

**Final Report
DuPont Niagara Falls Plant
Interim Remediation Program
September 1989**

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September 21, 1989
88C2075B-5

E. I. du Pont de Nemours and Co., Inc.
26th Street and Buffalo Avenue
Niagara Falls, New York 14302

Attention: Ms. Gwen Moody

Re: Final Report Du Pont Niagara Falls Plant
Remediation Summary Report

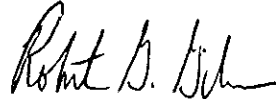
Dear Gwen:

Woodward-Clyde Consultants (WCC) is pleased to present this Final Report for the Interim Remediation Program at the Du Pont Niagara Plant.

If you should have any questions, please do not hesitate to call. We look forward to assisting Du Pont during the implementation of this program.

Very truly yours,

WOODWARD-CLYDE CONSULTANTS



for Lynn Rubisch Penniman, CPSS
Associate



for Frank S. Waller, P.E.
Senior Managing Principal

LRP/vbg/WM-8M



**FINAL REPORT
DU PONT NIAGARA FALLS PLANT
INTERIM REMEDIATION PROGRAM**

Prepared for:

**E.I. DU PONT DE NEMOURS AND COMPANY, INC.
NIAGARA FALLS PLANT**

Niagara Falls, New York

Prepared by:

WOODWARD-CLYDE CONSULTANTS

Plymouth Meeting, Pennsylvania

September 1989

EXECUTIVE SUMMARY

This proposal presents a summary of the Interim Remediation Program for the Du Pont Niagara Plant in Niagara Falls, New York as implemented pursuant to the order of consent with the New York State Department of Environmental Conservation, Index Number B9-0206-87-09.

Du Pont has voluntarily worked with the New York State Department of Environmental Conservation (NYSDEC) to identify and remediate contaminated areas. Remedial action has been completed or is in progress at several locations.

The west plant area bedrock groundwater regime is currently under interim remediation by pumping one or both of the Olin production wells. This system is reducing off-plant transport of indicator organic compounds. However, the overburden groundwater is relatively unaffected by this action. Therefore, Du Pont proposes an interim overburden groundwater remedial action plan, with the fundamental goal being containment and/or removal of contamination utilizing Best Available Technology, which is accomplished through the following objectives and scope.

OBJECTIVES OF REMEDIATION:

- o Create a hydraulic control in the overburden (A-zone) to reduce lateral off-plant contaminant migration.
- o Measure and record contaminant levels so that decreases are documented.
- o Install facilities to treat collected overburden groundwater.
- o Maintain a hydraulic control in the west plant area bedrock that will continue to reduce off-plant contaminant migration.
- o Based on the results of long-term monitoring and an endangerment assessment, confirm that the system is reducing the off-plant migration of contaminants.

SCOPE OF REMEDIATION:

- o Overburden groundwater will be pumped from a line of collection wells, installed along the long axis of the plant, to a new water treatment facility to be built which will discharge the treated water to the City of Niagara Falls Waste Water Treatment Plant.
- o Bedrock groundwater will continue to be collected by the Olin production wells and treated by carbon adsorption. The treated groundwater is discharged to a SPDES outfall.
- o A monitoring program will be continued to document groundwater levels for evaluating the hydraulic control of the pumping systems and to collect groundwater samples for analyzing the groundwater contaminant concentrations.

This program presents a description of the Interim Overburden Remediation System, together with a schedule for its implementation. Monitoring, performance criteria, and evaluation and reporting requirements are also established.

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1.0 INTRODUCTION

This proposal is a summary of the Interim Remediation Program for the Du Pont Niagara Plant in Niagara Falls, New York. This program states the Remediation Objectives and Scope (2.0), and presents the components of the Overburden Remediation System (3.0), and Bedrock Remediation System (4.0). The Monitoring (5.0), Implementation Schedule (6.0), Performance Criteria (7.0), and Evaluation and Reporting Requirements (8.0) are also presented. Three appendices are included in this program: QA/QC Plan (Appendix A), Health and Safety Plan (Appendix B) and Plans and Specifications (Appendix C). A brief description of site location and history has been included in this section. A list of all WCC reports relating to the plant studies, along with other pertinent references and source materials, are included in Table 1. The text of this report will reference the WCC documents (designated as R.#) for elaborations on specific topics. Other sources (designated as S.#) will also be referenced where appropriate.

1.1 BACKGROUND

The Du Pont Niagara Plant, which encompasses 52 acres, is bordered on the south side by the Robert Moses Parkway (formerly known as the Niagara Parkway) and on the north side by Buffalo Avenue, as shown on Plate 1. Gill Creek divides the plant into two approximately equal sections, east and west of the present-day stream channel.

The Niagara Plant has been in continuous operation since 1898, when the Niagara Electrochemical Company began the manufacture of sodium. Du Pont acquired the plant in 1930 and continued plant expansion with the introduction of new products and processes, including the production of both organic and inorganic chemicals. Plant history information prior to Du Pont's acquisition in 1930 is incomplete. Plant manufacturing peaked in size and diversity in the 1950's and, since that time, several processes/products have been eliminated. Du Pont has prepared a listing of products manufactured at the Niagara Plant over the last 80 plus years. Presented in Table 2 is a bar graph showing primary products and the times at which manufacture occurred.

In 1978, Du Pont searched its records to determine possible waste disposal areas within the plant area, and completed a survey (S.1) which detailed information on production areas, time of use, process chemistry, and waste disposal practices. Plate 2

summarizes the locations of suspected contaminant source activities. During 1983 Du Pont undertook additional hydrogeologic investigations to determine if the plant was a contributing source of contaminants located along the southern boundary (R.2). This plan, submitted to the NYSDEC in May 1983 (S.2), described in detail the steps to be taken to evaluate the potential presence and movement of chemical contaminants in both the overburden and bedrock groundwater systems.

To date, more than 60 integrated studies of the subsurface contamination or related conditions have been completed by WCC (Table 1). As data from these investigations have become available, Du Pont has voluntarily undertaken remedial actions to mitigate the environmental impact of such conditions. Since 1980, Du Pont has spent more than \$12.8 million on investigations and remedial actions, and an estimated \$7.7 million capital expenditure is planned to meet the objectives of this program. The locations of past remedial actions are shown on Plate 3.

2.0 REMEDIATION OBJECTIVES AND SCOPE

The primary objective of the proposed Interim Remediation Program is to control non-point source releases of contamination through the overburden and bedrock. Previous groundwater contamination studies have indicated that contaminants are migrating off-plant in both the overburden and bedrock. The present bedrock remediation system, which is the pumping of the Olin production wells, is controlling off-plant migration of contaminants within the west plant area bedrock zones. However, this system is relatively ineffective in controlling the off-plant migration of contaminants within the overburden zone.

The proposed Interim Overburden Remediation System will provide a system in the overburden zone for creating a hydraulic control. This will, over time, decrease contaminant levels in the overburden, will minimize overburden contaminant loading to the environment, and will reduce the contamination from the overburden to the bedrock. Described in this section of the program are the scope and details of the proposed overburden system.

The objectives of the remediation systems are as follows:

- o Create a hydraulic control in the overburden (A-zone) to reduce lateral off-plant contaminant migration by maintaining, to the degree practicable, an inward hydraulic gradient within the overburden over the general area of the plant.
- o Install facilities to treat collected overburden groundwater.
- o Monitor contaminant levels.
- o Maintain a hydraulic control in the west plant area bedrock that will reduce off-plant contaminant migration.
- o Confirm that the remediation system is reducing the off-plant migration of contaminants.

The following elements comprise the work proposed to meet the above objectives. Each of these are described in subsequent sections:

- o Overburden groundwater will be pumped from a line of 22 collection wells, installed along the long axis of the plant, to a new water treatment facility which will discharge the treated water to the City of Niagara Falls Waste Water Treatment Plant (Plate 4).
- o The new water treatment facility to be constructed by Du Pont will utilize steam stripping. Stripped organics will be condensed, stored, and periodically shipped off-plant as hazardous waste.
- o Bedrock groundwater will continue to be collected by the Olin production wells and treated by carbon adsorption. The treated groundwater will be discharged to a SPDES permitted Olin outfall.

- o The monitoring program will be continued to document groundwater levels for evaluating the hydraulic control of the pumping systems and to collect groundwater samples for analyzing the groundwater contaminant concentrations as described in this document.

3.0 INTERIM OVERBURDEN REMEDIATION SYSTEM

The overburden groundwater collection system will include a line of 22 pumping wells along the long axis of the plant. Five of these wells have already been installed. A water treatment plant will be constructed to treat the collected groundwater. The overburden collection system and water treatment operations are described below.

3.1 WATER TREATMENT

Permit applications for the water treatment plant have already been submitted to the NYSDEC (S.13) and the City of Niagara Falls. The treatment facilities (S.14) and excavation plan (S.15) are detailed in separate reports. The water treatment plant is being designed for a normal operating flow of 90 gpm and a maximum capacity of 270 gpm. Volatile organics will be removed by steam-stripping, and the treated water discharged to the City of Niagara Falls Waste Water Treatment Plant. Based on an analysis of New York State's Best Professional Judgement methodologies, this facility will meet all indicated BAT (Best Available Technology) target levels (S.14). Stripped organics will be condensed, stored, and periodically shipped off-plant as hazardous waste.

Ferrocyanide will be present in the stream that is discharged to the City of Niagara Falls Waste Water Treatment Plant. This material will be partially removed at the Niagara Falls Waste Water Treatment Plant and the effluent from this plant will be within the permit limits. Seven alternative methods of ferrocyanide removal from Niagara Plant groundwater were evaluated to determine if there was any cost effective technology to remove ferrocyanide before discharge to the city; none were identified (S.16, S.17).

Low levels (ppb) of contaminants may also be present in the discharge to the City of Niagara Falls Waste Water Treatment Plant. These will be removed in the City's treatment system.

The new groundwater treatment facility will include a groundwater equalization tank. This tank will allow for short-term interruptions in the treatment plant operations, without having to alter the pumping system. For longer interruptions, the pumping system would either be altered by reducing the pumping capacity or by temporarily shutting the system off. Influences on the hydraulic control of cutting off the pumping system on a short-term basis are discussed below (S.14).

3.2 PUMPING WELLS

Five pumping wells have already been installed (Plate 4). These pumping wells are 3 feet in diameter and are excavated down to the top-of-bedrock. A schematic for the pumping wells is shown on Plate 5.

3.2.1 LOCATIONS

The pumping wells (S.18) are to be located along the long axis of the plant. The well spacing is shown on Plate 4. Locations were based on results of the pump test (R.72) and plant access. Due to prior plant development, it may be necessary to relocate some of these wells in the field during construction. Relocations of up to 10 feet can be made without further review of the impact on the hydraulic control. In the event that larger relocations become necessary, the hydraulic control would be re-evaluated for actual field conditions.

3.2.2 CONSTRUCTION

The five pumping wells already installed were advanced through the overburden to the top of bedrock. Based on results of the pump test (R.72), the 17 new pumping wells will be extended 3 to 5 feet into the bedrock. An individual pump and a level control system will be placed in each well, such that the well level can be controlled to effect

the desired drawdown. The level control will be maintained by a pumping system that provides for continuous pumping, with a portion of the water being recirculated back to the well to provide for cooling of the pump and the remaining water going to the collection system piping and the treatment plant. A schematic of the pumping well controls is included as Plate 5. The individual wells are expected to typically pump approximately 1 to 5 gpm.

Well shafts shall be produced by a combination of machine drilling, hand excavation and removal of rock at the bottom of each shaft. Equipment will be cleaned of all soil, water or other excavated material before exiting the well construction boundary. If groundwater is encountered during excavation, it will remain in the hole or be pumped to an adjacent hole or to a tank truck and disposed in an approved facility (S.19).

3.3 HEALTH AND SAFETY PLAN

Du Pont has submitted excavation plans which contain the health and safety plans to the NYSDEC for both the installation of the pumping and monitoring wells (S.18) and the treatment facility (S.15). A description of the changes to the health and safety plans necessary for NYSDEC approval is included as Appendix B.

3.4 PLANS AND SPECIFICATIONS

Du Pont submitted Plans, Specifications, and Engineering Report (S.12) and a preliminary permit application (S.14). A description of the changes to the plans and specifications necessary for NYSDEC approval is included as Appendix C.

3.5 SYSTEM OPERATION

3.5.1 START-UP

After the pumping wells have been installed and the treatment plant completed, a limited number of pumping wells will be activated to start the creation of the

hydraulic control. The wells will be activated sequentially. The actual number of wells to be brought on-line and the rate at which they can be brought on-line must be determined in the field based upon the actual pumping conditions and the hydraulic capacity of the treatment plant.

Start up will be completed and steady state conditions will commence when the water levels in all piezometers exhibit change within ± 15 percent of the average level over four consecutive weeks, or the total pump rate exhibits change within ± 15 percent of the average rate over four consecutive weeks, or three months after all wells are on line, whichever occurs first.

3.5.2 NORMAL OPERATIONS

After steady-state pumping conditions have been achieved, normal operations will begin. For normal operations, the level control will be set in each well as determined appropriate.

3.5.3 TEMPORARY SHUTDOWNS

The pumping system can be shut down temporarily without having a major influence on the hydraulic control within the overburden. Shutdowns of up to 1 week will have minimal impact, but reasonable efforts will be maintained to limit the shutdowns to a maximum of 1 to 2 days duration. The NYSDEC will be notified by phone if any pumping well will be stopped for longer than two days, or if the treatment plant will be down for greater than 24 hours. The NYSDEC will also be notified if there are any outages that might result in loss of the hydraulic gradient.

4.0 EXISTING BEDROCK REMEDIATION SYSTEM

The bedrock remediation system consists of pumping of the Olin production wells, treating the water with carbon adsorption, and then discharge to a SPDES outfall.

Du Pont has entered into an agreement with Olin Corporation to maintain a minimum monthly average pumping rate of 500 gpm. The pumping rate and influent water quality are documented by Olin Corporation and the results are periodically furnished to Du Pont. The influent water quality is used to calculate the contaminant loadings to the Olin production wells. The NYSDEC will be notified by telephone if the Olin pumps or discharge treatment will be stopped for greater than 24 hours or concerning any change in the status of the Olin system.

5.0 MONITORING

A monitoring program will be maintained during the interim remediation system operation to evaluate and confirm that the remediation system is performing properly and is meeting the specified performance criteria. The monitoring program will include monitoring of existing utility and monitoring wells, new piezometers, designated permitted outfalls from the plant, and influent and effluent from the Du Pont and Olin treatment plants. Periodic audits for quality assurance/quality control (QA/QC) will be performed and results furnished to the NYSDEC by Du Pont. Components of the monitoring program are discussed in the following sections.

Monitoring Wells: As proposed, monitoring wells will adequately monitor the performance of the remediation program. A total of 73 monitoring wells (68 Du Pont and 5 DEC) will to be used at the Niagara Plant in the hydraulic monitoring program. Groundwater levels will be taken on the existing monitoring wells in accordance with the schedule presented in Table 5. Groundwater samples will be obtained and chemical analyses for Refined Indicator Parameters (RIP) (Table 3) conducted in accordance with the schedule presented in Table 6. Monitoring well depths will be measured prior to sampling. In addition, monitoring well maintenance will be performed in accordance with Du Pont's well maintenance program (S.51).

Pumping Wells: The schedule for collection of groundwater samples for the pumping wells are presented in Table 6. Wells will be sampled once within 48 hours of start-up for Refined Indicator Parameters (Table 3), and then monthly for the first two years of operation. These data will be sufficient to characterize water quality in the pumping wells. Influent samples to the Du Pont treatment facility will be sufficient thereafter to characterize the bulk water quality.

Piezometers: A total of 46 piezometers will be used to provide additional groundwater level monitoring points. The proposed locations of these piezometers are shown on Plate 4. This includes 27 overburden and 19 top-of-rock piezometers (4 overburden have already been installed). The frequency of water measurements to be taken in the piezometers is shown in Table 5. Hydraulic impact of the pumping wells will be monitored by the 8 pumping line overburden piezometers. Ten and nine piezometer couplets will be used to monitor the west and east plant, respectively.

Utility Wells: Three utility wells (R.4) (U1, U14, and U16) will be included in the monitoring program. The locations of the three utility wells are shown on Plate 4. Water level measurements will be made in accordance with the monitoring schedule presented in Table 5. Samples for groundwater quality will be obtained in accordance with the monitoring schedule presented in Table 6.

Outfalls - SPDES: There are six outfalls from the Niagara Plant, as described in Table 7 (R.40, and S.20, S.21, S.23, S.24 and S.25). Each SPDES permitted outfall, Outfalls 001E, 001W, 004, 005, 006, and 007 will be monitored for Refined Indicator Parameters once each quarter. In addition, water flow will be measured so that loadings can be calculated. Results of this monitoring will be included in the ongoing effectiveness evaluation and reporting.

Sewer Outlets - City of Niagara Falls Waste Water Treatment Plant: There are two outlets from the Du Pont Niagara Plant that discharge to the City of Niagara Falls sewer system, and are ultimately treated at the Niagara Falls Waste Water Treatment Plant prior to discharge to the Niagara River. These outlets are described in Table 7. Outlets 023 and 024 will be sampled and analyzed for RIP once each quarter. In addition, water flow will be measured so that loading rates can be calculated.

Outfalls - Storm Water Runoff: Stormwater outfalls will not be included in the monitoring program because they are dry during dry periods of the year (i.e., no base flow due to lack of groundwater infiltration) and surcharged with stormwater runoff during precipitation events (R.40, R.46 and R.47). There are twelve stormwater outfalls installed by

the State Power Authority. These were either installed or extended as part of the Power Project. Du Pont has initiated a separate investigation that has been reviewed by the NYSDEC (S.20, S.21, S.23 and S.24) to evaluate the integrity, flow, and discharge of the lines originating on Du Pont property. The results of a storm event sampling program were submitted to the NYSDEC and only low level contamination was present. Investigations indicate the groundwater infiltration does not appear to be a significant problem in the lines (R.46 and R.48).

Water Treatment Plants: The influent and effluent for the steam stripper and Olin GAC water treatment plant will be monitored for the Refined Indicator Parameters to evaluate the effectiveness of the treatment (R.30). The monitoring frequency will be in accordance with the schedule presented in Table 6.

Niagara River Monitoring: Water levels will be measured continuously at the intersection of Gill Creek and Du Pont Road to represent the Niagara River level.

Sampling and Analytical Protocols: Du Pont has submitted a Quality Assurance/Quality Control (QA/QC) plan to the NYSDEC (R.78). A description of the changes to the QA/QC plan necessary for NYSDEC approval is included as Appendix A.

6.0 IMPLEMENTATION SCHEDULE

The implementation schedule planned for the Interim Remedial Action Program is shown in Table 8. Conformance to this schedule depends upon regulatory review and approval within the indicated time periods. As shown, if the schedule is maintained, the overburden collection and treatment system would be in operation approximately 18 months after the construction work begins.

7.0 PERFORMANCE CRITERIA

Overburden performance criteria will be to operate the system to create (within 24 months) and maintain an inward hydraulic gradient as measured and/or projected to the plant site boundaries to the extent practicable.

Containment of overburden groundwater will be demonstrated when an inward hydraulic gradient is shown to exist within the plant as evidenced through the use of pertinent overburden/top of bedrock data and other available data from nearby monitoring points.

The inward hydraulic gradient will be measured and projected to the plant site boundaries using water level measurements from the monitoring points listed on Table 9 and by comparing these water levels with the Niagara Plant water level data collected to date.

8.0 EVALUATION AND REPORTING

The effectiveness of the interim overburden remediation program will be evaluated on a continuing basis and reported to the NYSDEC in accordance with the following schedule:

- o **Construction:** During the construction phase the NYSDEC will be issued quarterly reports. Reports will identify work completed, work to be performed during the following quarter, problems encountered during construction and an updated schedule. Verbal weekly status reports will be given to the NYSDEC.

- o **Start-up:** NYSDEC will be issued monthly status reports during start-up. These reports will be issued within 7 calendar days following the end of the reporting month. These reports will include: 1) activities completed during the previous reporting month; 2) monitoring data per Table 5 and 6; 3) groundwater level contours for the A and B-Zones; 4) technical problems associated with start-up; and 5) an updated schedule. Weekly verbal status reports including the expected next week's activities will be given to the

NYSDEC in addition to the monthly reports. The NYSDEC will also be provided access to system operational data.⁽¹⁾

- o **Operation:** Quarterly reports will be issued within 60 days following the end of the reporting quarter and will include analytical and water level data, non-point source contaminant loadings, and point source contaminant loadings, system operational data, and assessment of the program. This quarterly report will also include monthly groundwater level contours for the A and B-zones for the first 24 months of operation; thereafter, quarterly for all zones.
- o **Annual Reports** will include a summary of analytical results and remedial effectiveness and recommendations with respect to potential changes in the remedial system. Annual reports will be issued within 90 days following the end of the reporting year. The reporting year will end on the start-up anniversary date.
- o Annual reports are in addition to quarterly reports, quarterly reports are in addition to monthly reports.
- o After three years of operation, and annually thereafter for the duration of the program, the cost effectiveness of continuing the program will be re-evaluated, and the Endangerment Assessment will be updated.
- o Monitoring shall continue for a period of at least two years after pumping is discontinued.
- o Annual well maintenance inspection reports will be submitted to NYSDEC.

(1) "For purposes of Section 7.0, system operational data will be considered influent and effluent flows from the Du Pont and Olin treatment plants, influent and effluent concentrations from the Du Pont and Olin treatment plants, organic production, and other similar data that the NYSDEC might request that would describe overall system performance."

Tables

TABLE 1
LIST OF REFERENCES
INTERIM REMEDIATION PROGRAM
DU PONT NIAGARA PLANT
NIAGARA FALLS, NEW YORK

Reference No.	Document	Date of Submittal
<u>WOODWARD-CLYDE TO DU PONT</u>		
R. 1	"Subsurface Investigation and Monitoring Wells"	05/01/79
R. 2	"Geohydrologic Investigations", Volumes I and II	12/23/83
R. 3	<u>Geologic Logs</u>	01/12/84
R. 4	"Man-made Passageways Investigation"	02/17/84
R. 5	"Review of Cleanup of B-107 Landfill and Terrain Conductivity"	02/29/84
R. 6	"Supplemental Investigations & Remedial Program"	03/14/84
R. 7	"Remedial Investigation Via Recovery Wells"	03/20/84
R. 8	"Phase I Remediation Studies"	04/06/84
R. 9	<u>Field Work Procedures Geologic Logging of Rock Core</u>	04/06/84
R.10	"Geophysical Investigations"	04/11/84
R.11	"Phase II Remediation"	07/05/84
R.12	"Representative Samples Formulation"	09/07/84
R.13	"Groundwater Modeling for Remediation Studies"	09/27/84
R.14	"Sensitivity Analysis of Groundwater Modeling Parameters"	10/04/84
R.15	"Supplemental Man-made Passageways Investigation"	10/24/84
R.16	"Supplemental Geohydrologic Investigation"	10/24/84
R.17	"Investigation of Hydraulic Connection between A-zone and B-zone"	10/25/84
R.18	<u>Project Specifications re. Adams Avenue Sewer Cutoff</u>	11/01/84
R.19	"Contaminant Loading for Organic Compounds"	11/08/84
R.20	<u>Fourth Quarter Contaminant Loading Results</u>	04/16/85
R.21	"Geotechnical Investigation West Yard Maintenance Area"	05/15/85
R.22	"Pump Test Program"	06/19/85
R.23	<u>J-Zone Off-Site Contaminant Loading Rates</u>	07/01/85
R.24	<u>Supplemental Groundwater Modeling Analysis</u>	07/03/85
R.25	"Groundwater Collection System"	10/18/85
R.26	"Hydraulic Comparison Tile Drain and Pumping"	12/02/85
R.27	<u>Pump Well Design</u>	02/26/86

**TABLE 1
(continued)**

Reference No.	Document	Date of Submittal
R.28	"Monitoring Plan for A-zone Remediation"	02/26/86
R.29	"Justification of Configuration No. 2 Pumping Wells"	03/27/86
R.30	"Groundwater Monitoring Plan for Site Remediation"	03/27/86
R.31	"Hydraulic Impact of Olin Production Wells"	04/03/86
R.32	"Olin Pump Performance"	11/19/87
R.33	"Off-Site Contaminant Loading Rates, Fourth Quarter 1984 Through Third Quarter 1985"	04/03/86
R.34	"Off-Plant Contaminant Loading Rates, Fourth Quarter 1985 through Third Quarter 1986"	06/10/87
R.35	"Off-Plant Contaminant Loading Rates, Fourth Quarter 1986"	06/10/87
R.36	"Off-Plant Contaminant Loading Rates, First Quarter 1987"	07/22/87
R.37	"Off-Plant Contaminant Loading Rates, Second Quarter 1987"	08/21/87
R.38	"Off-Plant Contaminant Loading Rates, Third Quarter 1987"	01/08/88
R.39	"Numerical Simulation of Bedrock Water Bearing Zones"	04/08/86
R.40	"Infiltration/Inflow Study Plan"	08/28/87
R.41	"Endangerment Chemicals Loading Estimates"	06/02/87
R.42	"J-Zone Investigation"	06/11/87
R.43	"Response to DEC comments on J-Zone Investigation Report"	09/22/87
R.44	"Endangerment Assessment"	10/86
R.45	"West Plant Area Endangerment Chemical Evaluation"	08/12/87
R.46	"Southwest Niagara Plant Storm Sewer Evaluation"	06/02/87
R.47	"Du Pont Niagara Plant - Infiltration Study Plan Addendum"	11/25/87
R.48	"Response to DEC comments on Infiltration Plan"	11/02/87
R.49	"Adams Avenue Slurry Wall"	07/29/86
R.50	"Refinement of the Aqueous Indicator Parameter List"	10/07/86
R.51	"Groundwater Chemistry Quality Assurance/Quality Control Audit, Fourth Quarter 1985 and First Quarter 1986"	07/14/86
R.52	"Groundwater Chemistry Quality Assurance/Quality Control Audit, Second Quarter 1986 and Third Quarter 1986"	12/19/86
R.53	"Groundwater Chemistry Quality Assurance/Quality Control Audit, Fourth Quarter 1986"	07/30/86
R.54	"Groundwater Chemistry Quality Assurance/Quality Control Audit, First Quarter 1987"	08/27/87
R.55	"Groundwater Chemistry Quality Assurance/Quality Control Audit, Second Quarter 1987"	09/16/87
R.55A	"Addendum to Groundwater Chemistry Quality Assurance/Quality Control Audit, Second Quarter 1987"	10/16/87
R.56	"Groundwater Chemistry Quality Assurance/Quality Control Audit, Third Quarter 1987"	11/24/87
R.56A	"Addendum to Groundwater Chemistry Quality Assurance Quality Control Audit, Third Quarter 1987"	12/08/87

TABLE 1
(continued)

Reference No.	Document	Date of Submittal
R.57	"Quality Assurance/Quality Control Audit Manual, Fourth Quarter 1986 through Third Quarter 1987 for the Niagara Plant and Necco Park, Version 1.1	07/31/87
R.58	"1987 Field Audit Manual"	06/29/87
R.59	"General Testing Corporation Laboratory Audit"	10/28/87
R.60	"Non-Aqueous Phase Liquid Chemistry Quality Assurance/Quality Control Audit for the Niagara Plant	09/15/87
R.61	"Effects of Cap Emplacement on Endangerment Chemical Migration, West Yard Niagara Plant"	01/25/88
R.62	"Long-Term Pump Test Procedures"	01/25/88
R.63	"Quality Assurance/Quality Control Audit Manual, Fourth Quarter 1987 through Third Quarter 1989, Niagara Plant and Necco Park, Version 2.0"	02/26/88
R.64	"Off-Plant Contaminant Loading Rates, Fourth Quarter 1987"	03/11/88
R.65	"Groundwater Chemistry, Quality Assurance/Quality Control Audit, Fourth Quarter 1987"	03/11/88
R.66	"Draft Version 2 Remedial Action Program, Niagara Plant, Niagara Falls, New York"	03/14/88
R.67	"Groundwater Chemistry Quality Assurance/Quality Control Audit, First Quarter 1988"	05/18/88
R.68	"Off-Plant Contaminant Loading Rates, First Quarter 1988"	06/17/88
R.69	"1988 Field Audit, Niagara Plant"	07/07/88
R.70	"General Testing Corporation Laboratory Audit"	07/14/88
R.71	"Effectiveness Evaluation Adams Avenue Sewer Slurry Wall"	08/11/88
R.72	"Evaluation of Overburden Remediation System"	08/24/88
R.73	"Off-Plant Contaminant Loading Rates, Second Quarter 1988"	10/06/88
R.74	"Groundwater Chemistry Quality Assurance/Quality Control Audit, Second Quarter 1988"	11/04/88
R.75	"Response to NYSDEC letter, WCC Evaluation of Overburden Remediation System Report"	01/20/89
R.76	"Groundwater Chemistry Quality Assurance/Quality Control Audit, Third Quarter 1988"	01/24/89
R.77	"Off-Plant Contaminant Loading Rates, Third Quarter 1988"	02/02/89
R.78	"Response to NYSDEC letter, QA/QC Audit Manual Version 2.0 and Fourth Quarter 1987 Groundwater Chemistry QA/QC Audit"	02/07/89
R.79	"Off-Plant Contaminant Loading Rates, Fourth Quarter 1988"	03/22/88

**TABLE 1
(continued)**

Reference No.	Document	Date of Submittal
R.80	"Groundwater Chemistry Quality Assurance/Quality Control Audit, Fourth Quarter 1988"	03/28/89
R.81	"Draft Version 2, Remedial Action Program, Niagara Plant, Niagara Falls, New York"	03/14/89
R.82	"Long Term Pump Test, WCC Response to NYSDEC Comments"	03/25/89
R.83	"Overburden Remediation System Projected Time to Reach Steady State Conditions"	06/08/89
R.84	"Groundwater Chemistry Quality Assurance/Quality Control Audit, First Quarter 1989 Data Niagara Plant"	06/19/89
R.85	"Response to EPA Comments on the Quality Assurance/Quality Control Manual Version 2.0 with Regards to the Niagara Plant"	07/05/89
R.86	"Response to Comments in February 16, 1989 NYSDEC Letter"	07/05/89
R.87	"Off-Plant Contaminant Loading Rates, First Quarter 1989"	07/19/89

TABLE 1
(continued)

Reference No.	Document	Date of Submittal
<u>OTHER SOURCES</u>		
S.1	Questionnaire Results, Du Pont to Interagency Task Force on Hazardous Wastes.	11/13/78
S.2	"Groundwater Investigation Plan", Du Pont to New York Department of Environmental Conservation	5/83
S.3	"Report of The Niagara River Toxics Committee", Toxics Committee to the EPA	10/84
S.4	"Groundwater in the Niagara Falls Area, New York" N.Y. Conservation Department, Water Resources Division	1964
S.5	Data Request from New York Power Authority by WCC	11/07/84
S.6	"Niagara Power Project - Data-Statistics", Power Authority of the State of New York (New York Power Authority)	4/65
S.7	"Determining the Impact of Land Disposal - The Review of Organic Analytical Data," Environmental Testing and Certification Corporation (Internal Report)	1/86
S.8	"Evaluation of Extending Pump Well Collection System to West Yard at Du Pont Niagara Plant" Du Pont to NYSDEC	08/14/87
S.9	Letter, Du Pont to NYSDEC	04/22/86
S.10	"Gill Creek," Du Pont to New York State Department of Environmental Conservation	01/11/82
S.11	"Final Report - Cleanup of B-107 Landfill," Du Pont to Du Pont	02/16/81
S.12	"Niagara Plant Ground Water Remediation Plans, Specifications and Engineering Report"	02/05/87
S.13	"Du Pont Niagara Plant Ground Water Treatment Facilities, Preliminary Permit Applications"	03/18/87
S.14	"Groundwater Treatment Facilities - Engineering Report - and Permit Applications," Du Pont to NYSDEC	03/18/87
S.15	"Soil Excavation and Disposal Plan - Treatment Facilities Construction," Du Pont to NYSDEC	01/27/87
S.16	"Ground Water Remediation - Ferrocyanide Treatment Alternatives Review," Du Pont to NYSDEC	11/19/87
S.17	"Evaluation of Ferrocyanide Removal Facilities Investment and Operating Costs," Du Pont to NYSDEC	09/08/87
S.18	"Soil Excavation and Disposal Plan for Pumping Well Construction," Du Pont to NYSDEC	11/12/86
S.19	"Plan for Management of Soils and Groundwater Resulting from Excavation Work," Dupont to NYSDEC	10/29/86 (Rev. #2)
S.20	"E.I. du Pont de Nemours & Co., Inc., Niagara Falls (c), Niagara County SPDES Permit #NY 0003328," NYSDEC to Du Pont	06/28/85
S.21	"E.I. du Pont de Nemours & Co., Inc., Niagara Falls (c), Niagara County SPDES Permit #NY 0003328," Du Pont to NYSDEC	08/30/85

TABLE 1
(continued)

Reference No.	Document	Date of Submittal
<u>OTHER SOURCES (continued)</u>		
S.22	"E.I. du Pont de Nemours & Co., Inc., Niagara Falls (c), Niagara County SPDES Permit #NY 0003328," Du Pont to NYSDEC	09/10/85
S.23	"E.I. du Pont de Nemours & Co., Inc., Niagara Falls (c), Niagara County SPDES Permit #NY 0003328," Du Pont to NYSDEC	11/13/85
S.24	"E.I. du Pont de Nemours & Co., Inc., Niagara Falls (c), Niagara County SPDES Permit #NY 0003328," NYSDEC to Du Pont	12/19/85
S.25	"Reapplication for SPDES Permit NY-0003328 Including Niachlor Status of Compliance with Permit Conditions and Storm Water Discharge Information," Du Pont to NYSDEC	10/30/87
S.26	"Response to Comments on Proposed Discharge from the Plant Treatment Facilities to the Niagara Falls POTW"	11/02/87
S.27	"Ground Water Monitoring Program Scope of Work for Necco Park and Niagara Plant," Du Pont to NYSDEC	12/01/87
S.28	"Ground Water Sampling, Analyses, Elevations Scope of Work," Du Pont to NYSDEC	10/09/86
S.29	"Du Pont Niagara Plant - Sampling and Analytical Plan," Du Pont to NYSDEC	09/30/86
S.30	"Comments Infiltration/Inflow Study Plan Niagara Falls, New York," NYSDEC to Du Pont	12/18/87
S.31	"Groundwater Water Monitoring Analytical Results, Niagara Plant: Fourth Quarter 1986," Du Pont to NYSDEC	07/27/87
S.32	"Du Pont Niagara Plant, Hydraulic Conductivity of Recently Installed Monitoring Wells," Du Pont to NYSDEC	12/15/87
S.33	"Ferrocyanide Degradation Literature Review, Du Pont Ground Water Remediation Project" Du Pont to NYSDEC	12/29/87
S.34	"Ferrocyanide Low pH Treatment Test Work, Du Pont Ground Water Remediation Project," Du Pont to NYSDEC	02/05/88
S.35	"Comments on Long-Term Pump Test Proposal" NYSDEC to Du Pont	03/02/88
S.36	"SEQR Lead Agency Selection Du Pont Groundwater Remediation Application No. 90-88-0029" NYSDEC to Mayor Niagara Falls	05/24/88
S.37	"Copies of References from Draft Remedial Action Program" Du Pont to NYSDEC	06/10/88
S.38	"Request to Evaluate Additional Analysis on Niagara Plant Groundwater Samples," NYSDEC to Du Pont	07/06/88

**TABLE 1
(continued)**

Reference No.	Document	Date of Submittal
<u>OTHER SOURCES (continued)</u>		
S.39	"Response to Request to Evaluate Analysis on Niagara Plant Groundwater Samples," Du Pont to NYSDEC	07/22/88
S.40	"Comparison of Necco Park and Niagara Plant Safety and Health Plans - Remedial Activities," Du Pont and NYSDEC	10/19/88
S.41	"Comments on Evaluation of Overburden Remediation System," NYSDEC to Du Pont	10/27/88
S.42	"Response to Du Pont's Comments on Niagara Plant Health and Safety Plan," NYSDEC to Du Pont	11/22/88
S.43	"Du Pont Niagara Plant Remediation - Summary Report Outline," Du Pont to NYSDEC	01/18/89
S.44	"Response to comments on Safety and Health Plan, Du Pont Niagara Plant Remedial Action Program, Du Pont to NYSDEC	01/30/89
S.45	"Comments on QA/QC and Off-Plant Contaminant Loading Rates Third Quarter 1988 Data Reports"	02/16/89
S.46	"Response to DEC Comments on Part 373 Requirements," Du Pont to NYSDEC	02/28/89
S.47	"Du Pont Niagara Plant - Draft Remediation Summary Report, additional items" Du Pont to NYSDEC	03/20/89
S.48	"Response to Du Pont January 30, 1989 Comments on Health and Safety Plan," NYSDEC to Du Pont	04/10/89
S.49	"Response to Comments on Safety and Health Plan," Du Pont to NYSDEC	06/27/89
S.50	"Response to NYSDEC Requests Regarding the QA/QC Manual and Quarterly Audit Report" Du Pont to NYSDEC	07/13/89
S.51	"Well Maintenance Program - Scope of Work for Necco Park and Niagara Plant"	01/12/88

TABLE 2
 HISTORY OF CHEMICAL PROCESSES (1900's)
 INTERIM REMEDIATION PROGRAM
 DU PONT NIAGARA PLANT
 NIAGARA FALLS, NEW YORK

	00's	10's	20's	30's	40's	50's	60's	70's	80's
SODIUM/CHLORINE	■	■	■	■	■	■	■	■	○
SODIUM PEROXIDE	■	■	■	■	■	■			
HYDROGEN PEROXIDE	■	■	■	■	■	■			
SODIUM CYANIDE				■	■	■	■		
COPPER/ZINC CYANIDE				■	■	■	■	■	
AMMONIA				■	■	■			
"C-1"s				■	■	■	■	■	
"C-2"s				■	■	■	■	■	
METHANOL				■					
SODIUM PERBORATE				■	■	■	■		
VINYL CHLORIDE					■	■			
ADIPONITRILE						■	■		
THF						■	■		
N-METHYL PYRROLE						■	■	■	
POLYVINYL ALCOHOL						■	■	■	
POLYVINYL ACETATE						■	■	■	
TERATHANE®								■	○
ELECTRONIC MATERIALS								■	○
CAUSTIC/CHLORINE									○

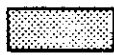

 PREVIOUSLY MANUFACTURED
 PRESENTLY MANUFACTURED

TABLE 3
REFINED INDICATOR PARAMETERS
INTERIM REMEDIATION PROGRAM
DU PONT NIAGARA PLANT
NIAGARA FALLS, NEW YORK

<u>Volatiles</u>	<u>Base/Neutrals</u>	<u>Inorganics and Other Parameters</u>
Benzene	1,4-Dichlorobutane	Total Cyanide
Carbon tetrachloride	bis(2-ethylhexyl)phthalate	Total recoverable phenolics
Chlorobenzene	1,2-Dichlorobenzene	Total organic halogens
Chloroform	1,4-Dichlorobenzene	Soluble barium
Chloromethane	Hexachlorobutadiene	pH
1,1-Dichloroethane	Hexachloroethane	Temperature
1,1-Dichloroethylene	Naphthalene	Specific gravity
trans-1,2-Dichloroethylene		Specific conductivity
cis-1,2-Dichloroethylene		Chloride
Methylene chloride		
1,1,2,2-Tetrachloroethane		
Tetrachloroethylene	<u>Pesticides/PCB's</u>	
Tetrahydrothiophene		
Toluene	alpha BHC	
1,1,1-Trichloroethane	beta BHC	
1,1,2-Trichloroethane	delta BHC	
Trichloroethylene	gamma BHC	
Vinyl chloride	Total PCB's	

TABLE 4

LOADING INDICATOR ORGANIC COMPOUNDS
INTERIM REMEDIATION PROGRAM
DU PONT NIAGARA PLANT
NIAGARA FALLS, NEW YORK

<u>Volatiles</u>	<u>Pesticides/PCB's</u>
Benzene	alpha BHC
Chlorobenzene	beta BHC
Chloroform	delta BHC
trans-1,2-Dichloroethylene	gamma BHC
cis-1,2-Dichloroethylene	Total PCB's
Methylene chloride	
1,1,2,2-Tetrachloroethane	
Tetrachloroethylene	
Trichloroethylene	
Vinyl chloride	

WM-8M

TABLE 5

**GROUNDWATER LEVEL MONITORING SCHEDULE
INTERIM REMEDIATION PROGRAM
DU PONT PLANT
NIAGARA FALLS, NEW YORK**

Monitoring Point ⁽¹⁾	Monitoring Point No.	Water Level Monitoring Frequency		
		During Start-up ⁽²⁾	First Two Year Normal Operations ⁽²⁾	
Piezometers	WPPO-1	Weekly	Monthly	Quarterly
	WPPT-2	Weekly	Monthly	Quarterly
	WPPO-3	Weekly	Monthly	Quarterly
	WPPT-4	Weekly	Monthly	Quarterly
	WPPT-5	Weekly	Monthly	Quarterly
	EPPT-1	Weekly	Monthly	Quarterly
	EPPT-2	Weekly	Monthly	Quarterly
	EPPT-3	Weekly	Monthly	Quarterly
	27-A	Weekly	Monthly	Quarterly
	WPT-1	Weekly	Monthly	Quarterly
	WPO-2	Weekly	Monthly	Quarterly
	WPT-2	Weekly	Monthly	Quarterly
	WPO-3	Weekly	Monthly	Quarterly
	WPT-3	Weekly	Monthly	Quarterly
	WPO-4	Weekly	Monthly	Quarterly
	WPT-4	Weekly	Monthly	Quarterly
	WPO-5	Weekly	Monthly	Quarterly
	WPT-5	Weekly	Monthly	Quarterly
	WPO-6	Weekly	Monthly	Quarterly
	WPT-6	Weekly	Monthly	Quarterly
	WPO-7	Weekly	Monthly	Quarterly
	WPT-7	Weekly	Monthly	Quarterly
	WPO-8	Weekly	Monthly	Quarterly
	WPT-8	Weekly	Monthly	Quarterly
	WPO-9	Weekly	Monthly	Quarterly
	WPT-9	Weekly	Monthly	Quarterly
	WPO-10	Weekly	Monthly	Quarterly
	WPT-10	Weekly	Monthly	Quarterly
	EPO-1	Weekly	Monthly	Quarterly
	EPT-1	Weekly	Monthly	Quarterly
	EPO-2	Weekly	Monthly	Quarterly
	EPT-2	Weekly	Monthly	Quarterly
	EPO-3	Weekly	Monthly	Quarterly
	EPT-3	Weekly	Monthly	Quarterly
	EPO-4	Weekly	Monthly	Quarterly
	EPT-4	Weekly	Monthly	Quarterly
	EPO-5	Weekly	Monthly	Quarterly
	EPT-5	Weekly	Monthly	Quarterly
	EPO-6	Weekly	Monthly	Quarterly
	EPT-6	Weekly	Monthly	Quarterly
	EPO-7	Weekly	Monthly	Quarterly
	EPT-7	Weekly	Monthly	Quarterly
	EPO-8	Weekly	Monthly	Quarterly
	EPT-8	Weekly	Monthly	Quarterly
	EPO-9	Weekly	Monthly	Quarterly
EPT-9	Weekly	Monthly	Quarterly	

TABLE 5
(continued)

Monitoring Point ⁽¹⁾	Monitoring Point No.	Water Level Monitoring Frequency		
		During Start-up ⁽²⁾	First Two Year Normal Operations ⁽²⁾	
Utility Wells (Existing)	U1	Monthly	Monthly	Quarterly
	U14	Monthly	Monthly	Quarterly
	U16	Monthly	Monthly	Quarterly
Monitoring Wells (Existing A-zone Wells)	1A-R	Weekly	Monthly	Quarterly
	2A	Weekly	Monthly	Quarterly
	3A	Weekly	Monthly	Quarterly
	4A-R	Weekly	Monthly	Quarterly
	5A-R	Monthly	Monthly	Quarterly
	6A-R	Monthly	Monthly	Quarterly
	7A-R	Monthly	Monthly	Quarterly
	8A	Weekly	Monthly	Quarterly
	9A	Weekly	Monthly	Quarterly
	10A	Weekly	Monthly	Quarterly
	12A	Weekly	Monthly	Quarterly
	13A	Weekly	Monthly	Quarterly
	14A	Weekly	Monthly	Quarterly
	15A	Weekly	Monthly	Quarterly
	16A	Weekly	Monthly	Quarterly
	17A	Monthly	Monthly	Quarterly
	18A	Monthly	Monthly	Quarterly
	19A	Monthly	Monthly	Quarterly
	20A	Monthly	Monthly	Quarterly
	21A	Weekly	Monthly	Quarterly
	22A	Monthly	Monthly	Quarterly
	23A-R	Monthly	Monthly	Quarterly
	24A	Weekly	Monthly	Quarterly
	Monitoring Wells (Existing B-zone Wells)	1B-R	Monthly	Monthly
2B		Monthly	Monthly	Quarterly
3B		Monthly	Monthly	Quarterly
5B-R		Monthly	Monthly	Quarterly
8B		Monthly	Monthly	Quarterly
12B		Monthly	Monthly	Quarterly
16B		Monthly	Monthly	Quarterly
19B		Monthly	Monthly	Quarterly
20B		Monthly	Monthly	Quarterly
22B		Monthly	Monthly	Quarterly
23B		Monthly	Monthly	Quarterly
24B		Monthly	Monthly	Quarterly

TABLE 5
(continued)

Monitoring Point ⁽¹⁾	Monitoring Point No.	Water Level Monitoring Frequency		
		During Start-up ⁽²⁾	First Two Year Normal Operations ⁽²⁾	
Monitoring Wells (Existing CD-zone Wells)	1C	Quarterly	Quarterly	Quarterly
	2C	Quarterly	Quarterly	Quarterly
	4C-R	Quarterly	Quarterly	Quarterly
	5CD-R	Quarterly	Quarterly	Quarterly
	7C-R	Quarterly	Quarterly	Quarterly
	15CD	Quarterly	Quarterly	Quarterly
	17B	Quarterly	Quarterly	Quarterly
	18C	Quarterly	Quarterly	Quarterly
	19CD1	Quarterly	Quarterly	Quarterly
	22C	Quarterly	Quarterly	Quarterly
	23C	Quarterly	Quarterly	Quarterly
	26CD	Quarterly	Quarterly	Quarterly
Monitoring Wells (Existing D-Zone Wells)	1D	Quarterly	Quarterly	Quarterly
	5D-R	Quarterly	Quarterly	Quarterly
	10D	Quarterly	Quarterly	Quarterly
	14D	Quarterly	Quarterly	Quarterly
	15D	Quarterly	Quarterly	Quarterly
	18D	Quarterly	Quarterly	Quarterly
	19D	Quarterly	Quarterly	Quarterly
	22D	Quarterly	Quarterly	Quarterly
23D	Quarterly	Quarterly	Quarterly	
Monitoring Wells (Existing F-Zone Wells)	1F	Quarterly	Quarterly	Quarterly
	5F-R	Quarterly	Quarterly	Quarterly
	7F	Quarterly	Quarterly	Quarterly
	10F	Quarterly	Quarterly	Quarterly
	15F	Quarterly	Quarterly	Quarterly
	17F	Quarterly	Quarterly	Quarterly
	22F	Quarterly	Quarterly	Quarterly
	23F	Quarterly	Quarterly	Quarterly
Monitoring Wells (Existing J-zone Wells)	1J	Quarterly	Quarterly	Quarterly
	4J	Quarterly	Quarterly	Quarterly
	8J	Quarterly	Quarterly	Quarterly
	15J	Quarterly	Quarterly	Quarterly
Monitoring Wells (Existing DEC Wells)	1	Quarterly	Quarterly	Quarterly
	2	Quarterly	Quarterly	Quarterly
	3	Quarterly	Quarterly	Quarterly
	4	Quarterly	Quarterly	Quarterly
	5	Quarterly	Quarterly	Quarterly

1 See Plate 4 for monitoring point locations.

2 Start-up and Normal Operations are defined in Sections 3.5.1 and 3.5.2 respectively of the text

TABLE 6

GROUNDWATER QUALITY MONITORING SCHEDULE⁽¹⁾
INTERIM REMEDIATION PROGRAM
DU PONT NIAGARA PLANT
NIAGARA FALLS, NEW YORK

Monitoring Point ⁽²⁾	Water Quality Monitoring Frequency		
	During Start-up ⁽³⁾	First Two Years	Normal Operations ⁽³⁾
GAC Influent	--	Quarterly	Quarterly
GAC Effluent	--	Quarterly	Quarterly
Treatment Plant Influent	Weekly	Twice/Month	Quarterly
Treatment Plant Effluent	Twice/Week	Weekly	Twice/Month
Pumping Wells	(4)	Monthly	--
Utility Wells (U1, U14, and U16)	--	Monthly	Quarterly
Outfalls (001E, 001W, 004, 005, 006, 007)	--	Quarterly	Quarterly
Outlets (023, 024)	--	Quarterly	Quarterly
Monitoring Wells ⁽⁴⁾ (Existing A-Zone Wells)			
1A-R	--	Monthly	Quarterly
2A	--	Monthly	Quarterly
3A	--	Monthly	Quarterly
4A-R	--	Monthly	Quarterly
5A-R	--	Quarterly	Quarterly
6A-R	--	Quarterly	Quarterly
7A-R	--	Quarterly	Quarterly
8A	--	Monthly	Quarterly
9A	--	Monthly	Quarterly
10A	--	Monthly	Quarterly
12A	--	Monthly	Quarterly
13A	--	Monthly	Quarterly
14A	--	Monthly	Quarterly
15A	--	Monthly	Quarterly
16A	--	Monthly	Quarterly
17A	--	Quarterly	Quarterly
18A	--	Monthly	Quarterly
19A	--	Quarterly	Quarterly
20A	--	Quarterly	Quarterly
21A	--	Monthly	Quarterly
22A	--	Quarterly	Quarterly
23A-R	--	Quarterly	Quarterly
24A	--	Monthly	Quarterly

TABLE 6
(continued)

Monitoring Point ⁽²⁾	Water Quality Monitoring Frequency		
	During Start-up ⁽³⁾	First Year	Normal Operations ⁽³⁾
Monitoring Wells - Existing B-Zone (1B-R, 2B, 3B, 5B-R, 8B, 12B, 16B, 19B, 20B, 22B, 23B, 24B)	--	Quarterly	Quarterly
Monitoring Wells - Existing CD-Zone (1C, 2C, 4C-R, 5CD-R, 7C-R, 15CD, 17B, 18C, 19CD1, 22C, 23C, and 26CD)	--	Quarterly	Quarterly
Monitoring Wells Existing D-Zone (1D, 5D-R, 10D, 14D, 15D, 18D, 19D, 22D, and 23D)	--	Quarterly	Quarterly
Monitoring Wells Existing F-Zone (1F, 5F-R, 7F, 10F, 15F, 17F, 22F, 23F)	--	Quarterly	Quarterly
DEC Wells (DEC 1, 2, 3, 4, and 5)	--	Quarterly	Quarterly

- (1) All analyses for RIP (Table 3).
- (2) See Plate 4 for monitoring point location.
- (3) Start-up and Normal Operations are defined in Sections 3.5.1 and 3.5.2, respectively of the text.
- (4) Sampled once within 48 hours of start up, sample water from each well, monthly thereafter.

TABLE 7
OUTFALLS
INTERIM REMEDIATION PROGRAM
DU PONT NIAGARA PLANT
NIAGARA FALLS, NEW YORK

<u>SPDES Outfall</u>	<u>Description</u>	<u>Discharge Point</u>
001 E 001 W	Non-contact cooling water and scrubber discharge from sodium	Diversion Sewer
004	Non-contact cooling water and treated process water from Terathane ^R	Niagara River
005	Non-contact cooling water from Power House	Niagara River
006	Non-contact cooling water from Liquefaction	Gill Creek
007	Non-contact cooling water from Niachlor Project	Gill Creek

CITY OF NIAGARA FALLS
WASTE WATER TREATMENT PLANT OUTLETS

023	Process discharge from Sodium Liquefaction, LRD, Terathane ^R , Powerhouse and Sanitary Sewage
024	EMD Process Discharges and Sanitary Sewage

TABLE 8

IMPLEMENTATION SCHEDULE⁽¹⁾
INTERIM REMEDIATION PROGRAM
DU PONT NIAGARA PLANT
NIAGARA FALLS, NEW YORK

<u>Item</u>	<u>Date</u>
Start Construction - Water Treatment	4 months after effective date of Record of Decision (ROD)
Mechanical Completion	19 months after effective date of ROD
Start Water Runs	21 months after effective date of ROD
Initiate Groundwater Feed	22 months after effective date of ROD

- (1) The intervals relative to the Consent Agreement will be finalized based on the effective date of the Record of Decision relative to the construction season.

TABLE 9
**PERFORMANCE CRITERIA MONITORING
 PERTINENT MONITORING POINTS
 DU PONT NIAGARA PLANT
 NIAGARA FALLS, NEW YORK**

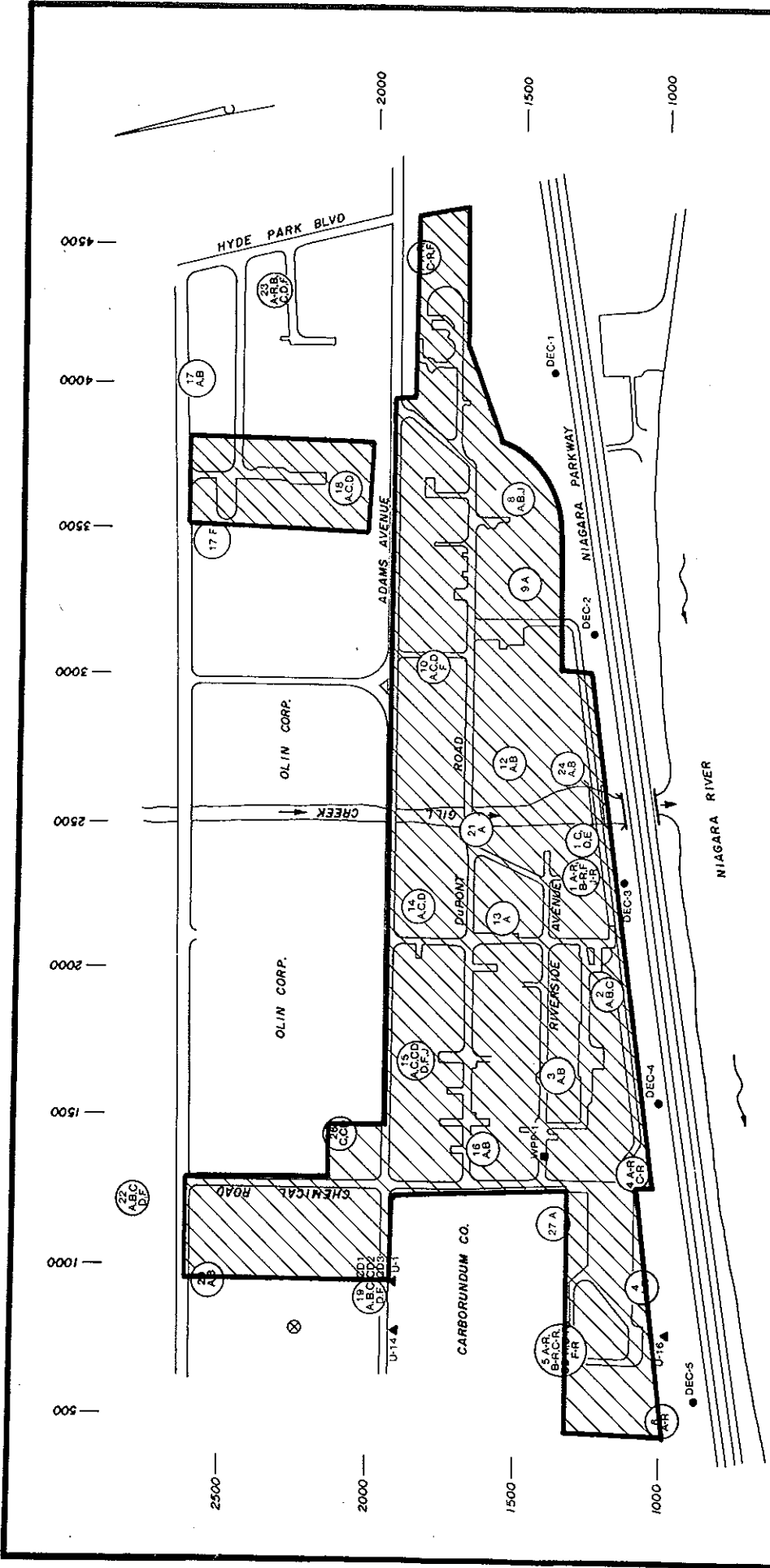
<u>In-Line Pertinent Monitoring Points</u>	<u>Outlying Pertinent Monitoring Points</u>	<u>Other Nearby Monitoring Points</u>
WPPO-1	WPO-2 WPO-10	WPT-1 WPT-2 WPT-10 MW-4A-R MW-16A MW-27A
WPPT-2	WPT-3 WPT-9	WPO-3 WPO-9 MW-3A MW-15A
WPPO-3	WPO-4 WPO-9	WPT-4 WPT-9 MW-2A
WPPT-4	WPT-4	WPO-4 MW-13A MW-1A-R
WPPT-5	WPT-6	WPO-5 WPT-5 WPO-6 MW-1A-R
PW-18 PW-19	WPO-7 WPO-8	WPT-7 WPT-8 MW-14A MW-21A
EPPT-1	EPT-1 EPT-7 EPT-8 EPT-9	EPO-1 EPO-2 EPO-7 EPO-8 EPO-9 MW-12A MW-24A

TABLE 9
(continued)

<u>In-Line Pertinent Monitoring Points</u>	<u>Outlying Pertinent Monitoring Points</u>	<u>Other Nearby Monitoring Points</u>
EPPT-2	EPT-2 EPT-6 EPT-7	EPO-2 EPO-6 EPO-7 MW-10A
EPPT-3	EPT-3 EPT-5 EPT-6	EPO-3 EPO-4 EPT-4 EPO-5 EPO-6 MW-8A MW-9A

WM-8M

Plates



LEGEND:

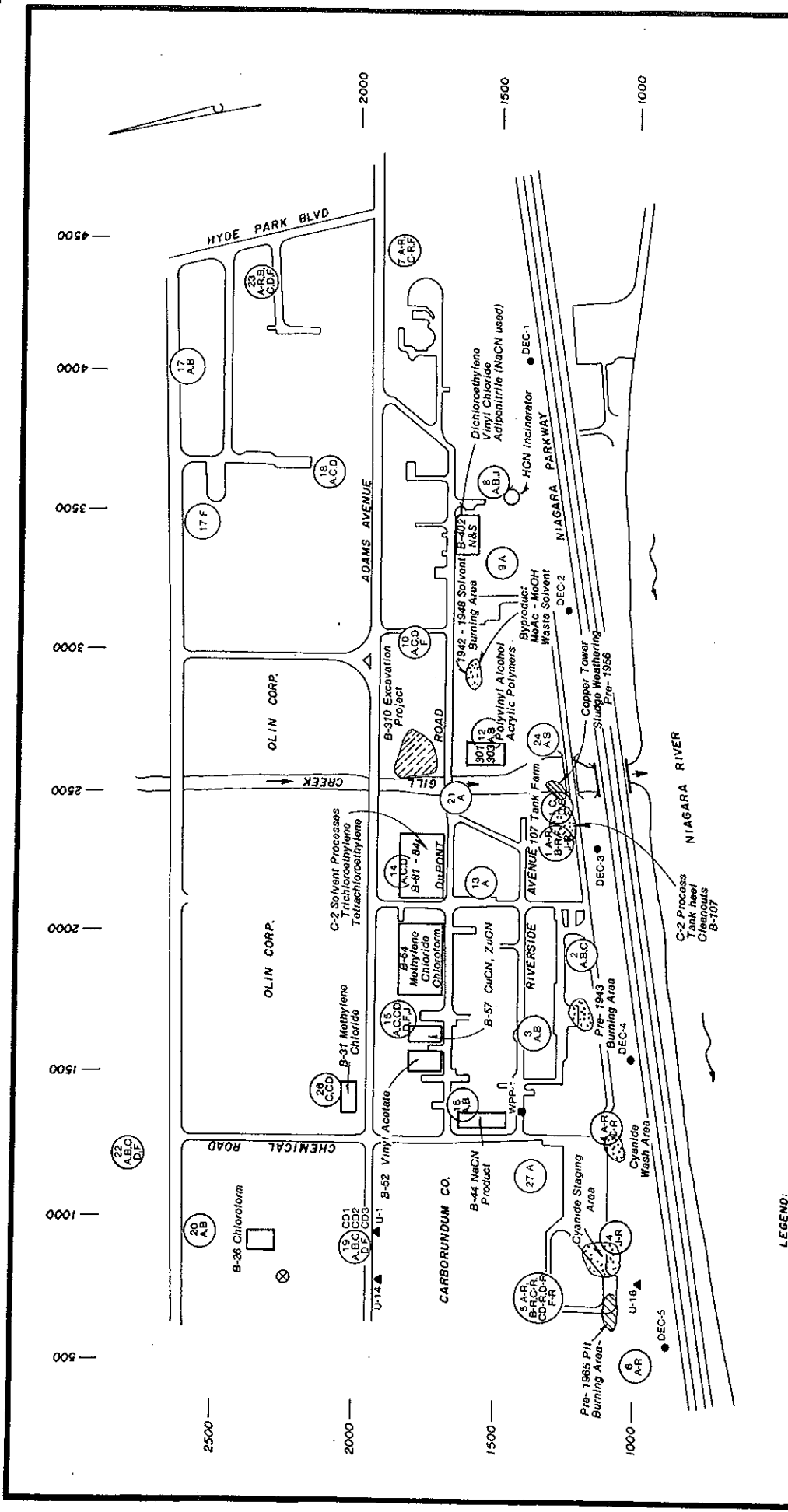
- WELL CLUSTER NUMBER (NO.)
- WELL TYPE (LETTER)
- ⊗ OLIN PRODUCTION WELL
- ▲ UTILITY WELLS
- PIEZOMETERS
- SITE BOUNDARY
- NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION MONITORING WELL

NIAGARA PLANT
BOUNDARY LOCATION PLAN
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
 CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

Drawn by: J.C.	Date: 3/9/89
Checked by: L.R.P.	Job: 88C2075B-5

SCALE IN FEET
 0 ————— 400

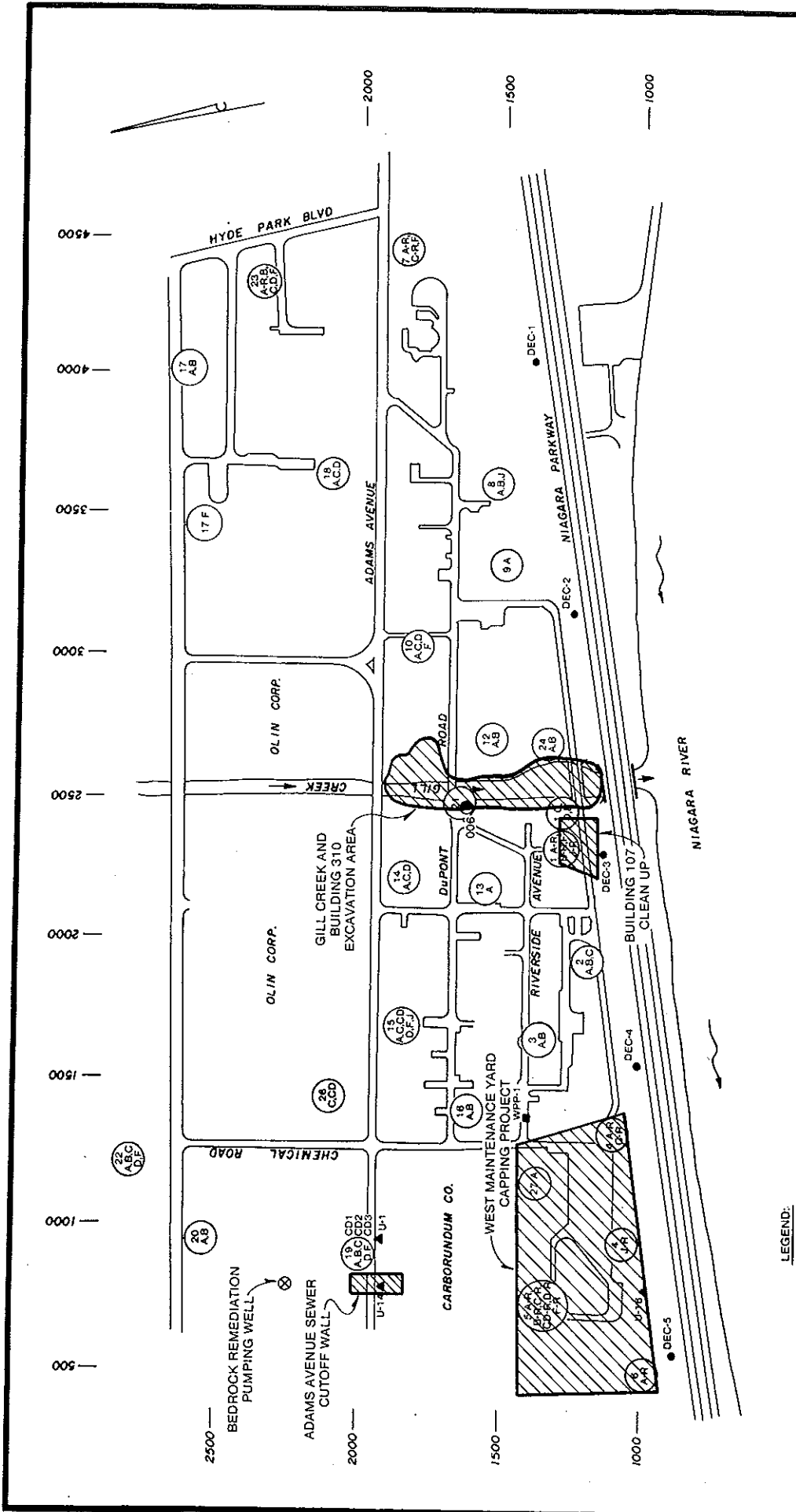


LOCATIONS OF HISTORICAL PROCESSES AND EVENTS
 NIAGARA PLANT
 E. I. DuPONT DE NEMOURS & CO.

WOODWARD-CLYDE CONSULTANTS
 CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

Drawn by: T.P. Date: 3/9/89
 Checked by: L.R.P. Scale in Feet: 0 400 800
 Job: 88C2075B-5

- LEGEND:**
- 17 WELL CLUSTER NUMBER (NO.)
 - A,B WELL TYPE (LETTER)
 - ⊗ OLIN PRODUCTION WELL
 - NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION MONITORING WELL



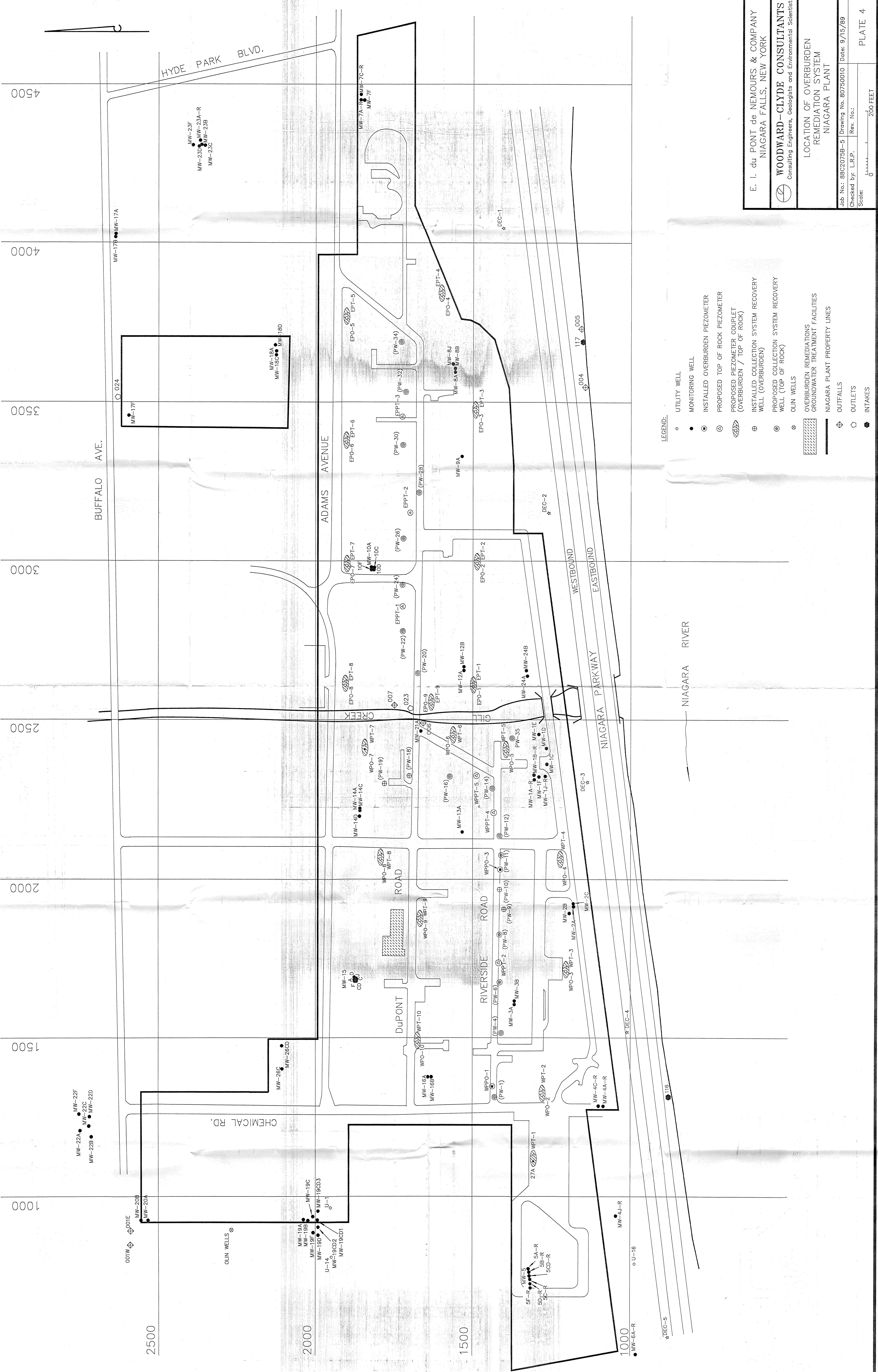
LOCATION OF PAST AND PRESENT
 REMEDIAL AREAS
 NIAGARA PLANT
 E. I. du PONT de NEMOURS & CO.

WOODWARD-CLYDE CONSULTANTS
 CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

Drawn by: J.C. Date: 3/9/89
 Checked by: L.R.P. Job: 88C20758-5

SCALE IN FEET
 0 400

- LEGEND:
- (22 ABC D/E) WELL CLUSTER NUMBER (NO.)
 - (17 AB) WELL TYPE (LETTER)
 - (X) OLIN PRODUCTION WELL
 - (●) DEC WELLS
 - (▲) UTILITY WELLS
 - (■) PIEZOMETERS
 - (●) OUTFALL DISCHARGE POINT



E. I. du PONT de NEMOURS & COMPANY
 NIAGARA FALLS, NEW YORK

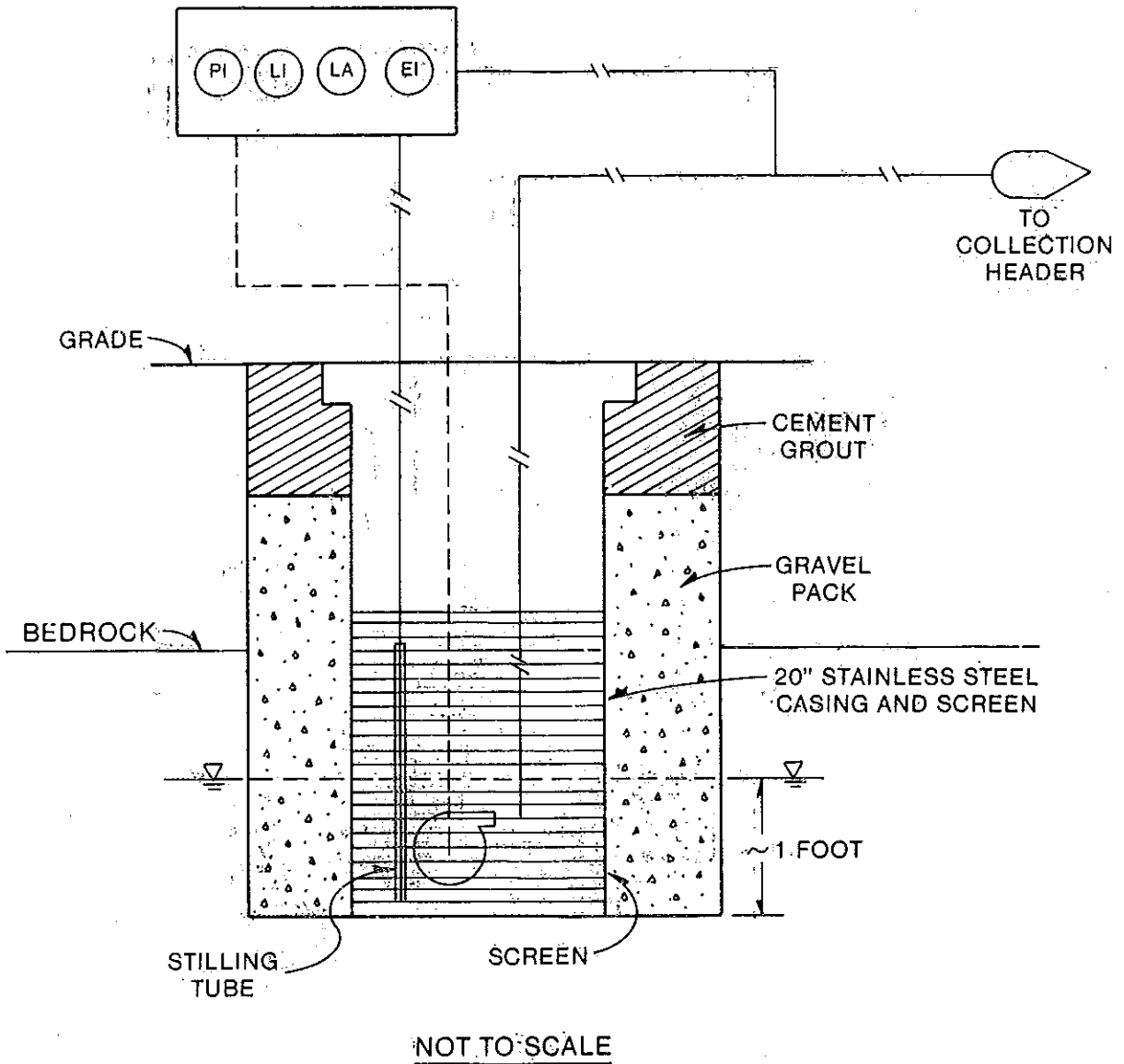
WOODWARD-CLYDE CONSULTANTS
 Consulting Engineers, Geologists and Environmental Scientists

LOCATION OF OVERBURDEN REMEDIATION SYSTEM
 NIAGARA PLANT

Job No: 88C2075B-5 | Drawing No: 80750010 | Date: 9/15/89
 Checked by: L.R.P. | Rev. No.: | Scale: 0" = 200 FEET

PLATE 4

- LEGEND:**
- UTILITY WELL
 - MONITORING WELL
 - ⊙ INSTALLED OVERBURDEN PIEZOMETER
 - ⊕ PROPOSED TOP OF ROCK PIEZOMETER
 - ⊗ PROPOSED PIEZOMETER COUPLER (OVERBURDEN / TOP OF ROCK)
 - ⊕ INSTALLED COLLECTION SYSTEM RECOVERY WELL (OVERBURDEN)
 - ⊙ PROPOSED COLLECTION SYSTEM RECOVERY WELL (TOP OF ROCK)
 - ⊗ OLIN WELLS
 - ▨ OVERBURDEN REMEDIATIONS GROUNDWATER TREATMENT FACILITIES
 - NIAGARA PLANT PROPERTY LINES
 - ↔ OUTFALLS
 - OUTLETS
 - INTAKES



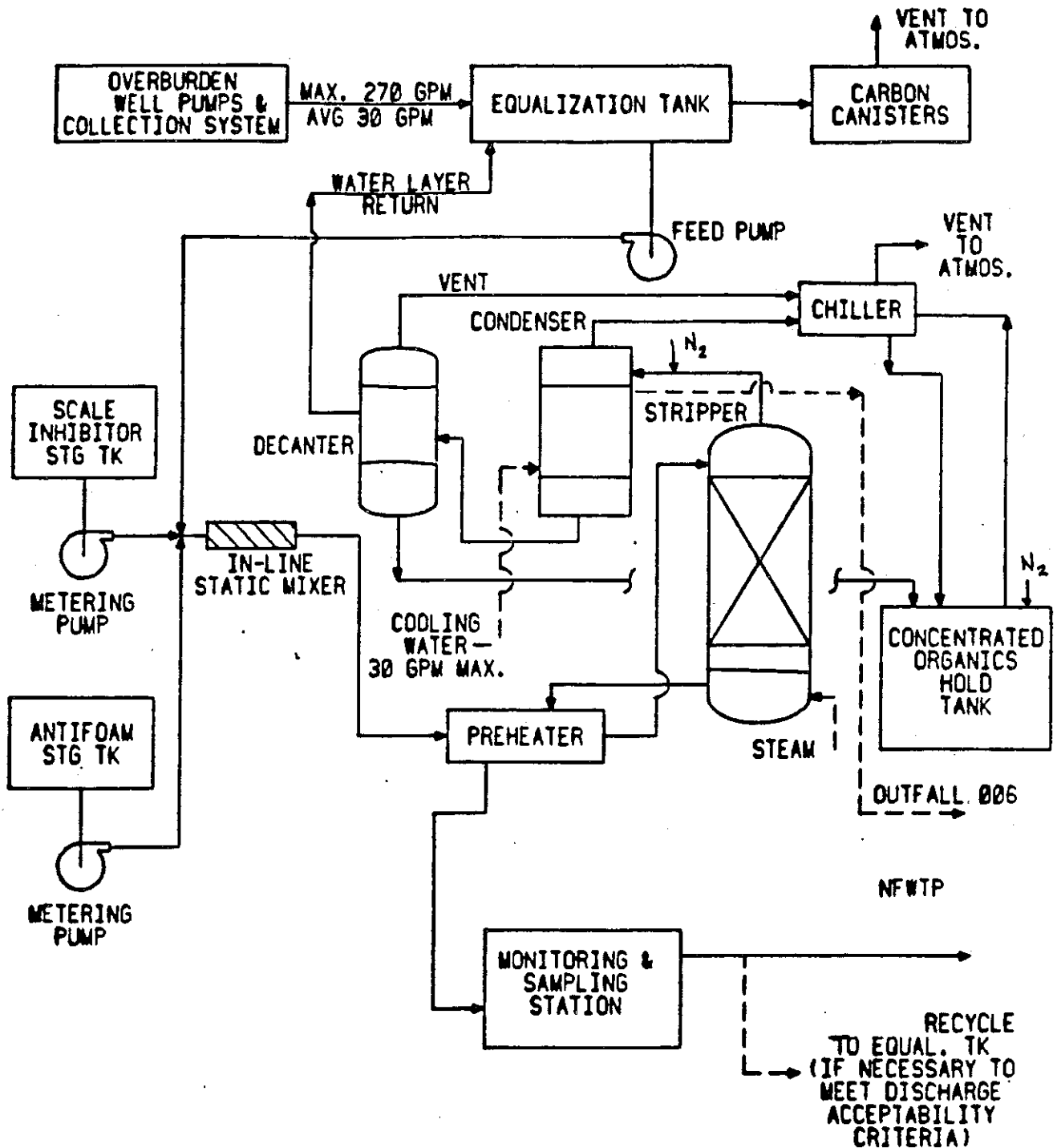
LEGEND:

- LI LEVEL INDICATOR
- PI PRESSURE INDICATOR
- LA LEVEL ALARM
- EI VOLTAGE/CURRENT INDICATOR

TYPICAL WELL PUMPING CONFIGURATION
 NIAGARA PLANT
 E. I. DU PONT DE NEMOURS & CO.



513472



GROUNDWATER TREATMENT
PROCESS SCHEMATIC
DuPONT-NIAGARA PLANT
NIAGARA FALLS, NEW YORK

Drawn by J.C.

SCALE IN FEET

Date: 9/15/89

Checked by: L.R.P.

N.T.S.

Job 88C2075B-5

Appendix A



ESTABLISHED 1802

E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED

NIAGARA FALLS, N.Y. 14302

CHEMICALS AND PIGMENTS DEPARTMENT

August 15, 1989

Mr. Peter Buechi
Regional Engineer
NYS Department of Environmental Conservation
600 Delaware Avenue
Buffalo, NY 14202

Dear Mr. Buechi:

DU PONT NIAGARA PLANT - GROUNDWATER REMEDIATION PROGRAM
LIST OF CHANGES TO QUALITY ASSURANCE/QUALITY CONTROL MANUAL

As requested by the NYSDEC, attached are the changes that will be incorporated into the revised Quality Assurance/Quality Control (QA/QC) Audit Manual for the Niagara Plant Groundwater Remediation Program. The revised manual, Version 3.0, is due for completion by the end of the third quarter of this year.

If you should have any questions, please contact me at (716) 278-5432.

Sincerely,

Gwen J. Moody
Project Manager
Groundwater Remediation

GJM:k1f
Attach.
5384

cc: Mr. C. Allen, NYSDEC (Albany)
Mr. Y. Erk, NYSDEC (Buffalo)
Mr. G. Bailey, NYSDEC (Buffalo)

DU PONT NIAGARA PLANT GROUNDWATER REMEDIATION
QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

A separate QA/QC Audit Manual will be prepared for the Du Pont Niagara Plant, and will be labeled Version 3.0. The following changes will be incorporated into this revised manual.

1. Analytical clean-up methods and procedures employed by the laboratory will be listed.
2. The laboratory chosen by Du Pont for this analytical program will maintain DOH ELAP certification for all applicable sub-categories of solid and hazardous waste. Furthermore, the selected laboratory will be listed as an acceptable laboratory in all applicable sub-categories of the current NYSDEC Technically Acceptable Laboratory list at the time of contract award by Du Pont.
3. An organizational chart with a designated Quality Assurance officer and signature page will be included. The Version 3.0 Manual, with these listed revisions, will be signed by the QA officer prior to submission to the NYSDEC. Qualifications of the QA officer and supporting staff, including a data validator, will be included. All data validators shall be independent of the laboratory chosen for the analysis. The criteria by which the data shall be validated will also be included.
4. Upon written request from the NYSDEC, Du Pont will supply relevant contractual information concerning their agreement with the Quality Assurance/Quality Control program consultant/auditor.
5. Beginning with the Second Quarter 1989 QA/QC Quarterly Audit Report, all chain-of-custody forms and Forms 1-13 will be supplied to the NYSDEC. When the Information Management System (IMS) becomes operational, Forms 1-13 will no longer be submitted.
6. Du Pont will submit, upon annual written request from the NYSDEC, raw data for analytical results. Submittal will be no more than one quarter's worth of raw data, and no more than once per year.
7. Du Pont will submit copies of the Annual Laboratory Audit Report(s) to the NYSDEC.

DU PONT NIAGARA PLANT GROUNDWATER REMEDIATION
QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

8. Pesticides/PCB surrogates dibutylchloroendate and tetrachloro meta-xylene will be included in Table D-5 for EPA Method 8080. The chlorinated hydrocarbon surrogate for EPA Method 8120 will be included in Table C-5.
9. Table D-3 will list pesticide/PCB analysis using EPA Method 8080. Table D-6 will be updated to include matrix spike analytes and recovery data for Method 8080. The typographical error on page 21 will be corrected to Tables D-7 and D-8 from Tables E-7 and E-8.
10. The external and internal GC calibration requirements will be changed to a minimum of five different concentration standards as stated in EPA Methods 8080, 8010, 8040, and 8120.
11. Clarification will be made to the calibration check on page F8, No. 16, stating that it does refer to the GC/MS daily calibration standard.
12. The following statements will be added to the appropriate sections of the Laboratory Evaluation Checklist:
 1. Did 4,4-DDT and Endrin exceed the 20 percent breakdown criteria? If so, what corrective action was taken?
 2. Method 8080 and 8120: If the clean-up procedure is used, did the laboratory demonstrate that the compounds of interest are being quantitatively recovered before applying the method to actual samples and that the associated QC samples are processed through the cleanup method?
 3. Required GC Instrument QC:
 - a. Were the criteria for percent RSD and percent D met for the initial and daily calibration, respectively?
 - b. Did the laboratory establish a retention time (RT) window for each compound of interest?
 - c. Were positively identified analytes confirmed on a second dissimilar column?

DU PONT NIAGARA PLANT GROUNDWATER REMEDIATION
QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

4. Required GC/MS Instrument QC:
 - a. Were the criteria for percent RSD and percent D met for the initial and daily calibration, respectively?
 - b. Were SPCC and CCC criteria met for each GC/MS instrument?
 - c. Were the analytes identified by comparison of the sample mass spectrum to the daily calibration standards?
 - d. Are the sample component RRT and daily standard component RRT within ± 0.006 RRT units?
 - e. Are all ions present in the daily standard mass spectrum at a relative intensity greater than 10 percent also present in the sample mass spectrum?
 - f. Do the relative intensities specified in "e" above agree within 20 percent between sample and standard spectra?
5. The QC procedures for EPA Methods 9250 (chloride), 9010 (cyanide), 9066 (phenolics), 9020 (TOX), 9060 (TOC), and 7080 (soluble barium) will be included. The No. 4 note at the bottom of Table B-6 (page B11) will be corrected. Spike data from the laboratory will be included, and questions pertaining to QC procedures for the above six EPA Methods will be added to the Laboratory Evaluation Checklist.
13. Data qualifiers are being incorporated into the QA/QC Program and will be presented with the Second Quarter 1989 Quarterly QA/QC Audit Report. A description of the data qualifiers will be included in the Version 3.0 Manual.
14. Samples will be analyzed using EPA Method 8270 in addition to 8240 and 8080 for EPA HSL organic compounds.
15. Any groundwater samples collected from newly installed monitoring wells will be analyzed for the HSL compounds specified in the Contract Laboratory Program (CLP) on a one-time basis.

DU PONT NIAGARA PLANT GROUNDWATER REMEDIATION
QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

16. QA/QC violations will be reported to the NYSDEC as part of the quarterly QA/QC audit reports.
17. All sample labels will contain the sample date.
18. The methods to be used for analyses TOC, TOX, and phenolics will be 9060, 9020, and 9066, respectively.
19. One laboratory blank will be run for each analysis date.
20. The holding time for total organic halogens will be seven days.
21. The holding time for chloride will be 28 days.
22. "Working Range Concentrations" will be replaced with the recommended PQL's as stated in SW-846, 3rd edition.
23. An entry will be included on the Version 3.0 Manual Audit form which indicates whether all required TIC's were reported.
24. The parameter "1-methyl-4,6-dinitrophenol" will be changed to "2-methyl-4,6-dinitrophenol."
25. The spike recovery range for dieldrin will be 29-136.
26. Starting and continuing with the First Quarter 1989 QA/QC Quarterly Audit Report, all field duplicate and lab replicate results will be reported.

Appendix B

Mr. Peter Buechi

2

August 16, 1989

6. All personnel working within those areas of the plant where groundwater remediation excavations are being conducted shall be trained in accordance with OSHA 1910.120.

If you have any comments, please contact me at (716) 278-5432.

Sincerely,



Gwen J. Moody
Project Manager
Groundwater Remediation

GJM:klf
5443

cc: Mr. Y. Erk, NYSDEC (Buffalo)
Mr. G. Bailey, NYSDEC (Buffalo)
Mr. A. Wakeman, NYSDEC (Albany)
Mr. C. Allen, NYSDEC (Albany)

Appendix C



E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED
NIAGARA FALLS, N.Y. 14302

CHEMICALS AND PIGMENTS DEPARTMENT

July 6, 1989

Mr. Peter Buechi
Regional Engineer
NYS Department of Environmental Conservation
600 Delaware Avenue
Buffalo, NY 14202

Dear Mr. Buechi:

UPDATE TO PLANS AND SPECIFICATIONS
DU PONT NIAGARA PLANT GROUNDWATER REMEDIATION PROGRAM

Mr. Yavuz Erk requested that Du Pont submit a list of changes that have been made to the Plans and Specifications for our proposed Groundwater Remediation Project. These changes are based on the Plans, Specifications and Engineering Report submitted to the DEC on February 5, 1987. The following changes are due to improved pumping well design, additional groundwater modeling and pump testing, and further review of EPA regulations.

Collection System

- Twenty-two (22) pumping wells will be installed to collect groundwater and maintain an inward gradient. Pumping wells PW2, PW5, PW7, PW13, PW15, PW17, PW21, PW23, PW25, PW27, PW29, PW31, and PW33 have been eliminated. A new pumping well (PW35) has been added and will be located at (approximately) coordinates N1380, E2440.
- Five pumping wells have already been installed and are drilled down to the top of the bedrock. The design for the remaining pumping wells has been modified to extend the wells three to five feet into the top of the bedrock. These wells will be screened in both the top of the bedrock and the overburden.

Treatment Facility

- Regulated nitrogen supply will be provided at the primary condenser.

Mr. Peter Buechi

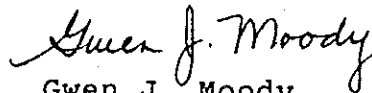
2

July 6, 1989

- Additional instrumentation will be provided to increase protection against discharging untreated groundwater through the stripper column bottoms to the city 023 outfall.
- A recycle line will be installed from the column bottoms to the stripper feed line to ensure that the feed rate to the column does not go below minimum turn-down rate.
- The equalization tank will be designed for the detection of leaks.

If you should have any questions, please call me at (716) 278-5432.

Sincerely,



Gwen J. Moody
Project Manager
Groundwater Remediation

GJM:klf
5072

cc: Y. Erk, NYSDEC (Buffalo)
C. Allen, NYSDEC (Buffalo)
G. Bailey, NYSDEC (Buffalo)
M. Hopkins, NCHD