SFUND RECORDS CTR
2067745

"Wallin, Sharon"
<WallinSL@cdm.com>
01/12/2005 03:48 PM

To Christopher Lichens/R9/USEPA/US@EPA, tperina@ch2m.com, cmclaugh@demaximis.com, Chuck McLaughlin <chuckrmc@earthlink.net>
cc "Chamberlin, David" <ChamberlinDC@cdm.com>
bcc
Subject Revised Phase 1a Addendum Report - Part 4 (Appendices E, F, and G)

History: This message has been forwarded.

This should be the last submittal. Let me know if you need anything else or have any problems with any of the attachments.

Thanks, Sharon

App_E_Figs.pdf AppF_Tables_Figures_Jan10 2005.pdf AppF_Advective Cont Velocities.pdf AppG_time series plot_rev.pdf
App_G_Hydrographs.pdf

Figure E-1, Recovery Test at OW2

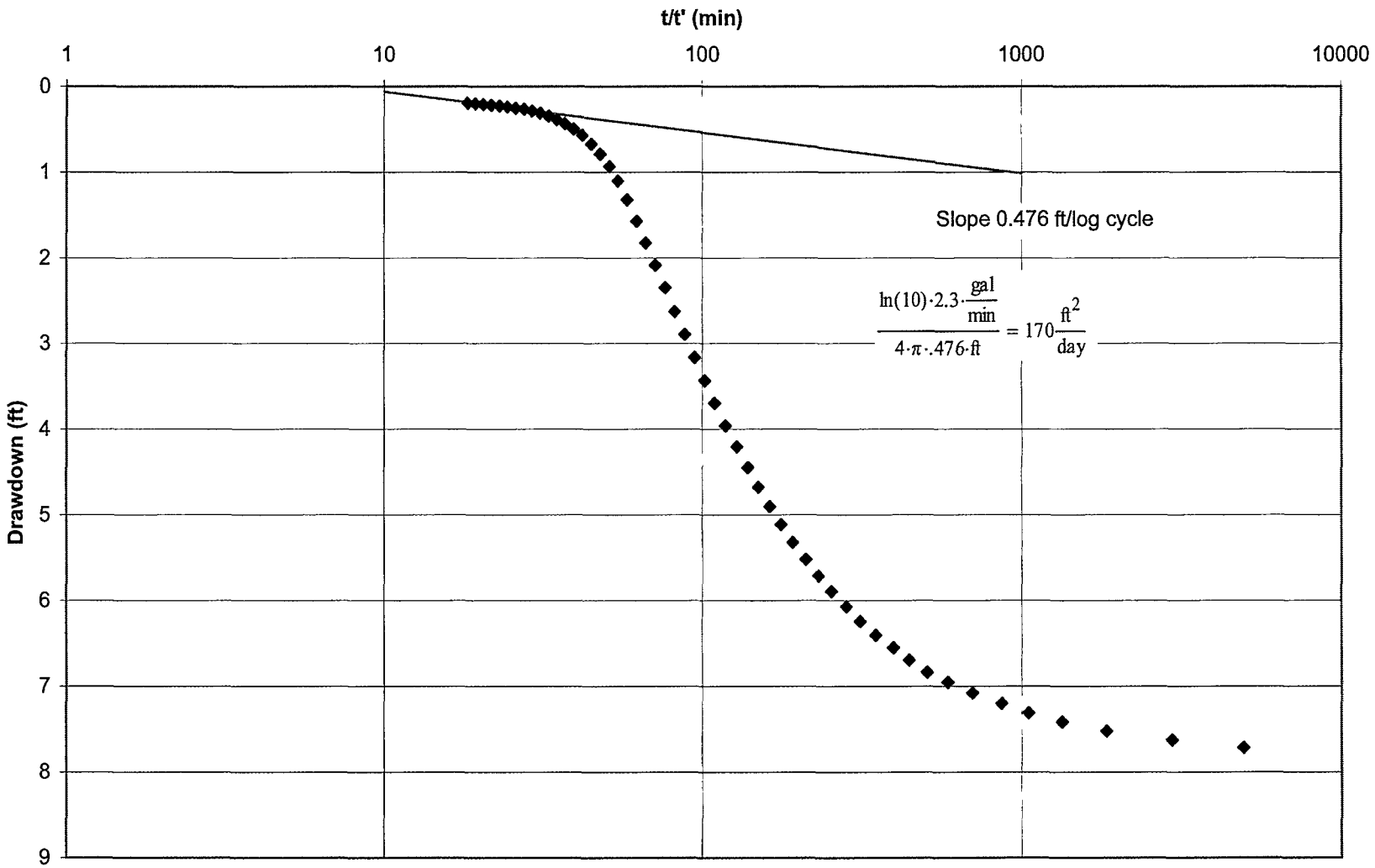

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Figure E-2, Recovery Test at Well OW3

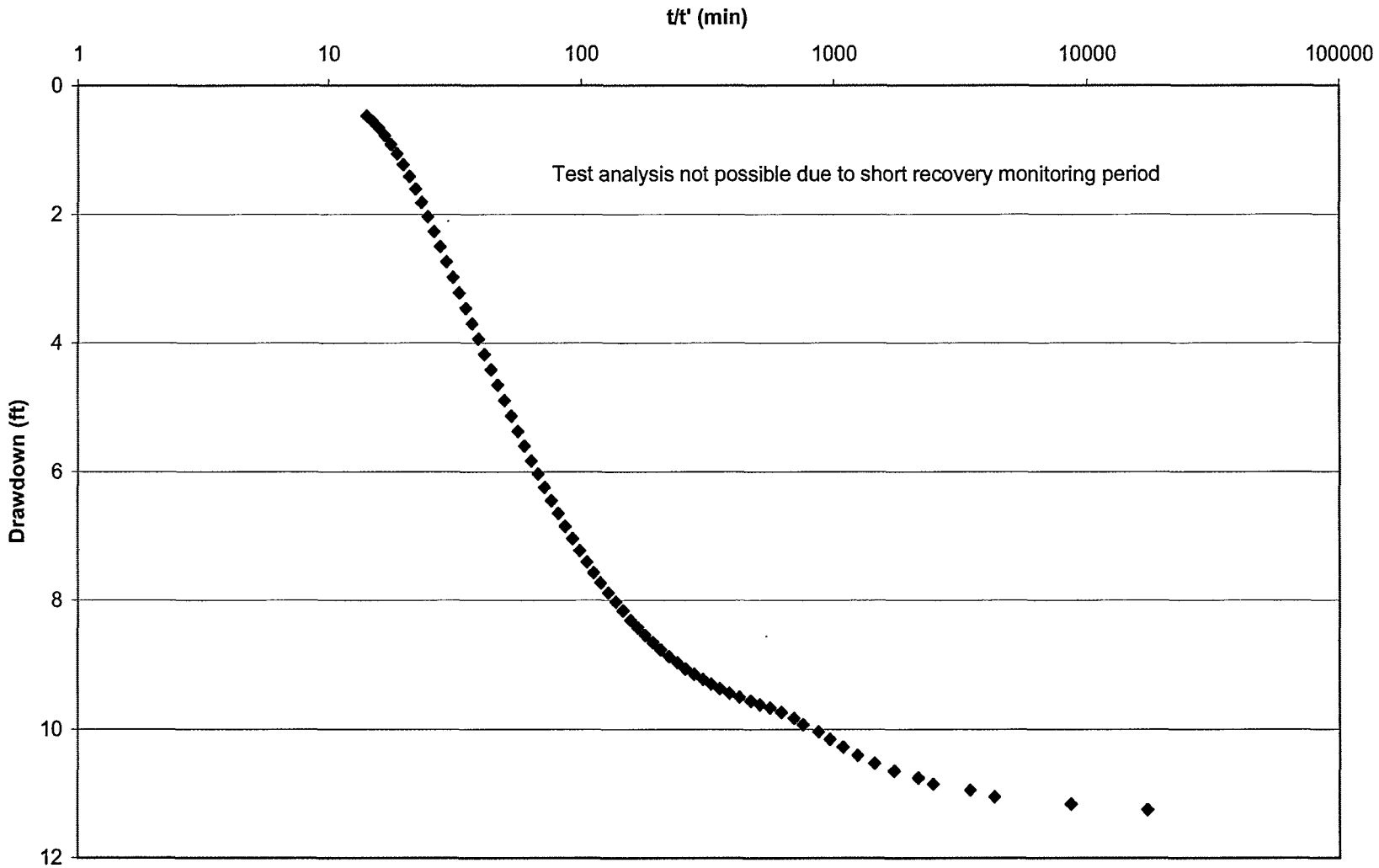

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Figure E-3, Recovery at Well OW4a

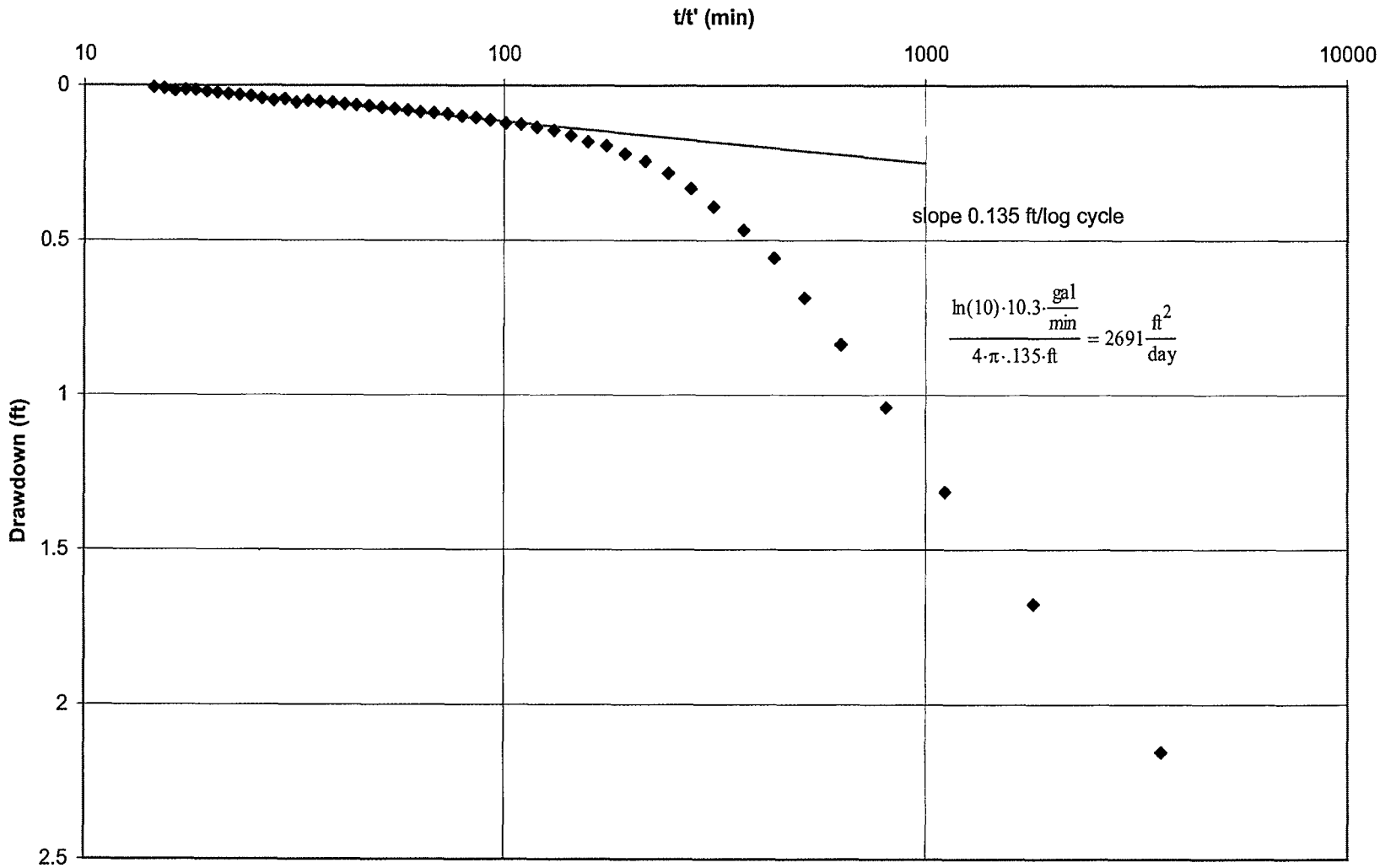

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Figure E-4, Recovery at Well OW8

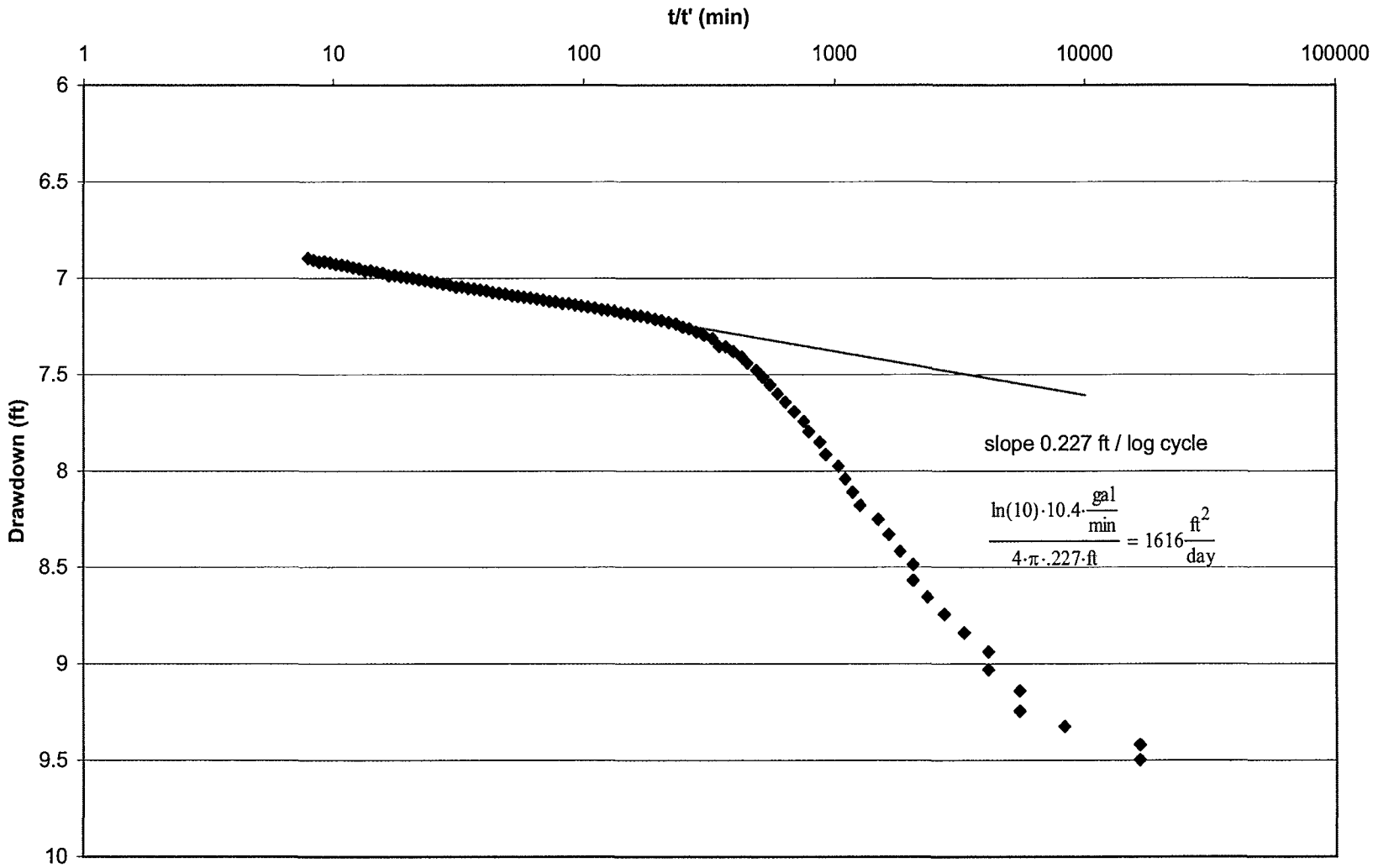

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Figure E-5, PZ-1 Pumping Phase, Neuman Analysis

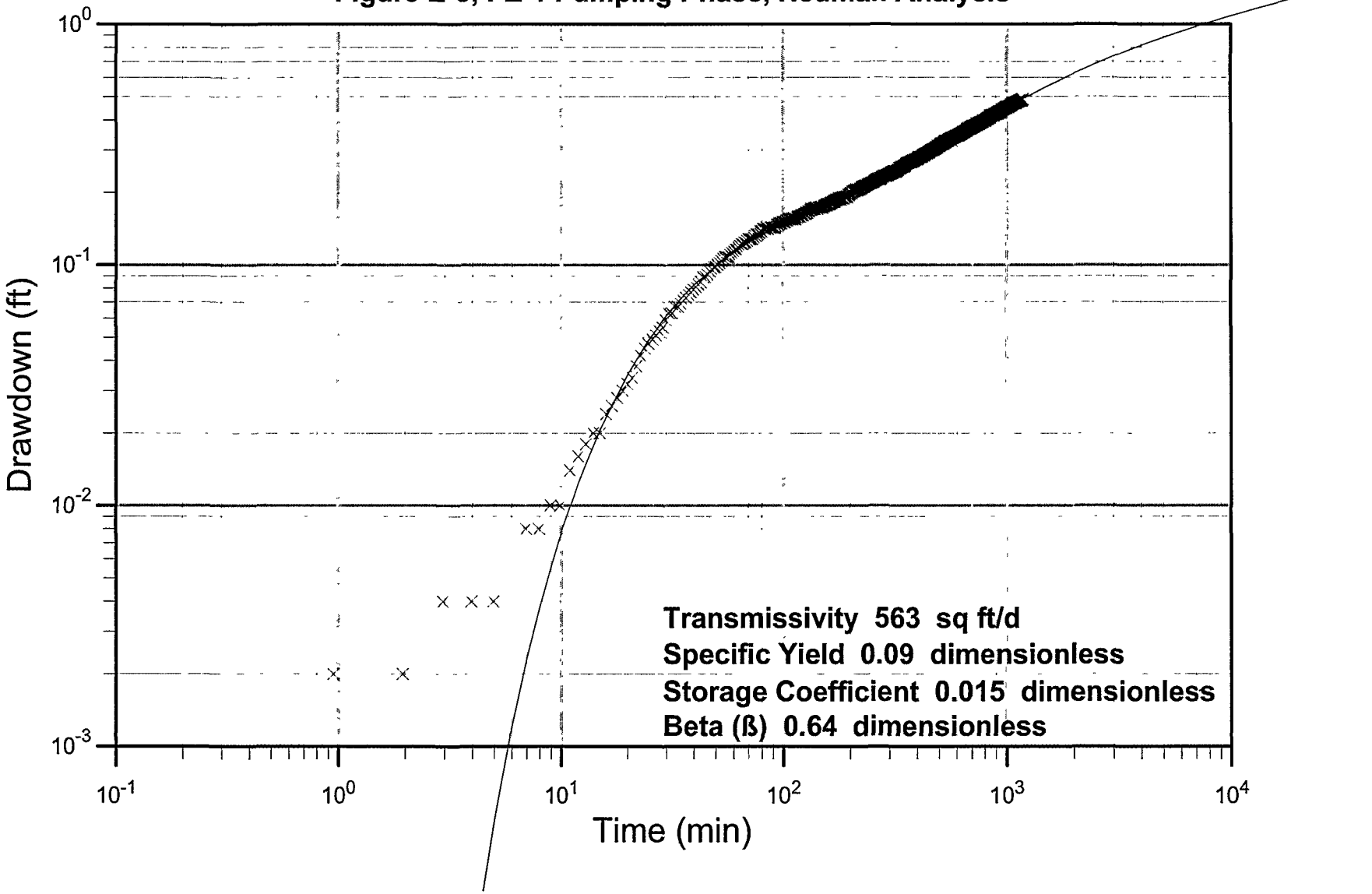

Figure E-6, PZ-2 Pumping Phase, Neuman Analysis

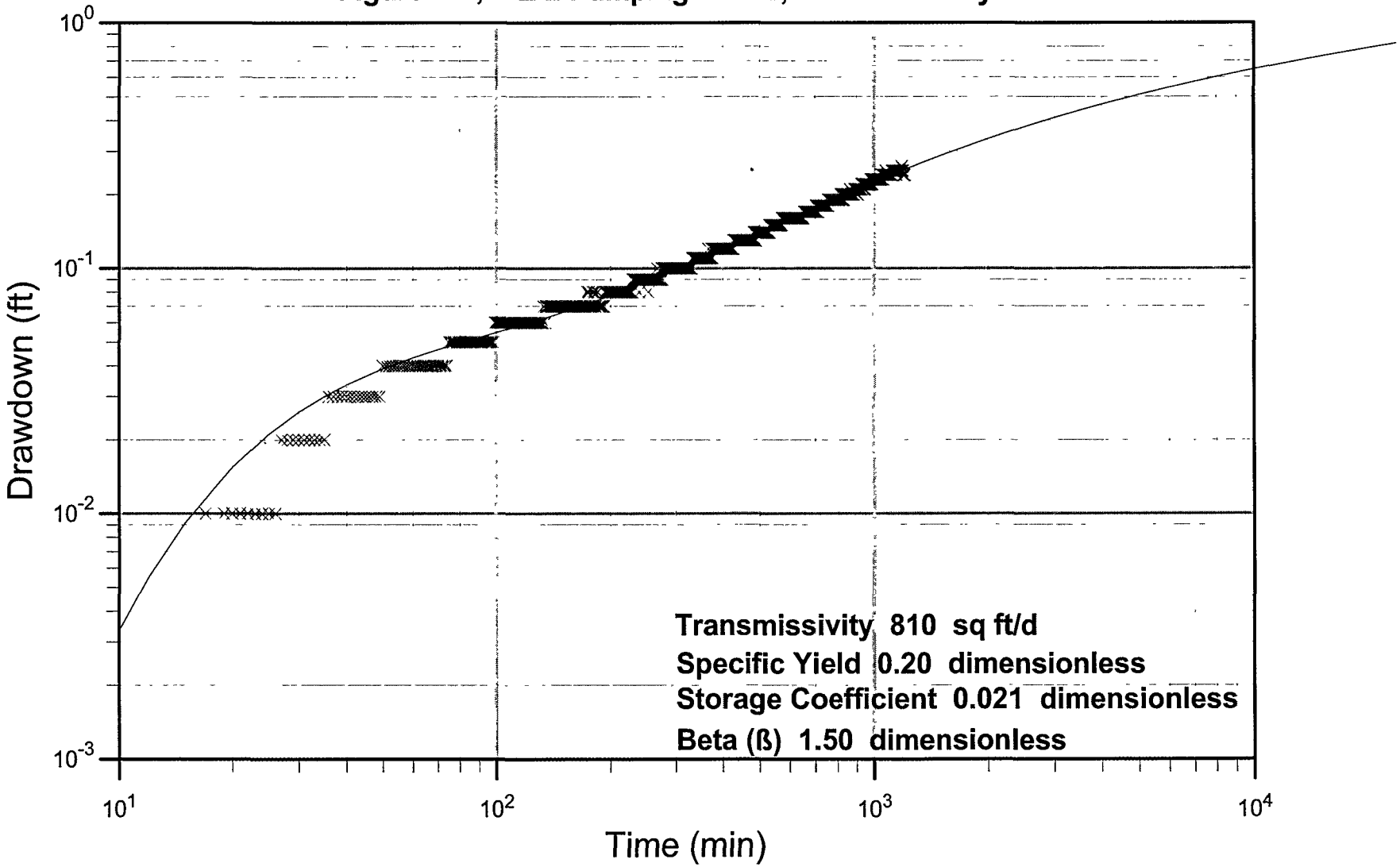

Figure E-7 Recovery at OW8 - Multi-well Test

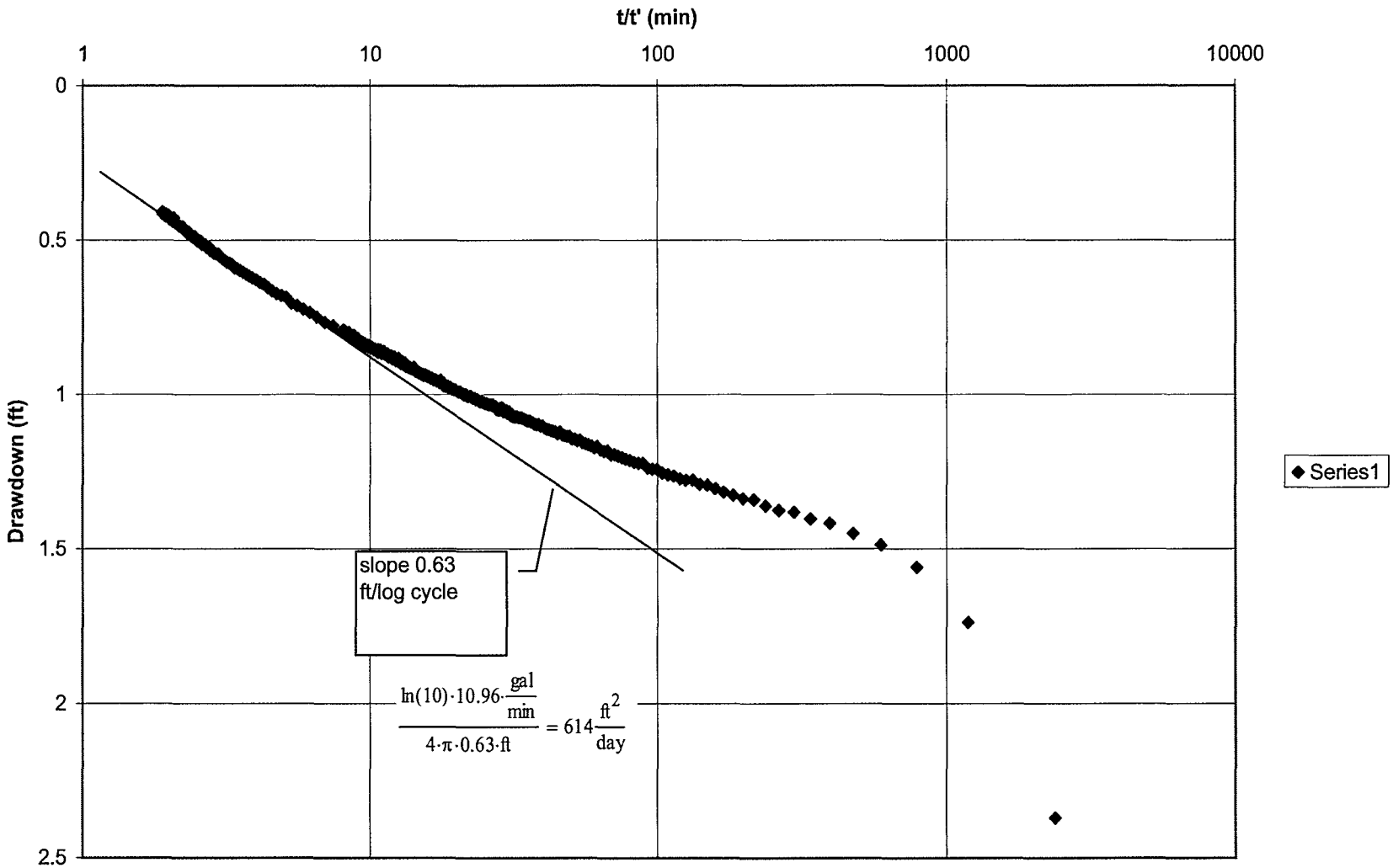

Figure E-8, OW-1b Water Level Response During Test at OW-8

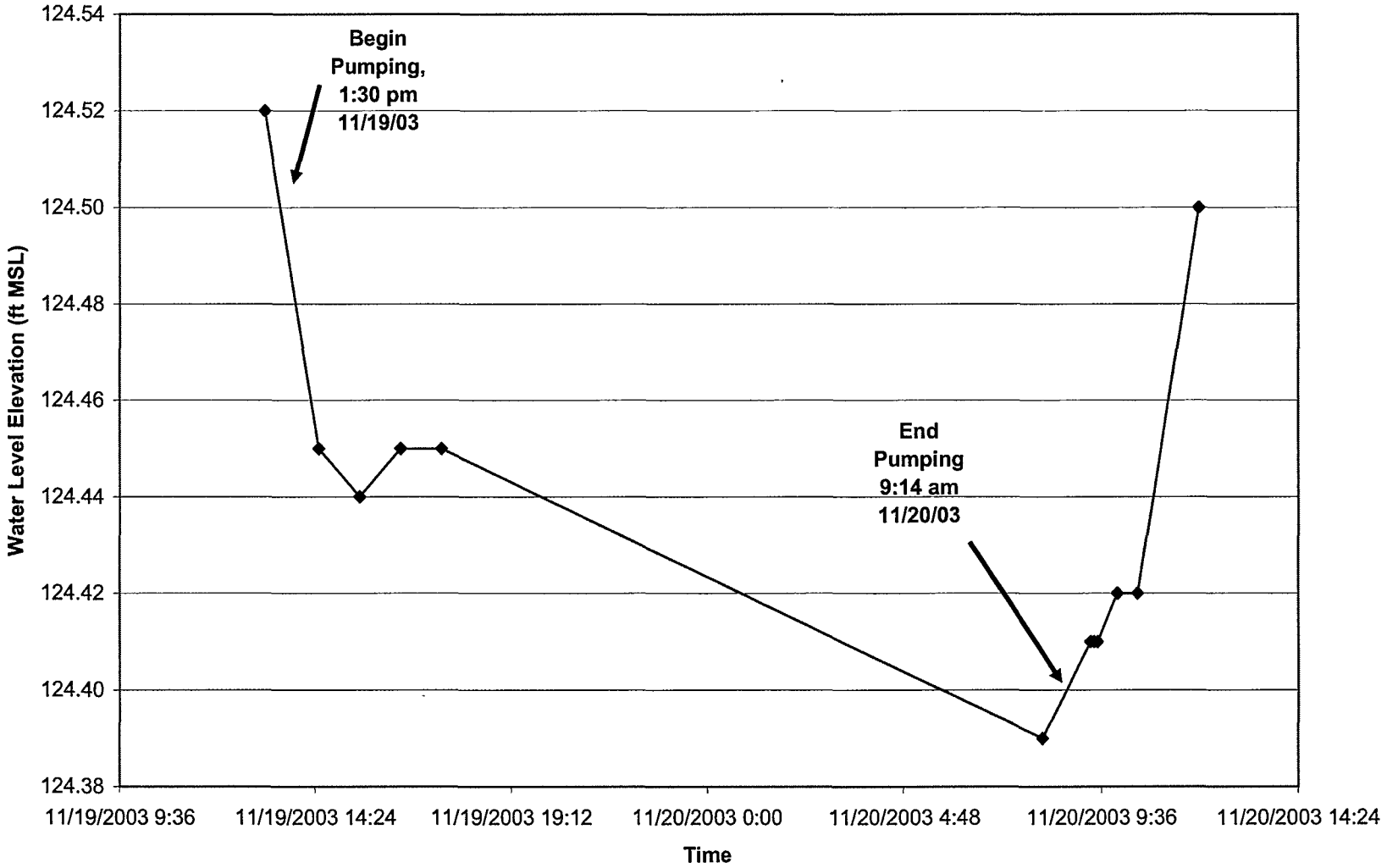

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Figure E-9, OW-2 Water Level Response During Test at OW-8

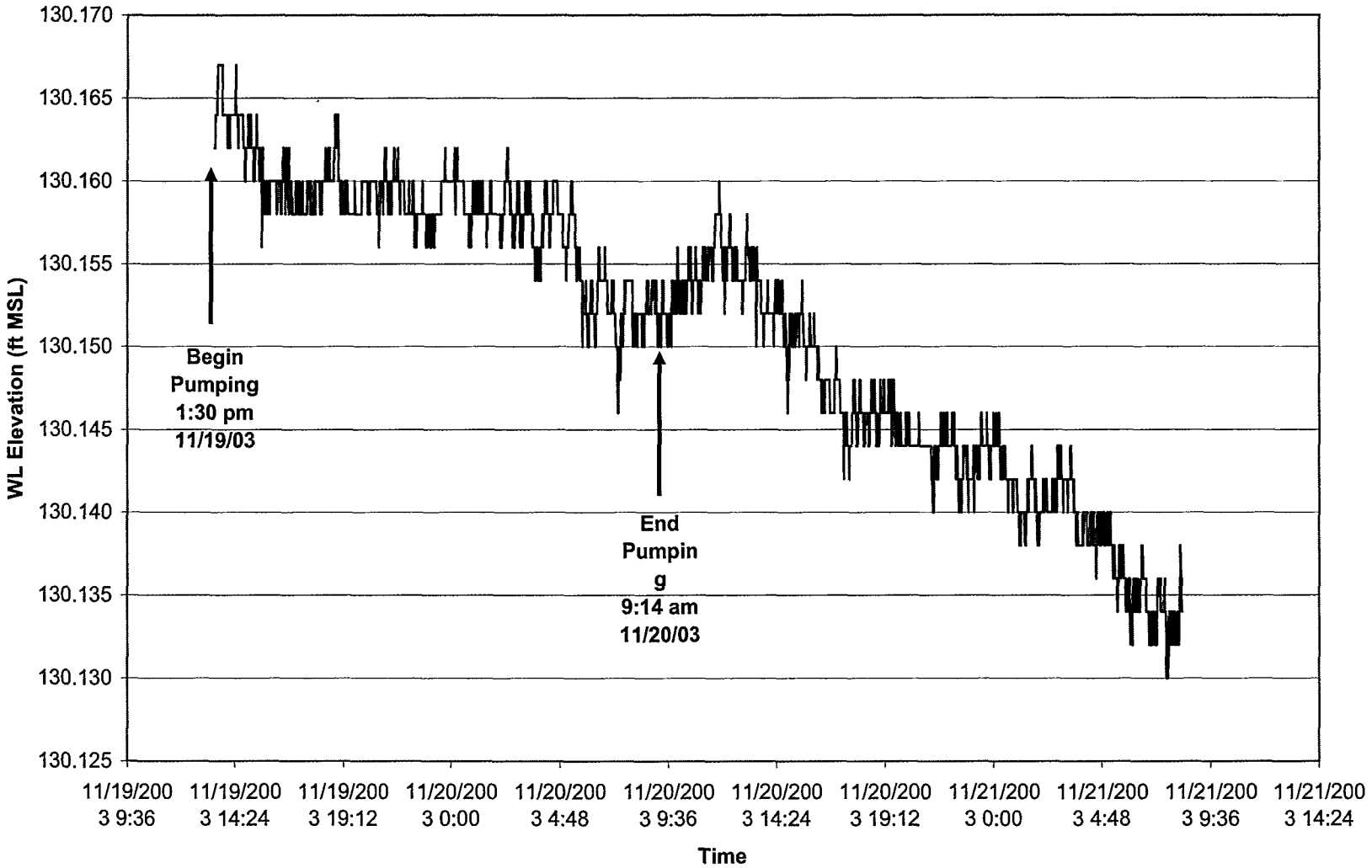

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Figure E-10, OW-3 Water Level Response During Test at OW-8

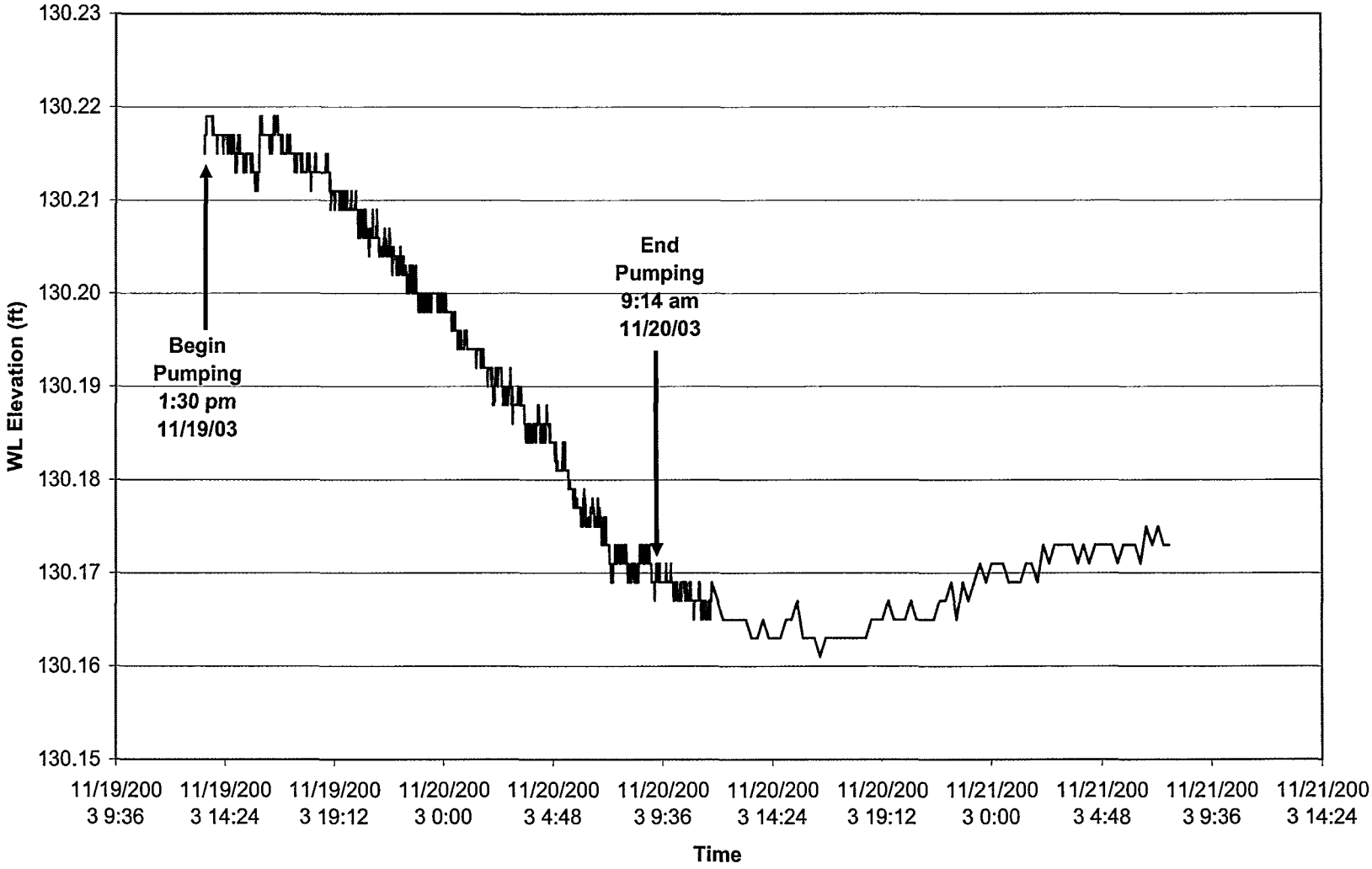

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Figure E-11, OW-4a Water Level Response During Test at OW-8

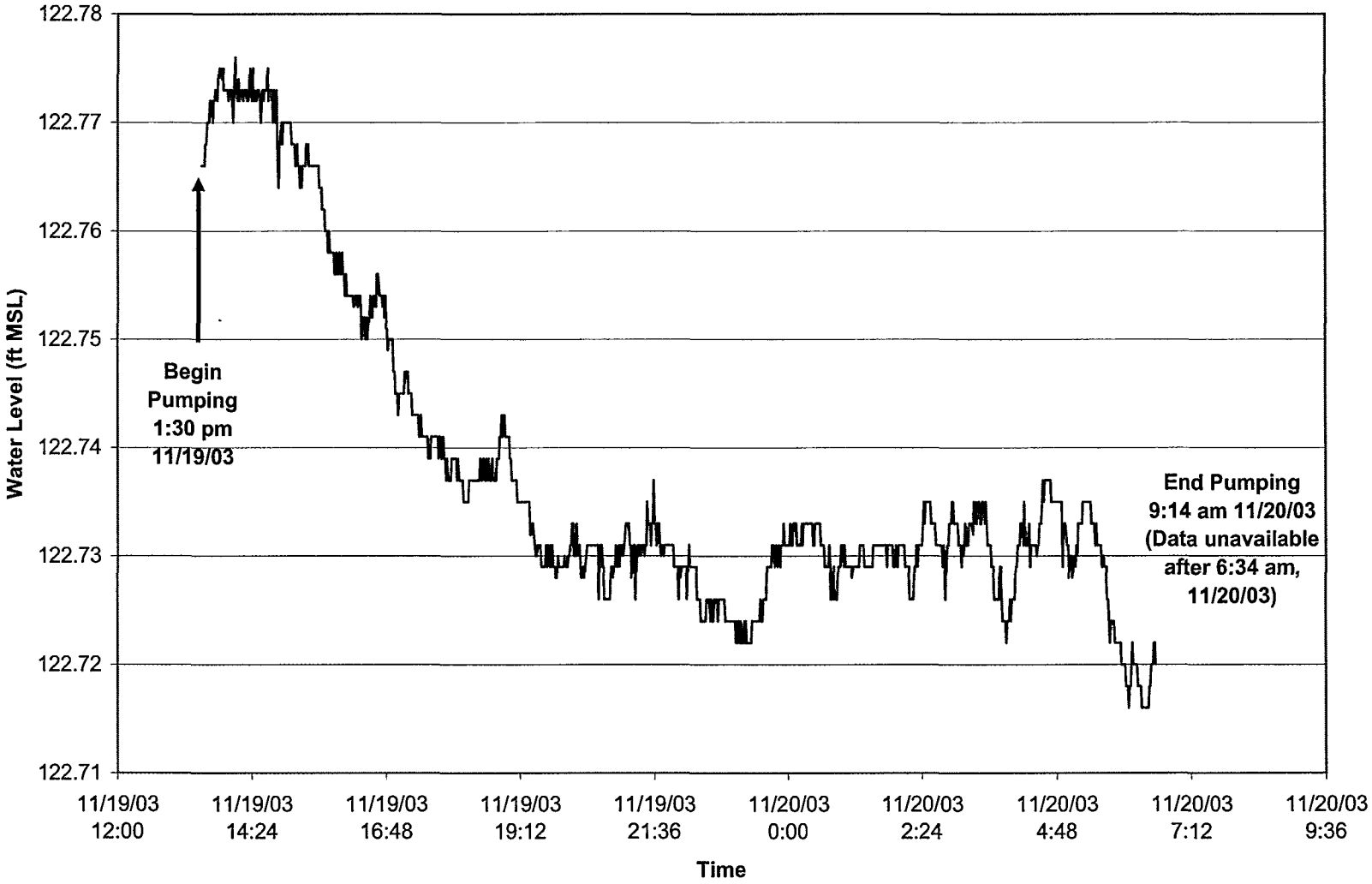

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Figure E-12, OW-7 Water Level Response During Test at OW-8

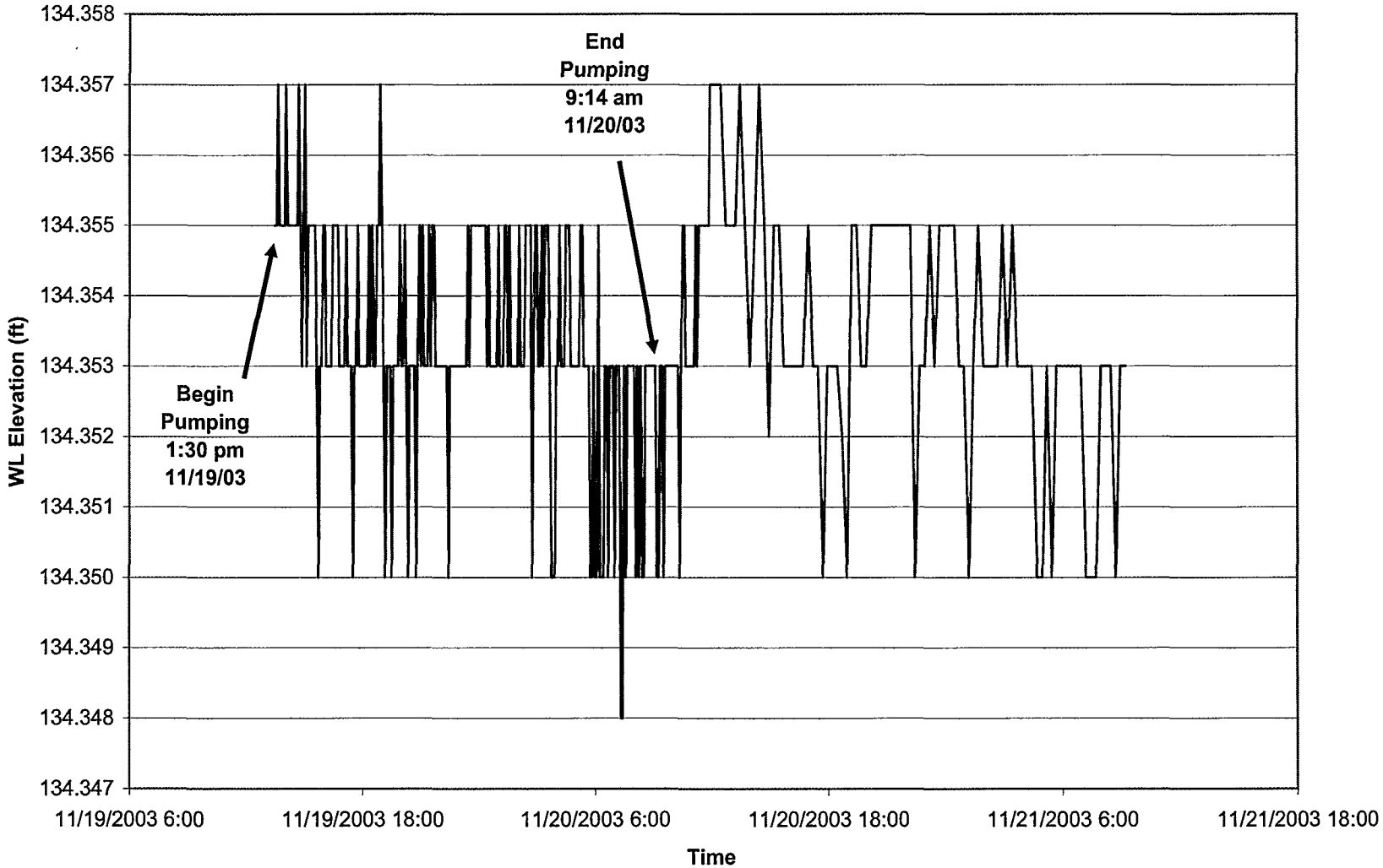

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Figure E-13, OW-7 Background Water Level Monitoring in November 2003

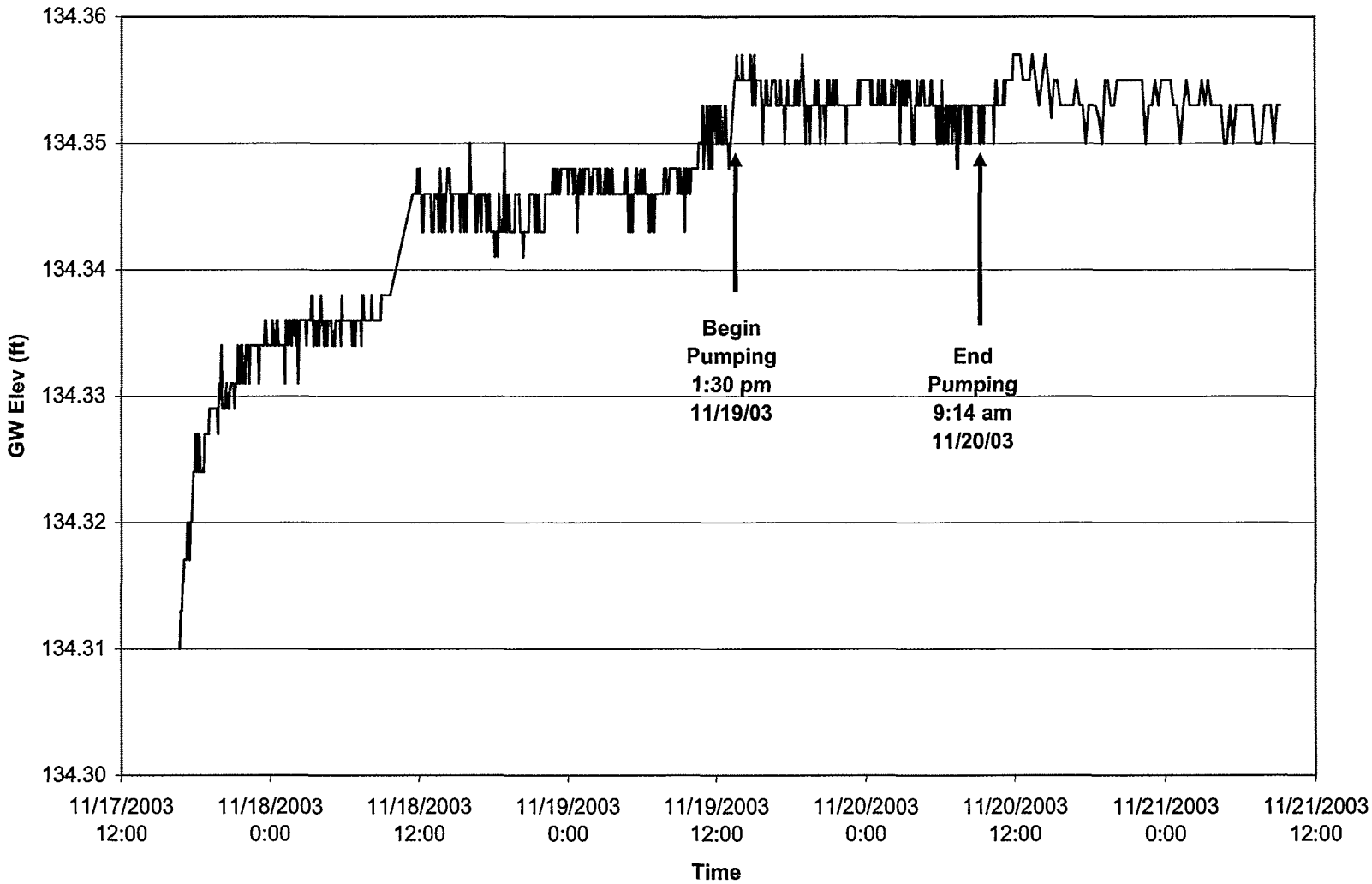

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Figure E-14, OW-1 Background Water Level Fluctuations, March-April 2004

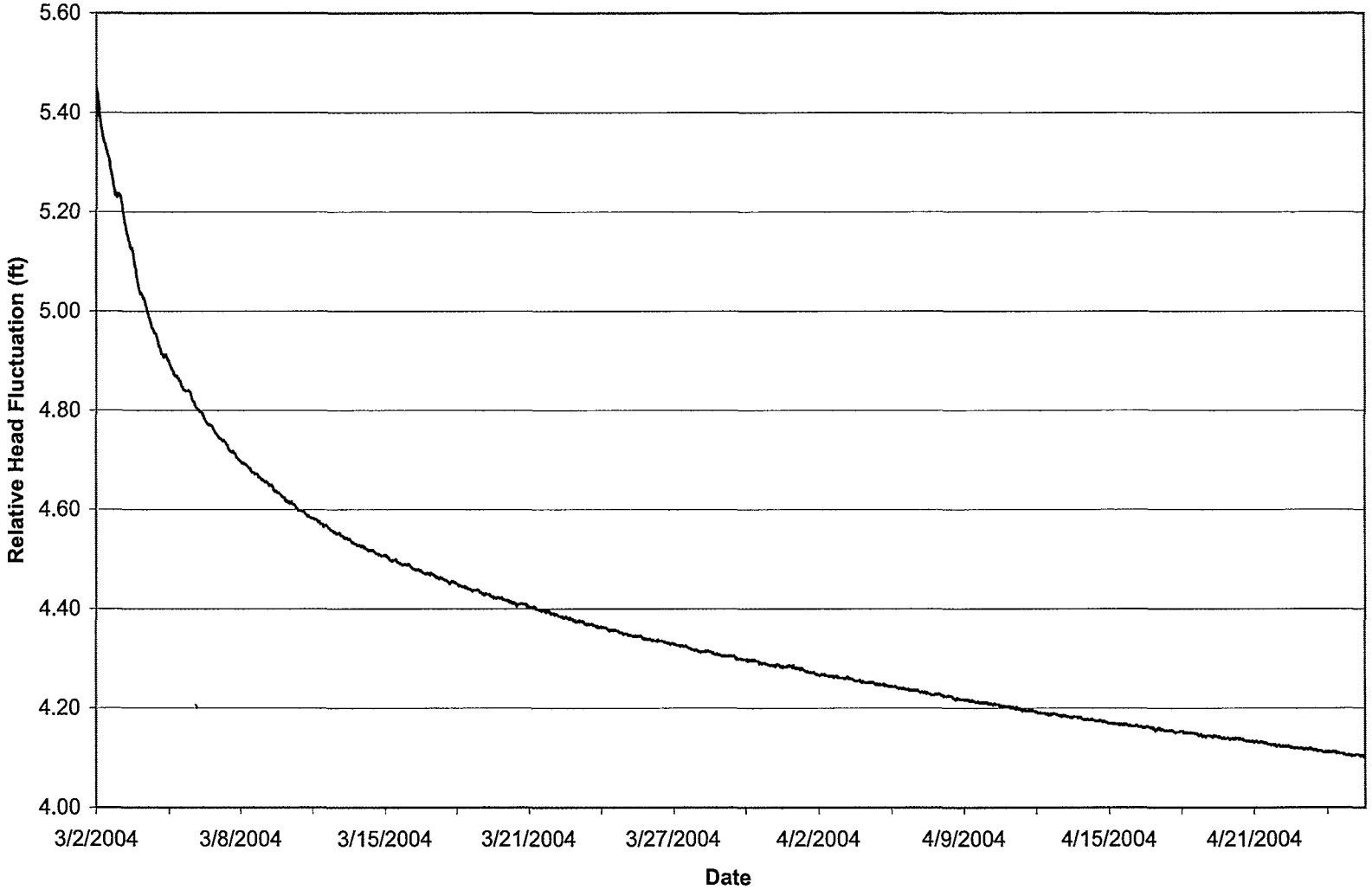

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Figure E-15, OW-1b Background Water Level Fluctuations, March-April 2004

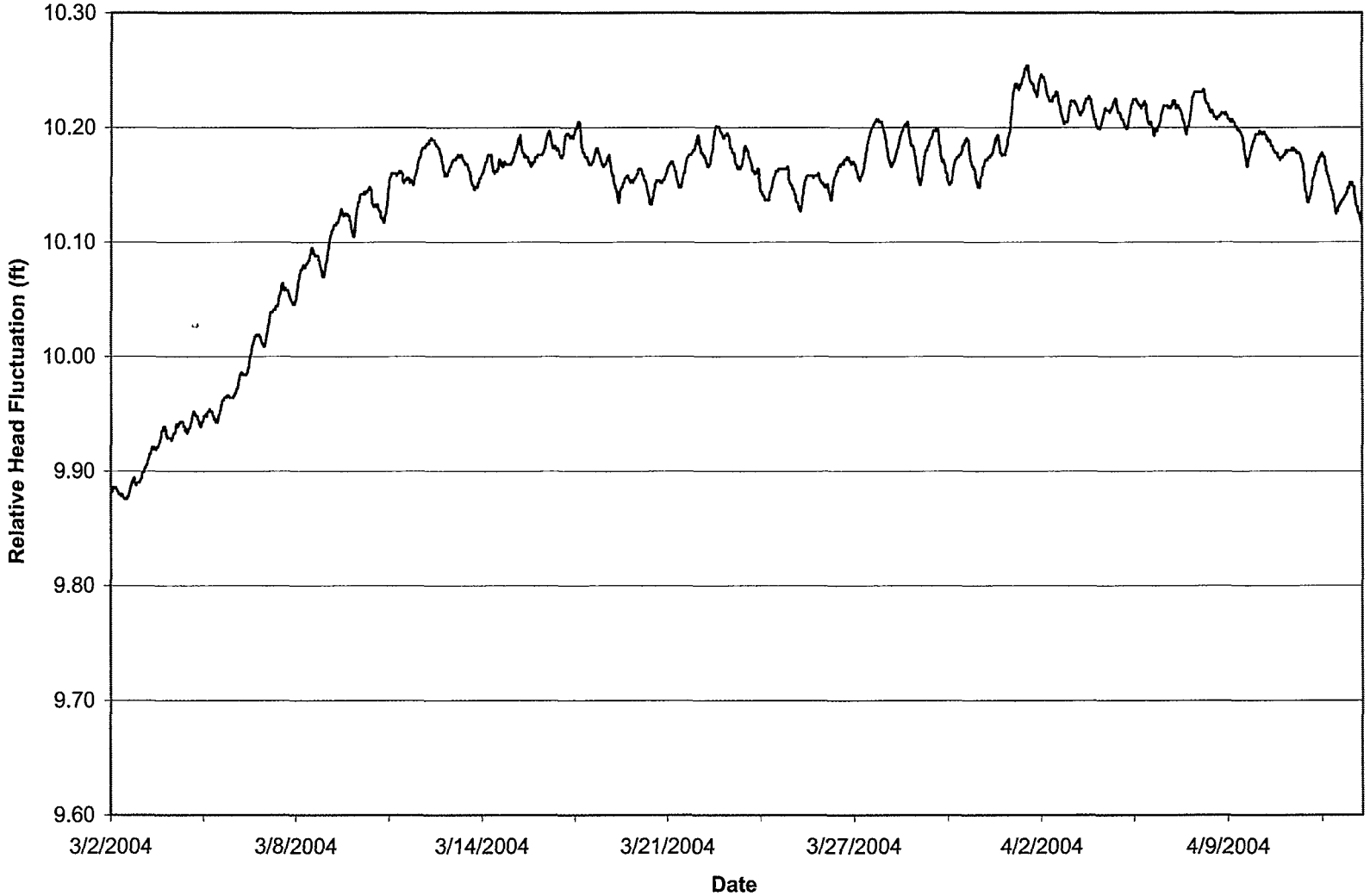

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Figure E-16, OW-4a Background Water Level Fluctuations, March-April 2004

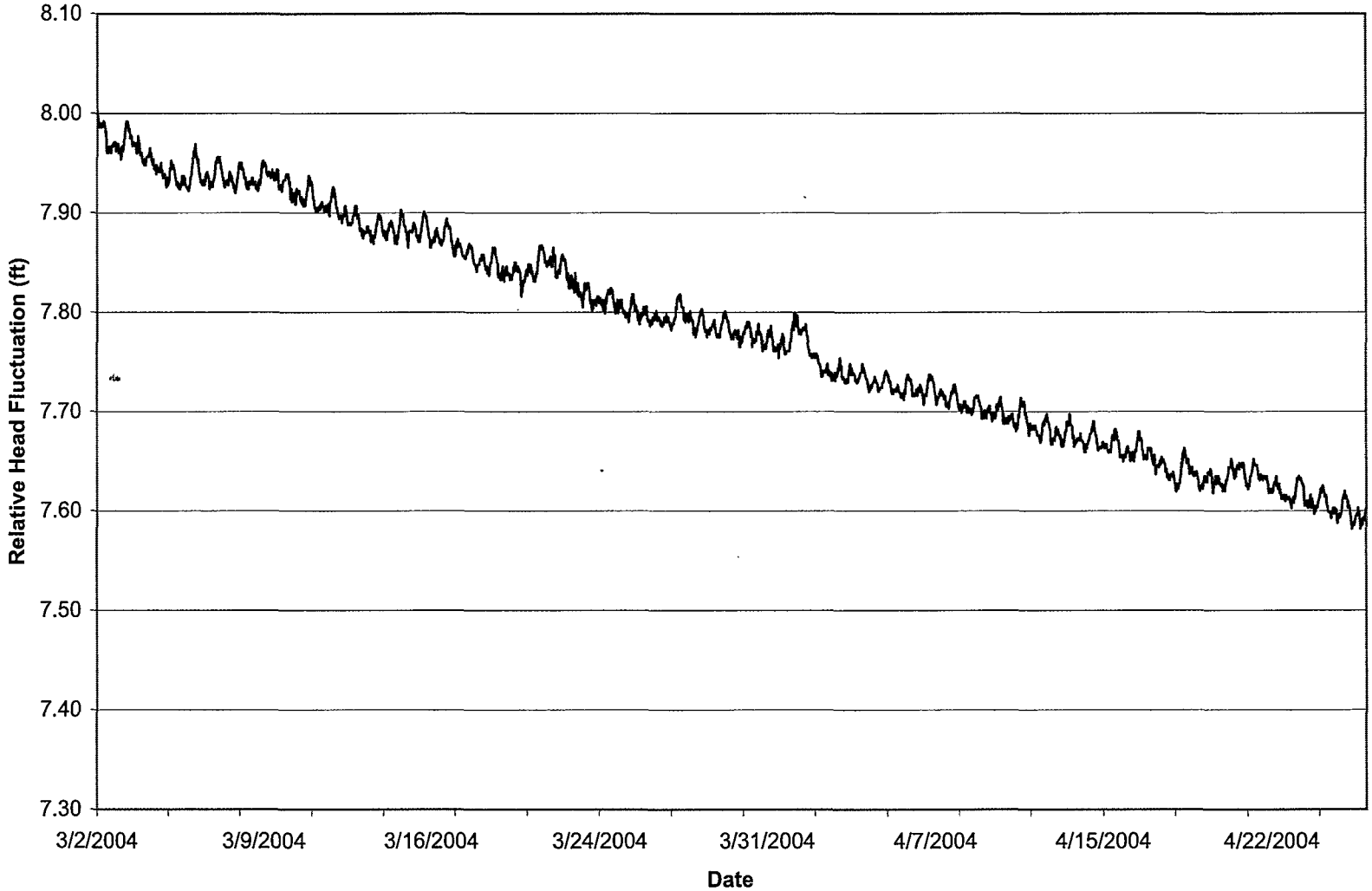

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Figure E-17, OW-4b Background Water Level Fluctuations, March-April 2004

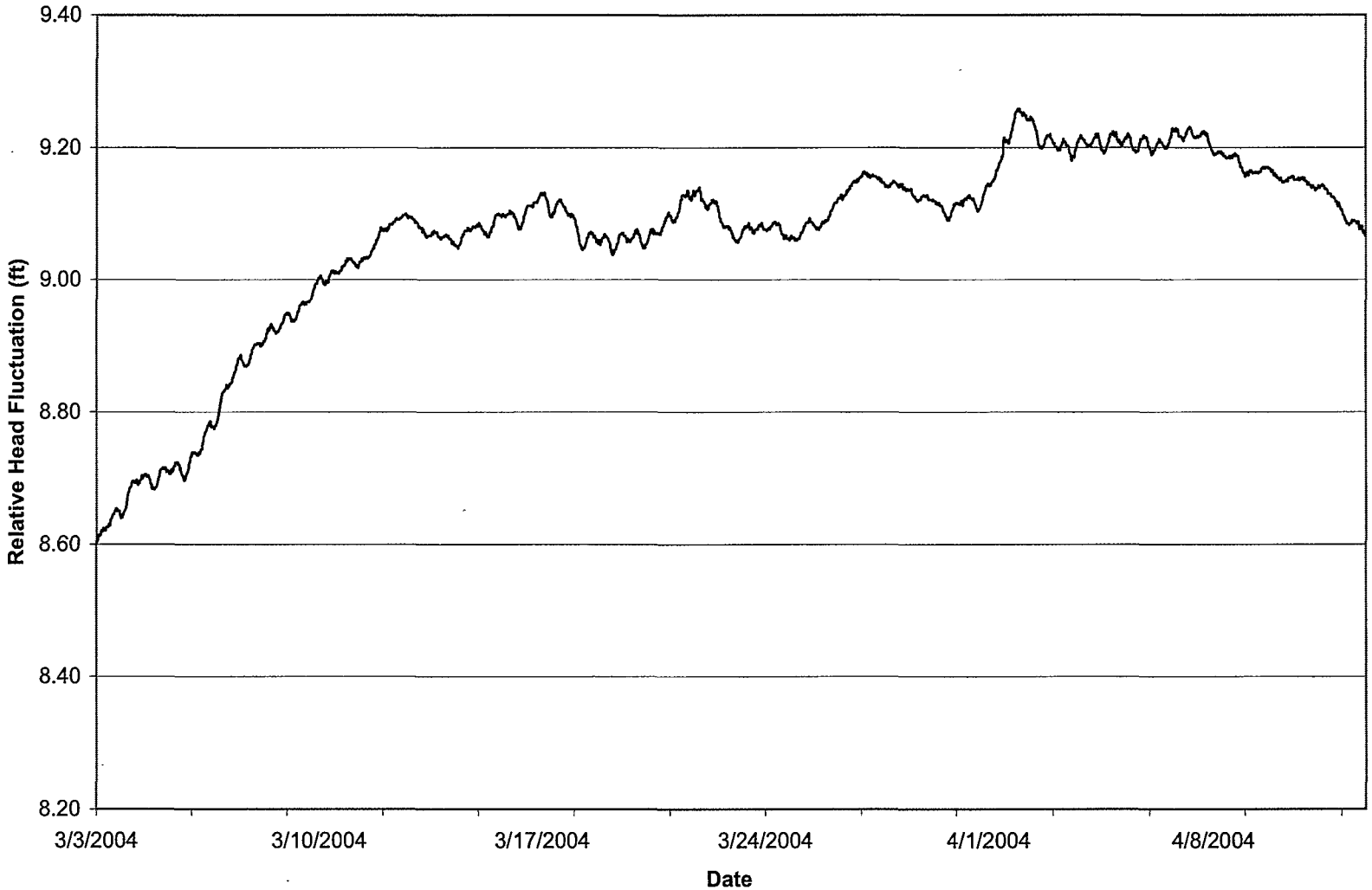

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Figure E-18, OW-7 Background Water Level Fluctuations, April 2004

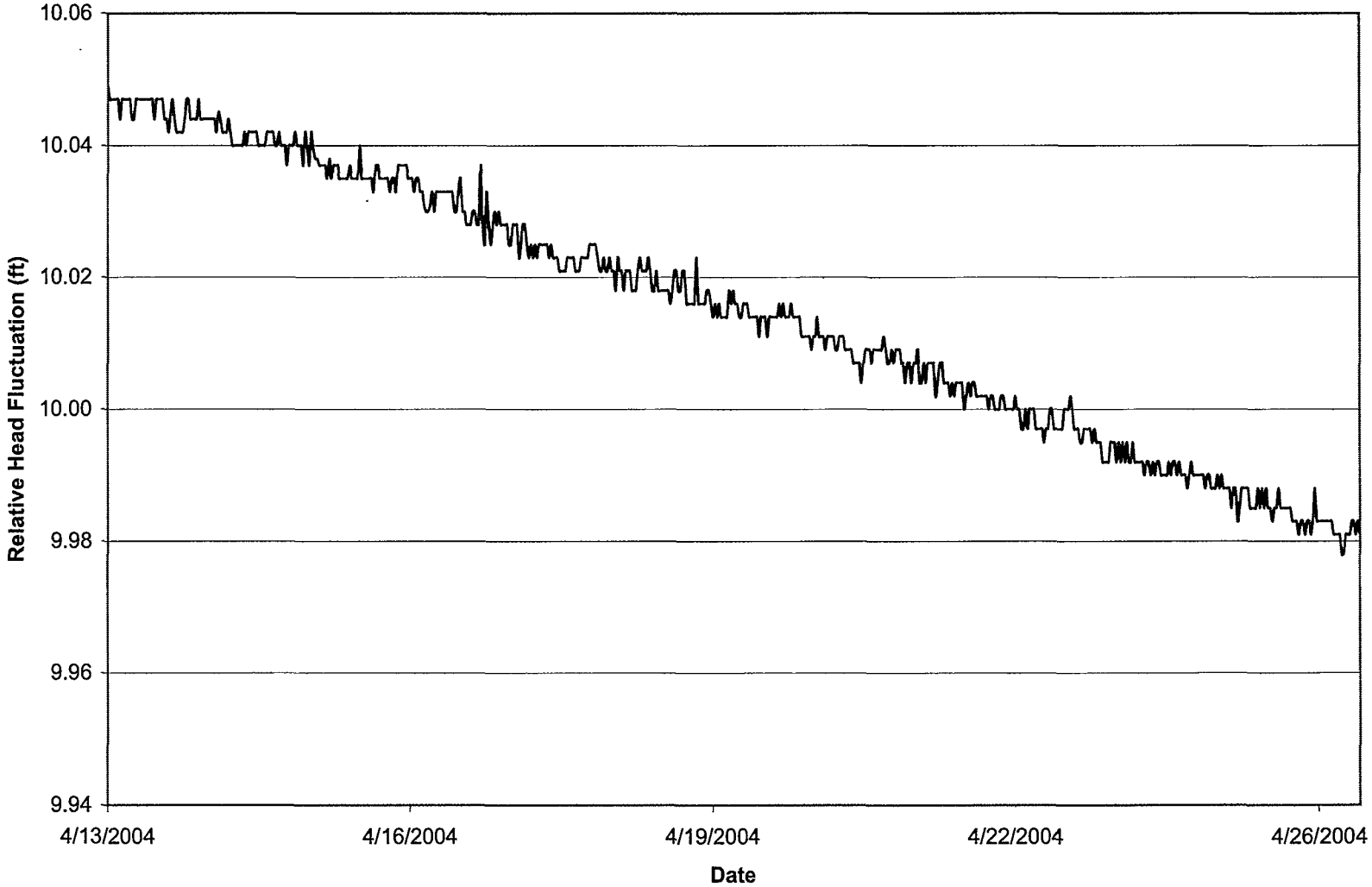

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Figure E-19, OW-8 Background Water Level Fluctuations, April 2004

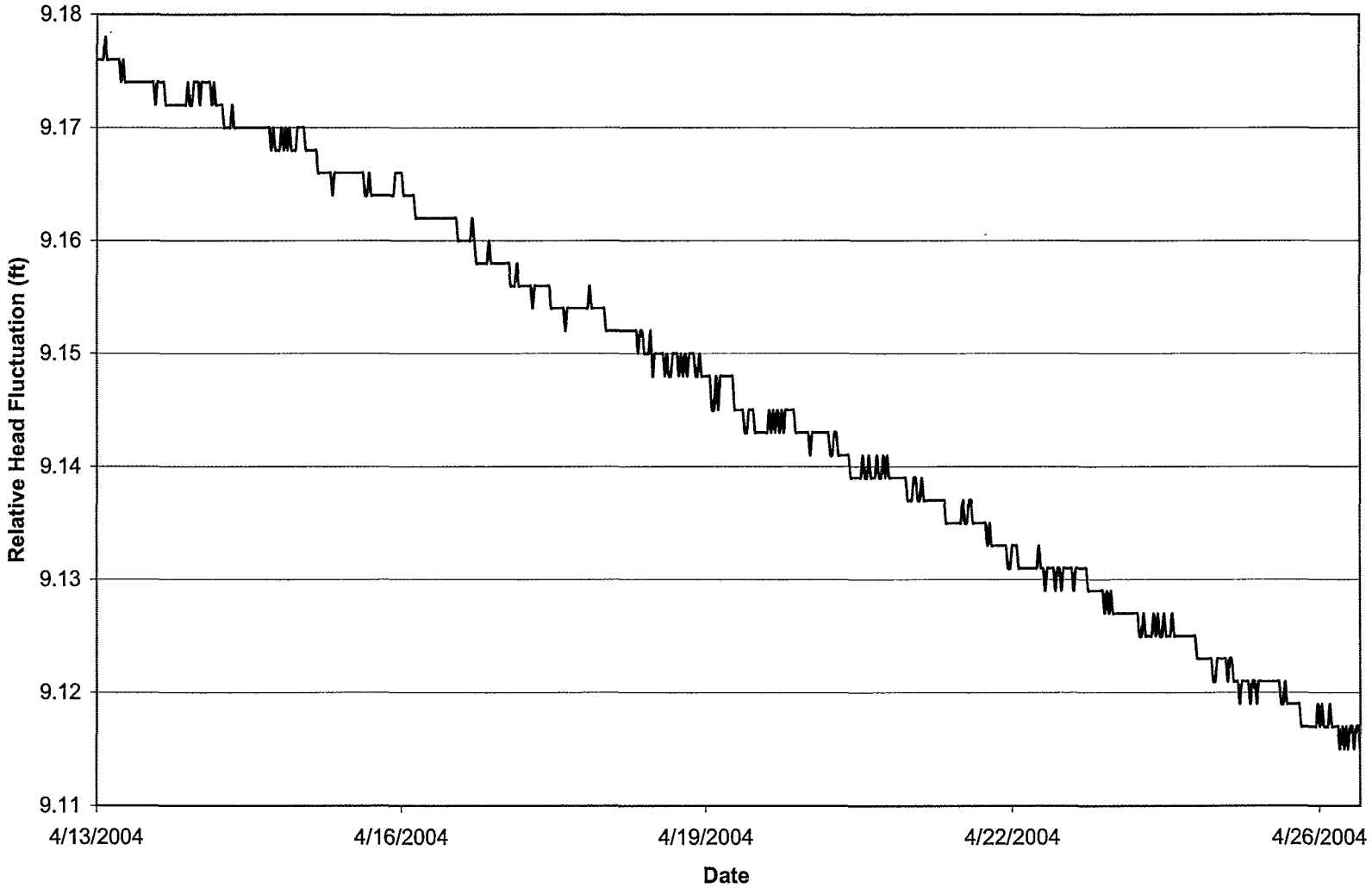

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Figure F-1 - Chloroethenes

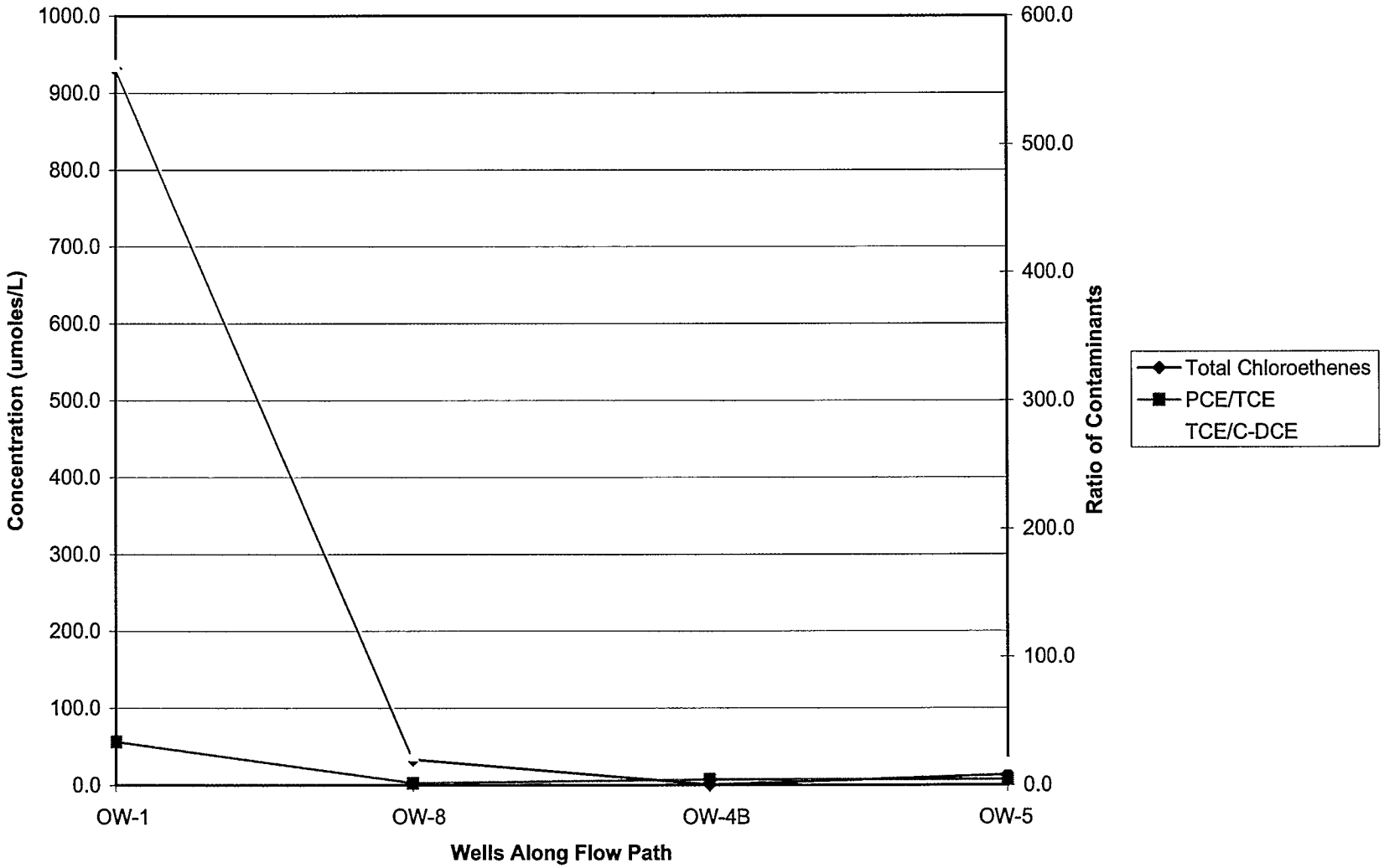


Figure F-2 - Chloroethanes

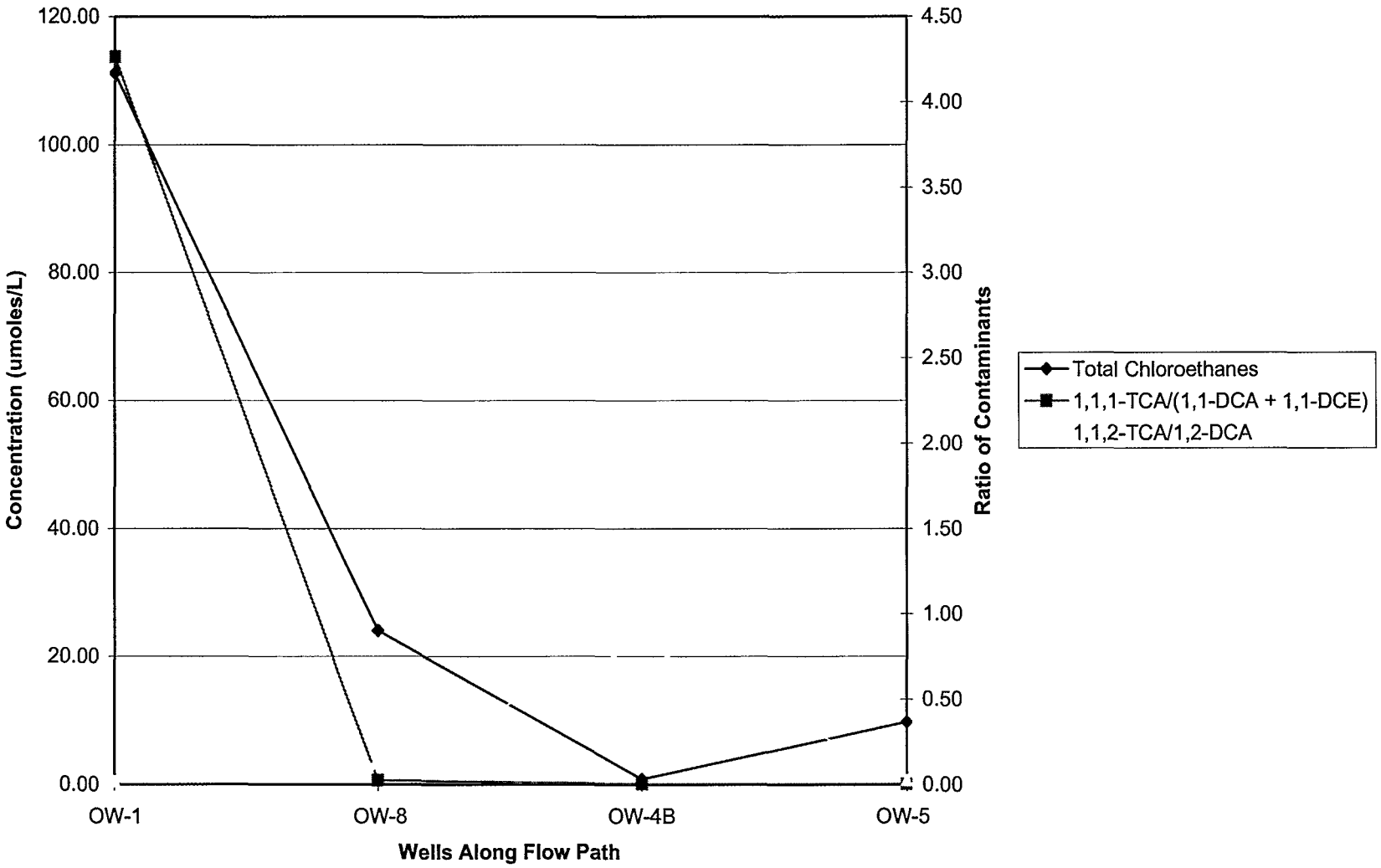


Table F-1

Flow path	OW-1 OW-8 OW 2 OW-3 OW-4A OW-5	OW-1B OW-4B

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
OW-1	150000	3500	4 6	904 5	26 6	0 0	931 2	34 0	561 4
OW-8	3400	1600	50	20 5	12.2	0 5	33 2	1 7	23 6
OW-4A	68	12	0.5	0 4	0 1	0 0	0 5	4 5	17 7
OW 5	1800	320	14	10 9	2 4	0 1	13 4	4 5	16 9
OW-1B	87	2 8	0.5	0 5	0 0	0 0	0 6	24 6	4 1
OW-4B	1 6	0.5	0.5	0 0	0 0	0 0	0 0	2 5	0 7

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
OW-1	5 3	12000	0 35	45	12	2000	0 03	89 95	0 00	0 45	0 12	20 63	111 19	4 27	0 02
OW-8	50	51	130	110	780	1300	0 30	0 38	0 97	1 11	7 88	13 41	24 06	0 03	0 12
OW-4A	0 5	0 3	0.5	0.5	0 45	79	0 00	0 00	0 00	0 01	0 00	0 81	0 83	0 00	0 82
OW-5	0 5	2 6	1 2	5 1	33	910	0 00	0 02	0 01	0 05	0 33	9 39	9 80	0 00	0 03
OW 1B	0 5	0 84	0.5	0.5	0 41	2 2	0 00	0 01	0 00	0 01	0 00	0 02	0 04	0 23	0 90
OW-4B	0 5	0 5	0.5	0 5	0.25	0 5	0 00	0 00	0 00	0 01	0 00	0 01	0 02	0 37	1 48

value indicated is one-half the reporting limit

Table F-2 - Contaminant Retardation Coefficient Estimates

Purpose: To estimate the advective groundwater transport velocity and contaminant migration rates within the shallow hydrogeologic zone at the Site.

Advective Transport Velocity Estimates, V_A

The advective groundwater transport velocity (V_A) may be estimated using the following relationship:

Equation $V_A = K_H / n_e * dh/dl$

where

V_A = Advective groundwater transport velocity (ft/day)
K_H = hydraulic conductivity (ft/day)
n_e = Assumed effective soil porosity (dimensionless)
dh/dl = hydraulic gradient (ft/ft)

For estimating purposes, the shallow hydrogeologic zone may be separated into three segments (Segment 1 - 3), each with unique hydrogeologic properities. Segment 1 refers to the area between monitoring wells OW-1 and OW-8; Segment 2 refers to the area between monitoring wells OW-8 and OW-4B, and Segment 3 refers to the area between monitoring wells OW-4B and OW-5. The aquifer parameters within each Segment are generalized below:

Parameter Value	Segment 1 (OW-1 to OW-8)	Segment 2 (OW-8 to OW-4B)	Segment 3 (OW-4B to OW-5)
K_H =	10	50 - 100	50 - 100
n_e =	0.2	0.2	0.2
dh/dl =	0.008	0.008	0.0011

The resulting advective groundwater transport velocity within the shallow hydrogeologic zone is estimate as:

Parameter Value	Segment 1 (OW-1 to OW-8)	Segment 2 (OW-8 to OW-4B)	Segment 3 (OW-4B to OW-5)
Minimum V_A =	0.42	2.1	0.27
Maximum V_A =		4.2	0.55

Note: Minimum and Maximum ranges for Segments 2 and 3 are based on lower and upper limits for K_H

Table F-2 - Contaminant Retardation Coefficient Estimates

Thus, the time required for groundwater to migrate within each Segment is summarized below:

Water Bearing Unit	Approximate Travel Distance (feet)	Advective Groundwater Transport			
		Minimum Transport Time		Maximum Transport Time	
		(days)	(years)	(days)	(years)
Segment 1	275	660	1.8	660	1.8
Segment 2	685	164	0.5	329	0.9
Segment 3	1940	3539	9.7	7077	19.4
Total	2900	4363	12.0	8066	22.1

Contaminant Migration Rate

Retardation Coefficient Estimates, R

The contaminant-specific retardation coefficient, R, may be estimated using the following relationship:

Equation $R = 1 + (\rho_b * K_d)/n_t$

where

R = Coefficient of retardation (dimensionless)
ρ_b = Soil bulk density (g/cm^3)
n_t = Assumed total soil porosity (dimensionless)
K_d = Distribution coefficient (cm^3/g) (see estimates below)

For the purposes of this exercise, the following assumptions are made

ρ_b = 1.59 (estimated average value for fine to coarse sands given in Table C.3.2 (USEPA, 1998))
n_t = 0.3

$Kd = K_{oc} * f_{oc}$

where

Koc = Organic carbon-water partitioning coefficient for a particular VOC compound (L/kg)
Source: (Table B.2.1 in USEPA, 1998)

Table F-2 - Contaminant Retardation Coefficient Estimates

The following table provides reference K_{OC} values for the primary chloroethene and chloroethane contamaninants detected in groundwater at the Site.

Compound	K_{OC} (L/kg)	Reference	
1,1,1-TCA =	183	(Howard, 1990)	
1,1-DCA =	40	(Howard, 1989)	
1,2-DCA =	92.5	(Howard, 1990)	Average value
1,1-DCE =	64.6	(Knox et al., 1993)	
PCE =	263	(Knox et al., 1993)	
TCE =	107	(Knox et al., 1993)	
cis-DCE =	80.2	(Jeng et. Al, 1992)	
trans-DCE =	58.9	(Knox et al., 1993)	

f_{OC} = Fraction of organic carbon in soils, equal to the TOC in soils/10[b]

The f_{OC} content of soils in the area of interest at the Site is approximately 0.15%. This value is based on the average f_{OC} data collected at soil borings GP-6 (0.14% at 60 foot depth; 0.195% at 80 foot depth) and B4 (0.12% at 75 feet).

The resulting retardation coefficient, R, for each contaminant is summarized below.

Compound	Kd	Retardation Coefficient ('R')
1,1,1-TCA =	0.27	2.5
1,1-DCA =	0.06	1.3
1,2-DCA =	0.14	1.7
1,1-DCE =	0.10	1.5
PCE =	0.39	3.1
TCE =	0.16	1.9
cis-DCE =	0.12	1.6
trans-DCE =	0.09	1.5
	Average R =	1.9

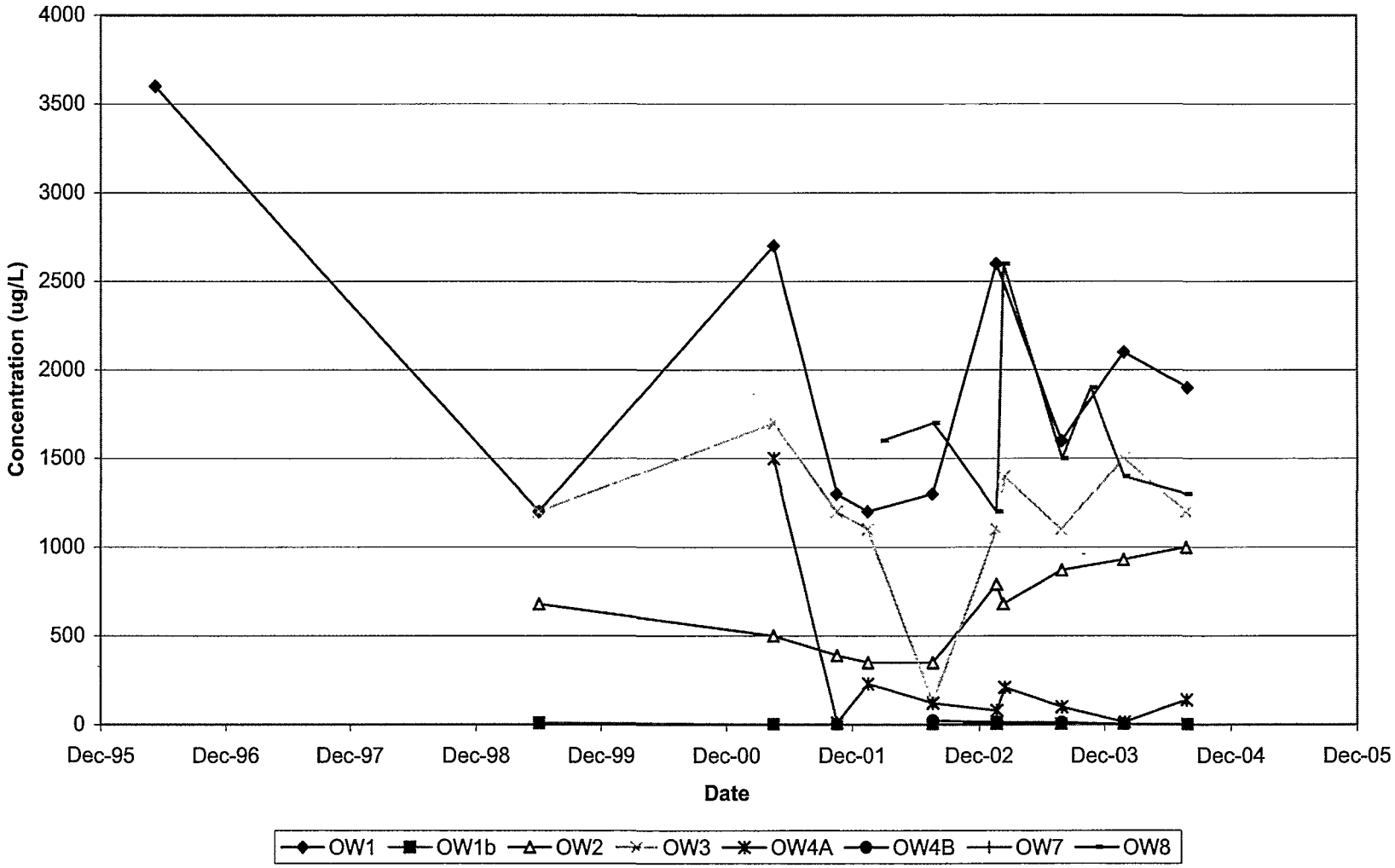
Contaminant Migration Rate, V_C

The contaminant migration rate, V_C, within each Segment is estimated by dividing the advective groundwater transport velocity by the average retardation coefficient (V_A/R). Thus, the time required for groundwater contaminants to migrate within each Segment is summarized below:

Table F-2 - Contaminant Retardation Coefficient Estimates

Water Bearing Unit	Approximate Travel Distance (feet)	Contaminant Migration Rate, V_C			
		Minimum Transport Time		Maximum Transport Time	
		(days)	(years)	(days)	(years)
Segment 1	275	1243	3.4	1243.20	3.4
Segment 2	685	310	0.8	619.34	1.7
Segment 3	1940	6665	18.3	13330.76	36.5
Total	2900	8218	22.5	15193	41.6

Time Series - 1,1-Dichloroethene (1,1-DCE)
Omega Chemical



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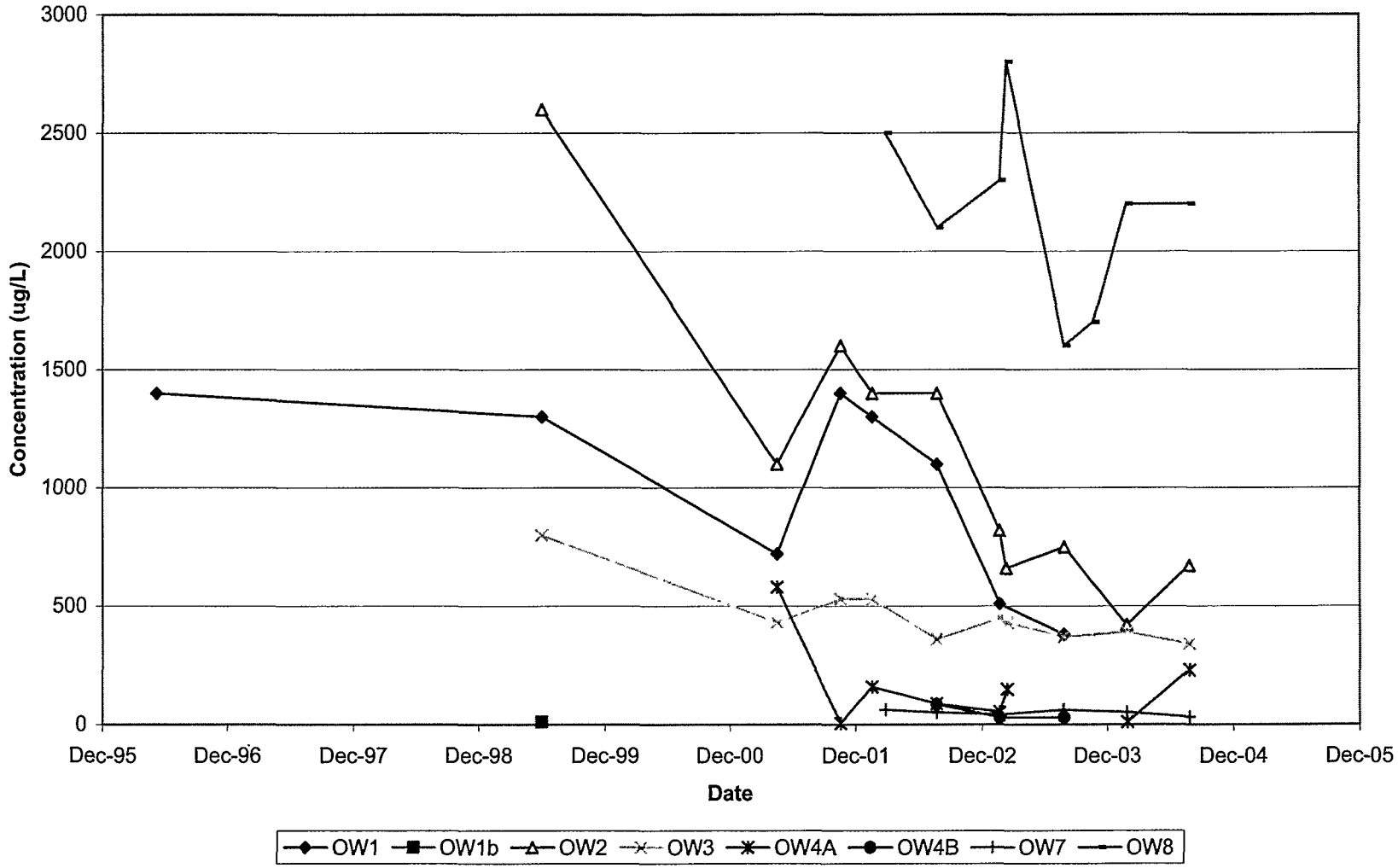
Time Series - Freon 113
Omega Chemical



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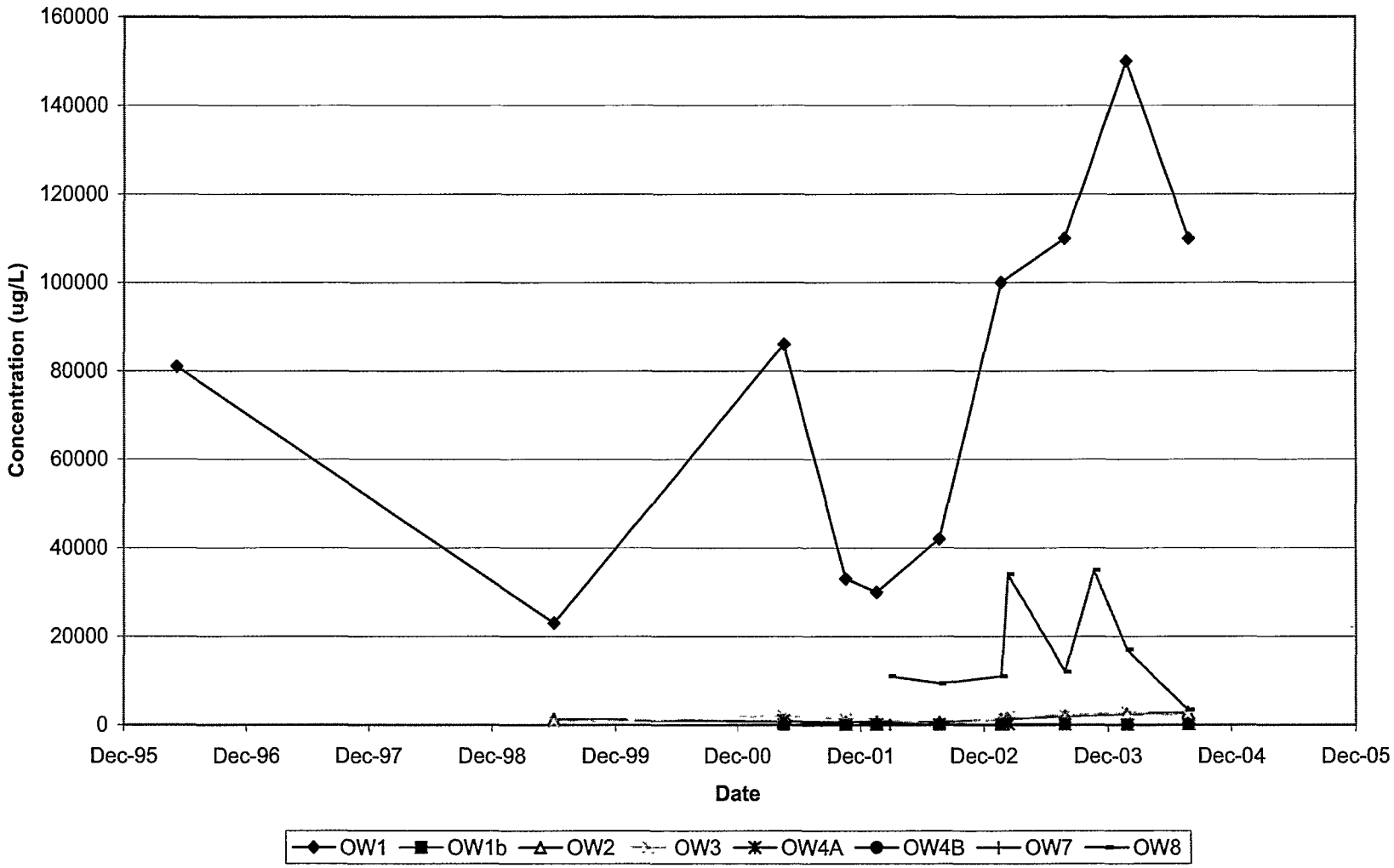
Time Series - Tetrachloroethene (PCE)
Omega Chemical



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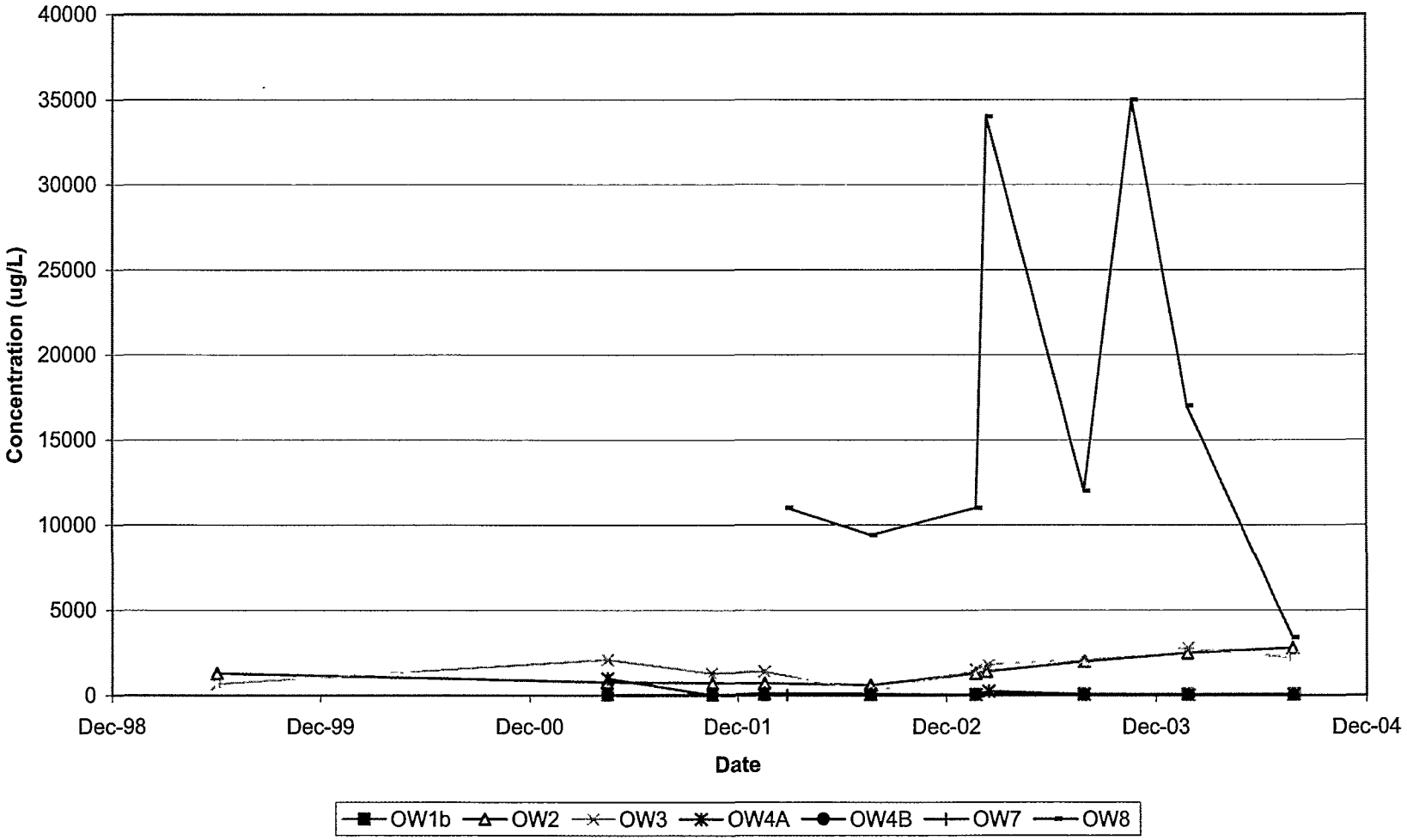
Time Series - Tetrachloroethene (PCE)
Without OW-1
Omega Chemical



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Time Series - Trichloroethene (TCE)
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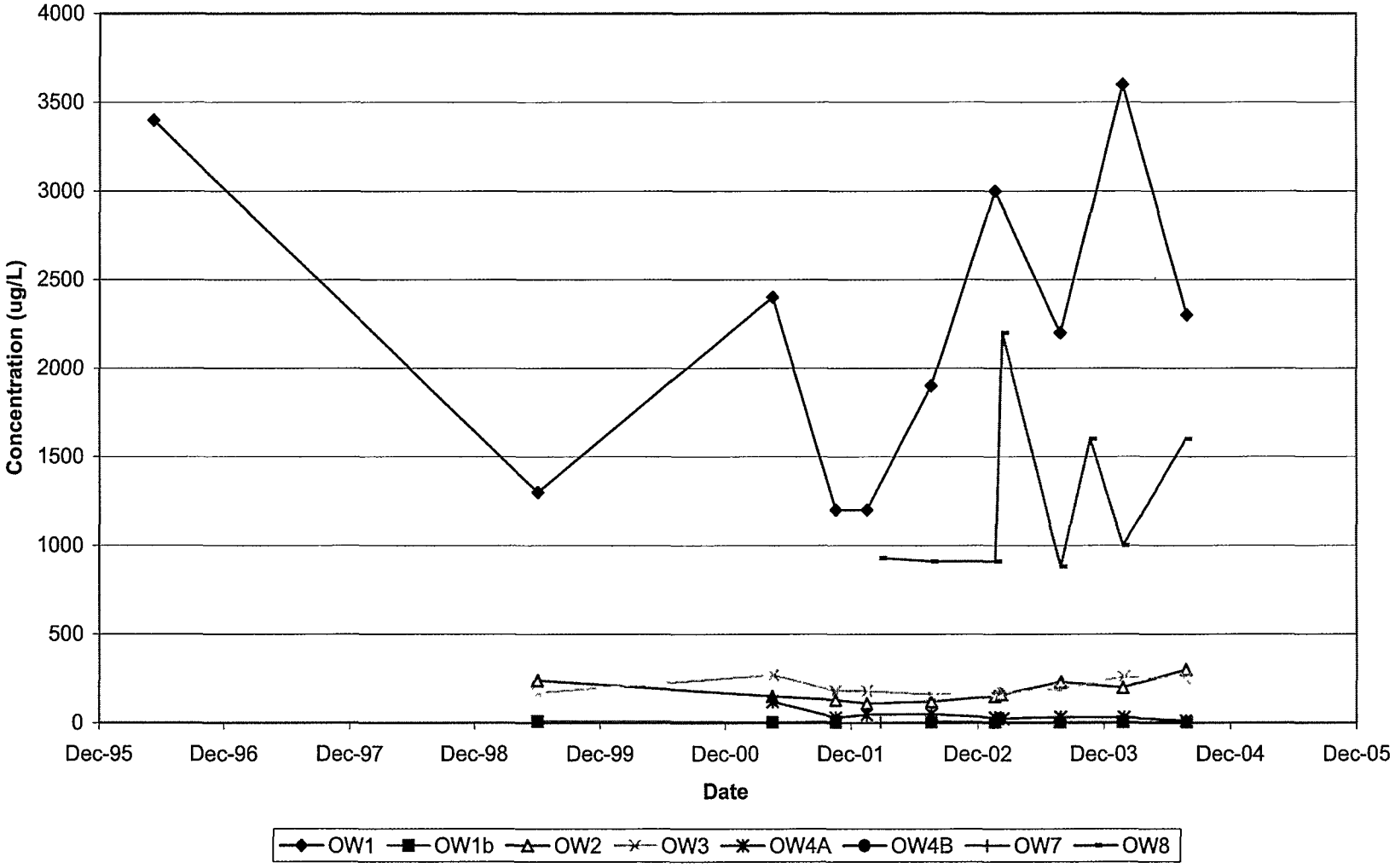

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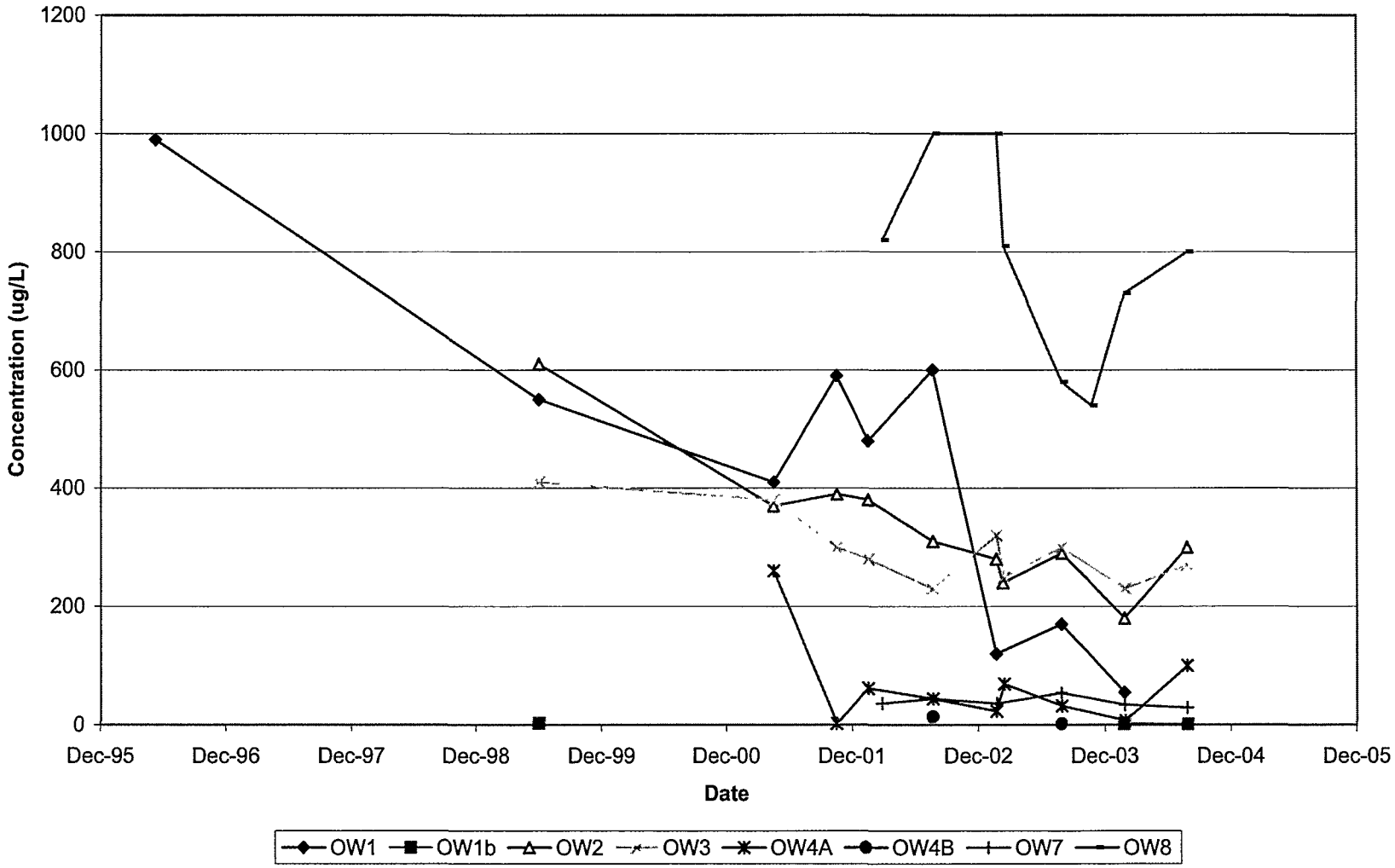
Time Series - Freon 111 Trichlorofluoromethane
Omega Chemical



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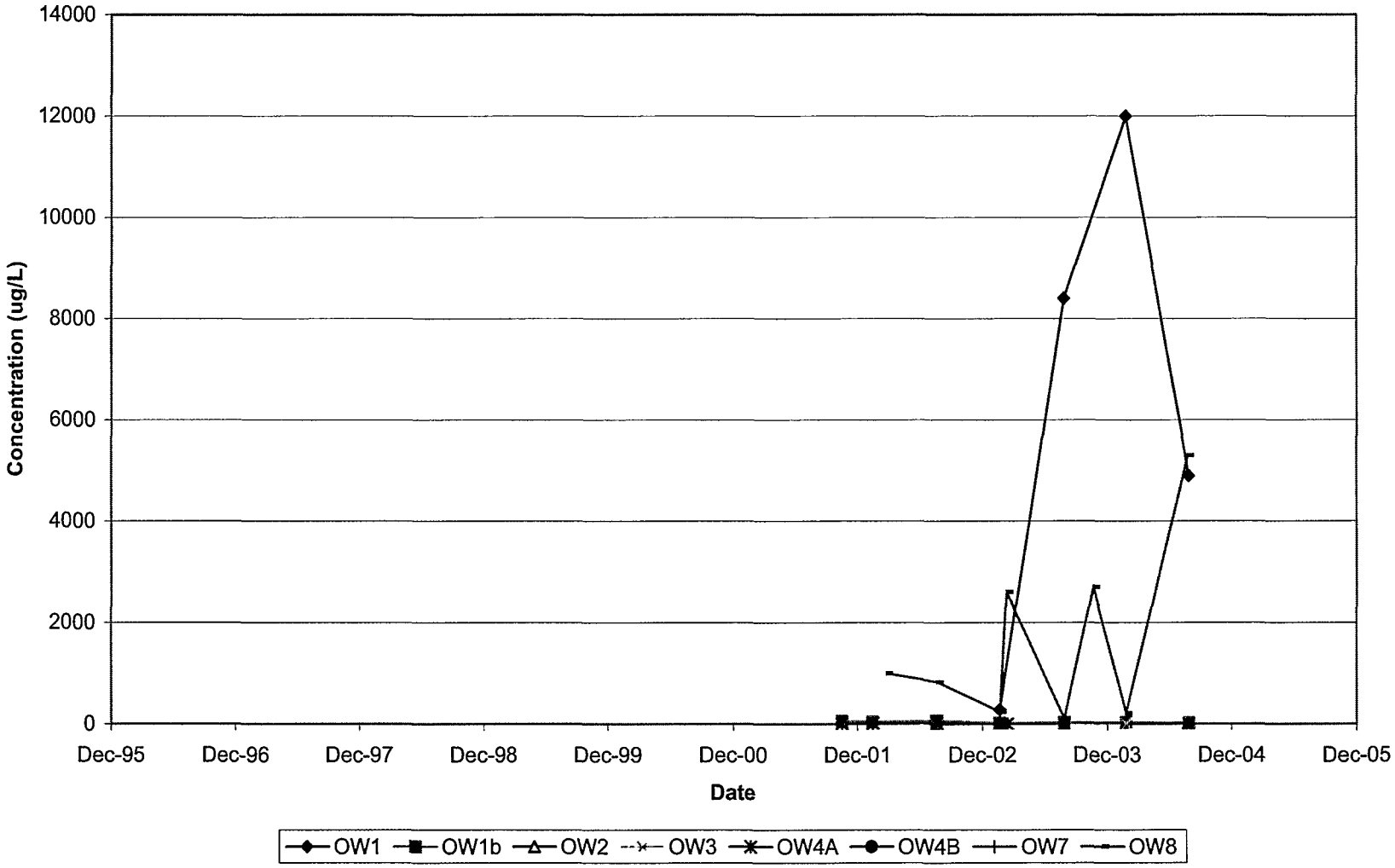
Time Series - 1,4-Dioxane
Omega Chemical



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Time Series - OW-1
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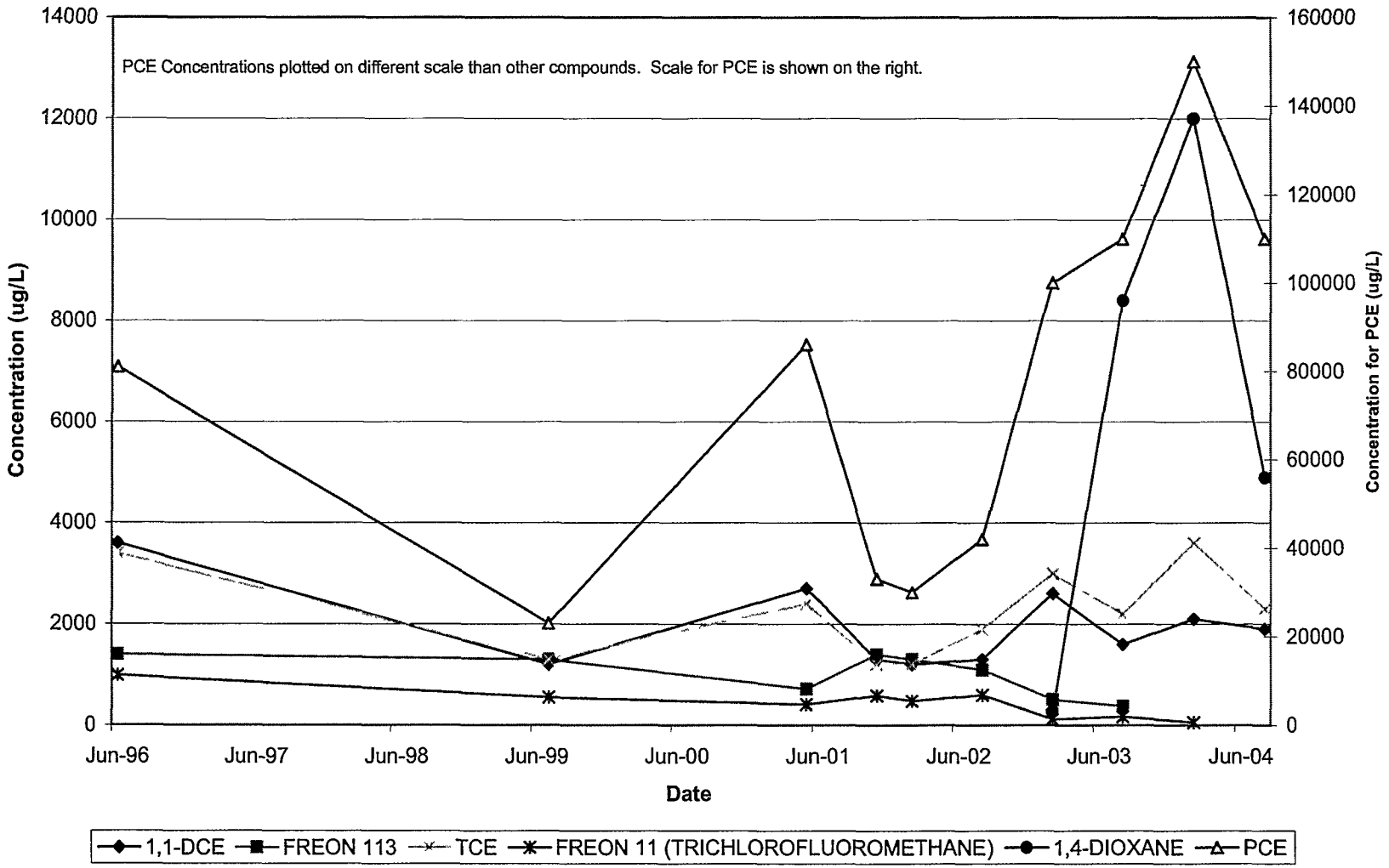

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Time Series - OW-1B
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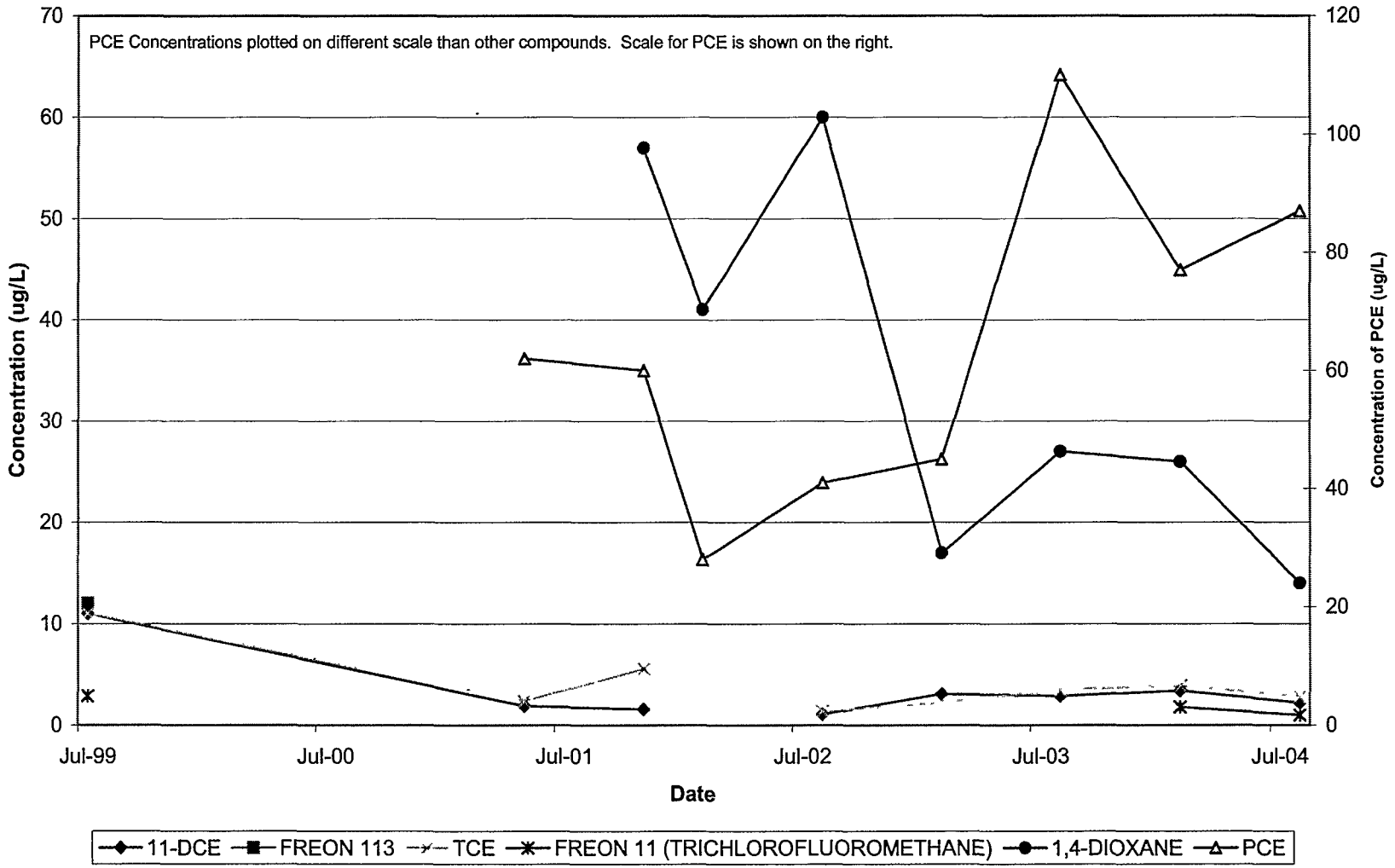

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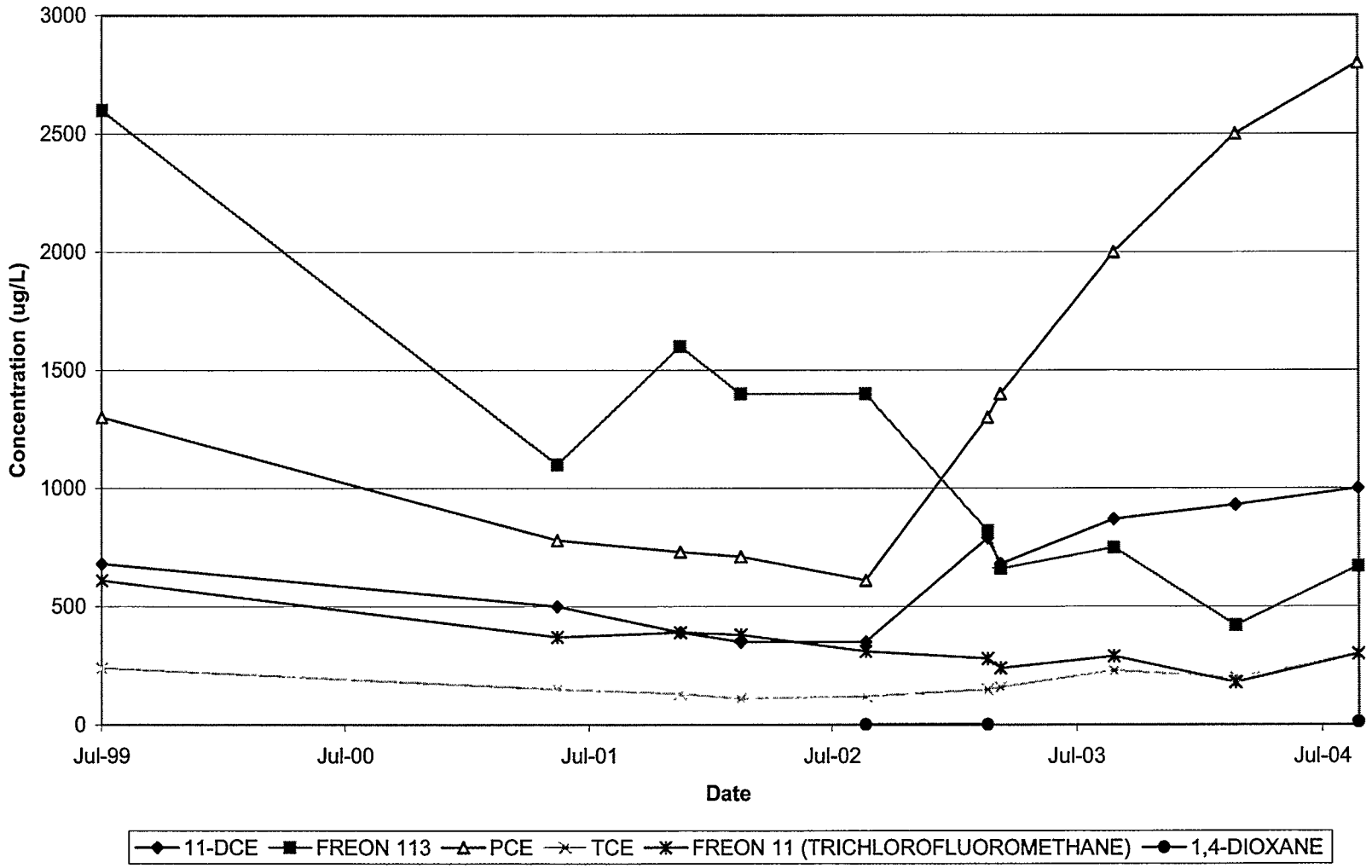

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Time Series - OW-3
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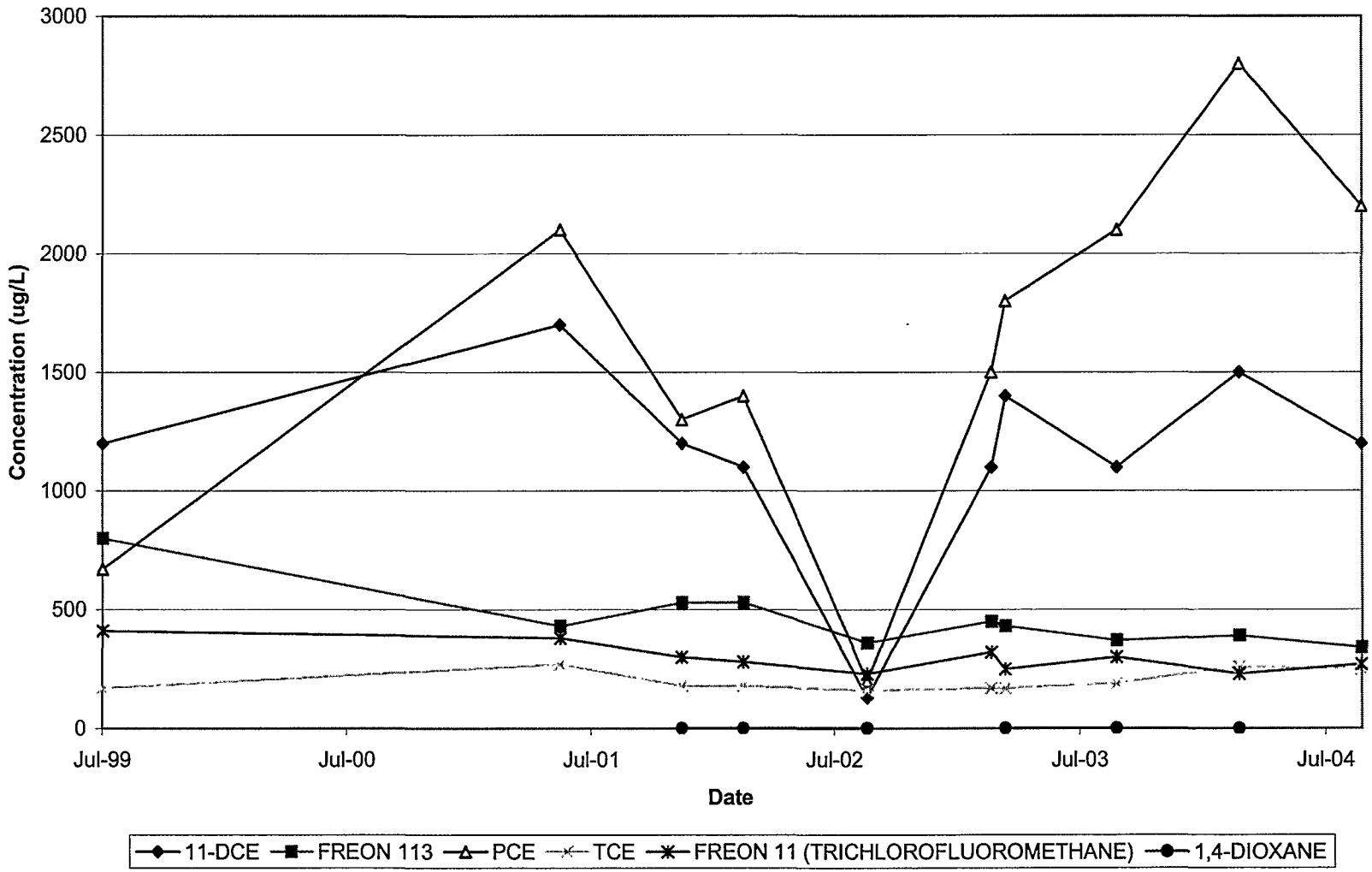

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Time Series - OW-4A
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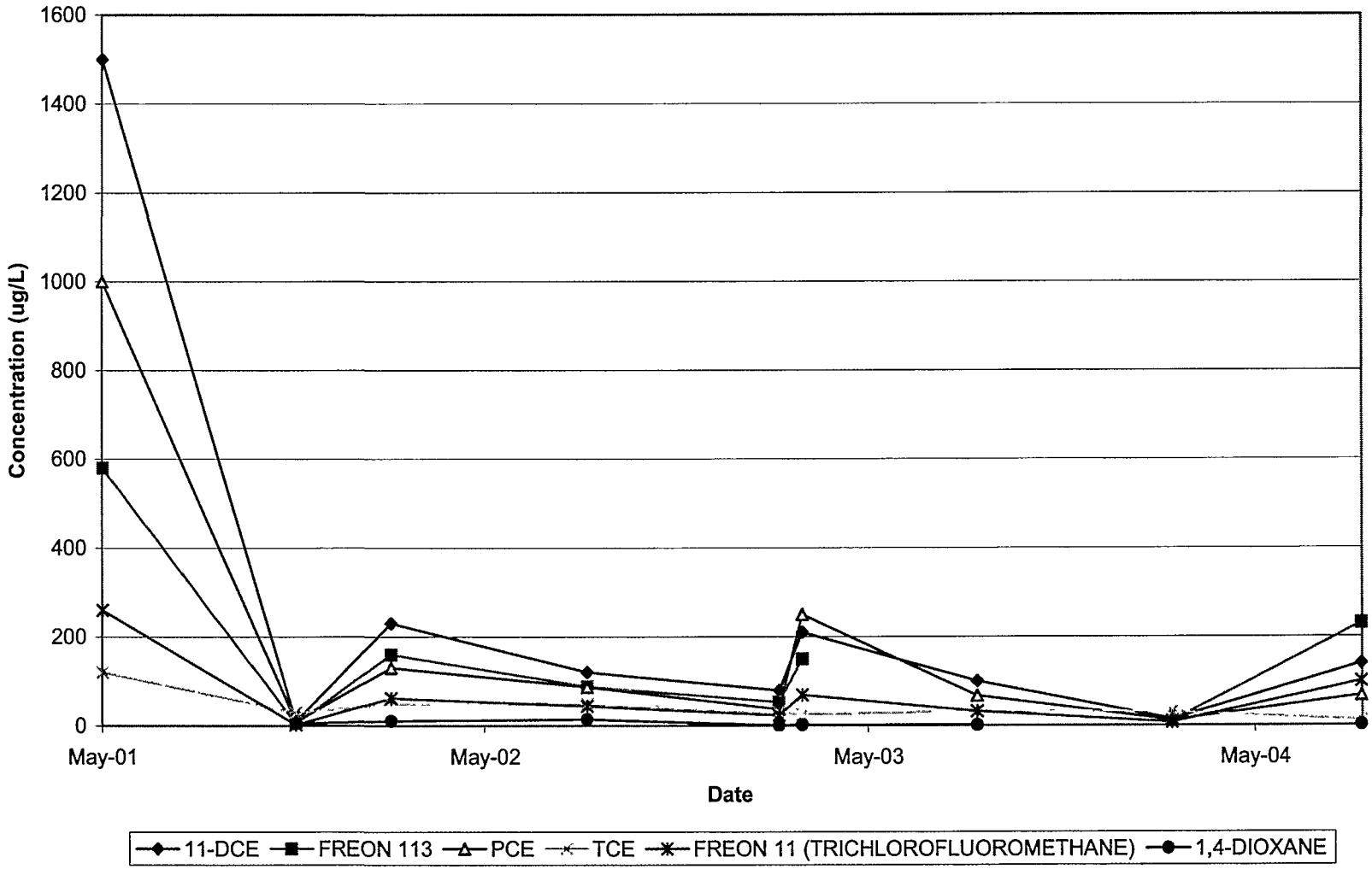

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Time Series - OW-4B
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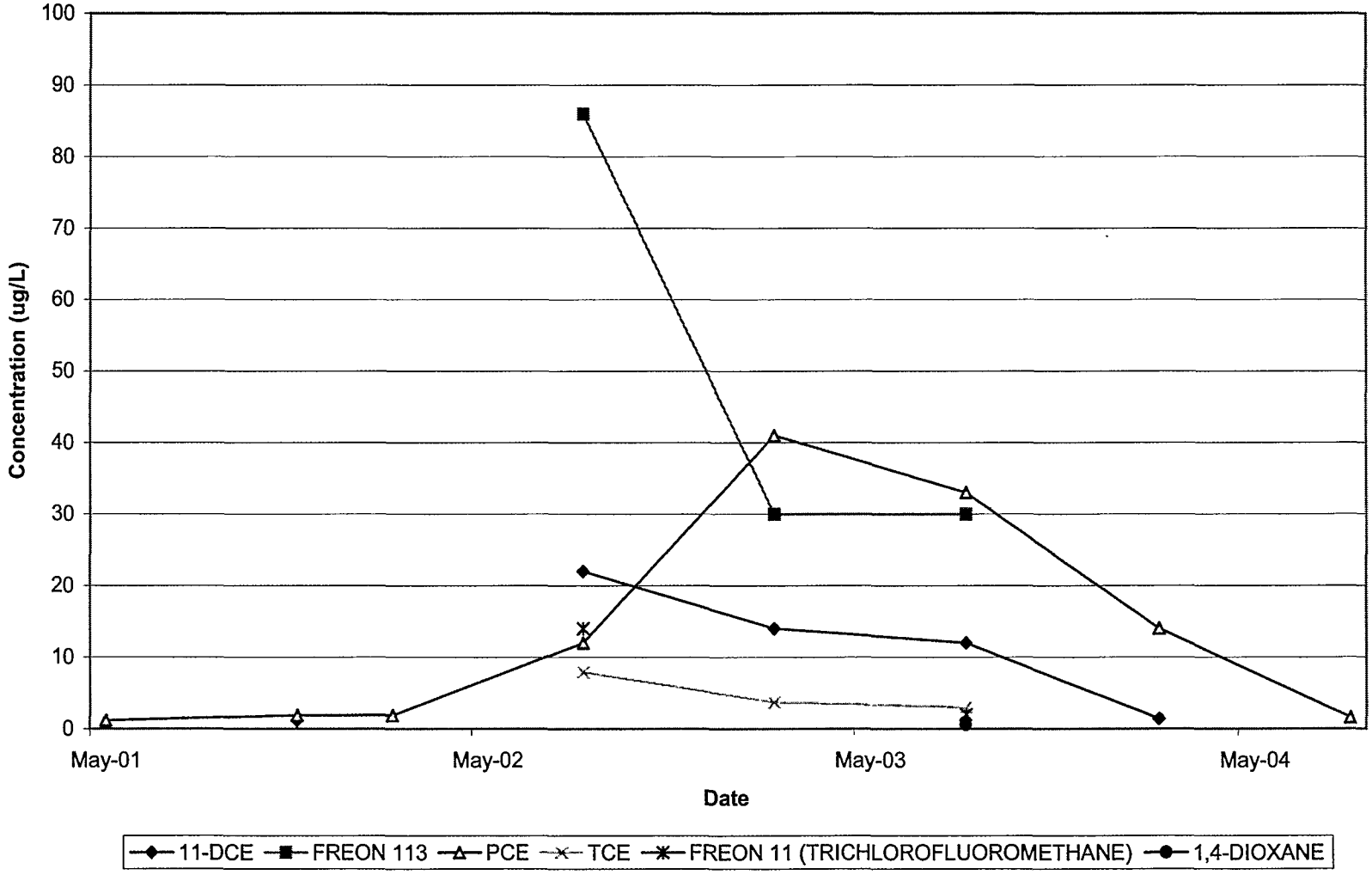

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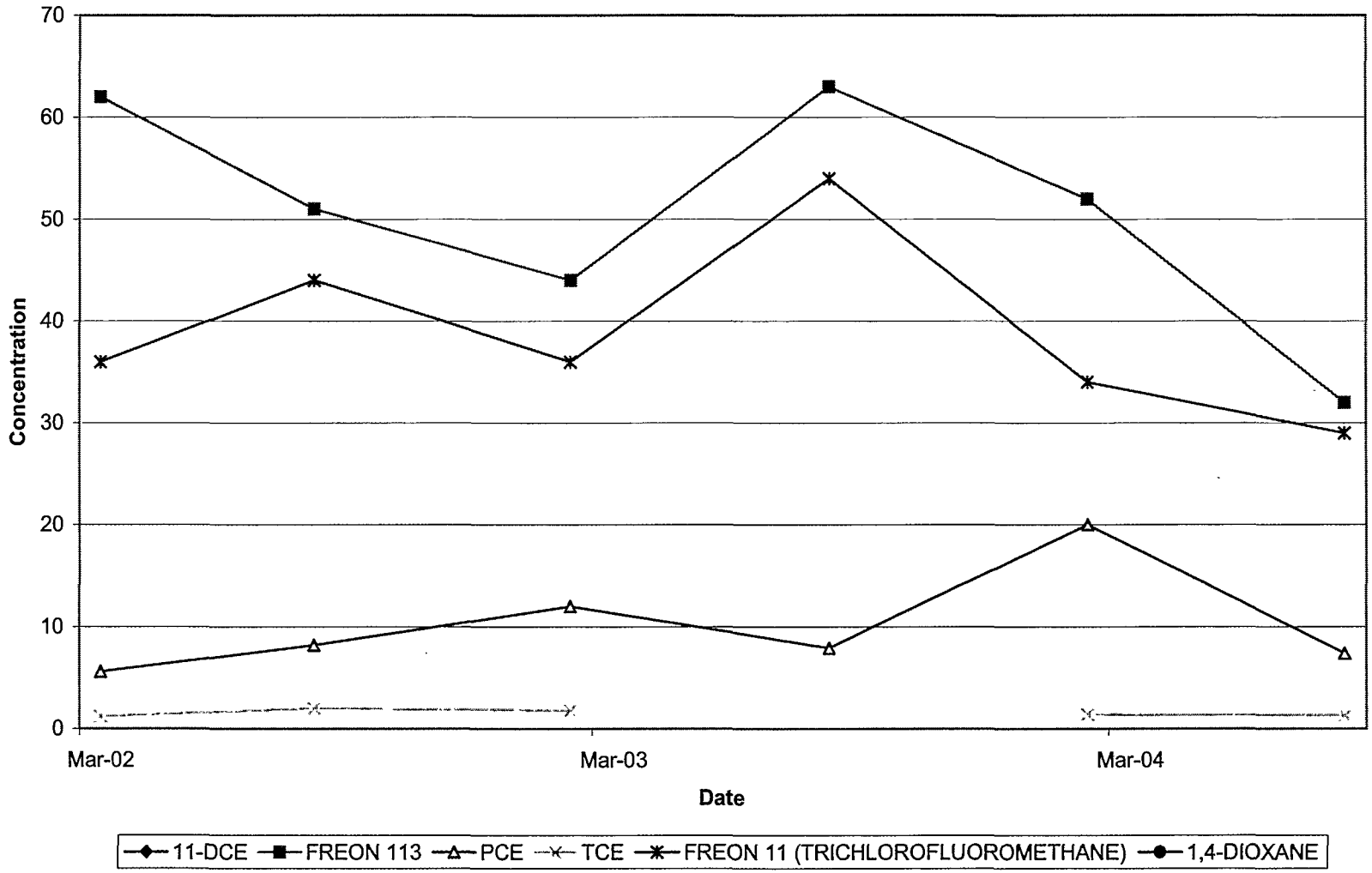
Time Series - OW-7
Omega Chemical



CDM

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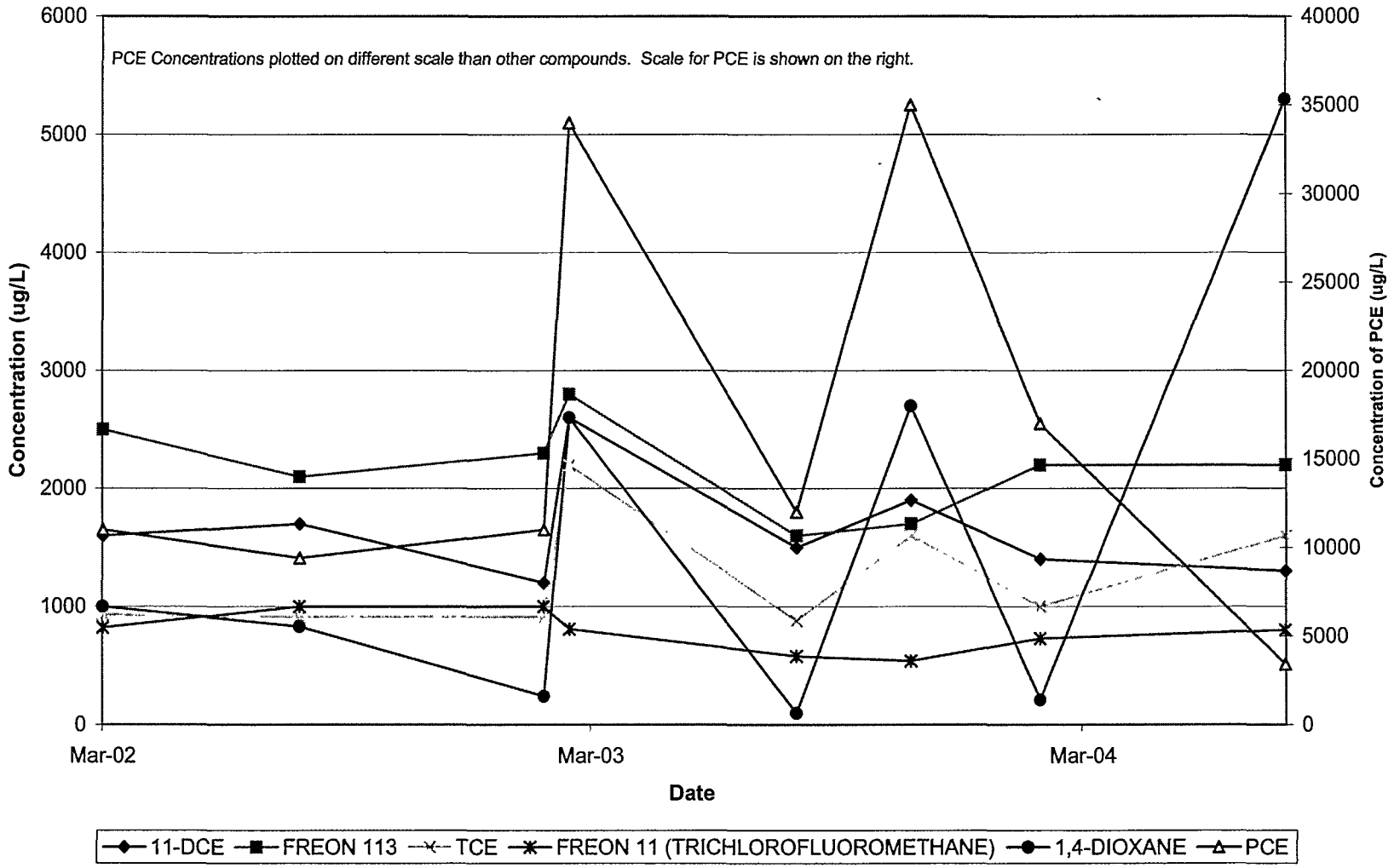
Time Series - OW-8
Omega Chemical



CDM

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Figure G-1, OW-1 Hydrograph 5/15/2001-8/25/2004

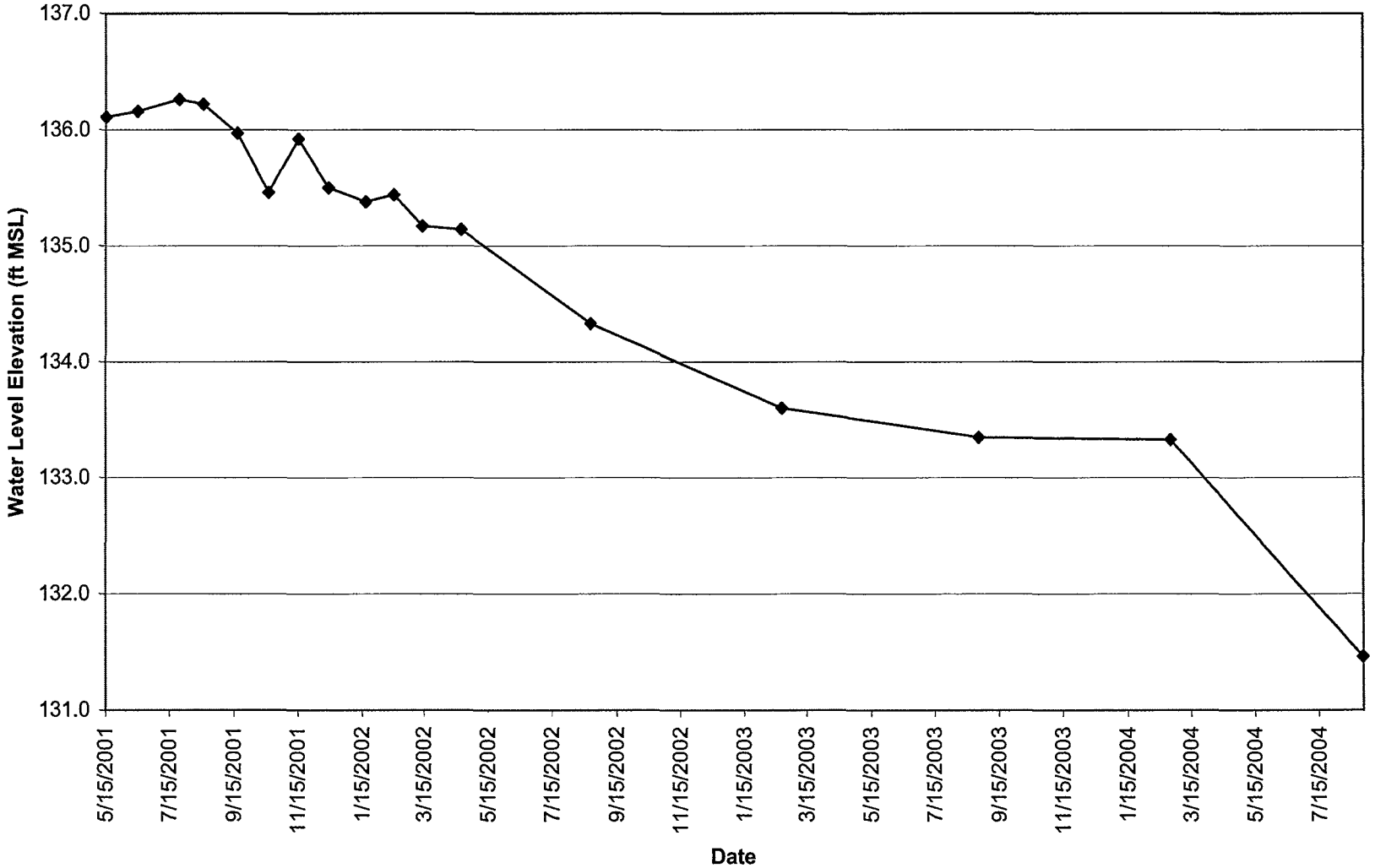

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Figure G-2, OW-1B Hydrograph 5/15/2001-8/25/2004

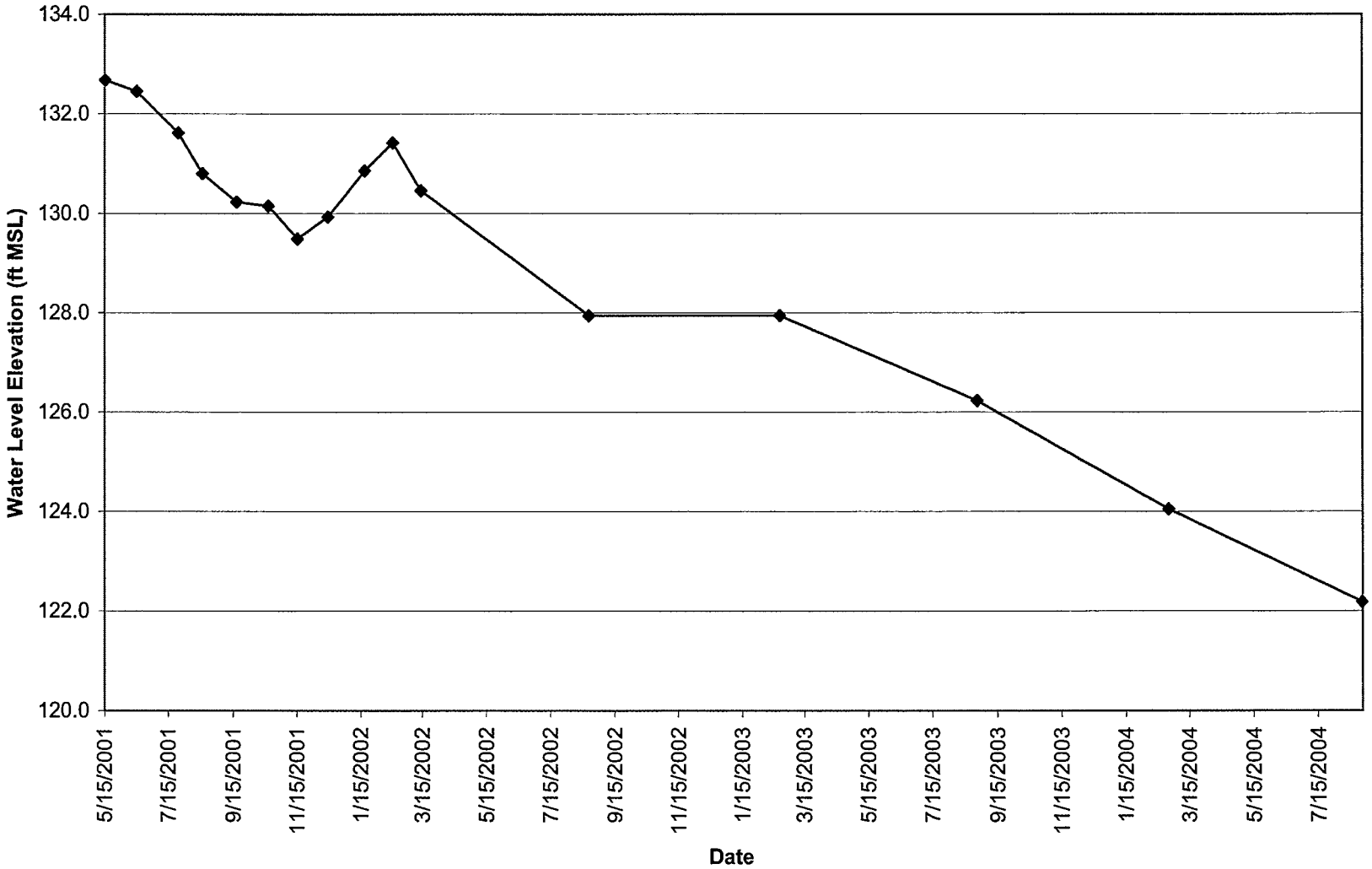

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Figure G-3, OW-2 Hydrograph 5/15/2001-8/25/2004

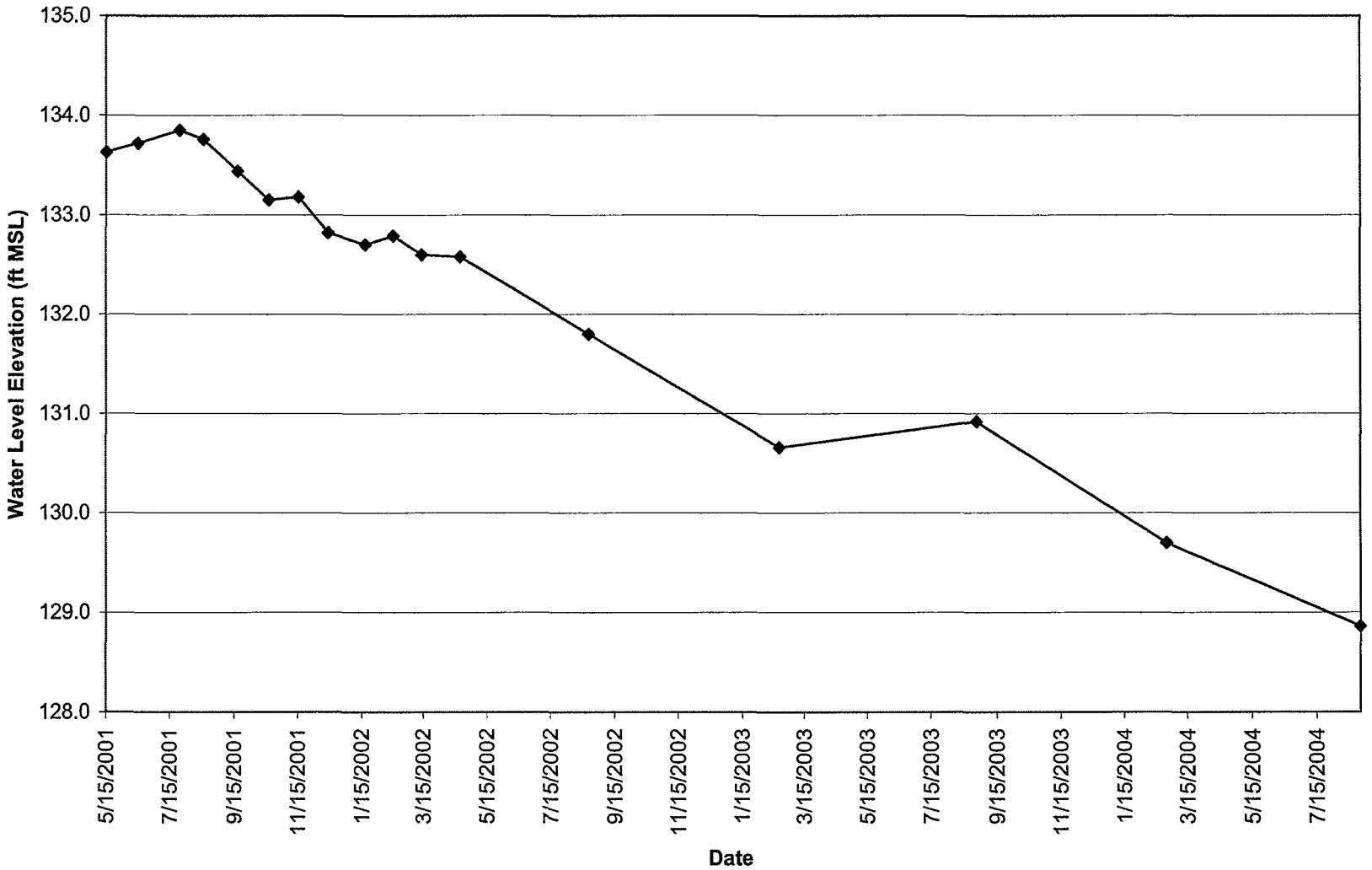

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Figure G-4, OW-3 Hydrograph 5/15/2001-8/25/2004

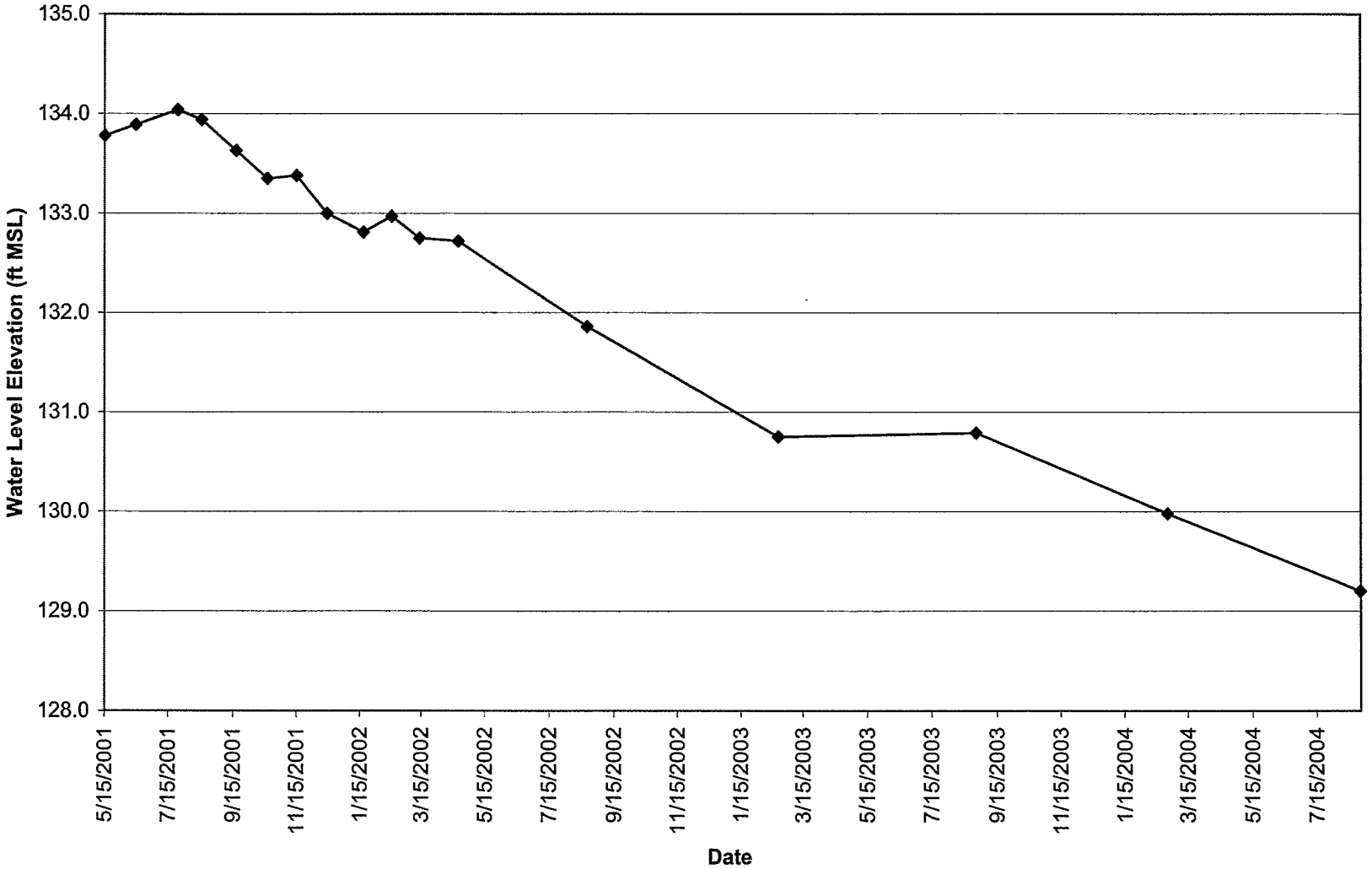

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Figure G-5, OW-4A Hydrograph 5/15/2001-8/25/2004

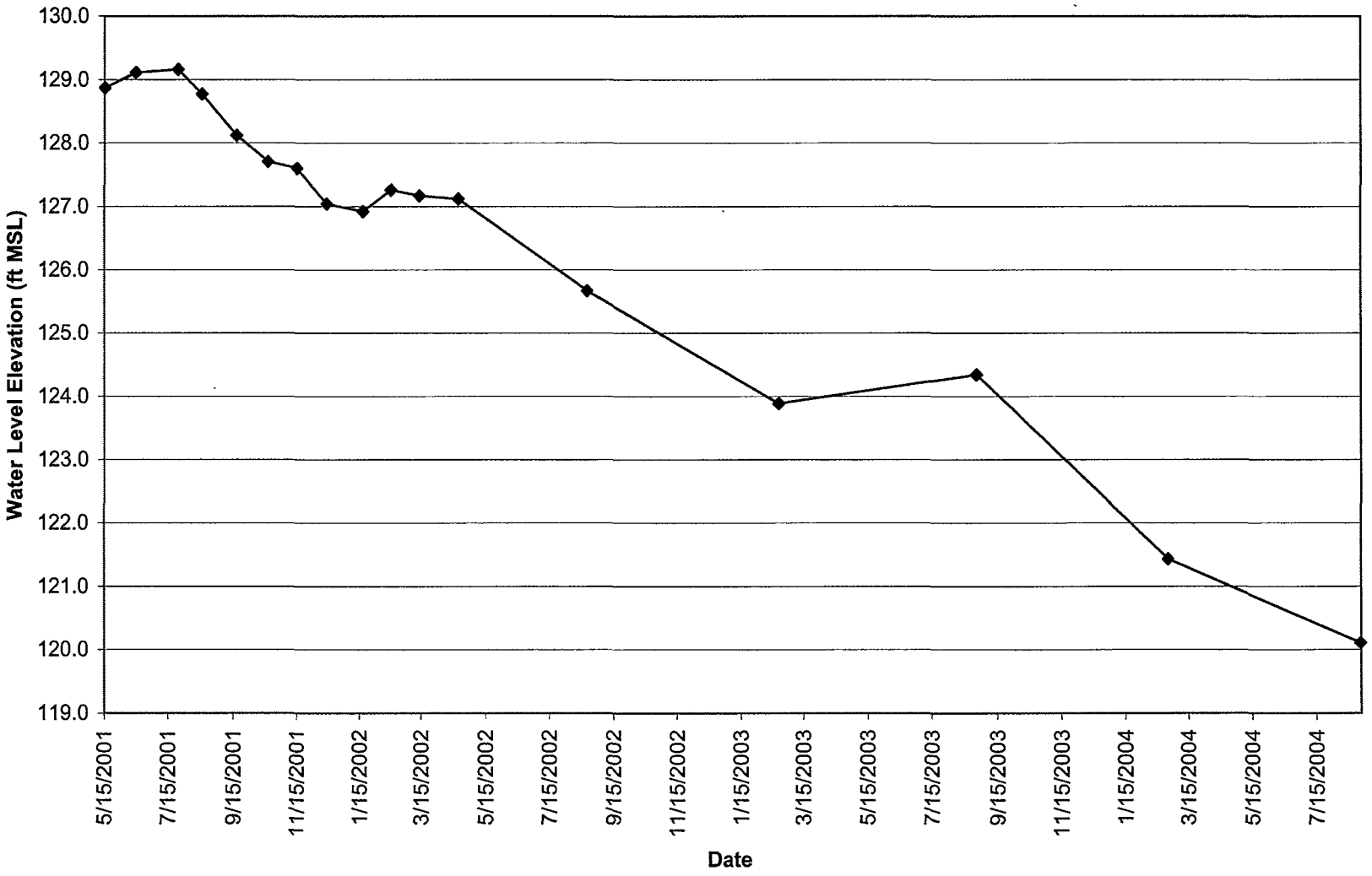

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Figure G-6, OW-4B Hydrograph 5/15/2001-8/25/2004

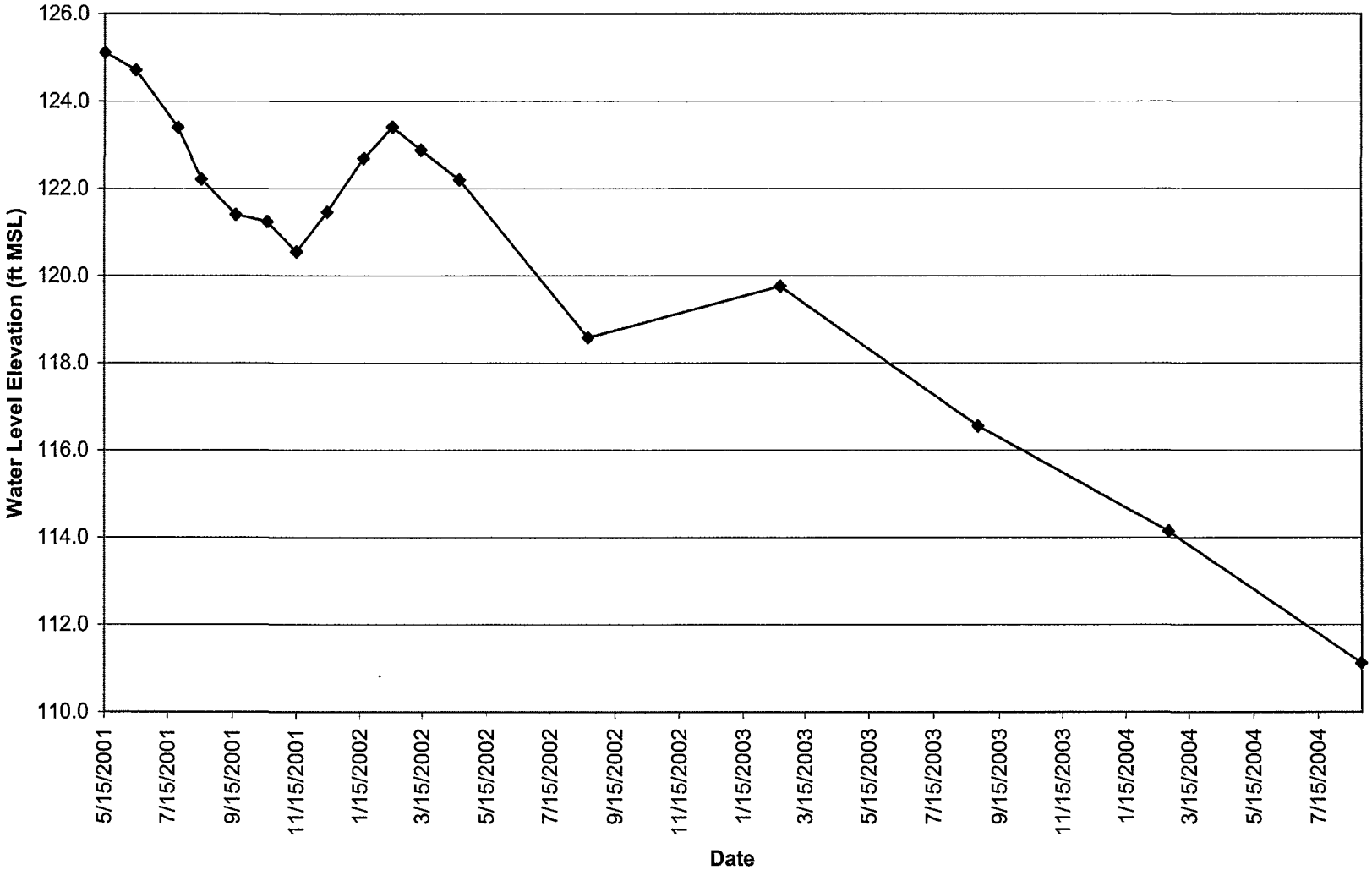

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Figure G-7, OW-5 Hydrograph 5/15/2001-8/25/2004

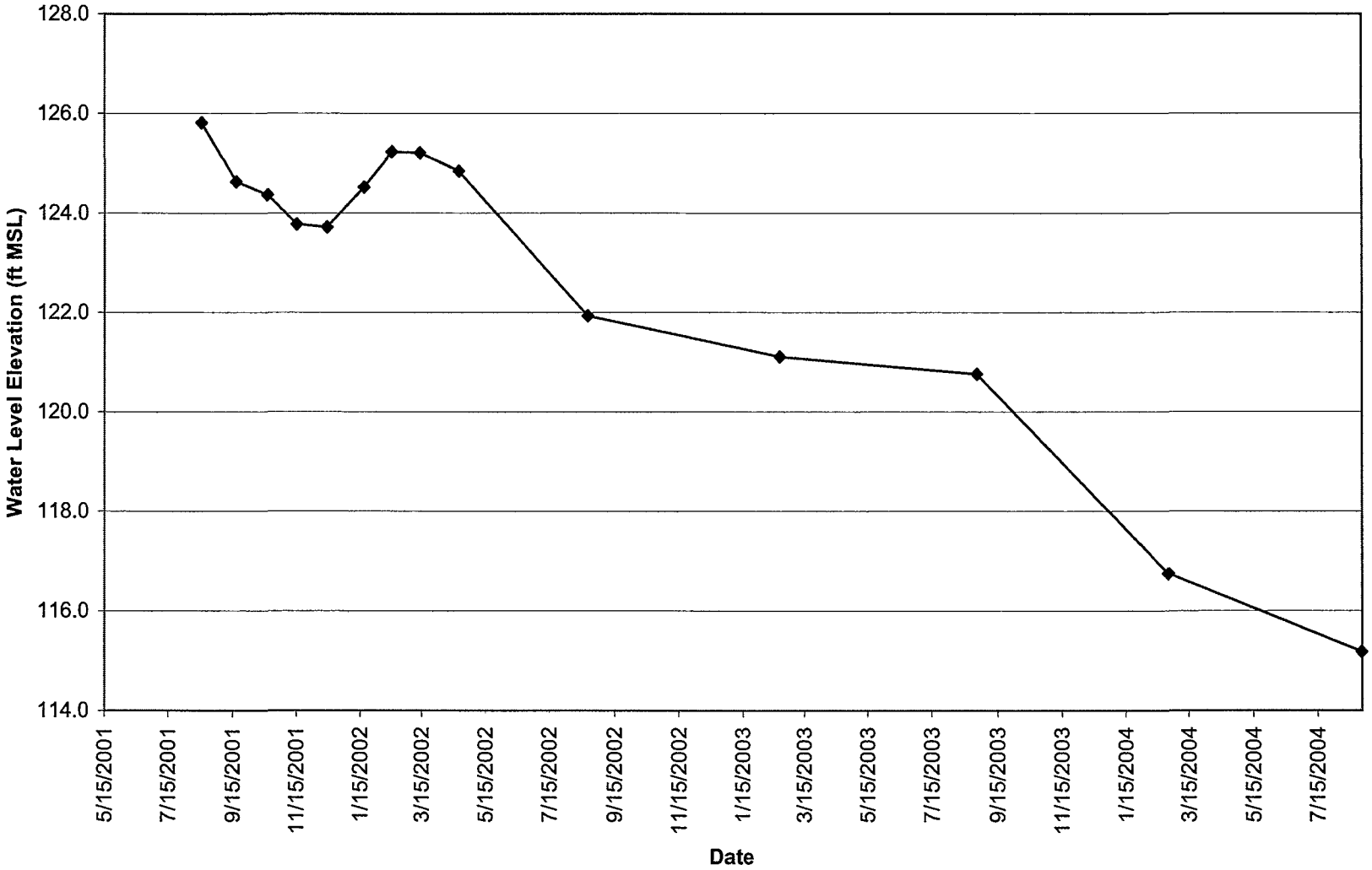

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Figure G-8, OW-6 Hydrograph 5/15/2001-8/25/2004

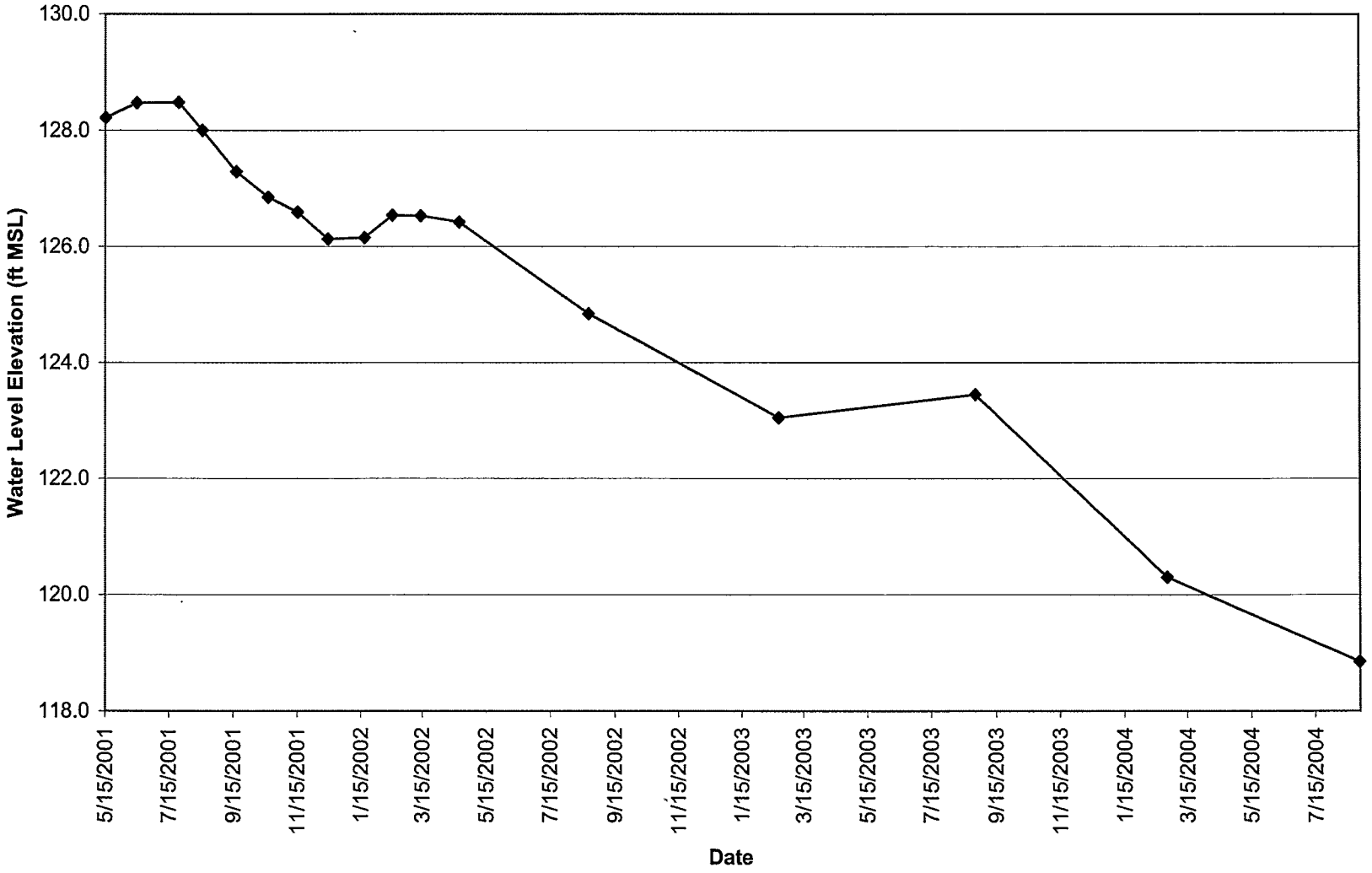

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Figure G-9, OW-7 Hydrograph 5/15/2001-8/25/2004

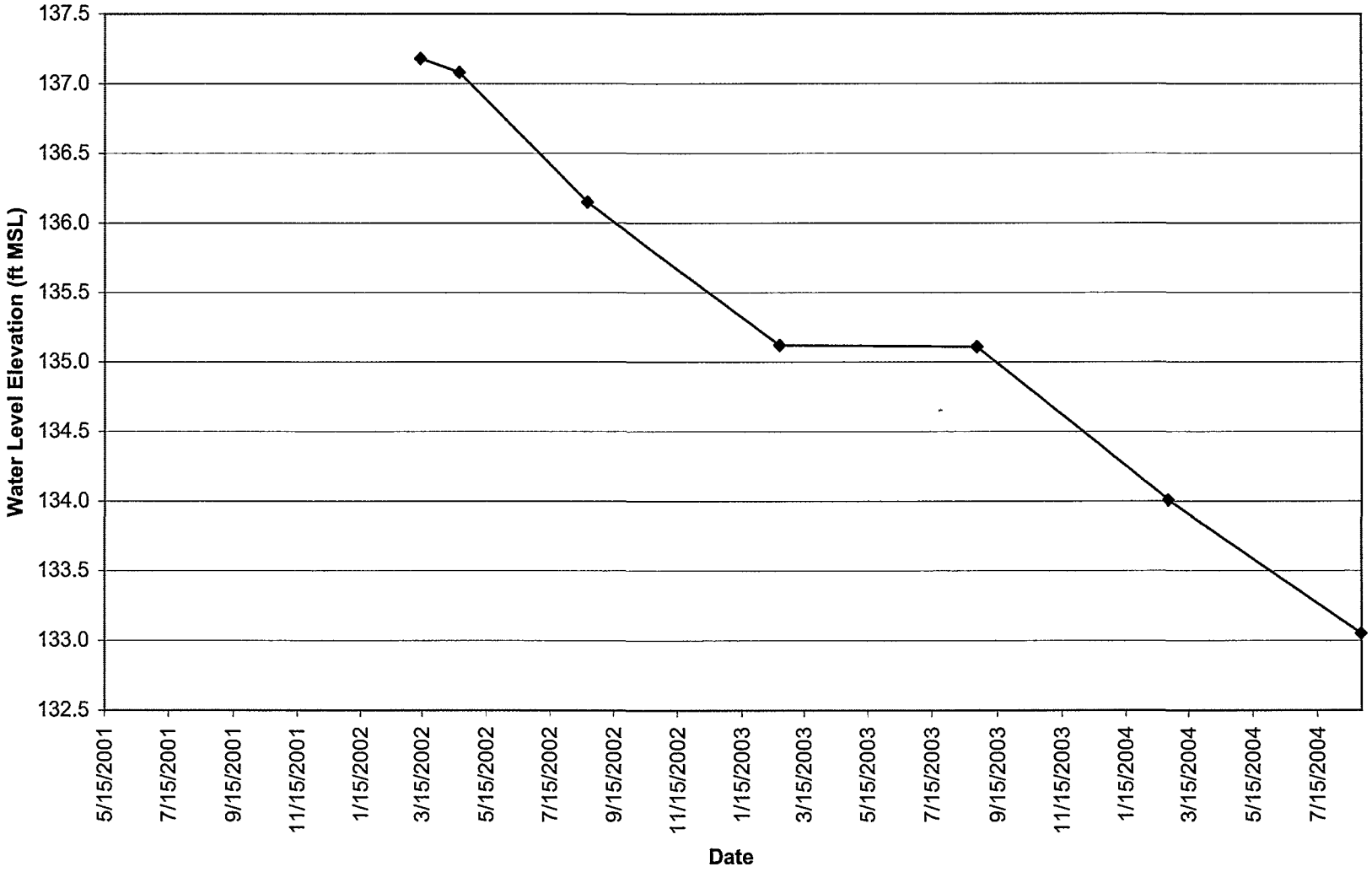

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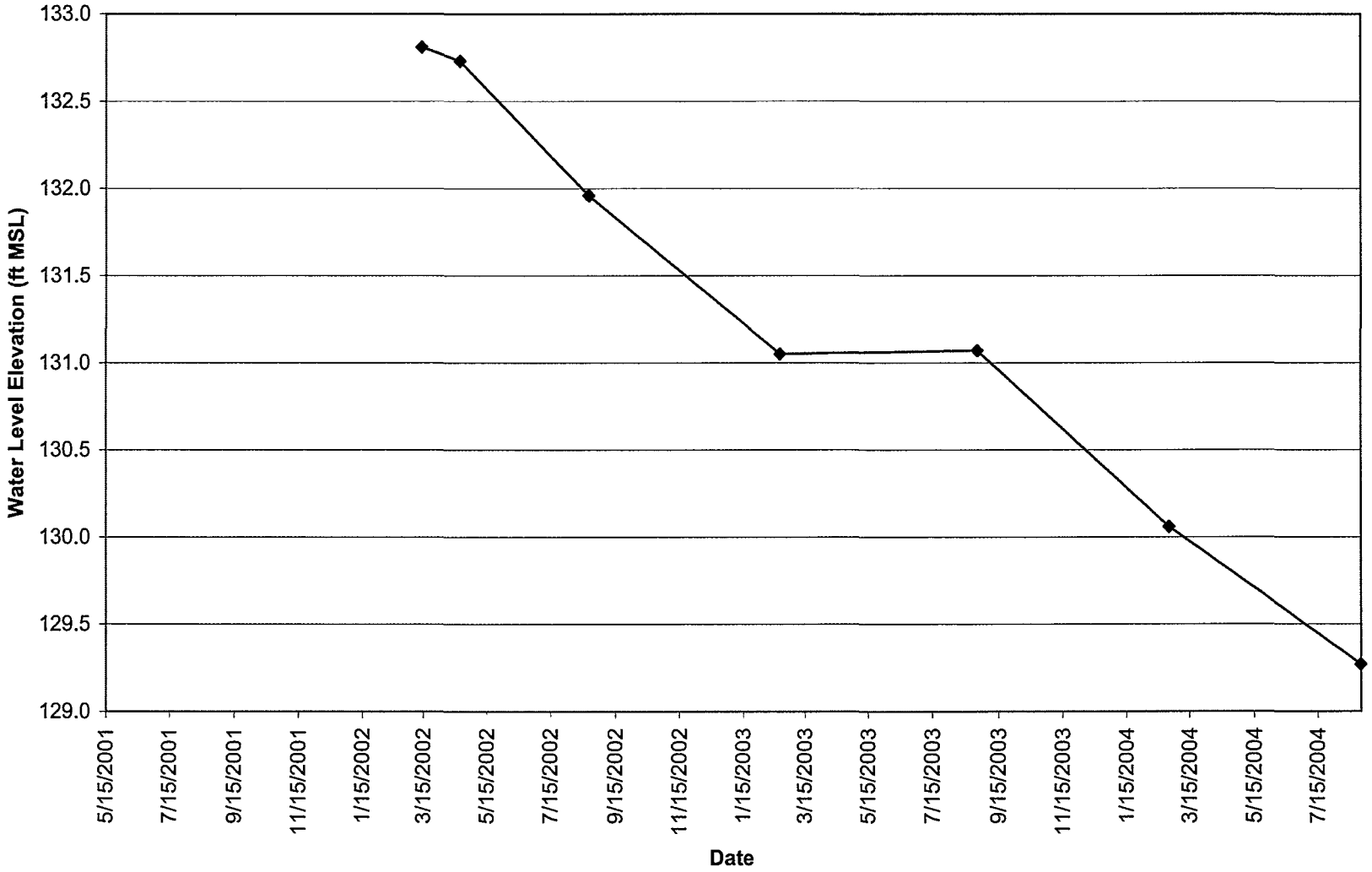
Figure G-10, OW-8 Hydrograph 5/15/2001-8/25/2004



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