal capacity may be available locally at two secure land burial facilities. However, disposal of soil materials removed from the plant property at an off-site facility would utilize local disposal capacity that may be better used for the disposal of other solid and/or hazardous waste materials from facilities that do not have on-site disposal capacity.

Off-site disposal would require transporting the materials over public highways to a disposal facility. Although disposal in a local facility would minimize the distance traveled, there would still be some potential for exposure during shipment of the excavated materials that may contain chemicals. Off-site disposal would not significantly reduce the volume, toxicity and mobility of the chemicals in the excavated soil beyond that which would result from on-site disposal in the subsurface drain or in the contemplated on-site storage facility.

5.7.4 On-Site Disposal

On-site disposal of excess excavated materials, such as in an interim storage facility would be done such that any drainage from the disposal area, including surface and groundwater, would be collected and treated in the proposed remedial groundwater treatment system. The anticipated small volume of collected water would be gravity-fed or pumped to the groundwater collection and treatment system. The treatment system would permanently reduce the volume and toxicity of chemicals in the excavated soil on site. See Sections 5.12.6 and 6.11.2 for more discussion of an interim storage facility.

The benefits of on-site disposal include the elimination of off-site disposal thus saving this disposal capacity for the disposal of hazardous materials from other facilities; and, reduced potential exposure from transportation of excavated materials that may contain chemicals.

Either on-site or off-site disposal would be protective of public health and the environment.

5.8 Sanitary Sewers

This section addresses remedial alternatives for the City of North Tonawanda's sanitary sewers in the vicinity of the Durez plant, including the following.

- o Wilson Avenue
- o Nash Road - Walck to Wilson
- o Walck Road - Penn Central RR to Nash Road
  - Nash Road to Jesella Drive

5.8.1 No Action

Because sediment builds up over time in the sanitary sewers, these sewers must be cleaned periodically. Therefore, there is not a no action alternative.

5.8.2 Sediment Removal

Sanitary sewer sediment now removed from the City sanitary sewers by the City DPW is sent to a sanitary landfill as is the sludge from the city's waste water treatment plant. This alternative would consist of removing sediment from the sanitary sewer pipes and manholes using conventional methods. Sections 5.9 and 5.10 below contain a more detailed description of the various sediment removal techniques that may be applicable to the sanitary sewers. Because of the relatively low volume of sediment and the small diameter of the sanitary sewers, it appears that the most appropriate methods would be:

- o hydraulic flushing with suction (hydraulic or vacuum) removal of sediments at one or more access points, (this is the method now used by the City DPW during routine maintenance);
- o mechanical removal of sediments; and,
- o combined mechanical and hydraulic methods.

Both removal technologies are readily available, well established and relatively straight forward in their implementation. Generally, hydraulic flushing is more effective than mechanical removal for removing low volumes of fine-grained sediment. Mechanical methods such as drag bucket dredging and power rodding would more effectively remove obstructions or large sediment volumes, but would require hydraulic flushing to remove all sediment. Similarly, there are no operation and maintenance requirements associated with this alternative. Sediment removal, by any commercially available method, is considered to be an appropriate alternative for the Durez area sanitary sewers.

Public exposure during sediment removal at the work area would be mitigated by restricting public access to the work area. Protecting City DPW workers from exposure can be accomplished by practicing good worker safety such as preventing personal contact with liquids and vapors. The odor threshold for some of the organics is low, so it is possible that odors could be detected during the operation. However, the odors from normal sanitary waste would more likely be detected than the odors from the small amount of chemicals that may be present in the sanitary sewer sediment. Exposure to volatile chemicals would be minimized by open air conditions of the activity, ensuring the immediate reduction of the concentrations of volatiles in the air.

We are advised that sanitary sewer sediment removed by the City during routine maintenance is disposed of at a sanitary landfill. Counsel for OCC advises that such disposal is consistent with the requirements of the Solid Waste Disposal Act (RCRA). Section 1004 (27) of RCRA specifically excludes from classification as a solid waste "solid or dissolved material in domestic sewage". EPA has interpreted this statutory provision as excluding from classification as a hazardous waste the mixture of hazardous waste and sanitary waste that passes through a sewer system. (40 CFR 261.4). EPA has determined that the wastes fall within this exemption when it first enters the sewer system. (45 Fed. Reg. 33097).

5.9 Pettit Creek Flume Storm Sewer

This section addresses the feasible alternatives for remediating sediments that may contain chemicals in the Pettit Creek Flume. The PCF is an integral component of the City of North Tonawanda storm sewer system. Remedial alternatives for the PCF are discussed separately from the other storm sewers because the PCF is not a typical storm sewer and requires special consideration. The remedial alternatives for the other storm sewers and inlet are described separately below in Sections 5.10 and 5.11, respectively.

5.9.1 No Action

The potential for public exposure by direct or indirect skin contact, ingestion, or inhalation of volatiles is considered remote. The PCF sediments are relatively isolated from and inaccessible to the general public. The sediments and chemicals are most prevalent in the upstream portion of the flume, away from the discharge point, which is itself relatively inaccessible.

The no action alternative is appropriate for evaluation because of the low potential for local exposure to the sediments if left in place, the increase in potential short-term exposure due to sediment removal and handling processes, and the lack of a proven commercially available, cost effective technology to treat and dispose of sediments containing chemicals. However, OCC has directed this study not to consider the no action alternative.

5.9.2 Sediment Storage in Place

Temporary storage of PCF sediment in place is appropriate for consideration provided that actions are taken to further isolate and monitor the sediment. Remedial actions to further isolate the sediments could include installation of a security grate at the outfall; posting of permanent warning signs inside manholes to advise sewer workers of safety precautions; and development, dissemination and implementation of a health and safety plan for authorized sewer workers.

Previous investigations of storm sewer sediment indicate that recent sediment overlies older sediment, which appears to contain most of the chemicals, and generally be quite firm and resistant to transport by sewer flows. The recent sediment layer would serve to reduce the tractive force exerted by the moving water on the underlying older sediment and would separate the moving water from the chemicals in the older sediment.

Nevertheless, an evaluation could be made to determine if significant downstream movement of sediments and/or chemical is occurring in the PCF during storm events. This could consist of conducting periodic sediment depth measurements at selected manholes at which sediment traps are installed. The traps would act as reference points for monitoring migration and would retard downstream migration of the sediment. Because this alternative would reduce the potential for human exposure by surface water pathways, it is considered a possible alternative as a temporary storage measure until adequate treatment and/or disposal technologies are developed. This alternative would reduce the mobility of chemicals in the sewers.

This alternative would minimize immediate or short-term exposure risk and be readily implementable. However, in-place storage would not totally eliminate potential sediment migration downstream, reduce the potential exposure of future workers entering the PCF, reduce the quantity of chemicals in the PCF or be highly reliable. Storage in place, however, would be adequately protective of public health and the environment in the absence of government approval of a permanent, cost-effective, commercially available treatment or disposal alternative.

5.9.3 Partial Sediment Removal

This alternative considers the removal of sediment from part of the PCF, and storage in place of the remaining sediment.

While OCC believes that sediment can safely remain in the PCF because of the lack of exposure, it has directed this study to assess partial sediment removal to facilitate PCF flow diversion to reduce street flooding on Eggert Drive.

Sediment would be removed from the PCF/Nash Road storm sewer north of Walck Road to Meadow Drive. Flow in this section of the PCF could then be diverted north to the Meadow Drive interceptor sewer, thus achieving a current objective of the City of North Tonawanda in its efforts to reduce flooding on Eggert Drive.

The disposition of removed sediment is discussed in Section 5.12. Approximately 253 cubic yards of the sediment (from the PCF/Nash Road sewer north of Wilson Avenue) could be taken to a NYS licensed disposal facility. Approximately 130 cubic yards of sediment (from the PCF between Walck and Wilson) would require on-site storage.

The partial sediment removal and diversion of the PCF should consider the following additional activities:

a. Remove sediment from the 15-inch diameter storm sewer on Walck Road west of Nash to Eggert Drive (20 cubic yards, suitable for disposal at a NYS licensed disposal facility).

b. Remove sediment from the 30-inch diameter Wilson Avenue storm sewer from the Durez plant to Nash Road (35 cubic yards requiring on-site storage).

c. Divert Durez plant storm sewers from Wilson Avenue to Walck Road.

d. Store in place remaining PCF sediment, as per Section 5.9.2.

e. To accommodate higher flows from Durez because of the Wilson Avenue diversion, remove sediment from the 42-inch diameter Walck Road storm sewer from Nash Road to the Penn Central railroad (105 cubic yards, requiring on-site storage).

5.9.4 Special Conditions Applicable to Sewer Sediment Removal

Sewer sediment removal provides a more active and permanent remedial action than in-place sediment isolation and monitoring because it reduces the potential for mobility of chemicals in the sewer. Although commercial sewer cleaning contractors and equipment are readily available, the PCF is not a typical sewer and requires special consideration. Selection of the alternative sediment removal methods evaluated below must take into account the site-specific conditions in the PCF to ensure thorough sediment removal and eliminate potential problems. These site specific conditions and the appropriate construction considerations are described below.

1. Box culvert shape typically 4 to 5 feet high and 5 to 8 feet wide with slightly concave upward floor;

   Alternative sediment removal methods must be capable of safely and cost-effectively adapting to the large, atypical, non-circular PCF sewer.

2. Structural deviations in PCF shape, width (ranging up to 12 feet) and height (ranging up to 9 feet);

   These deviations will require special attention during sediment removal and preclude the use of remotely controlled equipment. The enlarged sections could be considered for use as local internal staging areas.

3. Bends ranging up to 60° in the PCF between manholes;

   These bends may reduce the efficiency of remotely controlled sediment removal techniques.

4. Variable spacing between manholes to the PCF ranging up to approximately 815 feet;

   The alternative sediment removal methods must be capable of performing effectively at extended distances and possibly in both upstream and downstream directions from an access manhole to ensure complete sediment removal.

5. Areas of possible structural weakness within the PCF;

   The structural integrity of these areas is a possible safety concern and will need to be evaluated by a qualified structural inspector and assessed prior to sediment removal as to the level of repair work or safety precautions required.

6. Openings to the atmosphere;

   Disturbance of the sewer sediments during sediment removal may volatilize or mobilize chemicals that could vent or escape to the atmosphere through sewer openings. These openings should be repaired, or covered, plugged and monitored as appropriate during the removal process. Vapor control may also be necessary at the active manholes. Passive vapor control could be implemented by conducting the work during seasonal low temperature periods when volatilization will be minimized.

7. Presence of approximately 128 street laterals and other connections that intersect with the PCF;

   Specific precautions must be directed to preventing or minimizing sediments, dirty water, and/or vapor from migrating into the laterals and connections during sediment removal.

8. Obstructions from overhead cross pipes and many laterals and other connections that protrude into the PCF;

   These obstructions and protrusions locally may prevent the use of specific mechanical sediment removal methods such as drag bucket dredging. They also reduce access and available working space and may require additional precautionary steps for worker safety. Trimming of the more prominent protrusions should be considered, if necessary for the selected sediment removal method.

9. Constant flow of storm water from the upstream PCF and many street laterals and other connections;

   The sediment removal methods under consideration for the PCF would require control of ambient sewer flows to improve sediment removal efficiency, reduce the quantities of water generated, reduce water collection and possible treatment requirements, and reduce the risk of releasing sediment and water containing chemicals downstream. Control methods include temporarily plugging upstream and downstream sections, and laterals and connections within the active work zone; and diversion of upstream flow to nearby storm and sanitary sewers or around or through the active work zone. Diversions would be designed and operated to provide for maximum attainment of OCC's goal of "zero discharge" during storm sewer remediation. The sediment removal alternatives used must be sufficiently mobile to be capable of quick shutdown in the event of sudden surges in storm water flow. For this reason, sediment removal should be scheduled to coincide with anticipated seasonal dry weather periods.

10. Estimated PCF sediment volume of approximately 686 cubic yards that may contain chemicals;

    The alternative methods must be capable of cost-effectively, reliably and efficiently removing this quantity of material while minimizing or preventing risk to the remediation workers, public health and environment. It is assumed for evaluation purposes that all water coming into contact with the sediment during sediment removal would require treatment prior to ultimate discharge.

11. Local accumulations of coarse construction debris such as cobbles, brick, planks, concrete blocks, tile, a broken manhole cover and roots;

    These materials may be too large to handle by many sewer cleaning techniques. Consideration can be given to leaving them in place or removing them manually if they are not removed by the selected sediment removal process.

12. Variable distribution and characteristics of sediment on floor of PCF;

    The alternative sediment removal methods must be flexible to effectively and reliably handle the wide variation in sediment thickness, distribution, grain size, and density.

13. Variable quantities of sediment in laterals and other connections and on ledges;

    Sediment was observed in approximately 63 of 128 laterals and other connections during the video inspection of the PCF. Extremely high storm flows could have transported small amounts of sediment containing chemicals into some of the laterals especially those located near the invert. Much of this sediment may have been subsequently flushed from the laterals and connections by flow into the PCF.

However, the sediment in the lower level laterals and other connections and on ledges may contain small amounts of residual chemicals related to those detected on the PCF floor.

14. PCF location in residential and high traffic areas;

Selection of sediment removal and transporting methods must take into account public acceptance and attempt to minimize disruption of traffic. Consideration should be given to minimizing the exposure of the neighborhood to noise, odors and other sources of irritation.

5.9.5 PCF Sediment Removal Methods

Conventional and innovative sediment removal methods are evaluated below. The methods described are conventional unless indicated otherwise. Disposition of sediment removed is described in Section 5.12, temporary diversion of storm sewer flows during PCF sediment removal is presented in Section 5.13, and water treatment and disposal alternatives are evaluated in Section 5.14.

a. Manual Removal

Manual removal by hand tools may be applicable in the downstream areas where the sediment is thin and headroom is relatively high. This technique may be appropriate for removing the large-size construction debris too large to handle by alternative sediment removal methods. The manual workers could be accompanied by a cart or mechanical bucket operated by winches at adjacent manholes to transport the debris to a collection manhole. Manual removal could be done before or after sediment removal. However, manual removal done after sediment removal would facilitate working in the confined space, minimize the exposure risk to the workers, ensure that all buried large-size debris is removed, and enable an informed assessment as to whether removal of large debris is appropriate. Manual removal is probably the only alternative for removing large debris such as planks.

b. Mechanical Methods

Drag bucket scraping is a mechanical cleaning method appropriate for consideration. The method consists of setting up power winches and pulleys at adjacent manholes with a cable connected to both ends of the drag bucket. The bucket is repeatedly pulled through the sewer, scraping up sediment on each pass, until it comes back empty. Heavy accumulations of solids are removed and deposited into a truck for transport. This method is generally an effective, reliable and implementable alternative for conventional storm sewers. It has the advantage of removing thick or hard deposits and heavy debris such as cobbles, loose bricks and roots from the floor without using water; thereby minimizing the possible escape of disturbed sediments and water downstream. Removal is typically done manhole to manhole and remotely thereby minimizing potential worker exposure, but entry by workers would be necessary in the PCF to assist with the work.

Removal of sediment by mechanical methods does not remove all of the disturbed and loosened debris on the floor nor sediment on walls, ledges, at bends between manholes, and in the wide chambers and laterals. The bucket size is limited by the size of the access point and it is likely that many passes would be required. The technique is not feasible if there are significant obstructions or protrusions. Laterals protruding near the floor of the PCF within range of the bucket would require trimming, and bucket dredging would not be feasible where there are cross-pipes. A final sediment removal pass using another technique such as hydraulic flushing would be necessary. Because mechanical methods require surface handling of sediment when transferring the sediments to transport vehicles, significant amounts of solids and water from the manhole may be splashed onto the workers and adjacent areas. Alternate removal methods such as vacuuming or pumping into watertight tank trucks are more appropriate for removing the sediment from manholes.

Mechanical methods would not be sufficient for complete removal of sediment and would have to be combined with other techniques in order to achieve complete and safe sediment removal. Mechanical methods would be particularly effective, and reliable for helping to remove the scattered large construction debris and the thick sediment accumulations where cross-pipes are absent.

c. <u>Hydraulic Flushing</u>

Hydraulic flushing is a possible alternative for removing loose and moderately accumulated sediments. The technique consists of flushing the interior surface of the PCF from manhole to manhole using a high pressure, low volume clean water stream from a self-propelled nozzle. The water is supplied by a tank truck. The mobilized sediments are flushed back to the access manhole where they are removed along with the flush water by vacuum or double diaphragm pump into a vacuum or tanker truck. The technique is most effective for relatively small sediment thicknesses.

The propelled nozzle system can usually clean to a distance of approximately 500 feet from the sewer access point. Since PCF manhole spacings are up to approximately 800 feet apart, it will be necessary to work in both upstream and downstream directions from selected manholes. The total hydraulic sediment removal process could require set up at approximately 12 manholes. Repeat cycles up and down the PCF, each progressing farther than the previous, may be necessary in areas of thick sediment.

The main advantages of this technique are the remote-controlled operation, minimal handling of sediments, minimal worker exposure, adaptability to the non-uniform PCF cross-section and direct flushing of the walls, ledges, ceiling and floor of the PCF. The main disadvantage is the large quantity of residual waste water generated. The amount of water used depends upon the sediment thickness; therefore large quantities of water may be required in the upstream portion of the PCF where the sediment is thick. Other disadvantages include the increase in sediment load due to spalled concrete removed from walls; possible damage to weakened areas; and possible incomplete or difficult removal of coarse material and sediment at corners, bends, enlargements, laterals and areas of thick sediment. Finally, it may be difficult to control the movement of a self-propelled nozzle in the large, rectangular PCF.

d. Modified Hydraulic Flushing

A manually directed high pressure hydraulic system, incorporating a nozzle mounted on a manned low profile cart, could be used to flush the sediment to a convenient centralized collection location such as a specific manhole in a relatively unpopulated or low traffic area. Alternately, a series of temporary downstream settling basins could be constructed at manholes in the PCF prior to sediment removal using sand bag weirs to trap sediment contained in water released downstream during hydraulic flushing. This water would be relatively free of suspended solids by the time it reached the inlet and the reduced quantity of water collected at the manhole would significantly facilitate the sediment removal process. From these basins, the sediment could be pumped directly to the Durez plant through pipes temporarily placed in the PCF or vacuumed to a tanker truck at a manhole for transport to a dewatering/storage facility.

The main advantage of this technique over the self propelled method is its greater flexibility. Sediment can be swept in either direction from the access manhole, and toward an adjacent manhole, although downstream progress is preferable. Water can be directed to where it is needed most and omitted where it is not needed, relatively inaccessible locations such as laterals and benches can be cleaned and a final sediment removal pass may not be necessary. The major disadvantages relative to the self-propelled technique are the possible difficulties associated with implementability of this non-conventional method and the generation of large quantities of flush water that may be released to the inlet or may require collection and treatment.

e. Vacuum Methods

Vacuum suction techniques are commonly used with the self propelled hydraulic nozzle method for removing sediment accumulated at manholes. For this application, the vacuum truck or trailer is usually located within 25 feet of the collection manhole.

Heavy-duty vacuum cleaning could also be considered for removing sediment from the entire PCF. The method would consist of working from manhole to manhole sucking the sediments and water to a sealed truck at the surface using a lightweight 6 to 8 inch diameter vacuum hose and nozzle. The nozzle would be operated manually by a worker seated on low profile cart. A small diameter nozzle could be used to remove sediment from laterals and other connections intersecting with the PCF.

The main advantages of the vacuum method are that the sediment moves directly from the sewer to the transport vehicle, noise and vapor emissions into the work zone could be significantly reduced by use of mufflers and carbon filtering system, water is not introduced, the potential for releasing disturbed sediments downstream are minimal, laterals could be vacuumed 10 to 15 feet back from their discharge, and a final sediment removal pass may not be required.

On the negative side, the vacuum systems are slow to handle large quantities of sediment, expensive and suck up a lot of water with suspended solids that settle out slowly. The vacuum technique is not well suited for removing sediment at long distance from the vacuum truck. The maximum distances of sediment transport in the hose is limited to approximately 300 to 400 feet using conventional methods, and may be substantially less depending on the sediment particle size and density, velocity losses caused by bends, and reduced mechanical efficiency caused by particulate and vapor removal (carbon adsorption) from exhaust gases. Although this distance range may be suitable for most of the PCF, it is a significant limitation for manholes spaced 800 feet apart because coarser sediment may be left behind and plugging of the vacuum lines could occur. Should sediment plug the vacuum line, which is more likely at the longer distances, the progress of the work would be seriously retarded. Fortunately, sediment thicknesses are relatively small where manholes are spaced far apart, but some consideration should be given to the possibility that manual removal may be required for areas out of vacuum range. Despite precautions taken at the vacuum truck, noise levels would be high and there would be some potential for emission of organic vapors in the vacuum exhaust.

f. Combined Methods

In consideration of the varied conditions in the PCF, it will probably be necessary to use a combination of different methods for effective and safe sediment removal. The methods can be readily adapted to complement one another. Mechanical techniques commonly require hydraulic flushing methods for final sediment removal and vacumming methods for removing the sediment accumulated at manholes. Hydraulic flushing methods are often coupled with vacuuming for removing sediment flushed back to the manholes. Vacuum techniques could be used as a primary mode of sediment removal except for areas out of range of the vacuum. Manual removal of large debris would probably be required for all of these methods.

Use of a combination of techniques is considered to be the most appropriate remedial technology, because it would enable flexibility and adaptation to the specific PCF conditions and should result in the effective and reliable removal of sediment. The PCF sediment removal contractor would be required to have all of these methods available for use.

Public access to work areas would be restricted and sewer workers would wear appropriate protective clothing and adhere to a health and safety plan to minimize, or effectively eliminate, exposure. Vapor control would consist of continuous air monitoring at street level during cleaning when people are present. Although some of the chlorobenzenes have high vapor pressure and may yield an odor, their concentrations at street level would be dissipated by the above ground open-air work area.

g. Innovative PCF Cleaning Methods

Non-traditional sediment removal techniques adapted from mining and dredging technologies can be combined with the conventional methods described above. Hydraulic dredges and slurry pumps could be used in selected isolated portions of the PCF to take advantage of the PCF's size and open discharge. The dredges and slurry pumps would excavate the sediment which would then be transported as a sediment/water slurry relatively long distances underground within the PCF using a system of pipes and pumps. This would minimize street level operations, result in longer active work zones, reduce potential exposure, minimize traffic disruption, lead to relatively favorable public acceptance, and enable effective cleaning of areas not readily accessible to or suitable for mechanical, hydraulic or vacuum methods.

Excavated sediment would be transported by pipes to one or more central accumulation areas within the PCF for removal through manholes by pumps or vacuum, to watertight trucks. Alternately, the slurry could be pumped directly to temporary solids separation/storage facilities located at the Durez plant or adjacent to the inlet or the slurry could be pumped into a subbasin constructed within the inlet after the inlet is adequately isolated from the river by a cofferdam. Deposition of sediment into the inlet would substantially reduce sediment handling, transport and related exposure potential.

The major drawback to the dredging and pumping techniques is that they are not conventional methods for removing sewer sediments and may therefore, be associated with many possible difficulties in implementation and questions concerning reliability and effectiveness. Other disadvantages include generation of large quantities of water for possible treatment and the increased potential for downstream sediment transport due to the 1- to 2-foot draft needed for the suction dredge. Other methods such as hydraulic or vacuum cleaning would also be needed for removing residual sediment from the floor of the PCF laterals and benches. The effectiveness and reliability of these innovative techniques for sewer cleaning have not been demonstrated previously.

5.9.6 Sediment Transportation

Sediment and water removed from the PCF manholes would be pumped or vacuumed into watertight tank trucks for transportation. Precautions would be taken to minimize the potential impact of transfer and handling operations on the workers, public and community.

5.10 Other Storm Sewers

Sewers considered in this category are smaller in size than the PCF, have a circular cross-section, and are suitable for routine cleaning using conventional methods.

Specific sewer lines, which are included as "other storm sewers", drain into the PCF as follows.

- Wilson Avenue - This 30-inch diameter section is north of the Durez plant; the section under consideration is from the east end of Wilson, west to the PCF at Nash Road.

- Walck Road (Nash Road to Penn Central railroad) - This 42-inch diameter section is south of the Durez plant; the section under consideration is from the Penn Central Railroad, west to the PCF at Nash Road.

- Nash Road (PCF to Meadow Drive) - This section is directly upstream from the PCF.

- Walck Road (Nash Road to Eggert Drive) - This 15-inch diameter section is southwest of the Durez plant.

- Walck Road (Penn Central railroad to Erie Blvd) - This 30-inch diameter section is upstream (east) of the Durez plant.

- Miscellaneous street laterals and other connections - discharge points for these 2 to 48-inch diameter sewers were observed during inspection of the PCF.

5.10.1 No Action

The various storm sewer segments considered and the justification for the no action alternative are presented below.

a) Wilson Avenue, Nash Road to the Durez plant
Walck Road, Nash Road to Penn Central Railroad
Nash Road, PCF to Meadow Drive

Sediment in these storm sewers is isolated from and inaccessible to the general public. The no action alternative may be considered protective of public health and the environment because of the lack of pathways of the sediments to local exposure if left in place, the potential short-term increase in exposure due to sediment removal and handling and the lack of a proven commercial technology to treat and dispose of contaminated sediment after it is removed from the sewers. However, OCC has directed this study not to consider this alternative.

b) Walck Road from Eggert to Nash

The low (4.05 mg/l (ppm) total chlorobenzenes) chemistry level at Eggert and Walck, and the non-detected level on Eggert Drive, support a no action alternative as protective of public health and the environment (889 LEE, pp. 8-12; PH 1 SEW 86, pp. 5-8).

c) Walck Road from the Penn Central railroad to Erie Boulevard

The low (13.1 (mg/l) ppm dichlorobenzenes)) chemistry level at Walck and Erie and non-detected levels at Walck and Zimmerman support a no action alternative as protective of public health and the environment (PH 1 SEW 86, pp. 5-8).

d) Nash Road, South of the PCF to Duane Drive

The low (39.05 mg/l (ppm) total chlorobenzenes) chemistry level at Nash and Duane supports a no action alternative as protective of public health and the environment (889 LEE, pp. 8-12; PH 1 SEW 86, pp. 5-8).

e) Miscellaneous Street Laterals and Other Connections

It was common practice, during the development of North Tonawanda, to connect cellar floor and foundation drains to the sanitary sewer rather than the storm sewer because the elevation of the latter was too high to accept these flows by gravity. Sanitary sewers are typically buried deeper than the storm sewers in the vicinity of Durez. Most likely, the miscellaneous storm sewer laterals to the PCF are surface water drains.

The low (3.0 mg/l (ppm) total chlorobenzenes) to non-detected levels of chemicals in the miscellaneous PCF laterals support a no action alternative as protective of human health and the environment (Ph 1 SEW 86, pp. 5-8).

5.10.2 Sediment Removal

The sediment removal alternative for the storm sewers listed in Section 5.10.1 would be protective of public health and the environment because it would permanently and significantly reduce the volume of chemicals in the sewer sediment. The disposal of such sediment is evaluated separately below at Section 5.12. Sediment should be removed from these sewers before the PCF is remediated, in order to prevent the possibility of redeposition in the PCF. The alternative non-entry, conventional sediment removal methods evaluated below are suitable for both City and plant circular storm sewers. These methods are described briefly below and in more detail in Section 5.9.

a. Mechanical Methods

Mechanical methods are an effective and reliable technique for cleaning circular sewers. Implementation should be straightforward. Appropriate mechanical methods could consist of power rodding and drag bucket scraping. Power rodding machines push or pull scrapers, augers or brushes through the sewers and are frequently used to clear obstructions. Bucket scraping is described in Section 5.9.4. The bucket would be sized to fit the sewer line and manholes. The evaluation of mechanical methods presented for the PCF is appropriate for the circular storm sewers, except the possible difficulties associated with large debris, protruding laterals, cross-pipe obstructions, bends, enlargements, and ledges are not anticipated for these smaller circular sewers. However, possible difficulties associated with sags or collapses of the small sewers should be considered.

b. Hydraulic Flushing

High pressure hydraulic flushing is an established cleaning method and implementation in the circular sewers would be straightforward. The evaluation for conventional self-propelled hydraulic flushing described for the PCF in Section 5.9.4 is appropriate for these storm sewers, except the disadvantages in the PCF associated with the wide manhole spacings, non-circular shape, bends and enlargements would not be encountered. To eliminate the escape of flush water into the PCF during cleaning, the outfall of Wilson and Walck Avenues into the PCF would be temporarily plugged during cleaning and all flush water would be collected.

c. Vacuum Methods

Vacuum methods are suitable for sediment removal only in combination with mechanical or hydraulic flushing to remove sediment accumulated at manholes. The technique is described and evaluated in Section 5.9.4.

d. Combined Methods

The use of a combination of methods including mechanical, hydraulic and vacuum techniques is standard practice and well established and would result in more effective sediment removal than using individual techniques alone. Combination of the various methods are described in detail in Section 5.9.4.

Public access to work areas would be restricted and sewer workers would wear appropriate protective clothing and adhere to a health and safety plan to minimize, or effectively eliminate, exposure. Vapor control would consist of continuous street level air monitoring during cleaning when people are present. Although some of the chlorobenzenes have high vapor pressure and may yield an odor, their concentrations at street level would be dissipated by the above ground open-air work area.

5.11 Inlet

The inlet receives discharge from the PCF and empties into the Little Niagara River. The inlet contains approximately 3400 cubic yards of sediment containing chemicals overlying an approximately 22 to 30 foot thick, soft to stiff deposit of clay. The sediment ranges in thickness from approximately 2 to 6 feet and is typically a soft, sandy silty material with occasional thin dense layers. In the southwest section of the inlet, the bottom material is hard, rocky and difficult to penetrate. Except for this hard area, there is usually a marked contrast in penetration resistance at the sediment-clay interface. Scattered accumulations of debris, stumps, trees, and logs are present in the inlet. Shorelines, especially in the southeast portion of the inlet, are dominated by wetland-type vegetation. Water depths observed in the inlet in June 1986, ranged from 1.5 to 3 feet, and fluctuations due to regional weather conditions were noted.

A complication in this area is the presence of the Lockport water intake line. The 4-foot diameter, steel water line was originally installed in 1906-1907. Details regarding the installation and backfilling procedures are not available. In 1977, the pipe was lined with a 1.2-inch thick polyethylene sleeve. According to one drawing (General Location and Plot Plan-As Built, City of Lockport, Raw Water Pumping Station, Jan. 1969) the water line is located beneath the south side of the inlet at a depth of approximately 20 feet below grade. This drawing is reproduced as Figure 6.9. The soil above the water intake line contains sediment and reportedly approximately 15 feet of clay, but this must be verified because the drawing may not be completely accurate and the overburden thickness could be less than shown. The chemical and structural nature of this clay have not been determined; the effectiveness of the clay as a barrier to organic chemicals is not currently known. A program for investigating the nature of the clay and/or backfill adjacent to the water line is described in Section 6.13. The various alternatives for remediating the inlet are evaluated below.

5.11.1 No Action

The conditions of the inlet described at Sections 2.6.2 and 3.6 are such that the no action alternative does not meet the objectives stated in Section 1.0.

5.11.2 Containment and Sediment Storage in Place

Containing the sediment within the inlet and isolating it from potential migration pathways is a possible permanent alternative. Containment could consist of the following components; installation of a fence, construction of a cofferdam or silt curtain, diversion of PCF flow, and backfilling and capping. This alternative would protect public health and the environment because there would be a permanent and significant reduction of potential mobility of chemicals in the inlet sediment, provided that the underlying clay was an integral barrier to the downward migration of chemicals.

Components of this alternative are described and evaluated briefly below.

a. <u>Fence Installation</u>

Installation of a security fence around the inlet would partially eliminate access by the general public. Potential problems are right-of-way, placement to accommodate water level changes, security (vandalism), ice damage, small boat access, and inlet access by heavy equipment should additional remedial measures be implemented.

b. Cofferdam

Installation of a cofferdam at or near the mouth of the inlet would prevent the transport of bottom sediment to the Little Niagara River and isolate the inlet from river access. The cofferdam could also be designed to act as a weir if the PCF continues to discharge into the inlet, thereby substantially reducing the quantity of bottom and suspended sediments leaving the inlet. Should the PCF flow be diverted around the inlet, the cofferdam would essentially cut off the inlet sediment and water from the river. This alternative would decrease the mobility of the chemicals and would therefore be protective of public health and the environment.

The cofferdam would most likely consist of a single wall sheet pile structure. Sheet piling is appropriate because it could be readily installed using barge-mounted equipment, and could be utilized as a temporary structure with appreciable salvage value. It also has a relatively small footprint which would minimize disruption to existing river flows and would facilitate removal of sediment.

The cofferdam should be an effective and reliable engineered structure; installation is an established, albeit not always straightforward practice. To prevent potential problems, design and construction must take into account the presence of the Lockport water intake line, sediment that may contain chemicals at the cofferdam location, variable river currents, and the locally hard and cobbly or soft clay substrata with yet-to-be determined physical and chemical properties.

Installation of a cofferdam alone would not be entirely and permanently effective for decreasing chemical concentrations in the inlet, but would significantly reduce the transport of suspended sediments from the inlet. The cofferdam or silt curtain, described below, would be installed prior to removing sediment from the PCF.

c. Silt Curtain

A temporary flexible silt protector or curtain is an alternative to the sheet pile cofferdam. Such barriers are commercially available and have been designed to contain suspended sediment for conditions as extreme as 5 foot wave heights, one knot flow rates, and 30 foot water depths. The silt curtain consists of a weighted and anchored curtain canvas attached to the bottom and suspended from a floating boom. The silt curtain would not be as effective or reliable as a cofferdam for isolating the inlet, but could be considered a remedial alternative for short-term (two-year) use.

d. PCF Diversion

Diversion of the PCF flow around the inlet, coupled with installation of a cofferdam, would effectively and reliably isolate the inlet from remote surface water flow, but not from localized surface water drainage. It would prevent transport of suspended sediment into the river. This alternative would convert the inlet to a body of standing water without a surface water discharge to the river. Construction steps would include excavating a channel adjacent to the inlet, constructing a new PCF outfall, sealing the existing PCF outfall, and diverting flow into the new channel. Appropriate precautions would be taken during construction to prevent siltation of the river or erosion of the new channel. Design and construction would be implemented in coordination with the appropriate authorities.

e. Backfilling and Capping

Stabilization of inlet sediment in-place could be accomplished after diversion of the PCF by completely backfilling the inlet with clean inert material, covering it with an impervious clay cap, adding topsoil and seeding. This alternative would isolate the sediment from the surface environment and would help minimize generation of leachate in the buried sediment. However, it would not remove the chemicals or immobilize the chemicals i.e., prevent leachate from migrating into the river.

Provided the underlying clay is an integral barrier to the downward migration of chemicals, containment and storage in place would eliminate the potential exposure associated with sediment removal, transport and treatment.

5.11.3 Sediment Removal

The sediment removal alternative would permanently and significantly reduce the volume of chemicals in the inlet and thus protect public health and the environment. The issue of disposal of such sediment is treated separately below at Section 5.12 and treatment of water is evaluated in Section 5.14. Removal would be most effective if conducted after the PCF remediation. Applicable techniques for removing the sediment include hydraulic dredging, mechanical dredging and dewatering followed by excavation.

Removal of inlet sediment could provide public exposure along routes of transportation. Public access to the area during removal operations would be restricted.

a. Dredging - General

Dredging is a proven method of removing sediments, but experience indicates that sediment removal may not be 100 percent effective after a single pass; therefore, multiple passes may be needed. Precise control and selection of appropriate equipment and techniques are required to effect accurate and effective removal, and minimum resuspension and fugitive transport of sediment.

Dredging is greatly facilitated if it is conducted in a contained, quiet water environment. Installation of a cofferdam and diversion of the PCF flow prior to dredging would accomplish this and minimize negative impacts such as the escape of silt or suspended sediment into the River. It would also be good practice to dewater the inlet after dredging for visual inspection to ensure effective removal of sediments.

Two methods of dredging appropriate for consideration at the inlet, hydraulic and mechanical dredging, are described and evaluated below.

b. Hydraulic Dredging

Hydraulic dredging is an established and applicable technique for removing sediments. The size, isolation and water depth of the inlet suggest that a portable hydraulic dredge may be most suitable. Dredges of this type, such as a Mud Cat, are widely available. They are pontoon or similarly mounted and typically cut an approximate eight-foot wide strip along linear traverses controlled by a winch and anchored cable arrangement. Sediment is vacuumed up at approximately a 10 percent solids ratio at a moderately slow rate of approximately 35 to 50 cy/hr. The dredged material is pumped through pipes directly to a settling impoundment with minimal handling of the material. Sediment resuspension is minimal and is usually confined to within 20 feet of the dredge. The dredge operator should be able to detect the top of the clay substratum with the dredge during removal and thereby control the depth of cut into clay to the desired level of approximately 0.5 feet.

Hydraulic dredges have several drawbacks. They pump a large quantity of water that may require treatment. One or more nearby settling impoundments are needed for solids separation and temporary storage. The vacant industrial lots adjacent to the inlet may be appropriate for siting these structures. Should it be acceptable to recycle the supernatent from the settling lagoon and pump it back into the inlet by gravity flow through a second pipeline, the water treatment requirements and required volume of the settling basin would be significantly reduced. Should the inlet be completely isolated from the river and PCF flows, it may be feasible to store the inlet water in the inlet after dredging, rather than collect and treat it.

Hydraulic dredges are susceptible to debris damage; therefore, stumps, logs, tires, rocks, and other debris larger than approximately six inches in size must be manually or mechanically removed from the inlet prior to dredging. This material would be transported to the treatment/storage facility using watertight trucks. This pre-dredging removal increases the materials handling and risk of exposure. Removal of the large debris would be most effective if the inlet is dewatered before dredging.

A water depth (draft) of approximately two-feet is required for portable pontoon-mounted dredges. This is approximately the average water depth in the inlet, and does not leave much of a factor of safety for dredge mobility. The dredge may have to cut its own path as it progresses. However, installation of a sheet pile cofferdam before dredging would help increase water depth in the inlet and facilitate hydraulic dredging. Because the portable dredge makes linear traverses, it may not operate well adjacent to structures such as a cofferdam and some sediment may be left behind adjacent to the structure. The portable dredge may also have difficulty removing clay substratum material if the clay is stiff.

c. <u>Mechanical Dredging</u>

Mechanical dredges such as cranes with a clamshell or dragline bucket are appropriate for consideration for sediment removal. They are widely available, effective, can be land-or barge-based and are most applicable to shallow water, spatially confined, slow flow situations such as at the inlet. Excavated sediment is placed at approximately its in-situ moisture condition, directly into watertight trucks for transport, thereby eliminating the large volumes of water, treatment and handling costs and large settling pond associated with hydraulic dredging. Mechanical dredging techniques are not susceptible to debris damage, so the need for debris removed would be minimal. It is likely that the operator will be able to identify the top of clay with the bucket so that the depth of cut can be controlled.

The main disadvantages of mechanical dredging are that the sediments must be handled directly, and bucket dredges create much turbidity and splashing and cannot recover free liquids very well, though water tight buckets may be available. Their relatively slow production can be mitigated somewhat by use of a large bucket. The horizontal reach of the excavation bucket depends upon the specific equipment employed but may be on the order of 60 to 80 feet. Since the inlet is approximately 100 feet wide by 250 feet long, the excavation equipment must move around the area to achieve full coverage and complete sediment removal. This may increase the preparation effort such as land clearing, grading, construction of additional truck loading containment areas, and construction of temporary access roads into the inlet itself. The mechanically excavated sediment would be transported by watertight trucks to the treatment/storage facility. A number of trucks would be needed to keep the operation progressing continuously. Truck loading pads and haul roads would probably need to be constructed. Precautions would be taken to minimize the potential impact of transfer, handling and transport on the workers, public and nearby community.

d. Dewatering and Removal

Dewatering and sediment removal would consist of four basic components, installing a containment barrier, such as a sheet pile cofferdam to isolate the inlet from the river; diverting the PCF flow around the inlet; dewatering the inlet through use of a centrifugal pump; and removing the sediment using assorted earthwork equipment such as a bucket crane, front end loader, and watertight dump trucks. Vacuum equipment may be an effective and innovative way to remove the sediment.

A system of sumps and pumps would be utilized inside and around the perimeter of the inlet, as appropriate to help dewater the sediments and keep the area dry. A flexible geomembrane could be installed on the river-side wall of the cofferdam to reduce the infusion of river water through the cofferdam and minimize pumping requirements.

The crane and bucket method of sediment removal is similar to the mechanical dredging option. The principal difference being the sequence of the component work tasks, i.e., with the crane and bucket method, dewatering is done before sediment removal rather than afterward. By dewatering the inlet before sediment removal, the inlet water could be pumped directly to the river, whereas dewatering after dredging may require treatment of the inlet water. Sediment could be removed from the dewatered inlet with better control, greater flexibility, more thoroughness, possibly more effective monitoring of excavation depths and less potential for spillage than the dredging technique. The simpler operation would be more reliable and more cost-effective. A sump could be constructed on the exposed clay surface to collect residual liquids, which could be pumped out to an appropriate transport vehicle for subsequent treatment as described in Section 5.14.

The major disadvantages of dewatering/removal are that the feasibility of dewatering the inlet is not yet known and loose, wet sediments may be difficult to remove. Temporary access roads may have to be built into the inlet and consideration must be given to structural stability of the subgrade and the decontamination requirements for the construction equipment. Precautions would have to be taken to ensure that dust is not generated, although it is anticipated this would not be a problem because of the high water content of the sediments.

The vacuuming technique of sediment removal from the inlet would be relatively straightforward provided the large debris is removed by manual or mechanical means. Sediment and associated water would be vacuumed up and pumped directly into trucks without sediment handling. Potential noise and organic vapor problems should be minimal because of the relatively isolated location of the inlet.

e. Site Restoration

Implementation of sediment removal alternatives would permanently reduce the exposure potential of residual sediments to an acceptably minimal level. Inlet restoration would be necessary depending upon which remedial technologies were implemented. Alternatives for restoration could include one or more of the following:

- Return inlet to original preconstruction conditions
- Maintain the PCF diversion
- Maintain partial containment of inlet by removing, if necessary, part of the cofferdam for a spillway
- Maintain complete containment of inlet by preservation of cofferdam
- Reclaim inlet area by installation of a PCF culvert extension or by complete backfilling of the inlet.

5.12 Disposition of Removed Sediment

This section addresses the potential for treatment, storage and/or disposal at the Durez plant or at off-site facilities, of sediment that may be removed from the sewers.

5.12.1 Sediment Quantities

The following sediment volumes have been estimated for the various components of the Durez area sewers:

Storm Sewers	
PCF	686 cubic yards
Other storm sewers	250 cubic yards
Inlet	3400 cubic yards
Sanitary Sewers	42 cubic yards

Table 28 provides a more detailed breakdown of sediment volumes for the sanitary and storm sewers, respectively.

5.12.2 Sediment Characteristics

Physically the sewer sediment ranges from coarse-grained, sand and gravel-like material to fine-grained, silt-sized particles. Moisture contents range from 21 to 84 percent.

The results of chemical analyses of sediment samples are summarized in the following tables.

Sanitary Sewers	Table	24a
Storm Sewers (Phase 1)	Table	22
Storm Sewers (Phase 2)	Table	25a
Inlet	Table	27

Dioxin analyses are presented in Table 26.

Of those sewers that have been investigated, the following sewer sections are expected to contain sediment with less than two percent total organic chemicals, and no dioxin:

All sanitary sewers (up to 0.17 percent total organics)
PCF/Nash Road storm sewer from Wilson Avenue to Meadow Drive (0.58 percent total organics)
Walck Road storm sewer west of Nash (up to 13.1 mg/l (ppm) total organics)
Walck Road storm sewer east of the Penn Central railroad (up to 3.9 mg/l (ppm) total organics)
Nash Road storm sewer south of the PCF to Duane Drive 39 mg/l (ppm) total organics)

5.12.3 Off-Site Treatment

There is no existing commercially available, technologically acceptable, cost-effective treatment for dioxin-containing wastes as discussed at Section 4.12. Section 5.15 provides an assessment of developing treatment technologies.

All sediment removed from the sewers which does not contain dioxin may be suitable for off-site treatment. However, EPA has determined that there is insufficient capacity for remedial waste, 51 Fed. Reg. 40615 (Nov. 7, 1986). Section 5.12.2 contains a list of sewer segments that are expected to contain no dioxin.

5.12.4 Off-Site Disposal

There is no landfill in the U.S. authorized to accept dioxin containing wastes and no way for landfills to obtain EPA approval to supply such capacity. Recent EPA land disposal restrictions concerning dioxins and high level solvents have not encouraged landfill operators to apply for permission to accept dioxin-containing wastes under any conditions. Effective November 8, 1988, specified dioxin-containing wastes will be prohibited from land disposal (40 CFR 260/Nov. 7, 1986).

The EPA and State bans on landfilling of solvents are complex and pose substantial obstacles to the land disposal of remedial wastes containing solvents as has been noted at Section 4.12. Since the sediment, however, is not classified as a hazardous waste under F001-F005, its disposal is not currently subject to the federal land disposal law. Accordingly, the two major obstacles to the land disposal of this sediment are the federal management guidelines requirements for the disposal of dioxin and the state land disposal restrictions on solvents.

If permission to dispose of sediments at an off-site disposal facility was granted, minimal impacts would be anticipated because the facility would be under permit and subject to all the protective conditions which the regulatory authorities have imposed in order to protect public health and the environment. Permission for such disposal is, however, subject to regulatory hurdles described above at Section 4.12.

Some potential for exposure would exist from the point of removal of the sediment from the sewer until its arrival at the disposal facility. However, such exposure potential can be minimized by following an appropriate health and safety plan.

Removal from the sewers would permanently and significantly reduce the volume of chemicals in the sewer and under the circumstances described above should permanently and significantly reduce the mobility of the chemicals in the environment after disposal at the permitted disposal facility.

5.12.5 Interim Storage Adjacent to the Inlet

This alternative for the disposition of removed sediment would apply to sediment removed from the inlet and would consist of interim storage of sediment in a dewatering/interim storage cell located adjacent to the inlet. The sediment would be kept in the cell until a commercial cost-effective treatment technology became available. The cell would meet all current regulatory requirements for a hazardous waste landfill (40CFR 264 and 6NYCRR 373.2), and would be similar to the plant storage cell discussed in Section 5.12.6 below and Section 5.7.

The advantages of storage at this location include:

No transportation is required for sediment removed from the inlet;

The area is largely in industrial/commercial use, with few residences nearby.

Disadvantages include:

The need for a leachate treatment facility;

The proximity to the Niagara River and its flood plain;

The need for transportation of sediment removed from the sewers at locations other than the inlet;

OCC does not presently own the property required for the storage facility.

Technical feasibility considerations for this alternative are virtually the same as for a plant site interim storage facility. Costs for the this facility would be greater, however, to provide the same level of security, groundwater monitoring and leachate treatment that do (or will) exist at the Durez plant. A facility at the inlet would not benefit from the added protection provided by the proposed plant site groundwater collection system at Durez. This alternative would be more cost effective if leachate could be discharged to the NT WWTP (located only 0.5 miles north of the inlet on River Road) after simple pretreatment to remove suspended solids, than if leachate treatment must be provided to remove organic chemicals. This alternative would complement a sewer cleaning method that could readily transport removed sediment to the inlet within the confines of the PCF, e.g., by pipeline or conveyor.

This alternative would significantly reduce the potential for mobility (i.e., bio-availability) of the chemicals in the sediment, but would not permanently reduce the volume or toxicity of the chemicals. The alternative would not be expected to be permanent and would be less protective of public health and the environment, for the reasons stated above, than the alternatives of disposal at a licensed disposal facility or interim storage at the Durez plant.

5.12.6 Interim Storage at the Durez Plant

This alternative would provide for interim storage of removed sediment at the Durez plant.

OCC has completed the conceptual design of three on-site, interim storage options, including storage in a cell, and container storage in a large tank or a building (Options A, B1 and B2). The three are described briefly below and in more detail in the following sections a and b. Each would use the carbon treatment system, proposed to treat plant site groundwater (See Section 5.6 and 6.6), to treat liquids generated by dewatering operations.

An interim bulk storage cell (Option A) would store the sediment in a double-lined storage cell meeting current RCRA and NYS standards which would otherwise be necessary for construction of a hazardous waste landfill. An internal drain system would provide for continuous dewatering of the material following placement.

A dewatering/container storage facility (Option B) would provide for storage of the sediment in an existing plant storage tank (Option B1) or a building (Option B2) following water removal at a new dewatering facility, and transfer to poly-lined supersacks or drums.

a. Interim Bulk Storage Cell

1. REGULATORY TECHNICAL REQUIREMENTS

The technical requirements for the interim disposition of sediment in a storage cell are contained in 6 NYCRR Part 373-2, Final Status Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities, dated July 14, 1985. Portions of Sections 373-2.12, Waste Piles, and 373-2-14, Secure Land Burial Facilities, address the methodology presented herein. Pertinent criteria contained under these sections are outlined as follows.

1A. Design and operating requirements indicate that the waste facility must have:

1. A liner designed, constructed and installed to prevent migration of wastes out of the pile. The liner must be:

   - o chemically compatible with the wastes and potential leachate;
   - o of sufficient strength and thickness to prevent failure due to pressure gradients, climatic conditions, stress of installation and operation;
   - o placed on a foundation or base capable of providing support to the liner; and,
   - o installed to cover all surrounding earth likely to be in contact with the waste or leachate.

2. A leachate collection and removal system immediately above the liner designed, constructed, maintained and operated to collect leachate from the pile. This sytem must in turn be:

   - o chemically compatible with the wastes and potential leachate;

   - o of sufficient strength and thickness to prevent collapse under the pressure exerted by the overlying wastes, cover materials and operating equipment; and

   - o designed and operated to function without clogging.

3. A run-on control system, designed, constructed, operated and maintained to prevent flow onto the active operation during peak discharge from a minimum 25 year/24 hour storm event.

4. A run-off management system designed, constructed, operated and maintained to collect and control at a minimum the water volume resulting from a 25 year/24 hour storm event.

5. A management system to control wind dispersal of any particulate matter contained in the wastes.

6. A groundwater protection plan which satisfies the requirements of 6 NYCRR Part 373-2.6. Double lined facilities are not exempt from this provision.

1B. Monitoring and inspection requirements dictate that:

1. During construction liners must be inspected for uniformity, damage and imperfections.

2. Following construction or installation liners and covers must be inspected to ensure tight seams and joints and the absence of tears, punctures and blisters.

3. During operation the waste facility must be inspected weekly and after storms to detect evidence of:

   o deterioration, malfunction or improper operation of run-on and run-off control systems;

   o presence of liquid in leak detection system;

   o proper functioning of wind dispersal control system; and,

   o presence of leachate in and proper functioning of leachate collection and removal system.

1C. Closure and post-closure care requirements dictate that at closure all contaminated containment system components (liners, etc.) contaminated subsoils, structures and equipment contaminated with waste and leachate must be removed and managed as hazardous waste.

The term for interim disposition of the sewer sediments is indeterminate at present. For this reason, a plan for "temporary" closure, adapted from 6 NYCRR Part 373-2.14(g), Closure and post-closure care, is deemed relevant. In accordance with the intent of this section, the waste storage facility would be capped with a final cover designed and constructed to:

- o prevent the migration of surface water (run-on) into the stored wastes;
- o promote drainage and minimize erosion or abrasion of the cover;
- o accommodate settling and subsidence so that the cover's integrity is maintained; and,
- o function with minimum maintenance.

2. LOCATION

The proposed storage cell would be located within the existing boundaries of the Durez Division plant in North Tonawanda, New York. Specifically, the cell would be placed on the Panhandle, as shown in Figure 5.3. This Panhandle location is deemed most favorable for the following reasons:

- o it is encircled by a chain link fence and monitored by closed circuit television to control access;
- o its position beyond current active plant areas;
- o proposed groundwater collection and treatment systems will provide double redundancy for the cell's double-lined containment;
- o a thick, impermeable clay layer underlies this location;

- good acessibility for construction equipment;
- adequate boundary areas to maintain an adequate buffer or setback;
- absence of surface drainage features;
- the area is currently controlled by existing groundwater monitoring network;
- natural topography minimizes run-on potential;
- the area is outside of the 100-year flood plain.

3. STORAGE CELL CONCEPTUAL DESIGN

The proposed storage cell is intended to serve as the point of the interim disposition for sediment anticipated to be removed from the affected North Tonawanda sewers. Minimum criteria considered in the development of the storage cell's conceptual design include the following:

- isolation from local groundwater table
- protection from run-on
- protection from wind dispersal
- prevention of leachate generation
- ease of sediment placement
- conformance with local topography
- storage of 1500 to 1800 cubic yards of sediment (based on early estimates of storm sewer sediment volume)

The conceptual design proposed is an at-grade earth embankment structure having internal base dimensions of 100 by 150 feet. The maximum vertical height of sediment stored in the cell was assumed to be 3.5 feet. This vertical height dimension would be adjusted in the final design, as necessary, to accommodate the final volume determination. All sediment removed from the storm sewer system would be confined in one cell. Future sediment management activities may also entail the inlet area; a second cell or a larger single cell sufficient in size to contain the inlet area sediments (estimated at 2500 to 4300 cubic yards) could be developed at the same location.

Final design of the storage cell would include provision for liner chemical compatibility testing using concentrations comparable to those determined through the analytical testing of the sediments.

4. HANDLING OF WASTE SEDIMENT FOR STORAGE

Sediments removed during the sewer cleaning would be transported to the cell via self containing trucks. Free liquid contained within these vehicles would be decanted from the truck directly into the cell's center drain system. A discharge point has been provided on the cell's northern side for this purpose. This drainage system access point would also serve as a cleanout should the system become clogged. Following decanting the trucks would dispense their sediment load within the cell limits for storage. A 30 x 30 foot controlled unloading area would be utilized during cell operation as the dispensing point for all incoming sediment. A specific health and safety plan will be formulated for those people working at the storage cell.

5. STORAGE CELL OPERATION

As indicated on Figure 5.4 an operations support area would be developed along the northern perimeter of the storage cell. The controlled unloading area or dispensing point would be located at the cells northeast corner. Fresh sediment would be dispensed at this point and spread into the cell in a southerly (downslope) direction. In this fashion the sediment would be provided the greatest opportunity to dewater. Depending on the moisture content of the sediments it may be necessary to create a second unloading area in the northwest corner of the cell.

All transport vehicles would be skirted to minimize potential contact with the sediment being disposed. However, as an added measure of safety, all vehicles would be routed through a decontamination process prior to exiting the operations support area.

While wind dispersal of freshly placed sediment is not expected to be a problem due to the material's moisture content, all active areas of waste would be tarped on a daily basis. For each operating day only those areas to be utilized for waste disposal would be exposed. The berms should likewise serve to limit wind dispersal of particulate matter. The level of organics present in the sediments may also present an odor nuisance problem. Use of the tarp in periods of inactivity would minimize the potential for odor transport. The potential for gas formation under the liner cap is possible due to the level of organics present in the sediments, and the decomposition of vegetation that may be collected with the sediment. For this reason, provision for gas release has been incorporated into the cover design. No estimate on the level of gas formation is currently available. All support area materials that cannot be decontaminated would be disposed of in the storage cell prior to the placement of the final cover.

6. STORAGE CELL POST CLOSURE MONITORING

As noted earlier, the duration of interim storage for the storm sewer sediment is unknown at this time. Consequently, routine weekly monitoring of the storage cell would be necessary to check the sump and main drainage system and the leak detection system. Groundwater monitoring is discussed in Section 6.1.2. The location of existing monitoring wells is shown on Figures 2.1 and 5.4. Inspection of the cover materials and level of gas release would also be included in the weekly site review. Similar inspections would also be conducted following significant storm events, and required maintenance would be addressed immediately.

7. CONCLUSIONS

The evaluation of the bulk storage cell option is presented below as a summary of advantages and disadvantages.

Advantages

1. The storage cell would serve as a low visibility option for handling the storm sewer sediments.

2. The storage cell would be aesthetically consistent with the vegetated Panhandle following closure and establishment of vegetative cover.

3. Cell construction, operation and closure could be accomplished using conventional equipment.

4. The cell and its components would not be affected by extreme weather conditions, and would be quite secure upon completion of construction.

5. The storage cell offers volume flexibility in its design.

6. All currently identified sediments for clean-up could be handled/stored at one location.

7. Inlet area sediments could be stored at the same location through development of a second storage cell or a larger single cell.

8. The facility would require little or no maintenance once temporary closure is achieved and the area stabilized.

9. Liner materials have performed effectively under similar conditions where the concentraton of organic constituents has been less than 10 percent by weight.

10. A thick, impermeable clay layer underlies the proposed cell location.

11. The storage cell option offers simplicity and flexibility in the handling of the sediment in that:

    - the system as designed would permit decanting of free liquid from the transport vehicles directly to treatment, bypassing the cell;

    - special dewatering measures would not be necessary as the cell is designed to allow the sediment to freely dewater over time;

    - if dewatering and containerization of sediment were required, the cell could easily accept the resulting containers;

    - daily sediment quantities could be dispensed quickly and covered to minimize nuisance odor transport; and

    - material segregation by size would not be necessary. However, if desireable, the cell could be developed to handle sediment and also drummed waste.

- o the cell would allow sediment to be unloaded directly from the transport vehicle to its interim storage location without the intermediate transfer and handling (and associated risks of exposure) required by other interim storage options.

- o the cell could acomodate a gas venting system more readily than the other options.

- o the cell would readily accept non-sediment materials that may be removed with the sewer sediment, such as roots, vegetation, large stones, broken concrete masonry and drainage tile, lumber, etc. All of these materials have been observed in the Pettit Creek Flume and the inlet.

- o the cell could accept sediment as quickly as it could be unloaded from the transport vehicles, with no delay between vehicles to allow previously unloaded sediment to be processed and transferred.

12. The storage cell could be implemented in accordance with the currently established regulatory mandates defined by 6 NYCRR Part 373-2 and 40 CFR 264.

13. Following the term of interim disposition the sediments could be easily removed from the cell for final treatment or disposal.

Disadvantages

1. Liner compatibility would have to be evaluated.

2. Based on volume calculations, borrow materials would be required for berm and final cover construction if a second or larger storage cell is needed.

3. Storing sediment in the cell would require eventual treatment and disposal of liners, leachate collection system components, cover material, etc, that came in contact with the sediment.

4. While the proposed leak detection system would allow for the detection of leaks in a timely fashion, their repair would be difficult to effect, although possible.

It is the conclusion of this assessment that interim bulk storage in a cell at the Durez plant would be protective of public health and the environment.

b. Dewatering and Container Storage

1. DEWATERING

A plate and frame filter press or equivalent equipment would be utilized for dewatering the sediment. The filter press comes permanently mounted on a flat bed trailer, which includes a sludge pump, air compressor, and mechanical drag line for moving the dewatered sludge as it falls from the filter plates to the end of the flat bed trailer. The system arrives ready for operation requiring only the hook up of power and water. The trailer containing the system would remain on-site throughout the duration of dewatering operations.

For the prevention of odor and to minimize emissions, the entire operation would need to be carried out in a newly constructed building. The dewatering building would be equipped with a fan to provide adequate ventilation. The air from the discharge of the fan would pass through a filter/activated carbon system prior to discharge. The air discharged from the carbon system would be periodically monitored for organic content and the carbon replaced as necessary.

The building would be equipped with a curbed concrete slab and a sump such that any spillage could be easily washed up. Water from the sump would be removed by the sediment handling vacuum trucks for suspended solids removal and carbon treatment prior to discharge.

2. SEDIMENT HANDLING

After they are filled with sediment, the vacuum trucks would be brought into the building and hooked up to the dewatering trailer. The sediment would be pumped through the filter press until sediment accumulates in the press. If there is insufficient water present in the vacuum truck for sediment pumping, water from the discharge of the filter press can be recycled to the truck to minimize the amount of water addition.

When the filter press has reached its solids capacity loading, compressed air would be introduced to blow out remaining liquid into the collection system. Each of the press's plates would be spread in sequence by a hydraulic system and the dewatered solids would fall onto the bed of the trailer. A mechanical drag line would pull the solids to the edge of the trailer bed where they would fall into a chute and be transferred into the solids storage container, either a drum or a supersack.

Water that is generated at the dewatering station would be piped to the carbon treatment facility that is proposed to treat groundwater collected at the Durez plant. See Section 5.6 and 6.6.

3. DRUM STORAGE

Top opening 55-gallon drums would be filled directly from the chute off the trailer bed. The drums may have an inner liner, if needed, to minimize corrosion during storage, and would be top opening for ease of filling. It is estimated that approximately 6000 drums would be required to contain each 1500 cubic yards of sediment to be stored.

4. SUPERSACK STORAGE

Supersacks with a capacity of approximately 35 cubic feet would be filled directly from the chute off the trailer end. Once the supersacks are filled and closed they would be air tight. It is estimated that approximately 1160 supersacks would be required to contain each 1500 cubic yards of sediment to be stored.

5. STORAGE OF CONTAINERS

Two alternatives are presented below for the storage of containers filled with sediment.

An existing storage tank at the Durez plant could be used for storage of the filled supersacks. This is designated as Option B1; See Figure 5.7. As the supersacks were filled they would be webbed together using standard webbing for the supersack system. They would then be lifted by crane and lowered into the tank through a hole in the roof. During this operation there would be no odor since the sacks are sealed. After the loading was completed, the roof would be closed and the sacks stored as is. Removal of the sacks would be done similarly once a permanent treatment/disposal system was found. Tank storage was not considered for the 55-gallon drums because of the excessive handling required to lift each drum individually into the tank.

An existing or new building could be used for storage of the filled supersacks or drums. This is Option B2; See figure 5.8. The building could be a non-heated, prefabricated metal building or site-built pole building. The building would have a curbed concrete or asphalt floor with drains and a sump to collect any spillage or leakage. The sump would be inspected regularly and emptied as necessary.

6. CONCLUSIONS

The evaluation of the container storage option is presented below as a summary of advantages and disadvantages.

Advantages

1. Container storage of sediment, particularly in a building, could, under some circumstances, provide for simple leak detection.

2. Container storage would not contaminate significant quantities of materials, other than the storage containers, which would require future treatment or disposal.

3. Future treatment or disposal of the sediment could be facilitated if a treatment/disposal technology that would readily accept the filled containers is developed.

Disadvantages

1. The dewatering operation may limit the rate at which sediment can be removed from the sewers, thus extending the time required for remediation.

2. The transfer of sediment from the dewatering trailer to the containers would be done manually, thus increasing the risk of exposure and release of chemicals. The increase in these factors would be greatest for the smaller containers.

3. Sediment may require "pre-processing" to remove materials not suitable for introduction to the dewatering equipment. This may require manually removing the unsuitable materials from the sediment, and transferring them directly to containers.

4. Containers, such as supersacks, would be susceptible to damage during the handling required to fill, stack, and store the containers.

5. Gas generation in the containers from decomposing natural organic material would be difficult to control, and damage to the sealed containers could result in spillage of material.

6. Containers may have to be emptied of their contents to facilitate future sediment treatment or disposal.

7. The costs of the container alternatives would be significantly higher than the interim storage cell alternative.

It is the conclusion of the assessment that, as with the interim storage cell, interim container storage in a tank or building at the Durez plant would also be protective of public health and the environment.

5.12.7 Treatment at the Durez Plant

On-site treatment options could include incineration or other thermal treatment (e.g., pyrolysis), detoxification, stabilization, extraction and volume reduction. While these technologies are currently in various stages of development, none of them are commercially available for treatment of Durez area sewer sediment.

OCC has discussed on-site treatment of sewer sediment with such commercial waste management firms as Rollins, IT Enviroscience Corporation and Chemical Waste Management, as well as various independent researchers. OCC itself is conducting research on hazardous waste treatment. While much current research is promising, there is no commercially available process for on-site treatment of Durez area sewer sediment. Section 5.15 presents an assessment of several alternative treatment technologies currently under development.

The presently developing innovative technologies that have been considered in the preparation of this RAA include the following:

- Biological degradation research, by OCC
- Mobile incinerator, by USEPA and others
- Plasma arc technology by Pyrolysis Systems, Inc. and Westinghouse
- K-PEG detoxification by Chemical Waste Management (CWM) and others
- Solvent extraction by CWM and others
- Electric Pyrolzer by Westinghouse
- Infrared treatment by Shirco and others
- Enzyme treatment by Agro-K

5.13 Diversion of Storm Sewer Flows

The temporary diversion of storm sewer flows during remediation will by addressed by a detailed flow diversion plan to be developed in concert with the final design of the sewer cleaning program. Some general considerations for such a diversion plan can be addressed here, however.

The recently constructed Meadow Drive Interceptor (MDI) storm sewer has been installed to accept flows formerly going to the PCF from Nash Road north of Meadow and from Meadow west of Nash. The MDI could also accept flows from the PCF south of Meadow Drive. The following street sewers could be diverted by gravity to the MDI.

PCF, north of Walck Road
Walck Road, west of Nash Road, including Eggert Drive
Wilson Avenue (after diversion of Durez plant flows from Wilson Avenue to Walck Road)

These diversions to the MDI would accommodate high flows and probably could remain inplace during storm events.

Diversion of other storm sewer flows would require pumping, either around or through the active cleaning zone. Diversion could be to nearby sanitary sewers or to storm sewers downstream of the active cleaning zone. Street laterals and other laterals discharging to the active cleaning zone could simply be plugged at the PCF if their flows were low volume.

5.14 Water Treatment and Disposal

Depending on the method(s) chosen for remediating the Durez area sewers, various amounts of water will be generated by dredging and cleaning methods, and sediment dewatering. The water will contain levels of organic chemicals (chlorobenzenes) and suspended solids that may contain dioxins. The three alternatives for management of the resulting water are: discharge without treatment; removal of suspended solids prior to discharge; or, removal of suspended solids and carbon filtration prior to discharge.

5.14.1 Discharge Without Treatment

Water from dredging, cleaning and/or dewatering operations could be discharged to the City's storm or sanitary sewers or directly to the Little Niagara River. While this alternative has obvious merits based on technical and cost considerations, it would not achieve OCC's stated objective reducing exposure to chemicals, and is, therefore considered not appropriate.

5.14.2 Suspended Solids Removal

Water from dredging, cleaning and/or dewatering operations could be treated to remove suspended solids and the organic chemicals (TCDD) attached to the solids prior to discharge to the river, the storm sewers, or the NT wastewater treatment plant (WWTP) via the City's sanitary sewers.

Dredging operations to remove sediment at the inlet are the most likely to use this alternative. During dredging, suspended solids would be retained in the inlet by a silt curtain, sheet pile wall, or an alternative containment mechanism. If hydraulic dredging techniques were used, a temporary impoundment would be used to store and dewater removed sediment. Decant water from the impoundment could be returned directly to the inlet without further treatment. Decant water also could be treated for suspended solids removal prior to return to the inlet or discharge to the City's sanitary sewers for treatment at the WWTP.

A temporary dewatering/interim storage facility at the Durez plant also could employ this alternative. Decant water and leachate from the storage facility could be treated for suspended solids removal prior to discharge to either the City's storm or sanitary sewer system. Discharge to the storm sewer/PCF would be essentially the same as discharge directly to the inlet except that there would be some risk of redepositing chemicals in the storm sewer. Discharge to the sanitary sewer would result in the eventual removal of organic chemicals from the water at the North Tonawanda waste water treatment plant.

The technical feasibility of this alternative is very high with excellent performance, reliability and implementability. Cost should be moderate. This alternative is considered appropriate for use in remedial activities at the inlet.

The risk of exposure associated with this alternative can be maintained at an acceptably low level. During remedial construction, the level of organic chemicals dissolved in discharge water may be higher than they are now. There would also be a higher level of suspended solids that may have dioxins attached to them. However, these levels would be temporary and would occur only in the inlet, access to which would be restricted. Worker exposure would be limited by adhering to an appropriate health and safety plan.

5.14.3 Suspended Solids Removal and Carbon Treatment

This alternative is the same as that described in 5.14.2 above with the addition of carbon treatment to remove organic chemicals prior to discharge. This alternative could apply to water generated by dredging, cleaning and/or dewatering operations at the inlet or at the Durez plant.

While the technology is available for carbon treatment of aqueous streams, the complexity of the treatment system would somewhat reduce the reliability and implementability of the alternative. Effectiveness and performance would increase, however, as would the cost of the alternative, especially for use at the inlet. The availability of an existing carbon treatment system at the Durez plant (to treat collected groundwater) would make this alternative more attractive for the treatment of water generated by dewatering or storage facilities located at the plant. This alternative appears to be appropriate for remedial action at affected North Tonawanda sewers.

The risk of exposure associated with this alternative would be essentially zero beyond the treatment facility, access to which would be limited to workers. Worker exposure would be limited by a health and safety plan.

This alternative would be more protective of human health and the environment that those discussed above, because it would significantly and permanently reduce the volume, toxicity and mobility of chemicals in the water to be discharged.

5.15 Assessment of Developing Treatment Technologies

The purpose of this Section is to provide an assessment of various hazardous waste treatment technologies that are currently being developed and that may be applicable to the organic chemicals and dioxin-containing sewer sediment that may be generated by remediation of the North Tonawanda sewers in the vicinity of Durez.

Table 5.1, following this page, presents the results of preliminary screening of the considered treatment technologies. Listed are the general technologies and specific processes, if applicable, that could be used to treat the dioxin containing sewer sediment. This list was developed after review of numerous documents on the treatment of hazardous wastes that have been written or compiled by USEPA and others.

The right hand column of Table 5.1 provides an evaluation of the corresponding technology in the form of one or more evaluation codes; the codes are explained on page 3 of the table. For any technology that has a "1" in the evaluation column, a Technology Assessment Summary sheet is provided following the table.

TABLE 5.1
Screening of Treatment Technologies
Applicable to Dioxin-Containing Sewer Sediment

Technology	Process	Evaluation (1)
1a. Thermal-Low Temp		
Supercritical Water Oxidation	Modar Company	2,11
Wet Air Oxidation	Dow Chemical Co., IT Corp.	2,3,11
In-Situ Radio Frequency Heating	Illinois Institute of Technology	3,5,9,10
1b. Thermal-High Temp		
Incineration		
Mobile Incinerator	EPA, Pyrotech	1,4,8
Rotary Kiln	ENSCO, Rollins, SCA	1,4,8
Multiple Hearth		3,4,8
Fluidized Bed/ Circulating Bed	GA Technologies	3,4,8
Liquid Injection	Vulcanus	2,4,8
Infrared	Shirco, Inc.	1,4,8
Microwave Plasma	Westinghouse Plasma Torch	2,4,9,11
Plasma-Arc Pyrolysis	Westinghouse, Pyrolysis Systems Inc.	2,11
Electric Pyrolysis	Westinghouse, Pyrolysis Systems Inc.	1,4
High Temperature Fluid Wall Reactor	Huber Co. Advanced Electric Reactor	7,8
Molten Salt Combustor	Rockwell International	5,7,8

2. <u>Chemical</u>

Dechlorination	KPEG, APEG (USEPA)	1,5,9,10
	Acurex	5,8,10,11
	PCBX-Sunohio	5,8,10,11
	PPM	5,8,10,11
Chloroiodides		3,9
Chlorination		9
Catalytic Oxidation		9
UV Photolysis	IT Corporation	2,3,8,9,10,11
	LARC	3,5,11
Ultraviolet/Ozonation		2,8,9,11
Gamma Radiolysis		3,4,6

3. <u>Physical</u>

Carbon Adsorption		2,8
Fixation of Soil	Cement, Fly-ash	3,5,7,8
In-Situ Vitrification	Battelle Northwest Inst.	1,4,9
Solvent Extraction	Acurex	1,5,8,10
	OHM	1,8,10
	Soilex	1,8,10
	Chemical Waste Management	1,5,8,10

4. <u>Biological</u>

Micro-organisms	Bio-Clean	1,8,9,11
	White rot fungus (USEPA)	1,3,9
Enzymes		9

NOTES:

1. This is an emerging technology that is appropriate for further consideration for the treatment of the dioxin-containing sewer sediment.

2. Process is applicable only to aqueous or other liquid waste streams.

3. DRE is too low to have end stream declassified for disposal.

4. Process costs are high compared with other technologies.

5. Process may be intolerant of water in sediment and could require excessive drying of sewer sediment.

6. Process has been found to be ineffective.

7. Size reduction or other front-end processing may be required for sewer sediment.

8. Process generates RCRA waste that must be treated or disposed of.

9. Process is not well demonstrated for dioxin and/or site conditions and will require extensive laboratory and/or pilot scale development, and will not be available for application to sewer sediments to be removed within 12-24 months.

10. Process is more effective if combined with other technologies.

11. Process requires solvent extraction.

Method Rotary Kiln Incinerator

Description

Solid and/or liquid waste feed is introduced to a primary combustion chamber (operating temp. 1600^{o}F to 3000^{o}F) to achieve volatilization and destruction of organic contaminants. This process is facilitated by the rotation of the cylindrical, refractory lined primary chamber which provides sufficient mixing of solids to ensure complete heat transfer and volatilization. The air stream containing the volatilized organics is vented to a secondary combustion chamber or afterburner where further oxidation of the organics is achieved. Waste solids exit the primary combustion chamber in the form of ash and small soil particles. Off-gases must be neutralized and particulates must be removed prior to release to the atmosphere.

Applicability/Limitation

Rotary kiln incineration is applicable to the treatment of organically contaminated solids and/or liquids. Reliability of large scale units is not demonstrated for dioxin destruction. Feed rates can range from 75 million Btu/hour for large, fixed units to 15 million Btu/hour for mobile units. Packaging of wastes for incineration may be required with the attendant risk of exposure to workers.

Effectiveness

Rotary kiln incinerators have accomplished 99.9999% destruction removal efficiency for dioxin contaminated solid wastes.

Costs

Incineration of soils requires a large expenditure of capital. Process residuals must be treated and/or disposed in a secure landfill. The process also requires extensive air pollution abatement equipment and air stream monitoring. Mobilization and de-mobilization, operations and maintenance costs are significant. A literature review provides an average cost per ton of waste of $1500-2000 which is prohibitively high compared to other technologies.

Status

The USEPA owns and operates a mobile incinerator which has been demonstrated for treatment of dioxin-containing soil in Missouri. Several private firms are reportedly developing mobile units. No permits have been granted for the thermal treatment of dioxin.

Method Shirco Infrared System

Description

The Shirco Infrared system operates by passing solid waste feeds under infrared heating elements of a primary chamber to volatilize organic constituents. Oxidation of the organics in off-gases is accomplished in the secondary combustion chamber under operating temperatures of 2300°F. A scrubber system is provided for neutralization of the off-gases. Ash is discharged to a hopper from which it is conveyed to a drum.

Applicability/Limitation

The Shirco Infrared unit has been used for the treatment of organically contaminated hazardous waste solids and sludges. Solids must be finely divided. Mobile test units can process 100 pounds of waste per hour. A two ton per day system is under design.

Effectiveness

The mobile Shirco unit was used to treat dioxin contaminated soil at Times Beach, Missouri in July 1985. Shirco reports 99.9999% destruction removal efficiency of dioxin during these tests in which 646 lbs of soils was treated. Reduces volume, toxicity, and mobility of wastes.

Costs

No data available. Typical operating costs alone are expected to be in the range of $90/ton to $110/ton. These costs do not include capital and mobilization costs which would be significant.

Status

Commercially offered but has limited operating experience. No systems are in commercial operation. The technology has promise, but is considered to be in the developmental stage for dioxin treatment. No permit for treatment of dioxin-containing waste have been issued.

Method Electric Pyrolysis

Description

The Electric Pyrolyzer operates by rapidly transferring a large amount of energy to waste materials. Solids, sludges, and/or liquids are supplied to a radiant chamber where the operating temperature is 4000°F. A residence time of two seconds reduces organic contaminants to their atomic state. The energy level within the chamber is sufficient to melt most materials, including dirt, thus creating a molten bath. As the melt is removed from the Electric Pyrolyzer, inorganic hazardous materials will remain in the vitrified soil residue. The manufacturer states that the vitrified soil residue has excellent leach resistant characteristics and may provide for eventual delisting of the material as a hazardous waste.

Applicability/Limitations

Theoretically, this unit could be used to treat organically contaminated solid waste including those wastes containing dioxin.

Cost

No data.

Effectiveness:

This unit has not been evaluated for destruction removal efficiency of dioxin contaminated waste. Decreases volume, toxicity, and mobility of waste.

Status of Development

Westinghouse Waste Technology Services Division has developed a pilot-scale mobile Electric Pyrolyzer capable of processing 5 tons/day of soils. A RCRA Research Development and Demonstration permit will be sought in the future. Demonstration testing of this pilot scale unit may begin in 1987.

Method Chemical Dechlorination

Description

Dechlorination processes utilize chemical reagents or catalysts to remove chlorine from chlorinated molecules, to break apart chlorinated molecules, or to change the molecular structure of the molecules. Dechlorination of TCDD is used to remove chlorine atoms from the TCDD structure, thereby reducing its toxicity and making it amenable to other forms of treatment or disposal.

Of the available dechlorination reactions, nucleophilic substitution using alkali-based polyethylene glycol reagents (APEG) has given the best results. The preferred reactions of this type for use with TCDD contaminated sediments involve the use of potassium hydroxide and polyethylene glycols (KPEG) to form an alkoxide, which is the reactive species. Research studies at Wright State University have used sodium polyethylene glycol reagents (NAPEG) in batch processes at ambient temperatures to dechlorinate TCDD. The addition of a sulfoxide catalyst/co-solvent, usually dimethyl sulfoxide, greatly enhances the rate and degree of reaction. The reagent is either added directly to the soil with mixing (in-situ process) or can be mixed 1:1 volume with soil in an external reactor (slurry process). The dioxin is dechlorinated to a water soluble form, which may be then removed from the soil in the slurry process or allowed to biodegrade (in-situ process).

Applicability/Limitations

APEG based dechlorination processes are highly moisture sensitive. The APEG is extremely hygroscopic and is capable of pulling moisture from out of the surrounding environment resulting in deactivation of the process. The process is flexible in that it is applicable to TCDD dissolved in solvents or can be used directly on contaminated soils. Assuming the contaminated sediment is sufficiently dewatered and isolated from moisture, the process can be applied "in-situ". Alternatively, the reagent can be mixed with contaminated in an external reactor. Treatment effectiveness rises dramatically with temperatures; reaction efficiencies reportedly increase from 50% - 90% in the $20^{o}C-70^{o}C$ range.

Costs

Capital costs for a three reactor slurry process system are estimated to be approximately $2,350,000 for a 40,000 ton/year capacity. Capital costs for an in-situ treatment system would be similar. Operational costs are dependent primarily on the cost of reagents and the length of time necessary for treatment. Operational costs for the slurry process system are generally lower if reagents recovery and recirculation can be applied.

Effectiveness

Greater than 99.95 percent TCDD degradation was observed from a 2,4,5-TCP still bottoms sample contaminated with 250 ppm TCDD in laboratory testing of chemical dechlorination using the Vertac (APEG) process. TCDD levels have been reduced from 2000 ppb to <1 ppb, for a removal efficiency of greater than >99.95%. This efficiency was accomplished utilizing the slurry process at 70°C for 2 hours. Reagent recovery by washing has produced 94-99+% recovery.

Degradation of TCDD by dechlorination has been tested in the laboratory with greater than 99.95% efficiency. The Acurex mobile batch sodium reagent has been developed commercially for PCB. Test data has shown an 87% reduction in dioxin concentrations in transformer oil. Water destroys the reagent however, and the process would likely require extraction of TCDD from the sediment as a pretreatment. This process would therefore have application only as a subordinate final step to overall extraction and concentration operations.

Status/Availability

Commercial successful operations have been limited to PCB contaminated fluids, but efforts are being made to apply this process to soils containing dioxins.

Dechlorination is an emerging technology for dioxin treatment, but must be coupled with other treatment methods such as dewatering and/or solvent extraction for effective treatment of the Durez materials containing dioxin.

Method Insitu Vitrification

Description

Insitu vitrification is an electro-thermal technique for destroying and immobilizing organic chemicals in soil. The technique consists of heating the soil to approximately 2000°C using a system of four high-voltage electrodes inserted into uncontaminated soil adjacent to the area of interest. The high temperatures will melt and fuse the soil into an inert and stable glassy mass and will pyrolize many organic chemicals. Steam and offgas are collected using a vacuum hood and are treated. The technique was originally developed for in-situ stabilization of low level radioactive waste.

Applicability/Limitations

This technique is most applicable for treating/stabilizing in-situ soils that are relatively dry or, if below the water table, have a hydraulic conductivity less than 1×10^{-5} cm/sec. The presence of water greatly slows the process and would decrease the feasibility of this technique in the inlet. The procedure has not been tested for dioxin destruction. A major uncertainty in the method is the nature and required treatment of the offgas, especially in the presence of high concentrations of low boiling point organics or unconfined contaminated soils. On-site feasibility testing is necessary regarding performance requirements of the offgas treatment system and the type and quantity of secondary waste generated.

Cost

The estimated cost for in-situ soils is $100 to 250/ton for soils. Approximately 30 to 46% of the cost is for power.

Effectiveness

Previous testing on 500 ppm PCB wastes indicated a DRE of 99.9999% including offgas treatment. No residual PCB was detected in the vitrified block. The technique has not been used for dioxin treatment. Decreases volume, toxicity, and mobility of waste.

Status/Availability

The technique was developed by Battelle Northwest Laboratory. They have conducted large scale tests and have a mobile unit available. It is uncertain if this technique would be feasible for in-situ vitrification at the inlet. No permits have been issued for dioxin treatment.

Method Solvent Extraction

References

Description

Solvent extraction of dioxin from sediment is achieved by thoroughly and intimately contacting adequately processed sediment with a solvent that will preferentially remove dioxin from the sediment to a desired level in a specific contacting time. A multiple batch contacting process or a continuous countercurrent process is needed when a single contacting stage does not accomplish the desired level of removal.

Applicability/Limitations

Solvent extraction of materials from soil is a well developed industrial process. To date, however, no pilot or large scale processes using solvents to extract TCDD from soil and sediment have been used. Solvent extraction is used, with mixed results, in analytical procedures to extract TCDD from soil and sediment. Research has shown that TCDD binds to soil and becomes increasingly difficult to extract with time. Extraction from coarse soils or sediments is generally easier than from finer grained sediments. Using a solvent to extract dioxin from soil that has been contaminated for several years may be difficult. Contaminated sediment samples must be tested to determine the required solvent and level of processing necessary to achieve desired residual TCDD levels. There is considerable evidence that dioxin in a solvent phase poses a greater potential hazard than dioxin in soil or sediment.

Costs

No costs discussed.

Effectiveness of Extraction

97.5% efficiency by extracting a 90 gram sample of TCDD contaminated soil with 300 ml of methanol twice. May require large quantities of solvent, which would have to be treated.

Full scale solvent extraction from sludge produced 95.85 to 99.97% removal, from 343 ppm to 0.1 to 0.5 ppm. Solvent extraction would increase the mobility of chemicals contained in the Durez sediments and although the extract may be amenable to treatment, the risk of exposure by the public, workers and environment is increased.

Status/Availability

Acurex Corp. and Chemical Waste Management, Inc. are two companies that are known to be independently developing solvent extraction processes on a laboratory scale.

Pilot plant scale tests need to be conducted to determine effectiveness. Detailed studies must be performed to assess potential risks and benefits and to determine environmental and economic impacts.

Method: Biological Treatment

Reference:

Description

Biological treatment (microbial degradation, biodegradation, bioreclamation) consists of breaking down organic compounds in soil through the metabolic or cometabolic action of microorganisms.

Applicability/Limitations

The applicability of biological treatment must be determined on a site-specific basis. The technique has not yet been demonstrated at a hazardous waste site and organisms capable of commercially treating 2,3,7,8-TCDD have not yet been identified, although the very slow biodegradation of low concentrations of TCDD has been reported. Biological treatment is most applicable if the organic compounds in the waste are uniform in type and concentration and are not highly chlorinated. Limitations include the possible toxic effects of TCDD and high concentrations of other organics on the microbes; the relatively low concentration and solubility of TCDD that make it difficult to degrade completely; and the tight soil binding behavior of dioxin. Environmental factors such as pH, Eh, predators, competitors, microbe toxins, hydraulic conductivity of the soil, and oxygen and nutrient levels greatly affect suitability and should be controlled and stabilized for maximum effectiveness.

Costs

Costs are unknown, but are much lower than incineration and are estimated to be comparable to landfilling. Estimated at less than $200 per ton for the Bio-clean process.

Effectiveness

Degree of effectiveness and duration of treatment are uncertain, but residual chemicals will remain. Effectiveness is greatly improved if treatment is batch-mode rather than in-situ. Batches up to 100 cy may be feasible. Should reduce toxicity. Effectiveness may be improved if combined with other technologies.

Status/Availability

Need laboratory and pilot scale testing to determine applicability to chemicals at the Durez site. Techniques, such as white rot fungus, and Bio-Clean show promise for dioxin treatment; but currently are not demonstrated technologies for dioxin treatment.

Emerging sediment treatment process, but has not been demonstrated for dioxin treatment.

6.0 PROPOSALS FOR REMEDIATION

This section presents OCC's proposals for the conceptual design of the Durez plant property remediation and the remediation of certain affected North Tonawanda storm and sanitary sewers, securing in place sediments in the inlet, and for further investigation of the inlet clay, including the City of Lockport water intake line. The recommended components of the remedial plan have been selected from those assessed in Section 5.0.

6.1 Unconsolidated Zone Groundwater

6.1.1 Interceptor Drain

The proposed alignment of the interceptor drain is shown in Figures 6.1 and 6.2. A typical detailed section for the drain system is presented as Figure 6.3. Generally, the interceptor drain system will be constructed within and along the full perimeter of the Durez property with two lateral "arms", one on the plant's western boundary and one north of the Panhandle, near monitoring wells NP31 and NP44, respectively. A trench 3 to 5 feet wide, 10 to 13 feet deep, and approximately 8300 feet long will be excavated at least 22 inches into the thick impermeable clay layer. The western lateral will be approximately 100 feet long and the northern lateral will be approximately 200 feet long. The total depth of excavation will be determined by the depth to the top of the clay horizon and the design grade of the collection pipe in the trench.

The gravel pack component of the collector will be constructed of crushed stone and/or gravel which will have the necessary grain-size distribution to be free draining and to prevent plugging by the fine-grained native soil in which the collector trench will be excavated.

Slotted drain pipe will be placed at the design grade centered along the longitudinal axis of the trench. A layer of geotextile filter material will be placed over the pipe prior to backfilling. The trench will then be backfilled with gravel pack to a minimum elevation which will allow adequate flow and proper operation of the drain. The remaining hole will be backfilled with materials previously excavated from the trench, and covered with 4 to 6 inches of topsoil. Seed and fertilizer will be used in appropriate areas.

Manholes will be constructed as necessary at changes in grade and direction within the drain system. These will be built according to the typical manhole design presented in Figure 6.4 or an equivalent design. In addition, measures will be taken at each manhole to prevent any leakage along joints or connections.

Collection sumps will be constructed as necessary along the drainage system. The location of these sumps will be determined by the design grade of the system. Each sump will have an automatic drainage pumping plant which will discharge water to the groundwater treatment facility. A typical sump design is presented as Figure 6.5. As with the manholes, each collection sump will be constructed to prevent leakage.

6.1.2 Groundwater Monitoring

Groundwater monitoring will be an integral element of the unconsolidated zone groundwater remediation. Monitoring existing wells will provide the data necessary to assess the effectiveness of the proposed interceptor drain. The following wells should provide an effective monitoring well network.

- o NP-36
- o NP-29
- o NP-27
- o NP-35
- o NP-2
- o NP-22
- o NP-41
- o NP-50
- o NP-34
- o NP-37
- o NP-25
- o NP-9
- o P-32

Monitoring the changes in water levels in these wells will enable an evaluation of the effectiveness of the drain in controlling nearby groundwater flow and determining the zone of influence of the drain. Monitoring groundwater quality at wells in this network will provide an indication of improvements in the local groundwater quality through time as a result of groundwater remediation efforts. The frequency of water level monitoring and groundwater sampling, the parameters to be analyzed, and the wells to be sampled are somewhat dependent on the final design criteria for the interceptor drain. As such, they will be defined as the interceptor drain design is completed.

6.2 Bedrock Wells

Sealing is the recommended alternative for all of the bedrock wells.

Partial sealing of wells DW-7, DW-12, and DW-16 was completed during renovation of these wells as described in the Hydrogeologic Investigation Report by Recra Research, Inc. in October, 1980. Complete sealing will be accomplished by setting a packer inside, and at the bottom of the 4-inch casing and pressure grouting the remainder of the open bedrock borehole, below the casing. The packer will then be removed and grout will be placed to fill the remainder of the 4-inch casing.

The presence of contaminants in water samples collected from well DW-17 has been attributed to a migration pathway along the well casing connecting the unconsolidated and bedrock water bearing zones. The construction of DW-17 is shown in Figure 6.6.

In addition to sealing DW-17 internally, as described above, and having removed the source of chemicals by pumping P-6 (in the vicinity of DW-17), measures will be taken to ensure that chemicals will not migrate down the outside of the well casing. The exterior of DW-17 will be pressure grouted from the bottom of the 12-inch outer steel casing, which is approximately seven feet below the top of clay, to the ground surface.

6.3 Plant Sewers

6.3.1 Plant Storm Sewers

It is recommended that plant storm sewer outfalls 001, 005, 006 and 008 be disconnected from the Walck Road storm sewer and diverted to the proposed groundwater treatment and collection system prior to discharge to the NT storm sewer system.

Plant outfalls will be cleaned as necessary, in conjunction with a program to be developed for cleaning City storm sewers.

Figure 5.2 shows the storm sewer system at the Durez plant.

6.3.2 Plant Sanitary Sewers

No remedial action is proposed for plant sanitary sewers, however, sanitary sewers in the western portion of the plant that are no longer used will be plugged. Figure 5.1 shows the sanitary sewer system at the Durez plant.

Where the sanitary sewers or other utilities cross the proposed groundwater interceptor drain system, special attention will be given to controlling and directing to the interceptor drain any groundwater flow associated with the pipe/utility bedding.

6.4 Panhandle Surface Areas

For remediation of Panhandle surface areas, it is recommended that presently non-vegetated areas be covered with 4 to 6 inches of soil capable of sustaining plant growth, then treated with applications of seed, fertilizer and mulch, as necessary to establish good, vegetative cover. These areas are shown in Figures 6.1 and 6.8. Miscellaneous debris should be removed as necessary to facilitate the placement of cover.

Where it is determined by the Supervising Engineer during construction that the presence of chemicals or waste at the surface may adversely affect plant growth, it is recommended that surface soil and/or waste be removed to a depth of 6 to 12 inches and be replaced with clean fill, covered with 4 to 6 inches of topsoil and treated with applications of seed, fertilizer and mulch, as necessary to establish good, vegetative cover. The disposition of excavated material is addressed in Section 6.7.

It is recommended that presently vegetated areas remain undisturbed. It is recommended that ditches and drainageways remain undisturbed, except as discussed in the following paragraph and Section 6.5.

During construction of remedial measures, the best practical technology for the control of erosion and sedimentation should be applied, particularly to drainageways that discharge off-site. Control measures may include adequate mulch and mulch tacking, hay bale erosion controls, silt fences, sedimentation pools, etc. Final plans and specifications should address this subject in detail.

6.5 Panhandle Railroad Ditch

It is recommended that approximately 350 lineal feet of culvert pipe be placed in the railroad ditch, between the two Durez plant railroad spurs, as shown in Figures 6.1 and 6.8. The new culvert will connect the two existing drainage culverts that carry runoff under the embankments for the Durez plant railroad spurs. The culvert should be sized and laid at such a grade as to match the existing pipes. The pipe should be wrapped with filter fabric and backfilled to at least one foot above the pipe crown to protect it from disturbance. A marker tape should be laid in the fill above the pipe to warn anyone digging near the culvert of its presence. The fill should be gently graded to meet existing land surfaces and promote surface runoff. Inlet structures may be needed at one or both ends to allow surface runoff to enter the culvert.

It is recommended that other reaches of the railroad ditch remain undisturbed.

If, during installation of the groundwater collector trench, the surface soil of concern in the railroad ditch is removed, then the need for the proposed culvert will be eliminated.

6.6 Groundwater Treatment System

A schematic of the proposed carbon adsorption system and groundwater control network (interceptor drain system) is presented in Figure 6.7.

The collected groundwater will be transported to a bulk storage tank via subsurface pipelines from each collection sump. The pipeline system will empty directly into the surge tank. Sewer outfalls 001, 005, 006, and 008 will also be emptied into this tank for subsequent treatment. The water will be pumped from the tank to the carbon adsorption units for processing.

The adsorbers will operate downflow in series. The first bed will remove the bulk of the organic load. The second bed serves as a polishing or back-up unit which allows operation when the first bed is saturated with organics. When this occurs, the exhausted column is removed from service by valve sequencing on the piping module. The polishing column remains on-line to become the primary unit. The exhausted bed is rinsed with city water from a wash water tank and the rinse water is returned to the collection sump. The spent carbon is then pressure transferred in slurry form to an empty bulk carbon truck for disposal or off-site carbon regeneration. Regenerated carbon is then charged to the empty column from a second bulk truck. The "fresh" adsorption column is returned to service as the polishing unit. Spent carbon will be regenerated by outside contractors.

Carbon adsorption performance will be monitored by analyzing composite effluent samples from each carbon bed. Analysis from the first bed will be used to determine when carbon bed change-out is required. Analysis from the second bed will be performed to confirm the organic discharge levels. Effluent from the carbon adsorption system will be returned to the 42 inch diameter storm sewer in Walck Road via an underground pressure line.

6.7 Disposition of Excavated Material

As stated in Section 5.7.2, material excavated from the groundwater collection trench may be used to backfill the trench, regardless of chemistry levels. However, excess material would be excavated which would require disposal. The following proposals are made for the disposition of excess soil excavated from the groundwater collector trench, and for soil and other materials removed from the land surface during plant property remediation.

As part of the final design process, a pre-construction soil sampling program would be conducted along the proposed alignment of the groundwater interceptor trench. In addition to providing detailed geotechnical information, this program would provide an opportunity for sampling and analysis of soil to help determine the presence of chemicals, and the appropriate disposal method for excess material excavated from the trench.

Excess soil that contains chemicals below an acceptable level to be determined, based on the results of the pre-construction soil sampling program, may be used for subgrade preparation in panhandle areas that will receive additional soil cover, or as general fill in low areas. Excavated trench material that is used as fill should be covered with 4 to 6 inches of topsoil to promote vegetative growth.

Excess soil that contains chemicals in excess of the acceptable level, and other materials generated during plant property remediation that contain high levels of chemicals and/or cannot be used for backfill or grading would be placed in interim storage as described in Section 6.11.2.

6.8 Sanitary Sewers

As stated in Section 5.8.2, it is proposed that the following action be taken by OCC and the City of North Tonawanda:

a. The North Tonawanda DPW has historically cleaned the City's sanitary sewers on a scheduled or as-needed basis and should review, in cooperation with OCC, Phase 1 sanitary sewer data and video tapes to assess the need for removing sediment from the sewers to restore flow capacity;

b. The City should assess the need for a revised health and safety plan to promote worker protection;

c. The City should take steps to reduce the possibility for backups in the sanitary sewers in the vicinity of the Durez plant.

d. The City should assess the need for disposal of sanitary sewer sediment in a sanitary or secure landfill.

6.9 Storm Sewers

6.9.1 No Action

No action is proposed for the storm sewers on Walck Road east of the Penn Central Railroad, and on Nash Road south of the PCF to Duane Drive.

6.9.2 Removal and Storage In Place

OCC proposes that the sediment in the sewers listed below be removed using conventional techniques and disposed of in a NYS permitted hazardous waste landfill (sediment contains less than two percent organic chemicals and no dioxin). The table below shows the size and length of each segment and the estimated volume of sediment in each segment.

Segment	Size	Length (ft)	Sediment (c.y.)
PCF North of Wilson	4' x 5'	1169	198
Nash Road, PCF to Meadow Drive	48"	400	55
Walck Road, Eggert to Nash	15"	800	20
Total		2369	273

Sediment in the remaining storm sewers contains more than two percent organic chemicals and/or dioxin. There is no landfill authorized to accept these materials and there is no technically feasible or commercially available method for their treatment for ultimate disposal. Consequently, the only alternative is interim storage. While storage in place until a technically feasible and commercially available method for treatment and disposal is available would protect the public health and the environment, OCC proposes partial removal of sediment to facilitate the diversion of storm sewer flow to the Meadow Drive interceptor. This partial removal would involve the following:

a. Remove sediment from the 30-inch diameter Wilson Avenue storm sewer from the Durez plant to Nash Road (35 cubic yards requiring on-site storage).

b. Remove sediment from the PCF between Walck Road and Wilson Avenue (130 cubic yards requiring on-site storage).

c. Divert Durez plant storm sewer flows from Wilson Avenue to Walck Road.

d. To accommodate higher flows from the diversion of the Durez plant sewers from the Wilson Avenue sewer to the Walck Road sewer, remove sediment from the 42-inch diameter Walck Road storm sewer, from Nash Road to the Penn Central Railroad. (105 cubic yards requiring on-site storage). This segment of the Walck Road storm sewer would not be diverted to the Meadow Drive interceptor.

The table below shows the size and length of each segment and the estimated volume of sediment in each segment.

Segment	Size	Length (ft)	Volume (c.y.)
Wilson Avenue	30"	1800	35
Walck Road	42"	1900	105
PCF Nash Road, Wilson to Walck	4' x 5'	892	130
	Total	4592	270

Sediment in the following PCF segments would be stored in place on an interim basis as described in the alternative remedial program described at Section 5.9.2.

Segment	Size	Length (ft)	Volume (c.y.)
PCF			
Nash, South of Walck	4' x 5'	630	40
Nash to Rosebrock	4' x 8'	1939	226
Rosebrock to discharge	5' x 8'	5023	92
TOTAL		7592	358

While such interim in place storage continues, OCC proposes to appraise emerging technology as described at Section 6.11.3.

6.9.3 Methods

It is proposed that general and/or sewer cleaning specialty contractors be engaged to complete the sediment removal. The contractor(s) would be capable of employing the full range of conventional sewer cleaning techniques described in Section 5.9.4 including manual, mechanical, hydraulic and vacuum methods.

The specific details of the sewer remediation program would be developed during the final design phase. The basic concepts that would serve as the foundation for the program are stated below:

- Conventional, street-level based equipment and methods would be used, where possible, for sediment removal.

- Every effort would be made to remove sediment in as dry a state as feasible, to reduce the water that will require transport, treatment and disposal.

- During sediment removal, the "active" segment would be isolated from the storm sewer system with plugs at the upstream and downstream ends to prevent the inflow of storm water and the discharge of sediment. Laterals to the active segment may also be plugged. If necessary, upstream and lateral flows would be diverted from the PCF.

- Personnel entry to the PCF would be required to effectively remove sediment. All such work would be done using Level B protective clothing and equipment. A Health and Safety plan would be developed to cover all aspects of sewer remediation, and subsequent sediment handling.

6.9.4 Sediment Removal From Laterals

In an effort to increase flow capacity in the laterals, OCC would remove sediment from any lateral near its intersection with the PCF where the lateral is less than 24 inches above the invert (floor) of the flume.

6.10 Inlet

None of the inlet remedial alternatives contemplate undertaking any remedial work at the inlet until after the PCF remedial work is completed.

Because the proposal in Section 6.9 is for interim storage in place in the PCF pending development of cost effective commercially available, licensed treatment and disposal facilities for the sediment, it is proposed, on an interim basis, to obstruct sediment movement from the inlet to the Little Niagara River. Accordingly, it is proposed that a sheet pile wall be installed in the mouth of the inlet as described in Section 5.11.2(b), where a cofferdam was identified, as part of an alternative remedial program for permanent containment and storage in place of inlet sediment.

During this period of interim storage, OCC will continue its appraisal of emerging technology as described in Section 6.11.3.

6.11 Disposition of Removed Sediment

6.11.1 Disposal at Secure Land Burial Facility

It is recommended that sediment removed from the following storm sewers be disposed of at a local, commercial, secure land burial facility:

- o PCF/Nash Road storm sewer from Wilson Avenue to Meadow Drive

- o Walck Road storm sewer from Eggert Drive to Nash Road

Chemical analyses show that the sediment from the PCF/Nash Road storm sewers contains less than two percent organic chemicals and no dioxin, as discussed in Section 5.12.2. Sediment from the Walck Road storm sewer at Eggert Drive contained only 4.05 mg/l (ppm) total organic chemicals and is, therefore, expected to contain no dioxin.

The total volume of this sediment is expected to be approximately 273 cubic yards.

It is anticipated that the sediment would be transported and disposed of in bulk form, rather than in small containers (drums). If the material is too wet for bulk disposal as removed from the sewers, temporary, appropriate dewatering would be done at Durez to reduce water content of the sediment to a level that is acceptable for bulk land burial disposal. Decant water would be handled as discussed in Section 6.12.

6.11.2 Temporary Storage in Secure Cell

It is recommended that sediment removed from other portions of the PCF and other storm sewers (270 cubic yards) be stored temporarily at the Durez plant in a secure interim storage cell, pending the availability of a commercially available, cost effective treatment or disposal technology. The facility would be designed like a secure landfill with a double liner, leachate collection system and leak detection system.

The cell would be designed to facilitate the transfer of sediment directly from transport vehicles to the cell, where dewatering would take place. Cell volume would be 250 to 300 cubic yards, and cell dimensions would be approximately 40 by 70 feet by 3 feet high, to accommodate the storm sewer sediment. Further physical analyses would be conducted during facility design in order to predict the sediment's final density, volume and moisture characteristics.

The cell would consist of an above-grade soil/synthetic composite double liner and berm system; a leachate collection system, with a sump to facilitate leachate removal; a leak detection system; a temporary, operating cover to control air emissions; and, a final cover. The cell design/construction would meet the requirements for permitting a secure landfill as per 40 CFR 264 and 6NYCRR 373-2.

The groundwater collector trench and groundwater monitoring system proposed for the Durez plant and the thick natural clay layer underlying the plant property would provide a high degree of redundancy to the leak detection and prevention systems to be included in the cell design.

6.11.3 Appraisal of Emerging Technology

While temporary storage in place of sediments continues in the sewers, inlet or interim storage cell, OCC proposes to:

- o Develop criteria to appraise emerging treatment or disposal technology for commercial availability, technical feasibility to sediments, and cost effectiveness;

- o Facilitate trial batch treatment of sediment by providing sediment to requesting researchers.

6.12 Water Treatment and Disposal

Water that is removed directly from the storm sewers, by vacuum or hydraulic methods, would be transported to the Durez plant and treated to remove suspended solids and organic chemicals prior to discharge to the City's storm sewers.

Water generated by the handling or storage of sediment at the Durez plant would be treated to remove suspended solids and organic chemicals prior to discharge to the City's storm sewers. All such discharges will be in accordance with the Durez plant's Draft SPDES permit.

6.13 Additional Investigations

Prior to the design phase of final remediation for the inlet, a plan map of the inlet area would be prepared to help plan the remedial activities and the additional investigations described below.

6.13.1 Underlying Natural Clay

A surface investigation would be conducted in the inlet after the sediment has been removed. The purpose would be to determine the presence or absence of organic chemicals in the clay substratum. Procedural details would depend upon the sediment removal method, but conceptually would consist of a thorough visual inspection of the clay surface and, if necessary, digging shallow observation pits by hand to observe clay below the surface.

Appropriate physical tests would be performed on the clay to help determine the presence or absence of organic chemicals.

6.13.2 City of Lockport 48-inch Water Intake Pipe

Although the City of Lockport has installed a 1.2-inch thick high density polyethylene liner in 1977 for reconstruction of its steel intake pipe, the presence or absence of organic chemicals would be investigated in the backfill adjacent to the intake pipe which underlies the inlet. This work would be completed as part of the natural clay study. Procedural details for the investigation would depend upon the specific sediment removal method implemented, but conceptually would consist of the following:

Three borings would be drilled along the estimated location of the intake pipe. The intent will be to get close enough to the pipe to get within the bedding or backfill material. The estimated location would be based on available engineering plans and the results of a magnetometer survey. Borings would be advanced very slowly and carefully by appropriate drilling methods. Precautions would be taken to ensure physically and chemically representative samples, which would be collected continuously. All holes would be grouted upon completion. Appropriate physical and chemical tests would be performed to evaluate the nature of the backfill material and the presence or absence of organic chemicals.

TABLE 1

Summary of Chemical Analyses

Unconsolidated Deposit Groundwater
Summer 1980

	P1	P2	P3	P4	P5
pH, units (Field)	-,-	-,-	-,-	-, 6.75	-,-
pH, units (Lab)	8.90, 7.68	-, 7.44	9.80, 7.99	7.02, 7.76	12.46, 12.37
Conductance, umhos/cm	1290, 970	-, 2080	2010, 2810	1310, 1380	8410, 7450
Total Recoverable Phenolics (mg/l)	4.3, 2.3	0.023, 0.015	0.49, 0.71	0.22, 0.025	0.34, 0.62
Toluene	80, 290	ND10, ND10	ND10, ND10	ND10, ND10	98, 89
Monochlorobenzene	ND20, 85	ND20, ND10	-, $1.4x10^6$	ND20, 940	-, 4000
o-Dichlorobenzene	190, 160	22, 13	2600, 1500	2300, 3200	2300, 430
m-Dichlorobenzene	32, 62	ND10, ND10	780, 350	770, 2000	330, 52
p-Dichlorobenzene	170, 280	29, 18	2200, 1800	1400, 5000	1500, 350
1,2,3-Trichlorobenzene	ND10, ND10	ND10, ND10	ND10, ND10	370, 200	ND10, ND10
1,2,4-Trichlorobenzene	ND10, ND	ND10, ND10	ND10, ND10	680, 1100	ND10, 20
1,3,5-Trichlorobenzene	ND10, 23	ND10, ND10	ND10, ND10	27, 46	ND10, ND10

Commas separate sampling periods April 1980/June 1980.
All results are expressed as ug/L except where noted.
- Analysis not performed.
NDx = Not detected at or above x ug/L.
See Figure 2.1 for well locations.

TABLE 1

Summary of Chemical Analyses

Unconsolidated Deposit Groundwater
Summer 1980

	P7	P8	P9*	P10	P11
pH, units (Field)	-, 7.45	-, 6.75	-	-, 6.90	-, 6.60
pH, units (Lab)	7.61, 7.81	-, -	6.91	7.68, 7.68	8.27, 7.87
Conductance (umhos/cm)	3640, 2250	-, -	5100	936, 870	679, 452
Total Recoverable Phenolics (mg/l)	190, 44	0.024, -	0.21	0.022, 0.018	64, 190
Toluene	190, 680	ND10, -	ND10	ND10, ND10	480, 1100
Monochlorobenzene	ND20, 12000	ND20, -	ND20	ND20, ND10	ND20, 460
o-Dichlorobenzene	1000, 3200	ND10, -	ND10	ND10, ND10	17, 76
m-Dichlorobenzene	200, 1100	ND10, -	ND10	ND10, ND10	16, ND10
p-Dichlorobenzene	1300, 5500	ND10, -	ND10	ND10, ND10	25, 26
1,2,3-Trichlorobenzene	33, ND10	ND10, -	ND10	ND10, ND10	ND10, ND10
1,2,4-Trichlorobenzene	34, 910	ND10, -	ND10	ND10, ND10	ND10, ND10
1,3,5-Trichlorobenzene	ND10, ND10	ND10, -	ND10	ND10, ND10	ND10, ND10

Commas separate sampling periods April 1980/June 1980.

*Sampled during April 1980 only.

All results are expressed as ug/L except where noted.

- Analysis not performed.

NDx = Not detected at or above x ug/L.

See Figure 2.1 for well locations.

TABLE 1

Summary of Chemical Analyses

Unconsolidated Deposit Groundwater
Summer 1980

	P12	P13	P14	P15	P16
pH, units (Field)	- , 6.75	- , 6.75	- , 11.90	- , 6.75	- , 11.90
pH, units (Lab)	7.32, 7.49	7.47, -	12.34, 12.04	7.69, 7.36	12.57, -
Conductance (umhos/cm)	2900, 1810	1180, -	5620, 3270	4800, 4890	10300, -
Total Recoverable					
Phenolics (mg/l)	1.1, 29	0.021, -	0.098, 0.058	0.13, 0.48	0.049, -
Toluene (10)	180, ND10	ND10, -	ND10, ND10	ND10, 110	ND10, -
Monochlorobenzene	ND20, 1300	ND20, -	ND20, ND10	ND20, 160	ND20, -
o-Dichlorobenzene	54, ND10	ND10, -	ND10, ND10	58, ND10	ND10, -
m-Dichlorobenzene	21, ND10	29, -	ND10, ND10	25, ND10	ND10, -
p-Dichlorobenzene	170, ND10	18, -	12, ND10	25, ND10	ND10, -
1,2,3-Trichlorobenzene	ND10, ND10	ND10, -	ND10, ND10	ND10, ND10	ND10, -
1,2,4-Trichlorobenzene	ND10, ND10	ND10, -	ND10, ND10	ND10, ND10	ND10, -
1,3,5-Trichlorobenzene	ND10, ND10	ND10, -	ND10, ND10	ND10, ND10	ND10, -

Commas separate sampling periods April 1980/June 1980.

All results expressed as ug/L except where noted.

- Analysis not performed.

NDx = Not detected at or above x ug/L.

See Figure 2.1 for well locations.

TABLE 1

Summary of Chemical Analyses

Unconsolidated Deposit Groundwater
Summer 1980

	P17	P19	P20*	P21*	P22
pH, units (Field)	- , 12.10	- , 6.50	-	-	- , 6.80
pH, units (Lab)	12.49, -	7.14, 7.19	7.73	7.41	8.23, 7.49
Conductance (umhos/cm)	8640, -	7200, 5700	1770	1710	1220, 1510
Total Recoverable Phenolics (mg/l)	0.013, -	0.065, 0.207	0.037	0.028	0.047, 0.031
Toluene	ND10, -	ND10, ND10	ND10	ND10	ND10, ND10
Monochlorobenzene	ND20, -	ND20, 740	ND20	ND20	ND20, ND10
o-Dichlorobenzene	ND10, -	ND10, 46	37	52	ND10, ND10
m-Dichlorobenzene	ND10, -	ND10, ND10	ND10	ND10	ND10, ND10
p-Dichlorobenzene	11, -	ND10, 14	25	17	ND10, ND10
1,2,3-Trichlorobenzene	ND10, -	ND10, ND10	ND10	ND10	ND10, ND10
1,2,4-Trichlorobenzene	ND10, -	ND10, ND10	ND10	ND10	ND10, ND10
1,3,5-Trichlorobenzene	ND10, -	ND10, ND10	ND10	ND10	ND10, ND10

Commas indicate sampling periods April 1980/June 1980.

* Sampled during April 1980 only.

All results expressed as ug/L except where noted.

- Analysis not performed.

NDx = Not detected at or above x ug/L.

See Figure 2.1 for well locations.

TABLE 1

Summary of Chemical Analyses

Unconsolidated Deposit Groundwater
Summer 1980

	P23*	P24	P25	P26	P27*
pH, units (Field)	-,	- , 6.95	-, 7.00	-, 6.95	-,
pH, units (Lab)	7.71	7.17, 7.48	7.42, 7.39	6.46, 7.75	6.96
Conductance (umhos/cm)	1240	780, 765	1270, 890	1640, 1070	1600
Total Recoverable					
Phenolics (mg/l)	0.016	1.0, 0.11	ND0.01, 0.02	23, 5.1	0.014
Toluene	ND10	ND10, ND10	ND10, ND10	2400, 3300	ND10
Monochlorobenzene	ND20	ND20, ND10	ND20, ND10	-, 1200	ND20
o-Dichlorobenzene	ND10	ND10, ND10	ND10, ND10	13, 15	ND10
m-Dichlorobenzene	ND10	ND10, ND10	ND10, ND10	ND10, ND10	ND10
p-Dichlorobenzene	ND10	ND10, ND10	ND10, ND10	12, 15	ND10
1,2,3-Trichlorobenzene	ND10	ND10, ND10	ND10, ND10	ND10, ND10	ND10
1,2,4-Trichlorobenzene	ND10	ND10, ND10	ND10, ND10	ND10, ND10	ND10
1,3,5-Trichlorobenzene	ND10	ND10, ND10	ND10, ND10	ND10, ND10	ND10

Commas indicate sampling periods April 1980/June 1980.

* Sampled during April 1980 only.

All results are expressed as ug/L except where noted.

- Analysis not performed.

NDx = Not detected at or above x ug/L.

See Figure 2.1 for well locations.

TABLE 1

Summary of Chemical Analyses

Unconsolidated Deposit Groundwater
Summer 1980

	P28	P29*	P30*
pH, units (Field)	-, 6.85	-	-
pH, units (Lab)	7.73, 7.49	7.37	7.55
Conductance (umhos/cm)	1470, 1210	965	1870
Total Recoverable			
Phenolics (mg/l)	0.014, 0.002	0.042	0.023
Toluene	ND10, ND10	ND10	ND10
Monochlorobenzene	ND20, ND10	ND20	ND20
o-Dichlorobenzene	ND10, ND10	ND10	ND10
m-Dichlorobenzene	ND10, ND10	ND10	ND10
p-Dichlorobenzene	ND10, ND10	ND10	ND10
1,2,3-Trichlorobenzene	ND10, ND10	ND10	ND10
1,2,4-Trichlorobenzene	ND10, ND10	ND10	ND10
1,3,5-Trichlorobenzene	ND10, ND10	ND10	ND10

Commas indicate sampling periods April 1980/June 1980.
* Sampled during April 1980 only.
All results are expressed as ug/L except where noted.
- Analysis not performed.
NDx = Not detected at or above x ug/L.
See Figure 2.1 for well locations.

TABLE 2

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1982

		NP1	NP2	NP3	NP4	NP5
WATER	o-Chlorophenol	DRY	ND10	a	ND10	DRY
	p-Chlorophenol		ND10		ND10	
	2,4,5-Trichlorophenol		ND10		ND10	
	2,4,6-Trichlorophenol		ND10		ND10	
	Benzene		ND1		ND1	
	Toluene		ND1		ND1	
	Monochlorobenzene		ND1		ND1	
	o-Chlorotoluene		ND1		ND1	
	o-Dichlorobenzene		ND1		ND1	
	p-Dichlorobenzene		ND1		ND1	
	1,2,3 & 1,2,4-Trichlorobenzene		ND1		ND1	
	TOC, mg/L		60		51	
	Chloride, mg/L		510		270	
	TDS		1700		850	
	Phenols		ND100		ND100	
	pH, units		6.40		7.00	
	Conductivity, umhos/cm		2500		1525	
SOIL	% Moisture	13.8	16.0		17.0	16.8
	Total TCDD* (pg/g)	ND260	ND78		160, 470	ND57
	2,3,7,8-TCDD* (pg/g) (+co-eluting isomers)	ND260	ND78		ND96, ND51	ND57

Results are expressed as ug/L except where noted.
* Multiple values represent sub-sample analyses.
a - NP3 is a soil boring adjacent to NP10. For clarity, the soil results are presented under NP10.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
TOC samples were not purged due to concern over loss of volatile organics.

TABLE 2

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1982

		NP6	NP7		NP8	NP9
WATER	o-Chlorophenol	ND10	ND10, ND10	ND10	ND10	
	p-Chlorophenol	ND10	ND10, ND10	ND10	ND10	
	2,4,5-Trichlorophenol	ND10	ND10, ND10	ND10	ND10	
	2,4,6-Trichlorophenol	ND10	19, ND10	ND10	ND10	
	Benzene	ND1	ND1	ND1	ND1	
	Toluene	ND1	ND1	ND1	ND1	
	Monochlorobenzene	ND1	ND1	ND1	ND1	
	o-Chlorotoluene	ND1	ND1	ND1	ND1	
	o-Dichlorobenzene	ND1	ND1	ND1	ND1	
	p-Dichlorobenzene	ND1	ND1	ND1	ND1	
	1,2,3 & 1,2,4-Trichlorobenzene	ND1	ND1	ND1	ND1	
	TOC, mg/L	55	85	60	106	
	Chloride, mg/L	42	500	110	340	
	TDS, mg/L	500	1400	1000	2400	
	Phenols	ND100	ND100	ND100	ND100	
	pH, units	7.05	6.80	7.00	6.70	
	Conductivity, umhos/cm	880	3000	1310	2700	
SOIL	% Moisture	16.0	17.0	16.0	15.0	
	Total TCDD** (pg/g)	ND90	190		1300, 1100	ND60
	2,3,7,8-TCDD** (pg/g) (+co-eluting isomers)	ND90	ND110		ND96, ND60	ND60

Results are expressed as ug/L except where noted.
* Resampled and analyzed by GC and GC/MS.
**Multiple values represent sub-sample analyses.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
TOC samples were not purged due to concern over loss of volatile organics.
See Figure 2.1 for well locations.

TABLE 2

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1982

		NP10	NP11	P2	P11
WATER	o-Chlorophenol	ND10	ND10	ND10	59
	p-Chlorophenol	ND10	ND10	ND10	81
	2,4,5-Trichlorophenol	ND10	ND10	ND10	ND10
	2,4,6-Trichlorophenol	ND10	ND10	ND10	10
	Benzene	ND1	ND1	ND1	18
	Toluene	ND1	ND1	ND1	290
	Monochlorobenzene	ND1	ND1	ND1	740
	o-Chlorotoluene	ND1	ND1	ND1	ND1
	o-Dichlorobenzene	ND1	ND1	ND1	160
	p-Dichlorobenzene	ND1	ND1	2	200
	1,2,3, & 1,2,4-Trichlorobenzene	ND1	ND1	ND1	28
	TOC, mg/L	44	110	82	108
	Chloride, mg/L	2000	17	2400	24
	TDS, mg/L	3900	800	4400	350
	Phenols	ND100	ND100	ND100	49500
	pH, units	7.30	6.65	6.60	6.35
	Conductivity	6500	1075	7500	525
SOIL	% Moisture	15.6	14.8	-	-
	Total TCDD* (pg/g)	5500, 300, ND93		910, 110	- -
	2,3,7,8-TCDD (pg/g) (co-eluting isomers)	ND60	670, 72	-	-

Results are expressed as ug/L except where noted.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
TOC samples were not purged due to concern over loss of volatile organics.
* Multiple values represent average results of sub-samples analyses
- Analysis not performed.
See Figure 2.1 for well locations.

TABLE 2

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1982

		P14	P21	P24	P25
WATER	o-Chlorophenol	ND10, ND10*	DRY	ND10, ND10*	ND10, ND10*
	p-Chlorophenol	ND10, ND10*		27, 44*	ND10, ND10*
	2,4,5-Trichlorophenol	ND10, ND10*		ND10, ND10*	ND10, ND10*
	2,4,6-Trichlorophenol	12, ND10*		22, ND10*	19, ND10*
	Benzene	ND1		26	ND1
	Toluene	ND1		ND1	ND1
	Monochlorobenzene	4		105	ND1
	o-Chlorotoluene	2		ND1	ND1
	o-Dichlorobenzene	25		ND1	ND1
	p-Dichlorobenzene	ND1		2	ND1
	1,2,3, & 1,2,4-Trichlorobenzene	4		ND1	ND1
	TOC, mg/L	22		73	90
	Chloride, mg/L	70		4	17
	TDS, mg/L	350		600	700
	Phenols	ND100		260	ND100
	pH, units	6.20		7.00	7.20
	Conductivity, umhos/cm	600		900	1050
SOIL	% Moisture	-	18.2	-	-
	Total TCDD (pg/g)	-	ND90	-	-
	2,3,7,8-TCDD (pg/g) (co-eluting isomers)	-	ND90	-	-

*Resampled and analyzed by GC and GC/MS.
Results are expressed as ug/L except where noted.
NDx + Not detected at or above x ug/L for water and pg/g for soil.
TOC samples were not purged due to concern over loss of volatile organics.
- Analysis not performed.
See Figure 2.1 for well locations.

TABLE 2

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1982

		P26	P29	P31	P33
WATER	o-Chlorophenol	17	b	b	c
	p-Chlorophenol	8800	b	b	c
	2,4,5-Trichlorophenol	130	b	b	c
	2,4,6-Trichlorophenol	330	b	b	c
	Benzene	100	ND1	ND1	ND1
	Toluene	4200	ND1	ND1	ND1
	Monochlorobenzene	1200	ND1	ND1	ND1
	o-Chlorotoluene	27	ND1	ND1	ND1
	o-Dichlorobenzene	ND1	ND1	ND1	ND1
	p-Dichlorobenzene	150	ND1	ND1	ND1
	1,2,3, & 1,2,4-Trichlorobenzene	410	ND1	ND1	ND1
	TOC, mg/L	162	b	b	79
	Chloride, mg/L	57	12	140	62
	TDS, mg/L	650	450	1200	750
	Phenols	15600	b	b	ND100
	pH, units	6.70	7.05	6.85	6.80
	Conductivity, umhos/cm	900	650	1850	1280
SOIL	% Moisture	14.2	18.0	-	15.8
	Total TCDD (pg/g)	ND48	ND78	-	ND90
	2,3,7,8-TCDD (pg/g) (co-eluting isomers)	ND48	ND78	-	ND90

Results are expressed as ug/L except were noted.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
b = Partial sample only.
c = Sample lost due to lab accident.
- Anaylsis not performed.
See Figure 2.1 for well locations.

TABLE 3

Summary of Chemical Anaylses
Unconsolidated Deposit Groundwater and Soil
Summer 1983

		NP2	NP4	NP5	NP6	NP7
WATER	o-Chlorophenol	*	ND10	*	*	ND10
	p-Chlorophenol	*	ND10	*	*	ND10
	2,4,6-Trichlorophenol	*	ND10	*	*	ND10
	2,4,5-Trichlorophenol	*	ND10	*	*	ND10
	Benzene	ND1	ND1	ND1	ND1	ND1
	Trichloroethylene	ND10	ND10	ND10	ND10	ND10
	Toluene	ND1	ND1	ND1	ND1	ND1
	Tetrachloroethylene	ND10	ND10	ND10	ND10	ND10
	Monochlorobenzene	ND1	ND1	ND1	ND1	ND1
	Ethyl Benzene	ND1	ND1	ND1	ND1	ND1
	Styrene	ND1	ND1	ND1	ND1	ND1
	o-Chlorotoluene	ND1	ND1	ND1	ND1	ND1
	1,4-Dichlorobenzene	2	ND1	ND1	ND1	ND1
	1,2-Dichlorobenzene	2	ND1	ND1	ND1	ND1
	1,2,4-Trichlorobenzene	ND1	ND1	ND1	ND1	ND1
	1,2,3-Trichlorobenzene	ND1	ND1	ND1	ND1	ND1
	Nitrobenzene	-	-	-	-	-
	TOC, mg/L	*	5	*	*	6
	TOC Replicate	*	5	*	*	6
	Chloride, mg/L	*	110	*	*	250
	TDS, mg/L	*	610	*	*	980
	Phenols, mg/L	*	ND0.014	*	*	ND0.014
	Total Organic Nitrogen, mg/L	*	ND1	*	*	ND1
	Formaldehyde, mg/L	ND0.25	ND0.25	ND0.25	ND0.25	ND0.25
	pH, units	6.7	6.9	7.4	7.2	7.0
	Conductivity, umhos/cm	3100	1010	1040	770	1380
	Temperature, °C	20	22	20	20	17
SOIL	% Moisture	-	-	-	-	-
	Total TCDD (pg/g)	-	-	-	-	-
	2,3,7,8 TCDD & Coeluters (pg/g)	-	-	-	-	-

Results are expressed as ug/L except where noted.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
* Not enough water for analysis.
- Analysis not performed.
See Figure 2.1 for well locations.

TABLE 3

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1983

		NP8	NP9	NP10	NP11	NP13
WATER	o-Chlorophenol	ND10	*	ND10	ND10	ND10
	p-Chlorophenol	ND10	*	ND10	ND10	ND10
	2,4,6-Trichlorophenol	ND10	*	ND10	ND10	ND10
	2,4,5-Trichlorophenol	ND10	*	ND10	ND10	ND10
	Benzene	ND1	ND1	ND1	ND1	22
	Trichloroethylene	ND10	ND10	ND10	ND10	ND10
	Toluene	ND1	ND1	ND1	ND1	ND1
	Tetrachloroethylene	ND10	ND10	ND10	ND10	ND10
	Monochlorobenzene	ND1	ND1	ND1	ND1	330
	Ethyl Benzene	ND1	ND1	ND1	ND1	ND1
	Styrene	ND1	ND1	ND1	ND1	ND1
	o-Chlorotoluene	ND1	ND1	ND1	ND1	ND1
	1,4-Dichlorobenzene	ND1	ND1	ND1	ND1	9
	1,2-Dichlorobenzene	ND1	ND1	ND1	ND1	ND1
	1,2,4-Trichlorobenzene	ND1	ND1	ND1	ND1	ND1
	1,2,3-Trichlorobenzene	ND1	ND1	ND1	ND1	ND1
	Nitrobenzene	-	-	-	-	-
	TOC, mg/L	36	*	21	*	6
	TOC Replicate	5	*	11	*	66
	Chloride, mg/L	130	*	1500	*	5
	TDS, mg/L	950	*	3800	*	570
	Phenols, mg/L	ND0.014	*	ND0.014	*	ND0.014
	Total Organic Nitrogen, mg/L	ND1	*	ND1	*	ND1
	Formaldehyde, mg/L	ND0.25	*	1.1	ND0.25	1.2
	pH, units	7.0	7.2	6.3	6.8	6.8
	Conductivity, (umhos/cm)	1300	3020	5300	1170	990
	Temperature, °C	17	23	16	19	22
SOIL	% Moisture	-	-	-	-	-
	Total TCDD (pg/g)	-	-	-	-	-
	2,3,7,8 TCDD & Coeluters (pg/g)	-	-	-	-	-

Results are expressed as ug/L except where noted.
* Not enough water for analysis.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
- Analysis not performed.
See Figure 2.1 for well locations.

TABLE 3

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1983

		NP15	NP18	NP19	NP20	NP22
WATER	o-Chlorophenol	*	*	*	*	*
	p-Chlorophenol	*	*	*	*	*
	2,4,6-Trichlorophenol	*	*	*	*	*
	2,4,5-Trichlorophenol	*	*	*	*	*
	Benzene	87	*	ND1	1	*
	Trichloroethylene	ND10	*	ND10	ND10	*
	Toluene	140	*	ND1	ND1	*
	Tetrachloroethylene	ND10	*	ND10	ND10	*
	Monochlorobenzene	730	*	ND1	2	*
	Ethyl Benzene	4	*	ND1	1	*
	Styrene	3	*	ND1	ND1	*
	o-Chlorotoluene	ND1	*	ND1	ND1	*
	1,4-Dichlorobenzene	430	*	ND1	ND1	*
	1,2-Dichlorobenzene	670	*	ND1	ND1	*
	1,2,4-Trichlorobenzene	88	*	ND1	ND1	*
	1,2,3-Trichlorobenzene	12	*	ND1	ND1	*
	Nitrobenzene	*	*	*	*	*
	TOC, mg/L	*	*	*	*	*
	TOC Replicate	*	*	*	*	*
	Chloride, mg/L	*	*	*	*	*
	TDS, mg/L	*	*	*	*	*
	Phenols, mg/L	*	*	*	*	*
	Total Organic Nitrogen, mg/L	*	*	*	*	*
	Formaldehyde, mg/L	ND0.25	*	ND0.25	0.33	*
	pH, units	7.2	*	6.6	7.2	*
	Conductivity, umhos/cm	2060	*	2000	710	*
	Temperature, ^{o}C	19	*	33	17	*
SOIL	% Moisture	-	16	18	19	15
	Total TCDD (pg/g)	-	ND29	36	ND23	ND35
	2,3,7,8 TCDD & Coeluters (pg/g)	-	ND29	ND24	ND23	ND35

Results are expressed as ug/L except where noted.
* Not enough water for analysis.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
- Analysis not performed.
See Figure 2.1 for well locations.

TABLE 3

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1983

		NP23	NP24	NP25	NP27	NP28
WATER	o-Chlorophenol	ND10	ND10	*	ND10	ND10
	p-Chlorophenol	ND10	ND10	*	ND10	ND10
	2,4,6-Trichlorophenol	ND10	a	*	ND10	ND10
	2,4,5-Trichlorophenol	ND10	a	*	ND10	ND10
	Benzene	9	10	5	ND1	ND1
	Trichloroethylene	ND10	ND10	ND10	ND10	ND10
	Toluene	ND1	1	ND1	ND1	ND1
	Tetrachloroethylene	ND10	ND10	ND10	ND10	ND10
	Monochlorobenzene	ND1	ND1	ND1	ND1	ND1
	Ethyl Benzene	9	4	3	ND1	ND1
	Styrene	ND1	ND1	ND1	ND1	ND1
	o-Chlorotoluene	2	5	ND1	ND1	ND1
	1,4-Dichlorobenzene	ND1	a	ND1	ND1	ND1
	1,2-Dichlorobenzene	ND1	a	ND1	ND1	ND1
	1,2,4-Trichlorobenzene	3	a	ND1	ND1	ND1
	1,2,3-Trichlorobenzene	ND1	b	ND1	ND1	ND1
	Nitrobenzene	*	ND5(c)	*	-	-
	TOC, mg/L	*	*	*	4	4
	TOC Replicate	*	*	*	4	157
	Chloride, mg/L	*	*	*	32	10
	TDS, mg/L	*	*	*	930	1100
	Phenols, mg/L	*	*	*	ND0.014	ND0.014
	Total Organic Nitrogen, mg/L	*	*	*	ND1	ND1
	Formaldehyde, mg/L	*	ND0.25	ND0.25	ND0.25	0.30
	pH, units	7.0	7.3	7.1	6.8	6.9
	Conductivity, umhos/cm	610	1030	1630	1570	1360
	Temperature, ^{o}C	20	25	19	15	18
SOIL	% Moisture	-	-	-	-	13
	Total TCDD (pg/g)	-	-	-	-	ND24
	2,3,7,8 TCDD & Coeluters (pg/g)	-	-	-	-	ND24

Results are expressed as ug/L except where noted.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
a = GC/MS did not detect these compounds at or above 10 ug/L.
b = GC/MS did not detect these compounds at or above 1 ug/L.
c = Nitrobenzene quantitated by GC/MS.
* Not enough sample for analysis.
- Analysis not performed.

TABLE 3

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1983

		NP29	NP30	NP31	NP35	P10
WATER	o-Chlorophenol	ND10	b	26	ND10	ND10
	p-Chlorophenol	ND10	b	290	ND10	ND10
	2,4,6-Trichlorophenol	ND10	b	ND10 (a)	ND10	ND10
	2,4,5-Trichlorophenol	ND10	b	ND10	ND10	ND10
	Benzene	ND1	ND1	120	ND1	ND1
	Trichloroethylene	ND10	ND10	ND10	ND10	ND10
	Toluene	ND1	ND1	ND1	ND1	ND1
	Tetrachloroethylene	ND10	ND10	ND10	ND10	ND10
	Monochlorobenzene	ND1	ND1	600	ND1	ND1
	Ethyl Benzene	ND1	ND1	ND1	ND1	ND1
	Styrene	ND1	ND1	ND1	ND1	ND1
	o-Chlorotoluene	ND1	ND1	46	ND1	ND1
	1,4-Dichlorobenzene	ND1	ND1	26	ND1	ND1
	1,2-Dichlorobenzene	ND1	ND1	21	ND1	ND1
	1,2,4-Trichlorobenzene	ND1	ND1	ND1	ND1	ND1
	1,2,3-Trichlorobenzene	ND1	ND1	ND1	ND1	ND1
	Nitrobenzene	-	-	-	-	ND5
	TOC	3	5	26	4	8
	TOC Replicate	3	*	-	4	-
	Chloride	3	5	10	7	4
	TDS	530	810	860	670	720
	Phenols	ND0.014	ND0.014	2.8	ND0.014	ND0.014
	Total Organic Nitrogen	ND1	ND1	ND1	ND1	ND1
	Formaldehyde	ND0.25	ND0.25	ND0.25	ND0.25	ND0.25
	pH	7.1	6.9	6.8	6.9	7.2
	Conductivity	740	990	1090	930	820
	Temperature	18	16	21	21	20
SOIL	% Moisture	-	-	16	-	-
	Total TCDD (pg/g)	-	-	ND23	-	-
	2,3,7,8 TCDD & Coeluters (pg/g)	-	-	ND23	-	-

Results expressed as ug/L except where noted.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
* Not enough sample for analysis.
\- Analysis not performed.
a = GC/MS did not detect these compounds at or above 10 ug/L.
b = Sample lost due to lab accident.
See Figure 2.1 for well locations.

TABLE 2

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1982

		P34	P36
WATER	o-Chlorophenol	ND10	DRY
	p-Chlorophenol	ND10	
	2,4,5-Trichlorophenol	ND10	
	2,4,6-Trichlorophenol	ND10	
	Benzene	ND1	
	Toluene	ND1	
	Monochlorobenzene	ND1	
	o-Chlorotoluene	ND1	
	o-Dichlorobenzene	ND1	
	p-Dichlorobenzene	ND1	
	1,2,3, & 1,2,4-Trichlorobenzene	ND1	
	TOC, mg/L	67	
	Chloride, mg/L	6	
	TDS, mg/L	500	
	Phenols	ND100	
	pH, units	6.80	
	Conductivity, umhos/cm	900	
SOIL	% Moisture	15.4	15.6
	Total TCDD* (pg/g)	ND90, ND60, ND93	ND99
	2,3,7,8-TCDD* (pg/g) (co-eluting isomers)	ND90, ND60, ND93	ND99

Results are expressed as ug/L except where noted.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
* Multiple values represent sub-sample analyses.
See Figure 2.1 for well locations.

TABLE 3

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater and Soil
Summer 1983

		P21	P26	P29	P31	P32	P34
WATER	o-Chlorophenol	*	380	*	*	ND10	ND10
	p-Chlorophenol	*	3000	*	*	ND10	ND10
	2,4,6-Trichlorophenol	*	1200	*	*	ND10	ND10
	2,4,5-Trichlorophenol	*	ND10 (a)	*	*	ND10	ND10
	Benzene	ND1	93	ND1	ND1	7	ND1
	Trichloroethylene	ND10	ND10	ND10	ND10	ND10	ND10
	Toluene	ND1	4200	ND1	ND1	ND1	ND1
	Tetrachloroethylene	ND10	ND10	ND10	ND10	ND10	ND10
	Monochlorobenzene	ND1	900	ND1	ND1	310	ND1
	Ethyl Benzene	ND1	110	ND1	ND1	ND1	ND1
	Styrene	ND1	2	ND1	ND1	ND1	ND1
	o-Chlorotoluene	ND1	11	ND1	ND1	2	ND1
	1,4-Dichlorobenzene	ND1	87	ND1	ND1	120	ND1
	1,2-Dichlorobenzene	ND1	10	ND1	ND1	82	ND1
	1,2,4-Trichlorobenzene	ND1	ND1	ND1	ND1	ND1	ND1
	1,2,3-Trichlorobenzene	ND1	ND1	ND1	ND1	ND1	ND1
	Nitrobenzene	-	-	*	-	-	-
	TOC, mg/L	*	150	*	*	4	7
	TOC Replicate	*	150	*	*	*	54
	Chloride, mg/L	*	70	*	*	400	17
	TDS, mg/L	*	670	*	*	1300	550
	Phenols, mg/L	*	ND0.014	*	*	ND0.014	ND0.014
	Total Organic Nitrogen, mg/L	*	ND1	*	*	ND1	ND1
	Formaldehyde, mg/L	*	ND0.25	*	*	ND0.25	ND0.25
	pH, units	*	7.1	7.2	6.4	7.1	7.0
	Conductivity, umhos/cm	*	900	150	1400	1940	820
	Temperature °C	*	23	29	24	20	20
SOIL	% Moisture	-	-	-	-	-	-
	Total TCDD (pg/g)	-	-	-	-	-	-
	2,3,7,8 TCDD & Coeluters (pg/g)	-	-	-	-	-	-

Results expressed as ug/L except where noted.
NDx = Not detected at or above x ug/L for water or pg/g for soil.
* Not enough sample for analysis.
- Analysis not performed.
a = GC/MS did not detect this compound at or above 10 ug/L.

Table 4
Summary of Chemical Analyses
Unconsolidated Deposit Groundwater
February 1984

SUPPLEMENTARY SAMPLES FROM "PANHANDLE" AREA

	Units[c]	NP-14	NP-15	NP-16	NP-22
o-Chlorophenol	ug/L	ND_{10}	56	ND_{10}	ND_{10}
p-Chlorophenol	ug/L	ND_{10}	150	ND_{10}	ND_{10}
2,4,6-Trichlorophenol	ug/L	ND_{10}	ND_{10}	ND_{10}	ND_{10}
2,4,5-Trichlorophenol	ug/L	ND_{10}	ND_{10}	ND_{10}	ND_{10}
Benzene	ug/L	ND_1	92	ND_1	ND_1
Trichloroethylene	ug/L	ND_{10}	ND_1	ND_{10}	ND_{10}
Toluene	ug/L	ND_1	39	ND_1	ND_1
Tetrachloroethylene	ug/L	ND_{10}	ND_{10}	ND_{10}	ND_{10}
Monochlorobenzene	ug/L	ND_1	980	ND_1	ND_1
Ethyl Benzene	ug/L	ND_1	2	ND_1	ND_1
Styrene	ug/L	ND_1	1	ND_1	ND_1
o-Chlorotoluene	ug/L	ND_1	2	ND_1	ND_1
1,4-Dichlorobenzene	ug/L	ND_1	680	ND_1	ND_1
1,2-Dichlorobenzene	ug/L	ND_1	940	ND_1	ND_1 [b]
1,2,4-Trichlorobenzene	ug/L	ND_1	28	ND_1	ND_1
1,2,3-Trichlorobenzene	ug/L	ND_1	ND_{10}	ND_1	ND_1
TOC	mg/L	8	29	6	4
Chloride	mg/L	*	*	*	*
TDS	mg/L	*	*	*	*
Phenols	mg/L	*	*	*	*
TON	mg/L	*	*	*	*
Formaldehyde	mg/L	$ND_{0.25}$	$ND_{0.25}$	$ND_{0.25}$	$ND_{0.25}$
pH		8.8	6.9	7.2	6.6
Specific Conductivity @25° umhos/cm		1100	1900	1900	1500
Temperature	°C	4	8	7	3

LEGEND:

* - Insufficient sample for complete analysis.

(a) - Possible interference.

(b) - GC/MS did not detect this compound.

(c) - ug/L = ppb, mg/L = ppm.

See Figure 2.1 for well locations.

Table 4, Cont.
Summary of Chemical Analyses
Unconsolidated Deposit Groundwater
February 1984

SUPPLEMENTARY SAMPLES FROM "PANHANDLE" AREA

	NP-34	NP-17	P-23	P-27	Blank
o-Chlorophenol	*	ND_{10}	ND_{10}	ND_{10}	ND_{10}
p-Chlorophenol	*	ND_{10}	ND_{10}	ND_{10}	ND_{10}
2,4,6-Trichlorophenol	*	ND_{10}	ND_{10}	ND_{10}	ND_{10}
2,4,5-Trichlorophenol	*	ND_{10}	ND_{10}	ND_{10}	ND_{10}
Benzene	ND_1	ND_1	ND_1	ND_1	ND_1
Trichloroethylene	ND_{10}	ND_{10}	ND_{10}	ND_{10}	ND_{10}
Toluene	ND_1	ND_1	ND_1	ND_1	ND_1
Tetrachloroethylene	ND^{10}	ND_{10}	ND_{10}	ND_{10}	ND_{10}
Monochlorobenzene	ND_1	ND_1	ND_1	ND_1	ND_1
Ethyl Benzene	ND_1	ND_1	ND_1	ND_1	ND_1
Styrene	ND_1	ND_1	ND_1	ND_1	ND_1
o-Chlorotoluene	ND_1	ND_1	ND_1	ND_1	ND_1
1,4-Dichlorobenzene	ND_1	ND_1	ND_1	ND_1	ND_1
1,2-Dichlorobenzene	ND_1	ND_1	ND_1	ND_1	ND_1
1,2,4-Trichlorobenzene	ND_1	ND_1	ND_1	ND_1	ND_1
1,2,3-Trichlorobenzene	ND_1	ND_1	ND_1	ND_1	ND_1
TOC	*	13	22	4	1
Chloride	*	*	5	4	$ND_{0.1}$
TDS	*	*	780	1030	5
Phenols	*	*	$ND_{0.14}$	$ND_{0.14}$	$ND_{0.14}$
TON	*	*	ND_1	ND_1	ND_1
Formaldehyde	$ND_{0.25}$	$ND_{0.25}$	$ND_{0.25}$	$ND_{0.25}$	$ND_{0.25}$
pH	7.7	11.7	6.8	6.9	5.2
Specific Conductivity @25° umhos/cm	1100	8100	1100	1300	2.7
Temperature	3	9	3	5	-

LEGEND:

* - Insufficient sample for complete analysis.

(a) - Possible interference.

(b) - GC/MS did not detect this compound.

(c) - ug/L = ppb, mg/L = ppm.

See Figure 2.1 for well locations.

TABLE 5

Summary of Chemical Analyses
Unconsolidated Deposit Groundwater
May 1985

Parameter	NP-15	NP-39	NP-40	NP-41
Benzene	ND1	7	550	ND1
Trichloroethylene	ND10	ND10	ND10	ND10
Toluene	5	ND1	18	ND1
Tetrachloroethylene	ND10	ND10	ND10	ND10
Monochlorobenzene	150	110	2050	ND1
Ethyl Benzene	ND1	ND1	81	ND1
Styrene	ND1	ND1	5	ND1
ortho-Chlorotoluene	ND1	2	2	ND1
1,4-Dichlorobenzene	150	25	1150	ND1
1,2-Dichlorobenzene	200	33	1350	ND1
1,2,4-Trichlorobenzene	14	9	24	ND1
1,2,3-Trichlorobenzene	ND1	2	2	ND1
Nitrobenzene	--	--	ND5	ND5
ortho-Chlorophenol	--	--	12	ND10
para-Chlorophenol	--	--	95	ND10
2,4,5-Trichlorophenol	--	--	ND10	ND10
2,4,6-Trichlorophenol	--	--	ND10	ND10
TRP (a) mg/L	--	--	0.70	ND0.1
Chloride (b) mg/L	--	--	ND2	ND2
TON (b) mg/L	--	--	0.33	0.05
TDS (b) mg/L	--	--	1094	748
Formaldehyde (c) mg/L	--	--	ND0.25	ND0.25
TOC (c) mg/L	--	--	150	98
pH	--	--	7.8	7.0
Temp (c)	--	--	17	20
Conductivity (umhos/cm)	--	--	1670	1160

Concentrations in ug/L unless otherwise noted.

(a) Buffalo Testing Laboratories TRP results not accurate below 50 ug/L.

(b) Durez Environmental Laboratory

(c) OCC Grand Island Laboratory

ND_x indicated that the compound was not detected at or above a concentration of x mg/L = ppm; ug/L = ppb.

--- No analysis due to lack of sample.

See Figure 2.1 for well locations.

TABLE 5, Cont.
Summary of Chemical Analyses

Unconsolidated Deposit Groundwater
May 1985

Parameter	NP-42	NP-43	NP-44	NP-45
Benzene	1	ND1	700	16
Trichloroethylene	ND10	ND10	ND10	ND10
Toluene	ND1	ND1	13	ND1
Tetrachloroethylene	ND10	ND10	ND10	ND10
Monochlorobenzene	100	ND1	9500	550
Ethyl Benzene	ND1	ND1	2	ND1
Styrene	ND1	ND1	2	ND1
ortho-Chlorotoluene	ND1	ND1	ND1	ND1
1,4-Dichlorobenzene	13	ND1	2700	260
1,2-Dichlorobenzene	21	ND1	700	360
1,2,4-Trichlorobenzene	ND1	ND1	31	ND
1,2,3-Trichlorobenzene	ND1	ND1	15	ND1
Nitrobenzene	ND5	ND5	ND5	ND5
ortho-Chlorophenol	ND10	ND10	13	ND10
para-Chlorophenol	ND10	ND10	1100	ND10
2,4,5-Trichlorophenol	ND10	ND10	ND10	ND10
2,4,6-Trichlorophenol	ND10	ND10	ND10	ND10
TRP (a) mg/L	0.19	ND0.1	1.75	ND0.1
Chloride (b) mg/L	ND2	4.8	ND2	6.5
TON (b) mg/L	0.04	0.03	0.95	0.20
TDS (b) mg/L	784	995	1011	1421
Formaldehyde (c) mg/L	ND0.25	ND0.25	ND0.25	ND0.25
TOC (c) mg/L	81	107	131	139
pH	6.8	6.4	7.7	6.9
Temp (c)	21	22	19	20
Conductivity (umhos/cm)	1180	1470	140	2200

Concentrations in ug/L unless otherwise noted.
(a) Buffalo Testing Laboratories TRP results not accurate below 50 ug/L.
(b) Durez Environmental Laboratory
(c) OCC Grand Island Laboratory
ND_x indicated that the compound was not detected at or above a concentration of x mg/L = ppm; ug/L = ppb.
No analysis due to lack of sample.
See Figure 2.1 for well locations.

Table 6
Summary of Chemical Analyses
Unconsolidated Deposit Groundwater
December 1985

Parameter	NP-40	NP-41	NP-42	NP-43	NP-44
Benzene	340	ND1	ND1	ND1	70
Trichloroethylene	ND10	ND10	ND10	ND10	ND10
Toluene	11	ND1	ND1	ND1	2
Tetrachloroethylene	ND10	ND10	ND10	51	ND10
Monochlorobenzene	1700	ND1	ND1	ND1	2500
Ethyl Benzene	34	ND1	ND1	ND1	1
Styrene	ND1	ND1	ND1	ND1	ND1
ortho-Chlorotoluene	3	ND1	ND1	ND1	1
1,4-Dichlorobenzene	940	ND1	ND1	ND1	2900
1,2-Dichlorobenzene	100	ND1	ND1	ND1	990
1,2,4-Trichlorobenzene	15	ND1	ND1	ND1	48
1,2,3-Trichlorobenzene	2	ND1	ND1	ND1	14
Nitrobenzene	ND5	ND5	ND5	ND5	ND5
ortho-Chlorophenol	11	ND10	ND10	ND10	25
para-Chlorophenol	120	ND10	ND10	ND10	5200
2,4,6-Trichlorophenol	ND10	ND10	ND10	ND10	ND10
2,4,5-Trichlorophenol	ND10	ND10	ND10	ND10	ND10
TRP (a) mg/L	1.04	ND0.5	ND0.5	ND0.5	4.65
Chloride (b) mg/L	14.2	6.0	8.3	5.4	19.4
TON (b) mg/L	ND0.7	ND0.1	ND0.1	ND0.1	1.2
TDS (b) mg/L	1101	691	783	705	1217
Formaldehyde (c) mg/L	ND0.25	ND0.25	ND0.25	ND0.25	ND0.25
TOC (c)	34	ND10	ND10	ND10	33
pH	6.9	6.8	7.1	7.1	6.8
Temp (C)	11	11	10	12	10
Conductivity(umhos/cm)	1396	913	913	836	1430

Results as ug/L unless otherwise noted

(a) Buffalo Testing Laboratories - TRP results not accurate below 50 u/L
(b) Durez Environmental Laboratory
(c) OCC Grand Island Laboratory
(ND) indicates that compound was not detected at or above a concentration of x mg/L = ppm; ug/L = ppb.
\- No analysis due to lack of sample

See Figure 2.1 for well locations.

Table 6 (Cont'd)
Summary of Chemical Analyses

Unconsolidated Deposit Groundwater

December 1985

Parameter	NP-45	NP-46	NP-47	NP-48
Benzene	8	ND1	ND1	ND1
Trichloroethylene	ND10	ND10	ND10	ND10
Toluene	ND1	ND10	ND1	ND1
Tetrachloroethylene	ND10	ND10	ND10	ND10
Monochlorobenzene	213	ND1	ND1	ND1
Ethyl Benzene	ND1	ND1	ND1	ND1
Styrene	ND1	ND1	ND1	ND1
ortho-Chlorotoluene	ND1	ND1	ND1	ND1
1,4-Dichlorobenzene	46	ND1	ND1	ND1
1,2-Dichlorobenzene	66	ND1	ND1	ND1
1,2,4-Trichlorobenzene	ND1	ND1	ND1	ND1
1,2,3-Trichlorobenzene	ND1	ND1	ND1	ND1
Nitrobenzene	ND5	ND5	ND5	ND5
ortho-Chlorophenol	N10	ND10	ND10	ND10
para-Chlorophenol	ND10	ND10	ND10	ND10
2,4,6-Trichlorophenol	ND10	ND10	ND10	ND10
2,4,5-Trichlorophenol	ND10	ND10	ND10	ND10
TRP (a) mg/L	ND0.5	ND0.5	ND0.5	ND0.5
Chloride (b) mg/L	15.9	-	-	-
TON (b) mg/L	ND0.1	1.1	ND0.1	ND0.1
TDS (b) mg/L	1360	-	-	-
Formaldehyde (c) mg/L	ND0.25	ND0.25	ND0.25	ND0.25
TOC (c) mg/L	16	ND10	ND10	ND10
pH	6.9	6.0	7.1	7.0
Temp (C)	12	14	12	19
Conductivity(umhos/cm)	1440	1045	792	770

Results as ug/L unless otherwise noted

(a) Buffalo Testing Laboratories - TRP results not accurate below 50 u/L
(b) Durez Environmental Laboratory
(c) OCC Grand Island Laboratory
(ND indicates that compound was not detected at or above a concentration of x mg/L = ppm; ug/L = ppb.
\- No analysis due to lack of sample

See Figure 2.1 for well locations.

Table 6 (Cont'd)
Summary of Chemical Analyses

Unconsolidated Deposit Groundwater

December 1985

Parameter	NP-49	NP-50	NP-51	Field Blank
Benzene	ND1	ND1	ND1	ND1
Trichloroethylene	ND10	ND10	ND10	ND10
Toluene	ND1	ND1	ND1	ND1
Tetrachloroethylene	ND10	ND10	ND10	ND10
Monochlorobenzene	ND1	ND1	ND1	ND1
Ethyl Benzene	ND1	ND1	ND1	ND1
Styrene	ND1	ND1	ND1	ND1
ortho-Chlorotoluene	ND1	ND1	ND1	ND1
1,4-Dichlorobenzene	ND1	ND1	ND1	ND1
1,2-Dichlorobenzene	ND1	ND1	ND1	ND1
1,2,4-Trichlorobenzene	ND1	ND1	ND1	ND1
1,2,3-Trichlorobenzene	ND1	ND1	ND1	ND1
Nitrobenzene	ND5	ND5	ND5	ND5
ortho-Chlorophenol	ND10	ND10	ND10	ND10
para-Chlorophenol	ND10	ND10	ND10	ND10
2,4,6-Trichlorophenol	ND10	ND10	ND10	ND10
2,4,5-Trichlorophenol	ND10	ND10	ND10	ND10
TRP (a) mg/L	ND0.5	ND0.5	ND0.5	ND0.5
Chloride (b) mg/L	21.7	4.6	7.8	0
TON (b) mg/L	ND0.1	ND0.1	ND0.1	1.9
TDS (b) mg/L	921	462	648	10
Formaldehyde (c) mg/L	ND0.25	ND0.25	ND0.25	ND0.25
TOC (c) mg/L	ND10	ND10	17	ND10
pH	7.0	7.2	7.2	6.5
Temp (C)	10	10	12	17
Conductivity(umhos/cm)	1012	1040	748	2.3

Results as ug/L unless otherwise noted

(a) Buffalo Testing Laboratories - TRP results not accurate below 50 u/L
(b) Durez Environmental Laboratory
(c) OCC Grand Island Laboratory
(ND) indicates that compound was not detected at or above a concentration of x mg/L = ppm; ug/L = ppb.
\- No analysis due to lack of sample

See Figure 2.1 for well locations.

TABLE 7

Summary of Chemical Analyses
Unconsolidated Deposit - Clay
June 1984

			SPIKE RECOVERIES*		
	DB-4	DB-9	Blank Soil + Spike	DB-9 + Spike	DB-4 + Spike
1,2,4-Trichlorobenzene	ND0.05	ND0.05	92	85	94
1,2,3-Trichlorobenzene	ND0.05	ND0.05	91	89	99
1,2,4,5-Tetrachlorobenzene	ND0.05	ND0.05	114	107	116
1,2,3,4-Tetrachlorobenzene	ND0.05	ND0.05	103	106	110
Pentachlorobenzene	ND0.05	ND0.05	98	115	117
Hexachlorobenzene	ND0.05	ND0.05	89	100	100
Orthochlorophenol	ND2	ND2	101	108	NA
3,4-Dichlorophenol	ND2	ND2	89	96	NA
2,3,6-Trichlorophenol	ND2	ND2	95	102	NA
2,4,5-Trichlorophenol	ND2	ND2	92	107	NA
2,3,4-Trichlorophenol	ND2	ND2	89	90	NA
3,4,5-Trichlorophenol	ND2	ND2	90	99	NA
2,3,5,6-Tetrachlorophenol	ND2	ND2	96	101	NA
Pentachlorophenol	ND2	ND2	87	87	NA

NDX = Not detected at or above x mg/kg
NA = Not analyzed

* % Recovery =

$$\frac{\text{(Total Conc. [mg/kg]Found in Spike Sample)-(Conc.[mg/kg]Found in Unspiked Sample)}}{\text{Concentration (mg/kg) spiked into sample}} \times 100$$

See Figure 2.1 for well locations.

Table 8
Summary of Chemical Analyses

Bedrock Wells
Summer 1980

	W7	W12	W16	W17
pH, units (Field)	-	-	-	-
pH, units (In Lab)	7.28,7.71	-,7.63	7.14,7.56	6.98,7.34
Conductance, umhos/cm	4120,3970	-,3720	4300,4110	13400,10900
Total Recoverable Phenolics, mg/L	0.018,0.075	0.060,0.011	0.019,ND0.01	ND0.01,ND0.01
Toluene	ND10,240	ND10,ND10	ND10,ND10	ND10,ND10
Monochlorobenzene	ND20,ND10	ND20,ND10	ND20,ND10	ND20,ND10
o-Dichlorobenzene	ND10,ND10	ND10,ND10	ND10,ND10	ND10,ND10
m-Dichlorobenzene	ND10,ND10	ND10,ND10	ND10,ND10	ND10,ND10
p-Dichlorobenzene	ND10,ND10	ND10,ND10	ND10,ND10	ND10,ND10
1,2,3-Trichlorobenzene	ND10,ND10	ND10,ND10	ND10,ND10	ND10,ND10
1,2,4-Trichlorobenzene	ND10,ND10	ND10,ND10	ND10,ND10	ND10,ND10
1,3,5-Trichlorobenzene	ND10,ND10	ND10,ND10	ND10,ND10	ND10,ND10

Comment: comma separates 2 sampling periods of 4/3/80 and 6/12/80.

Results are expressed in ug/L except where noted.

ND_x means that amount at or above the value of x ug/L was not detected.

- Analysis not performed.

See Figure 2.1 for well locations.

TABLE 9
Summary of Chemical Analyses

Bedrock Wells
Summer 1982

	W7	W12	W16	W17
o-Chlorophenol	ND_{10}	ND_{10}	ND_{10}	ND_{10}
p-Chlorophenol	ND_{10}	ND_{10}	ND_{10}	ND_{10}
2,4,5-Trichlorophenol	ND_{10}	ND_{10}	ND_{10}	ND_{10}
2,4,6-Trichlorophenol	ND_{10}	ND_{10}	ND_{10}	ND_{10}
Benzene	2	ND_1	ND_1	2
Toluene	19	ND_1	ND_1	2
Monochlorobenzene	ND_1	3	ND_1	21
o-Chlorotoluene	ND_1	ND_1	ND_1	ND_1
o-Dichlorobenzene	ND_1	ND_1	ND_1	ND_1
p-Dichlorobenzene	ND_1	ND_1	ND_1	ND_1
1,2,3 & 1,2,4-Trichlorobenzene	ND_1	ND_1	ND_1	1
TOC* (mg/L)	34	43	32	29
Chloride (mg/L)	440	450	480	3000
TDS (mg/L)	3700	3200	3700	8200
Phenols	ND_{100}	ND_{100}	ND_{100}	ND_{100}

All values reported as ug/L unless specified.

* Total organic carbon values are maximum values. Inorganic carbon was converted to CO_2 but not purged due to concern over loss of volatile organics. CO_2 remaining in the sample would result in higher TOC results.

** ND_x means that amount at or above the value of x ug/L was not detected.

See Figure 2.1 for well locations.

TABLE 10

Summary of Chemical Analyses

Bedrock Wells

Summer 1983

	W7	W12	W16	W17
o-Chlorophenol	ND10	ND10	ND10	ND10
p-Chlorophenol	ND10	ND10	ND10	ND10
2,4,6-Trichlorophenol	ND10	ND10	ND10	ND10
2,4,5-Trichlorophenol	ND10	ND10	ND10	ND10
Benzene	ND1	ND1	ND1	ND1
Trichloroethylene	ND10	ND10	ND10	ND10
Toluene	27	ND1	ND1	ND1
Tetrachloroethylene	ND10	ND10	ND10	ND10
Monochlorobenzene	ND1	2	ND1	19
Ethyl Benzene	ND1	ND1	ND1	ND1
Stryrene	ND1	ND1	ND1	ND1
o-Chlorotoluene	ND1	ND1	ND1	ND1
1,4-Dichlorobenzene	ND1	ND1	ND1	ND1
1,2-Dichlorobenzene	ND1	ND1	ND1	ND1
1,2,4-Trichlorobenzene	ND1	ND1	ND1	ND1
1,2,3-Trichlorobenzene	ND1	ND1	ND1	ND1
Nitrobenzene	--	--	--	--
TOC, mg/L	3 (3)a	2 (2)a	2 (2)a	3(1)a
Chloride, mg/L	430	380	447	2900
TDS, mg/L	3800	3900	4100	11000
Phenols, mg/L	ND0.014	ND0.014	ND0.014	ND0.014
TON, mg/L	ND1	ND1	ND1	ND1
Formaldehyde, mg/L	ND0.25	ND0.25	ND0.25	ND0.25
pH, units	7.2	6.9	7.1	6.8
Conductivity, umhos/cm	4400	4200	4800	10300
Temperature (^oc)	15	15	16	15

Results are expressed in ug/L except where noted.

ND_x - Not detected at or above x ug/L.

()a - TOC Replicate analysis from duplicate sample bottle.

See Figure 2.1 for well locations.

TABLE 11a

Summary of Chemical Analyses
Bedrock Wells

Well #	Date	BEN	TCE	Tol	PCE	MCB	ET Ben	Styr	OCT	14DCB
DW-16	01/29/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	02/05/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	02/12/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	02/20/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	02/26/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	03/05/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	03/12/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	03/19/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	03/26/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	04/23/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	05/21/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	06/25/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-16	07/25/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-17	01/29/85	ND1	ND10	ND1	ND10	19	ND1	ND1	ND1	ND1
DW-17	02/05/85	ND1	ND10	ND1	ND10	23	ND1	ND1	ND1	ND1
DW-17	02/12/85	ND1	ND10	ND1	ND10	19	ND1	ND1	ND1	ND1
DW-17	02/20/85	ND1	ND10	ND1	ND10	23	ND1	ND1	ND1	ND1
DW-17	02/28/85	ND1	ND10	ND1	ND10	29	ND1	ND1	ND1	ND1
DW-17	03/05/85	ND1	ND10	ND1	ND10	34	ND1	ND1	ND1	ND1
DW-17	03/12/85	ND1	ND10	ND1	ND10	44	ND1	ND1	ND1	ND1
DW-17	03/19/85	ND1	ND10	ND1	ND10	37	ND1	ND1	ND1	ND1
DW-17	03/26/85	ND1	ND10	ND1	ND10	37	ND1	ND1	ND1	ND1
DW-17	04/23/85	ND1	ND10	ND1	ND10	28	ND1	ND1	ND1	ND1
DW-17	05/21/85	ND1	ND10	ND1	ND10	33	ND1	ND1	ND1	ND1
DW-17	06/25/85	ND1	ND10	ND1	ND10	32	ND1	ND1	ND1	ND1
DW-17	07/25/85	ND1	ND10	ND1	ND10	28	ND1	ND1	ND1	ND1

All units in ug/L=ppb

NA=Not Analyzed

NDx=Not detected at or above x ug/L

See Figure 2.1 for well locations.

Table 11a (continued)

Well #	Date	12DCB	124TCB	123TCB	Nitro	DCP	PCP	245TCP	246TCP
DW-16	01/29/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	02/05/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	01/12/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	02/20/85	ND1	ND1	ND1	ND5	ND10	ND10	ND10	ND10
DW-16	02/26/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	03/05/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	03/12/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	03/19/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	03/26/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	04/23/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	05/21/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	06/25/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-16	07/25/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	01/29/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	02/05/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	02/12/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	02/20/85	ND1	ND1	ND1	ND5	ND10	ND10	ND10	ND10
DW-17	02/28/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	03/05/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	03/12/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	03/19/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	03/26/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	04/23/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	05/21/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	06/25/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-17	07/25/85	ND1	ND1	ND1	NA	NA	NA	NA	NA

All units in ug/L=ppb
NA=Not Analyzed
NDx=Not detected at or above x ug/L
See Figure 2.1 for well locations.

TABLE 11a (continued)

Well #	Date	BEN	TCE	Tol	PCE	MCB	ET Ben	Styr	OCT	14DCB
DW-7	01/29/85	ND1	ND10	4	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	02/05/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	02/12/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	02/20/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	02/26/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	03/05/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	03/12/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	03/19/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	03/26/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	04/23/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	05/21/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	06/25.85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
DW-7	07/25/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	01/29/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	02/05/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	02/12/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	02/20/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	02/26/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	03/05/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	03/12/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	03/19/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	03/26/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	04/23/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	05/21/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	06/25/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1
F.BLK	07/25/85	ND1	ND10	ND1	ND10	ND1	ND1	ND1	ND1	ND1L

All units in ug/L

NA = Not Analyzed

NDx = Not Detected at or above x ug/l

See Figure 2.1 for well locations.

Table 11a (continued)

Well #	Date	12DCB	124TCB	123TCB	Nitro	DCP	PCP	245TCP	246TCP
DW-7	01/29/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	02/05/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	02/12/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	02/20/85	ND1	ND1	ND1	ND5	ND10	ND10	ND10	ND10
DW-7	02/26/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	03/05/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	03/12/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	03/19/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	03/26/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	04/23/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	05/21/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	06/25/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
DW-7	07/25/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	01/29/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	02/05/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	02/12/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	02/20/85	ND1	ND1	ND1	ND5	ND10	ND10	ND10	ND10
F.BLK	02/26/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	03/05/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	03/12/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	03/19/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	03/26/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	04/23/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	05/21/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	06/25/85	ND1	ND1	ND1	NA	NA	NA	NA	NA
F.BLK	07/25.85	ND1	ND1	ND1	NA	NA	NA	NA	NA

All units in ug/L

NA=Not Analyzed

NDx=Not Detected at or above x ug/L

See Figure 2.1 for well locations.

TABLE 11b
Summary of Chemical Analyses

Bedrock Wells

Well #	Date	Day of Year	Temp. (C)	pH	Chloride (mg/L)*	T.D.S. (mg/L)*	Cond. (umhos/cm)
DW-17	1/29/85	29	12.0	6.6	2792	8869	9000
DW-17	2/5/85	36	10.0	6.2	1980	5677	7700
DW-17	2/12/85	43	11.0	6.6	1620	5748	6800
DW-17	2/19/85	50	11.0	6.5	1610	5438	6200
DW-17	2/26/85	57	12.0	6.6	1332	3617	6000
DW-17	3/5/85	64	11.0	6.6	1236	5284	5600
DW-17	3/12/85	71	11.0	6.6	1268	4898	5700
DW-17	3/19/85	78	11.0	6.4	1208	4787	5500
DW-17	3/26/85	85	12.0	6.6	1111	4909	5500
DW-17	4/23/85	113	13.0	7.4	1027	5421	5400
DW-17	5/21/85	141	12.0	7.2	1044	4716	5400
DW-17	6/25/85	176	13.0	6.6	914	5266	5300
DW-17	7/30/85	211	13.0	6.6	980	5509	5020
DW-16	1/29/85	29	10.0	6.8	506	3754	4100
DW-16	2/5/85	36	8.0	6.2	336	3777	4300
DW-16	2/12/85	43	10.0	6.8	306	3768	4200
DW-16	2/19/85	50	11.0	6.8	591	3913	4200
DW-16	2/26/85	57	12.0	6.6	546	3860	4400
DW-16	3/5/85	64	10.0	6.8	644	4047	4300
DW-16	3/12/85	71	11.0	7.0	546	3795	4200
DW-16	3/19/85	78	10.5	6.6	566	3764	4400
DW-16	3/26/85	85	10.0	6.8	613	4064	4500
DW-16	4/23/85	113	12.0	7.8	552	4005	4300
DW-16	5/21/85	141	11.0	7.4	593	3897	4500
DW-16	6/25/85	176	11.0	7.0	569	4121	4400
DW-16	7/30/85	211	12.0	6.6	550	4132	4030
DW-7	1/29/85	29	10.0	6.8	392	3632	3900
DW-7	2/5/85	36	8.0	6.2	424	3566	4000
DW-7	2/12/85	43	11.0	6.6	390	3492	3700
DW-7	2/19/85	50	11.0	7.2	370	4000	4000
DW-7	2/26/85	57	12.0	6.8	387	3617	3700
DW-7	3/5/85	64	12.0	6.6	398	3566	3700
DW-7	3/12/85	71	10.0	6.2	396	3521	3500
DW-7	3/19/85	78	10.0	6.4	383	3532	3800
DW-7	3/26/85	85	11.0	6.6	364	3540	3500
DW-7	4/23/85	113	12.0	7.6	368	3574	3600
DW-7	5/21/85	141	12.0	7.4	377	3501	3800
DW-7	6/25/85	176	11.0	6.6	377	3616	3700
DW-7	7/30/85	211	11.0	6.6	361	3794	3800

*mg/L = ppm
See Figure 2.1 for well locations.

TABLE 12
Summary of Chemical Analyses

Panhandle Surface Water
June 1984

	Site A	Site B	Site D	Site E	Site F	Field Blank
o-Chlorophenol	ND10	ND10	ND10	22*	ND10	ND10
p-Chlorophenol	ND10	ND10	ND10	ND10	ND10	ND10
2,4,6-Trichlorophenol	ND10	ND10	ND10	ND10	ND10	ND10
2,4,5-Trichlorophenol	ND10	ND10	ND10	ND10	ND10	ND10
Benzene	ND1	ND1	ND1	ND1	ND1	ND1
Trichloroethylene	ND10	ND10	ND10	ND10	ND10	ND10
Toluene	ND1	ND1	ND1	ND1	ND1	ND1
Tetrachloroethylene	ND10	ND10	ND10	ND10	ND10	ND10
Monochlorobenzene	ND1	ND1	ND1	ND1	ND1	ND1
Ethyl Benzene	ND1	ND1	ND1	ND1	ND1	ND1
Styrene	ND1	ND1	ND1	ND1	ND1	ND1
o-Chlorotoluene	ND1	ND1	ND1	ND1	ND1	ND1
1,4-Dichlorobenzene	ND1	ND1	ND1	ND1	ND1	ND1
,2-Dichlorobenzene	ND1	ND1	ND1	ND1	ND1	ND1
1,2,4-Trichlorobenzene	ND1	ND1	ND1	ND1	ND1	ND1
1,2,3-Trichlorobenzene	ND1	ND1	ND1	ND1	ND1	ND1
Nitrobenzene	ND5	ND5	ND5	ND5	ND5	ND5
TRP	ND50	ND50	ND50	NS	ND50	ND50
Chloride mg/L	58.4	52.0	48.3	NS	40.0	0.0
TON mg/L	1.7	4.4	2.72	NS	3.91	0.52
TDS (0.50 u Filter)	503	537	488	NS	520	22
Formaldehyde mg/L	0.28	ND0.25	0.35	NS	0.37	ND
TOC mg/L	66	36	35	51	40	6

All values reported in ug/L except where noted.
NDx - Not detected at or above x ug/l.
NS - Insufficient amount of sample for analysis.
* - Identified by GC but not confirmed at or above 10 ug/L by GC/MS.
See Figure 2.6 for surface water sample locations.

TABLE 13
Summary of Chemical Analyses

Near-Surface Soil
August 1983

	SS-1	SS-2*	SS-2A	SS-2B	SS-2C	SS-2D	SS-2E	SS-2F	SS-3
1,2,4-Trichlorobenzene	ND0.05	25	61	29	0.70	30	0.55	2.7	0.19
1,2,3-Trichlorobenzene	ND0.05	13	29	11	0.37	11	0.25	0.99	0.10
1,2,4,5-Tetrachlorobenzene	ND0.05	11	19	14	0.23	11	0.12	0.37	ND0.05
1,2,3,4-Tetrachlorobenzene	ND0.05	10	16	10	0.18	10	0.10	0.67	ND0.05
Pentachlorobenzene	ND0.05	10	13	12	0.15	10	0.06	0.13	ND0.05
Hexachlorobenzene	ND0.05	12	15	17	0.26	12	0.11	0.14	0.09
2-Chlorophenol	ND100	ND100	ND100	ND100	ND100	ND100	ND100	ND100	ND100
3,4-Dichlorophenol	ND20	ND20	ND20	ND20	ND20	ND20	ND20	ND20	ND20
2,4,5-Trichlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10	ND10	ND10
2,3,4-Trichlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10	ND10	ND10
2,3,6-Trichlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10	ND10	ND10
3,4,5-Trichlorophenol	ND10	15	17	ND10	ND10	ND10	ND10	ND10	ND10
2,3,5,6-Tetrachlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10	ND10	ND10
Pentachlorophenol	ND10	ND10	14	ND10	ND10	ND10	ND10	ND10	ND10

All units in ug/gm - ppm

* Not considered to be representative sample (see Section III - Sampling & Analytical Chemistry CONT INV 84).

NDx = Not detected at or above x ppm

See Figure 2.7 for sample locations.

Table 13 (continued)

	SS-4	SS-8	SS-9	SS10	SS-10A	SS-14	SS-15
1,2,4-Trichlorobenzene	0.18	ND0.05	ND0.05	0.30	2.5	ND0.05	ND0.05
1,2,3-Trichlorobenzene	0.11	ND0.05	ND0.05	0.15	0.81	ND0.05	ND0.05
1,2,4,5-Tetrachlorobenzene	ND0.05	ND0.05	ND0.05	0.16	0.87	ND0.05	ND0.05
1,2,3,4-Tetrachlorobenzene	ND0.05	ND0.05	ND0.05	0.11	0.61	ND0.05	ND0.05
Pentachlorobenzene	ND0.05	ND0.05	ND0.05	0.15	0.69	ND0.05	ND0.05
Hexachlorobenzene	ND0.05	ND0.05	ND0.05	0.27	0.96	ND0.05	ND0.05
2-Chlorophenol	ND100	ND100	ND100	ND100	ND100	ND100	ND100
3,4-Dichlorophenol	ND20	ND20	ND20	ND20	ND20	ND20	ND20
2,4,5-Trichlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10
2,3,4-Trichlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10
2,3,6-Trichlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10
3,4,5-Trichlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10
2,3,5,6-Tetrachlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10
Pentachlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10

All units in ug/gm - ppm

* Not considered to be representative sample (see Section III - Sampling & Analytical Chemistry CONT INV 84).

NDx = Not detected at or above x ppm

See Figure 2.7 for sample locations.

Table 14
TCDD Data Summary
Near Surface Soils
August 1983

DB-1 Column

Sample	Total TCDD	2,3,7,8, & Co-eluters
SS-1	0.89	0.10
SS-2	8.0	0.84
SS-2B	4.3	1.0
SS-2C	0.92	0.15
SS-2D	4.3	0.83
SS-2E	0.2	0.07
SS-2F	0.34	0.06
SS-4	0.29	0.06
SS-10	5.5	0.64
SS-15	1.1	0.09
SS-15 (Dup.)	0.55	0.08

CPS-2 Column

Sample	Total TCDD	2,3,7,8
SS-2A	19	0.29
SS-2B	29	0.84
SS-3	3.7	0.18
SS-8	1.2	0.05
SS-9	0.26	0.07
SS-14	0.51	0.03
SS-15	2.5	0.20

* ng/g = ppb

See Figure 2.7 for sample locations.

TABLE 15
Summary of Chemical Analyses

Panhandle Surface Soil
June 1984

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
1,2,4-Trichlorobenzene	0.23	0.056	0.080	0.17	0.68	3.0	0.09
1,2,3-Trichlorobenzene	0.20	ND0.05	ND0.05	0.082	0.44	1.3	ND0.05
1,2,4,5-Tetrachlorobenzene	0.17	ND0.05	ND0.05	0.053	0.18	2.1	0.09
1,2,3,4-Tetrachlorobenzene	0.28	ND0.05	ND0.05	ND0.05	0.13	1.3	0.06
Pentachlorobenzene	0.38	ND0.05	ND0.05	ND0.05	0.093	1.9	0.11
Hexachlorobenzene	1.2	0.12	0.092	0.087	0.13	2.2	0.10
Orthochlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2
3,4-Dichlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2
2,3,6-Trichlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2
2,4,5-Trichlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2
2,3,4-Trichlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2
3,4,5-Trichlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2
2,3,5,6-Tetrachlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2
Pentachlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2
	2.46	0.176	0.172	0.392	1.653	11.8	0.45

Concentrations in mg/kg (dry wt.).
ND2 Not detected at or above 2.0 mg/kg.
ND0.05 Not detected at or above 0.05 mg/kg.
See Figure 2.8 for sample locations.

Table 16b

NON-VEGETATED COVER

Categories

A Roadways marked as dotted lines.

B Bare soil in areas 44, 45, 54 and 55.

C Tar-like deposits in areas 2, 4, 21 and 22.

D Resin slabs in areas 34, 37, 43, 59 and 60.

E Spent catalyst pellets in areas 6, 12, 13, 24, 25, 26, 27, 29 and 36.

F Non-Chemical miscellaneous (lumber, branches,concrete, etc.) in areas 3, 5, 38, 40, 57 and 58.

G Raschig rings in area 42.

H General debris in areas 7, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 23, 28, 30, 31, 32, 33, 35, 39, 41, 46, 47, 48, 49, 50, 51, 52, 53, 56 and 61.

Sample List

Sample No.	Description	Map Location
1	Roadway (composite)	
2	Tar	
3	Soil Adjacent to tar	Site 2
4	Bare soil	Site 44
5	Spent Catalyst (composite)	Sites, 36, 26, and 12
6	Soil in the area of site 33	
7	Soil in the area of site 13	
8	Soil in the area of site 16	
9	Soil in the area of site 37	
10	Reddish resin (large piece near site 9	
11	Resin pieces (composite)	Sites 33, 13 and 16

TABLE 17

Summary of Chemical Analyses

Off-site Soil
December 1984 - April 1985

Compounds*	Site Designation 2R	5R	6R
1,2,4-Trichlorobenzene	ND0.05	ND0.05	ND0.05
1,2,3-Trichlorobenzene	ND0.05	ND0.05	ND0.05
1,2,4,5-Tetrachlorobenzene	ND0.05	ND0.05	ND0.05
1,2,3,4-Tetrachlorobenzene	ND0.05	ND0.05	ND0.05
Pentachlorobenzene	ND0.05	ND0.05	ND0.05
Hexachlorobenzene	ND0.05	ND0.05	ND0.05
Orthochlorophenol	ND2	ND2	ND2
3,4-Dichlorophenol	ND2	ND2	ND2
2,3,6-Trichlorophenol	ND2	ND2	ND2
2,4,5-Trichlorophenol	ND2	ND2	ND2
2,3,4-Trichlorophenol	ND2	ND2	ND2
3,4,5-Trichlorophenol	ND2	ND2	ND2
2,3,5,6-Tetrachlorophenol	ND2	ND2	ND2
Pentachlorophenol	ND2	ND2	ND2

* Concentrations in mg/kg (dry wt.).

NDxx - Not detected at or above xx mg/kg.

See Figure 2.9b for sample locations.

TABLE 20
Summary of Chemical Analyses

Filtercake Chlorophenols
July 1982

	Walck & Nash	Walck 6A	Walck 6B	Walck 6K	R4 Wilson
o-Chlorophenol	ND10*	ND10	ND10	ND10	ND10
p-Chlorophenol	ND10	ND10	ND10	ND10	ND10
2,4,5-Trichlorophenol	ND10	ND10	ND10	ND10	ND10
2,4,6-Trichlorophenol	ND10	ND10	ND10	ND10	ND10

* - NDx means that amount at or above the value of X ug/L was not detected.
See Figure 2.1 for sample locations.

TABLE 21
Summary of Chemical Analyses

Sewer Bedding Piezometers
Fall 1983

	D-11	D-12	D-15	D-17	D-18	D-19	Field Blank
o-Chlorophenol	620	23	110	29	230	84	ND10
p-Chlorophenol	34	110	51	ND10	76	38	ND10
2,4,6-Trichlorophenol	ND10	ND10	ND10	ND10	ND10	ND10	ND10
2,4,5-Trichlorophenol	ND10	NDL0	ND10	ND10	ND10	ND10	ND10
Benzene	6500	25	8	1	1000	210	ND1
Trichloroethylene	ND10	ND10	ND10	ND10	ND10	ND10	ND10
Toluene	2	2	2	1	5	3	ND1
Tetrachlorethylene	ND10	ND10	ND10	ND10	ND10	ND10	ND10
Monochlorobenzene	1500	2000	4100	98	8400	3900	ND1
Ethyl Benzene	ND1	ND1	ND1	ND1	ND1	ND1	ND1
Styrene	ND1	ND1	ND1	ND1	ND1	ND1	ND1
o-Chlorotoluene	ND1	1	5	ND1	2	ND1	ND1
1,4-Dichlorobenzene	43	700	2700	200	130	120	ND1
1,2-Dichlorobenzene	10	1100	3600	350	210	200	ND1
1,2,4-Trichlorobenzene	3	78	380	140	2	5	ND1
1,2,3-Trichlorobenzene	1	48	360	85	ND1	1	ND1
TOC (mg/L)	*	59	*	*	*	*	12
TOC Replicate	*	50	*	*	*	*	14
Chloride (mg/L)	*	84	*	*	*	*	--
TDS (mg/L)	*	430	*	*	*	*	--
TON (mg/L)	*	NDL	*	*	*	*	--

NDx - Not detected at or above x ug/L.
* - Not enough sample for analysis.

See Figure 2.1 for sample locations.

D- Represents piezometers in the series. Piezometers Delta 11, 18 and 19 are located in sanitary sewer bedding. Piezometers Delta 12, 15 and 17 are located in storm sewer bedding.

Table 22

Summary of Chemical Analyses,
Phase 1 Durez Area Storm Sewer Sediment
January 1986

Composite/Sample Number
Concentrations in Percent

Compound	1	2	3	4	5	6	Z163-4
Benzene	ND20	ND20	ND20	ND20	0.0051	0.0250	NA
Toluene	0.0040	0.0070	0.0220	0.0018	0.0072	0.0590	NA
Monochlorobenzene	0.0089	0.0390	0.1400	0.1200	0.6900	1.8000	NA
Styrene	ND20	ND26	ND20	ND20	ND20	ND20	NA
o-Chlorotoluene	0.0100	0.0180	0.4700	0.0970	0.4900	0.3700	NA
p-Dichlorobenzene**	0.1700	0.3600	1.8000	0.3600	1.5000	2.5000	ND0.5
o-Dichlorobenzene	0.1400	0.4700	1.7000	0.3200	1.1000	1.6000	ND0.5
1,2,4-Trichlorobenzene	0.1750	0.8900	1.6100	0.3750	0.2600	0.7700	*260
1,2,3-Trichlorobenzene	0.0605	0.3500	0.5400	0.1900	0.1200	0.3000	*156
1,2,4,5-Tetrachlorobenzene	0.0090	0.0620	0.0935	0.1700	0.0710	0.0720	*35
1,2,3,4-Tetrachlorobenzene	0.0014	0.0110	0.0290	0.1750	0.0740	0.0405	*58(1)
Pentachlorobenzene	0.00022	0.0027	0.0155	0.0955	0.0430	0.0310	*15
Hexachlorobenzene	0.00012	0.0019	0.0120	0.0735	0.0320	0.0240	*15
Phenol	0.00031	ND2.5	0.00032	ND2.5	ND2.5	0.0063	NA
ortho-Chlorophenol	ND2.5	ND2.5	ND2.5	ND2.5	ND2.5	0.00076	NA
3,4-Dichlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	NA
2,4,5-Trichlorophenol	ND1	ND1	ND1	ND1	ND1	ND1	NA
2,3,6-Trichlorophenol	ND1	ND2.5	ND2.5	ND2.5	ND2.5	ND2.5	NA
2,3,4,6-Trichlorophenol	ND1	ND1	ND1	ND1	ND1	ND1	NA
Pentachlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	NA
Total	0.579	2.21	6.43	1.98	4.39	7.6	--

NA - Not Analyzed
NDx - Not detected at or above x ug/g.
(1) - Coeluting compound - concentration of 1,2,3,4-Tetrachlorobenzene may be less than reported.
** - Includes 1,3-and 1,4 Dichlorobenzenes; isomers coelute.
* - Z163-4 results are in ng/g (ppb)

Composite/Sample Locations:
1. PCF, Nash, North of Wilson
2. Wilson Avenue
3. PCF, Nash, Walck to Wilson
4. PCF, Nash to Rosebrock
5. PCF, Nash, South of Walck
6. Walck Road
Z163-4. Nash Road, South of Meadow

See Figure 2.10 for sample locations.

Table 23

Volatile Chemical Characteristics

Chemical	Composite Number	Sediment Concentration (ppm)	Odor[1] Threshold	TLV[1]	Vapor[2] Pressure	Air Level (ppm-15 min)
Acetone	*	*	20	750	266	*
Chlorobenzene	6	18,000	0.05	75	8.8	41
1,2-Dichlorobenzene	3	17,000	0.024	50	1.2	5
1,4-Dichlorobenzene	6	25,000	0.011	75	0.4	6
1,2,3-Trichlorobenzene	3	5,400	--	--	0.02	0.1
1,2,4-Trichlorobenzene	3	16,100	0.064	5	0.3	1.0
1,2,3,4-Tetrachlorobenzene	4	1,750	--	--	0.002	0.001
1,2,4,5-Tetrachlorobenzene	4	1,700	--	--	0.004	0.002
Pentachlorobenzene	4	955	--	--	0.00002	0.0001
Hexachlorobenzene	4	735	--	--	0.000001	0.000004

1 - units are ppm

2 - units are mm of mercury

* - Acetone is not found in sewer sediment and is included here for reference only. Acetone is a volatile chemical commonly used in nail polish remover.

See Table 22 and Figure 2.10 for sample locations.

Table 24a

Summary of Chemical Analyses
Phase I Durez Sanitary Sewer Sediments
March 1986

	Z201	Z202	Z203	Z204	Z205	Z206	Z208	Z209
1,2,4-Trichlorobenzene	44	6.1	5.5	2.4	69	91	42	65
1,2,3-Trichlorobenzene	20	2.7	3.8	0.88	29	50	21	35
1,2,4,5-Tetrachlorobenzene[(a)]	20	5.5	2.2	0.62	22	42	21	35
1,2,3,4-Tetrachlorobenzene	15	4.4	1.8	0.43	18	39	18	36
Pentachlorobenzene	20	8.4	2.5	0.81	22	33	20	32
Hexachlorobenzene	28	19	5.7	2.1	31	39	25	35
Benzene	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2
Toluene	ND2	ND2	ND2	ND2	ND2	2	ND2	ND2
Monochlorobenzene	80	3	ND2	3	6	170	85	14
Styrene	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2
o-Chlorotoluene	55	10	12	12	54	220	180	130
p-Dichlorobenzene[(b)]	440	13	18	16	54	720	280	150
o-Dichlorobenzene	190	10	8	10	41	280	140	120
Phenol	ND2	ND2	ND2	ND2	11	6.0	ND2	ND2
ortho-Chlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2
3,4-Dichlorophenol	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1
2,4,5-Trichlorophenol	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1
2,3,6-Trichlorophenol	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1
2,3,5,6-Trichlorophenol	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1
Pentachlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2

	Z210	Z211	Z212	Z213	Z214	Z215	Z216	Z217	Z218
1,2,4-Trichlorobenzene	5.0	1.4	0.035	0.34	0.25	24	6.3	24	1.7
1,2,3-Trichlorobenzene	3.1	0.94	0.19	0.29	0.093	7.7	3.8	5.8	0.78
1,2,4,5-Tetrachlorobenzene[(a)]	1.4	0.63	0.061	0.097	0.037	1.0	0.71	3.4	1.5
1,2,3,4-Tetrachlorobenzene	1.5	1.2	0.041	0.014	0.036	0.26	0.19	0.50	0.034
Pentachlorobenzene	1.6	0.81	0.017	0.011	0.014	0.041	0.051	0.026	ND0.01
Hexachlorobenzene	2.4	1.5	0.022	ND0.01	0.012	0.056	0.057	0.018	ND0.01
Benzene	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2
Toluene	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2
Monochlorobenzene	7	ND2	ND2	ND2	ND2	ND2	2	ND2	ND2
Styrene	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2
o-Chlorotoluene	6	ND2	9	ND2	ND2	2	2	ND2	ND2
p-Dichlorobenzene[(b)]	35	4	17	3	10	18	13	8	7
o-Dichlorobenzene	41	3	15	4	9	12	10	7	5
Phenol	ND2	ND2	ND2	ND2	ND2	11	6.0	ND2	ND2
ortho-Chlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2
3,4-Dichlorophenol	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1
2,4,5-Trichlorophenol	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1
2,3,6-Trichlorophenol	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1
2,3,5,6-Trichlorophenol	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1	ND1
Pentachlorophenol	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2	ND2

Concentrations in micrograms/gram
NDx - Not detected at or above x ug/g = ppm. All units in ug/g.

(a) - Coeluting compound - concentration of 1,2,4,5-tetrachlorobenzene may be less than reported in all of the samples.
* Includes 1,3 - and 1,4 - Dichlorobenzene; Isomers coelute.
See Table 24b and Figure 2.11 for sample locations.

Table 24b

Sample Locations
Phase 1 Sanitary Sewer Samples

Sample	Manhole	Street
Z201	A13	Walck Road at Jessella Drive
Z202	A12	Walck Road
Z203	A11	Walck Road
Z204	A9, A10	Walck Road at Eggert Avenue
Z205	A8	Walck Road
Z206	A7	Nash Road at Walck Road
Z208	A6	Walck Road
Z209	A5	Walck Road
Z210	A4	Walck Road
Z211	A4	Walck Road
Z212	A2	Walck Road
Z213	B6	Wilson Avenue
Z214	B5	Wilson Avenue
Z215	B4	Wilson Avenue
Z216	B3	Wilson Avenue
Z217	N3	Nash Road
Z218	N1	Nash Road

Table 25a
Summary of Chemical Analyses
Phase 2 Storm Sewer Investigation
June 1986

Sample Location
(Map Site Number)

Compound	1	2A	2B	3	4	5	6	7	8	9	10	12
Benzene	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0
Toluene	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	7.6
Monochlorobenzene	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	1.1	ND1.0	13	13	ND1.0	ND1.0
Styrene	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0
2-Chlorotoluene	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	1.8	33	ND1.0	ND1.0
1,4-Dichlorobenzene	5.3	ND1.0	ND1.0	1.2	ND1.0	ND1.0	1.5	1.5	15	94	2.7	ND1.0
1,3-Dichlorobenzene	7.8	ND1.0	ND1.0	2.7	ND1.0	ND1.0	ND1.0	1.5	8.0	79	2.4	1.5
1,2,4-Trichlorobenzene	ND0.1	ND0.1	ND0.1	0.15	ND0.1	0.23	0.10	ND0.1	0.71	215	3.9	ND0.1
1,2,3-Trichlorobenzene	ND0.1	ND0.1	ND0.1	ND0.1	ND0.1	0.12	ND0.1	ND0.1	0.10	63	2.1	ND0.1
1,2,4,5-Tetrachlorobenzene	ND0.1	ND0.1	ND0.1	ND0.1	ND0.1	0.20	ND0.1	ND0.1	ND0.1	69	2.6	ND0.1
1,2,3,4-Tetrachlorobenzene	ND0.1	ND0.1	ND0.1	ND0.1	ND0.1	0.16	ND0.1	ND0.1	ND0.1	64	2.1	ND0.1
Pentachlorobenzene	ND0.1	ND0.1	ND0.1	ND0.1	ND0.1	0.16	ND0.1	ND0.1	0.21	75	2.1	ND0.1
Hexachlorobenzene	ND0.1	ND0.1	ND0.1	ND0.1	ND0.1	0.14	ND0.1	ND0.1	0.23	79	2.1	ND0.1
TOTAL	13.1	---	---	4.05	---	1.01	2.7	3.0	39.05	784	20	9.1

Notes: All results are expressed as mg/Kg, dry weight.
No sample taken at Location 11.
NDx = Not detected at or above x ug/ml.
See Table 25b and Figure 2.12 for sample locations.

Table 25b

Sample Locations
Phase 2 Storm Sewer Samples

Sample	Manhole	Street
1	NA	Walck Road at Erie Avenue
2A	6AA	Walck Road at Zimmerman Street
2B	6AA	Walck Road at Zimmerman Street
3	NA	Walck Road at Eggert Avenue
4	NA	Eggert Drive
5	NA	Prospect Avenue
6	NA	Esthen Road
7	NA	Euclid Avenue
8	NA	Nash Road at Duane Drive
9	9	PCF, at Gilmore Avenue at Fifth Avenue
10	1	PCF, at River Road
12	33	Nash Road at Meadow Drive

NA=Not Available

Table 26

Results of TCDD Analyses
Phase 1 and 2 Samples
July 1986

Composite	Location	2,3,7,8-TCDD[1] (ng/g)	Total TCDD (ng/g)
1	Nash North of Wilson	ND0.4	6
2	Wilson Avenue	ND0.7	40
3	Nash Between Walck and Wilson	6	160
4	Treichler to Nash (Nash to Rosebrook)	110	6800
5	Nash South of Walck	55	2500
6	Walck Road	15	520
Inlet	Sample No. 1001	15	680

1. 2,3,7,8-TCDD specific analysis using 60 meter SP-2330 column.
2. NDx = Not detected at x ng/g.
3. See Figures 2.10 and 2.13 for sample locations.

Table 27

Summary of Chemical Analyses
Phase 2 Inlet Investigation
July 1986

Compound	101 (0-6")	102 (6"-2')	210 (0-6")	301 (0-6")	401 (0-6")	403 (2'-5')	501 (0-6")
Benzene	57	1.0	43	760	162	140	2.4
Toluene	18	ND1.0	18	58	4.4	5.4	2.4
Monochlorobenzene	1854	16	2310	128	500	1500	3.9
Styrene	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0
2-Chlorotoluene	1514	66	1100	8650	38	3	ND1.0
1,4-Dichlorobenzene	1119	32	1300	2300	114	300	2.9
1,2-Dichlorobenzene	1432	33	1460	2870	98	430	6
1,2,4-Trichlorobenzene	440	76	645	1700	116	165	3.5
1,2,3-Trichlorobenzene	280	31	230	5600	37	95	1.2
1,2,4,5-Tetrachlorobenzene	230	17	76	260	41	46	1.2
1,2,3,4-Tetrachlorobenzene	270	15	43	200	34	62	1.2
Pentachlorobenzene	98	13	40	180	24	27	1.0
Hexachlorobenzene	75	18	40	160	34	21	1.4
Total (%)	0.7	0.03	0.7	2.3	0.1	0.3	0.003

Notes:
(0-6") - Number in () is sediment sample depth
All results are expressed in mg/kg, dry weight
NA - Not Available
The last two digits in each sample number indicate the sample depth 01=0-6"
02=6"-2'
03=2'-5'

The first digit(s) represent the sample collection area
See Figure 2.13 for sample locations.

Table 27 (continued)

Summary of Chemical Analyses
Phase 2 Inlet Investigation
July 1986

Compound	601 (0-6")	701 (0-6")	702 (6"-2')	801 (0-6")	901 (0-6")	1001 (0-6")	1002 (6"-2')
Benzene	111	250	155	24	23	182	5.0
Toluene	16	27	239	5.7	8.5	51	5.0
Monochlorobenzene	690	900	3300	260	683	930	136
Styrene	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0	ND1.0
2-Chlorotoluene	180	920	2600	2.9	17	4150	435
1,4-Dichlorobenzene	260	660	3600	59	410	2000	370
1,2-Dichlorobenzene	390	560	3400	52	506	1600	476
1,2,4-Trichlorobenzene	280	410	1100	4.7	450	1100	330
1,2,3-Trichlorobenzene	110	180	510	1.5	58	490	170
1,2,4,5-Tetrachlorobenzene	120	110	330	1.7	46	280	100
1,2,3,4-Tetrachlorobenzene	100	85	300	0.68	51	260	130
Pentachlorobenzene	62	85	210	3.2	63	230	83
Hexachlorobenzene	27	87	190	6.4	88	230	63
Total (%)	0.2	0.4	1.6	0.04	0.2	1.2	0.2

Table 28

North Tonawanda/Durez Area Sewers
Estimated Sediment Volumes

SANITARY SEWERS

Segment	Diameter (Inches)	Length (Feet)	Estimated Sediment Volume (cu.ft)
Walck Road	18	1300	120
Nash to Jesella	18	658	631
Nash to Penn Central Railroad (PCRR)	15	980	248
Nash Road	12	835	67
Wilson Avenue	8	1321	62
TOTAL		5094	1128 (41.8 c.y.)

STORM SEWERS

Segment	Size	Length (Feet)	Estimated Sediment Volume (c.y.)
Pettit Creek Flume (PCF)			
Rosebrock to Discharge	8'	5023	92
Rosebrock to Nash	8'	1939	226
Nash-South of Walck	5'	630	40
-Walck to Wilson	5'	892	130
-North of Wilson	5'	1169	198
PCF SUBTOTAL		9653	686
Wilson Avenue	30"	1800	35
Walck Road			
Nash to PCRR	42"	1900	105
East of PCRR	30"	280	25
Nash to Eggert	15"	800	20
Nash Road			
PCF to Meadow	48"	400	55
South of PCF	48"	175	10
TOTAL			936

See Figures 2.11 and 2.12 for segment locations.

Insert Fig 2.1

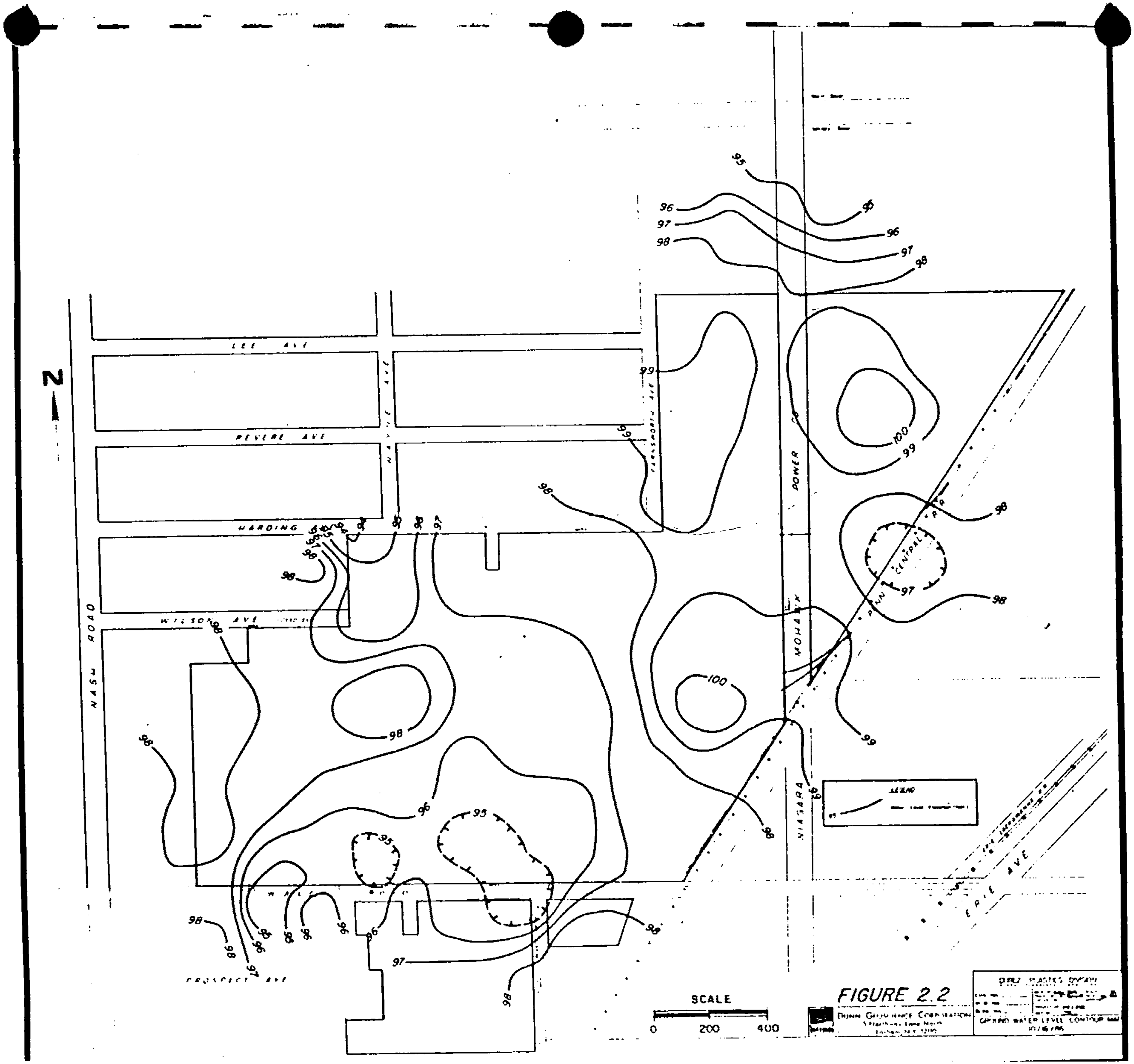

N
LEE AVE
REVERE AVE
HARDING
WILSON AVE
NASH ROAD
PROSPECT AVE
POWER
MOHAWK
NIAGARA
ERIE AVE
95
96
97
98
99
100
SCALE
0
200
400

FIGURE 2.2

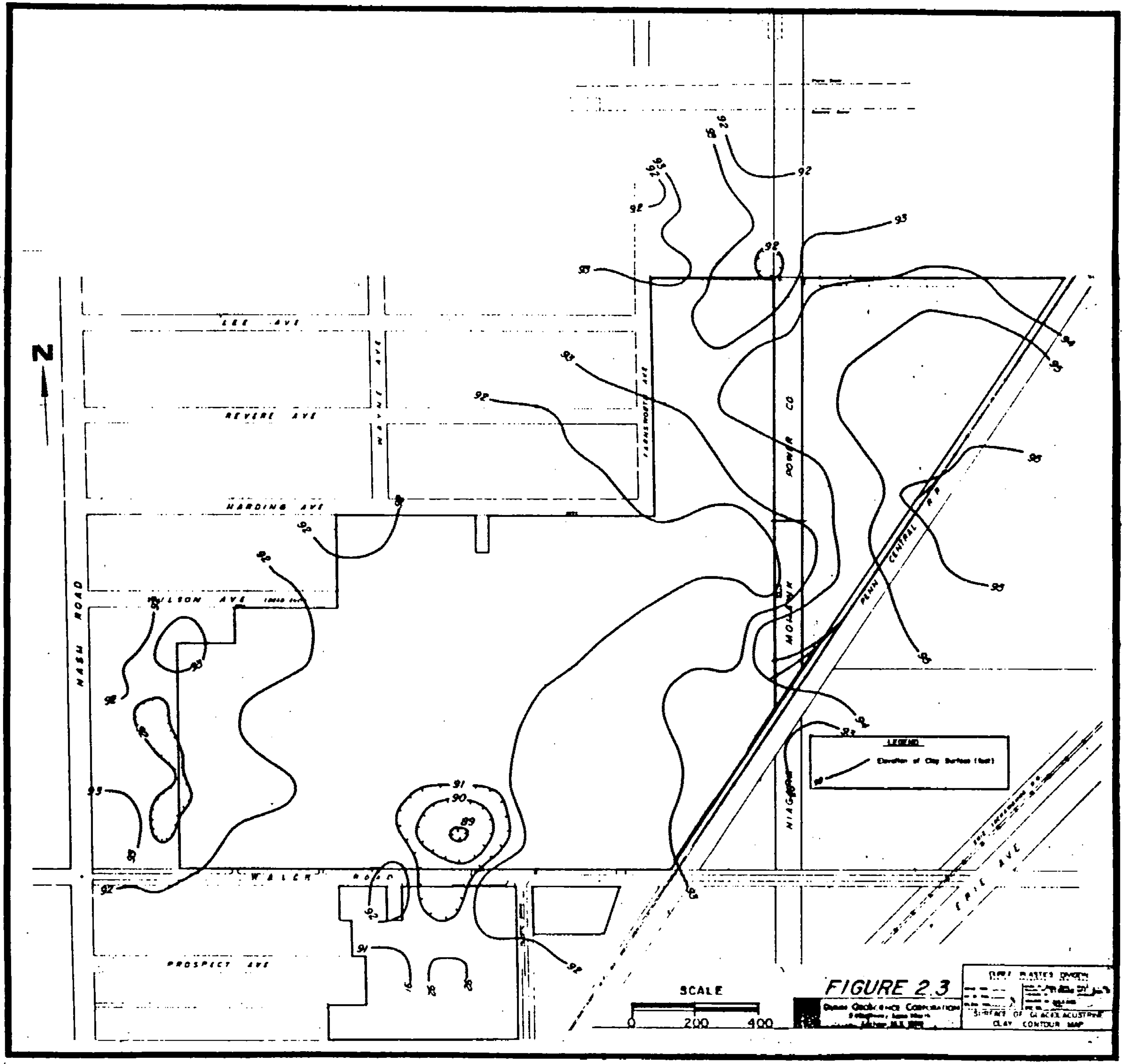

N
LEE AVE
REVERE AVE
HARDING AVE
WILSON AVE
WAYNE AVE
FARNSWORTH AVE
NASH ROAD
WALCK ROAD
PROSPECT AVE
POWER CO
MOHAWK
NIAGARA
PENN CENTRAL RR
ERIE AVE
LEGEND
Elevation of Clay Surface (feet)
SCALE
0
200
400
SURFACE OF GLACIOLACUSTRINE CLAY CONTOUR MAP

FIGURE 2.3

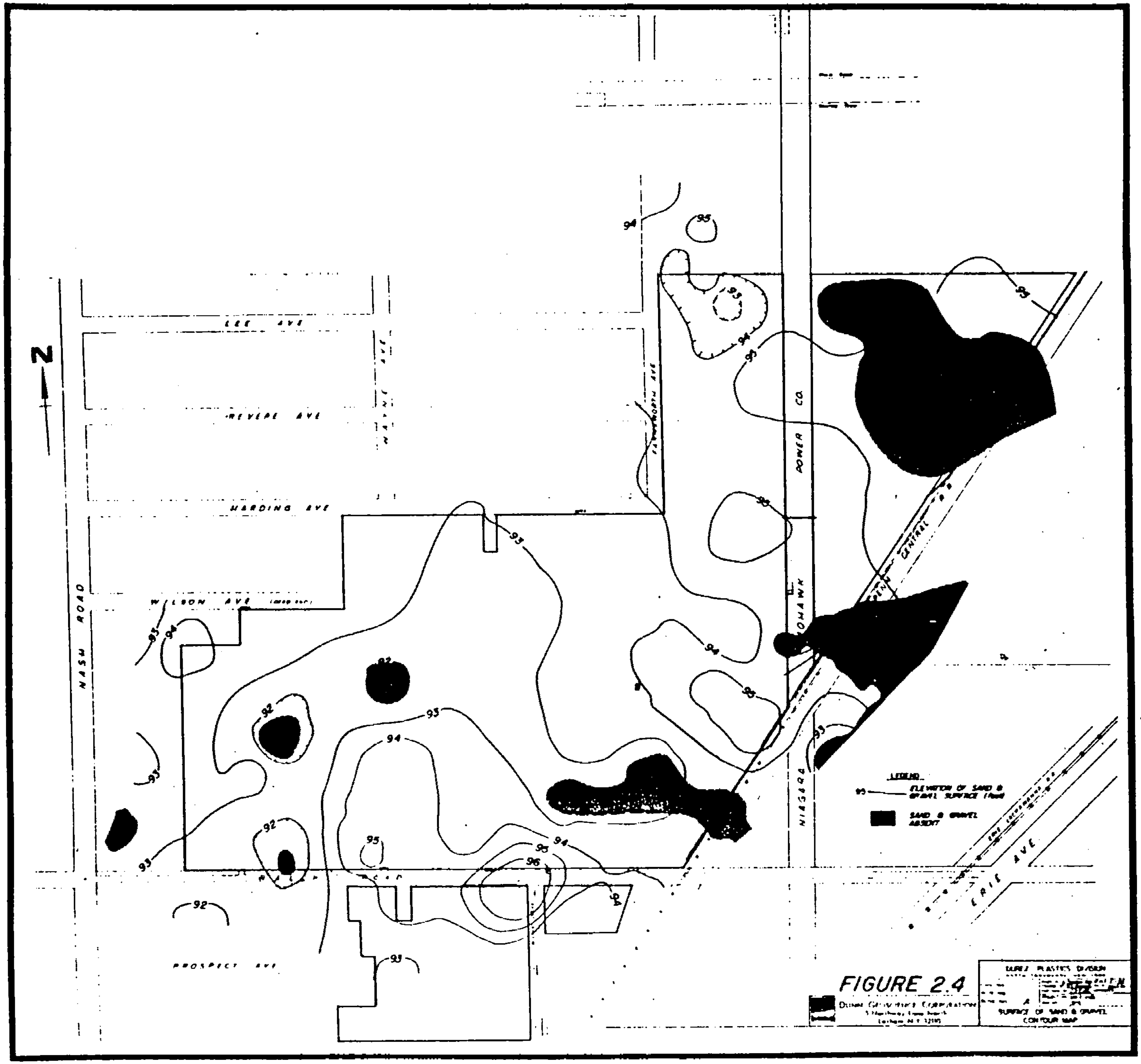

N
LEE AVE
REVERE AVE
HARDING AVE
WILSON AVE
NASH ROAD
PROSPECT AVE
POWER CO.
MOHAWK
NIAGARA
ERIE AVE
LEGEND
ELEVATION OF SAND & GRAVEL SURFACE (feet)
SAND & GRAVEL ABSENT
SURFACE OF SAND & GRAVEL CONTOUR MAP

FIGURE 2.4

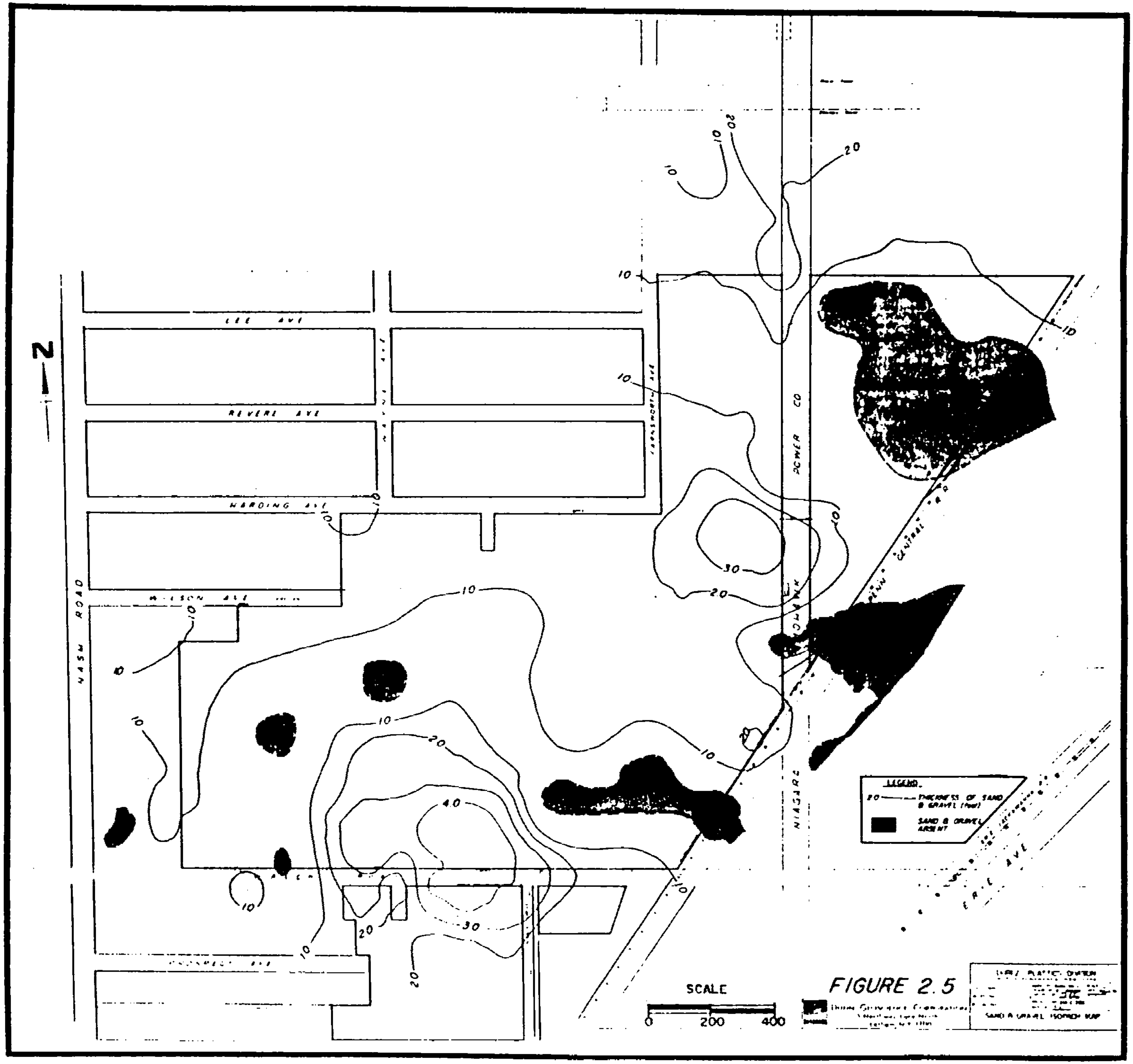
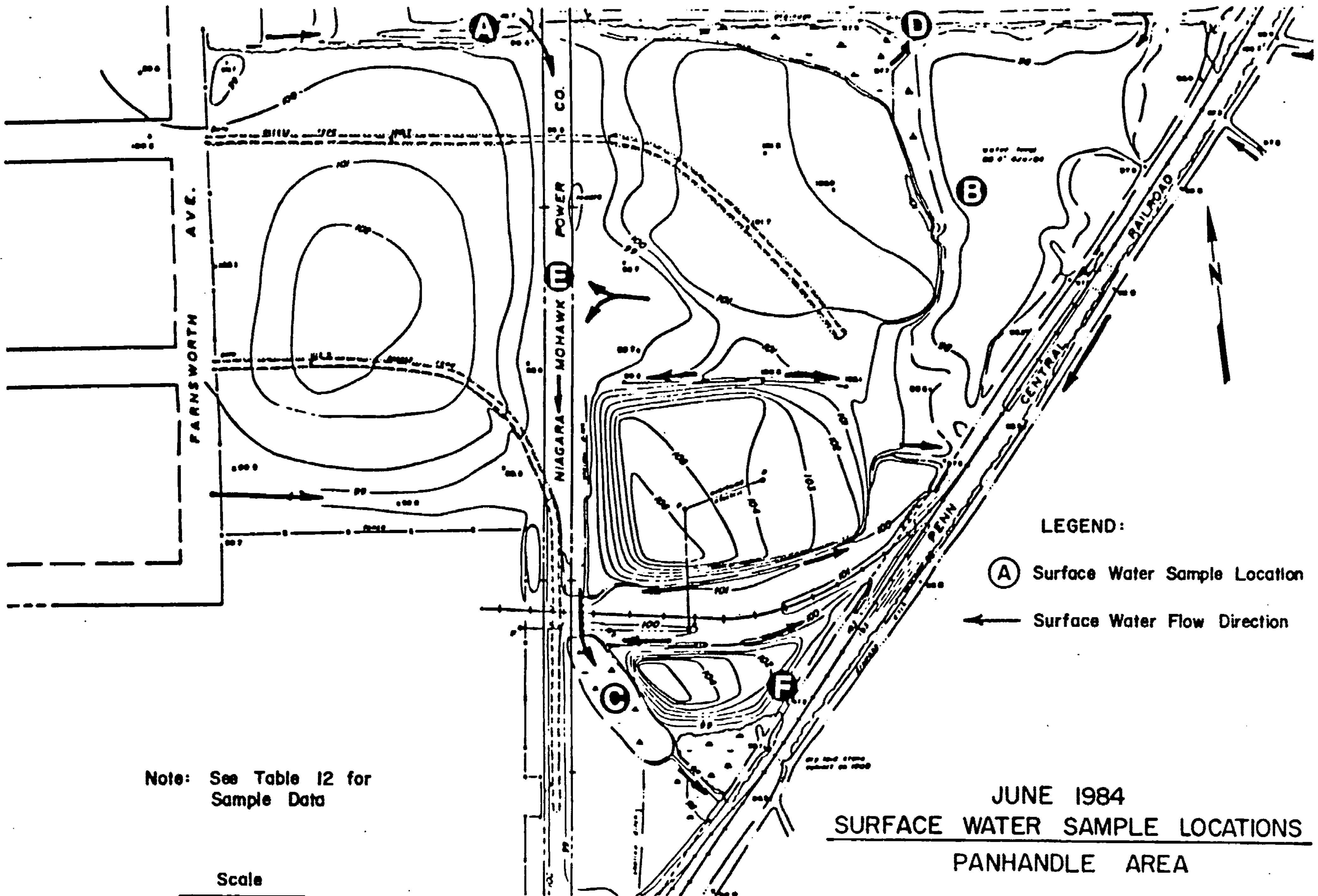

N
LEE AVE
REVERE AVE
HARDING AVE
WILSON AVE
NASH ROAD
POWER CO
NIAGARA
ERIE AVE
10
20
30
40
LEGEND
THICKNESS OF SAND & GRAVEL (feet)
SAND & GRAVEL ABSENT
SCALE
0
200
400
SAND & GRAVEL ISOPACH MAP

FIGURE 2.5



LEGEND:

(A) Surface Water Sample Location

⟵ Surface Water Flow Direction

Note: See Table 12 for Sample Data

Scale

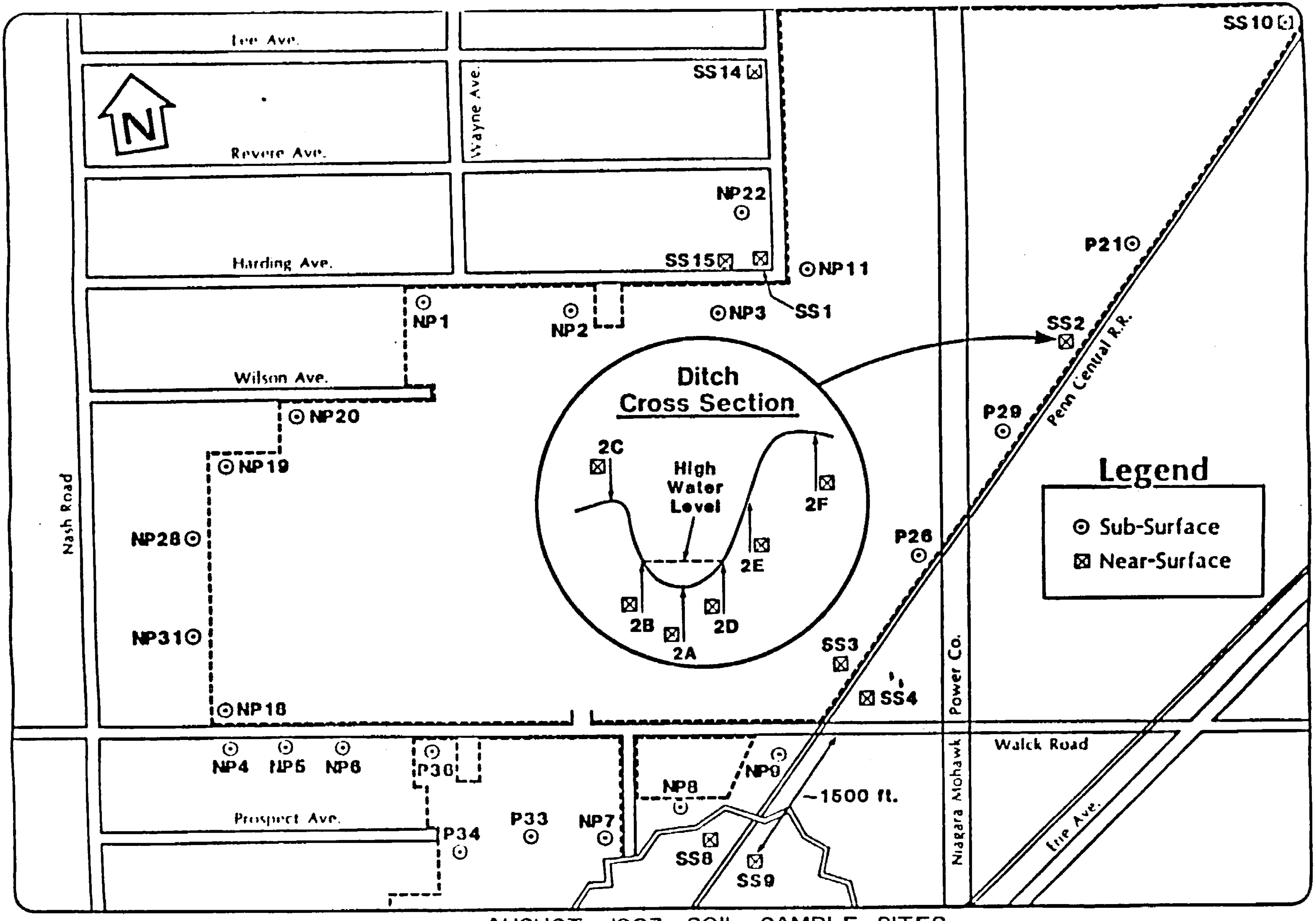
0' 158'

JUNE 1984

SURFACE WATER SAMPLE LOCATIONS

PANHANDLE AREA

FIGURE 2.6

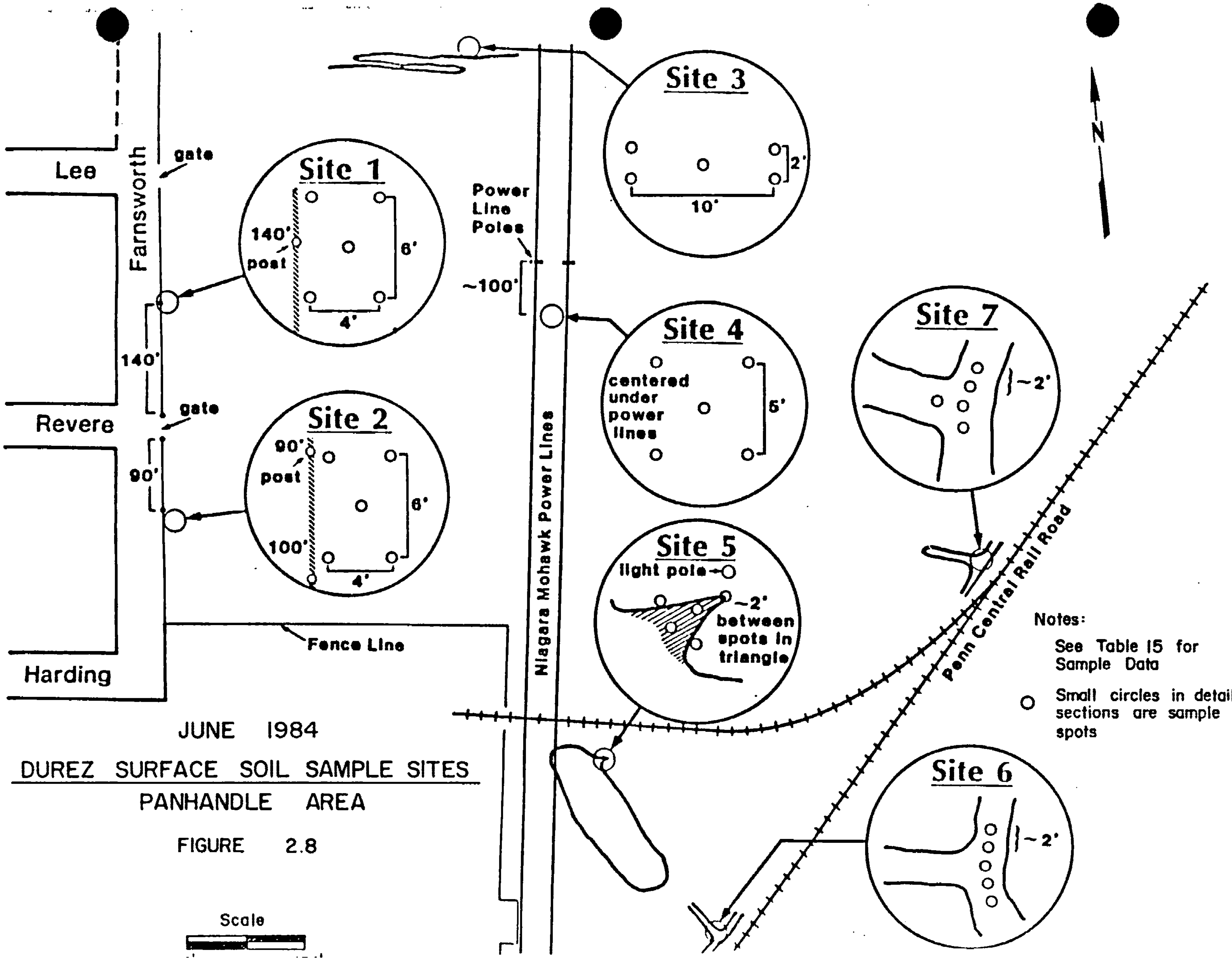


AUGUST 1983 SOIL SAMPLE SITES

PANHANDLE AREA

FIGURE 2.7

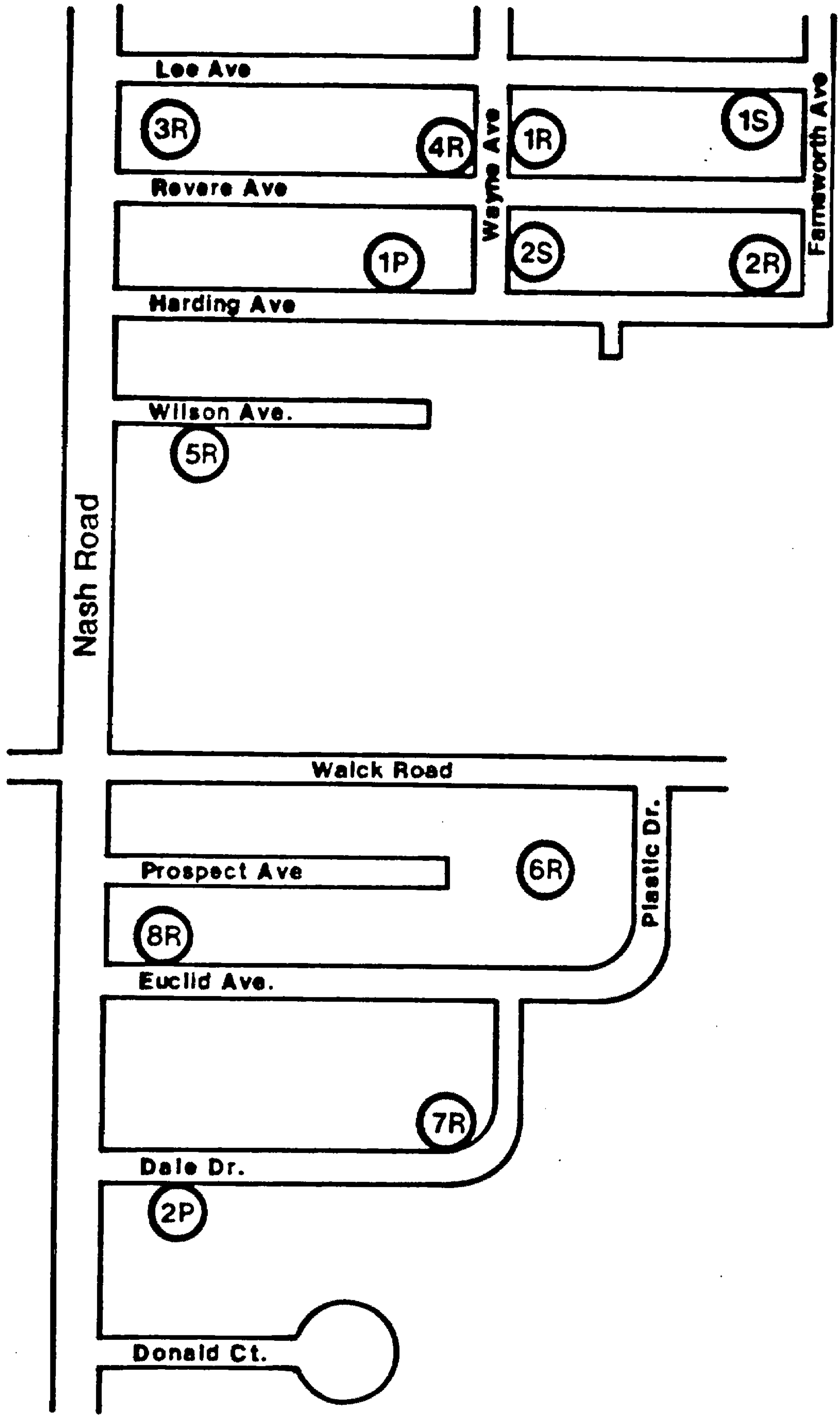
Note: See Tables 13 & 14 for Sample Data


Lee
Revere
Harding
Farnsworth
gate
gate
140'
90'
Site 1
140'
post
6'
4'
Site 2
90'
post
100'
6'
4'
Fence Line
Power
Line
Poles
~100'
Niagara Mohawk Power Lines
Site 3
2'
10'
Site 4
centered
under
power
lines
5'
Site 5
light pole
~2'
between
spots in
triangle
Site 7
~2'
Site 6
~2'
Penn Central Rail Road
N
Notes:
See Table 15 for Sample Data
Small circles in detail sections are sample spots
Scale
JUNE 1984
DUREZ SURFACE SOIL SAMPLE SITES
PANHANDLE AREA
FIGURE 2.8

Insert Fig 2.9a

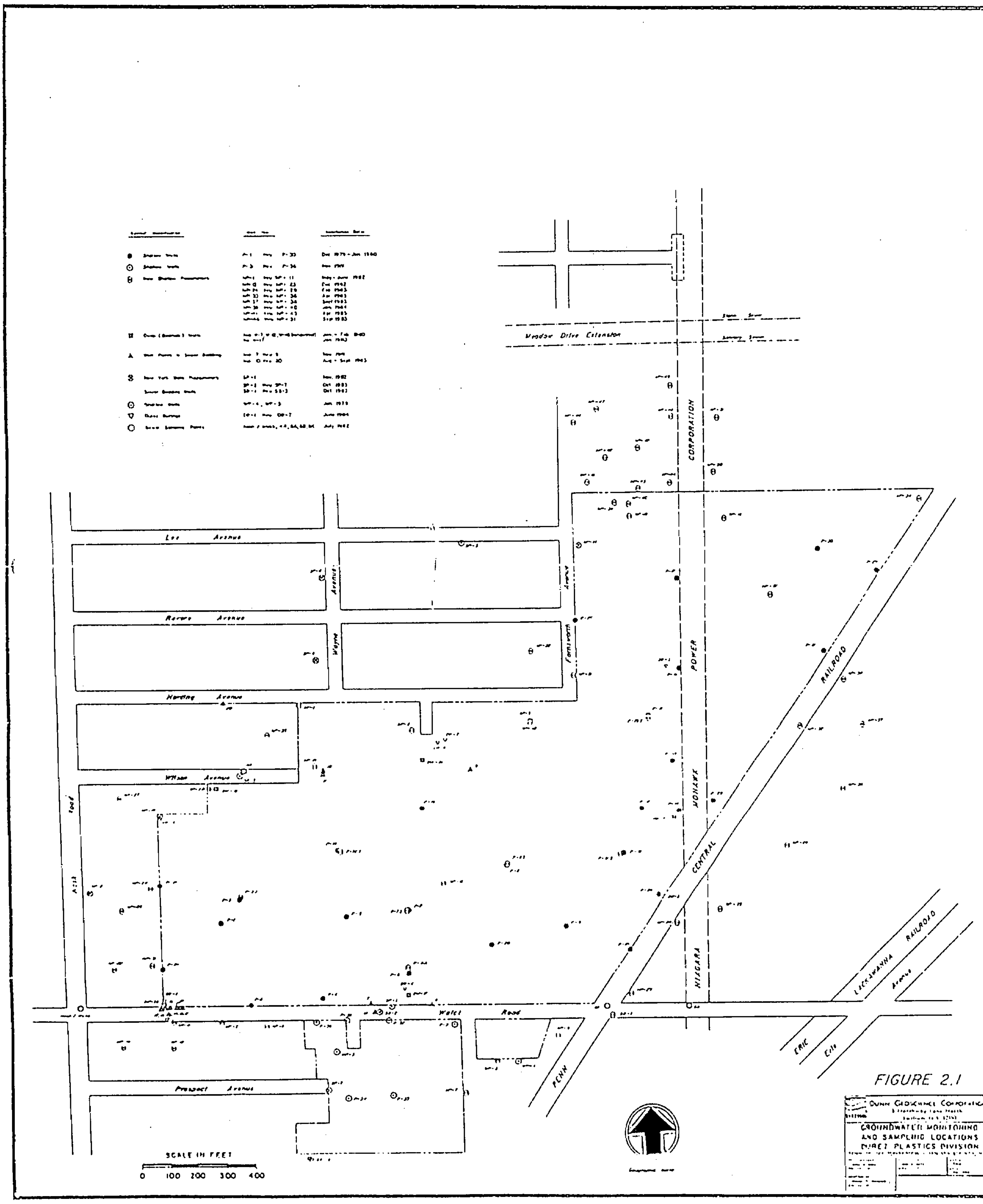
FIGURE 2.9b

Off-Site Soil Survey Locations



Insert Fig 2.10

Insert Fig. 2.11



Meadow Drive Extension
Lee Avenue
Harding Avenue
Wilson Avenue
Prospect Avenue
Wayne Avenue
Farnsworth Avenue
Walck Road
Penn
Erie
Lackawanna Railroad
Niagara Mohawk Power Corporation
Central Railroad
SCALE IN FEET
0 100 200 300 400
Dunn Geoscience Corporation
GROUNDWATER MONITORING AND SAMPLING LOCATIONS
DUREZ PLASTICS DIVISION

FIGURE 2.1

Insert Fig 2.12

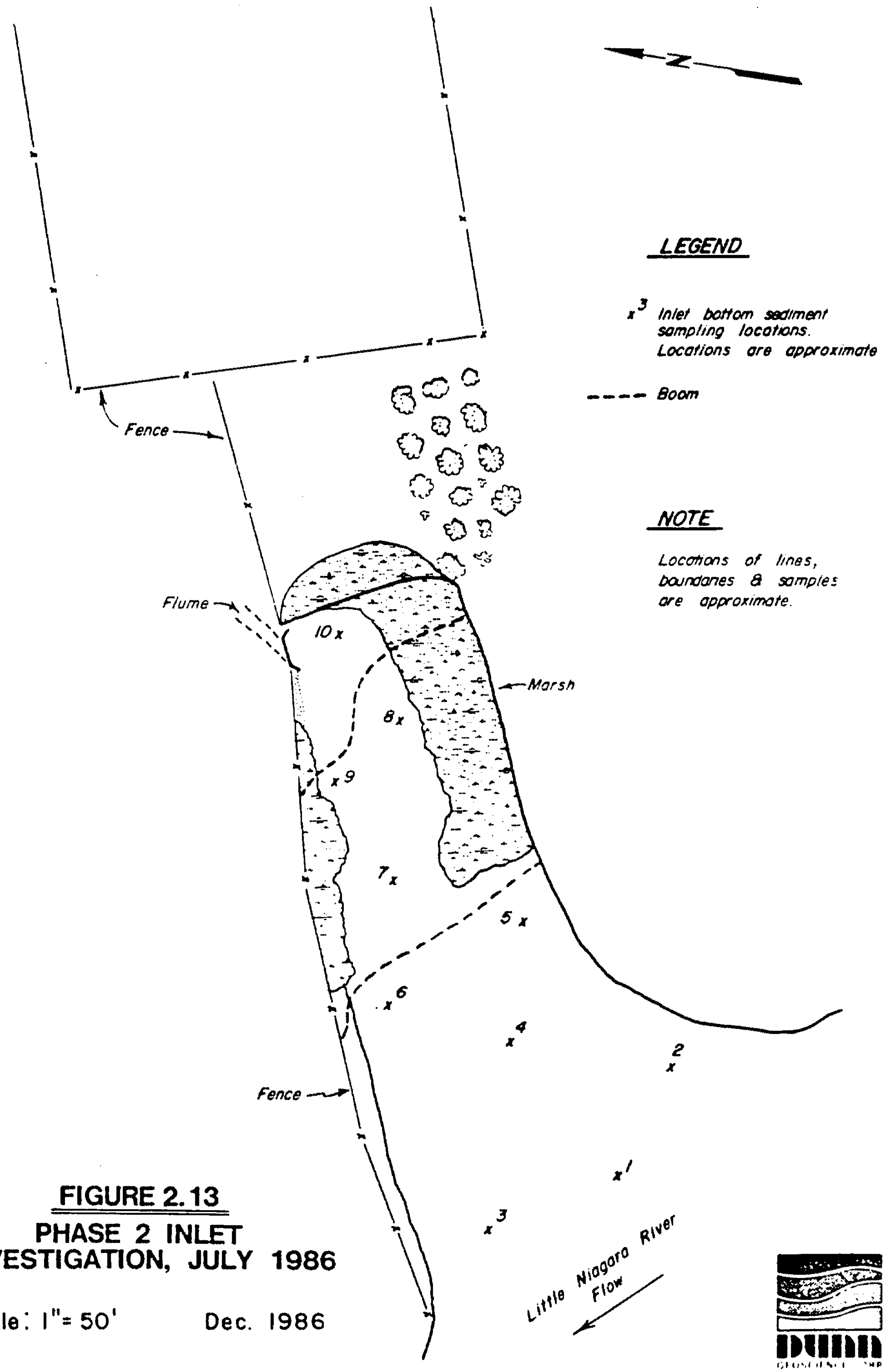


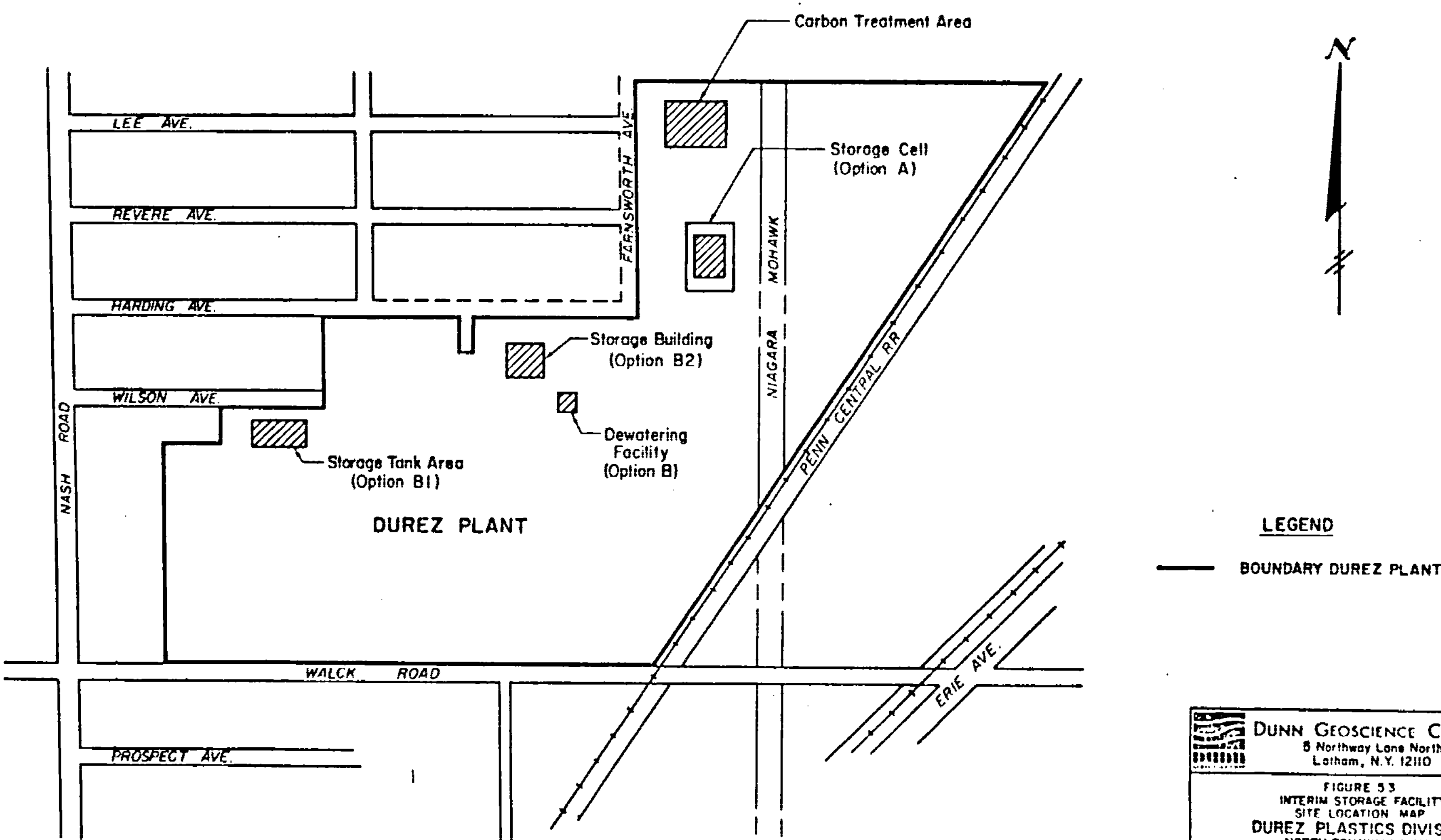
FIGURE 2.13

PHASE 2 INLET INVESTIGATION, JULY 1986

Scale: 1" = 50'   Dec. 1986

Insert Fig 5.1

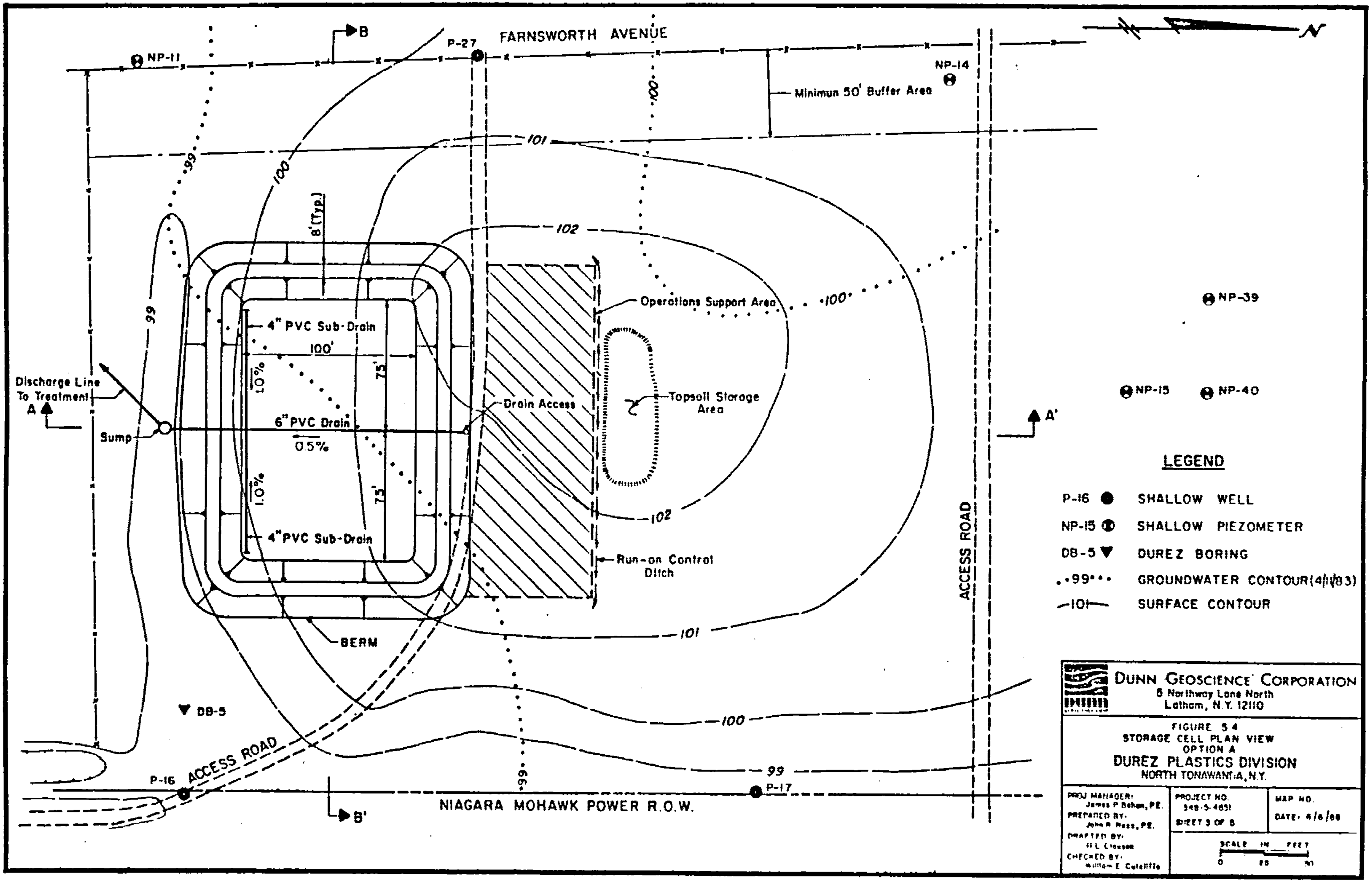
Insert Fig. 5.2



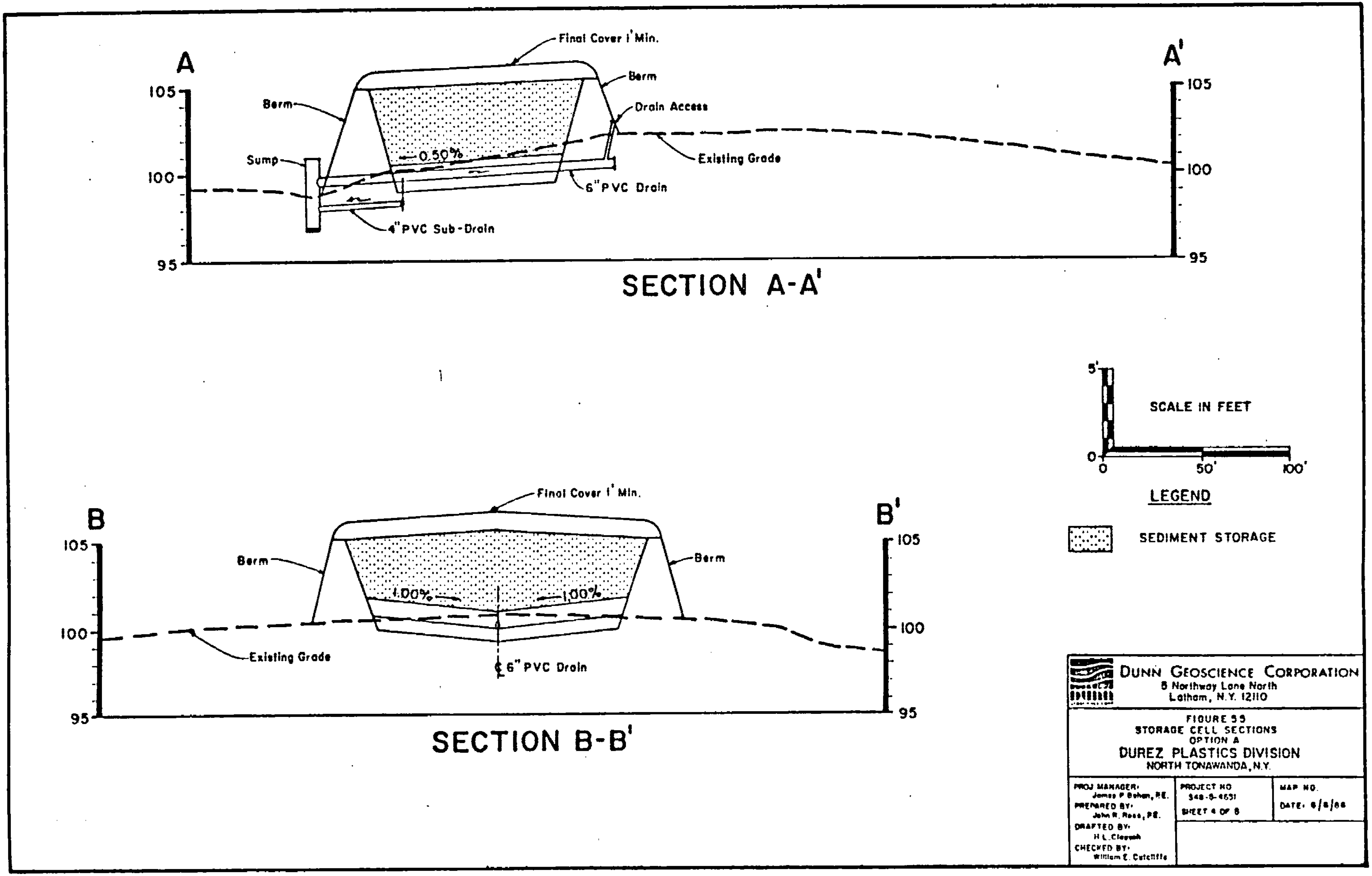
DUNN GEOSCIENCE CORPORATION
8 Northway Lane North
Latham, N.Y. 12110

FIGURE 53
INTERIM STORAGE FACILITY
SITE LOCATION MAP
DUREZ PLASTICS DIVISION
NORTH TONAWANDA, N.Y.

PROJ MANAGER: James P Bohan, P.E.	PROJECT NO 348-9-4651	MAP NO.
PREPARED BY: John R Ross, P.E.	SHEET 1 OF 5	DATE: 6/6/86
DRAFTED BY: H L [illegible]	SCALE IN FEET 0 [illegible] [illegible] 500	
CHECKED BY: William E. Cutcliffe		



FARNSWORTH AVENUE
B
B'
A
A'
N
P-27
NP-11
NP-14
NP-15
NP-39
NP-40
P-16
P-17
DB-5
Minimun 50' Buffer Area
8' (Typ.)
4" PVC Sub-Drain
100'
75'
1.0%
6" PVC Drain
0.5%
Discharge Line To Treatment
Sump
Drain Access
BERM
Operations Support Area
Topsoil Storage Area
Run-on Control Ditch
ACCESS ROAD
NIAGARA MOHAWK POWER R.O.W.
99
100
101
102
LEGEND
P-16 SHALLOW WELL
NP-15 SHALLOW PIEZOMETER
DB-5 DUREZ BORING
99 GROUNDWATER CONTOUR(4/11/83)
101 SURFACE CONTOUR
DUNN GEOSCIENCE CORPORATION
6 Northway Lane North
Latham, N.Y. 12110
FIGURE 5.4
STORAGE CELL PLAN VIEW
OPTION A
DUREZ PLASTICS DIVISION
NORTH TONAWANDA, N.Y.
PROJ MANAGER: James P Behan, P.E.
PREPARED BY: John R Ress, P.E.
CHECKED BY: William E Cutcliffe
PROJECT NO. 348-5-4651
SHEET 3 OF 8
MAP NO.
SCALE IN FEET



A
A'
105
100
95
Final Cover 1' Min.
Berm
Berm
Drain Access
Sump
0.50%
Existing Grade
6" PVC Drain
4" PVC Sub-Drain
SECTION A-A'
B
B'
Final Cover 1' Min.
Berm
Berm
1.00%
1.00%
Existing Grade
℄ 6" PVC Drain
SECTION B-B'
5'
0
0
50'
100'
SCALE IN FEET
LEGEND
SEDIMENT STORAGE
DUNN GEOSCIENCE CORPORATION
8 Northway Lane North
Latham, N.Y. 12110
FIGURE 59
STORAGE CELL SECTIONS
OPTION A
DUREZ PLASTICS DIVISION
NORTH TONAWANDA, N.Y.
PROJ MANAGER: James P Behan, P.E.
PREPARED BY: John R. Ross, P.E.
DRAFTED BY: H L Cleswh
CHECKED BY: William E. Cutcliffe
PROJECT NO 348-8-4631
SHEET 4 OF 8
MAP NO.
DATE: 6/8/86

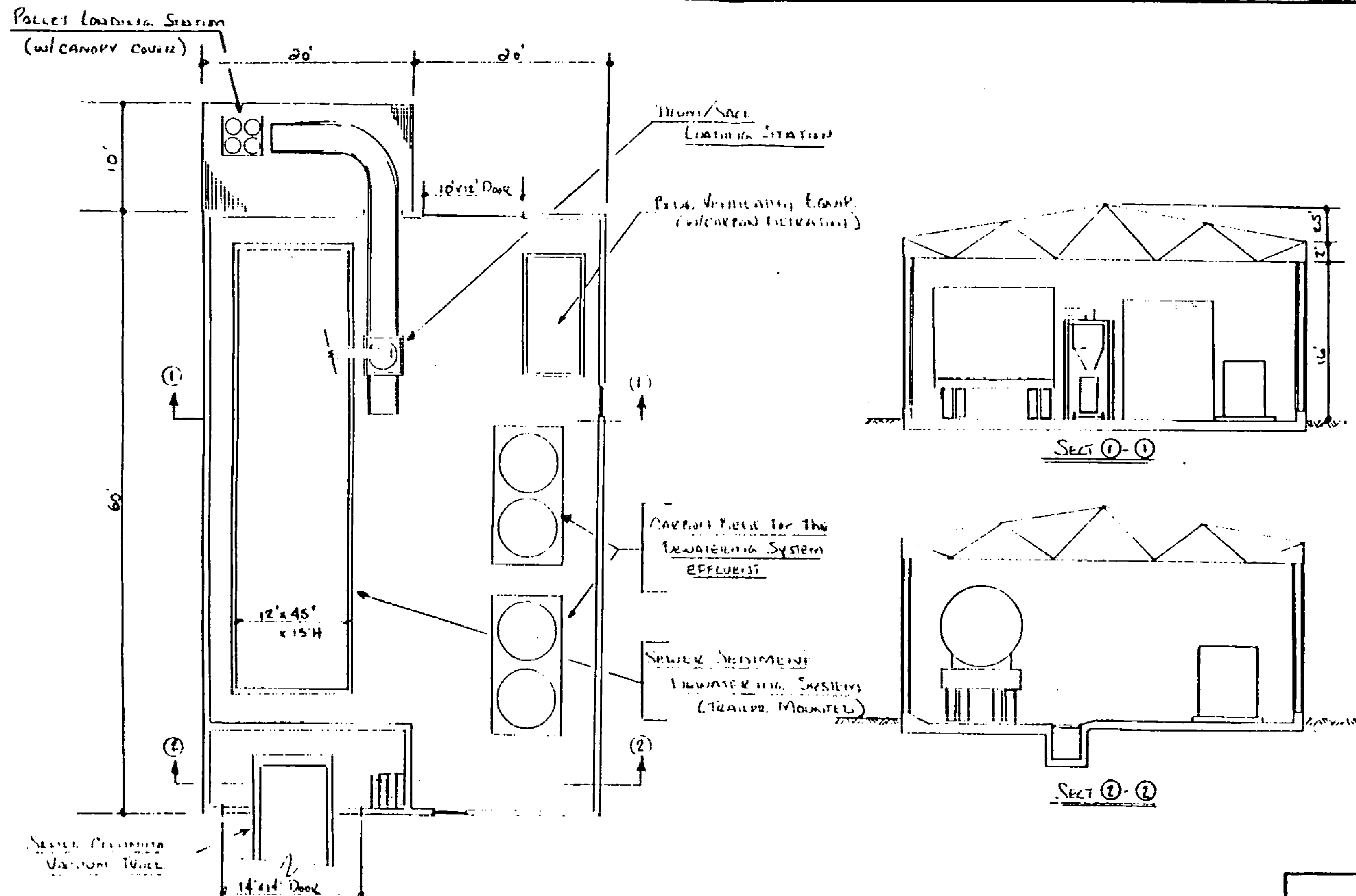


FIGURE 5.6

NO	REVISIONS	DRWN	CHKD	APP.	DATE

APPROVAL:	SOD. LDR	ENGR.	DATE
STR. AND CIVIL			
MECHANICAL			
ELECT. AND INST.			
PROCESS			
PROJECT			

DRAWN BY ________ DATE 6/86
DSGN. CAL. BY ________ DATE ________
CHECKED BY ________ DATE ________

Occidental Chemical Corporation
North Tonawanda, New York

Sewer Cleaning - Sediment Dewatering Facility Program (Option B)

SCALE 1" = 10'-0" | BLDG. NO. Yard | DWG. A-

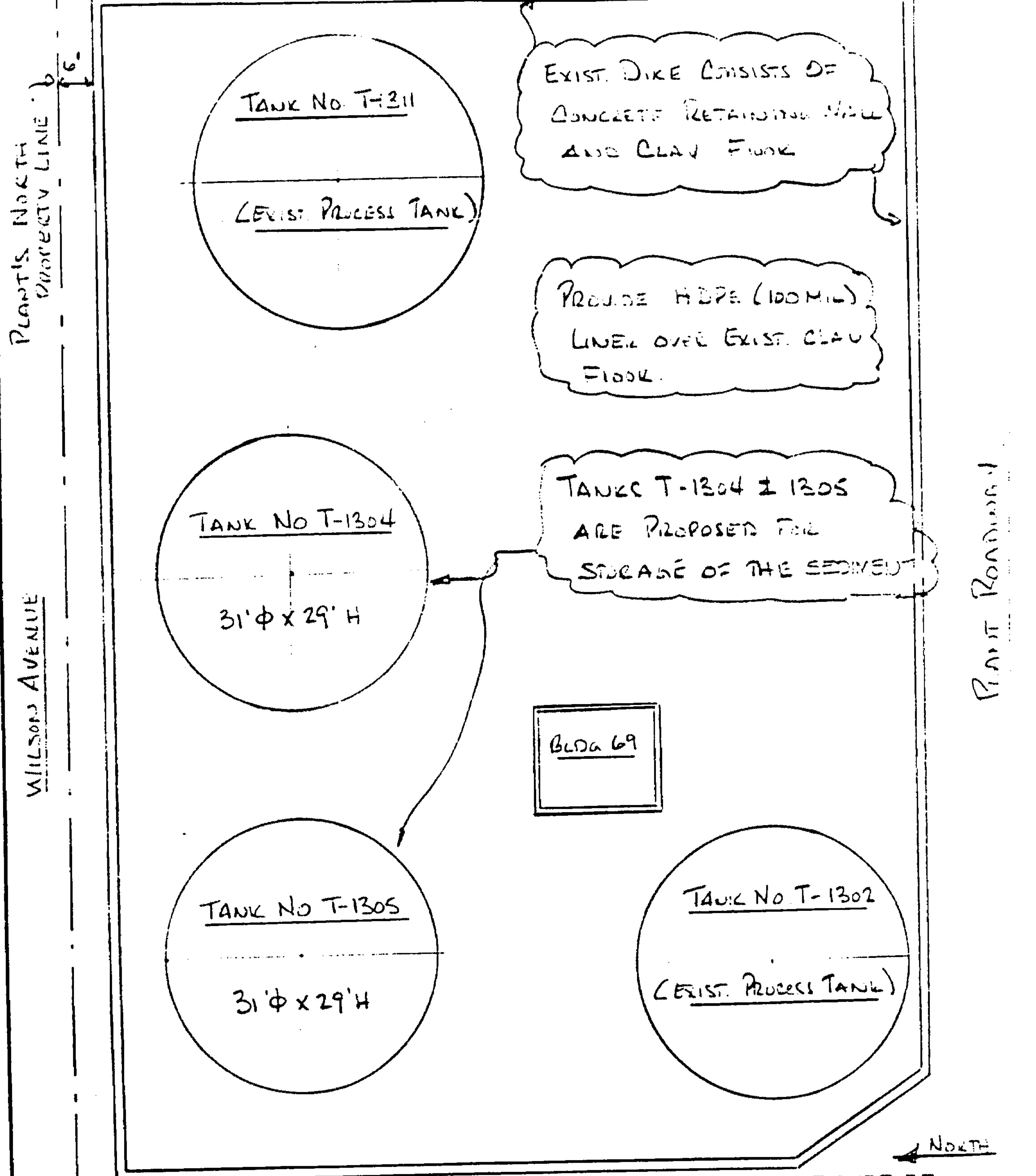


FIGURE 5.7

NO.	REVISIONS	DRWN	CHKD	APP.	DATE

DRWN BY ________ DATE ____
DSGN BY ________ DATE ____
CHKD BY ________ DATE ____
APP. ________ DATE ____

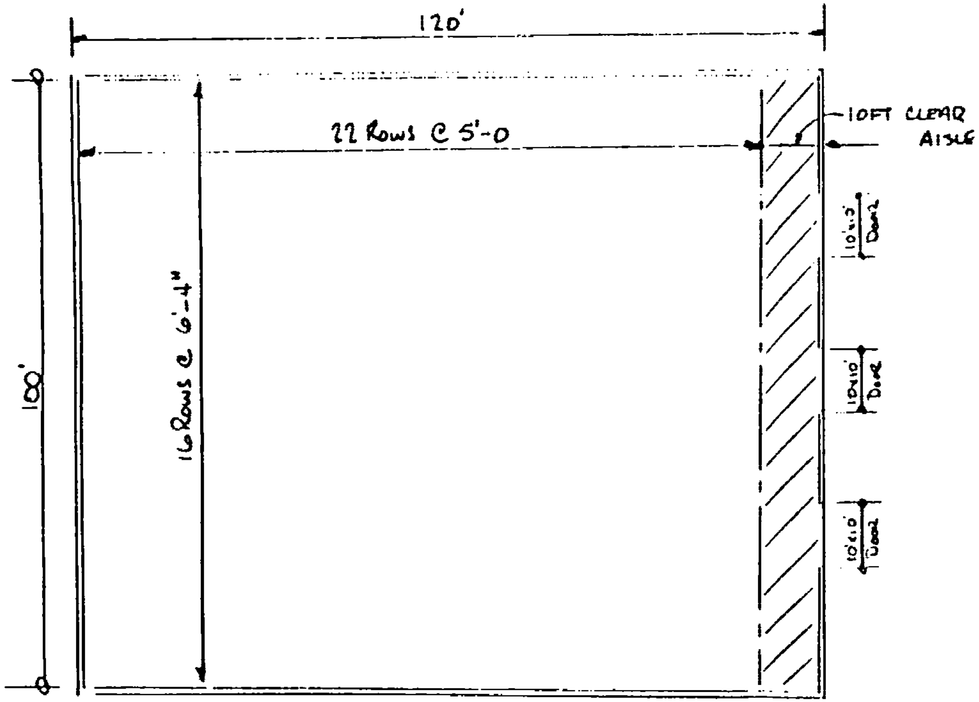
SCALE 1/16" = 1'-0"
BLDG. NO. TANK FARM

OXY OCCIDENTAL CHEMICAL CORPORATIC

TANK STORAGE FACILITY (OPTION B1)

DWG. D-

FORM G-178



PLAN

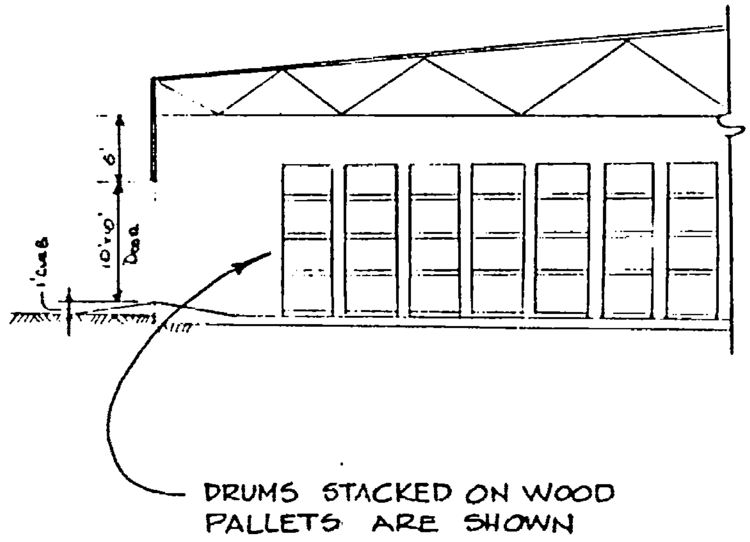


FIGURE 5.8

NO	REVISIONS	DRWN	CHKD	APP.	DATE

APPROVAL:	SOD. LDR	ENGR.	DATE
STR. AND CIVIL			
MECHANICAL			
ELECT. AND INST.			
PROCESS			
PROJECT			

DRAWN BY ______ DATE
DSGN CAL. BY ______ DATE ______
CHECKED BY ______ DATE ______

Occidental Chemical Corporation
North Tonawanda, New York

Sewer Cleaning Program - Sediment Storage Building
(Option B2)

SCALE None | BLDG NO YARD | DWG. A-

Insert Fig 6.1

Insert Fig 6.2

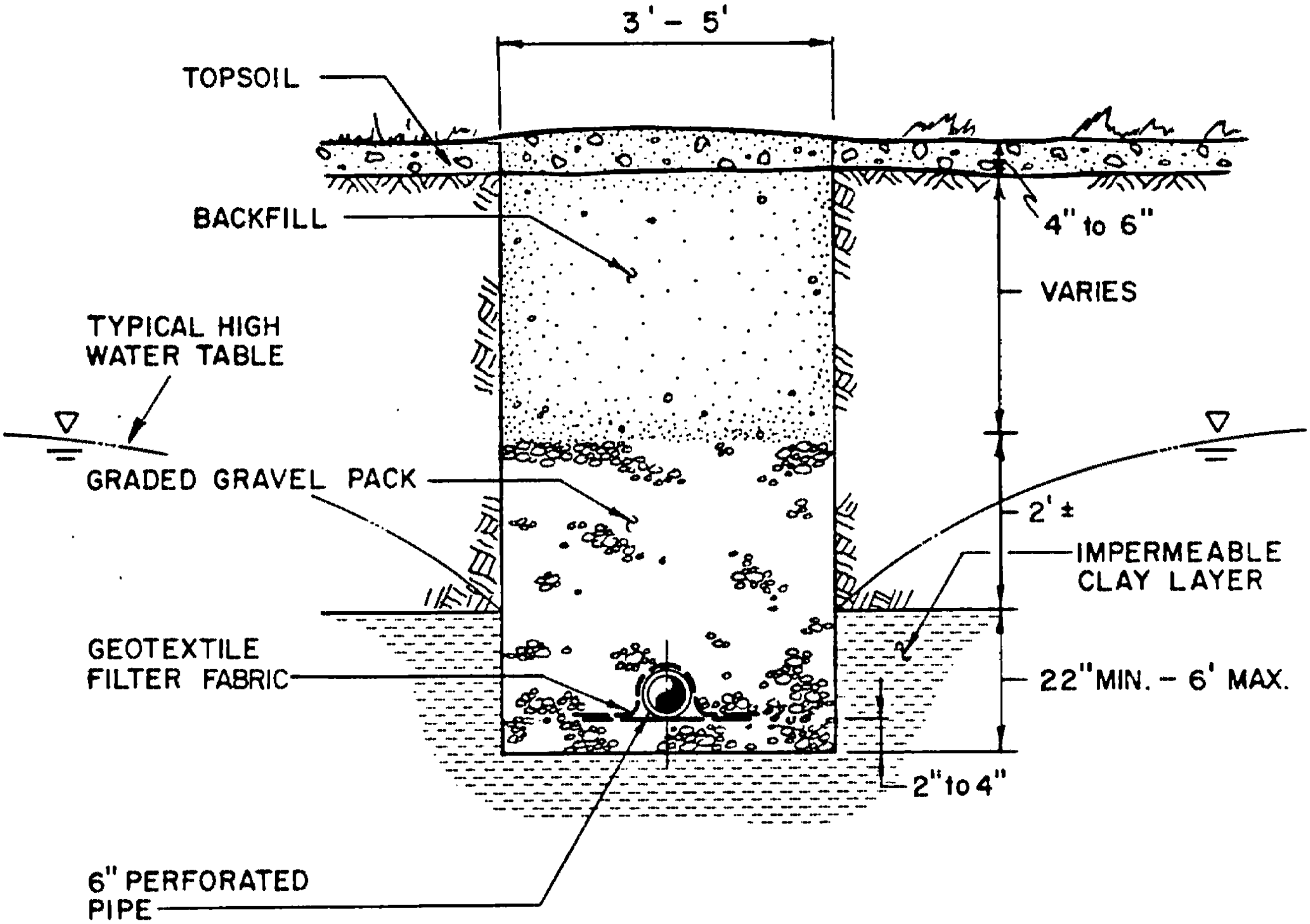
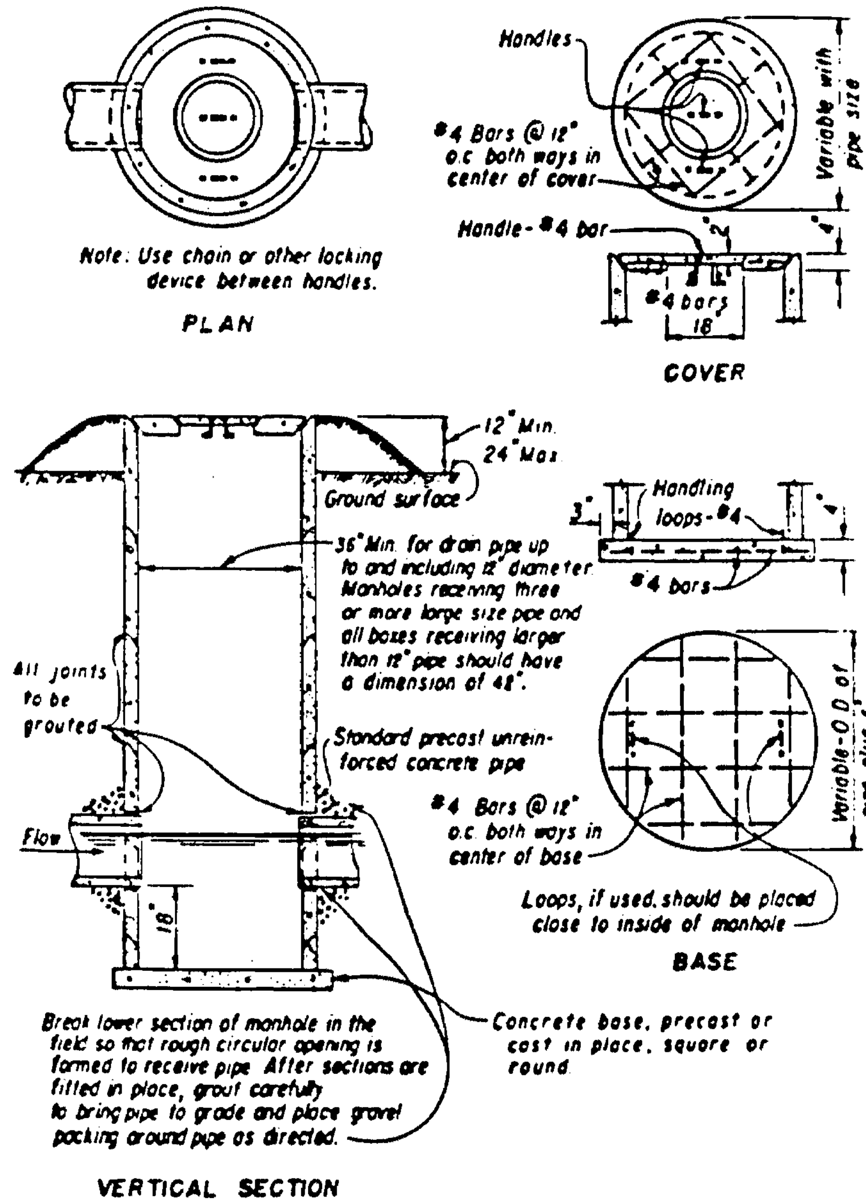


FIGURE 63

TYPICAL SECTION OF INTERCEPTOR DRAIN

NOT TO SCALE

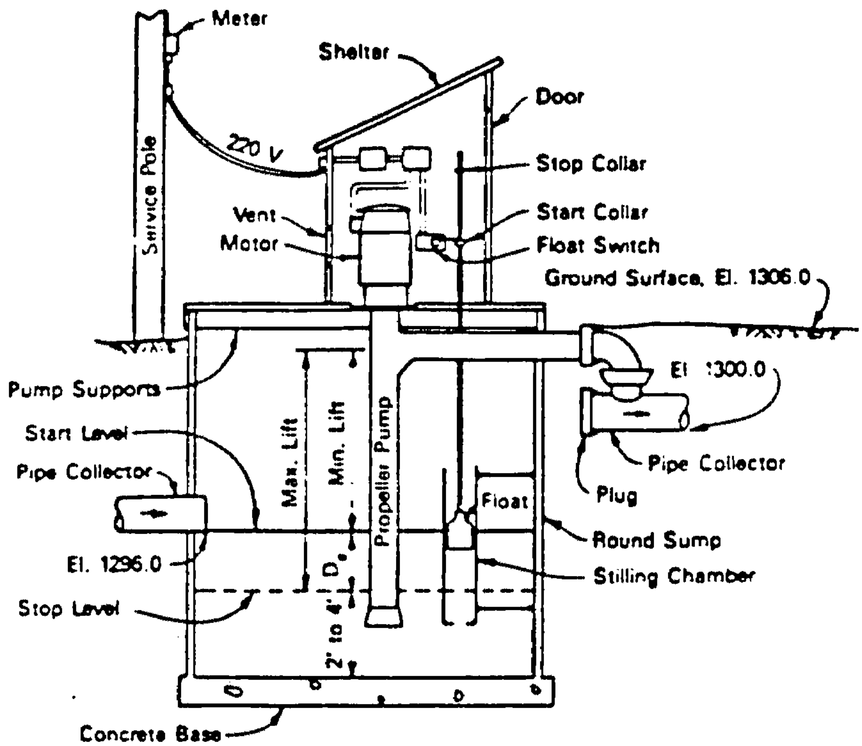
TYPICAL MANHOLE DESIGN FOR A CLOSED DRAIN



Source: Bureau of Reclamation, 1978

FIGURE 6.4

TYPICAL DESIGN OF AN AUTOMATIC DRAINAGE PUMPING PLANT



Source: Bureau of Reclamation, 1978

FIGURE 6.5

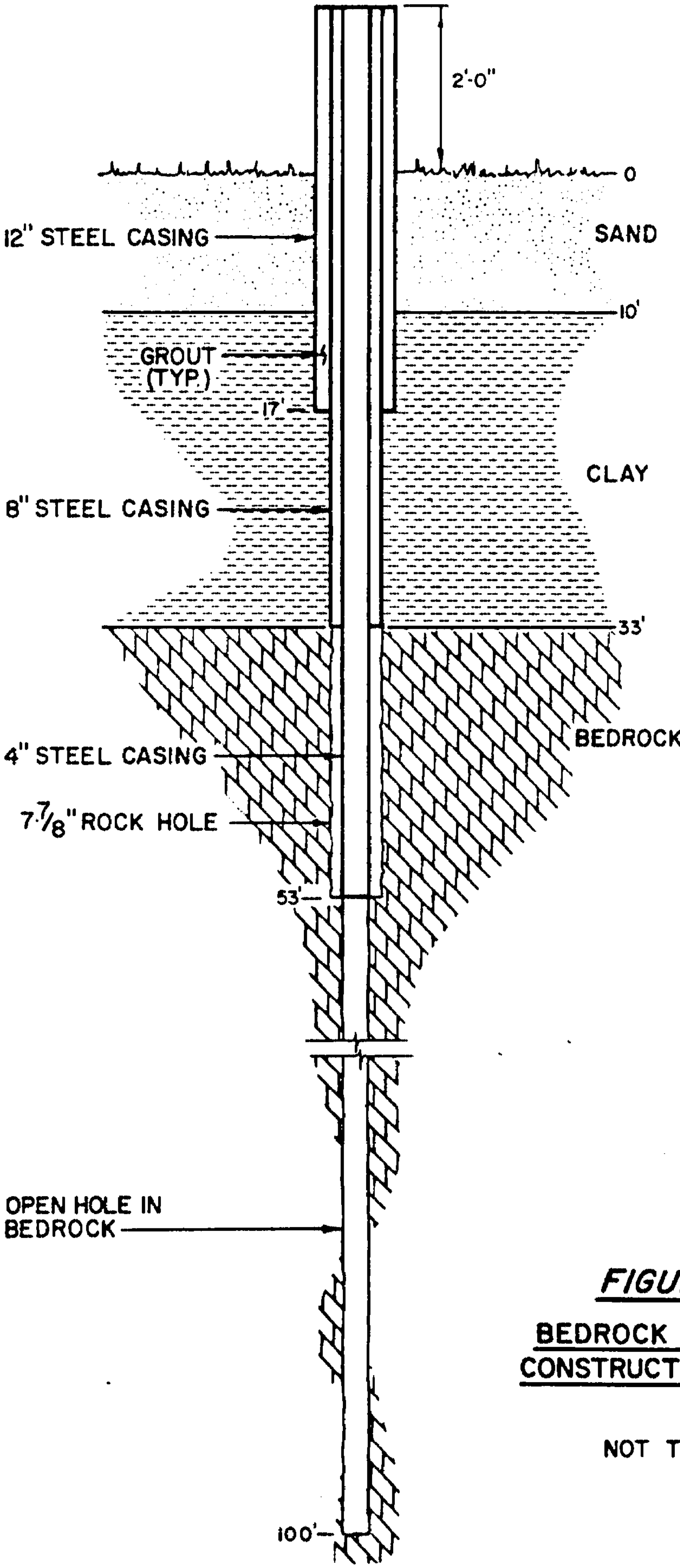


FIGURE 6.6

BEDROCK WELL DW-17
CONSTRUCTION DETAILS

NOT TO SCALE

Insert Fig 6.7

Insert Fig 6.8

Insert Fig 6.9

APPENDIX

OCCIDENTAL CHEMICAL CORPORATION
DUREZ DIVISION
NORTH TONAWANDA, NEW YORK

ENVIRONMENTAL CHEMICAL AND HYDROGEOLOGIC ANALYSES

DATA INDEX

Prepared by:

DUNN GEOSCIENCE CORPORATION
LATHAM, NEW YORK

Date:

December, 1986

OCCIDENTAL CHEMICAL CORPORATION
DUREZ DIVISION
NORTH TONAWANDA, NEW YORK

ENVIRONMENTAL CHEMICAL AND HYDROGEOLOGIC ANALYSES

DATA INDEX

The following data index has been prepared to assist the reader in locating specific chemical and hydrogeologic information concerning environmental analyses at the Durez Facility of the Occidental Chemical Corporation.

A large amount of data has been reported in several major investigations by OCC or its consultants. This data has been here categorized by specific analytical parameters and the associated hydrogeologic components to which they were applied, at the times indicated by the reports in which the information is found. A bibliography of these reports and a key to their identification follows.

Specific methodologies or descriptions of sampling and analytical protocols have not been included in this index. Such information can be gathered from appropriate sections of the various reports and from a May, 1982, report entitled "Protocols for Sampling and Analysis of Groundwater, Storm Sewers and Soil Under 'Appendix B' of the Consent Order."*

*Consent order refers to the Order on Consent entitled, "In the Matter of a Field Investigation Pursuant to Article 27, Title 13 of the State of New York by HOOKER CHEMICALS & PLASTICS CORP."

BIBLIOGRAPHY

1. Hydrogeologic Investigation
   Durez Division
   Hooker Chemicals and Plastics Corp.
   Walck Road, North Tonawanda
   Niagara County, New York
   1980

   Prepared by: Recra Research Inc. and Wehran Engineering, P.C., October 1980

2. Subsurface Investigation Report on Shallow Piezometers and Wellpoints
   Hooker Durez Division
   North Tonawanda, New York

   Prepared by: Empire Soils Investigations, Inc., November 1981

3. Report of Continuing Field Investigations - Summer 1982

   Section I: Introduction, Summary and Conclusions
   Section II: Hydrogeology
   Section III: Sampling and Analytical Chemistry

   Prepared by: Occidental Chemical Corporation, November 1982

4. Report of Continuing Field Investigations and Exposure Assessment - 1983

   Section I: Introduction, Summary and Conclusions
   Section II: Hydrogeology
   Section III: Sampling and Analytical Chemistry

   Prepared by: Occidental Chemical Corporation, January 1984

5. Report of Continuing Field Investigations and Exposure Assessment - 1983

   New York State Comments and Requests for Clarification
   OCC Response

   Prepared by: Occidental Chemical Corporation, March 1984

6. Report of Continuing Field Investigations and Exposure Assessment - 1984

   Section I: Introduction, Conclusions, Exposure Assessment and Site Operations
   Section II: Hydrogeology
   Section III: Sampling and Analytical Chemistry

   Prepared by: Occidental Chemical Corporation, July 1984

7. Report of Continuing Field Investigations and Exposure Assessment

   Site Operation Plan
   Clay Integrity Report

   Prepared by: Dunn Geoscience Corporation, August 1984

8. Report of Continuing Field Investigations and Exposure Assessment

   Site Operation Plan
   Clay Integrity
   Final Report

   Prepared by: Dunn Geoscience Corporation, November 1984

9. Site Remediation Program and Alternatives Considered for 889 Lee Avenue

   Prepared by: Dunn Geoscience Corporation, March 1985

10. Site Operations Plan
    Investigation of the Durez Area
    Storm and Sanitary Sewers

    Prepared by: Dunn Geoscience Corporation, October 1985; Revised November 1985

11. Report of Continuing Field Investigations
    Report on Site Operations Plan - Summer 1984

    Bedrock Aquifer
    Off-Site Soil Survey
    Panhandle Surface Investigation
    889 Lee Avenue

    Prepared by: Occidental Chemical Corporation and Dunn Geoscience Corporation, February 1986

12. Report of Continuing Field Investigations
    North Panhandle Hydrogeologic/Analytical Program

    Prepared by: Occidental Chemical Corporation, June 1986

13. Report of Continuing Field Investigations
    Phase 1 Report/Durez Area Sewer Investigation

    Prepared by: Occidental Chemical Corporation, July 1986

14. Report of Continuing Field Investigations
    Phase 2 Report/Durez Area Sewer Investigation

    Prepared by: Occidental Chemical Corporation, September 1986

KEY FOR BIBLIOGRAPHY

No.	Abbreviation
1	Recra 80
2	Empire 81
3	SUMR 82
4	CONT INV 83
5	RESPONSE
6	CONT INV 84
7	CLAY INTG 84
8	CLAY FINAL 84
9	889 LEE
10	SOP SEW 85
11	SOP 86
12	PAN 86
13	Ph 1 SEW 86
14	Ph 2 SEW 86

KEY FOR ABBREVIATIONS

p	= page	Cl	= Chloride
T	= Table(s)	TDS	= Total Dissolved Solids
Fg	= Figure(s)	OKN	= Organic Kjeldahl Nitrogen
		TON	= Total Organic Nitrogen
PL	= Plate(s)	GC/MS	= Gas Chromatrography/Mass Spectroscopy
Appx	= Appendix		

NOTE: In some of the report appendices, several memos from OCC Research Center are included with analytical information. If all such memos in a given appendix do not apply to the data index section specifically being researched, then the appropriate memo is identified by its date of submittal.

DATA INDEX
TABLE OF CONTENTS

DATA INDEX

1.0 SHALLOW AQUIFER CHARACTERISTICS

1.1 Soil Boring Logs

- Recra 80 - Appx B, Appx C
- Empire 81 - Appx B
- SUMR 82 - Section II Appx
- CONT INV 83 - Section II Appx A
- CONT INV - Section III, Section 1.0, T 1.1, p 3 - Soil Compositing Summary
- CLAY INTG 84 - Appx
- CLAY FINAL 84 - Appx A
- PAN 86 - Appx B

1.2 Boring Locations

- Recra 80 - Map 1
- Empire 81 - Appx A
- SUMR 82 - Section II, PL 4.1
- CONT INV 83 - Section I, Fg 4.1, p 29
- CONT INV 83 - Section II, Fg 2.1, p 24
- CONT INV 83 - Section III, Section 1.0, Fg 1.1, p 6
- CLAY INTG 84 - Fg 1
- CLAY FINAL 84 - Fg 1
- PAN 86 - Appx A, Fg 1

1.3 Groundwater Level and Flow Data

1.3.1 Tabular Data - Groundwater Level Elevations

- Recra 80 - Appx F
- SUMR 82 - Section II, T 5.2, p 31-32
- CONT INV 83 - Section II, Appx B
- PAN 86 - T 3.1

1.3.2 Groundwater Level Contour and Divide Maps

- Recra 80 - May 6 (GWL)
- SUMR 82 - Section I, Fg 2.2, p 6 (GWL/Divide)
- SUMR 82 - Section II, Fg S.1, p V (GWL)
- CONT INV 83 - Fg 4.1-4.15, p 29-43 (GWL)
- CONT INV 83 - Fg 4.16-4.20, p 44-48 (Divide)
- CONT INV 84 - Section II, Section 1.0, 6 Maps (GWL)
- PAN 86 - Fg 5-25

1.3.3 Groundwater Level Hydrographs

- SUMR 82 - Fg 5.1, p 36
- CONT INV 83 - Section II, Appx C
- CONT INV 84 - Section II, Part 2.0

1.3.4 Hydraulic Conductivity

- SUMR 82 - p 28
- RESPONSE - p 5; p 23, 24

1.4 Stratigraphy
- Recra 80 - Fg 4, p 23
- SUMR 82 - Section II, T 3.1, p 8
- SUMR 82 - Section II, T 5, p 23
- CONT INV 83 - Section II, Fg 3.2, p27/Sand & Gravel Contour Map
- CONT INV 83 - Section II, Fg 3.3, p 28/Sand & Gravel Isopach Map
- PAN 86 - Fg 3/Sand & Gravel Contour Map
- PAN 86 - Fg 4/Sand & Gravel Isopach Map

1.5 Analytical Chemistry - Groundwater

1.5.1 Data Summaries
- SUMR 82 - Section I, T 5.1, p 40
- CONT INV 83 - Section III, T 11, p 7-8
- CONT INV 84 - Section I, T 3.4, p 17
- CONT INV 84 - Section III, T I

1.5.2 Other Parameters
- Recra 80 - T 4, p 49-60 (Chlorobenzenes only)
- SUMR 82 - Section III, T 4.1.1-4.1.4, p 339-342
- SUMR 82 - Section III, T 4.5, 4.6, p 346, 347 (Duplicate Analyses)
- SUMR 82 - Section III, T 4.7.1, 4.7.2 p 348, 349 (Filtered vs. Non Filtered)
- SUMR 82- Section III, T 4.8, 4.9, 4.11, p 350, 351, 353 (Extraction Efficiency Validation)
- CONT INV 83 - Section III, T 3.1-3.8, p 9-16
- CONT INV 83 - Section III, T 3.11-3.13, p 19-21 (Duplicate Analyses)
- CONT INV 83 - Section III, T 3.15-3.19, p 23-27 (Spike Recoveries)
- CONT INV 83 - Section III, Appx 3B, T I (12/8/83)
- CONT INV 84 - Section III, Appx 2A, T I-V (4/2/84)
- PAN 86 - T 6.1-6.3, Appx C

1.5.3 Phenols
- Recra 80 - T 4, p 49-60
- SUMR 82 - Section III, T 2.1.0, p 176
- CONT INV 83 - Section III, T 1, p 6
- CONT INV 83 - Section III, Appx 5A, T 1, 8/1/83 & 11/2/83
- CONT INV 84 - Section III, Appx 2C, T I
- PAN 86 - T 6.1-6.3, Appx C

1.5.4 pH and Conductivity
- Recra 80 - T 4, p 49-60
- SUMR 82 - Section III, t 1.2, P 14
- CONT INV 83 - Section III, T 1.2, p 4-5
- PAN 86 - T 6.1-6.3, Appx C

1.5.5 Total Organic Carbon
- SUMR 82 - Section III, T 4.1.1-4.1.4, p 339-342
- CONT INV 83 - Section III, Appx 3C, T 1-3 (10/3/83) and T I (11/14/83)
- CONT INV 84 - Section III, Appx 2B
- PAN 86 - T 6.1-6.3, Appx C

1.5.6 Miscellaneous Wet Chemistry
- SUMR 82 - Section III, T 2.1.0, p 176 (Cl, TDS)
- CONT INV 83 - Section III, T 2.1, p 2 (Cl, TDS, OKN)
- CONT INV 83 - Section III, Appx 2A (Cl, TDS, OKN)
- CONT INV 83 - Section III, Appx 5A, T 2 (Formaldehyde) (8/1/83 & 11/2/83)
- CONT INV 84 - Section III, Appx 2C, T II (Formaldehyde)
- CONT INV 84 - Section III, Appx 2D (Cl, TDS, OKN)
- PAN 86 - T 6.2-6.3, Appx C

1.6 Analytical Chemistry - Soils

1.6.1 Data Summaries
- SUMR 82 - Section I, T 5.1, p 40
- CONT INV 83 - Section III, T II, p 7-8

1.6.2 Tetrachlorodibenzodioxins (TCDD)
- SUMR 82 - Section I, Fg 2.4, p 9 (Map)
- SUMR 82 - Section I, Fg 5.2-5.4, p 43-45 (Chromatograms)
- SUMR 82 - Section III, T 3.1, p 202
- SUMR 82 - Section III T 3.5, 3.6, p 206, 207
- SUMR 82 - Section III, Fg 3.1-3.14, p 213-226 (Chromatograms)
- SUMR 82 - Section III, Fg 3B.2-3B.11, p 306-316 (Chromatograms)
- SUMR 82 - Section III, Fg I-III, p 5-7 (Isomer Pattern Comparison)
- SUMR 82 - Section III, Fg 3B.22, p 327
- CONT INV 83 - Section III, T 4.4-4.6, p 14-16
- CONT INV 83 - Section III, p 17 (Chromatogram)
- CONT INV 83 - Section III, Table 1.1, p 3 (Compositing Summary)
- CONT INV 84 - Section I, T 3.2, p 12-13 (Sub-surface)
- CONT INV 84 - Section I, Fg 3.2, p 10 (Sampling sites)
- CONT INV 84 - Section III, Appx 3C

2.0 CLAY (AQUICLUDE) CHARACTERISTICS

2.1 Clay Boring Logs
- Recra 80 - Appx B
- CLAY FINAL 84 - Appx A

2.2 Boring Locations
- Recra 80 - Map
- CLAY FINAL 84 - Fg 1

2.3 Stratigraphy
- Recra 80 - Fg 4, p 23
- Recra 80 - Map 5, Contour Map, Top of clay
- SUMR 82 - Section II, T 3.1, p 8
- SUMR 82 - Section II, T 5.1, p 23
- CONT INV 83 - Section II, Fg 3.1, p 26/Contour Map, Top of Clay
- CLAY INTG 84 - Section 3.4
- CLAY FINAL 84 - Section 4.4
- PAN 86 - Fg 2 (Clay Contour)

2.4 Hydraulic Conductivity and Permeability
- Recra 80 - T 3, p 36 and 37
- Recra 80 - Appx E
- CLAY INTG 84 - Section 3.6, T 1
- CLAY FINAL 84 - Sections 1.1 and 3.4, T 1
- CLAY FINAL 84 - Appx E/Empire Reports

2.5 Analytical Chemistry

2.5.1 Chlorobenzenes and Chlorophenols
- CLAY FINAL 84 - Sections 1.9 and 3.5 (Descriptive)
- CLAY FINAL 84 - Appx 6

3.0 BEDROCK AQUIFER CHARACTERISTICS

3.1 Bedrock Boring Logs
- Recra 80 - Appx B and Map 4 (Geologic Cross Section)

3.2 Boring Locations
- Recra 80 - Map 1

3.3 Stratigraphy
- Recra 80 - Fg 4, p 23
- Recra 80 - p 22-25
- SUMR 82 - Section II, p 9-12
- SUMR 82 - Section II, T 3.1, p 8
- SUMR 82 - Section II, T 5.1, p 23

3.4 Analytical Chemistry

3.4.1 Data Summaries
- Recra 80 - T 4, p 62-62
- Recra 80 - p 68 (descriptive)

- SUMR 82 - Section I, T 5.1, p 40
- SUMR 82 - Section III, p 2
- CONT INV 83 - Section I, T II, p 18
- CONT INV 83 - Section II, Section 4.2, p 9 (descriptive)
- CONT INV 83 - Section III, T II, p 8
- SOP 86 - Section 2.0, T A/B

3.4.2 Chlorobenzenes
- Recra 80 - T 4, p 61-62
- SOP 86 - Section 2.0, T 1-14, Fg 1

3.4.3 Phenols
- Recra 80 - T 4, p 61-62
- SOP 86 - Section 2.0, T 1, 7, 8

3.4.4 pH and Conductivity
- Recra 80 - T 4, p 61-62
- SOP 86 - Section 2.0, T B, Fg 2-4

4.0 SURFACE/NEAR SURFACE SOILS

4.1 Sampling Locations
- CONT INV 84 - Section I, Fg 3.2, p 10 (TCDD)
- CONT INV 84 - Section III, Fg 1
- 889 LEE - Fg 2a
- SOP 86 - Section 3.0, T 3.1, Fg 3.1 and Pocket Map
- SOP 86 - Section 4.0, Fg 3.2, 3.3 and Pocket Map

4.2 Analytical Chemistry

4.2.1 Data Summaries
- CONT INV 84 - Section I, T 3.3.1, p 14
- CONT INV 84 - Section III, T II
- 889 LEE - T 2.3 (Physical characteristics)
- 889 LEE - T 2.1 (Chlorobenzenes)
- SOP 86 - Section 3.0, T 1
- SOP 86 - Section 4.0, T 2.3, 2.4

4.2.2 Tetrachlorodibenzodioxins
- CONT INV 84 - Section I, T 3.2, p 11

4.2.3 Chlorophenols
- CONT INV 84 - Section III, Appx 3A (All tables)
- 889 LEE - T 2.8-2.10
- SOP 86 - Section 3.0, T 1, Attachment B
- SOP 86 - Section 4.0, T 4.7-4.9, 4.11

4.2.4 Chlorobenzenes
- CONT INV 84 - Section III, Appx 3B (All tables)
- 889 LEE - T 2.2
- 889 LEE - T 2.4 (GC/MS)

- 889 LEE - T 2.5-27 (Quality Assurance)
- 889 LEE - Fg 2.1-2.3 (GC/MS Chromatograms)
- SOP 86 - Section 3.0, T 1, Attachment B
- SOP 86 - Section 4.0, T 4.4-4.6, 4.10

4.2.5 Spent Catalyst Pellets
- CONT INV 83 - Section III, Appx 6B

5.0 SURFACE WATER

5.1 Sampling Locations
- CONT INV 83 - Section II, p 49 (Surface Water Flow)
- CONT INV 83 - Section III, Section 6.2, p 1
- SOP 86 - Section 4.0, Fg 3.1 and Pocket Map

5.2 Analytical Chemistry
- CONT INV 83 - Section III, Apx 6A
- SOP 86 - Section 4.0, T 2.1, 2.2, 4.1, 4.2, 4.3

6.0 SEWERS

6.1 Sewer Sampling Sites and Flow
- SUMR 82 - Section I, Fg 2.4, p 9
- CONT INV 83 - Section I, Fg 5.2.1
- CONT INV 83 - Section II, Fg 2.1, p 24
- CONT INV 83 - Section II, Fg 4.23, p 51 (Sanitary Sewer Flow)
- Ph 1 SEW 86 - Appx B, Fg B-1; T 2.1 (Storm Sewers)
- Ph 1 SEW 86 - Appx B, Fg B-2; T 3.1 (Sanitary Sewers)
- Ph 2 SEW 86 - Appx B, PL 1; T 2.1 (Storm Sewers)
- Ph 2 SEW 86 - Fg 3-1 (Inlet)

6.2 Analytical Chemistry - Sewer Water

6.2.1 Data Summaries
- SUMR 82 - Section I, T 5.1, p 40
- CONT INV 83 - Section I, T 5.2.1 (Outfall Data)

6.2.2 Other Parameters
- SUMR 82 - Section III, T 4.2, p 343
- SUMR 82 - Section III, T 4.6, p 347 (Chlorophenols)
- SUMR 82 - Section III, T 4.10, p 352 (Chlorobenzenes)
- CONT INV 83 - Section I, T 4.5, p 34

6.2.3 Phenols
- SUMR 82 - Section III, T 2.2.1, p 177

6.2.4 Tetrachlorodibenzodioxins
- SUMR 82 - Section I, Fg 5.5, p 46 (Isomer Pattern Comparison)
- SUMR 82 - Section III, T 3.2, p 203
- SUMR 82 - Section III, Fg 3.15,p 227 (Chromatogram)

6.2.5 Total Organic Carbon
- SUMR 82 - Section III, T 4.2, p 343

6.2.6 Miscellaneous Wet Chemistry
- SUMR 82 - Section III, T 2.1.1, p 177 (Cl and TDS)
- SUMR 82 - Section III, T 4.4, p 345 (Particulates)

6.3 Analytical Chemistry - Sewer Sediment

6.3.1 Tetrachlorodibenzodioxin
- SUMR 82 - Section III, T 3.3, p 204
- SUMR 82 - Section III, T 3.8, p 209 (Recovery Data)
- Ph 2 SEW 6 - T 2.5; Appx D-1

6.3.2 Chlorophenols
- SUMR 82 - Section III, T 4.3, p 344

6.3.3 Other Parameters
- Ph 1 SEW 86 - T 2.3, T 2.4, Appx D-1 (Storm Sewers)
- Ph 1 SEW 86 - T 3.3, Appx D-2 (Sanitary Sewers)
- Ph 2 SEW 86 - T 2.3, 2.4; Appx D-1 (Storm sewer)
- Ph 2 SEW 86 - T 3.2; Appx D-2 (Inlet)

7.0 SEWER BEDDING PIEZOMETERS

7.1 Boring Logs
- Empire 81 - Appx B
- CONT INV 83 - Section II, Appx A

7.2 Piezometer Locations
- Empire 81 - Appx A
- CONT INV 83 - Section II, Fg 2.1, p 24
- CONT INV 83 - Section II, Fg 2.2, p 25
- CONT INV 83 - Section III, Fg 1.2, p 7

7.3 Water Levels
- RESPONSE - T 2.1, p 12

7.4 Analytical Chemistry

7.4.1 Data Summaries
- CONT INV 83 - Section I, T II, p 18
- CONT INV 83 - Section II, T II, p 8

7.4.2 Other Parameters
- CONT INV 83 - Section III, T 3.9, 3.10, 3.14/p 17, 18, 22
- CONT INV 83 - Section III, Appx 3B, T I, II (GC/MS) (11/17/83)

7.4.3 Total Organic Carbon
- CONT INV 83 - Section III, Appx 3C, T I (11/14/83)

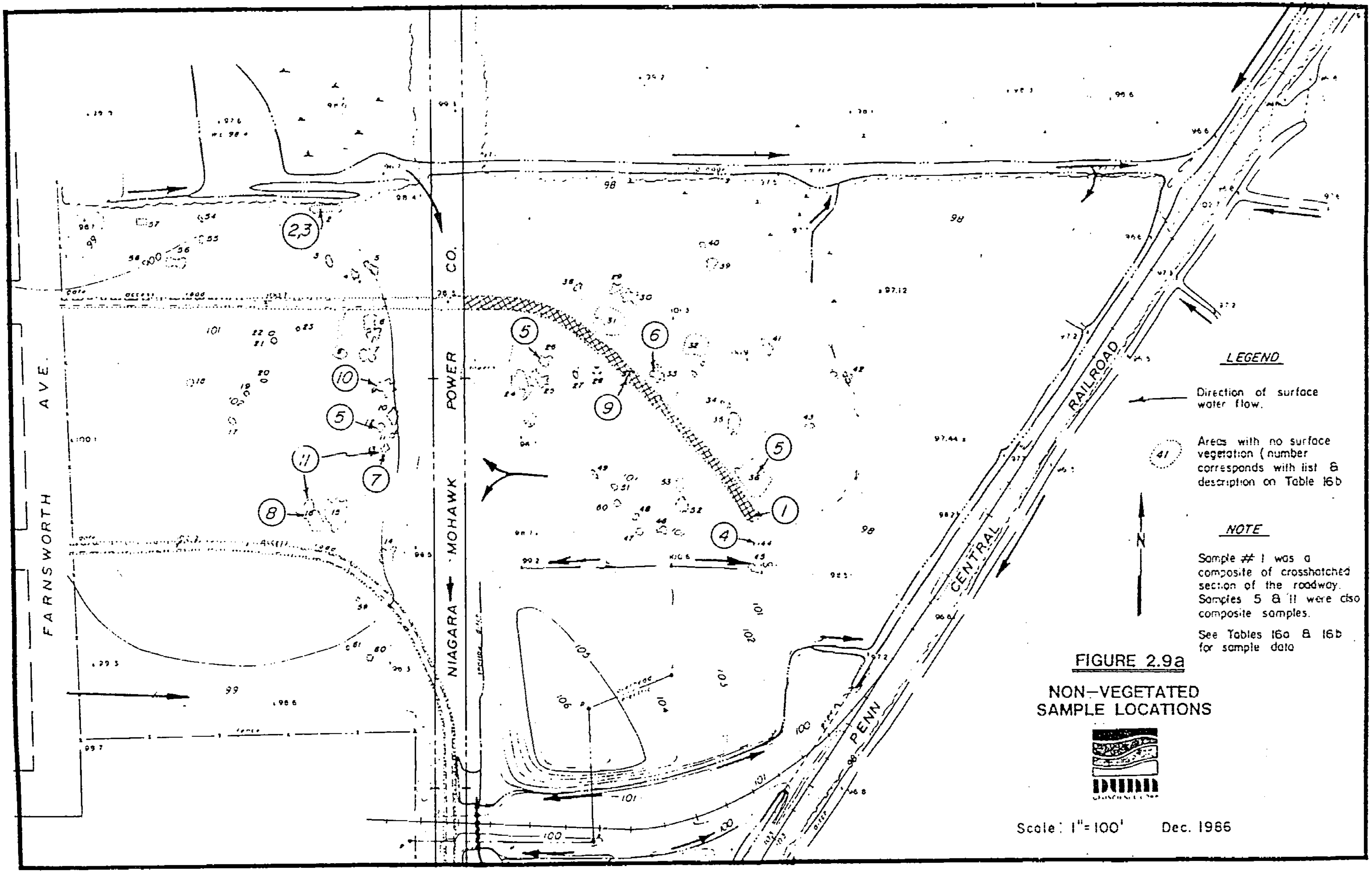


FIGURE 2.9a

NON-VEGETATED SAMPLE LOCATIONS

Scale: 1"=100' Dec. 1986

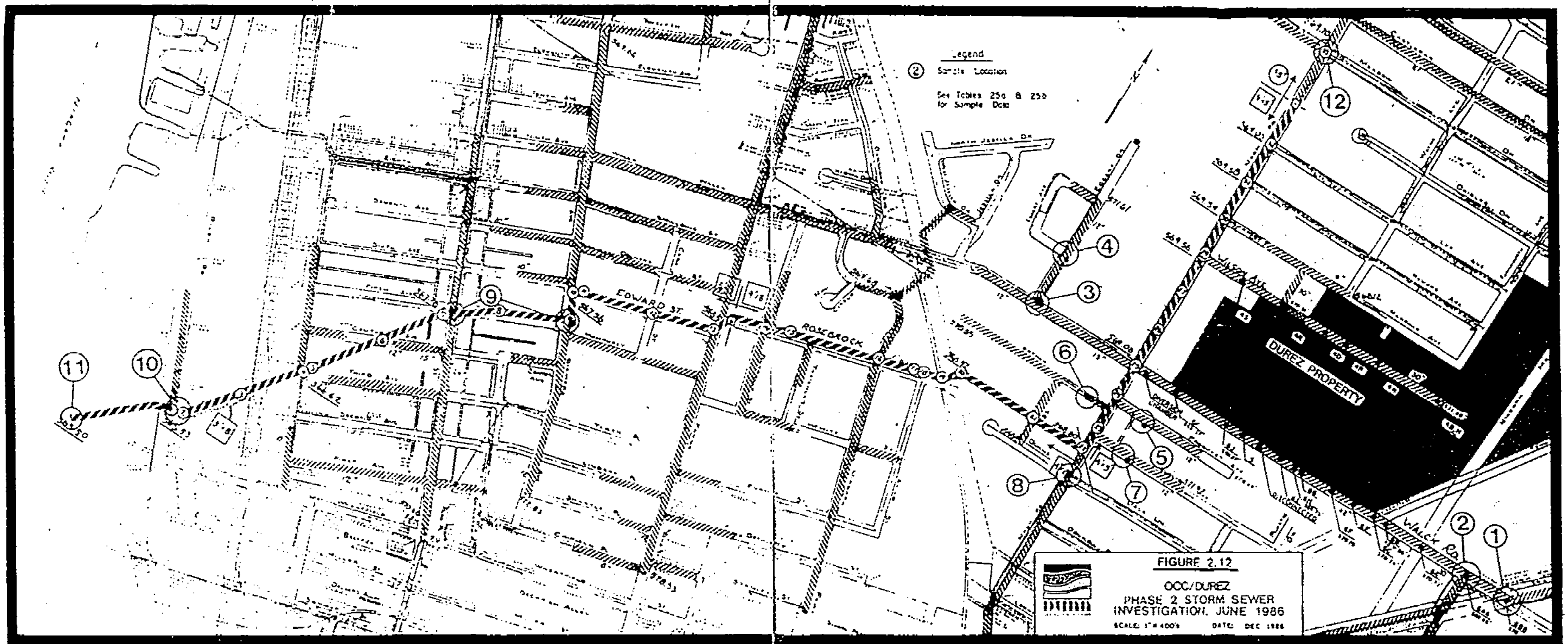
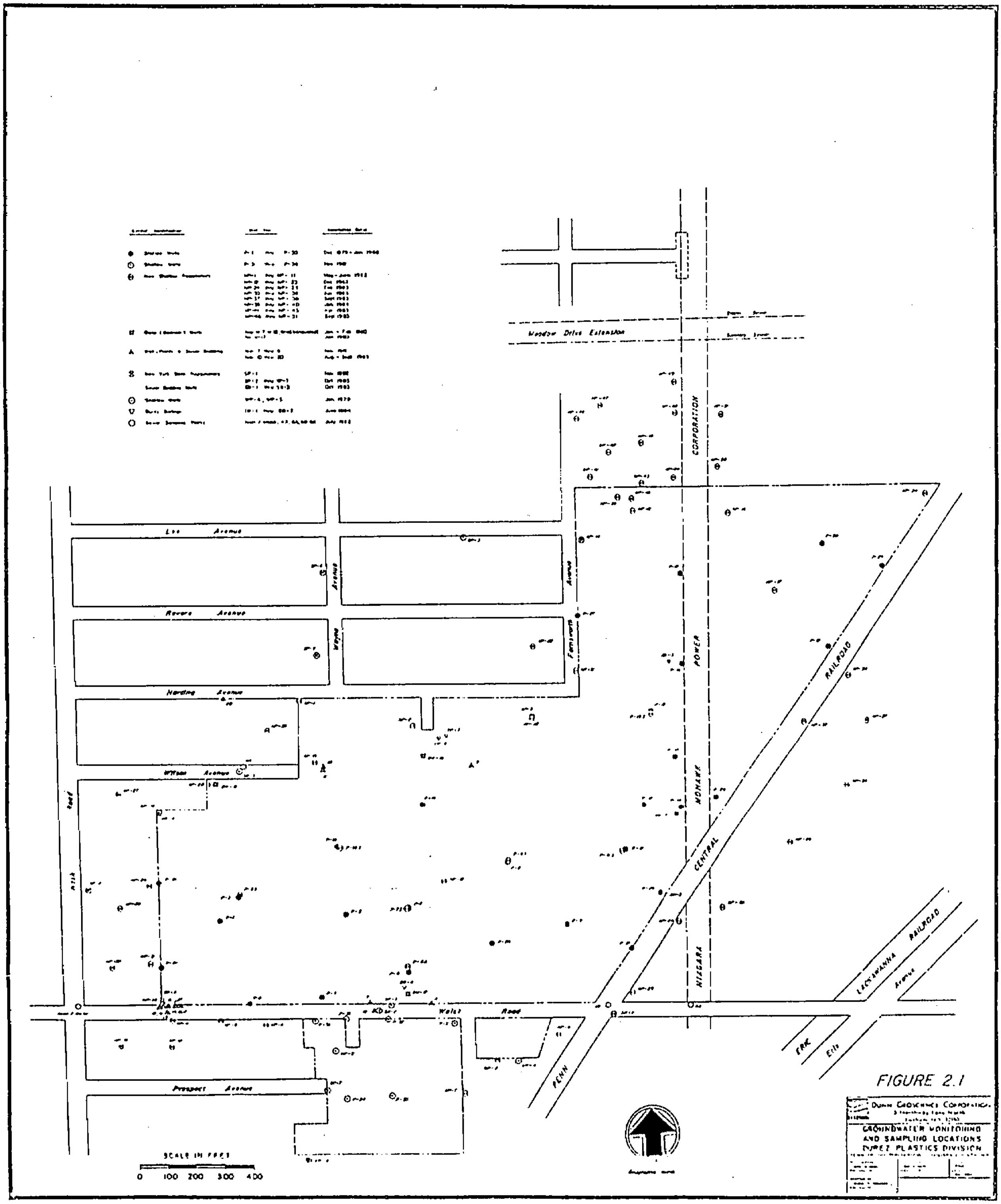


FIGURE 2.12

OCC/DUREZ
PHASE 2 STORM SEWER
INVESTIGATION, JUNE 1986

SCALE: 1"=400' DATE: DEC 1986



Lee Avenue
Revere Avenue
Harding Avenue
Wilson Avenue
Walck Road
Prospect Avenue
Wayne Avenue
Farnsworth Avenue
Meadow Drive Extension
CORPORATION
NIAGARA MOHAWK POWER CORPORATION
NEW YORK CENTRAL RAILROAD
PENN
ERIE
LACKAWANNA RAILROAD
SCALE IN FEET
0 100 200 300 400
Dunn Geoscience Corporation
GROUNDWATER MONITORING AND SAMPLING LOCATIONS DUREZ PLASTICS DIVISION

FIGURE 2.1

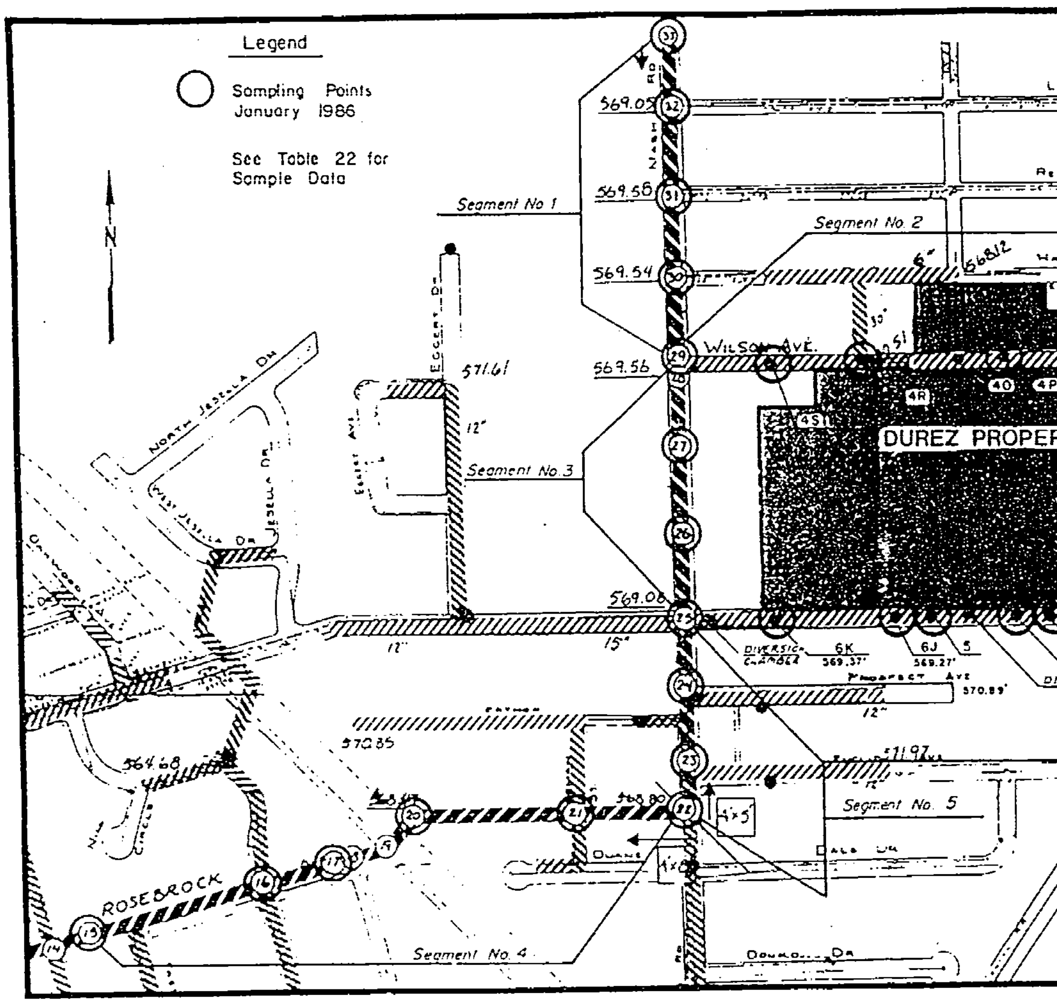


FIGURE 2.10
OCC/DUREZ
PHASE 1 STORM SEWER
INVESTIGATION, JAN. 1986
Dec 1986 Scale: 1" = 400'

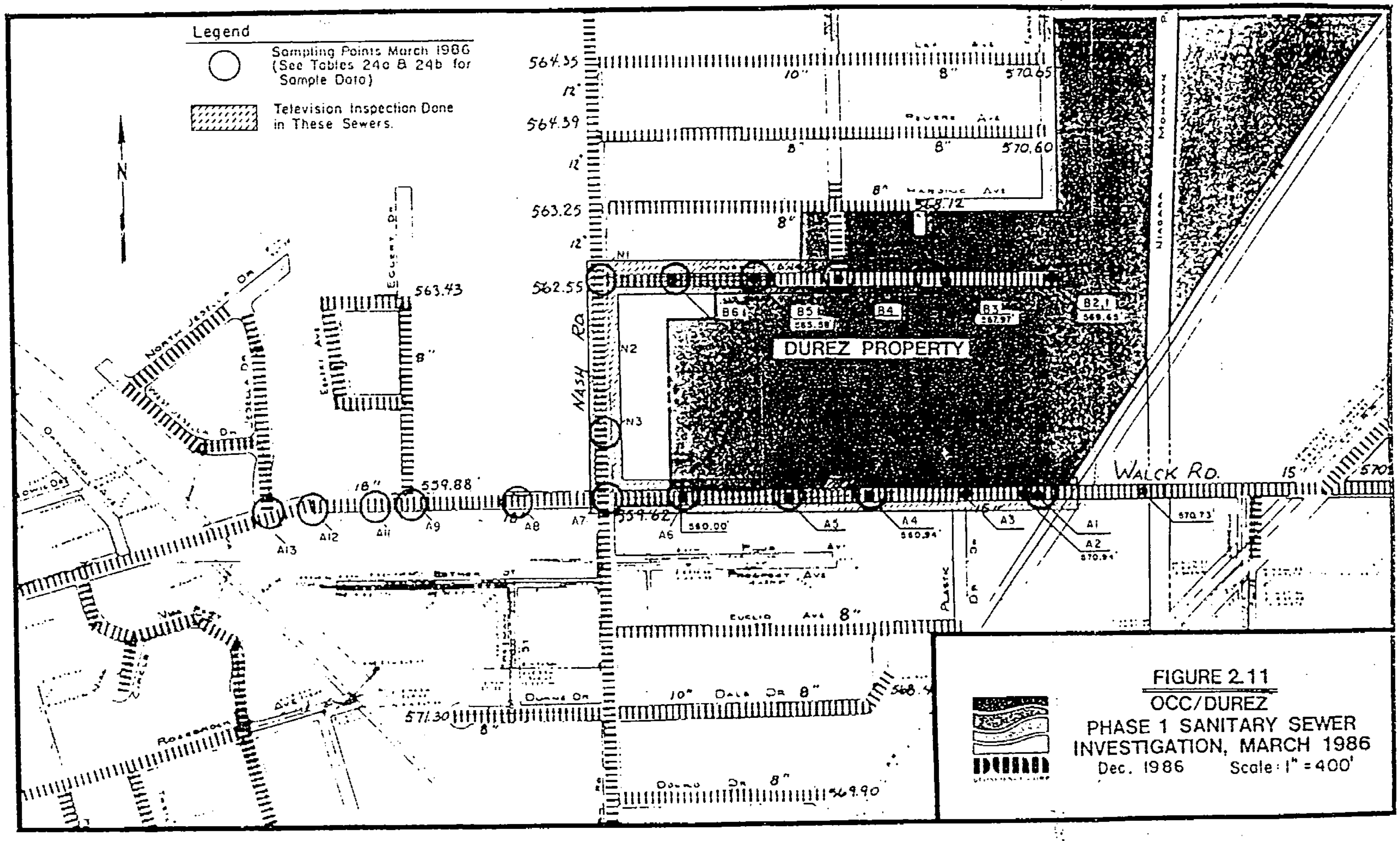


FIGURE 2.11
OCC/DUREZ
PHASE 1 SANITARY SEWER INVESTIGATION, MARCH 1986
Dec. 1986 Scale: 1" = 400'

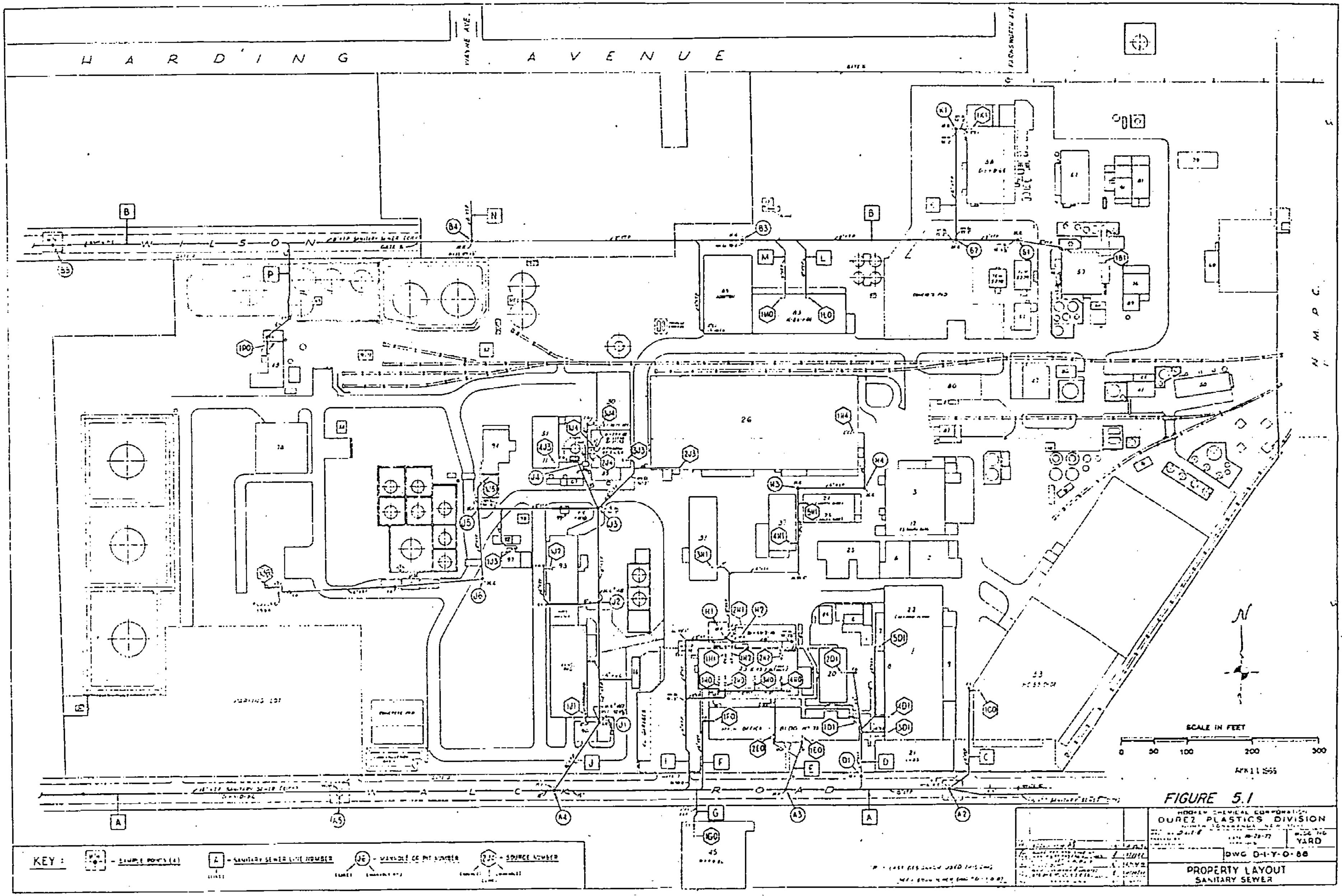

H A R D I N G   A V E N U E
W I L S O N
W A L C K   R O A D
N. M. P. C.
N
PARKING LOT
SCALE IN FEET
0 50 100 200 300
KEY:
- SAMPLE POINTS
- SANITARY SEWER LINE NUMBER
- MANHOLE OR PIT NUMBER
- SOURCE NUMBER
HOOKER CHEMICAL CORPORATION
DUREZ PLASTICS DIVISION
YARD
DWG D-1-Y-0-88
PROPERTY LAYOUT
SANITARY SEWER

FIGURE 5.1

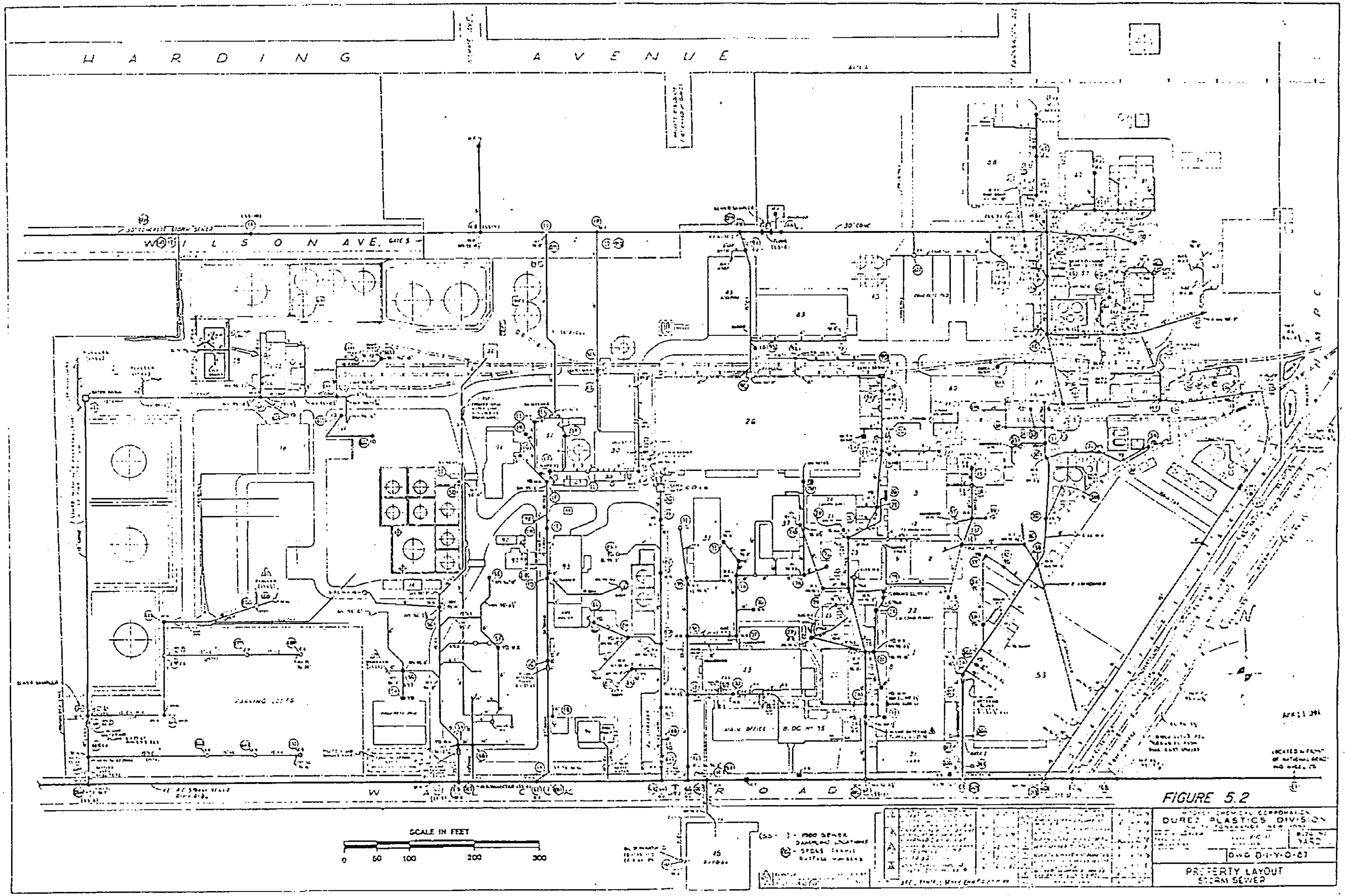

HARDING AVENUE
WILSON AVE.
26
53
PARKING LOTS
MAIN OFFICE
SCALE IN FEET
0 50 100 200 300
DUREZ PLASTICS DIVISION
YARD
DWG D-I-Y-O-87
PROPERTY LAYOUT
STORM SEWER

FIGURE 5.2

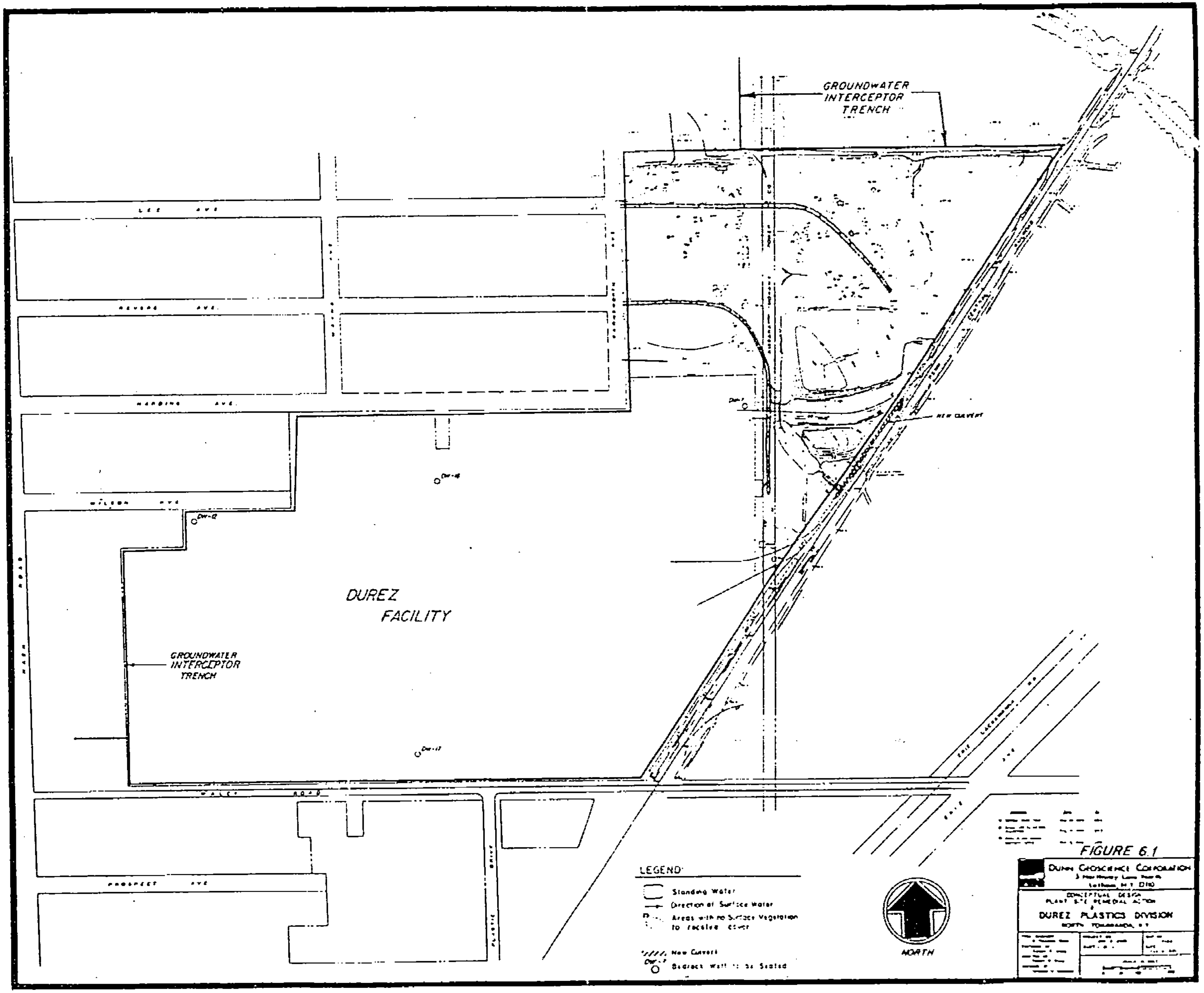
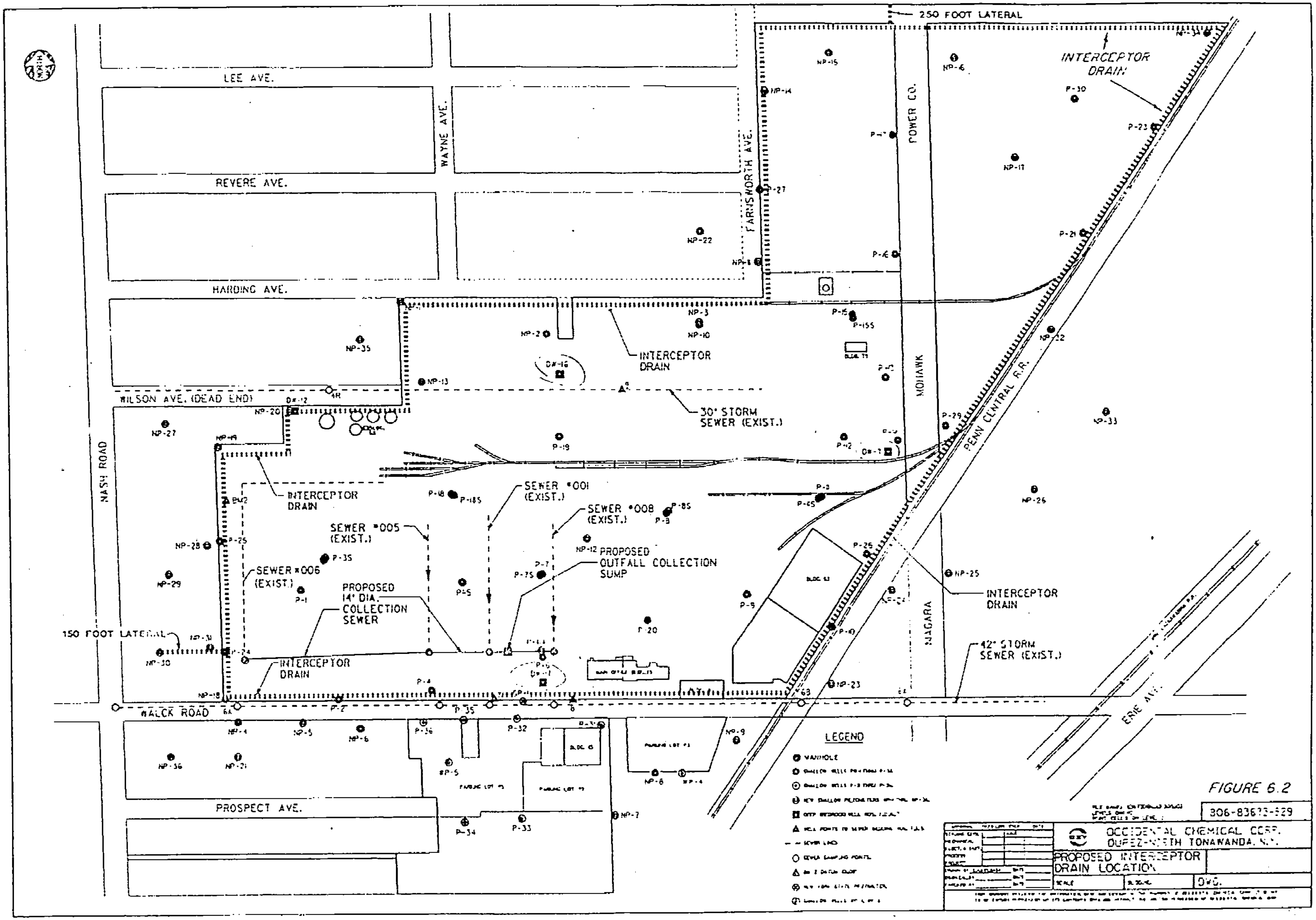
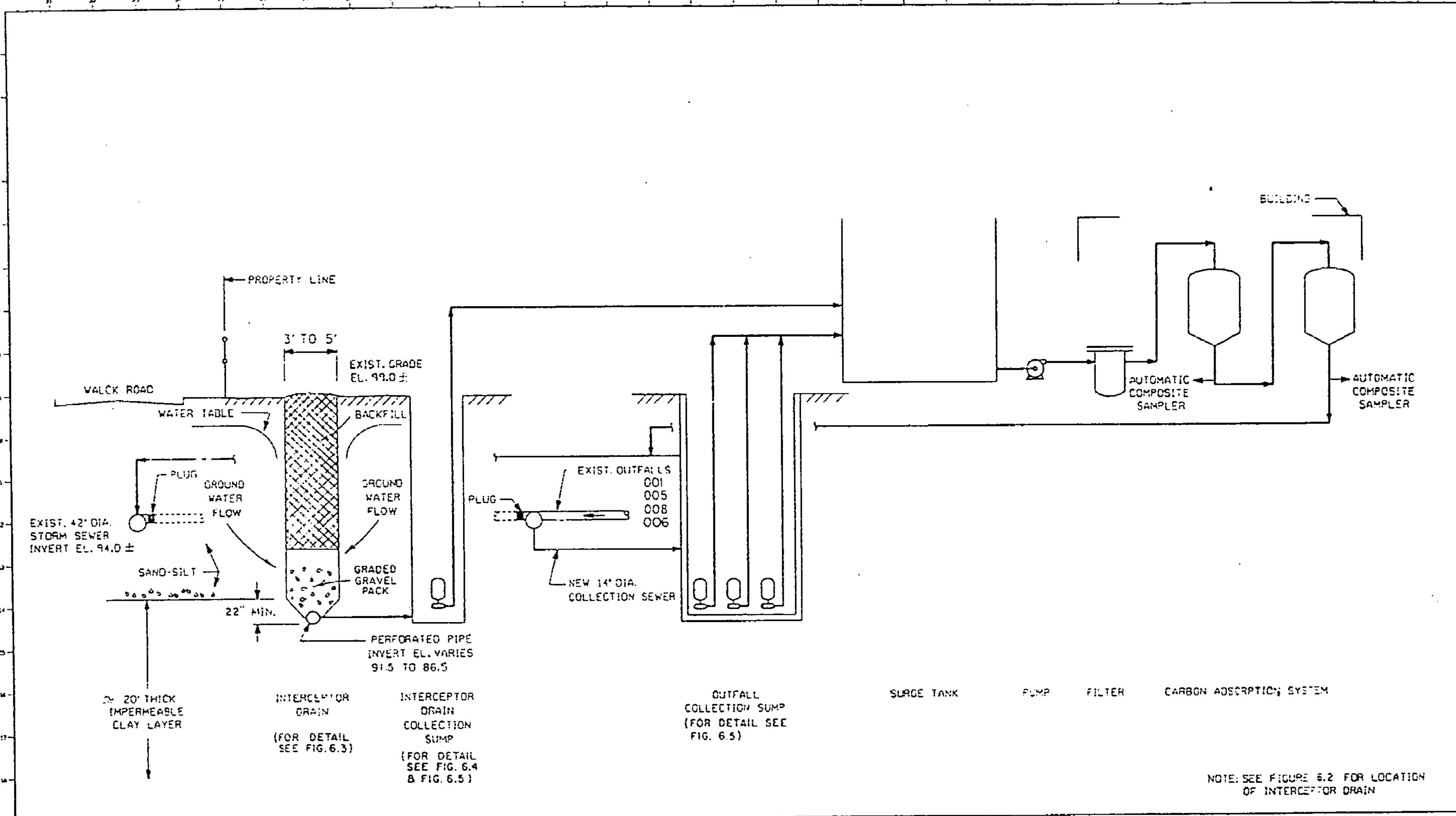

GROUNDWATER INTERCEPTOR TRENCH
LEE AVE
REVERE AVE
HARDING AVE
WILSON AVE
NEW CULVERT
DUREZ FACILITY
GROUNDWATER INTERCEPTOR TRENCH
WALCK ROAD
PROSPECT AVE
LEGEND
Standing Water
Direction of Surface Water
Areas with no Surface Vegetation to receive cover
New Culvert
Bedrock Well to be Sealed
NORTH
DUNN GEOSCIENCE CORPORATION
CONCEPTUAL DESIGN
PLANT SITE REMEDIAL ACTION
DUREZ PLASTICS DIVISION
NORTH TONAWANDA, N.Y.

FIGURE 6.1



250 FOOT LATERAL
INTERCEPTOR DRAIN
LEE AVE.
REVERE AVE.
HARDING AVE.
WILSON AVE. (DEAD END)
WAYNE AVE.
FARNSWORTH AVE.
POWER CO.
MOHAWK
NIAGARA
NASH ROAD
WALCK ROAD
PROSPECT AVE.
ERIE AVE.
PENN CENTRAL R.R.
30" STORM SEWER (EXIST.)
SEWER #001 (EXIST.)
SEWER #008 (EXIST.)
SEWER #005 (EXIST.)
SEWER #006 (EXIST.)
PROPOSED 14" DIA. COLLECTION SEWER
PROPOSED OUTFALL COLLECTION SUMP
150 FOOT LATERAL
42" STORM SEWER (EXIST.)
LEGEND
FIGURE 6.2
306-83673-529
OCCIDENTAL CHEMICAL CORP.
DUREZ-NORTH TONAWANDA, N.Y.
PROPOSED INTERCEPTOR DRAIN LOCATION



REVISIONS

OCCIDENTAL CHEMICAL CORP.
DUREZ DIVISION
NORTH TONAWANDA, N.Y.

DWG

GROUNDWATER CONTROL AND TREATMENT

FIGURE 6.7

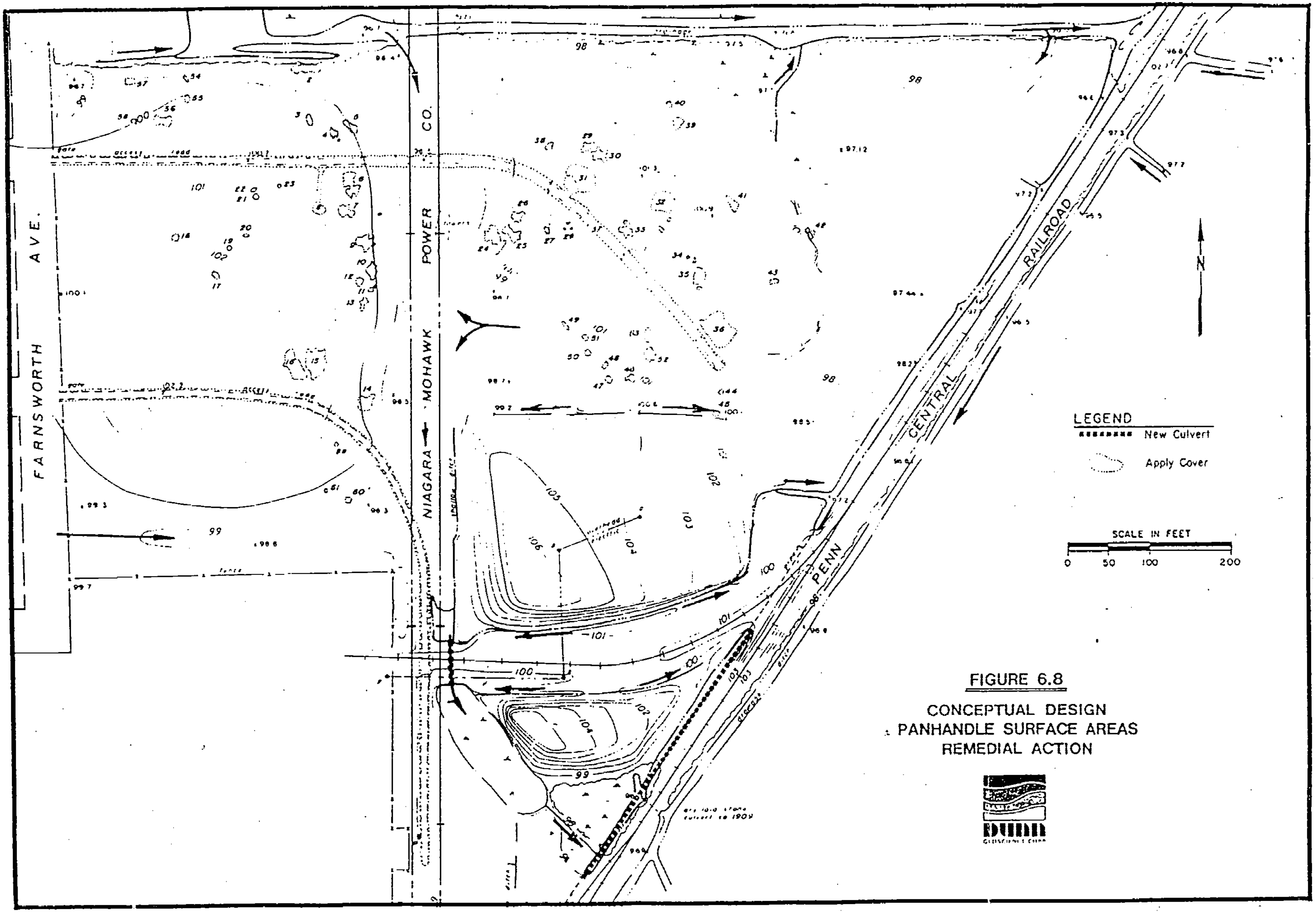


FIGURE 6.8

CONCEPTUAL DESIGN
PANHANDLE SURFACE AREAS
REMEDIAL ACTION

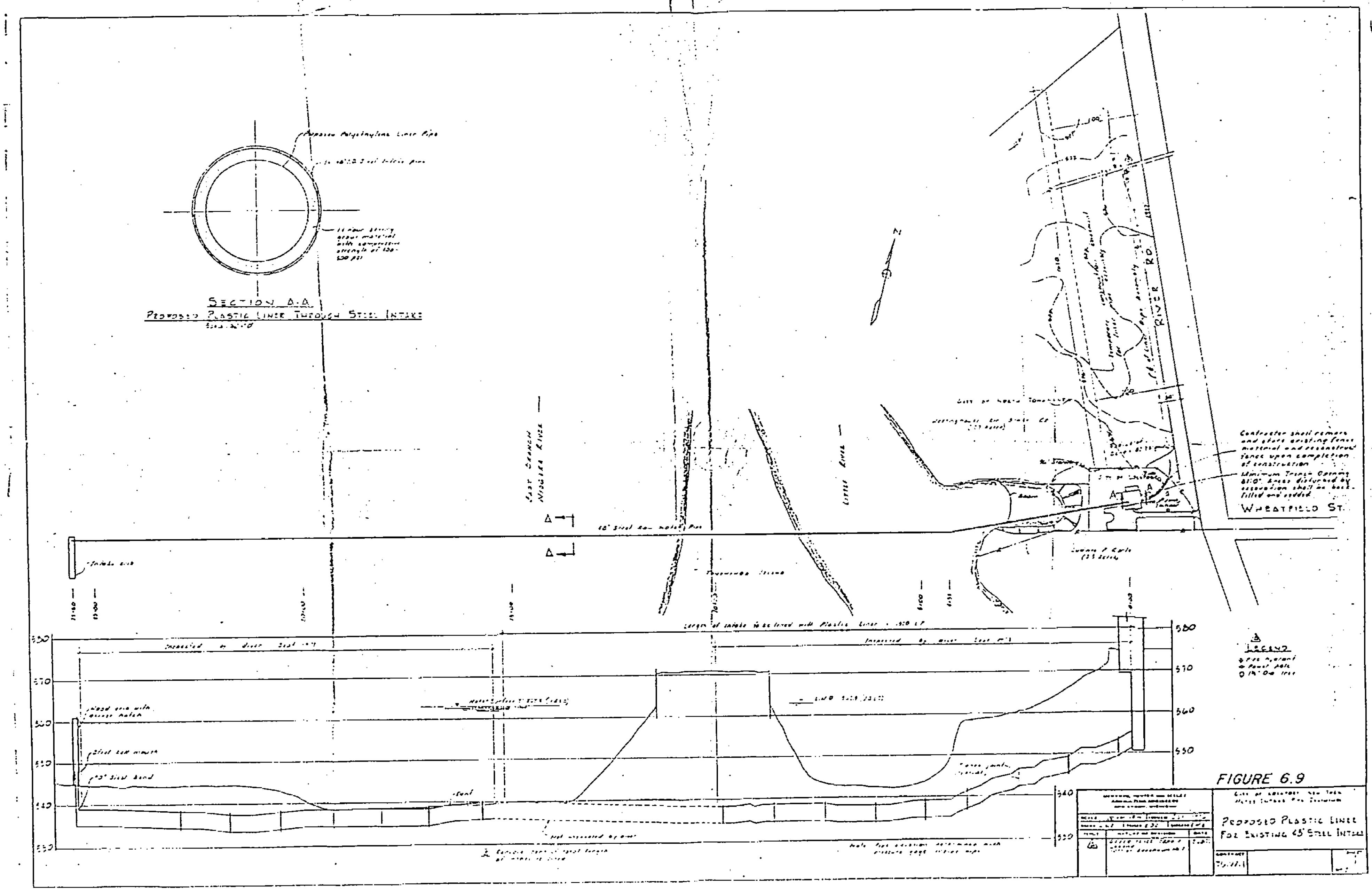

SECTION A-A
PROPOSED PLASTIC LINER THROUGH STEEL INTAKE
RIVER RD.
WHEATFIELD ST.
Contractor shall remove and store existing fence material and reconstruct fence upon completion of construction
LEGEND
580
570
560
550
540
530
PROPOSED PLASTIC LINER FOR EXISTING STEEL INTAKE

FIGURE 6.9