Off-Plant Contaminant Loading Rates First Quarter, 1987 Niagara Plant Niagara Falls, New York

Woodward-Clyde Consultants

Consulting Engineers, Geologists and Environmental Scientists

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Woodward-Clyde Consultants

July 22, 1987
87C2555G-1

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

Attention: Mr. Richard J. Gentilucci
Operations Manager
Environmental Affairs

OFF-PLANT CONTAMINANT LOADING RATES
FIRST QUARTER 1987

Gentlemen:

In accordance with your request, Woodward-Clyde Consultants has calculated contaminant loading rates for the Niagara Plant using data for the Fourth Quarter 1987. The loading rates were calculated for the indicator organic compounds.

We appreciate the opportunity to be of service to DuPont on this project. If you have any questions, please contact us.

Very truly yours,

WOODWARD-CLYDE CONSULTANTS

Madalyn Dixon
Staff Geologist

Lynn Rubisch Penniman, CPSS
Project Manager

MD/LRP/vbg/WM-8E

cc: R. Marczewski
F. Waller
A. Hirsch
K. McIntosh

OFF-PLANT CONTAMINANT LOADING RATES FIRST QUARTER 1987

Prepared for:

E. I. DU PONT DE NEMOURS AND COMPANY

Niagara Falls, New York

Prepared by:

WOODWARD-CLYDE CONSULTANTS

Plymouth Meeting, Pennsylvania

July 1987

EXECUTIVE SUMMARY

Off-plant contaminant loading rates have been calculated by Woodward-Clyde Consultants using groundwater elevation and water quality data for the first quarter 1987. Loading rates were calculated for the indicator organic compounds.

The total contaminant loading rates were separated into that portion captured by the current bedrock groundwater remediation program (Olin Production Wells) and that portion migrating to the off-plant hydrologic environment. The total first quarter 1987 loading rate was 55 pounds per day. Of this total, 47 pounds per day were estimated to be captured by the Olin production wells and 7.9 pounds per day were estimated to be migrating to the off-plant hydrologic environment.

These results indicate the present bedrock groundwater remediation program contains approximately 86 percent of the non-point source contaminant migration. Excluding the contaminant migration in the overburden, the percent containment within the bedrock is approximately 90. The percent containment for the first quarter 1987 is consistent with that of previous sampling periods.

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1.0 INTRODUCTION

In accordance with the Niagara Plant environmental monitoring program, Woodward-Clyde Consultants (WCC) calculated contaminant loading rates using groundwater elevation and water quality measurements for the first quarter of 1987. These loading rates, in conjunction with loading rates calculated for previous sampling periods, reflect the impact of the operating bedrock groundwater remediation program.

2.0 METHODS

Contaminant loading rates were calculated using water quality and groundwater elevation data obtained from monitoring wells at the Niagara Plant (Plate 1). As in previous reports, loading rates were not estimated for those zones not considered significant water-bearing zones (C, E, and J). The compounds used for these contaminant loading rate calculations are listed in Table 1. Note that both the cis and trans isomers for 1,2-dichloroethylene have been included. The methodology used to estimate contaminant loading rates is presented in Appendix A.

3.0 RESULTS

Appendix B contains contour maps used to estimate hydraulic gradients, transmissivities and contaminant concentrations for water-bearing zones A, B, CD, D and F. Figures B-1 through B-5 present the groundwater contour maps for each zone. Flow sections are delineated within each zone for all maps. Figures B-6 and B-10 show the transmissivity distribution for each zone. Figures B-11 through B-15 present total indicator organic concentration contour maps for each zone. Appendix C contains tabulated values used in calculations and the resultant groundwater flow rates. Appendix D contains groundwater flow rates and indicator organic concentrations used in calculations and the resultant contaminant loading rates. Average values presented in this report have been calculated using results from WCC reports "Off-Site Contaminant Loading Rates Fourth Quarter 1984 Through Third Quarter 1985" (April 3, 1986), "Off-Plant Contaminant Loading Rates Fourth Quarter 1985 Through Third Quarter 1986" (June 10, 1987) and "Off-Plant Contaminant Loading Rates Fourth Quarter 1986" (June 10, 1987).

3.1 GROUNDWATER FLOW RATES

Table 2 presents the estimated off-plant groundwater flow rates for each water-bearing zone for the first quarter 1987. Groundwater flow rates for all monitoring periods to date are plotted over time on Plate 2. The maximum flow rate for a single zone was 76.7 gpm in the CD-zone and the minimum value was 7.3 gpm in the F-zone. These values are consistent with flow rates for previous sampling periods.

3.2 CONTAMINANT LOADING RATES

Table 3 presents contaminant loading rates per zone for the first quarter 1987. The rate of non-point source contaminant migration is given by the total contaminant loading rates. Plates 3 and 4 show total contaminant loading rates by water-bearing zone plotted over time for all samplings to date.

The total contaminant loading rates are divided into that portion captured by the Olin production wells and that portion estimated to migrate to the off-plant hydrologic environment (Table 3). The rates for all samplings to date are plotted over time on Plate 5.

The remedial influence of the Olin production wells has been shown by WCC to extend throughout most of the west plant area (WCC report "Hydraulic Impact of Olin Production Wells at the Niagara Plant" dated April 3, 1986 and "Final Report, Pump Test Program," dated June 19, 1985). A groundwater divide geographically located near Gill Creek marks the eastern extent of the remediated area. As groundwater levels in the Olin wells are not available for use in preparing groundwater elevation contours, the impact of the production wells may not be completely represented on the first quarter contour maps. Flow sections estimated discharge to the Olin wells in their entirety are B-1, CD-1, CD-2 and F-1. In addition, 90 percent of flow section CD-3 and 50 percent of B-2, D-1 and F-2 are estimated to discharge to the Olin wells.

The net off-plant loading rates are estimated for those flow sections beyond the remedial influence of the Olin production wells. These include the total of the A-zone loading rates. Those flow sections within the bedrock east of Gill Creek are also considered to discharge primarily off-plant.

4.0 CONCLUSIONS

The sum of the estimated contaminant loading rates for the first quarter 1987 is 54.7 pounds per day. Of the total, the portion captured by the Olin production wells is 46.8 pounds per day. These values indicate 86 percent of non-point source contaminant migration is contained by the present bedrock groundwater remediation program. The net off-plant loading rate is 7.9 pounds per day. Excluding the contaminant migration in the overburden, off-plant non-point source contaminant migration is 5.1 pounds per day, percent containment within the bedrock is approximately 90.

The effectiveness of the in-place bedrock groundwater remedial program is consistent with that of all previous monitoring periods. The average total contaminant loading rate to date is 78 pounds per day. The average rate captured by the Olin wells is 67 pounds per day. The average net off-plant loading rate is 10 pounds per day. Excluding the A-zone the average net off-plant loading rate is 7.1 pounds per day.

5.0 LIMITATIONS

The groundwater flow rate calculations were based on an assumption that Darcy flow conditions exist. These methods will yield estimates of groundwater flow and contaminant loading rates with order-of-magnitude accuracy, and could be expected to vary from the estimates provided. The loadings presented are calculated from available subsurface geologic and groundwater chemistry data and are subject to confirmation and/or revision as additional information becomes available.

Tables

TABLE 1

INDICATOR ORGANIC COMPOUNDS
USED IN LOADING RATE CALCULATIONS
FIRST QUARTER 1987
Niagara Plant
E.I. du Pont de Nemours and Company

Benzene

Chlorobenzene

Chloroform

trans-1,2-Dichloroethylene

cis-1,2-Dichlorothylene

Methylene chloride

1,1,2,2-Tetrachloroethane

Tetrachloroethylene

Trichloroethylene

Vinyl chloride

A-BHC

B-BHC

D-BHC

G-BHC

PCB-1254

TABLE 2

FIRST QUARTER 1987
OFF-PLANT GROUNDWATER FLOW RATES
Niagara Plant
E.I. du Pont de Nemours and Company

Water-Bearing Zone	Groundwater Flow Rate (gpm)
A-Zone	31.26
B-Zone	45.52
CD-Zone	76.73
D-Zone	10.15
F-Zone	7.31

TABLE 3

CONTAMINANT LOADING RATES BY ZONE
FIRST QUARTER 1987
TOTAL, TO OLIN, NET OFF-PLANT
Niagara Plant
E.I. du Pont de Nemours and Company

Water-Bearing Zone	INDICATOR ORGANIC LOADING RATES (lb/day) Total	To Olin(1)	Net Off-Plant	Percent Containment
A-Zone(2)	2.87	0.00	2.87	0.0
B-Zone	2.51	1.23	1.28	49
CD-Zone	47.74	44.84	2.90	94
D-Zone	1.27	0.62	0.65	49
F-Zone	.32	.09	.23	28
Total	54.71	46.78	7.93	86
Total Excluding A-Zone	51.84	46.78	5.06	90

(1) Flow sections B-1, CD-1, CD-2, and F-1 discharge entirely to the Olin wells, 50 percent of B-2, 90 percent of CD-3, 50 percent of D-1, and 50 percent of F-2 also discharge to the Olin wells.

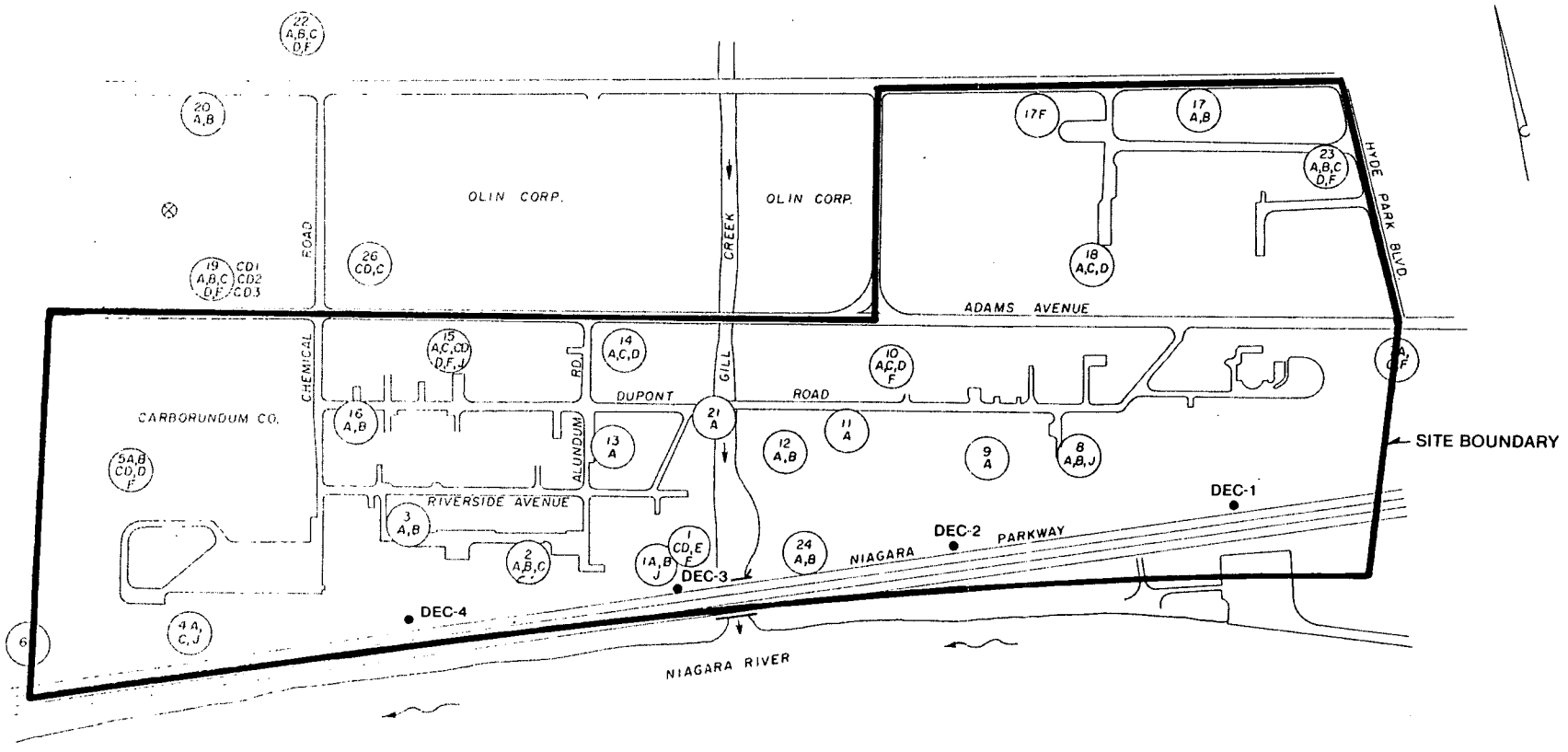
(2) The A-Zone is considered overburden and is not influenced by the bedrock groundwater remediation program.

TABLE 4

AVERAGES TO DATE
INDICATOR ORGANIC LOADING RATE TOTALS
FOURTH QUARTER 1984 THROUGH FIRST QUARTER 1987
Niagara Plant
E.I. du Pont de Nemours and Company

Water-Bearing Zone	Average for 4th Qtr 1984 to 1st Qtr 1987	1st Qtr 1987 Rates	Average To Date
TOTAL LOADING RATES (lb/day)			
A	2.9	2.87	2.9
B	13	2.51	12
C	64	47.74	62
D	0.4	1.27	0.50
F	0.5	.32	0.50
Total	81	54.71	78
LOADING RATES TO THE OLIN PRODUCTION WELLS (lb/day)			
A	0.0	0.0	0.0
B	10	1.23	9.1
CD	59	44.84	57
D	0.4	0.62	0.42
F	0.05	0.09	0.06
Total	69	46.78	67
LOADING RATES OFF-PLANT			
A	2.9	2.87	2.9
B	2.8	1.28	2.7
CD	4.2	2.90	4.1
D	0.01	0.65	0.07
F	0.5	.23	0.47
Total	10	7.93	10
TOTAL EXCLUDING A-ZONE	7.1	5.06	7.1

Plates



LEGEND:

17 A,B — WELL CLUSTER NUMBER (NO.) / WELL TYPE (LETTER)

⊗ OLIN PRODUCTION WELL

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

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

Drawn by: T.P.	SCALE IN FEET 0 300	Date: 7/2/87
Checked by: K.R.M.		Job: 87 C 2555 G-1

PLATE 1

GROUNDWATER FLOW RATES BY ZONE
DuPont Niagara Plant

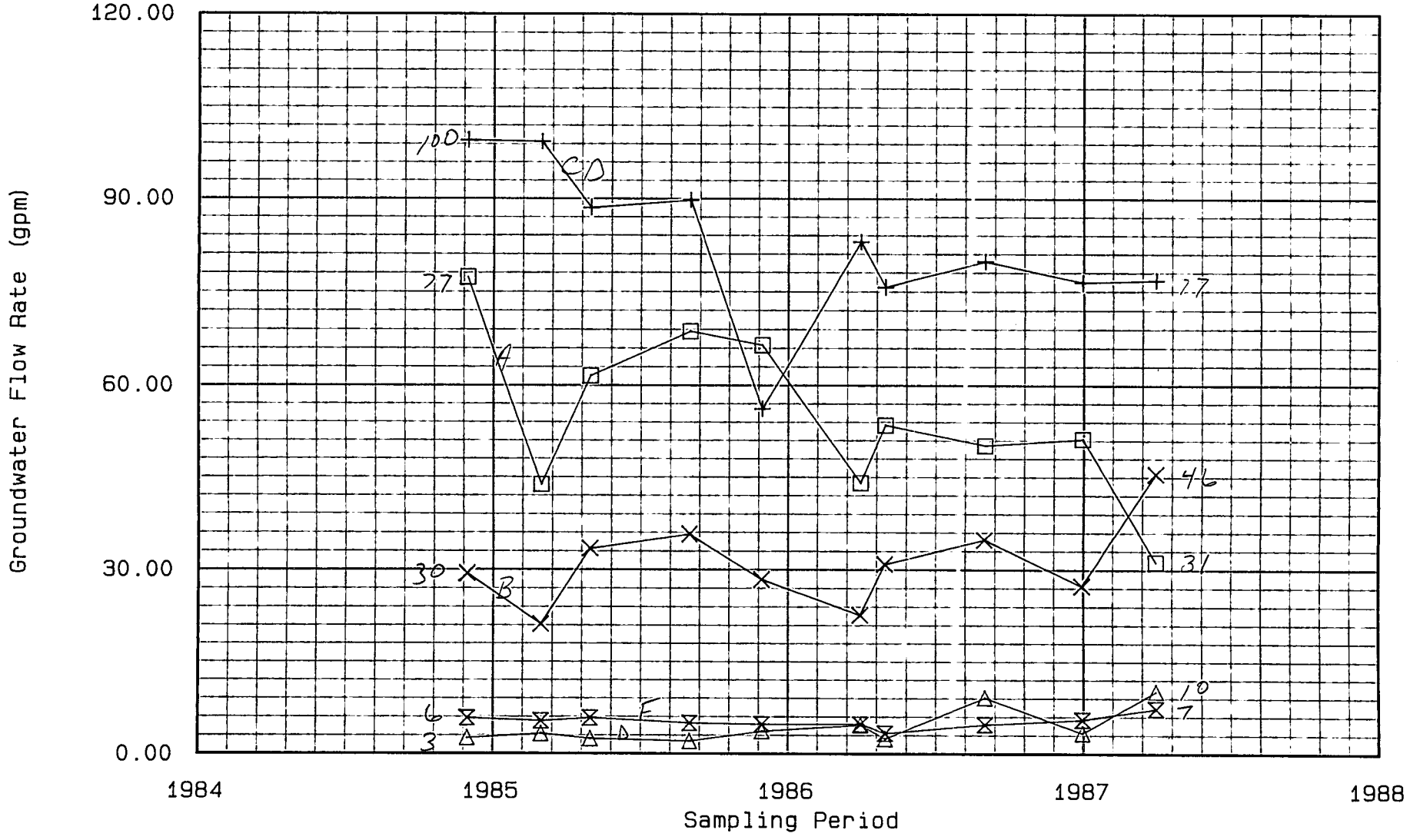


Plate 2

CONTAMINANT LOADING RATES FOR B- AND CD-ZONES
DuPont Niagara Plant

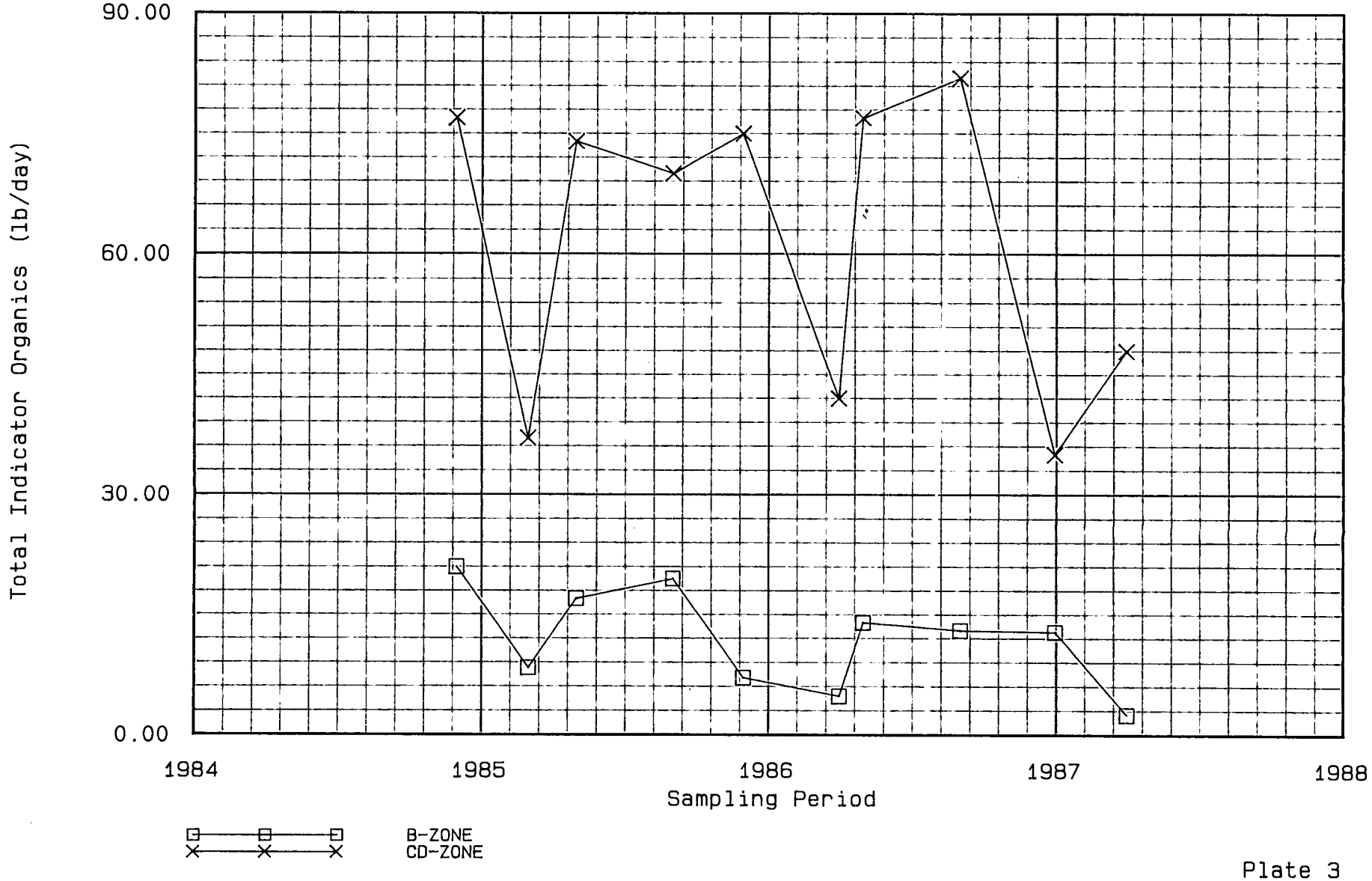


Plate 3

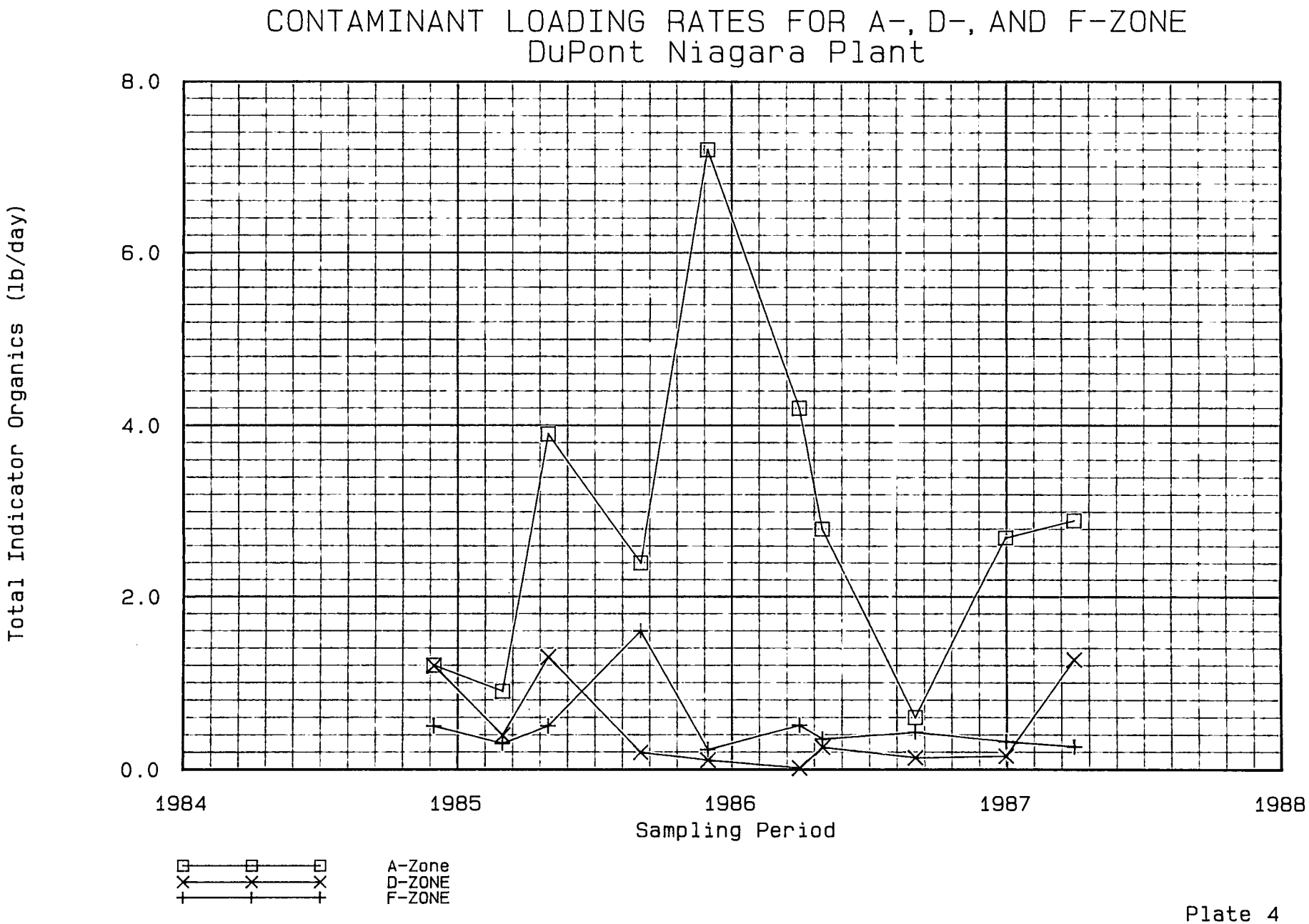

CONTAMINANT LOADING RATES FOR A-, D-, AND F-ZONE
DuPont Niagara Plant
Total Indicator Organics (lb/day)
8.0
6.0
4.0
2.0
0.0
1984
1985
1986
1987
1988
Sampling Period
A-Zone
D-ZONE
F-ZONE

Plate 4

TOTAL CONTAMINANT LOADING RATES, DUPONT NIAGARA PLANT
Total, to Olin, and Net Off-Plant

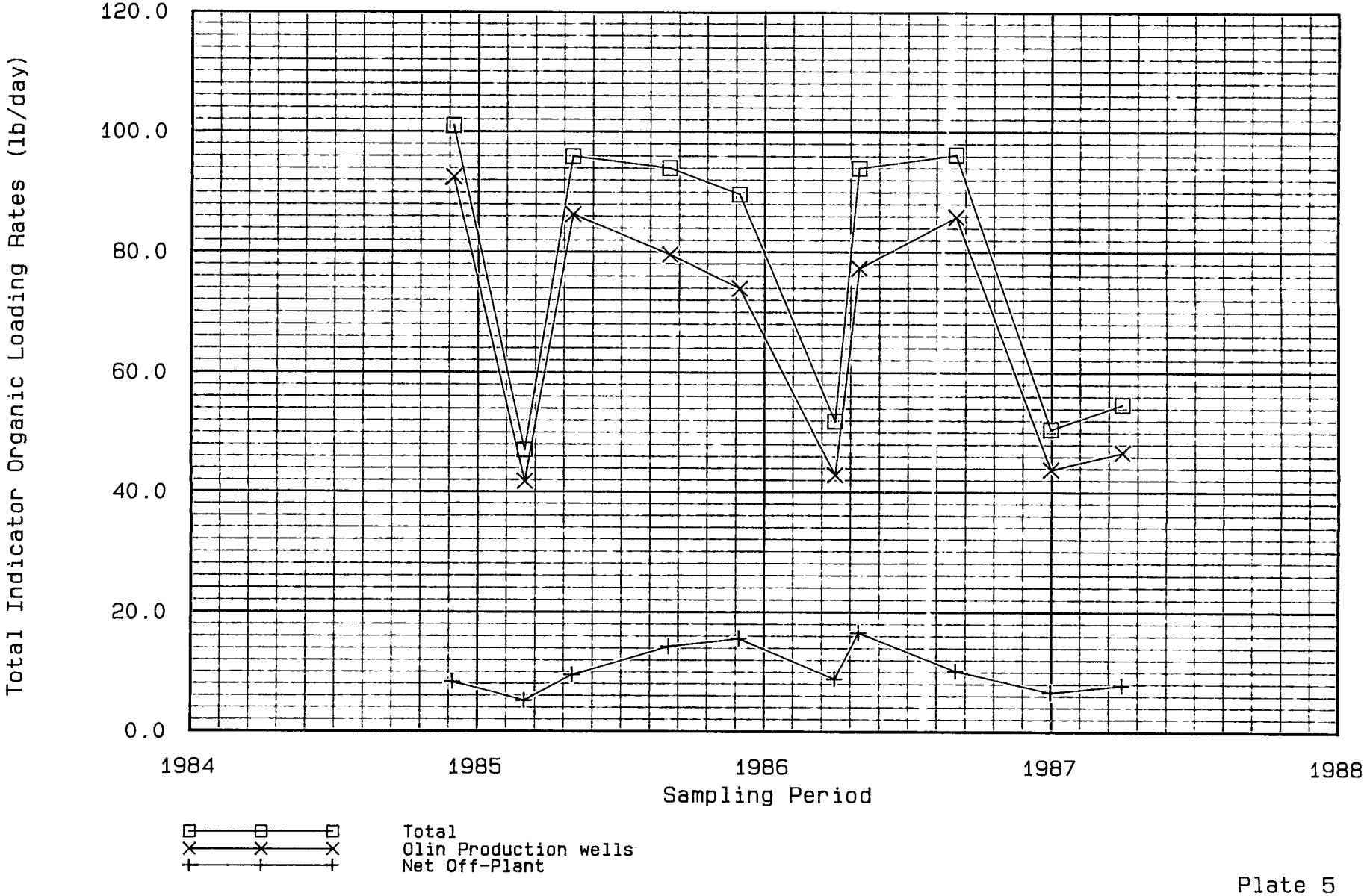


Plate 5

Appendix A

APPENDIX A

METHODOLOGY

Contaminant loading rates are a measure of contaminant migration through the subsurface at a designated site boundary. Contaminant concentrations from groundwater monitoring wells, estimated groundwater flow rates, and Darcy's Law are used to calculate contaminant loading rates. This methodology describes the procedures used to calculate contaminant loading rates at Du Pont's Niagara Plant.

ESTIMATION OF GROUNDWATER FLOW RATE AND DISTRIBUTION

Groundwater flow rates are calculated using Darcy's Law as it is applied to fractured media of which a regional spatial continuum is assumed.

$$Q = Tiw$$

where: Q = groundwater flow (ft^3/sec)
T = transmissivity (ft^2/sec)
i = hydraulic gradient
w = flow section width (ft)

Application of the above equation requires definition on the subsurface groundwater flow system. Groundwater elevation data are contoured on a site base map to estimate the hydraulic gradient and its distribution within the subsurface. Elevation data are plotted and equipotential lines are interpolated between data points, yielding a representation of the distribution of fluid potential for each water-bearing zone.

On the basis of the hydraulic head distribution, each hydrologic zone is divided into distinct regions of flow bounded by flow lines. Each flow section boundary represents theoretically impermeable boundaries; that is, there is no groundwater flow across flow lines. The projection of flow sections reduces the region of flow for more accurate calculation of flow rates and also creates a visible sense of the flow system.

The hydraulic gradient (1) is the change in groundwater head with a change in distance in a given direction. The hydraulic gradient is measured from the contour maps within each flow section the site boundary. The change in hydraulic head is divided by the corresponding change in linear distance. The width (w) of each flow section is measured at the downgradient plant site boundary.

Transmissivity (T) is the hydraulic conductivity of a unit width of the full thickness of the aquifer under a unit hydraulic gradient. Transmissivity is determined using site-specific slug test data for confined hydraulic conditions. Transmissivity for unconfined conditions, such as the overburden zone, is determined by multiplication of saturated thickness and measured hydraulic conductivity values. The transmissivity data were plotted and contour maps were prepared. The values used in calculating flow rates for each flow section were obtained from the contour maps using weighted averaging at the downgradient flow zone boundary.

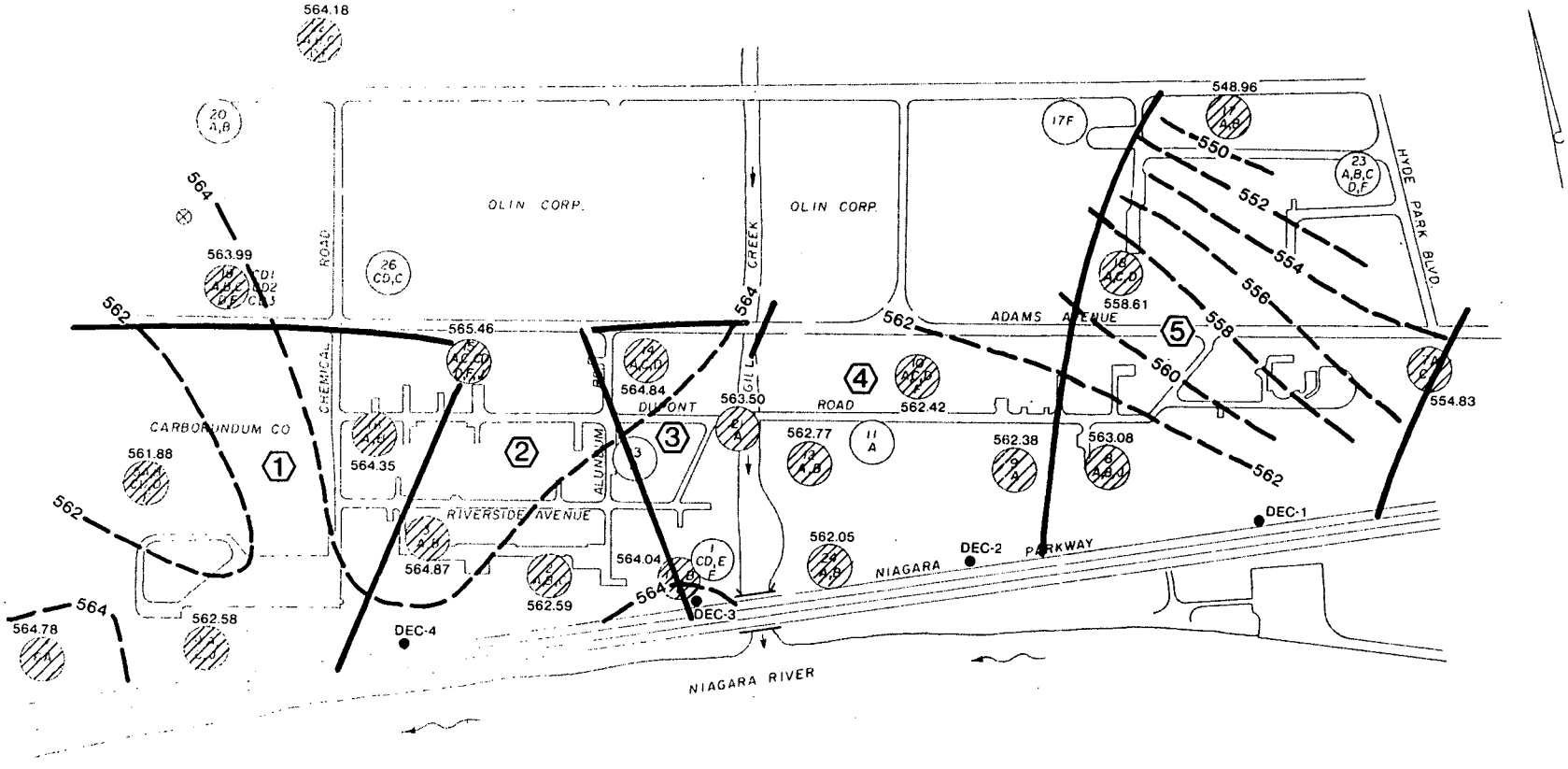
ESTIMATION OF CONTAMINANT CONCENTRATIONS

Total indicator organic data from samples taken at the site were plotted and isoconcentration contour maps were contracted. TIO concentration values are used in calculations obtained through weighted averaging of concentrations at the downgradient flow section boundary.

ESTIMATION OF CONTAMINANT LOADING RATES

Average concentration values and groundwater flow rates are used to calculate contaminant loading rates per flow section. These values are expressed in pounds per day leaving the plant. The total of all flow sections is equal to the off-plant loading rate per water-bearing zone. Loading rates are calculated at a line perpendicular the groundwater flow section used. This line is coincident with the plant boundaries (where possible) any may change depending on the configuration of the groundwater contours.

Appendix B



A-ZONE GROUNDWATER ELEVATION CONTOURS
FIRST QUARTER, 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

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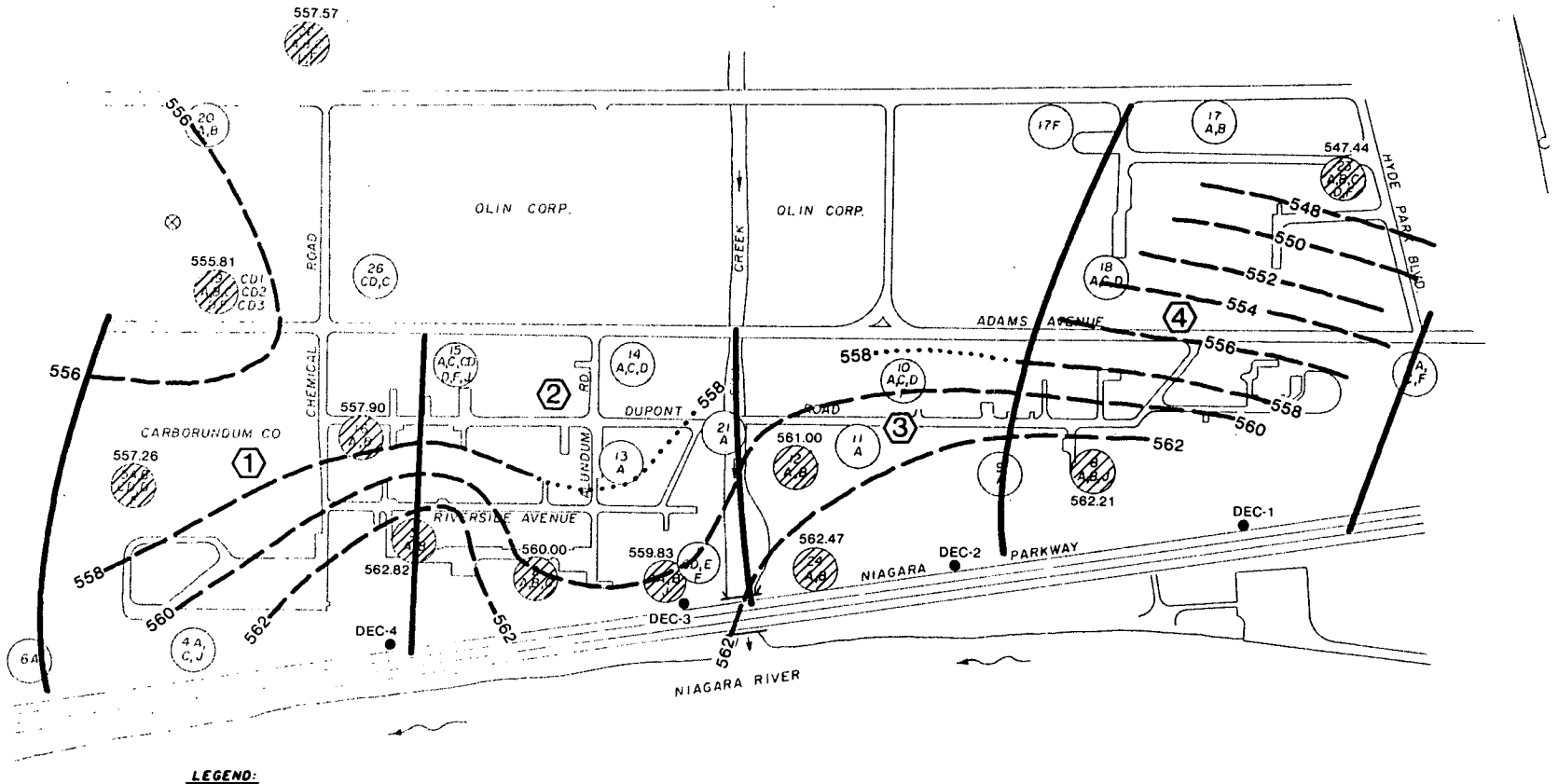
Checked by: M.D.		Job: 87C2555 G-1

FIGURE B-1



LEGEND:

- WELL CLUSTER NUMBER (NO.)
- WELL TYPE (LETTER)
- OLIN PRODUCTION WELL
- —550— GROUNDWATER ELEVATION CONTOUR (ft.)
- WELL USED IN STUDY
- FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

B-ZONE GROUNDWATER ELEVATION CONTOURS
FIRST QUARTER, 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
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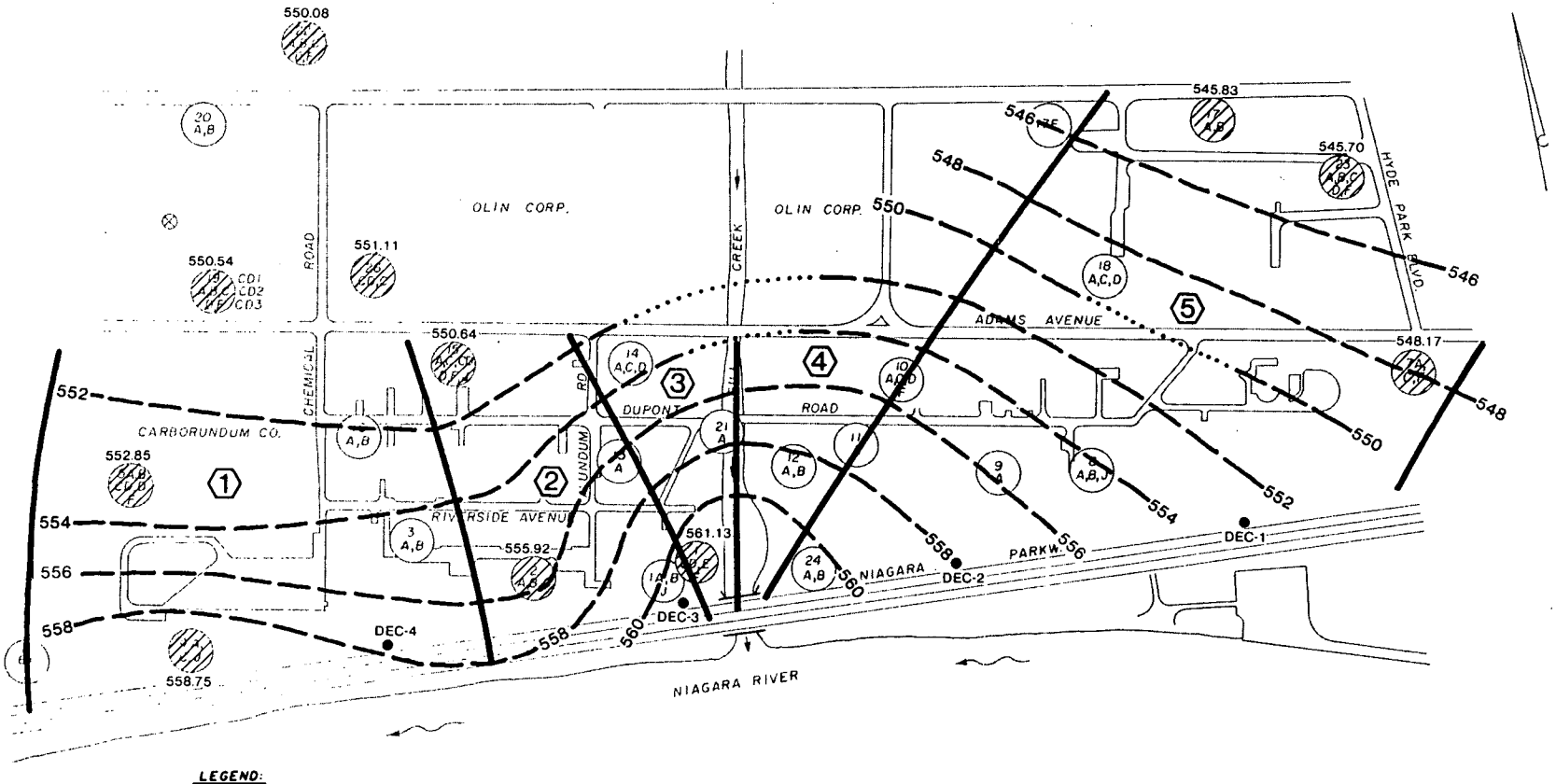
FIGURE B-2



LEGEND:

- WELL CLUSTER NUMBER (NO.) / WELL TYPE (LETTER)
- OLIN PRODUCTION WELL
- 550 — GROUNDWATER ELEVATION CONTOUR (ft.)
- WELL USED IN STUDY
- FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

CD-ZONE GROUNDWATER ELEVATION CONTOURS
FIRST QUARTER, 1987
NIAGARA PLANT
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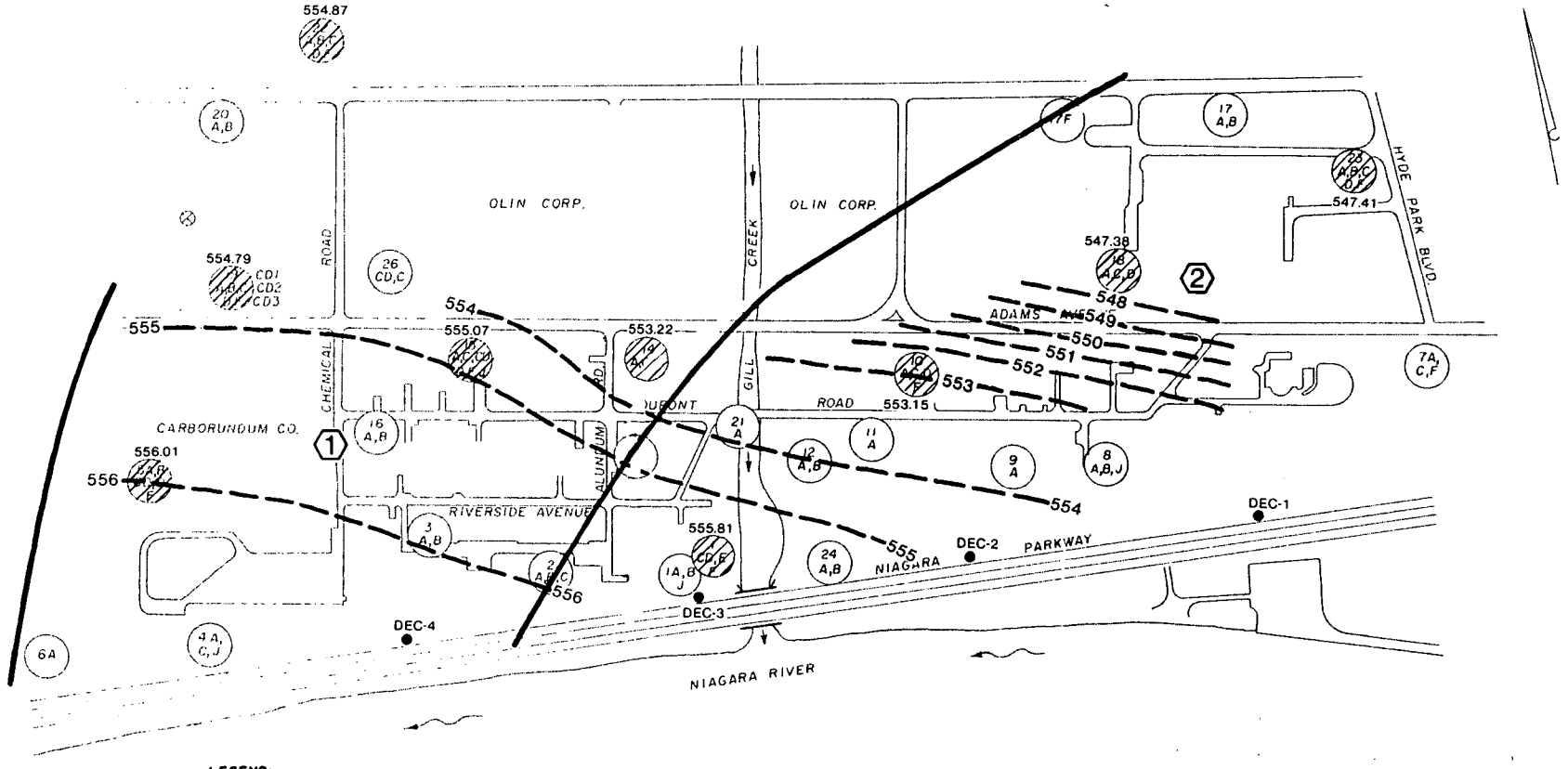
FIGURE B-3



D-ZONE GROUNDWATER ELEVATION CONTOURS
FIRST QUARTER, 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

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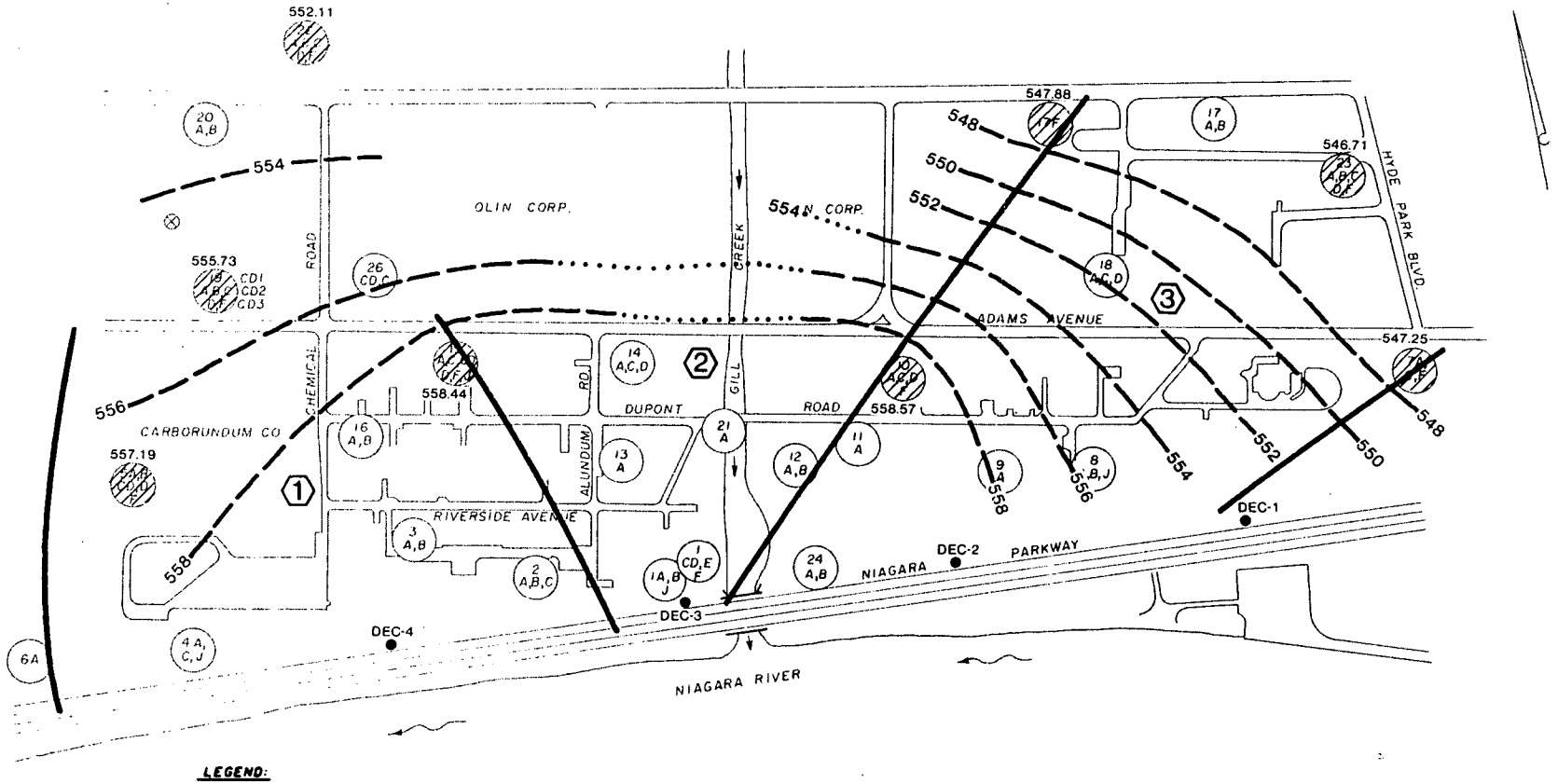
FIGURE B-4



LEGEND:

- WELL CLUSTER NUMBER (NO.)
- WELL TYPE (LETTER)
- OLIN PRODUCTION WELL
- 550 — GROUNDWATER ELEVATION CONTOUR (ft.)
- WELL USED IN STUDY
- FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

F-ZONE GROUNDWATER ELEVATION CONTOURS
FIRST QUARTER, 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

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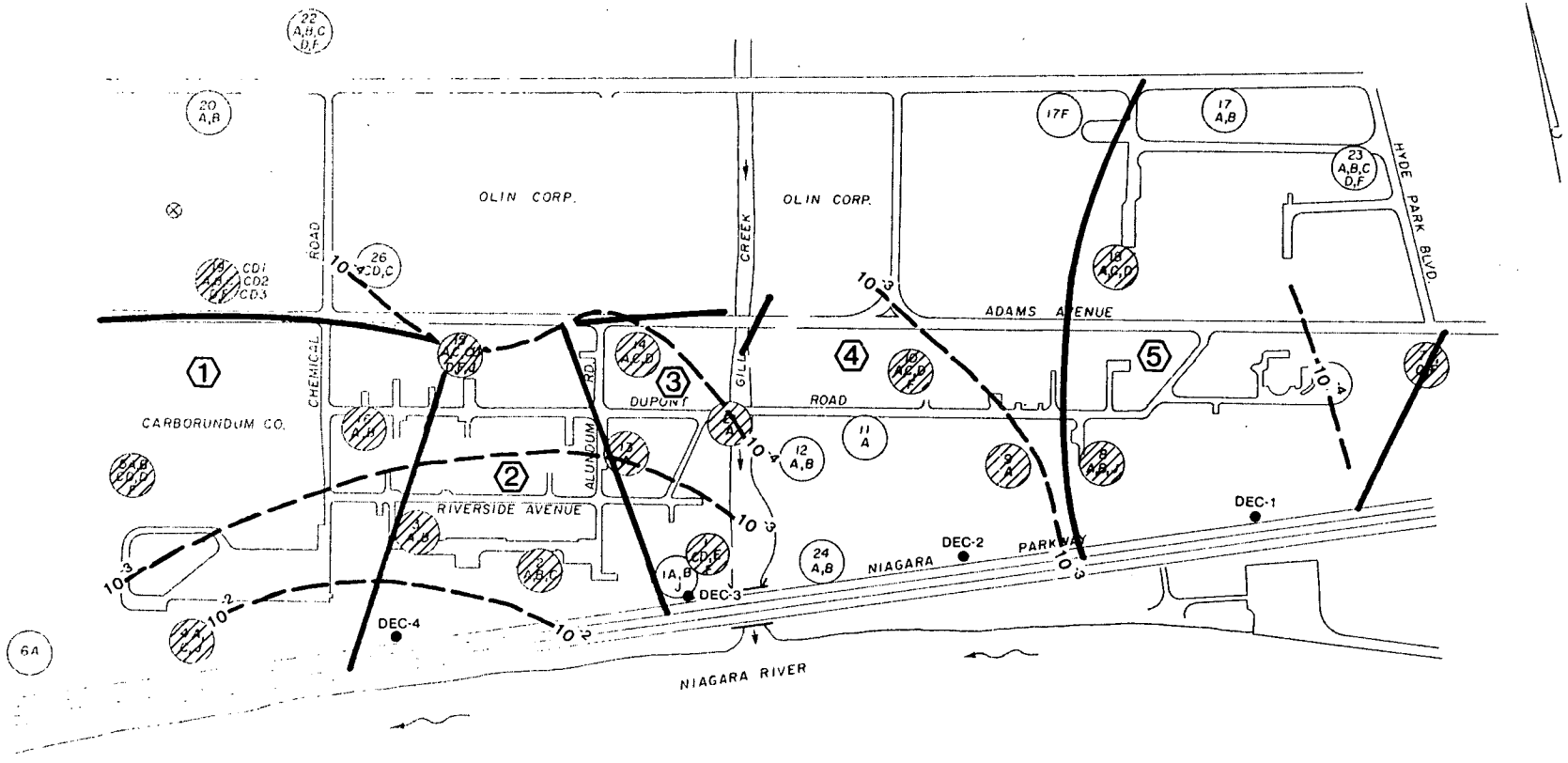
FIGURE B-5



LEGEND:

- WELL CLUSTER NUMBER (NO.)
- WELL TYPE (LETTER)
- OLIN PRODUCTION WELL
- 10^{-3} TRANSMISSIVITY CONTOUR (ft.^{2}/sec.)
- WELL USED IN STUDY
- FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

A-ZONE TRANSMISSIVITY CONTOURS
FIRST QUARTER, 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

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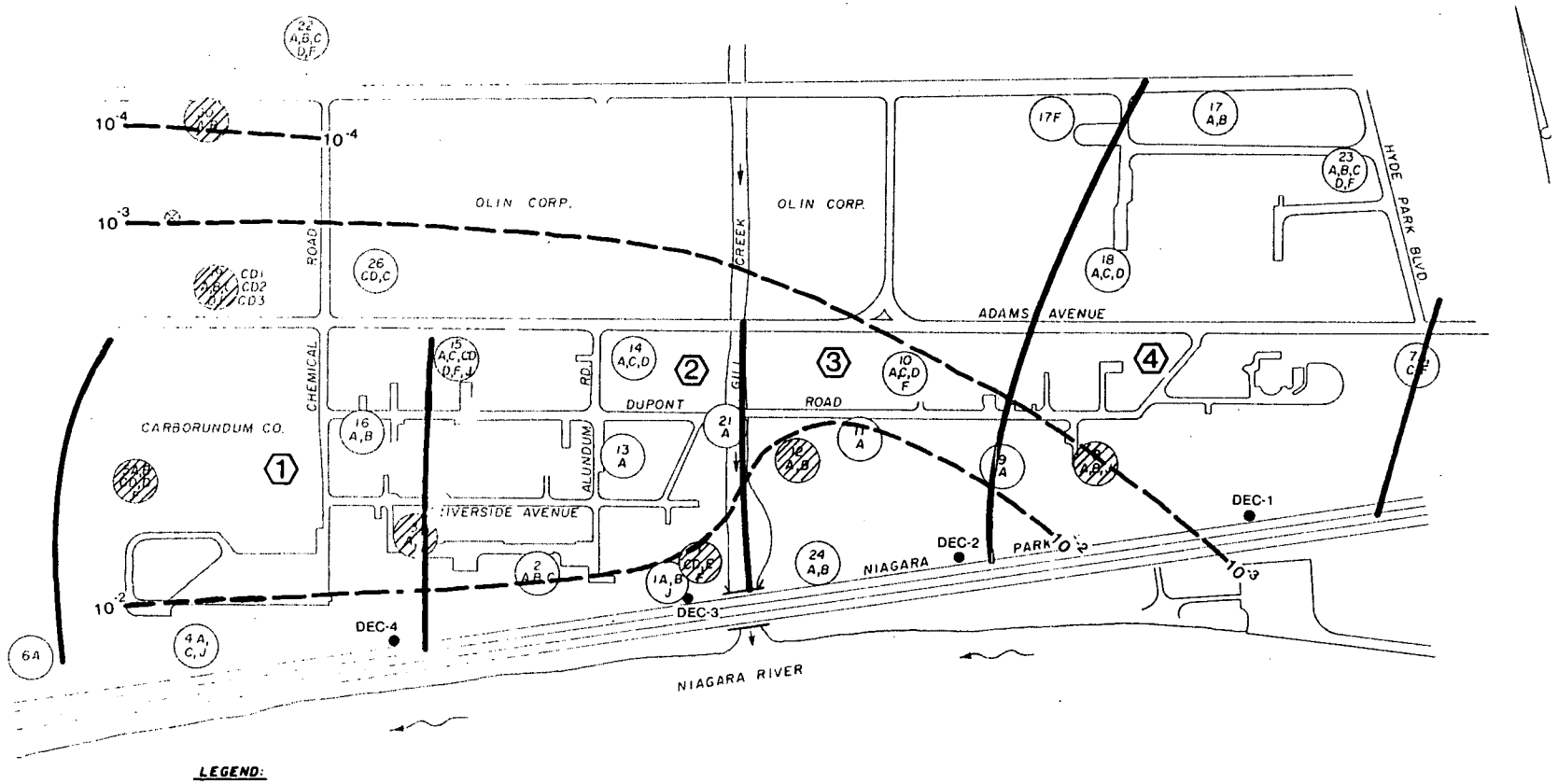
FIGURE B-6



LEGEND:

- WELL CLUSTER NUMBER (NO.)
- WELL TYPE (LETTER)
- OLIN PRODUCTION WELL
- TRANSMISSIVITY CONTOUR (ft.^{2}/sec.)
- WELL USED IN STUDY
- FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

B-ZONE TRANSMISSIVITY CONTOURS
FIRST QUARTER, 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
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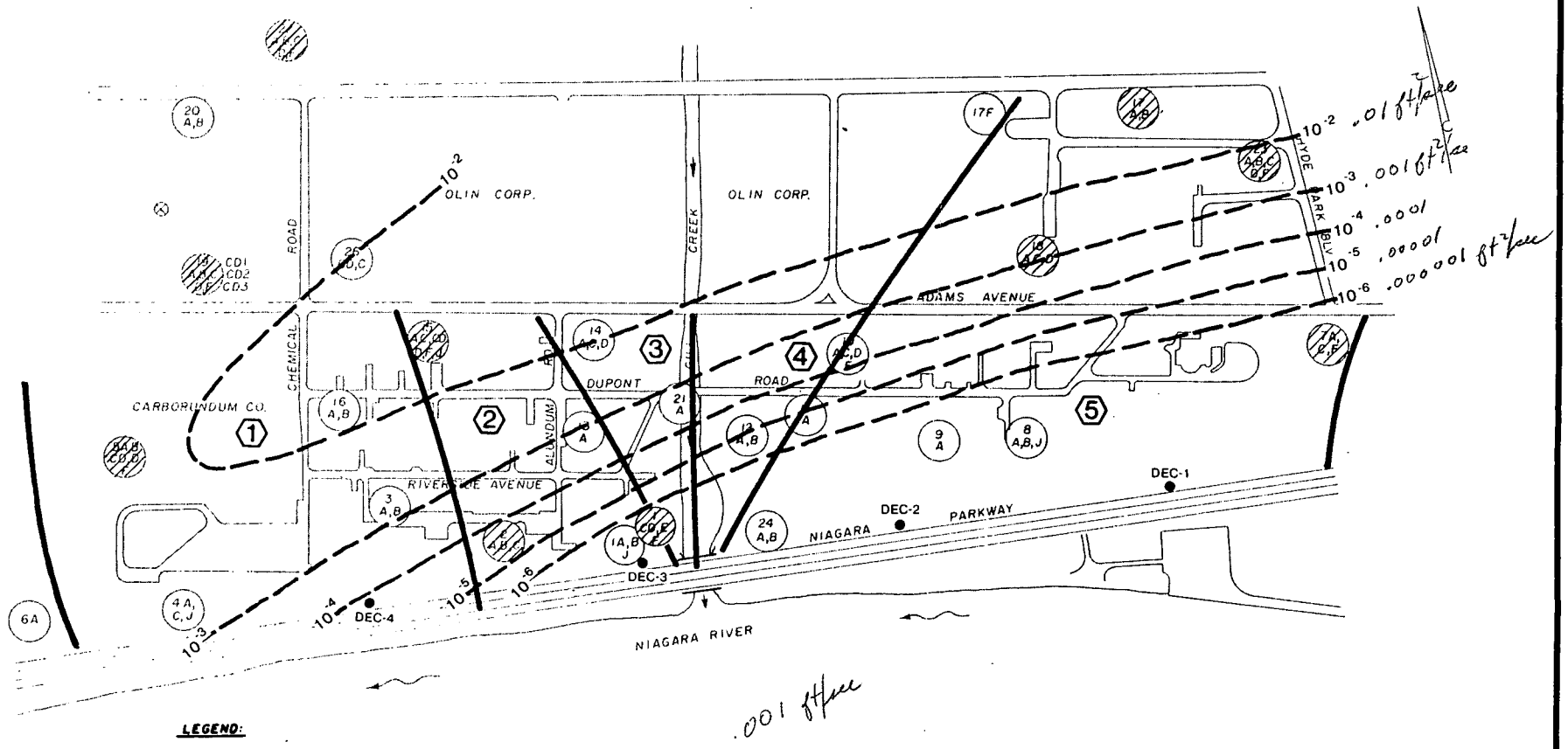
FIGURE B-7



LEGEND:

- WELL CLUSTER NUMBER (NO.)
- WELL TYPE (LETTER)
- OLIN PRODUCTION WELL
- 10^{-3} TRANSMISSIVITY CONTOUR (ft.²/sec.)
- WELL USED IN STUDY
- FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

CD-ZONE TRANSMISSIVITY CONTOURS
FIRST QUARTER, 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

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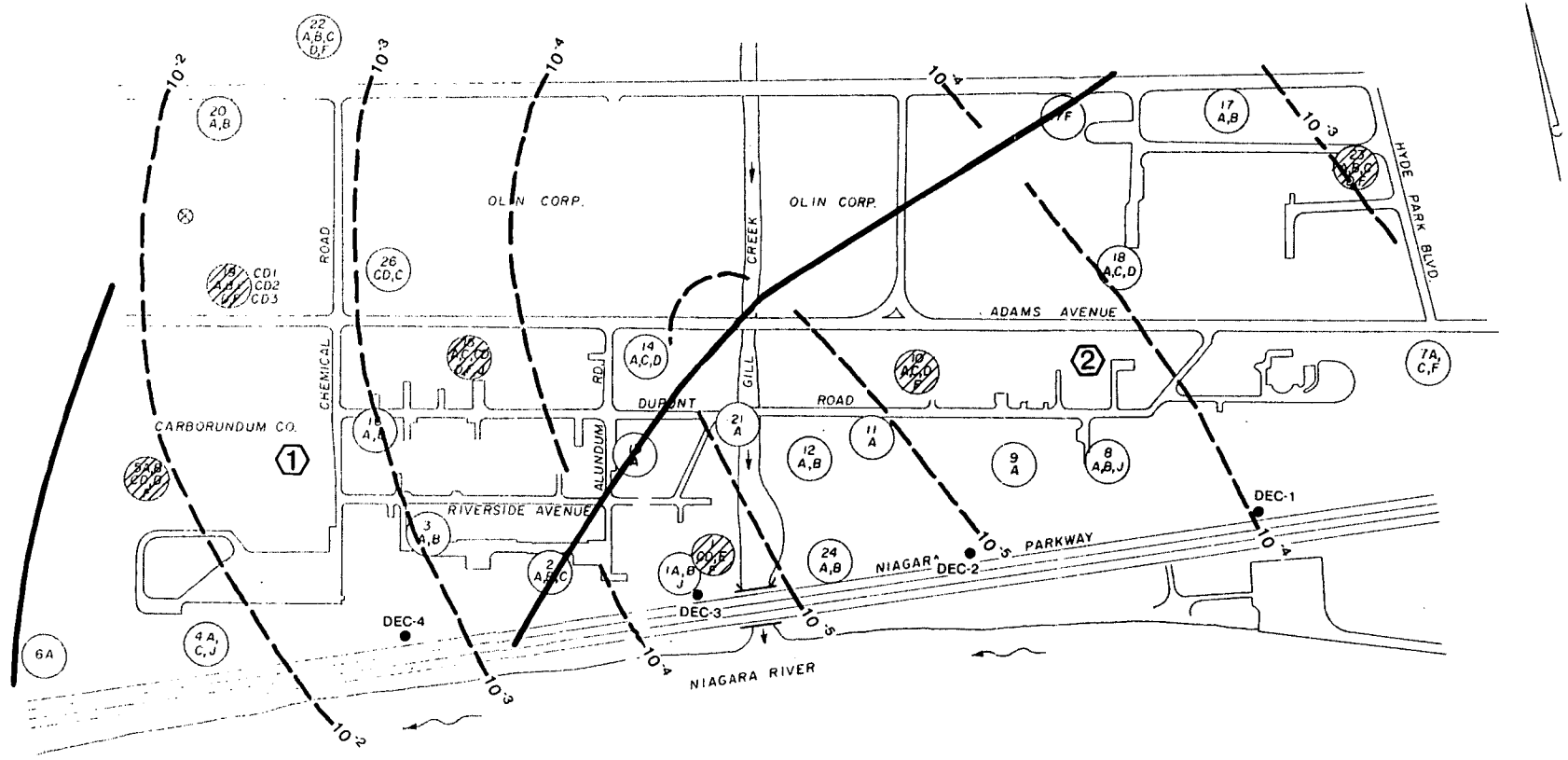
FIGURE B-8



LEGEND:

- WELL CLUSTER NUMBER (NO.)
- WELL TYPE (LETTER)
- OLIN PRODUCTION WELL
- 10-3 TRANSMISSIVITY CONTOUR (ft.²/sec.)
- WELL USED IN STUDY
- FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

D-ZONE TRANSMISSIVITY CONTOURS
FIRST QUARTER, 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

Drawn by: D.G.	SCALE IN FEET 0 300	Date: 7/2/87
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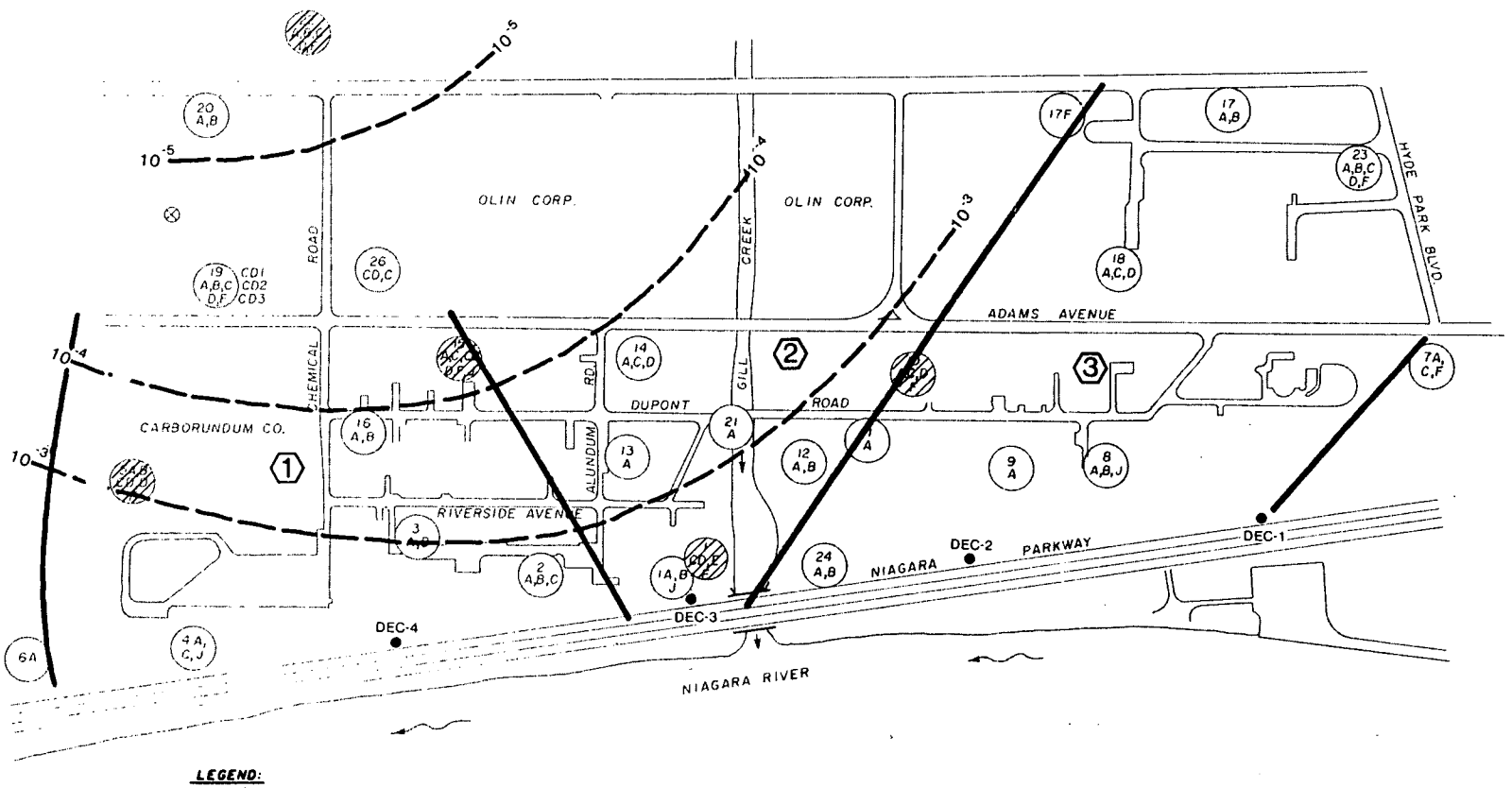
FIGURE B-9



LEGEND:

- WELL CLUSTER NUMBER (NO.) / WELL TYPE (LETTER)
- OLIN PRODUCTION WELL
- 10^{-3} TRANSMISSIVITY CONTOUR (ft.²/sec.)
- WELL USED IN STUDY
- FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

F-ZONE TRANSMISSIVITY CONTOURS
FIRST QUARTER, 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

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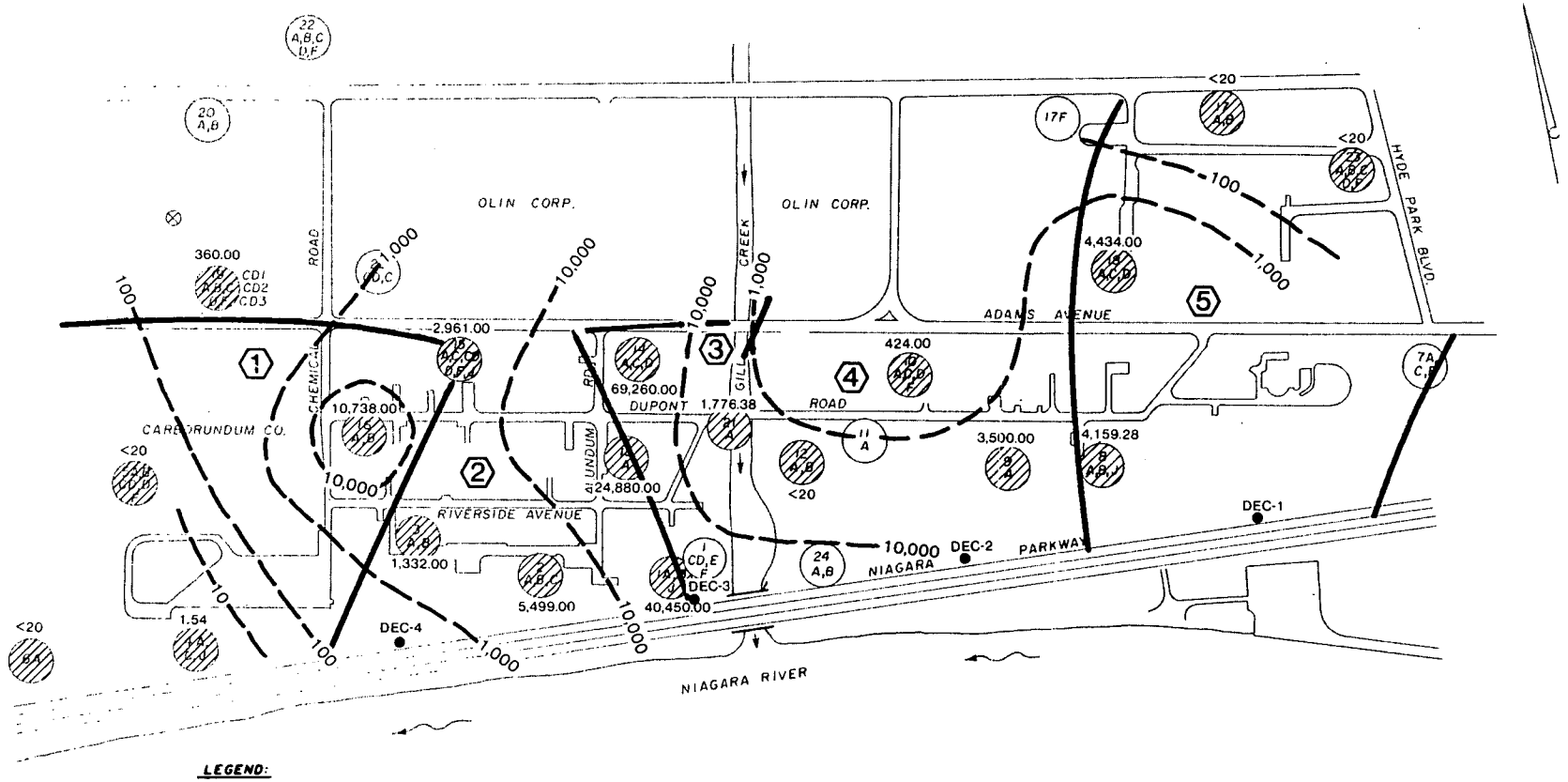
FIGURE B-10

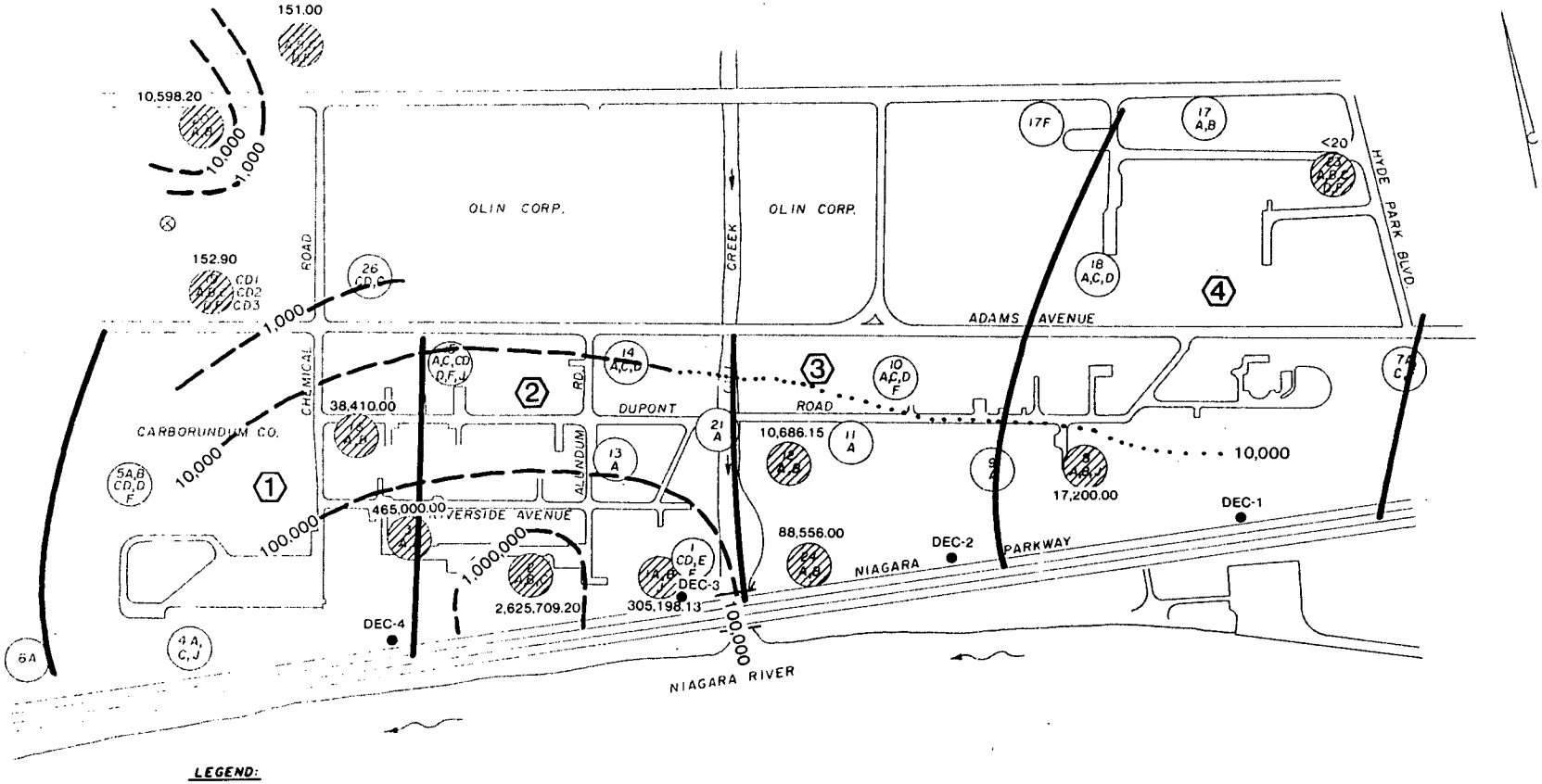


A-ZONE INDICATOR ORGANICS
FIRST QUARTER 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

Drawn by: D.G.	SCALE IN FEET 0 300	Date: 7/2/87
Checked by: M.D.		Job: 87C2555 G-1

FIGURE B-11



LEGEND:

- 17 A,B — WELL CLUSTER NUMBER (NO.) / WELL TYPE (LETTER)
- ⊗ OLIN PRODUCTION WELL
- ····100— CONCENTRATION CONTOUR (ppb)
- WELL USED IN STUDY
- 3 FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

B-ZONE INDICATOR ORGANICS
FIRST QUARTER 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

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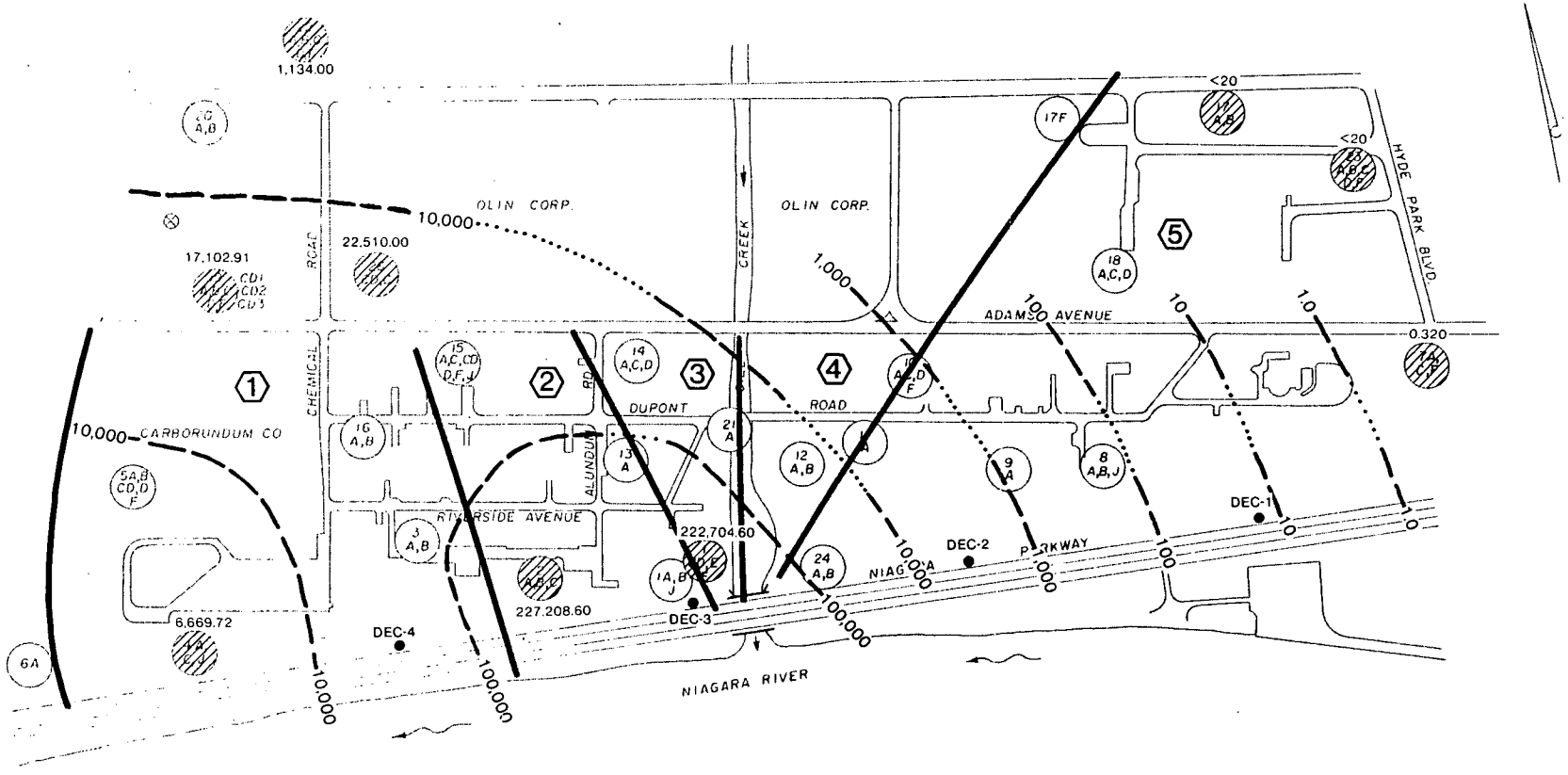
Checked by: M.D.		Job: 87C2555 G-1

FIGURE B-12



LEGEND:

- WELL CLUSTER NUMBER (NO.)
- WELL TYPE (LETTER)
- OLIN PRODUCTION WELL
- 100 — CONCENTRATION CONTOUR (ppb)
- WELL USED IN STUDY
- FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

CD-ZONE INDICATOR ORGANICS
FIRST QUARTER, 1987
NIAGARA PLANT
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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

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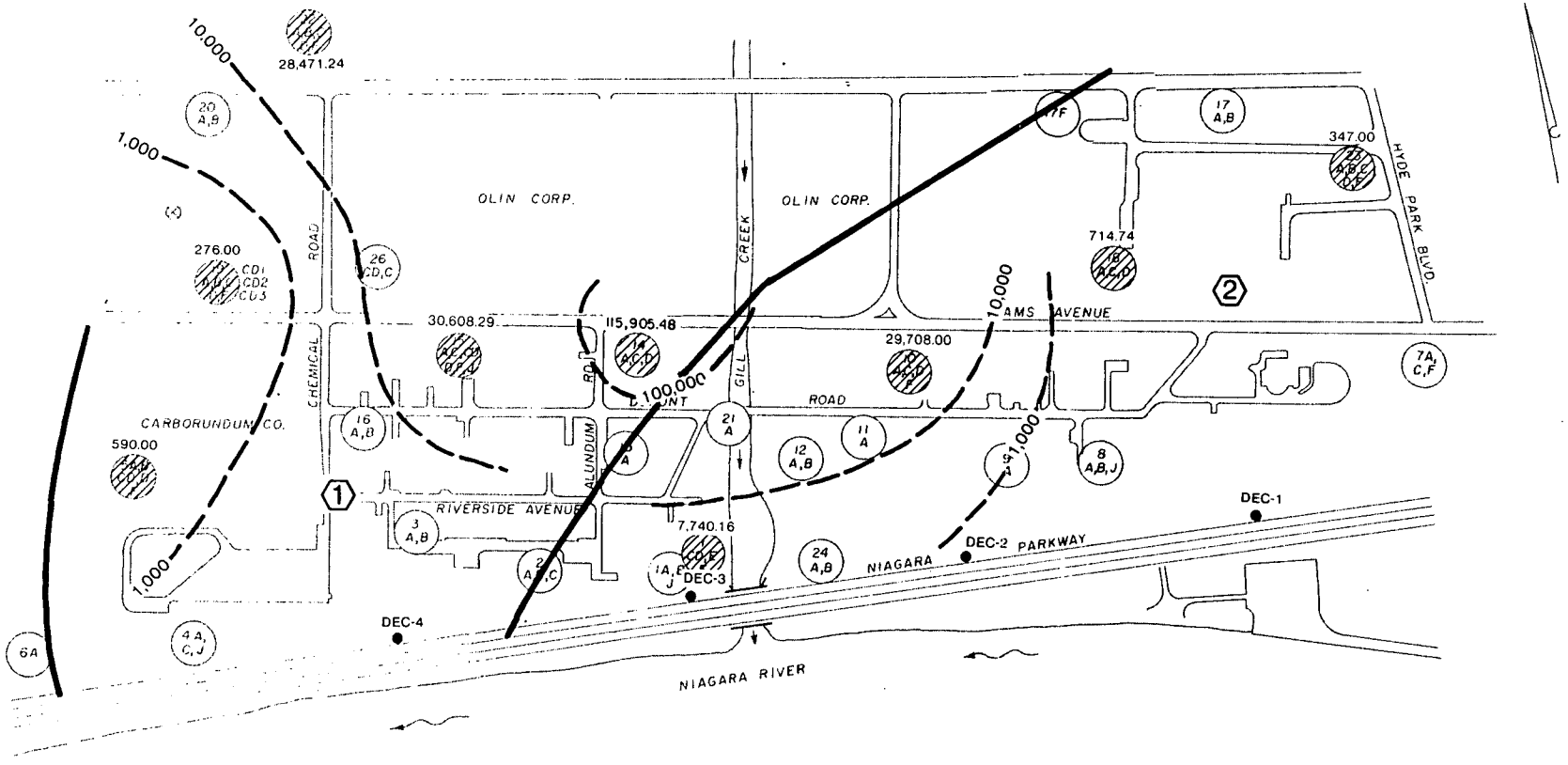
Checked by: M.D.		Job: 87C2555 G-1

FIGURE B-13



LEGEND:

- 17 A,B — WELL CLUSTER NUMBER (NO.) / WELL TYPE (LETTER)
- ⊗ OLIN PRODUCTION WELL
- ···100— CONCENTRATION CONTOUR (ppb)
- WELL USED IN STUDY
- 3 — FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

D-ZONE INDICATOR ORGANICS
FIRST QUARTER, 1987
NIAGARA PLANT
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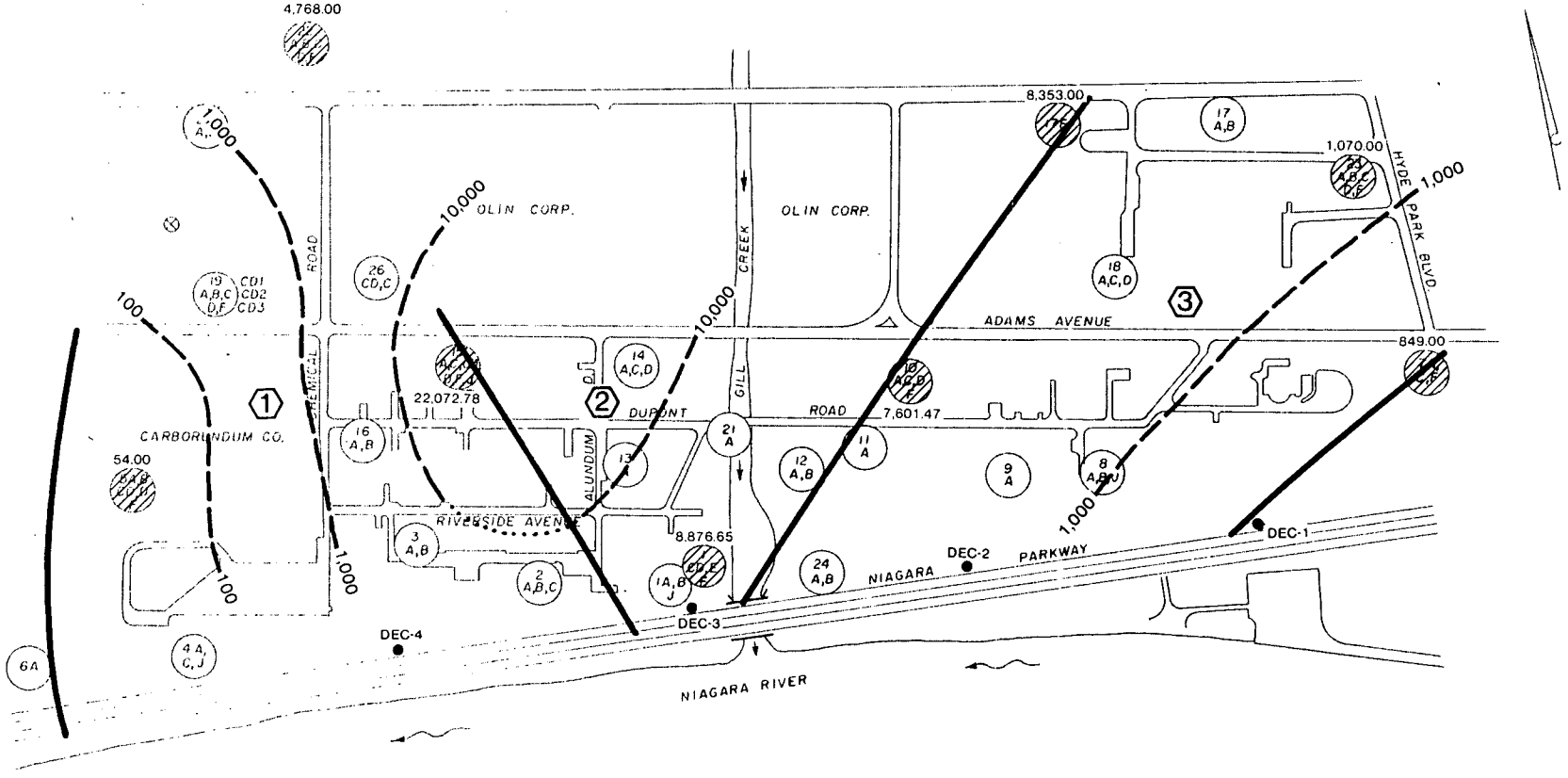
WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

Drawn by: J.C.	SCALE IN FEET 0 300	Date: 7/2/87
Checked by: M.D.		Job: 87C2555 G-1

FIGURE B-14



LEGEND:

- WELL CLUSTER NUMBER (NO.) / WELL TYPE (LETTER)
- OLIN PRODUCTION WELL
- CONCENTRATION CONTOUR (ppb)
- WELL USED IN STUDY
- FLOW ZONE NO.
- FLOW ZONE DIVIDING LINE

F-ZONE INDICATOR ORGANICS
FIRST QUARTER, 1987
NIAGARA PLANT
E. I. du PONT de NEMOURS & COMPANY

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

Drawn by: J.C.	SCALE IN FEET 0 300	Date: 7/2/87
Checked by: M.D.		Job: 87C2555 G-1

FIGURE B-15

Appendix C

GROUNDWATER FLOW RATES
DUPONT NIAGARA PLANT
A-ZONE : FIRST QUARTER 1987

FLOW SECT	TRANSMISSIVITY (FT**2/SEC)	GRADIENT (FT/FT)	FLOW SECT WIDTH (FT)	FLOW RATE (GPM)
1	5.0000E-4	8.5000E-3	1125.00	2.14
2	1.0000E-2	5.5000E-3	950.00	23.45
3	5.0000E-4	4.3000E-3	775.00	.75
4	1.0000E-3	3.1000E-3	825.00	1.15
5	5.0000E-4	1.6000E-2	1050.00	3.77
		TOTAL FLOW RATE (GPM):		31.26

$Q = T \cdot I \cdot W \times 60\ min/hr \times 7.48\ g/cf = gpm$

GROUNDWATER FLOW RATES
DUPONT NIAGARA PLANT
B-ZONE : FIRST QUARTER 1987

FLOW SECT	TRANSMISSIVITY (FT**2/SEC)	GRADIENT (FT/FT)	FLOW SECT WIDTH (FT)	FLOW RATE (GPM)
1	5.0000E-3	1.0000E-2	800.00	17.95
2	5.0000E-3	9.4000E-3	800.00	16.87
3	1.0000E-3	6.6000E-3	750.00	2.22
4	1.0000E-3	1.8000E-2	1050.00	8.48
		TOTAL FLOW RATE (GPM):		45.53

GROUNDWATER FLOW RATES
DUPONT NIAGARA PLANT
CD-ZONE : FIRST QUARTER 1987

FLOW SECT	TRANSMISSIVITY (FT**2/SEC)	GRADIENT (FT/FT)	FLOW SECT WIDTH (FT)	FLOW RATE (GPM)
1	5.0000E-3	1.1000E-2	900.00	22.22
2	1.0000E-2	9.6000E-3	385.00	16.59
3	1.0000E-2	1.5000E-2	450.00	30.29
4	1.0000E-3	1.3000E-2	500.00	2.92
5	1.0000E-3	1.0000E-2	1050.00	4.71
		TOTAL FLOW RATE (GPM):		76.73

GROUNDWATER FLOW RATES
DUPONT NIAGARA PLANT
D-ZONE : FIRST QUARTER 1987

FLOW SECT	TRANSMISSIVITY (FT**2/SEC)	GRADIENT (FT/FT)	FLOW SECT WIDTH (FT)	FLOW RATE (GPM)
1	1.0000E-3	5.2000E-3	1475.00	3.44
2	1.0000E-3	1.1500E-2	1300.00	6.71

TOTAL FLOW RATE (GPM): 10.15

GROUNDWATER FLOW RATES
DUPONT NIAGARA PLANT
F-ZONE : FIRST QUARTER 1987

FLOW SECT	TRANSMISSIVITY (FT**2/SEC)	GRADIENT (FT/FT)	FLOW SECT WIDTH (FT)	FLOW RATE (GPM)
1	5.0000E-5	4.7000E-3	950.00	.10
2	5.0000E-4	5.8000E-3	1200.00	1.56
3	1.0000E-3	1.2000E-2	1050.00	5.65
		TOTAL FLOW RATE (GPM):		7.32

Appendix D

FIRST QUARTER 1987
GROUNDWATER FLOW RATES
GPM

FLOW SECT	A-ZONE	B-ZONE	CD-ZONE	D-ZONE	F-ZONE
1	2.14	17.95	22.22	3.44	.10
2	23.45	16.87	16.59	6.71	1.56
3	.75	2.22	30.29		5.65
4	1.15	8.48	2.92		
5	3.77		4.71		
TOTAL	31.26	45.52	76.73	10.15	7.31

CONTAMINANT LOADING RATES
TOTAL INDICATOR ORGANICS
FIRST QUARTER 1987
DUPONT NIAGARA PLANT

CONCENTRATION OF INDICATOR ORGANICS (PPB)

FLOW SECTIONS	A ZONE	B-ZONE	CD-ZONE	D-ZONE	F-ZONE
1	10.00	1,000.00	20,000.00	30,000.00	1,000.00
2	10,000.00	10,000.00	75,000.00	400.00	10,000.00
3	5,000.00	10,000.00	75,000.00		2,000.00
4	750.00	20.00	5,000.00		
5	20.00		10.00		

INDICATOR LOADING RATES (LBS/DAY)

FLOW SECTIONS	A-ZONE	B-ZONE	CD-ZONE	D-ZONE	F-ZONE
1	2.57005E-4	2.15572E-1	5.337066E0	1.239390E0	1.20096E-3
2	2.816251E0	2.026019E0	1.494294E1	3.22337E-2	1.87349E-1
3	4.50360E-2	2.66613E-1	2.728280E1		1.35708E-1
4	1.03582E-2	2.03682E-3	1.75340E-1		
5	9.05523E-4		5.65652E-4		
TOTAL	2.8728	2.5102	47.7387	1.2716	.3242

SL #