CCP
Cook Composites and Polymers

Headquarters
P.O. Box 419389
Kansas City, MO 64141-6389
(816) 391-6000
FAX (816) 391-6215

HW/GWM
246004330

March 15, 1994

recd 3-25-94

Ms. Jill Fermanich
Wisconsin Department of Natural Resources
Hazardous Waste Management Section
101 South Webster Street
Madison, WI 53707-7921

RE: 1993 ANNUAL GROUNDWATER REPORT

Dear Jill:

Enclosed are two copies of the 1993 Annual Groundwater Report for Cook Composites & Polymers Co's (CCP) Saukville, WI facility. The report presents a summary of the analytical data collected during the four quarterly sampling events conducted at CCP in 1993; it also provides an evaluation of water level and groundwater quality trends at the site. The data indicate that the remedial systems currently operating at CCP are effectively preventing groundwater contamination from migrating off-site. Volatile organic compound (VOC) concentration trends over the past 5 years suggest that the contamination is diminishing near the site boundaries and is being removed via the extraction wells and collection systems.

If you have any questions concerning the report, please feel free to contact me at (816) 391-6025.

Sincerely,
Cook Composites and Polymers Co.
Craig R. Bostwick
Craig R. Bostwick
Corporate Manager Environmental & Safety

Enclosures

cc: Mr. Robert Smith (2 copies)
Mr. Franklin Shultz (2 copies)
Mr. James Rickun, RMT (letter only)

1993 ANNUAL REPORT

PREPARED FOR
COOK COMPOSITES AND POLYMERS
SAUKVILLE, WISCONSIN

PREPARED BY
RMT, INC.
MADISON, WISCONSIN

MARCH 1994

Craig O. Bartholomew
Project Hydrogeologist

Bernd W. Rehm
Senior Consulting Hydrogeologist

James S. Rickun
Vice President, Northern Region/
Air Program Manager

RMT, INC. – MADISON, WI
744 HEARTLAND TRAIL ▪ 53717-1934
P.O. BOX 8923 ▪ 53708-8923
608/831-4444 ▪ 608/831-3334 FAX

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EXECUTIVE SUMMARY

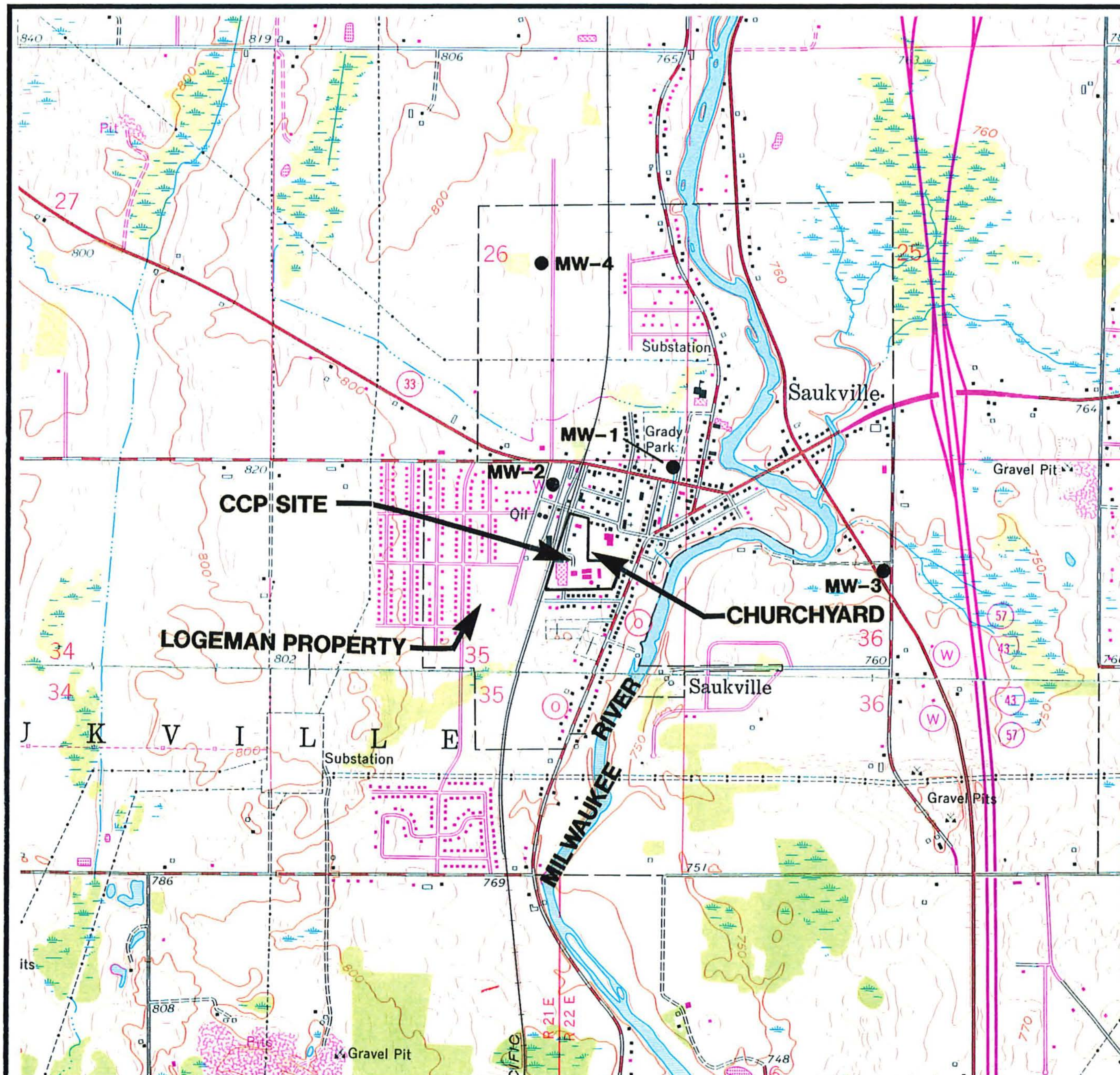
The groundwater flow and quality information that is presented in this report indicates that the remedial systems operating at the Cook Composites and Polymers Company (CCP) site are effectively preventing contaminants from migrating off-site.

The existing monitoring data indicate that site cleanup will require long-term monitoring. Therefore, quarterly sampling frequency may be reduced to semiannual sampling frequency without any loss of remediation trend.

Section 1
INTRODUCTION

CCP operates a polyester, alkyd, and urethane resin manufacturing plant in Saukville, Wisconsin (Figure 1). Prior to 1991, the plant was owned and operated by Freeman Chemical Corporation.

In compliance with the 1987 Corrective Action Order on Consent (CAO) V-W-88-R-002, CCP completed four rounds of groundwater sampling and analysis in 1993, including January (winter), April (spring), July (summer), and October (fall) sampling events. The summer event comprised the annual sampling event. Sigma Environmental Services, Inc. (Sigma), in Oak Creek, Wisconsin, conducted the groundwater sampling for the 1994 quarterly sampling events. All groundwater samples were analyzed at RMT, Inc. (RMT), Laboratories in Madison, Wisconsin. All field data and results of chemical analyses of groundwater were compiled by RMT of Madison, Wisconsin, and were submitted in quarterly reports by CCP to the USEPA Region V and the Wisconsin Department of Natural Resources (WDNR). Volatile organic compound (VOC) exceedances of Wisconsin Administrative Code NR 141 Preventive Action Limits (PALs) are reported quarterly by CCP in accordance with NR 508.



STATE LOCATION

0 2000 4000
SCALE: 1"=2000'

SITE LOCATION, MUNICIPAL WELLS, AND OFFSITE AREAS OF CONCERN

COOK COMPOSITES AND POLYMERS

SOURCE: BASE MAP FROM PORT WASHINGTON WEST AND CEDARBURG, WISCONSIN 7.5 MINUTE USGS QUADRANGLES.

RMT INC.

DWN. BY: DPR
DATE: FEBRUARY 1994
PROJ.# 1832.67
FILE # 18326701

FIGURE 1

Section 2
PURPOSE AND SCOPE

This document presents a summary of the data collected during the four quarterly groundwater sampling events that were conducted at CCP in 1993 and provides an evaluation of water level and groundwater quality trends at the site. Since the water quality data have been submitted to the USEPA and the WDNR in the quarterly reports, they will not be reproduced in this document.

The scope of this report includes the following:

- A summary of water levels that were measured in on-site monitoring wells in 1993, and potentiometric surface maps of the glacial drift and shallow dolomite hydrogeologic units for selected quarters
- An evaluation of groundwater flow directions in the glacial drift and shallow dolomite hydrogeologic units, and the effects of precipitation and well pumping on these patterns of groundwater flow
- A summary of the site groundwater monitoring program and the quarterly total VOC concentrations by well
- A presentation of the VOC data in the form of isoconcentration maps for the glacial drift and shallow dolomite wells
- A presentation of the VOC concentration trends by well
- An evaluation of the trends in groundwater quality for each monitoring well group for 1993, compared to historical data
- An evaluation of the effectiveness of plume containment by shallow dewatering and deep pumping, based on groundwater flow and quality data

Section 3
SUMMARY OF RESULTS

3.1 Groundwater Monitoring Program Summary

The groundwater monitoring program at the CCP Saukville site consists of 44 monitoring points, including 20 glacial drift wells, 12 shallow dolomite wells, and 6 deep dolomite wells, as well as 3 Ranney collectors (essentially French drains) and 3 publicly owned treatment works (POTW) sampling points. The monitoring points are grouped according to three sampling objectives: receptor, perimeter, and remediation progress monitoring. This well organization is presented in Table 1.

Receptor points include four municipal water supply wells (MW-1 through MW-4); POTW influent, effluent, and sludge monitoring points; and the Ranney collectors (RC-1, RC-2, and RC-3). The Ranney collectors are monitored because they discharge to the sanitary sewer. Perimeter points are monitoring wells on- and off-site that are located at or beyond the edge of the contaminant plume. These wells are intended to provide the necessary information to define the lateral extent of the plume. Remediation progress points are monitoring wells that are located within the contaminant plume. These wells provide information concerning the effectiveness of the on-site remedial systems.

Each of these well groupings is further subdivided into glacial drift and shallow dolomite hydrogeologic units. Some monitoring points, such as the deep municipal wells, are not easily categorized under this system, but the majority of the monitoring points are wells that are screened in one of these two units. This subdivision allows for a more effective evaluation of on-site groundwater flow and quality trends.

3.2 Groundwater Flow

3.2.1 Description of Hydrogeologic Units

The glacial drift hydrogeologic unit consists of clay, silt, sand, and gravel of glacial till, glaciolacustrine, and glaciofluvial origins. These sediments generally range from approximately 10 to 25 feet in thickness. The stratigraphic order of the deposits from

TABLE 1 SUMMARY OF 1993 GROUNDWATER SAMPLING PROGRAM COOK COMPOSITES AND POLYMERS					
Monitoring Objective/ Well Group	Unit Monitored	Sampling Point	Sampling Frequency and EPA Method Number		
			Quarterly	Semiannually[1]	Annually[2]
Receptor	Glacial drift	RC-1	8020		
		RC-2	8020		
		RC-3	8020		
	Deep dolomite	MW-1	8240		
		MW-2*	8240		
		MW-3	8240		
		MW-4	8240		
	POTW	POTW-I	8240		
		POTW-E	8240		
		POTW-S	8240		
Perimeter	Glacial drift	W-01A		8240	
		W-03B		8240	
		W-04A		8240	
		W-08		8240	
		W-20		8240	
		W-27		8240	
	Shallow dolomite	W-03A		8240	
		W-07		8240	
		W-22		8240	
		W-23		8240	
		W-25		8240	
	Deep dolomite	PW-08		8240	

TABLE 1 (CONTINUED)

SUMMARY OF 1993 GROUNDWATER SAMPLING PROGRAM
COOK COMPOSITES AND POLYMERS

Monitoring Objective/ Well Group	Unit Monitored	Sampling Point	Sampling Frequency and EPA Method Number		
			Quarterly	Semiannually[1]	Annually[2]
Remediation progress	Glacial drift	W-06A			8020
		W-19A			8020
		W-37			8020
		W-41			8020
		W-42			8020
		W-43			8020
		W-47			8020
	Shallow dolomite	W-21A			8020
		W-24A			8020
		W-28			8020
		W-29			8020
		W-38			8020
	Deep dolomite	W-30			8020

NOTES:

1 Semiannual samples were collected in April and October.
2 Annual samples were collected in July.
* MW-2 was monitored once because it is not used for water supply purposes.

the ground surface down is typically sand and silt overlying a laterally continuous layer of laminated silt and clay (glaciolacustrine) above dense clay (glacial till). A thin layer of sand and gravel (glacial outwash) lies between this till unit and bedrock.

The shallow bedrock beneath the site is the Niagaran Dolomite, which is highly fractured in its upper 10 to 15 feet and which contains abundant solution channels and cavities at depth. The elevation of the bedrock surface is highly variable across the site, as defined by soil boring and seismic reflection investigations (Minnesota Geophysical Associates, Inc. [MGA], 1989). A bedrock high (20 feet below ground surface) is located near the center of the site, and a dramatic closed depression in the bedrock surface, which has been characterized as a karst feature or sink hole (Figure 2), is located in the northeastern corner of the site. In this area, the depth to bedrock is up to 205 feet below ground surface.

3.2.2 Groundwater Levels and Flow Patterns in 1993

Groundwater levels in site monitoring wells were measured prior to purging during quarterly sampling events. Table 2 presents a summary of water levels for each quarter, and Figure 2 shows the locations of site monitoring wells. The water level data were used to construct potentiometric surface maps for the glacial drift and the shallow dolomite hydrogeologic units. Groundwater levels in the glacial drift unit decreased an average of 4 feet between the spring and fall quarters. The potentiometric surface maps are included in Appendix A.

The Glacial Drift Hydrogeologic Unit

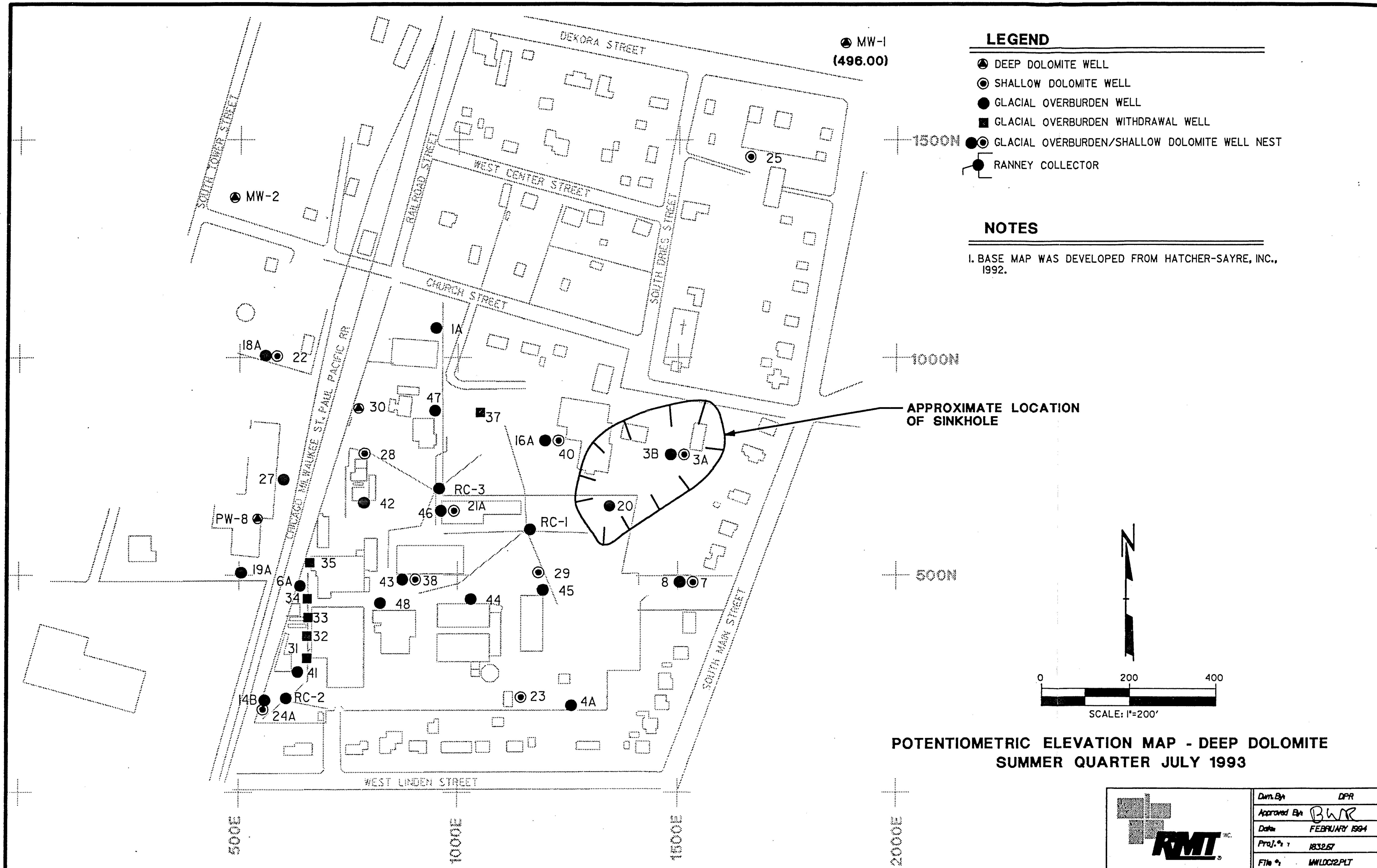
The potentiometric surface in the glacial drift as shown on Figures 3a through 3d (Appendix A) is coincident with the water table. Wells W-3B and W-20 are completed as piezometers within the glacial drift present in the sinkhole located in the northeastern portion of the site (Figure 2). The hydraulic heads within these two wells are representative of the part of the flow system present in the shallow dolomite unit. Therefore, water levels from wells W-3B and W-20 were not used to construct the water table maps on Figures 3a through 3d, but have been used to construct the potentiometric surface maps for the shallow dolomite unit (Figures 4a through 4c).

TABLE 2

COOK COMPOSITES & POLYMERS
SUMMARY OF WATER LEVELS, 1993 (FT, MSL)

HYDROGEOLOGIC UNIT	WELL I.D.	WINTER (JANUARY)	SPRING (APRIL)	SUMMER (JULY)	FALL (OCTOBER)
Glacial Drift	1A	759.47	762.73	760.82	759.27
	3B	739.30	739.63	741.18	723.29
	4A	753.80	756.25	754.88	749.95
	6A	765.63	767.31	766.57	765.79
	8	751.50	749.15	754.72	750.32
	14B	766.13	768.41	766.24	765.07
	16A	757.18	763.30	760.98	757.43
	18A	766.81	771.18	770.46	767.43
	19A	766.29	770.18	767.60	766.32
	20	736.14	735.61	738.30	736.99
	27	767.94	770.62	769.87	767.87
	41	758.82	762.38	759.92	754.75
	42	760.38	761.22	761.04	759.55
	43	757.64	766.32	759.55	757.53
	44	< 753.65	756.29	757.79	756.53
	45	< 753.10	< 753.10	< 753.10	< 753.10
	46	761.12	762.48	760.62	761.26
	47	760.04	766.09	760.88	760.02
	48	762.93	763.87	763.10	762.75
	37	757.64	766.32	764.42	765.13
Shallow Dolomite	3A	739.01	739.04	740.73	735.94
	7	744.49	749.38	748.19	744.37
	21A	698.60	698.18	NA	714.29
	22	730.72	732.77	731.72	730.52
	23	744.54	744.73	755.73	744.71
	24A	758.94	761.98	760.19	754.96
	25	749.27	749.76	750.14	749.01
	28	742.02	741.01	745.64	744.57
	29	734.82	730.45	741.87	733.20
	38	750.75	751.35	752.92	751.84
	39	758.80	762.12	760.12	758.28
	40	742.03	741.21	747.12	744.35
Deep Dolomite	MW-1	536.00	506.00	496.00	501.00
	MW-2	726.03	721.03	NA	NA
	MW-3	NA	NA	NA	NA
	MW-4	NA	NA	NA	NA
	PW-8	735.96	738.72	737.80	741.24
	30	682.81	678.20	685.14	689.64

NOTES:
1. WATER LEVELS IN RANNEY COLLECTORS (RC-1 THROUGH RC-3) AND WITHDRAWAL WELLS W-31 THROUGH W-35 WERE NOT MEASURED.
   NA = NOT AVAILABLE



POTENTIOMETRIC ELEVATION MAP - DEEP DOLOMITE
SUMMER QUARTER JULY 1993

FIGURE 2

The potentiometric surfaces (Figures 3a through 3d; Appendix B) provide information regarding the degree to which shallow groundwater withdrawal is dewatering much of the glacial drift unit. A comparison of these maps to the summary of well running times (Table 3) indicates that pumping has not only influenced groundwater elevations between RC-2 and W-37, but is also directing groundwater flow toward RC-1 on the eastern portion of the site. Thus, the system is controlling off-site migration of groundwater.

The water table remained within the glacial drift unit, even at its lowest level during the fall quarter when it was located approximately 9 feet above the bedrock surface over much of the site. Over the past 6 years, water levels have remained fairly constant in glacial drift monitoring wells—water elevations that were measured in 1993 are generally equal to those that were measured in these wells from 1988 to 1992.

Groundwater levels generally decreased across the site from the spring to the summer quarter in response to typical spring recharge events. The total precipitation measured in 1993 (Table 4) was 21.85 inches, which was 1.5 inches below the average of the previous 5 years.

The Shallow Dolomite Hydrogeologic Unit

The potentiometric surface in the shallow dolomite unit for the winter, spring, and fall quarters is shown on Figures 4a, 4b, and 4c (Appendix A). A map for the summer quarter was not prepared because water level data were not obtained from a sufficient number of wells. The variation in water levels over 1993 was generally insignificant but levels have generally increased since 1992.

The contours on Figures 4a, 4b, and 4c indicate that groundwater in the shallow dolomite flows inward toward the center of the site, as a result of the pumping of the on-site wells, with the most significant effects resulting from the pumping at well W-21A. A cone of depression up to 40 feet deep is defined centering on withdrawal well W-21A.

TABLE 3

SUMMARY OF WELL RUNNING TIMES (1993)

Well I.D	Hydrogeologic Unit	Monthly Running Time (hours)												Annual Total (hours)	Comments
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		
W-31	Glacial drift	1.5	0.0	30.3	543.5	34.8	26.0	0.8	0.0	0.2	0.0	0.0	0.0	673.1	Water table maps indicate that the groundwater elevation was above the bottom of the well at each monitoring event.
W-32		490.1	363.9	333.4	663.9	674.3	824.7	452.7	31.8	0.0	0.0	0.0	0.0	3834.8	Water table maps indicate that the groundwater elevation was above the bottom of the well at each monitoring event.
W-33		20.3	6.4	24.3	57.2	12.2	11.7	6.9	4.1	9.9	3.7	2.5	2.5	161.7	Pumping duration was typically 2 to 5 hours per week from January through July and less than or equal to 1 hour per week thereafter.
W-34		837.6	674.3	814.5	669.2	674.1	824.7	670.2	670.7	837.5	651.0	675.6	840.2	8839.6	Consistent—elevated months were 5 weeks long.
W-35		4.0	2.2	3.5	4.8	3.1	4.0	3.2	2.3	2.7	1.9	1.4	1.6	34.7	Pumping duration was typically between 0.3 to 1 hour per week.
W-37		14.8	5.0	11.0	15.0	0.0	9.1	0.7	0.0	3.8	0.0	0.0	0.0	59.4	Water table maps indicate that the groundwater elevation was above the bottom of the well at each monitoring event.
RC-1		28.8	10.9	51.0	404.2	83.8	234.3	290.3	56.1	28.2	15.4	30.5	66.1	1299.6	Thirty-one weeks had less than 10 hours of pumping; only 8 weeks had greater than 50 hours of pumping.
RC-2		811.1	542.5	643.7	663.7	673.8	837.4	664.6	671.9	837.5	668.0	675.7	840.2	8530.1	Consistent throughout the year—high months were 5 weeks long.
RC-3		54.9	13.3	132.6	501.6	139.0	232.7	83.2	25.3	66.3	22.5	0.0	0.0	1271.4	Fifteen weeks had no pumping; 23 weeks had pumping greater than 0 to less than 50 hours.
W-21A	Shallow dolomite	837.6	668.0	680.4	600.5	626.5	827.0	638.3	543.0	364.2	317.6	353.0	693.7	7149.8	Fairly consistent at greater than 100 hours per week, except September, October, and November.
W-24A		45.6	35.0	36.8	17.3	31.8	33.2	4.4	5.5	15.3	10.4	6.9	15.4	257.6	Fairly consistent with only 6 weeks greater than 10 hours pumping per week.
W-28		837.4	674.6	814.5	669.0	507.0	837.7	672.3	671.4	837.3	672.5	673.8	842.1	8709.6	Consistent throughout the year—high months were 5 weeks long.
W-29		119.4	149.5	257.2	97.8	50.7	73.8	69.9	258.7	572.1	462.6	298.7	375.6	2786.0	Twenty-nine weeks had pumping of less than 50 hours per week.

TABLE 4

SUMMARY OF PRECIPITATION AMOUNTS, 1993[1]
COOK COMPOSITES AND POLYMERS

Month	Precipitation (in inches)					
	1988	1989	1990	1991	1992	1993
January	2.01	0.67	1.84	0.11	0.73	1.20[2]
February	0.87	1.01	0.60	0.20	1.25	0.00
March	0.82	2.71	2.47	1.85	1.77	0.65[2]
April	3.43	0.90	1.36	1.15	1.70	3.77
May	0.44	3.49	4.01	3.32	0.58	1.97
June	0.89	1.88	3.79	4.04	0.57	2.91
July	1.28	4.01	1.38	2.37	2.49	2.66
August	1.88	5.15	2.21	2.00	2.35	2.45
September	5.48	1.44	2.46	1.82	2.20	2.06
October	1.68	1.74	2.74	2.88	0.88	0.36
November	4.40	0.49	2.52	2.62	3.26	0.64
December	2.08	0.20	1.07	0.77	1.04[2]	0.21
TOTALS	25.26	23.69	26.45	23.13	18.82	21.85

NOTES

1 Precipitation was measured in an on-site gauge by CCP personnel.
2 Snow values were reported for these months and converted to inches of water using 1 inch rain = 10 inches snow.

The Deep Dolomite Hydrogeologic Unit

Water levels measured in the deep dolomite unit during the winter, spring, and summer quarters are shown on Figures 5a, 5b, and 5c (Appendix A). Potentiometric maps for the deep dolomite were not prepared because pumping rates and durations at three locations at which measurements were made are unknown. The variation in water levels between quarters is likely due to the changes in pumping rates at the four locations. The data available are insufficient to determine the local flow patterns in the deep dolomite.

3.3 Groundwater Quality

3.3.1 Background

Table 1 presents the sampling schedule that was developed for 1993 groundwater monitoring, along with the VOC analysis method used each quarter. The parameters analyzed for in Methods 8240 and 8020 are listed in Table 5. The winter, spring, and fall quarter samples were analyzed for the full VOC list (8240), and the summer quarter samples were analyzed for either the full VOC list or the shorter aromatic VOC list (8020) as part of the annual sampling event.

3.3.2 Total VOC Data

The tabulated results of VOC concentrations in each well and the supporting laboratory data sheets were presented in the four quarterly reports (RMT, 1993b, 1993c, 1993d, and 1993e). Tables 6, 7, and 8 present a summary of total VOC concentrations in each well for each of the four quarters. The wells are organized by monitoring objective and hydrogeologic unit as described in Subsection 3.1 and Table 1. Figure 2 shows the locations of the monitoring wells. The lateral distribution of VOCs in the glacial drift unit and in the shallow dolomite unit for the year is depicted on two composite isoconcentration maps. Composite maps were constructed using all four quarters of data to illustrate the VOC results for 1993. The isoconcentration maps are included on Figures 6 and 7 of Appendix C.

VOC Patterns in the Glacial Drift Unit

The extent of VOC contamination in the glacial drift unit for 1993 is shown on Figure 6 of Appendix C. As noted in Subsection 3.2, wells W-3B and W-20 are completed in

TABLE 5

SUMMARY OF ANALYTES ANALYZED FOR IN METHODS 8240 AND 8020
COOK COMPOSITES & POLYMERS

Volatile Organic Compounds by Method 8240		Aromatic Volatile Organic Compounds by Method 8020
Chloroethane	1,1,2,2-Tetrachloroethane	Benzene
Chloromethane	1,2-Dichloropropane	Toluene
Bromomethane	trans-1,2-Dichloropropene	Ethylbenzene
Vinyl chloride	Trichloroethene	Chlorobenzene
Methylene chloride	Dibromochloromethane	Xylenes (total)
Acetone	1,1,2-Trichloroethane	1,4-Dichlorobenzene
Carbon disulfide	Benzene	1,3-Dichlorobenzene
1,1-Dichloroethene	cis-1,3-Dichloropropene	1,2-Dichlorobenzene
1,1-Dichloroethane	Bromoform	
1,2-Dichloroethene (total)	2-Hexanone	
Chloroform	4-Methyl-2-Pentanone	
1,2-Dichloroethane	Tetrachloroethene	
2-Butanone	Toluene	
1,1,1-Trichloroethane	Chlorobenzene	
Carbon tetrachloride	Ethylbenzene	
Vinyl acetate	Styrene	
Bromodichloromethane	Xylenes (total)	

TABLE 6A - TOTAL VOCS DETECTED, 1993
RECEPTOR GROUP - GLACIAL UNIT

SAMPLE ID	01/93		04/93		07/93		10/93	
RC-1	25290	UG/L	12800	UG/L	8256	UG/L	3645.7	UG/L
RC-2	74140	UG/L	16600	UG/L	12130	UG/L	14749	UG/L
RC-2 DUP			23200	UG/L	16900	UG/L		
RC-3	18700	UG/L	21700	UG/L	18940	UG/L	44120	UG/L

TABLE 6B - TOTAL VOCS DETECTED, 1993
RECEPTOR GROUP - SHALLOW DOLOMITE UNIT

SAMPLE ID	01/93		04/93		07/93		10/93	
MW-01	ND	UG/L	ND	UG/L	ND	UG/L	ND	UG/L
MW-01 DUP							ND	UG/L
MW-02					1.8	UG/L		
MW-03	1	UG/L	ND	UG/L	ND	UG/L	ND	UG/L
MW-04	ND	UG/L	ND	UG/L	ND	UG/L	ND	UG/L
MW-04 DUP	ND	UG/L						
POTW-E	1	UG/L	ND	UG/L	ND	UG/L	ND	UG/L
POTW-I	6.3	UG/L	163	UG/L	87.4	UG/L	691	UG/L
POTW-S	40	UG/L	514	UG/L	1520	UG/L	57	UG/L

Total VOCs were calculated by summing all measured and estimated values, except those qualified with a "U", which are considered undetected because of associated blank contamination.
ND = None detected.

03-JAN-94:cksitvoc TAB6.BJC

TABLE 7A - TOTAL VOCS DETECTED, 1993
PERIMETER GROUP - GLACIAL UNIT

SAMPLE ID	04/93		10/93	
W-01A	ND	UG/L	ND	UG/L
W-03B	.4	UG/L	ND	UG/L
W-04A	.3	UG/L	ND	UG/L
W-20	1.6	UG/L	12	UG/L
W-20 DUP	.8	UG/L		
W-27	169.2	UG/L	160	UG/L
W-27 DUP			160	UG/L

TABLE 7B - TOTAL VOCS DETECTED, 1993
PERIMETER GROUP - SHALLOW DOLOMITE UNIT

SAMPLE ID	04/93		10/93	
PW-08	8	UG/L	ND	UG/L
W-03A	1.1	UG/L	ND	UG/L
W-03A DUP	.6	UG/L		
W-07	ND	UG/L		
W-22	19.7	UG/L	5	UG/L
W-23	10	UG/L	23	UG/L
W-25	1.2	UG/L	ND	UG/L

Total VOCs were calculated by summing all measured and estimated values, except those qualified with a "U", which are considered undetected because of associated blank contamination.
ND = None detected.

03-JAN-94:cksitvoc TAB7.BJC

3.4.1 The Glacial Drift Unit

The groundwater quality data and water table maps suggest little or no off-site migration of site contaminants. The concentrations of total VOCs in remediation progress wells is generally within ranges established over the past 3 years. Exceptions include well W-47 in the northwestern portion of the site, which has shown a decreasing trend in VOC concentrations over the past 3 years, and W-19A just west of the site, which showed a two magnitude decrease in concentrations between 1992 and 1993. These data indicate that off-site migration of contaminated groundwater within the glacial drift unit is being effectively controlled.

3.4.2 The Shallow Dolomite Unit

Over the past 3 years, VOC concentrations in the shallow dolomite have remained moderate to high in remediation progress wells. Perimeter wells in this unit generally contained low (less than about 20 μg/L) to nondetectable levels of VOCs. Migration of the contaminant plume in the shallow dolomite is being effectively controlled.

3.4.3 The Deep Dolomite Unit

VOC concentrations in the deep dolomite receptor and remediation progress wells (e.g., MW-1, MW-3, MW-4, and W-30) continue at near or below detection limits. VOC concentrations at PW-08 and MW-2 have fluctuated over the past few years. VOC concentrations at W-30 have decreased since 1989.

3.4.4 Hydraulic Communication Between the Aquifers

The hydrogeologic data indicate a degree of hydraulic communication between the two units. Downward seepage from source areas in the glacial drift into the shallow dolomite through fractures in the upper portion of the bedrock has been documented in previous studies (e.g., Hatcher-Sayre, 1988).

Section 4

REFERENCES

Hatcher-Sayre, Inc. 1988. Freeman Chemical Corporation, Saukville, Wisconsin. Corrective measures activities Task 1, description of past and current conditions, site construction document report. Revision 1. February 15, 1988.

Hatcher-Sayre, Inc. 1992. Cook Composites and Polymers Company, Saukville, Wisconsin. 1992 Annual report. March 1992.

Minnesota Geophysical Associates, Inc. 1989. Seismic reflection survey for Hatcher-Sayre, Inc. Freeman Chemical, Co., site in Saukville, Wisconsin. February.

RMT, Inc. 1993a. 1993 Annual report. Prepared for: Cook Composites and Polymers Co. February 1993.

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RMT, Inc. 1992d. 1993 Summer quarter groundwater results. Prepared for: Cook Composites and Polymers Co. September 1993.

RMT, Inc. 1992e. 1993 Fall quarter groundwater results. Prepared for: Cook Composites and Polymers Co. December 1993.

APPENDIX A

POTENTIOMETRIC SURFACE MAPS

The potentiometric surfaces (Figures 3a through 3d; Appendix B) provide information regarding the degree to which shallow groundwater withdrawal is dewatering much of the glacial drift unit. A comparison of these maps to the summary of well running times (Table 3) indicates that pumping has not only influenced groundwater elevations between RC-2 and W-37, but is also directing groundwater flow toward RC-1 on the eastern portion of the site. Thus, the system is controlling off-site migration of groundwater.

The water table remained within the glacial drift unit, even at its lowest level during the fall quarter when it was located approximately 9 feet above the bedrock surface over much of the site. Over the past 6 years, water levels have remained fairly constant in glacial drift monitoring wells—water elevations that were measured in 1993 are generally equal to those that were measured in these wells from 1988 to 1992.

Groundwater levels generally decreased across the site from the spring to the summer quarter in response to typical spring recharge events. The total precipitation measured in 1993 (Table 4) was 21.85 inches, which was 1.5 inches below the average of the previous 5 years.

The Shallow Dolomite Hydrogeologic Unit

The potentiometric surface in the shallow dolomite unit for the winter, spring, and fall quarters is shown on Figures 4a, 4b, and 4c (Appendix A). A map for the summer quarter was not prepared because water level data were not obtained from a sufficient number of wells. The variation in water levels over 1993 was generally insignificant but levels have generally increased since 1992.

The contours on Figures 4a, 4b, and 4c indicate that groundwater in the shallow dolomite flows inward toward the center of the site, as a result of the pumping of the on-site wells, with the most significant effects resulting from the pumping at well W-21A. A cone of depression up to 40 feet deep is defined centering on withdrawal well W-21A.

TABLE 3

SUMMARY OF WELL RUNNING TIMES (1993)

Well I.D.	Hydrogeologic Unit	Monthly Running Time (hours) Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total (hours)	Comments
W-31	Glacial drift	1.5	0.0	30.3	543.5	34.8	26.0	0.8	0.0	0.2	0.0	0.0	0.0	673.1	Water table maps indicate that the groundwater elevation was above the bottom of the well at each monitoring event.
W-32		490.1	363.9	333.4	663.9	674.3	824.7	452.7	31.8	0.0	0.0	0.0	0.0	3834.8	Water table maps indicate that the groundwater elevation was above the bottom of the well at each monitoring event.
W-33		20.3	6.4	24.3	57.2	12.2	11.7	6.9	4.1	9.9	3.7	2.5	2.5	161.7	Pumping duration was typically 2 to 5 hours per week from January through July and less than or equal to 1 hour per week thereafter.
W-34		837.6	674.3	814.5	669.2	674.1	824.7	670.2	670.7	837.5	651.0	675.6	840.2	8839.6	Consistent—elevated months were 5 weeks long.
W-35		4.0	2.2	3.5	4.8	3.1	4.0	3.2	2.3	2.7	1.9	1.4	1.6	34.7	Pumping duration was typically between 0.3 to 1 hour per week.
W-37		14.8	5.0	11.0	15.0	0.0	9.1	0.7	0.0	3.8	0.0	0.0	0.0	59.4	Water table maps indicate that the groundwater elevation was above the bottom of the well at each monitoring event.
RC-1		28.8	10.9	51.0	404.2	83.8	234.3	290.3	56.1	28.2	15.4	30.5	66.1	1299.6	Thirty-one weeks had less than 10 hours of pumping; only 8 weeks had greater than 50 hours of pumping.
RC-2		811.1	542.5	643.7	663.7	673.8	837.4	664.6	671.9	837.5	668.0	675.7	840.2	8530.1	Consistent throughout the year—high months were 5 weeks long.
RC-3		54.9	13.3	132.6	501.6	139.0	232.7	83.2	25.3	66.3	22.5	0.0	0.0	1271.4	Fifteen weeks had no pumping; 23 weeks had pumping greater than 0 to less than 50 hours.
W-21A	Shallow dolomite	837.6	668.0	680.4	600.5	626.5	827.0	638.3	543.0	364.2	317.6	353.0	693.7	7149.8	Fairly consistent at greater than 100 hours per week, except September, October, and November.
W-24A		45.6	35.0	36.8	17.3	31.8	33.2	4.4	5.5	15.3	10.4	6.9	15.4	257.6	Fairly consistent with only 6 weeks greater than 10 hours pumping per week.
W-28		837.4	674.6	814.5	669.0	507.0	837.7	672.3	671.4	837.3	672.5	673.8	842.1	8709.6	Consistent throughout the year—high months were 5 weeks long.
W-29		119.4	149.5	257.2	97.8	50.7	73.8	69.9	258.7	572.1	462.6	298.7	375.6	2786.0	Twenty-nine weeks had pumping of less than 50 hours per week.

TABLE 4

SUMMARY OF PRECIPITATION AMOUNTS, 1993[1]
COOK COMPOSITES AND POLYMERS

Month	Precipitation (in inches)					
	1988	1989	1990	1991	1992	1993
January	2.01	0.67	1.84	0.11	0.73	1.20[2]
February	0.87	1.01	0.60	0.20	1.25	0.00
March	0.82	2.71	2.47	1.85	1.77	0.65[2]
April	3.43	0.90	1.36	1.15	1.70	3.77
May	0.44	3.49	4.01	3.32	0.58	1.97
June	0.89	1.88	3.79	4.04	0.57	2.91
July	1.28	4.01	1.38	2.37	2.49	2.66
August	1.88	5.15	2.21	2.00	2.35	2.45
September	5.48	1.44	2.46	1.82	2.20	2.06
October	1.68	1.74	2.74	2.88	0.88	0.36
November	4.40	0.49	2.52	2.62	3.26	0.64
December	2.08	0.20	1.07	0.77	1.04[2]	0.21
TOTALS	25.26	23.69	26.45	23.13	18.82	21.85

NOTES

1 Precipitation was measured in an on-site gauge by CCP personnel.
2 Snow values were reported for these months and converted to inches of water using 1 inch rain = 10 inches snow.

The Deep Dolomite Hydrogeologic Unit

Water levels measured in the deep dolomite unit during the winter, spring, and summer quarters are shown on Figures 5a, 5b, and 5c (Appendix A). Potentiometric maps for the deep dolomite were not prepared because pumping rates and durations at three locations at which measurements were made are unknown. The variation in water levels between quarters is likely due to the changes in pumping rates at the four locations. The data available are insufficient to determine the local flow patterns in the deep dolomite.

3.3 Groundwater Quality

3.3.1 Background

Table 1 presents the sampling schedule that was developed for 1993 groundwater monitoring, along with the VOC analysis method used each quarter. The parameters analyzed for in Methods 8240 and 8020 are listed in Table 5. The winter, spring, and fall quarter samples were analyzed for the full VOC list (8240), and the summer quarter samples were analyzed for either the full VOC list or the shorter aromatic VOC list (8020) as part of the annual sampling event.

3.3.2 Total VOC Data

The tabulated results of VOC concentrations in each well and the supporting laboratory data sheets were presented in the four quarterly reports (RMT, 1993b, 1993c, 1993d, and 1993e). Tables 6, 7, and 8 present a summary of total VOC concentrations in each well for each of the four quarters. The wells are organized by monitoring objective and hydrogeologic unit as described in Subsection 3.1 and Table 1. Figure 2 shows the locations of the monitoring wells. The lateral distribution of VOCs in the glacial drift unit and in the shallow dolomite unit for the year is depicted on two composite isoconcentration maps. Composite maps were constructed using all four quarters of data to illustrate the VOC results for 1993. The isoconcentration maps are included on Figures 6 and 7 of Appendix C.

VOC Patterns in the Glacial Drift Unit

The extent of VOC contamination in the glacial drift unit for 1993 is shown on Figure 6 of Appendix C. As noted in Subsection 3.2, wells W-3B and W-20 are completed in

TABLE 5

SUMMARY OF ANALYTES ANALYZED FOR IN METHODS 8240 AND 8020
COOK COMPOSITES & POLYMERS

Volatile Organic Compounds by Method 8240		Aromatic Volatile Organic Compounds by Method 8020
Chloroethane	1,1,2,2-Tetrachloroethane	Benzene
Chloromethane	1,2-Dichloropropane	Toluene
Bromomethane	trans-1,2-Dichloropropene	Ethylbenzene
Vinyl chloride	Trichloroethene	Chlorobenzene
Methylene chloride	Dibromochloromethane	Xylenes (total)
Acetone	1,1,2-Trichloroethane	1,4-Dichlorobenzene
Carbon disulfide	Benzene	1,3-Dichlorobenzene
1,1-Dichloroethene	cis-1,3-Dichloropropene	1,2-Dichlorobenzene
1,1-Dichloroethane	Bromoform	
1,2-Dichloroethene (total)	2-Hexanone	
Chloroform	4-Methyl-2-Pentanone	
1,2-Dichloroethane	Tetrachloroethene	
2-Butanone	Toluene	
1,1,1-Trichloroethane	Chlorobenzene	
Carbon tetrachloride	Ethylbenzene	
Vinyl acetate	Styrene	
Bromodichloromethane	Xylenes (total)	

TABLE 6A - TOTAL VOCS DETECTED, 1993
RECEPTOR GROUP - GLACIAL UNIT

SAMPLE ID	01/93		04/93		07/93		10/93	
RC-1	25290	UG/L	12800	UG/L	8256	UG/L	3645.7	UG/L
RC-2	74140	UG/L	16600	UG/L	12130	UG/L	14749	UG/L
RC-2 DUP			23200	UG/L	16900	UG/L		
RC-3	18700	UG/L	21700	UG/L	18940	UG/L	44120	UG/L

TABLE 6B - TOTAL VOCS DETECTED, 1993
RECEPTOR GROUP - SHALLOW DOLOMITE UNIT

SAMPLE ID	01/93		04/93		07/93		10/93	
MW-01	ND	UG/L	ND	UG/L	ND	UG/L	ND	UG/L
MW-01 DUP							ND	UG/L
MW-02					1.8	UG/L		
MW-03	1	UG/L	ND	UG/L	ND	UG/L	ND	UG/L
MW-04	ND	UG/L	ND	UG/L	ND	UG/L	ND	UG/L
MW-04 DUP	ND	UG/L						
POTW-E	1	UG/L	ND	UG/L	ND	UG/L	ND	UG/L
POTW-I	6.3	UG/L	163	UG/L	87.4	UG/L	691	UG/L
POTW-S	40	UG/L	514	UG/L	1520	UG/L	57	UG/L

Total VOCs were calculated by summing all measured and estimated values, except those qualified with a "U", which are considered undetected because of associated blank contamination.
ND = None detected.

03-JAN-94:cksitvoc TAB6.BJC

TABLE 7A - TOTAL VOCS DETECTED, 1993
PERIMETER GROUP - GLACIAL UNIT

SAMPLE ID	04/93		10/93	
W-01A	ND	UG/L	ND	UG/L
W-03B	.4	UG/L	ND	UG/L
W-04A	.3	UG/L	ND	UG/L
W-20	1.6	UG/L	12	UG/L
W-20 DUP	.8	UG/L		
W-27	169.2	UG/L	160	UG/L
W-27 DUP			160	UG/L

TABLE 7B - TOTAL VOCS DETECTED, 1993
PERIMETER GROUP - SHALLOW DOLOMITE UNIT

SAMPLE ID	04/93		10/93	
PW-08	8	UG/L	ND	UG/L
W-03A	1.1	UG/L	ND	UG/L
W-03A DUP	.6	UG/L		
W-07	ND	UG/L		
W-22	19.7	UG/L	5	UG/L
W-23	10	UG/L	23	UG/L
W-25	1.2	UG/L	ND	UG/L

Total VOCs were calculated by summing all measured and estimated values, except those qualified with a "U", which are considered undetected because of associated blank contamination.
ND = None detected.

03-JAN-94:cksitvoc TAB7.BJC

TABLE 8A - TOTAL VOCS DETECTED, 1993
REMEDIATION PROGRESS GROUP - GLACIAL UNIT

SAMPLE ID	07/93	
W-06A	173790	UG/L
W-19A	5.5	UG/L
W-37	150000	UG/L
W-37 DUP	153000	UG/L
W-41	930	UG/L
W-42	19580	UG/L
W-43	46700	UG/L
W-47	53900	UG/L

TABLE 8B - TOTAL VOCS DETECTED, 1993
REMEDIATION PROGRESS GROUP - SHALLOW DOLOMITE UNIT

SAMPLE ID	07/93	
W-21A	38250	UG/L
W-24A	ND	UG/L
W-28	19.7	UG/L
W-28 DUP	13.2	UG/L
W-29	3000	UG/L
W-30	7.2	UG/L
W-38	3913	UG/L

Total VOCs were calculated by summing all measured and estimated values, except those qualified with a "U", which are considered undetected because of associated blank contamination.
ND = None detected.

03-JAN-94:cksitvoc TAB8.BJC

the glacial drift in the sinkhole and are therefore more representative of water quality in the shallow dolomite aquifer. Isoconcentration contours in the glacial drift unit (Figure 6) do not include VOC detections in the Ranney collectors because these are composite groundwater samples that were collected from areas of the site through radial collection lines.

The pattern of VOC concentrations in 1993 (Figure 6) is similar to those observed in 1992 and in previous years (RMT, 1993a; and Hatcher-Sayre, Inc., 1992).

Three major features (plumes) are apparent in the pattern of VOC concentrations in the glacial drift unit (Figure 6 of Appendix C). The first plume, which is located in the northern portion of the site, is centered at the former hazardous waste incinerator/former urethane laboratory area with concentrations greater than 100,000 μg/L and may extend off-site to the east under the churchyard. The second plume, which is located in the southwestern portion of the site, is centered in the area of the former dry well and extends a short distance to the south and east. The third prominent plume that is centered around W-43 with a total VOC concentration greater than 40,000 μg/L. This plume appears to originate in the vicinity of the former tank farm area and is effectively captured by the collection lines of RC-1. The water table maps (Figure 3a and 3d) and the isoconcentration map (Figure 6 of Appendix C) indicates that off-site migration of impacted groundwater is generally being controlled by on-site pumping.

VOC Patterns in the Shallow Dolomite Unit

The extent of VOC contamination in the shallow dolomite unit for 1993 is shown on Figure 7 of Appendix C. The level and pattern of VOC concentrations are similar to those documented in 1992 (RMT, 1993a).

The concentrations of detected VOCs in the shallow dolomite are highest near the center of the site (well W-21A), and decrease with distance in all directions to levels generally below 10 μg/L at the perimeter of the site. This indicates that off-site migration of impacted groundwater is being controlled by on-site pumping.

3.3.3 VOC Trends by Monitoring Objective

This section describes trends in total VOC concentrations for each of the monitoring objectives. The variation in total VOC concentrations for individual wells is presented in Appendix D. The discussion that follows is organized by monitoring objective (receptor, perimeter, remediation progress) followed by the hydrogeologic unit (glacial drift, shallow dolomite, deep dolomite). The total VOC data shown prior to 1992 were obtained from Hatcher-Sayre, Inc.

Receptor Monitoring

Ranney Collectors and POTW

Total VOCs were monitored in the shallow groundwater that was discharged from the Ranney collectors (RC-1, RC-2, and RC-3) and in the influent, effluent, and sludge samples that were collected at the POTW. These analyses were performed to monitor the levels of chemical compounds leaving the CCP site and being processed at the POTW. The total VOC detected in 1993 are shown in Table 6A. The total VOC concentrations in the collector discharges are variable, but over the 3 years of record, have typically been on the order of 10 to 30 mg/L for RC-1 and RC-2. Collector RC-3 data suggest a downward trend in concentrations, from 40 mg/L in early 1990 to 20 to 30 mg/L in 1993.

Ranney collector discharge is mixed with wastewaters from diverse sources upon arrival at the POTW, which explains the variability in POTW influent VOC concentrations. The low or nondetectable levels of VOCs in the discharge effluent demonstrate that the discharge from CCP does not adversely affect the permit requirements for the POTW.

Municipal Wells (Deep Dolomite Wells)

VOC concentrations in the municipal wells (MW-1 through MW-4) were at nondetectable levels (or below the reporting limits) for 1993, indicating that the Village water supply wells continue to be unaffected by site groundwater impacts. The total VOC concentration reported in Table 6B of 1.8 μg/L in well MW-2 represents VOCs detected below the reporting limit.

Perimeter Monitoring

Glacial Drift Wells

VOC concentrations in the perimeter wells screened in the glacial drift in 1993 were generally low (≤ 10 μg/L) or nondetectable. These concentrations are consistent with those of the past 3 years. W-27 (the exception), continued to show a high degree of variability in chlorinated hydrocarbon concentrations and a return to concentrations in excess of 100 μg/L. Well W-27 is upgradient of the CCP facility; therefore, increased concentrations suggest an off-site source of chlorinated constituents.

Exceedances of Wisconsin Administrative Code NR 140 Enforcement Standards (ES) were limited to well W-27. This well contained the chlorinated hydrocarbon trichloroethene (TCE) at levels above the ES. Well W-27 has consistently shown concentrations of chlorinated VOCs since 1988. The presence of these compounds in upgradient wells suggests migration from an upgradient source.

Shallow Dolomite Wells

Perimeter wells screened in the shallow dolomite generally showed low (≤ 10 μg/L) or nondetectable levels for total VOCs. Exceptions include wells W-22 and W-23, which contained total VOCs ranging from 5 to 23 μg/L. Well W-22 contained benzene above the NR 140 ES in 1993. Well W-22 contained 1,2-dichloroethane (a gasoline additive) in 1989 at a concentration above the ES. However, well W-22 is upgradient of the CCP facility. Well W-23 contained vinyl chloride at levels exceeding the NR 140 ES in 1992 and 1993.

Remediation Progress Monitoring

Glacial Drift Wells

The remediation progress wells in the glacial drift unit were only sampled during the summer sampling round. In general, VOC levels were within ranges established over the past 3 years. Well W-19A is an exception. Total VOC concentrations from this upgradient well decreased by a factor of approximately 100 in the 1993 sample. Over the last 2 years, the total VOC concentration from W-47 also appears to have decreased from approximately 600,000 to 50,000 μg/L. The concentration in well W-42, on the other hand, appears to have about doubled since early 1990.

Several glacial remediation progress wells screened in the glacial drift contained VOCs in excess of NR 140 ESs. These wells include W-06A, W-42, and W-43, which contained benzene, toluene, ethylbenzene, and xylene (BTEX) compounds; wells W-37 and W-47, which contained toluene, ethylbenzene, and xylene; and well W-41 which contained xylene above the ES. The presence of BTEX compounds may be consistent with past site activities. Chlorinated compounds have consistently been detected in well W-19A and occasionally detected in wells W-42 and W-6A. All of these remediation progress wells are located on the west side or just west of the site. Chlorinated compounds were also found in wells W-47 and W-48, both of which are in the western part of the site, in 1990 and 1991.

Dolomite Wells

VOC levels in remediation progress wells screened in the shallow dolomite displayed concentrations within ranges established over the past 3 years. W-21, W-24A, W-28, and W-38 show little change in concentration over the 3 years. Two wells show trends of decreasing concentrations; concentrations in W-29 decreased from approximately 7,000 to 3,000 μg/L and in W-30 from 100 to 10 μg/L. Well W-29 is within the drawdown area caused by CCP remedial actions, while W-30 is a deep dolomite well.

Several wells contained VOCs at concentrations exceeding the respective ESs. These wells include W-21A with BTEX exceedances, and W-29, and W-38 with exceedances of benzene and xylene. These three wells are located near the center of the site. Chlorinated compounds were consistently detected in remediation progress well W-24A, which is located on the southwestern corner of the site, from 1988 through 1992. Only one remedial progress well screened in the shallow dolomite and not located on the west side of the site (W-29) showed concentrations of chlorinated compounds (1988 and 1992).

3.4 Plume Containment

The discussion in this section combines groundwater flow and quality trends from the receptor, perimeter, and remediation progress wells in the glacial drift and dolomite, to present an evaluation of the effectiveness of the plume containment in the remedial system at the Saukville site.

3.4.1 The Glacial Drift Unit

The groundwater quality data and water table maps suggest little or no off-site migration of site contaminants. The concentrations of total VOCs in remediation progress wells is generally within ranges established over the past 3 years. Exceptions include well W-47 in the northwestern portion of the site, which has shown a decreasing trend in VOC concentrations over the past 3 years, and W-19A just west of the site, which showed a two magnitude decrease in concentrations between 1992 and 1993. These data indicate that off-site migration of contaminated groundwater within the glacial drift unit is being effectively controlled.

3.4.2 The Shallow Dolomite Unit

Over the past 3 years, VOC concentrations in the shallow dolomite have remained moderate to high in remediation progress wells. Perimeter wells in this unit generally contained low (less than about 20 μg/L) to nondetectable levels of VOCs. Migration of the contaminant plume in the shallow dolomite is being effectively controlled.

3.4.3 The Deep Dolomite Unit

VOC concentrations in the deep dolomite receptor and remediation progress wells (e.g., MW-1, MW-3, MW-4, and W-30) continue at near or below detection limits. VOC concentrations at PW-08 and MW-2 have fluctuated over the past few years. VOC concentrations at W-30 have decreased since 1989.

3.4.4 Hydraulic Communication Between the Aquifers

The hydrogeologic data indicate a degree of hydraulic communication between the two units. Downward seepage from source areas in the glacial drift into the shallow dolomite through fractures in the upper portion of the bedrock has been documented in previous studies (e.g., Hatcher-Sayre, 1988).

Section 4

REFERENCES

Hatcher-Sayre, Inc. 1988. Freeman Chemical Corporation, Saukville, Wisconsin. Corrective measures activities Task 1, description of past and current conditions, site construction document report. Revision 1. February 15, 1988.

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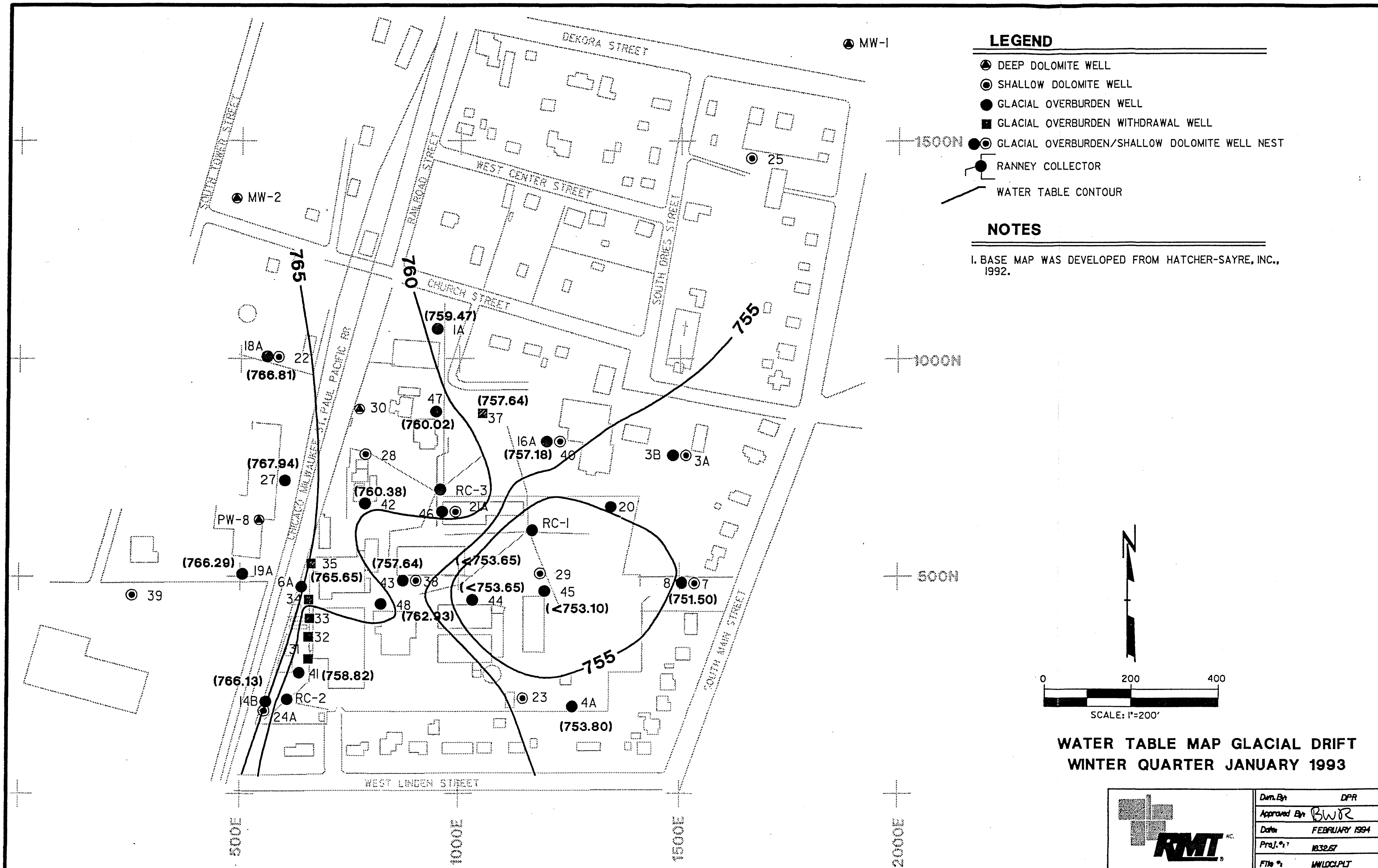
RMT, Inc. 1992e. 1993 Fall quarter groundwater results. Prepared for: Cook Composites and Polymers Co. December 1993.

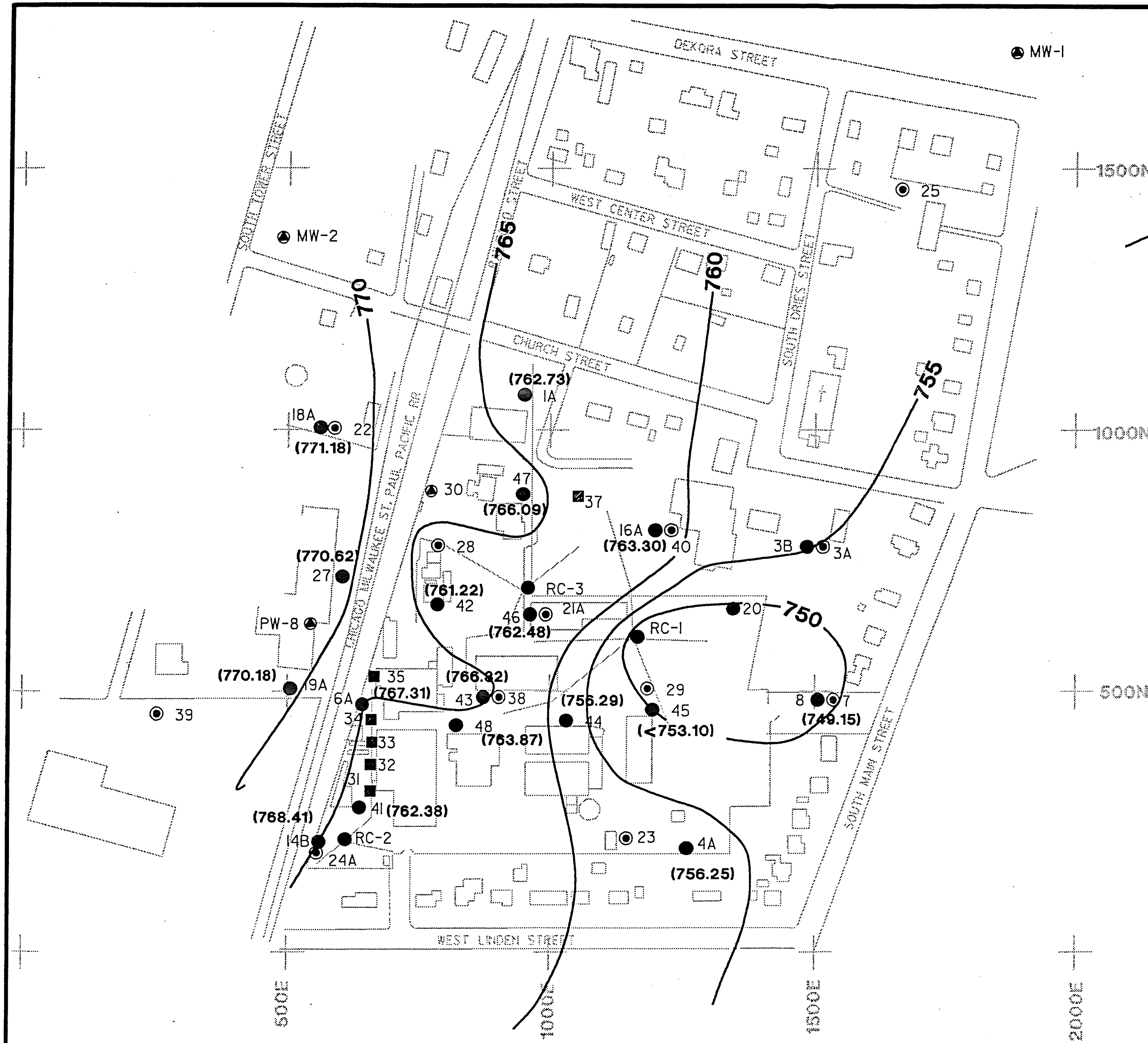
APPENDIX A

POTENTIOMETRIC SURFACE MAPS



WATER TABLE MAP GLACIAL DRIFT
WINTER QUARTER JANUARY 1993

FIGURE 3a



LEGEND

- DEEP DOLOMITE WELL
- SHALLOW DOLOMITE WELL
- GLACIAL OVERBURDEN WELL
- GLACIAL OVERBURDEN WITHDRAWAL WELL
- GLACIAL OVERBURDEN/SHALLOW DOLOMITE WELL NEST
- RANNEY COLLECTOR
- WATER TABLE CONTOUR

NOTES

1. BASE MAP WAS DEVELOPED FROM HATCHER-SAYRE, INC., 1992.

N

0 200 400

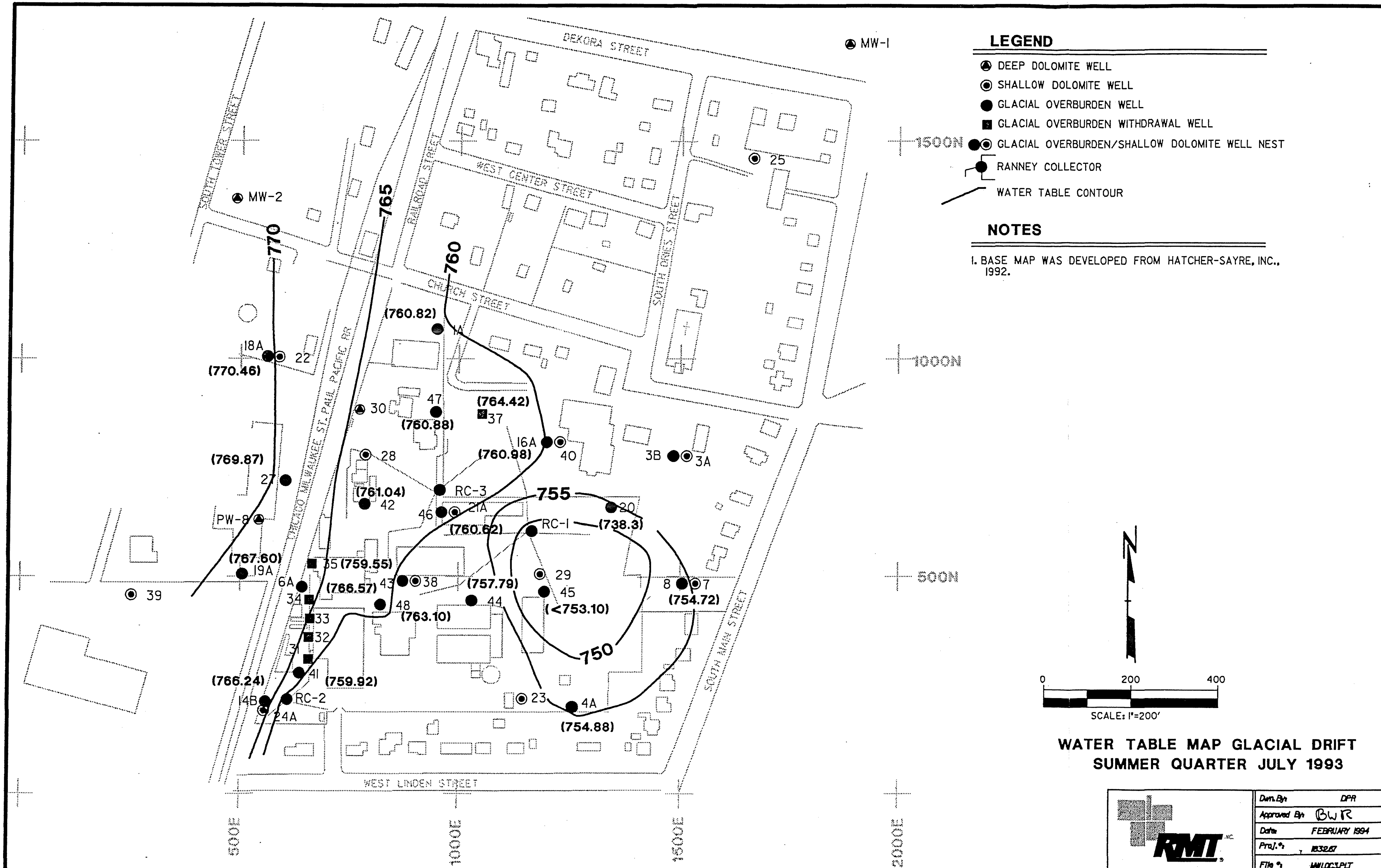
SCALE: 1"=200'

WATER TABLE MAP GLACIAL DRIFT
SPRING QUARTER APRIL 1993

RMT INC.

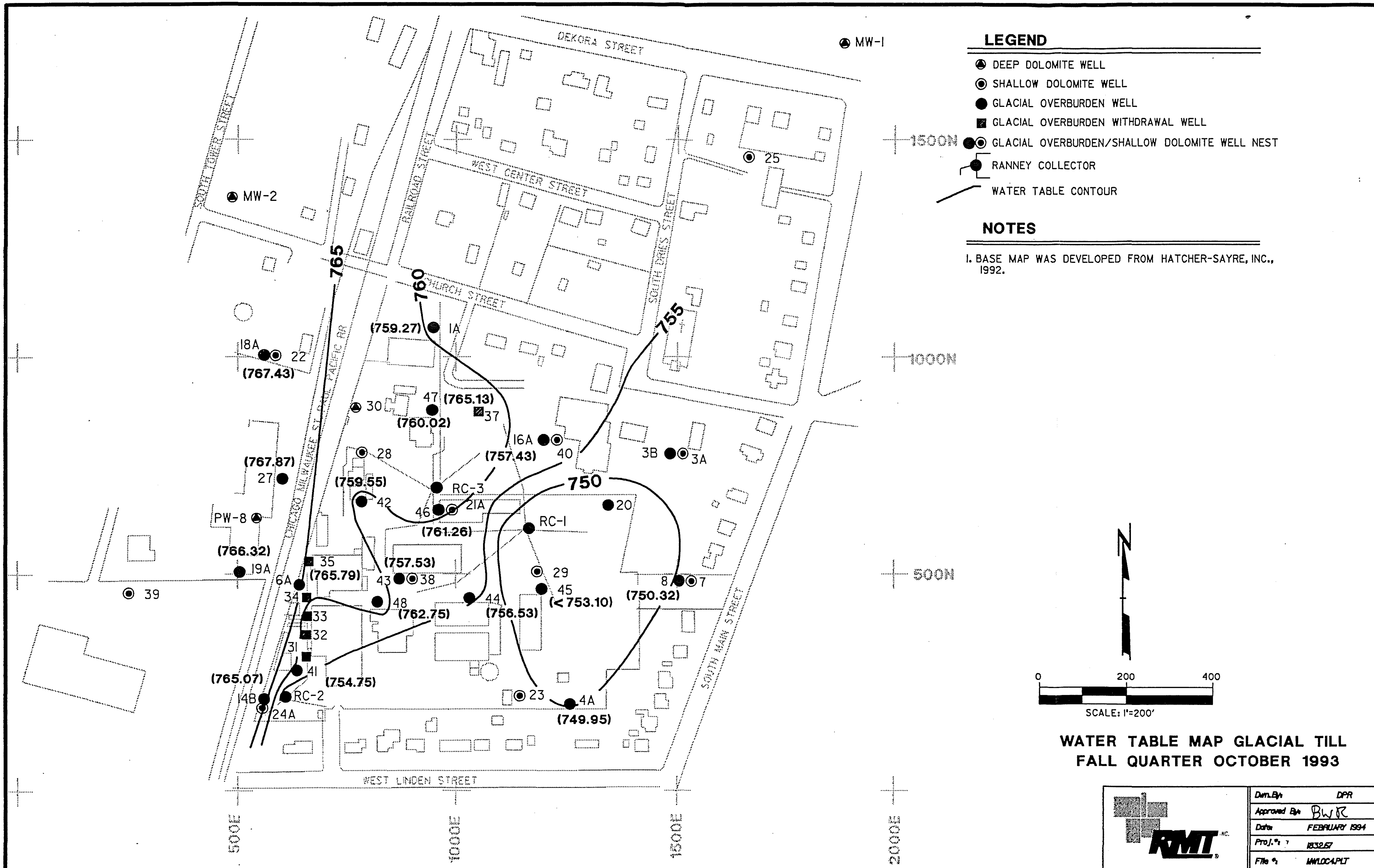
Dwn.By	DPR
Approved By	BWR
Date	FEBRUARY 1994
Proj.#	1832.57
File #	MWLOC2.PLT

FIGURE 3b



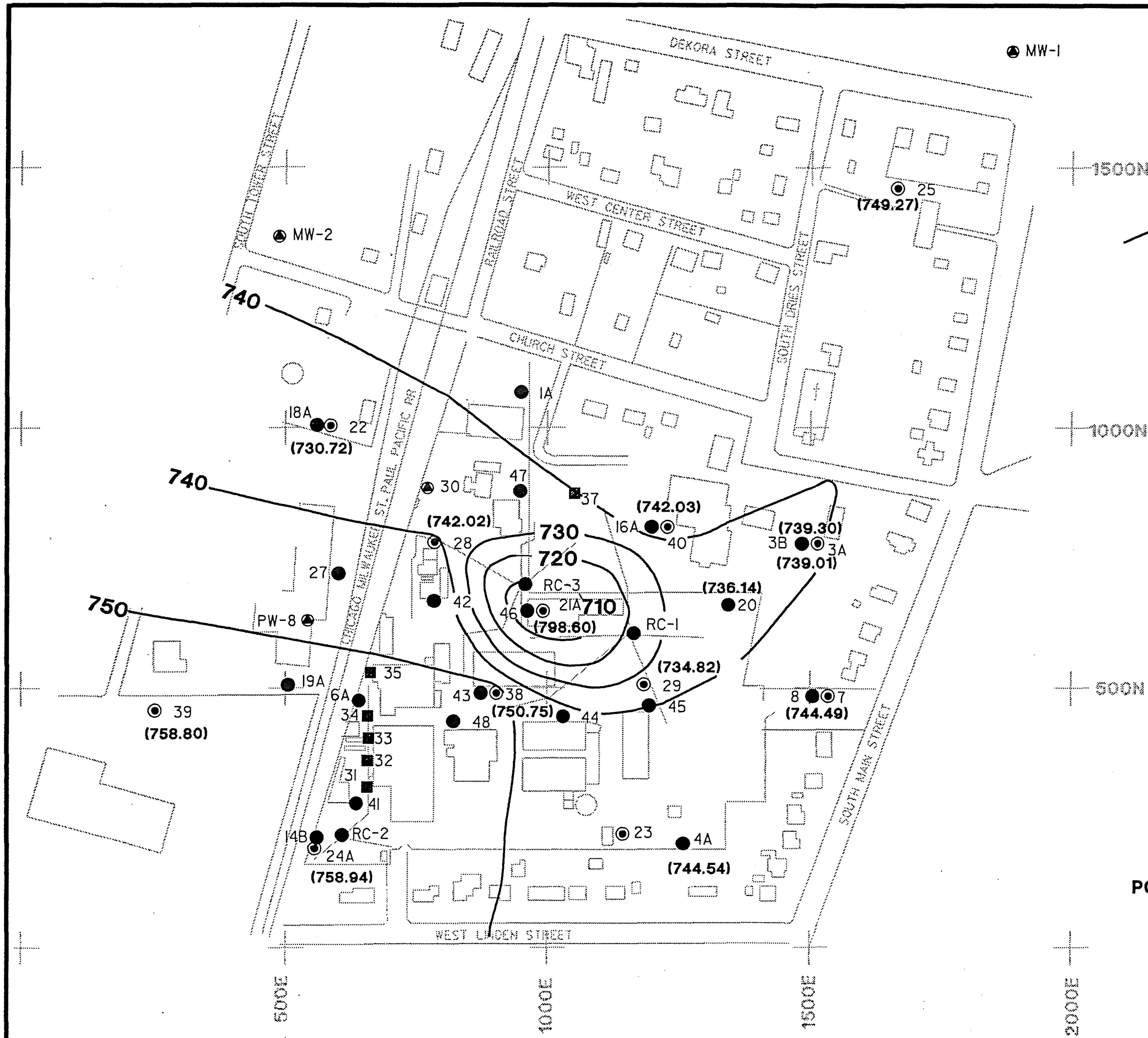
WATER TABLE MAP GLACIAL DRIFT
SUMMER QUARTER JULY 1993

FIGURE 3c



LEGEND
DEEP DOLOMITE WELL
SHALLOW DOLOMITE WELL
GLACIAL OVERBURDEN WELL
GLACIAL OVERBURDEN WITHDRAWAL WELL
GLACIAL OVERBURDEN/SHALLOW DOLOMITE WELL NEST
RANNEY COLLECTOR
WATER TABLE CONTOUR
NOTES
1. BASE MAP WAS DEVELOPED FROM HATCHER-SAYRE, INC., 1992.
DEKORA STREET
WEST CENTER STREET
CHURCH STREET
WEST LINDEN STREET
SOUTH TOWER STREET
RAILROAD STREET
SOUTH DRIES STREET
SOUTH MAIN STREET
CHICAGO MILWAUKEE ST. PAUL PACIFIC RR
MW-1
MW-2
765
760
755
750
(759.27) 1A
18A 22
(767.43)
30
47 (765.13)
37
(760.02)
16A
40
3B 3A
(757.43)
28
(767.87)
27
(759.55)
RC-3
42
46 21A
20
RC-1
(761.26)
PW-8
(766.32)
19A
35
(765.79)
(757.53)
43 38
29
8 7
39
6A
34
48
44
45
(< 753.10)
(750.32)
(762.75)
(756.53)
33
32
31
41
(754.75)
(765.07)
14B
RC-2
24A
23
4A
(749.95)
25
1500N
1000N
500N
500E
1000E
1500E
2000E
N
0 200 400
SCALE: 1"=200'
WATER TABLE MAP GLACIAL TILL
FALL QUARTER OCTOBER 1993
RMT INC.
Drn. By: DPR
Approved By: BWR
Date: FEBRUARY 1994
Proj. #: 1832.67
File #: MWLOC4.PLT

FIGURE 3d



LEGEND

- DEEP DOLOMITE WELL
- SHALLOW DOLOMITE WELL
- GLACIAL OVERBURDEN WELL
- GLACIAL OVERBURDEN WITHDRAWAL WELL
- GLACIAL OVERBURDEN/SHALLOW DOLOMITE WELL NEST
- RANNEY COLLECTOR
- POTENTIOMETRIC CONTOUR

NOTES

1. BASE MAP WAS DEVELOPED FROM HATCHER-SAYRE, INC., 1992.
2. LOCAL FLOW IS TOWARD THE CENTER OF THE SITE DUE TO PUMPING AT MW-21A

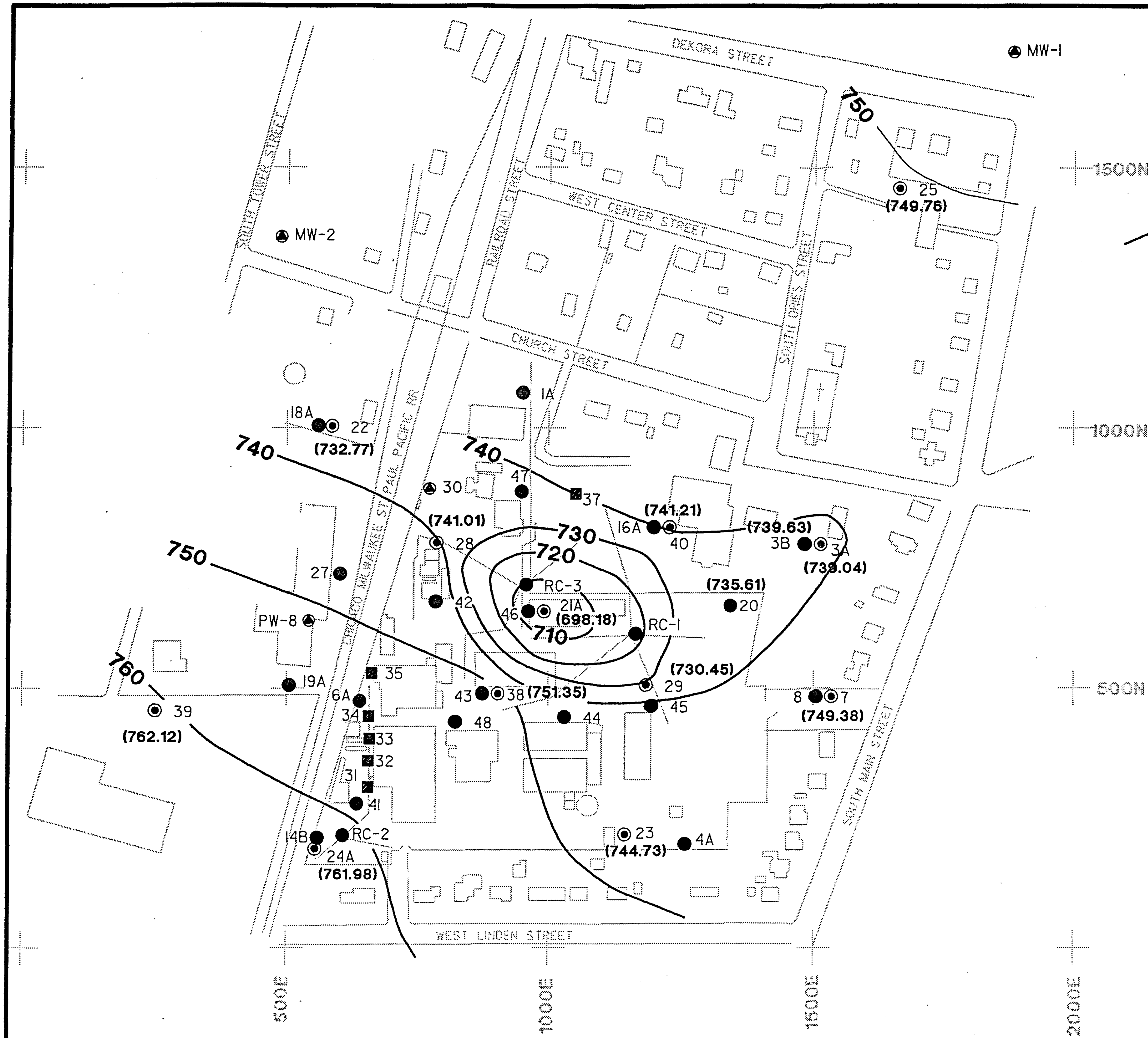
POTENTENTIOMETRIC MAP - SHALLOW DOLOMITE
WINTER QUARTER JANUARY 1993

RMT INC.

Dwn. By:	DPR
Approved By:	BWR
Date:	FEBRUARY 1994
Proj. #:	1832.67
File #:	MWLOC5.PLT

FIGURE 4a

Design File: ...32.67...5.plt
User = project
Plot File = mwloc5.prf
Plot Date = Tue Feb 22 17:36:55 1994
Pen Table = DEFAULT.TBL



LEGEND

- DEEP DOLOMITE WELL
- SHALLOW DOLOMITE WELL
- GLACIAL OVERBURDEN WELL
- GLACIAL OVERBURDEN WITHDRAWAL WELL
- GLACIAL OVERBURDEN/SHALLOW DOLOMITE WELL NEST
- RANNEY COLLECTOR
- POTENTIOMETRIC CONTOUR

NOTES

1. BASE MAP WAS DEVELOPED FROM HATCHER-SAYRE, INC., 1992.
2. FLOW IS TOWARD THE CENTER OF THE SITE DUE TO PUMPING AT MW-21A

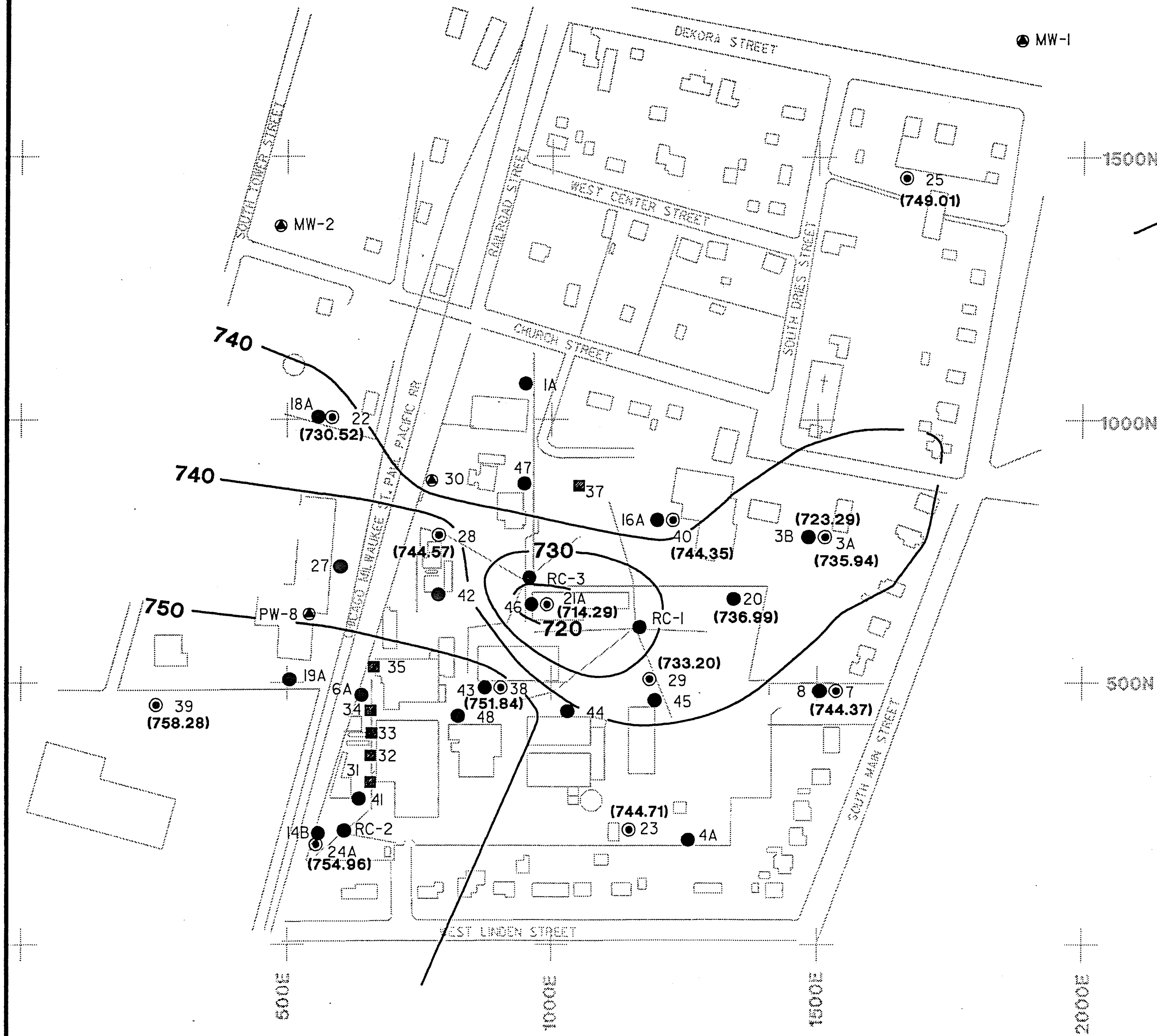
POTENTIOMETRIC SURFACE MAP - SHALLOW DOLOMITE SPRING QUARTER APRIL 1993

RMT INC.

Dwn. By:	DPR
Approved By:	BWR
Date:	FEBRUARY 1994
Proj. #:	1832.67
File #:	MWLOC6.PLT

FIGURE 4b

Plot File = mwloc6.prf
Plot Date = Tue Feb 22 18:03:37 1994
Pen Table =DEFAULT.TBL



LEGEND

- DEEP DOLOMITE WELL
- SHALLOW DOLOMITE WELL
- GLACIAL OVERBURDEN WELL
- GLACIAL OVERBURDEN WITHDRAWAL WELL
- GLACIAL OVERBURDEN/SHALLOW DOLOMITE WELL NEST
- RANNEY COLLECTOR
- POTENTIOMETRIC CONTOUR

NOTES

1. BASE MAP WAS DEVELOPED FROM HATCHER-SAYRE, INC., 1992.
2. FLOW IS TOWARD THE CENTER OF THE SITE DUE TO PUMPING AT MW-21A

0 200 400

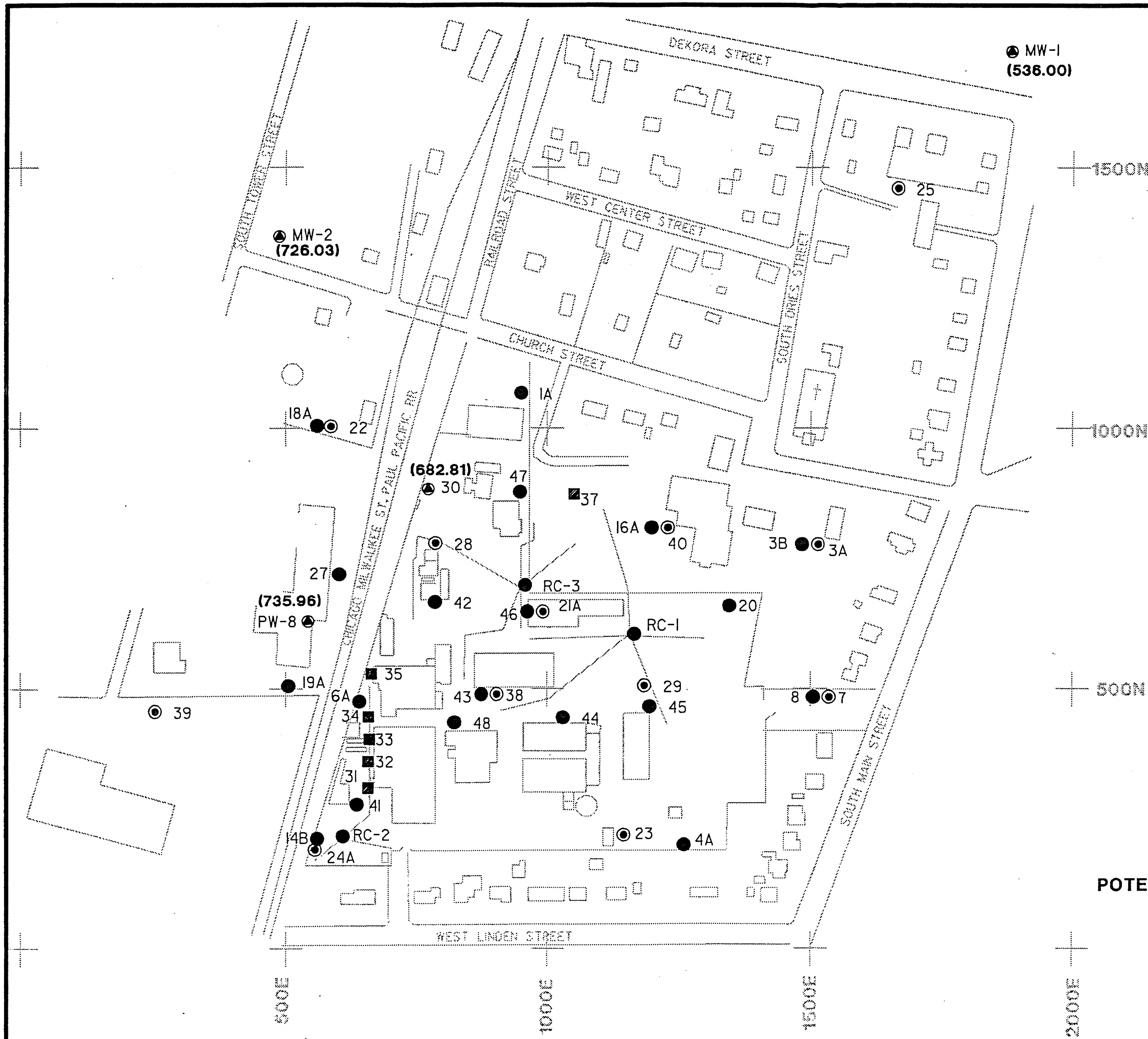
SCALE: 1"=200'

POTENTIOMETRIC MAP -SHALLOW DOLOMITE FALL QUARTER OCTOBER 1993

RMT INC.

Dwn. By	DPR
Approved By	BWR
Date	FEBRUARY 1994
Proj. #	1832.67
File #	MWLOC7.PLT

FIGURE 4c



LEGEND

- DEEP DOLOMITE WELL
- SHALLOW DOLOMITE WELL
- GLACIAL OVERBURDEN WELL
- GLACIAL OVERBURDEN WITHDRAWAL WELL
- GLACIAL OVERBURDEN/SHALLOW DOLOMITE WELL NEST
- RANNEY COLLECTOR

NOTES

1. BASE MAP WAS DEVELOPED FROM HATCHER-SAYRE, INC., 1992.

0 200 400

SCALE: 1"=200'

POTENTIOMETRIC ELEVATION MAP - DEEP DOLOMITE
WINTER QUATER JANUARY 1993

RMT INC.

Dwn. By	DPR
Approved By	BWR
Date	FEBRUARY 1994
Proj. #	1832.67
File #	MWLOCS.PLT

FIGURE 5a

APPENDIX B

HYDROGEOLOGIC CALCULATIONS

APPENDIX B

HYDROGEOLOGIC CALCULATIONS

Potentiometric Surface - Shallow Dolomite

1. Vicinity of W-24A to W-38 (Spring Quarter, April 1993)

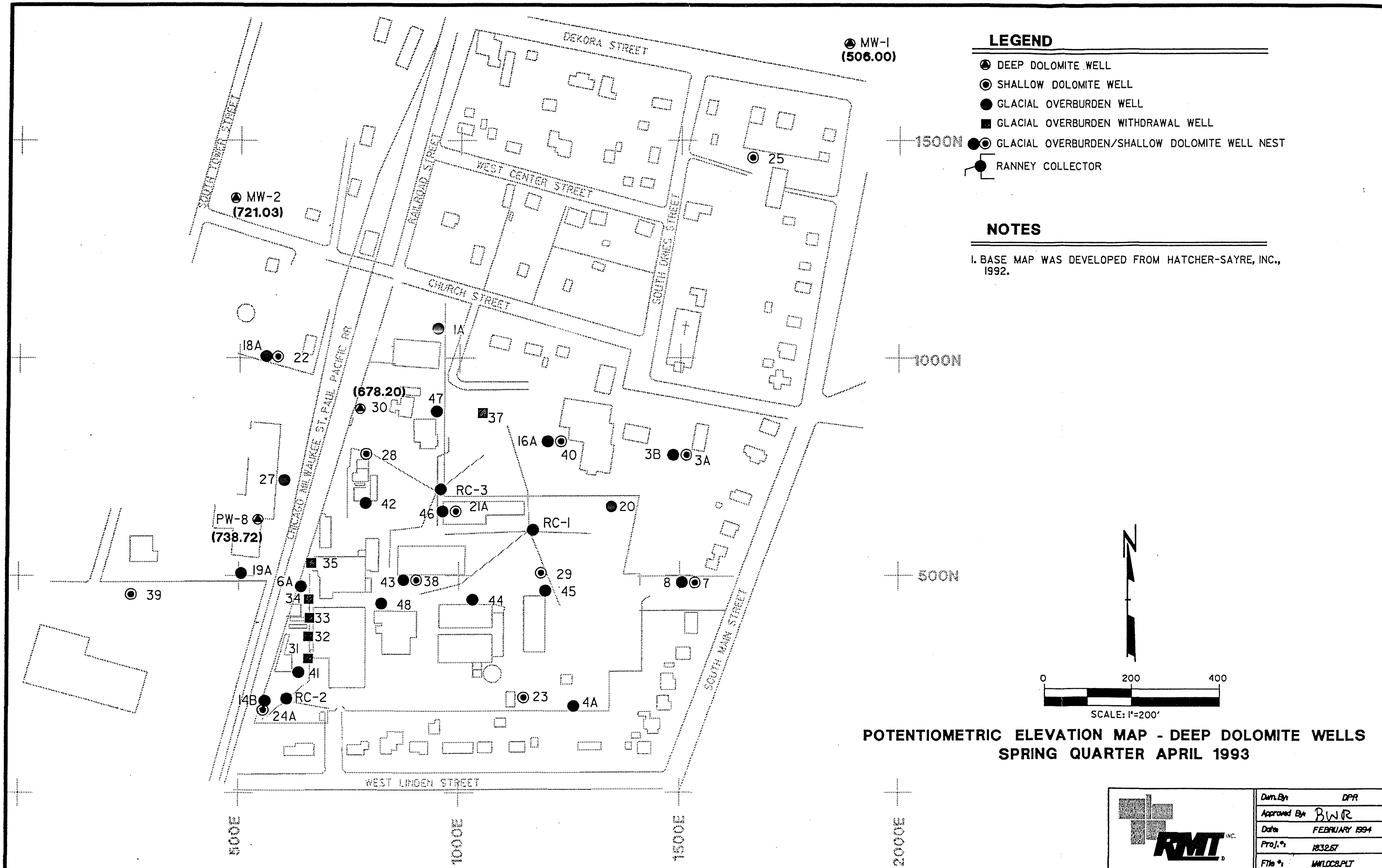
$$i = \frac{dh}{dl} = \frac{761.98 - 751.35}{(2.32)200} = 0.0229\ ft/ft = 0.023 ft/ft$$

2. Vicinity of W-38 to W-21A

$$i = \frac{dh}{dl} = \frac{751.35 - 698.18}{(0.9)200} = 0.2954\ ft/ft = 0.3 ft/ft$$

APPENDIX C

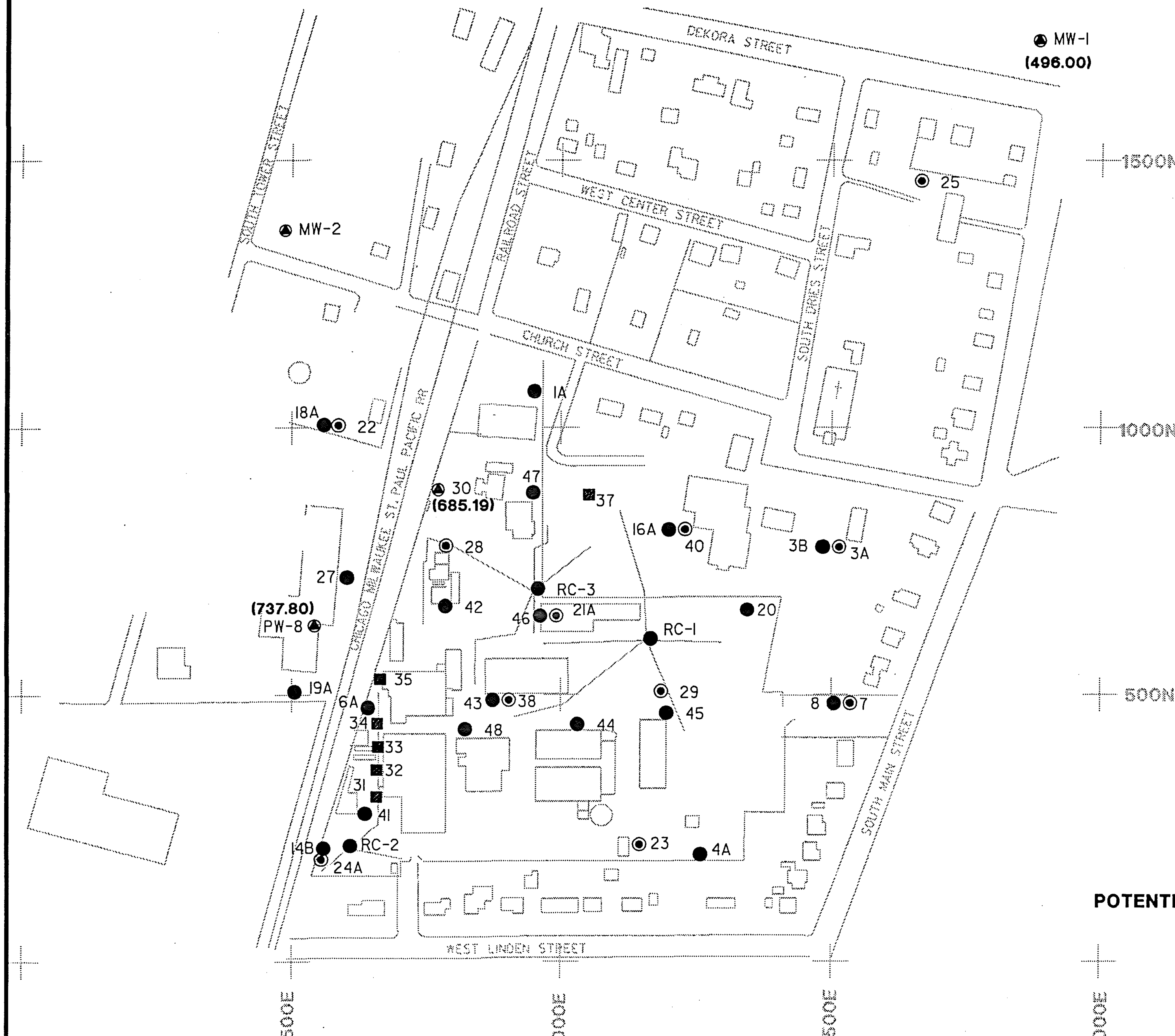
ISOCONCENTRATION MAPS



POTENTIOMETRIC ELEVATION MAP - DEEP DOLOMITE WELLS
SPRING QUARTER APRIL 1993

FIGURE 5b

Plot File = mwloc8.prf
Plot Date = Tue Feb 22 18:01:34 1994
Pen Table = DEFAULT.TBL



LEGEND

- DEEP DOLOMITE WELL
- SHALLOW DOLOMITE WELL
- GLACIAL OVERBURDEN WELL
- GLACIAL OVERBURDEN WITHDRAWAL WELL
- GLACIAL OVERBURDEN/SHALLOW DOLOMITE WELL NEST
- RANNEY COLLECTOR

NOTES

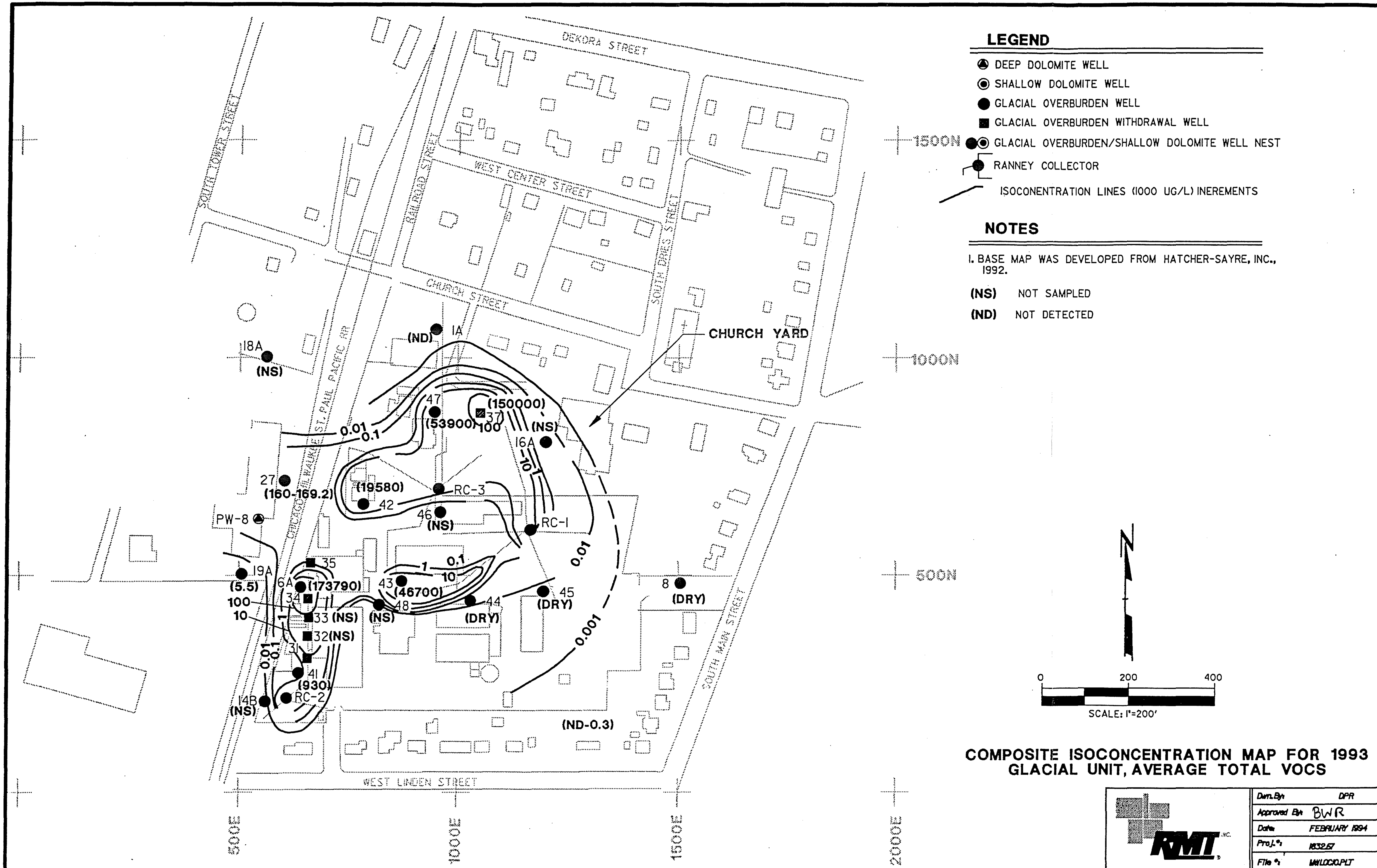
1. BASE MAP WAS DEVELOPED FROM HATCHER-SAYRE, INC., 1992.

POTENTIOMETRIC ELEVATION MAP - DEEP DOLOMITE
SUMMER QUARTER JULY 1993

RMT INC.

Dwn.By:	DPR
Approved By:	BWR
Date:	FEBRUARY 1994
Proj.#:	R03257
File #:	MWLOC13.PLT

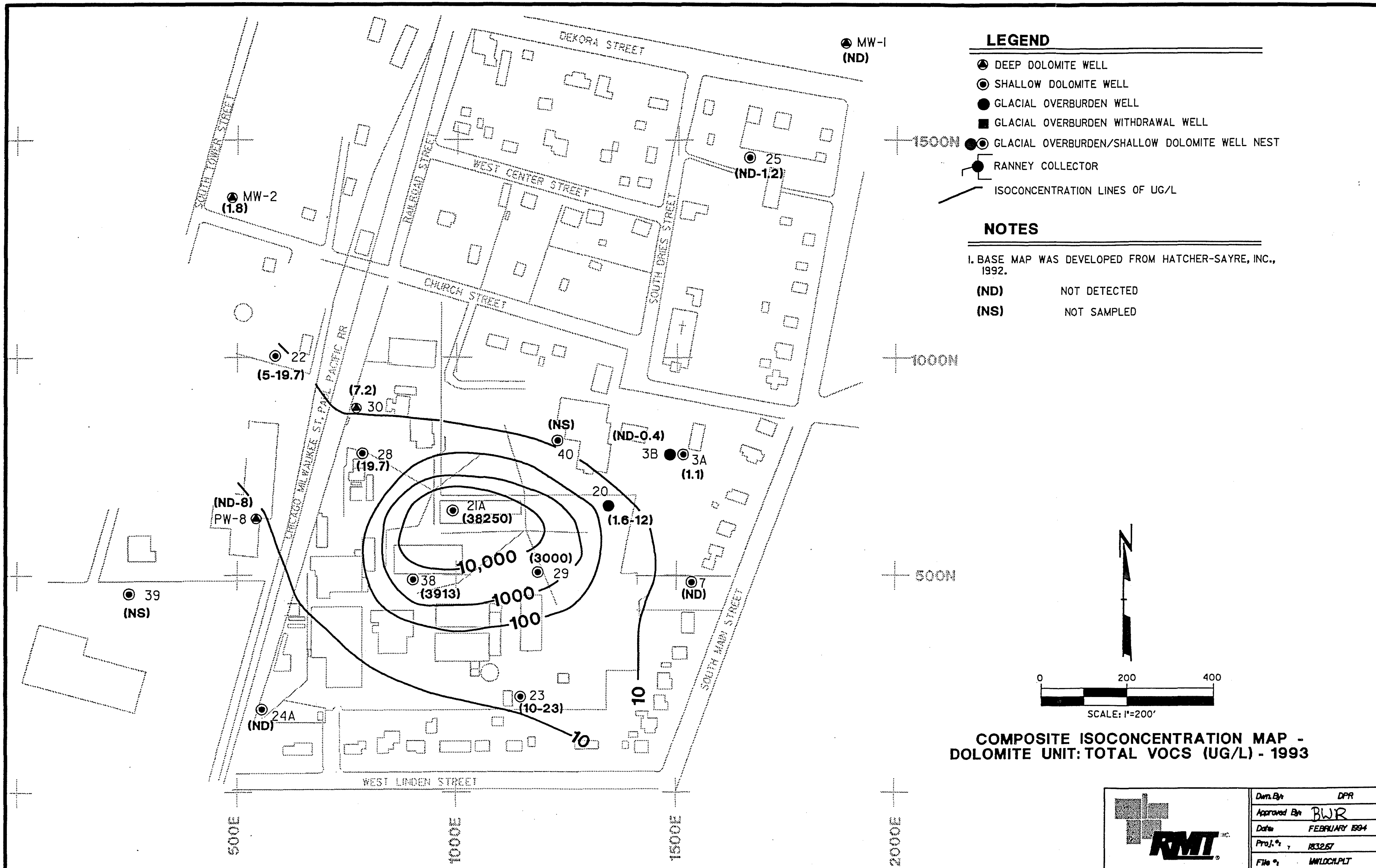
FIGURE 5c



COMPOSITE ISOCONCENTRATION MAP FOR 1993
GLACIAL UNIT, AVERAGE TOTAL VOCS

FIGURE 6

User ID = project
Plot File = mwloc10.prf
Plot Date = Wed Feb 23 16:02:44 1994
Pen Table = DEFAULT.TBL



COMPOSITE ISOCONCENTRATION MAP - DOLOMITE UNIT: TOTAL VOCS (UG/L) - 1993

FIGURE 7

APPENDIX D

TREND ANALYSIS PLOTS

APPENDIX D

TREND ANALYSIS PLOTS

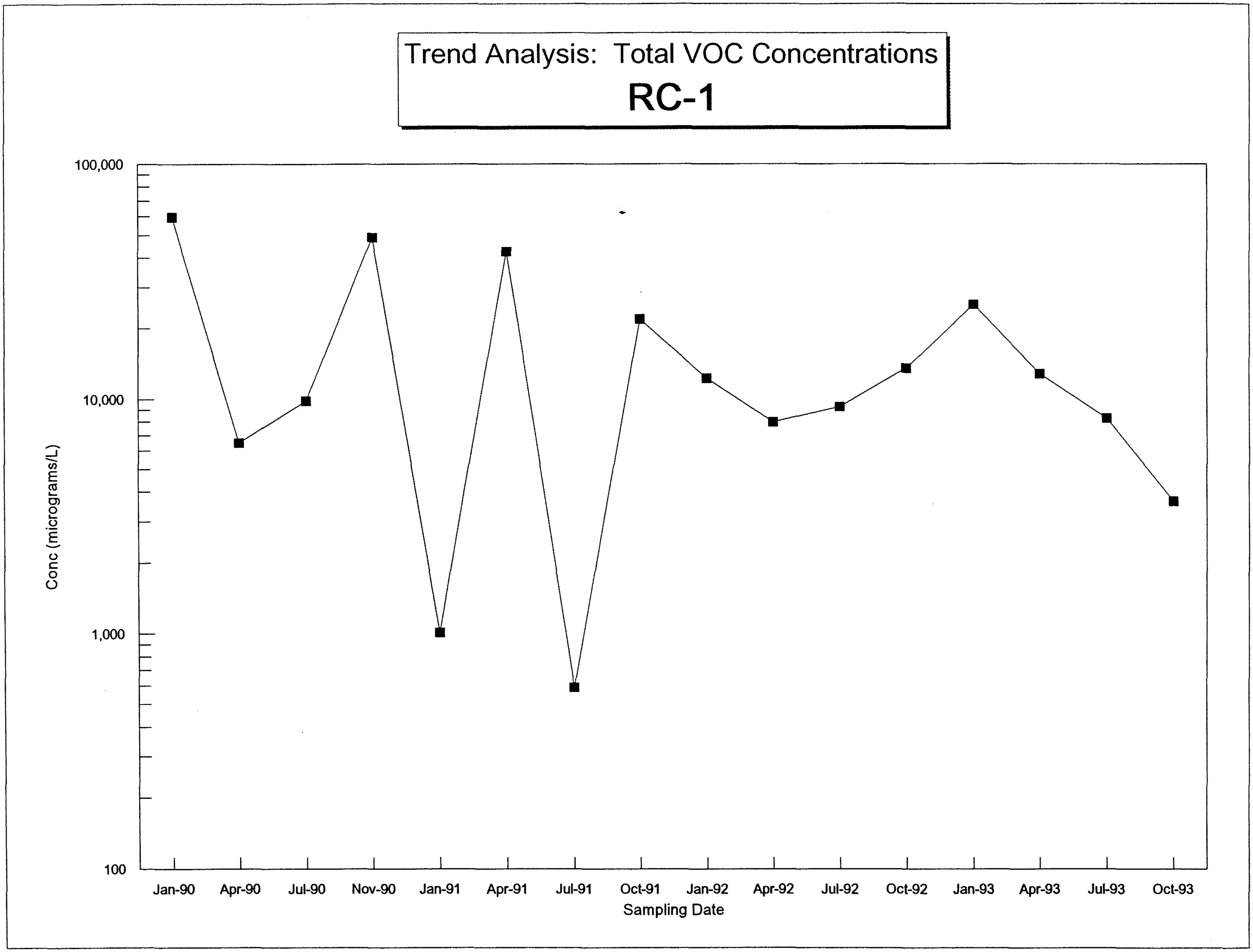
Glacial Wells

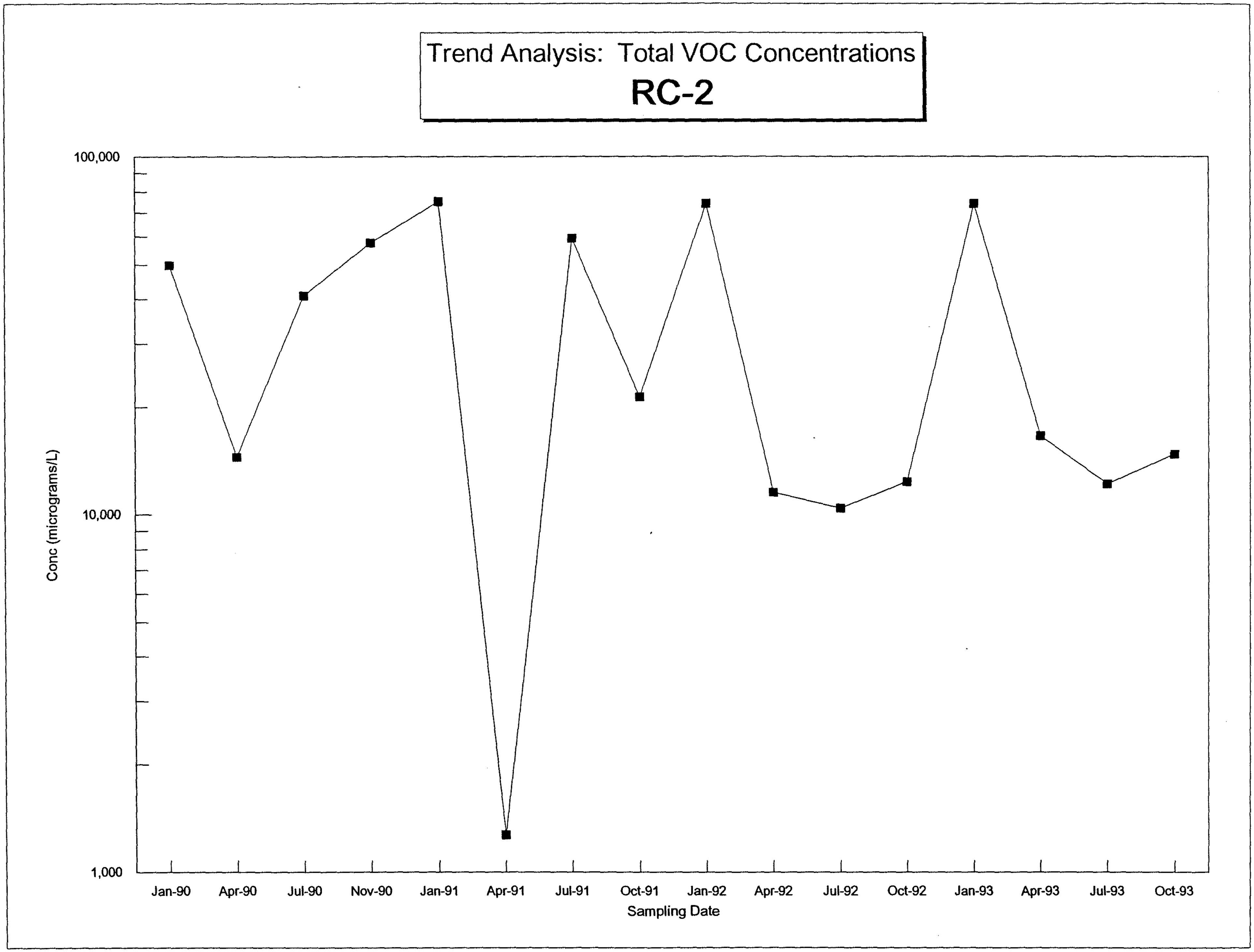
Receptor:	RC-1, RC-2, RC-3
Perimeter:	W-01A, W-03B, W-04A, W-20, W-27,
Remediation Progress:	W-06A, W-19A, W-37, W-41, W-42, W-43, W-47

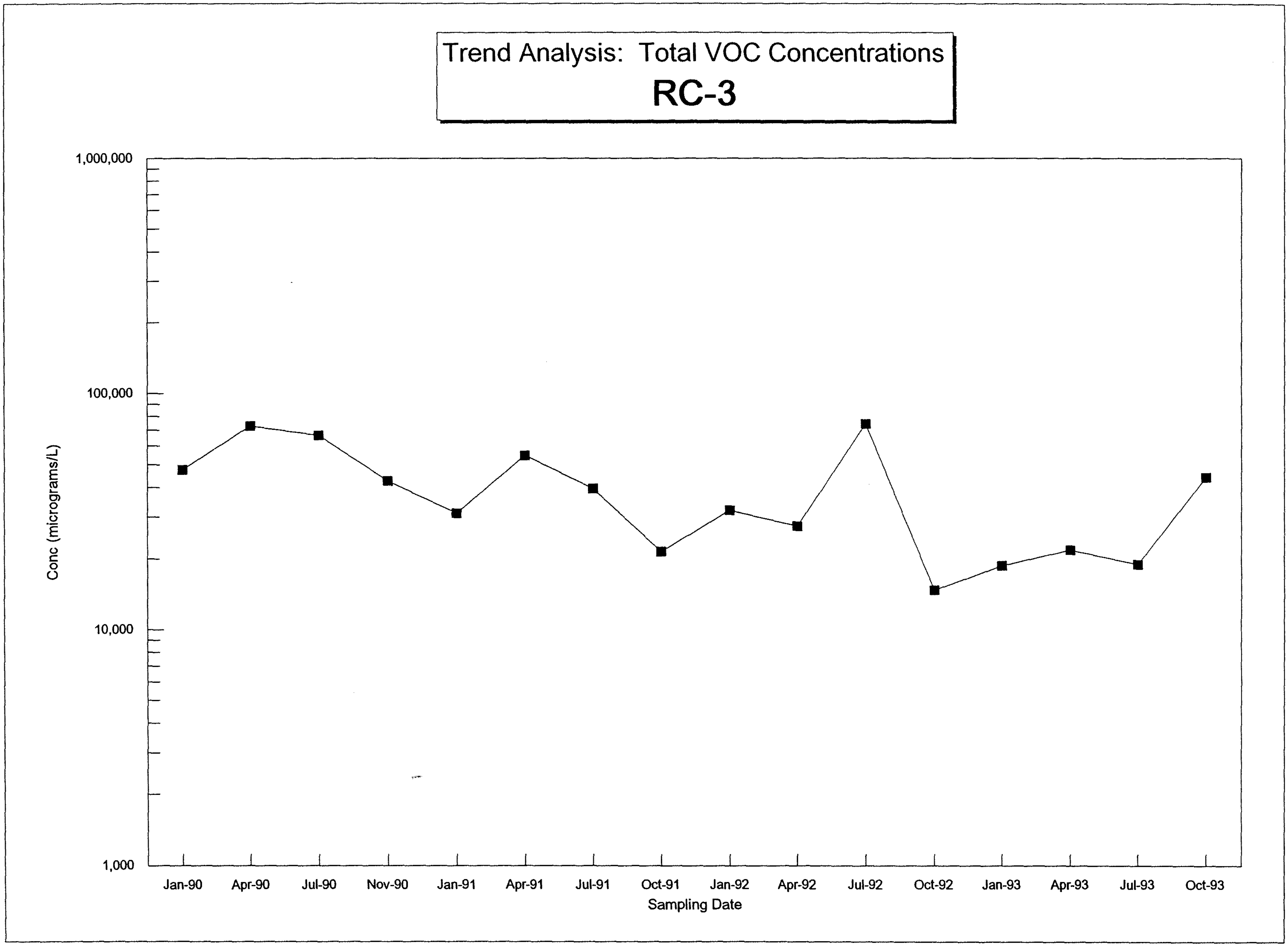
Dolomite Wells

Receptor:	MW-1, MW-2, MW-3, MW-4
Perimeter:	W-03A, W-07, W-22, W-23, W-25, PW-08
Remediation Progress:	W-21A, W-24A, W-28, W-29, W-30, W-38

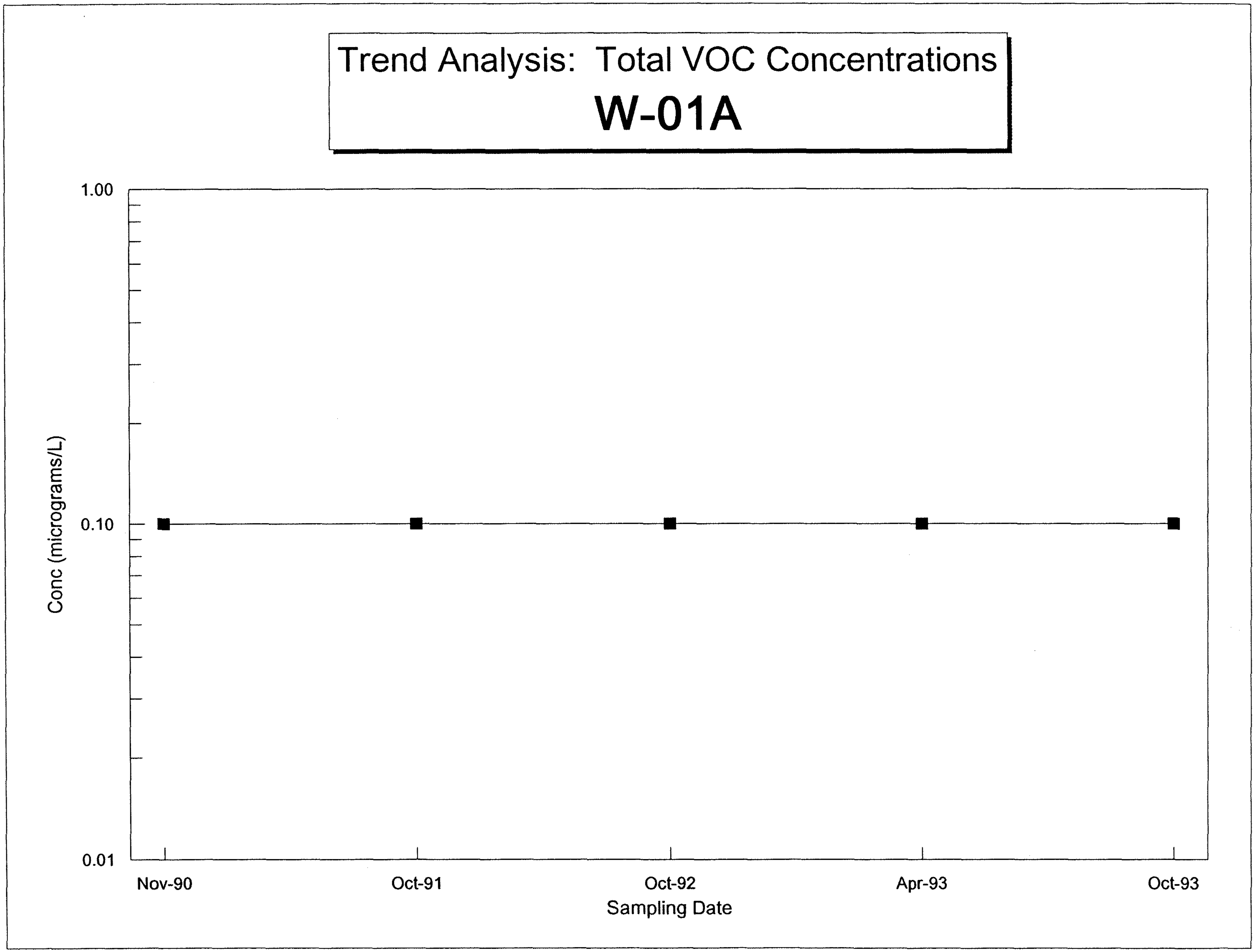
NOTES: When sample analyses indicate non-detectable levels of total VOCs, these events are depicted on the following plots by a symbolic value of 0.01 μg/L. This value does not represent the detection limit (or the absolute concentration) because of changes in laboratories, methods, and detection limits since 1983.


Trend Analysis: Total VOC Concentrations
RC-1
100,000
10,000
1,000
100
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jan-93
Apr-93
Jul-93
Oct-93
Sampling Date

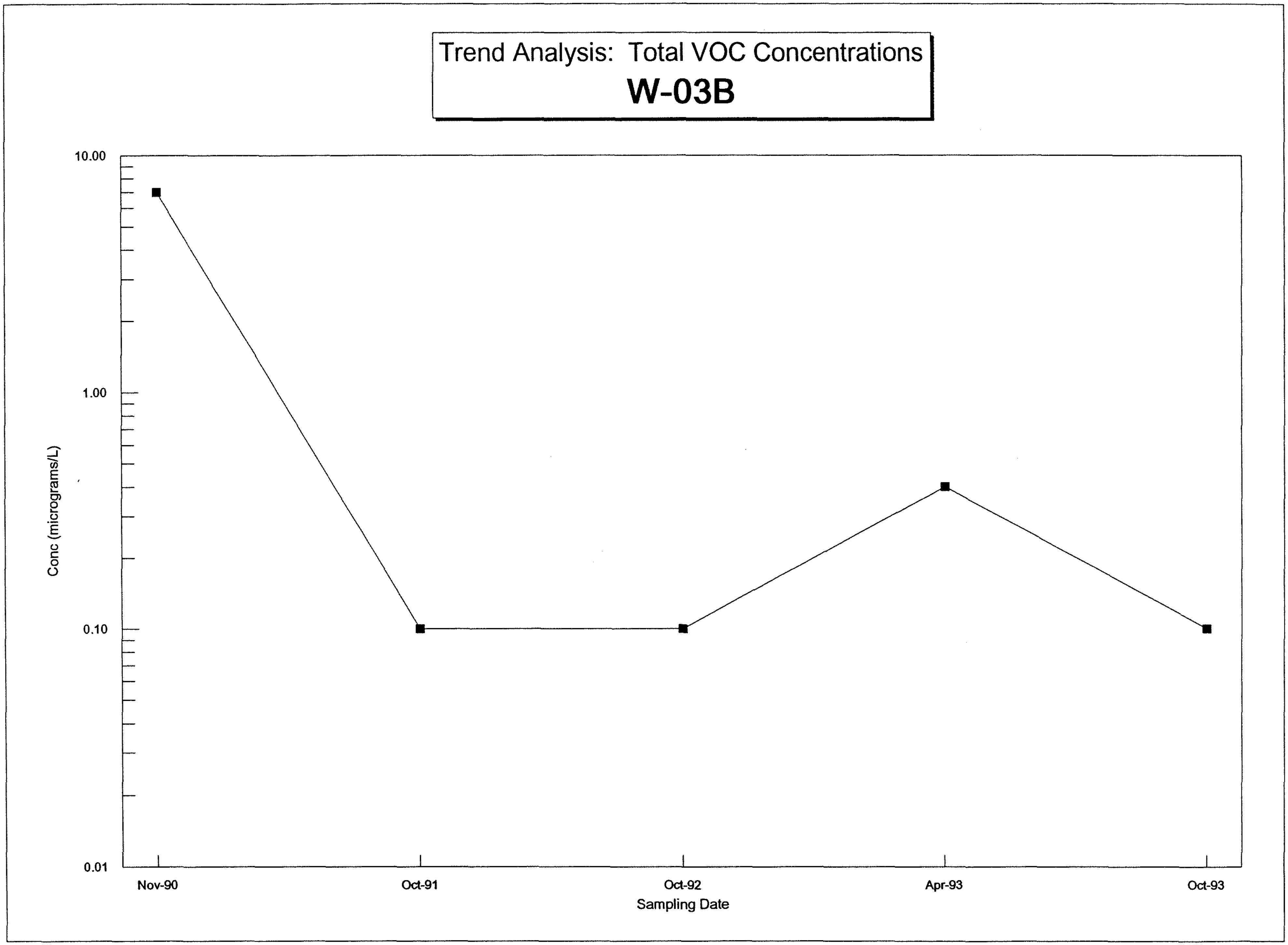

Trend Analysis: Total VOC Concentrations
RC-2
100,000
10,000
1,000
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jan-93
Apr-93
Jul-93
Oct-93
Sampling Date



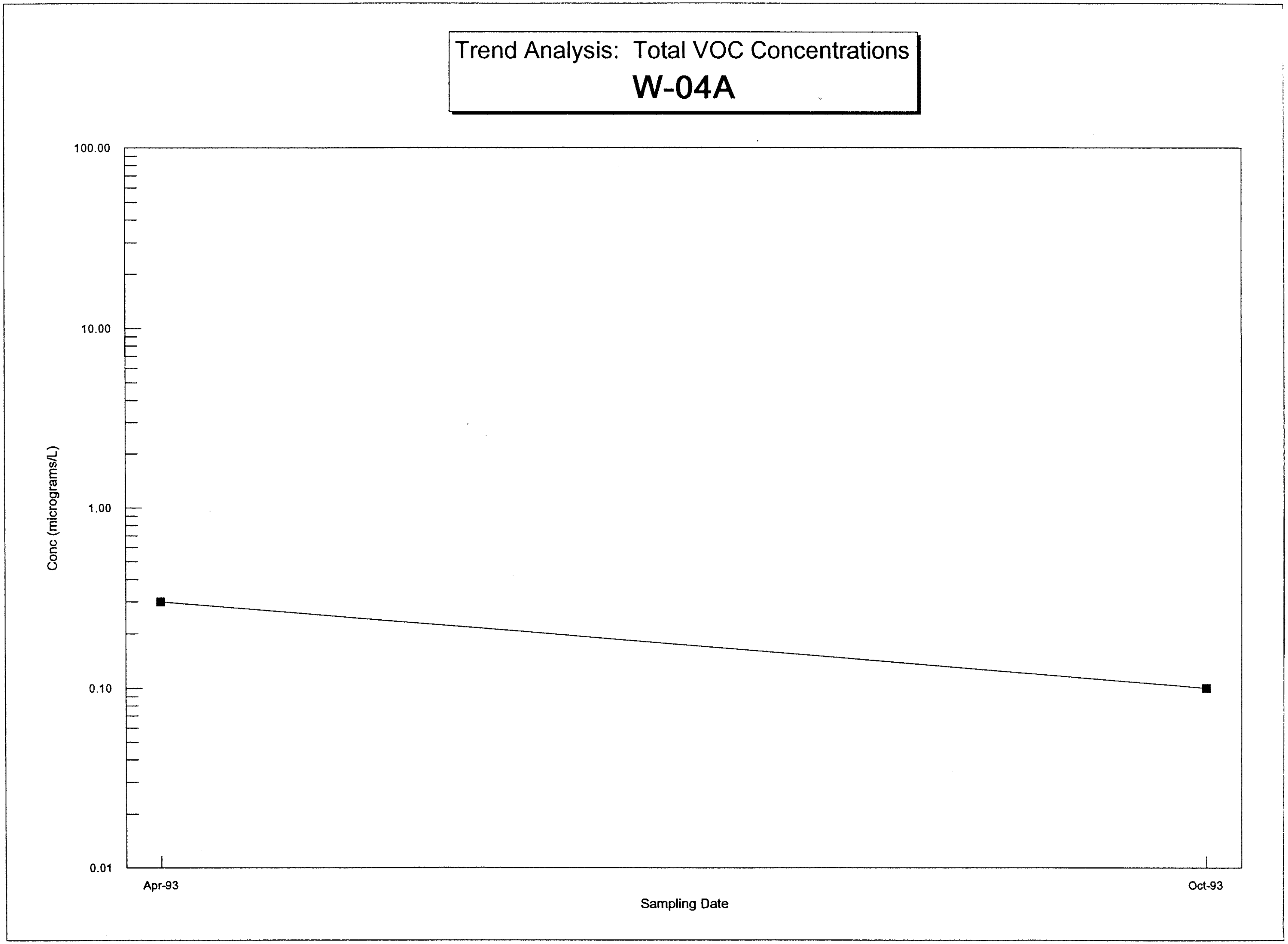
Trend Analysis: Total VOC Concentrations
RC-3
1,000,000
100,000
10,000
1,000
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jan-93
Apr-93
Jul-93
Oct-93
Sampling Date

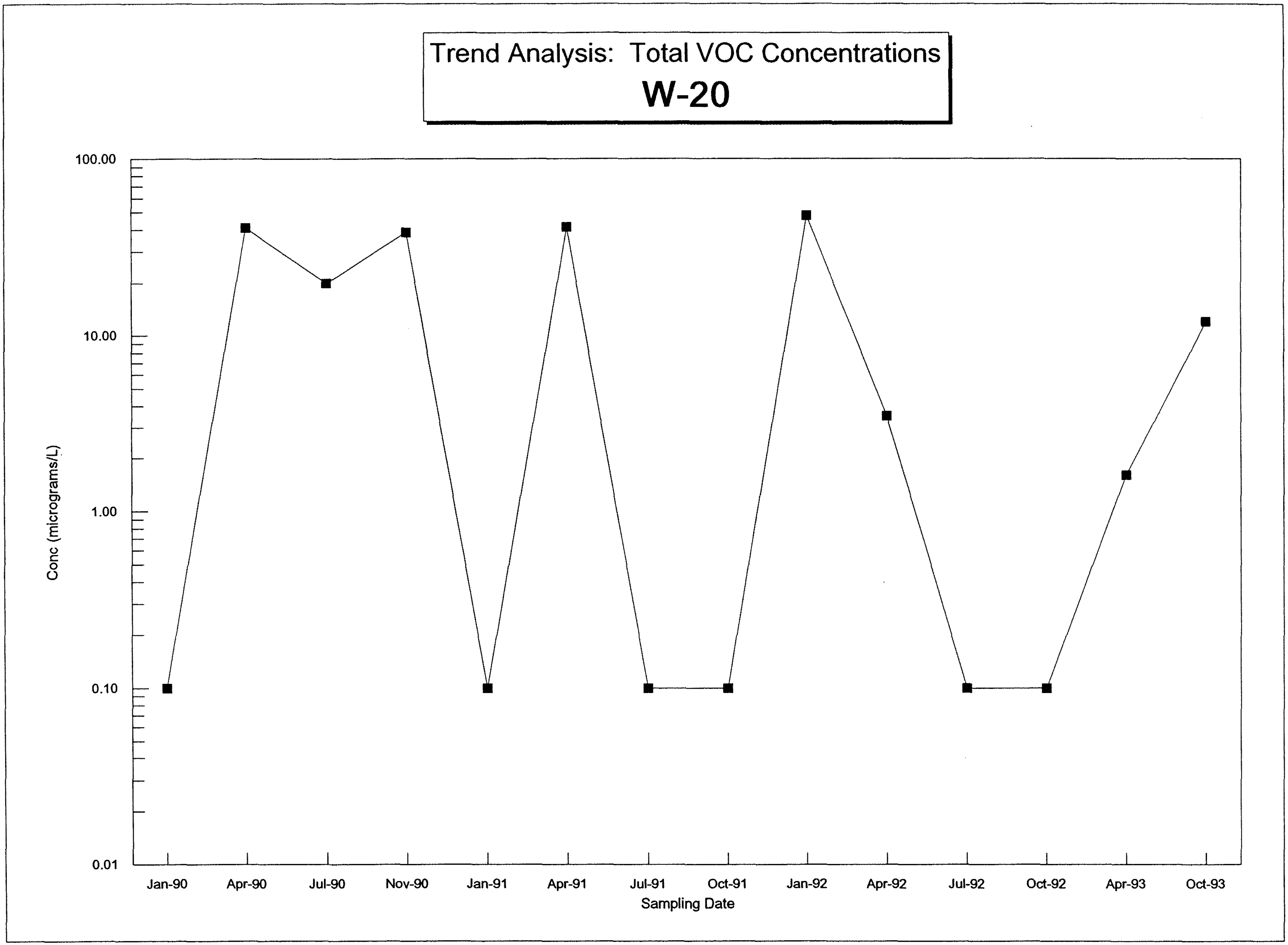


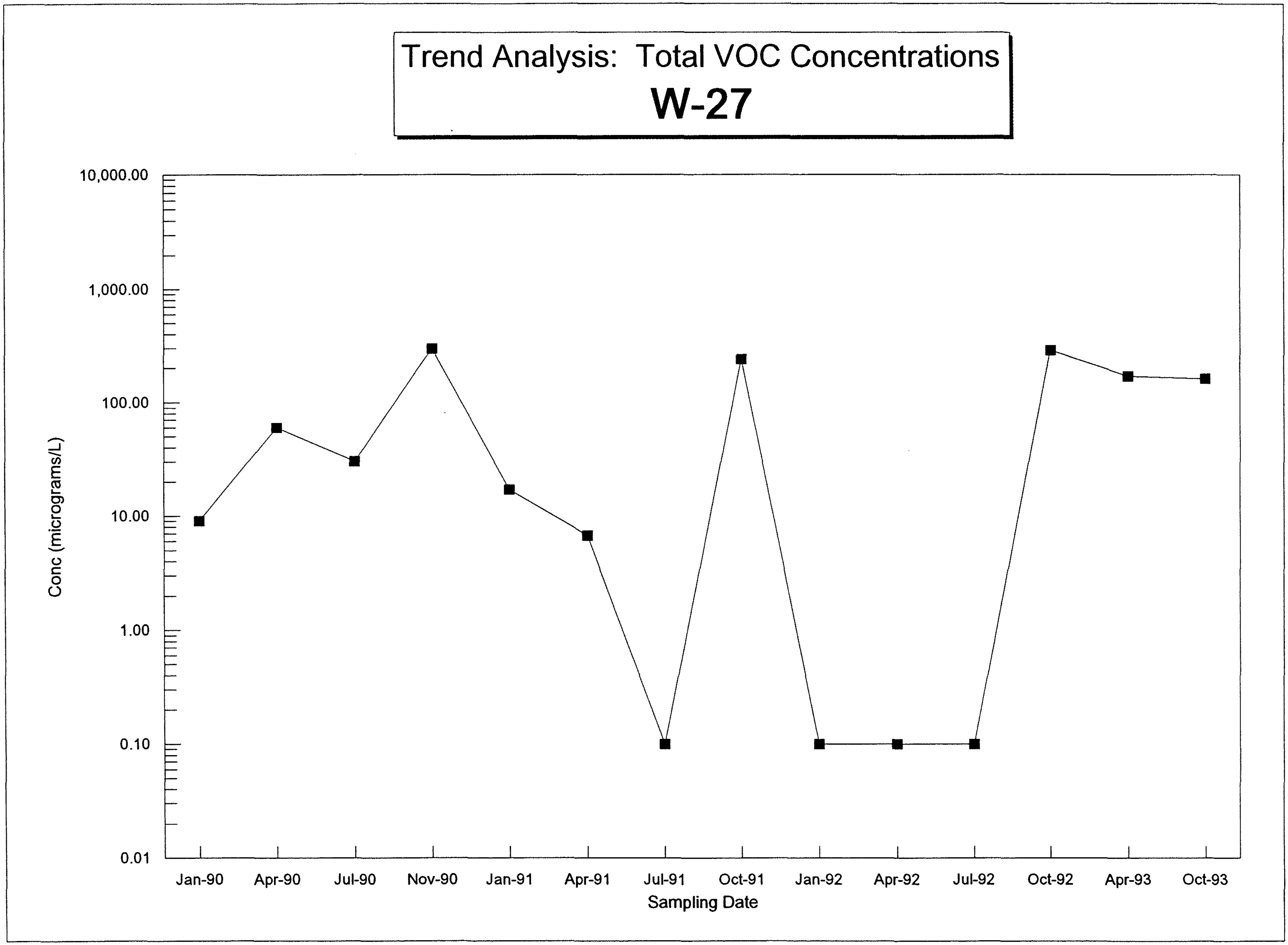
Trend Analysis: Total VOC Concentrations
W-01A
1.00
0.10
0.01
Conc (micrograms/L)
Nov-90
Oct-91
Oct-92
Apr-93
Oct-93
Sampling Date

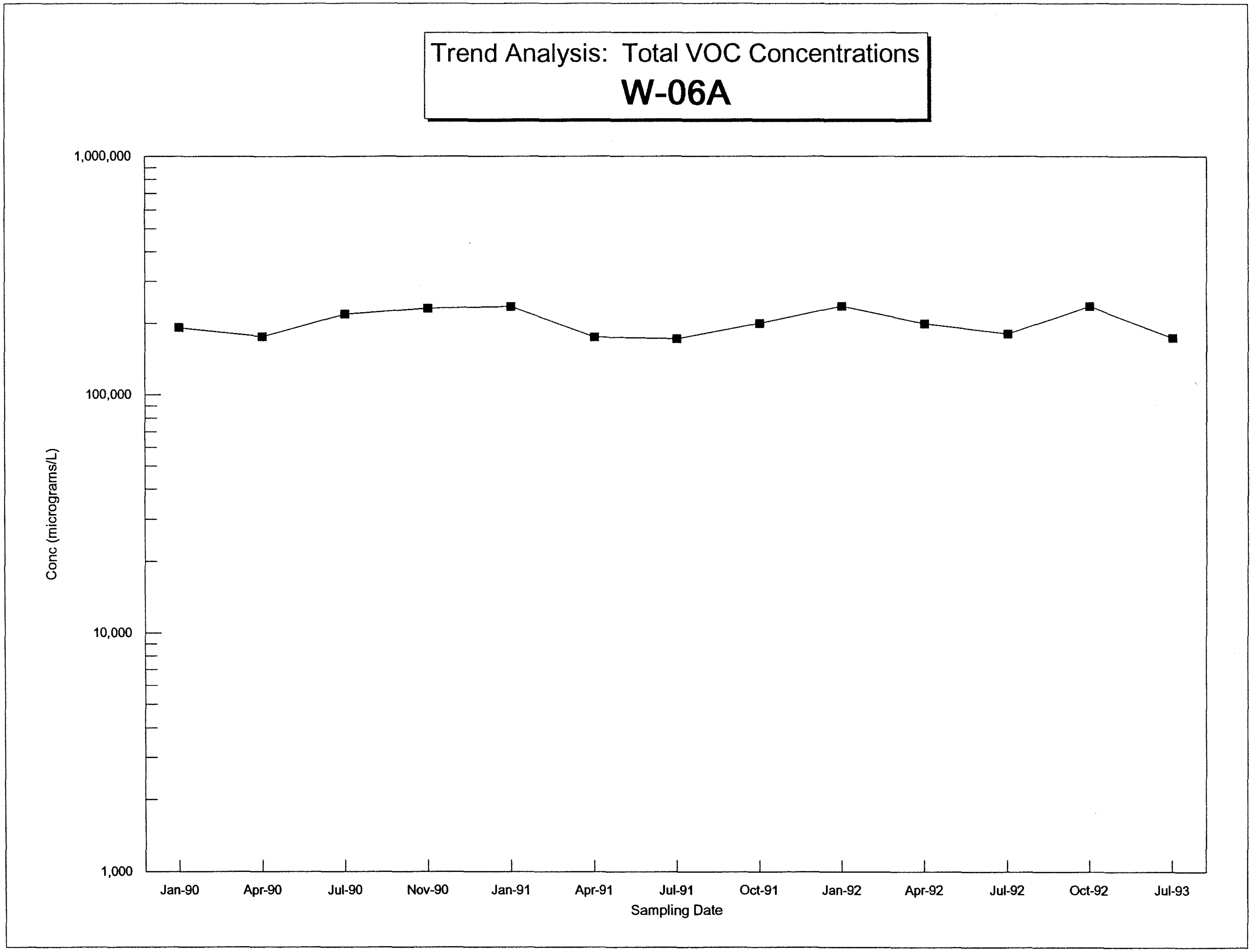


Trend Analysis: Total VOC Concentrations
W-03B
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Nov-90
Oct-91
Oct-92
Apr-93
Oct-93
Sampling Date

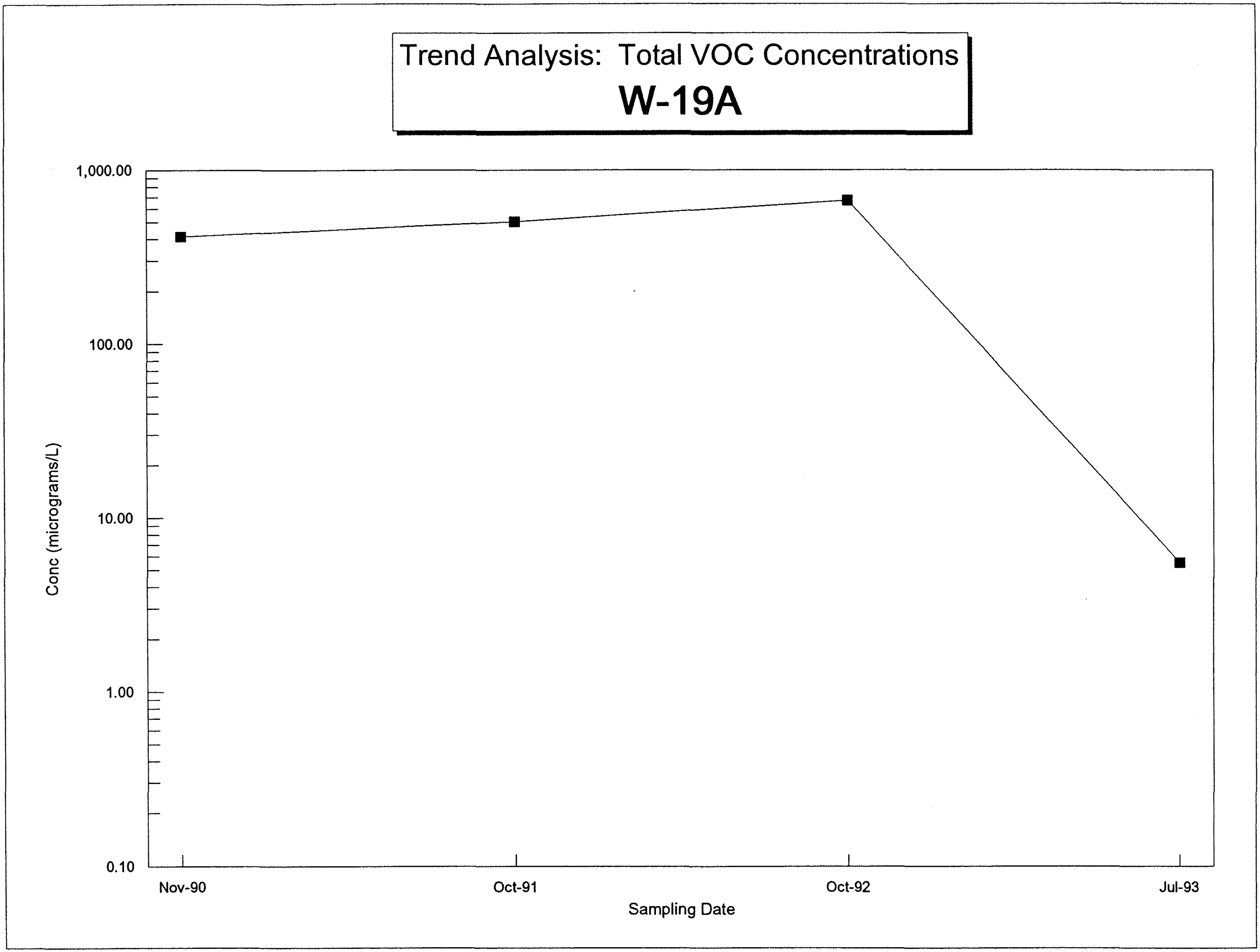

Trend Analysis: Total VOC Concentrations
W-04A
100.00
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Apr-93
Oct-93
Sampling Date


Trend Analysis: Total VOC Concentrations
W-20
100.00
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Apr-93
Oct-93
Sampling Date

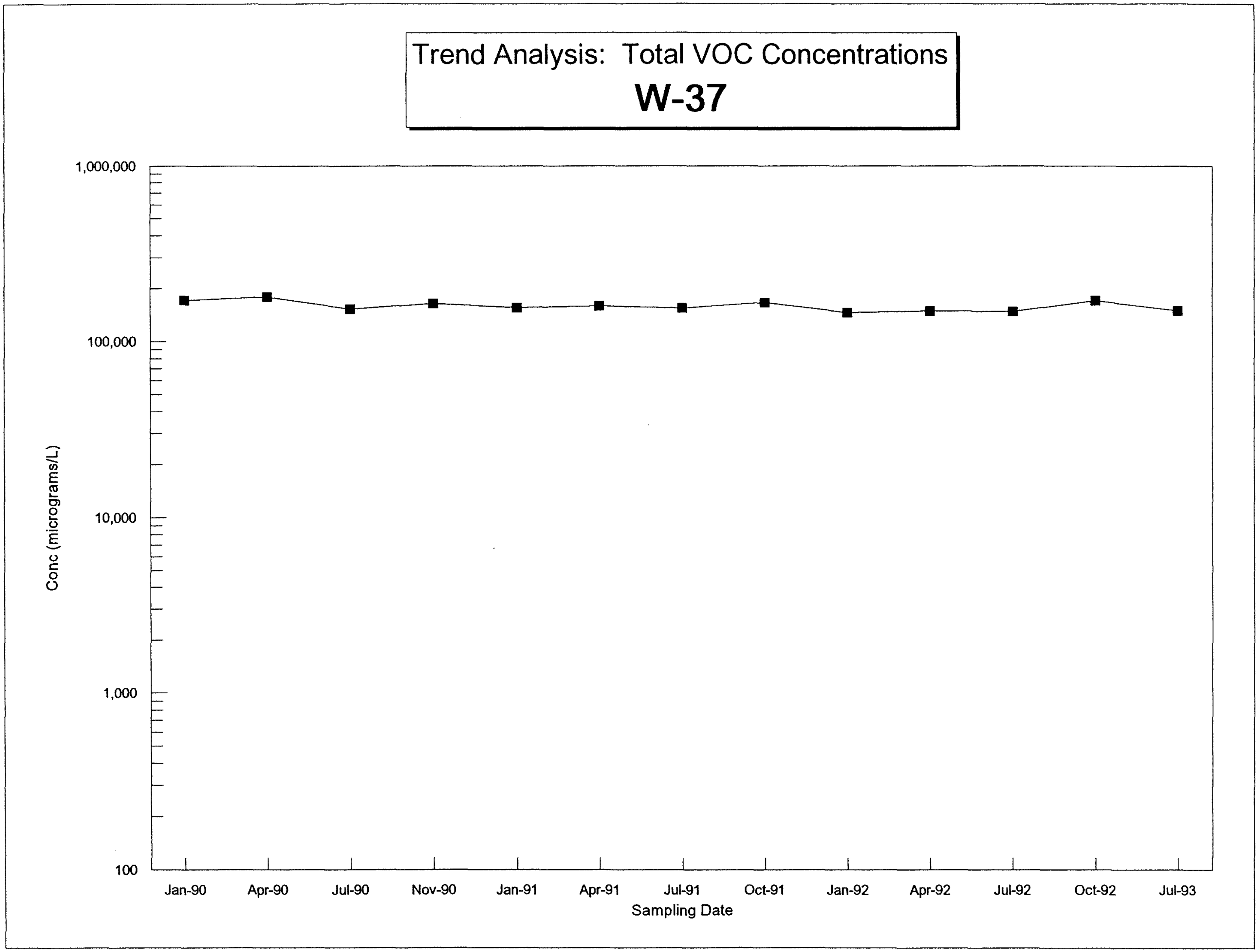

Trend Analysis: Total VOC Concentrations
W-27
Conc (micrograms/L)
10,000.00
1,000.00
100.00
10.00
1.00
0.10
0.01
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Apr-93
Oct-93
Sampling Date



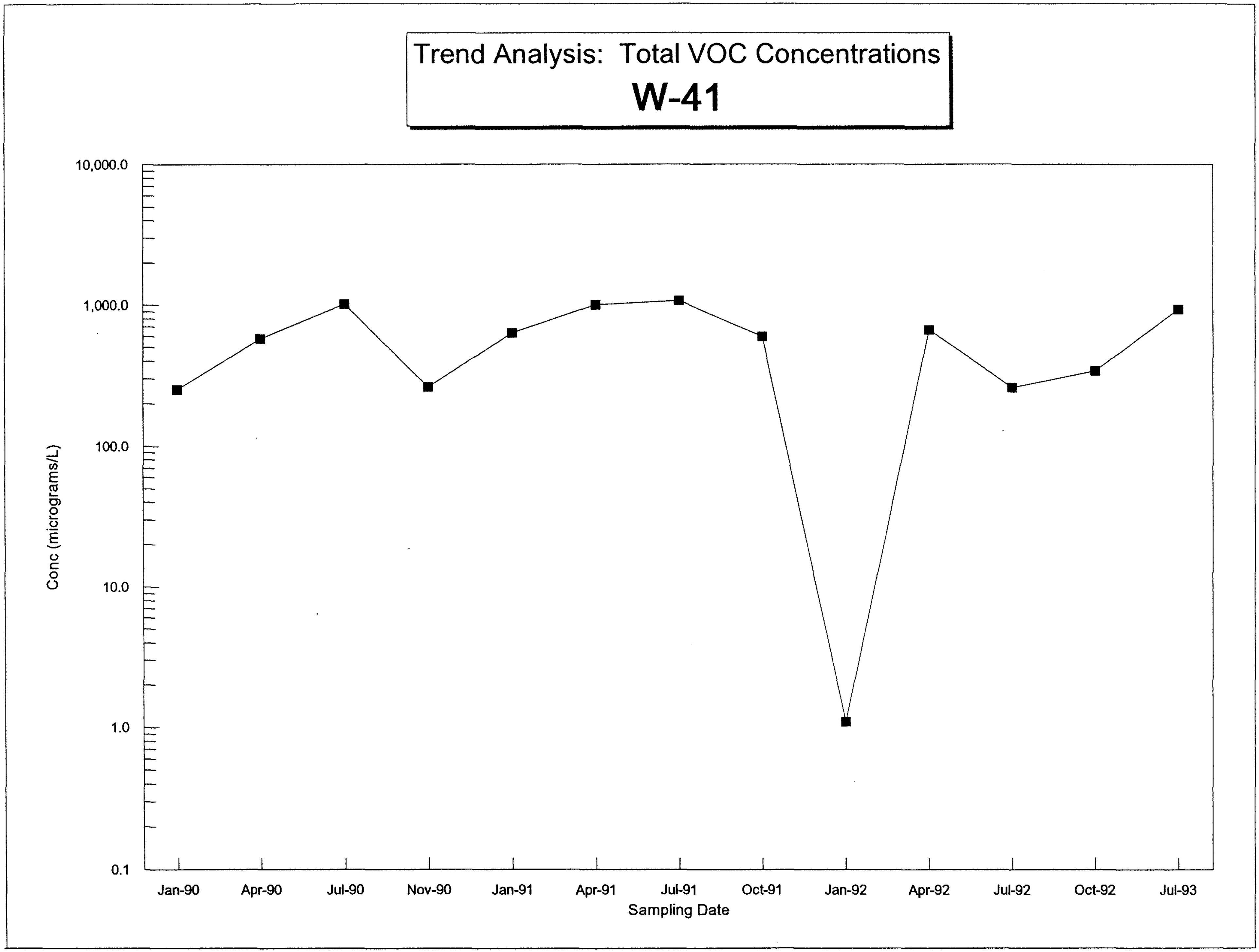
Trend Analysis: Total VOC Concentrations
W-06A
1,000,000
100,000
10,000
1,000
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date

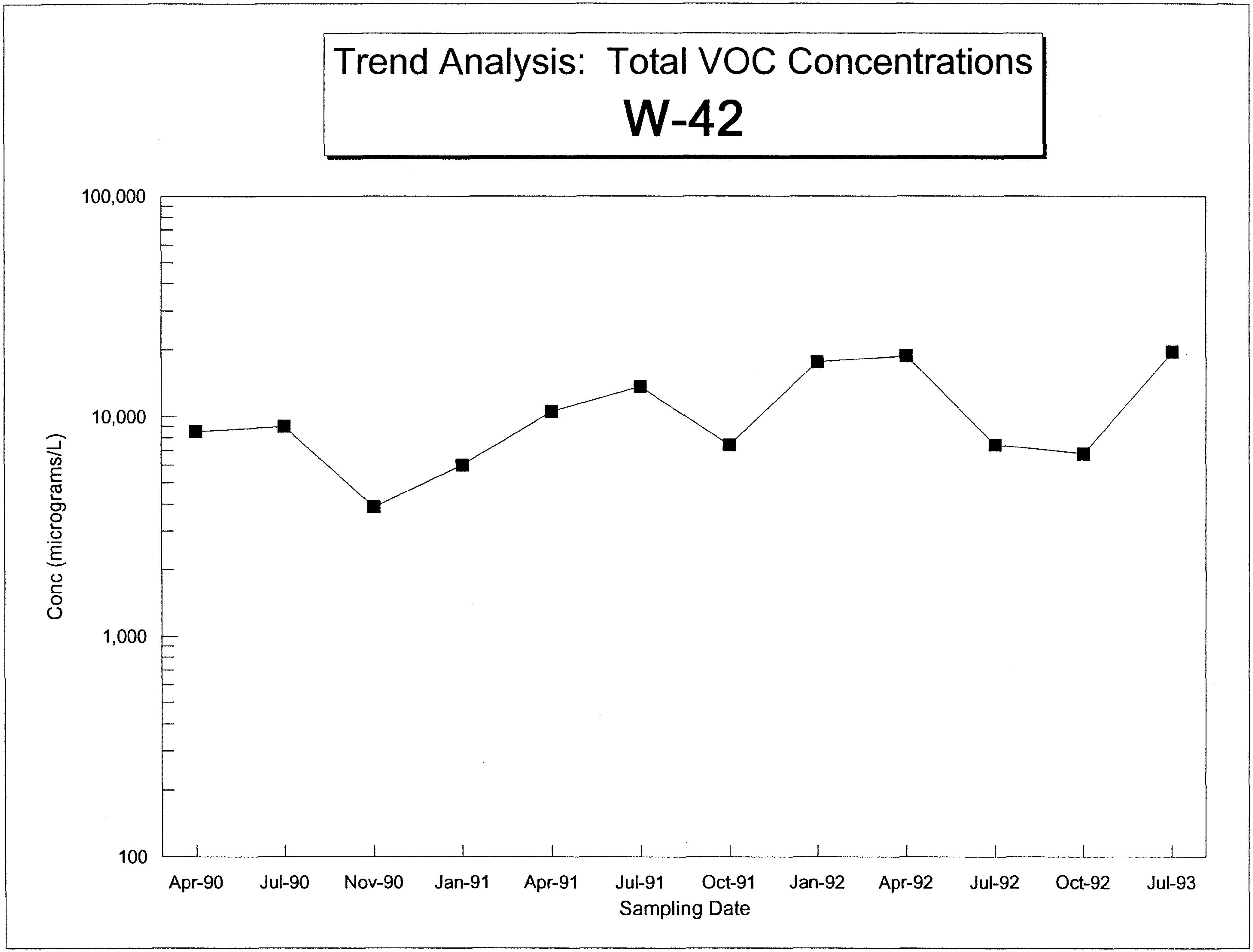


Trend Analysis: Total VOC Concentrations
W-19A
1,000.00
100.00
10.00
1.00
0.10
Conc (micrograms/L)
Nov-90
Oct-91
Oct-92
Jul-93
Sampling Date

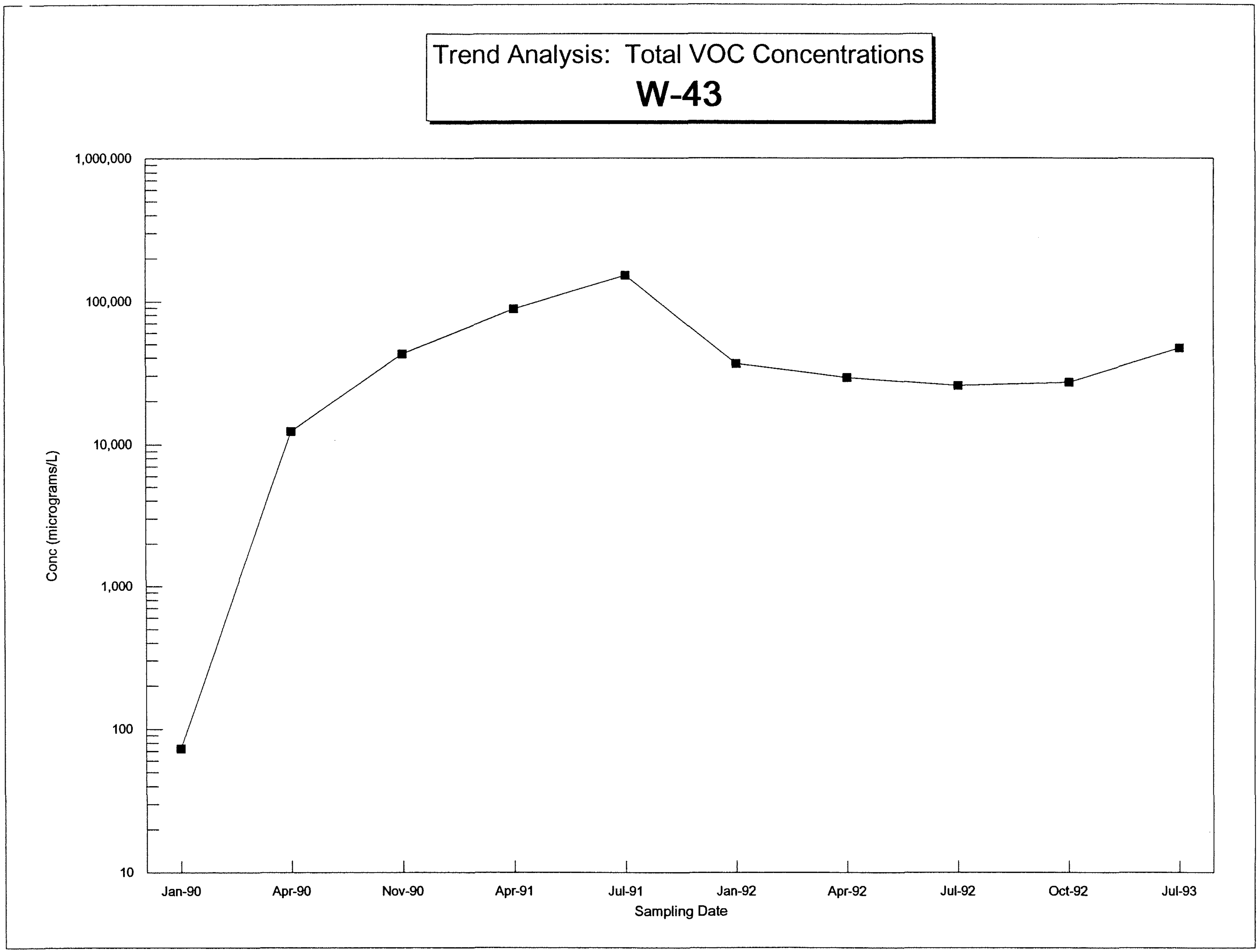


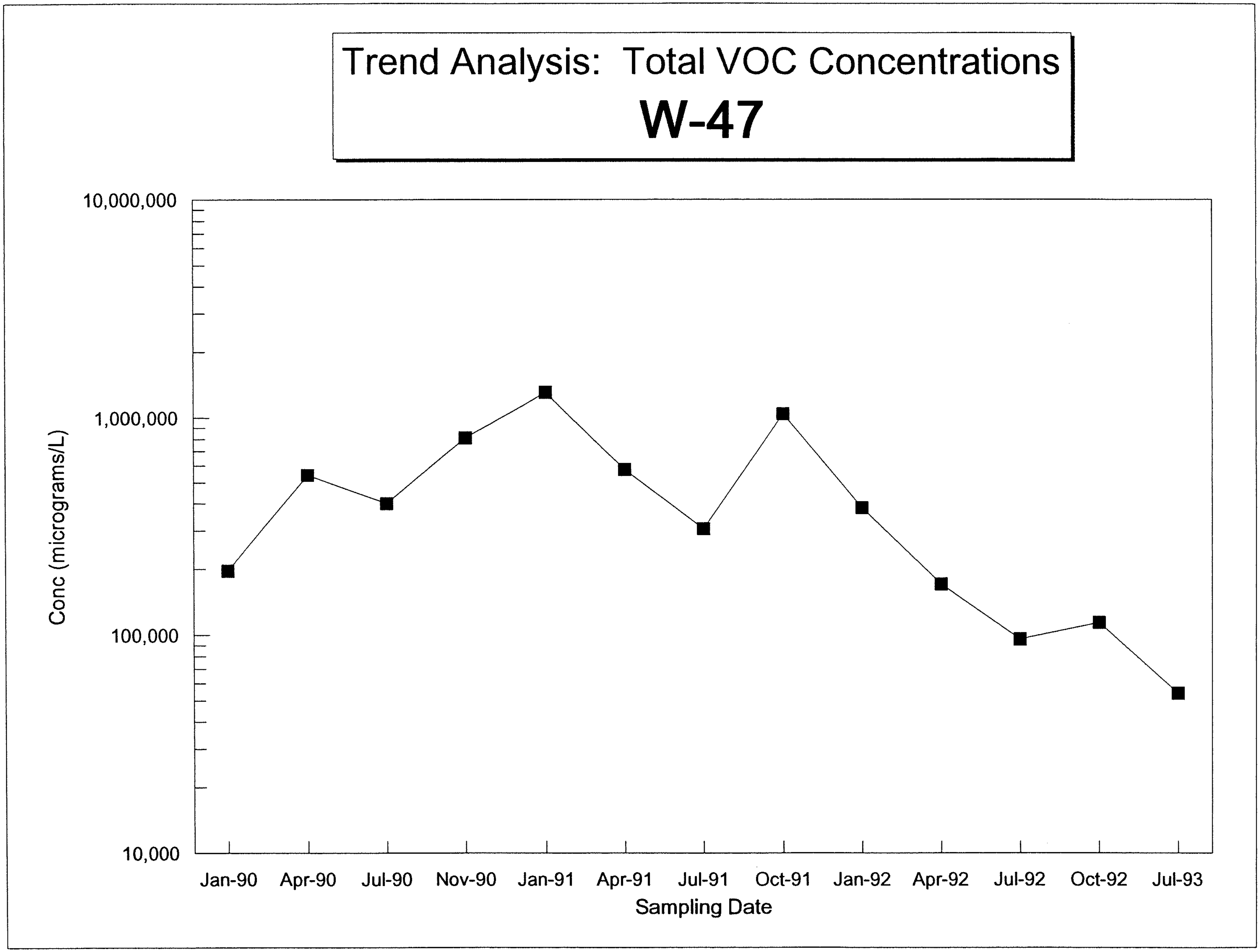
Trend Analysis: Total VOC Concentrations
W-37
1,000,000
100,000
10,000
1,000
100
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date

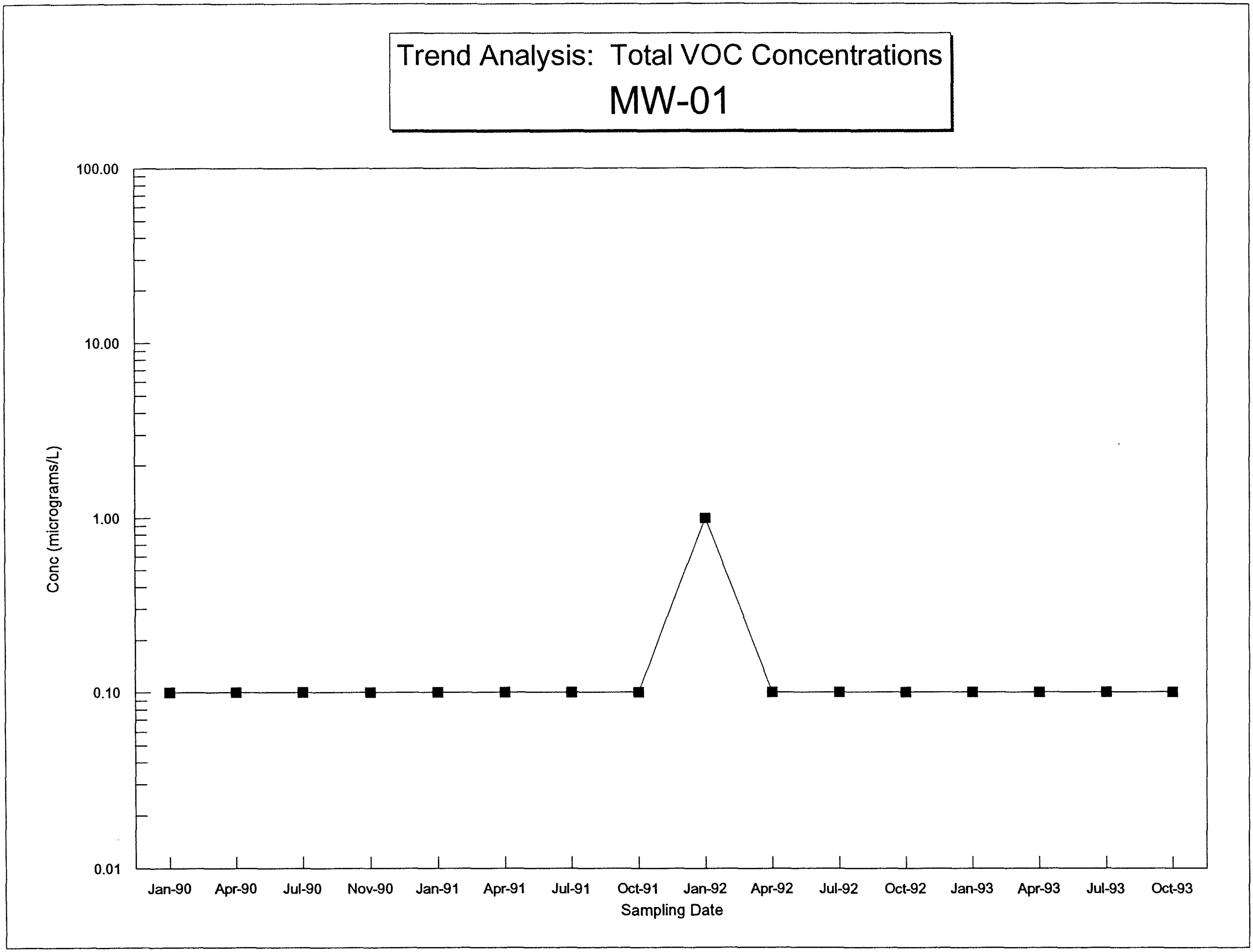

Trend Analysis: Total VOC Concentrations
W-41
10,000.0
1,000.0
100.0
10.0
1.0
0.1
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date

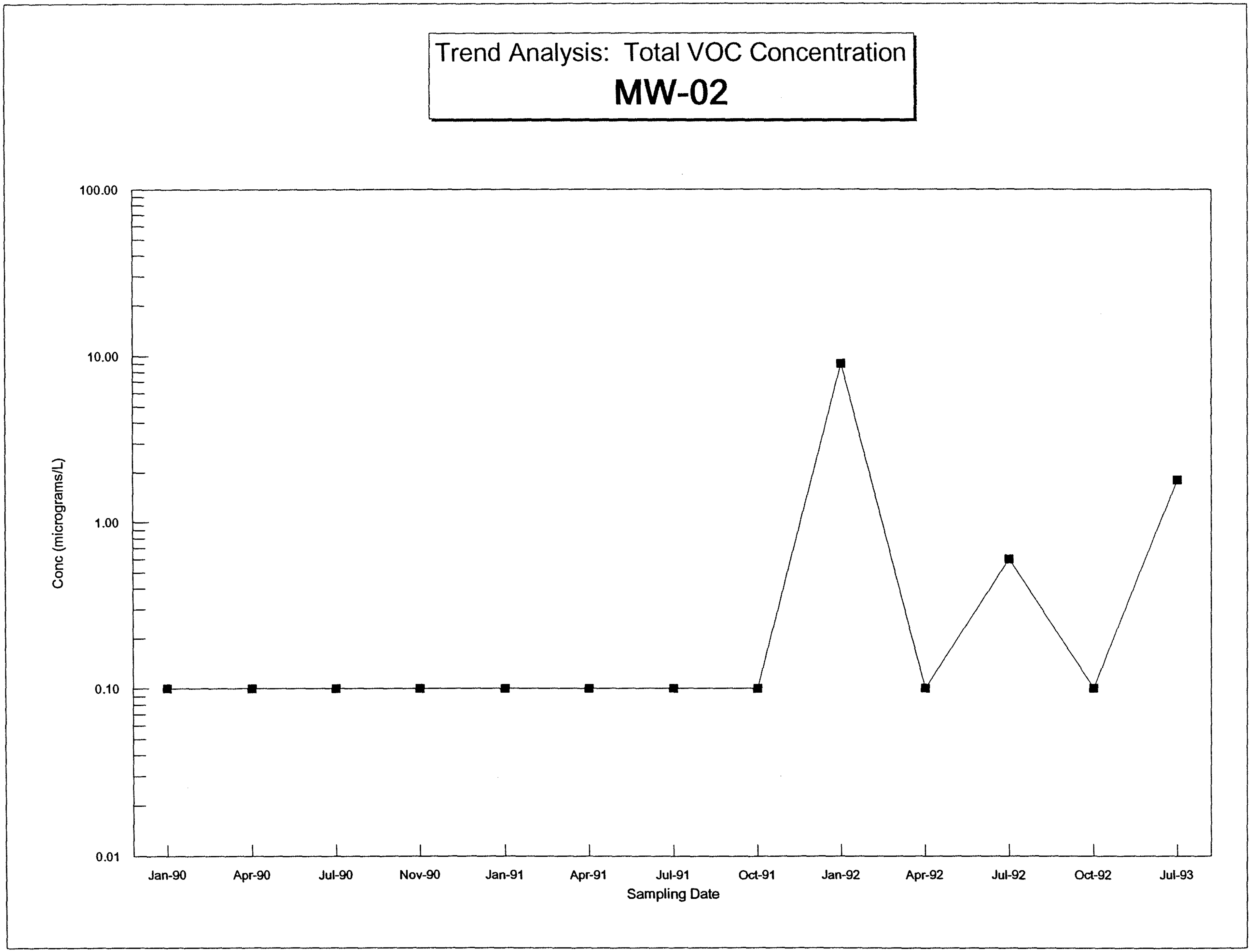


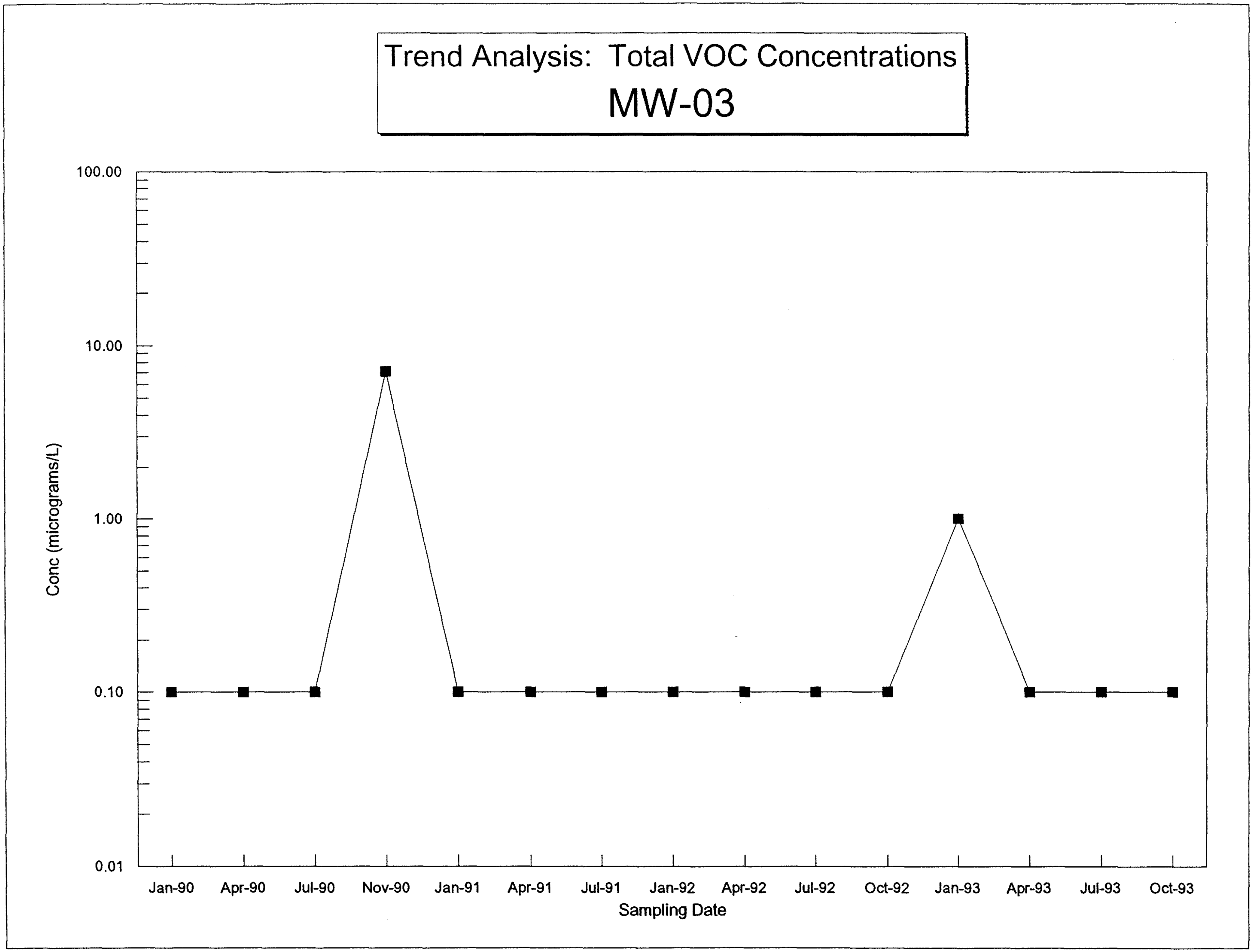
Trend Analysis: Total VOC Concentrations
W-42
100,000
10,000
1,000
100
Conc (micrograms/L)
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date

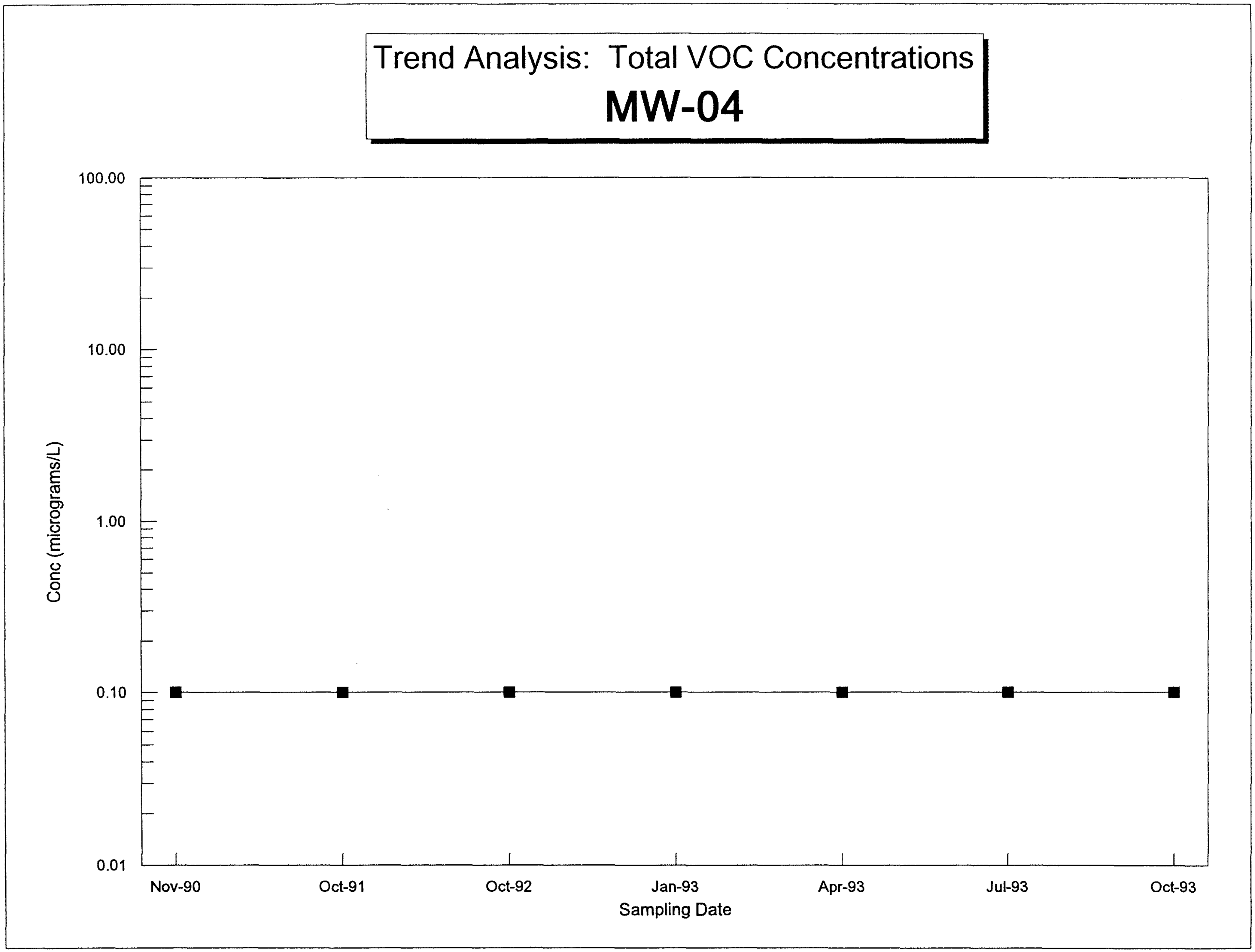

Trend Analysis: Total VOC Concentrations
W-43
1,000,000
100,000
10,000
1,000
100
10
Conc (micrograms/L)
Jan-90
Apr-90
Nov-90
Apr-91
Jul-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date

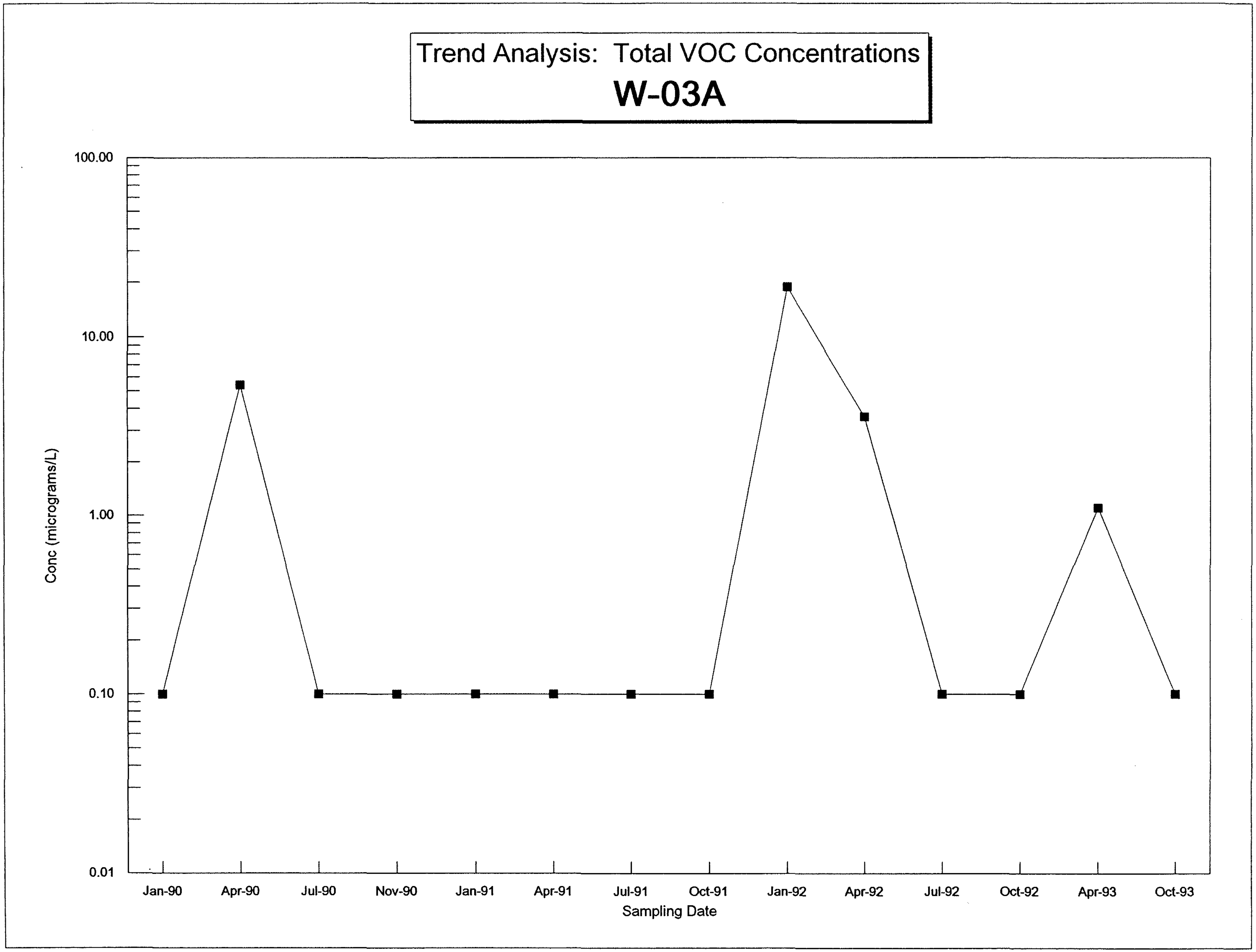

Trend Analysis: Total VOC Concentrations
W-47
10,000,000
1,000,000
100,000
10,000
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date


Trend Analysis: Total VOC Concentrations
MW-01
100.00
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jan-93
Apr-93
Jul-93
Oct-93
Sampling Date

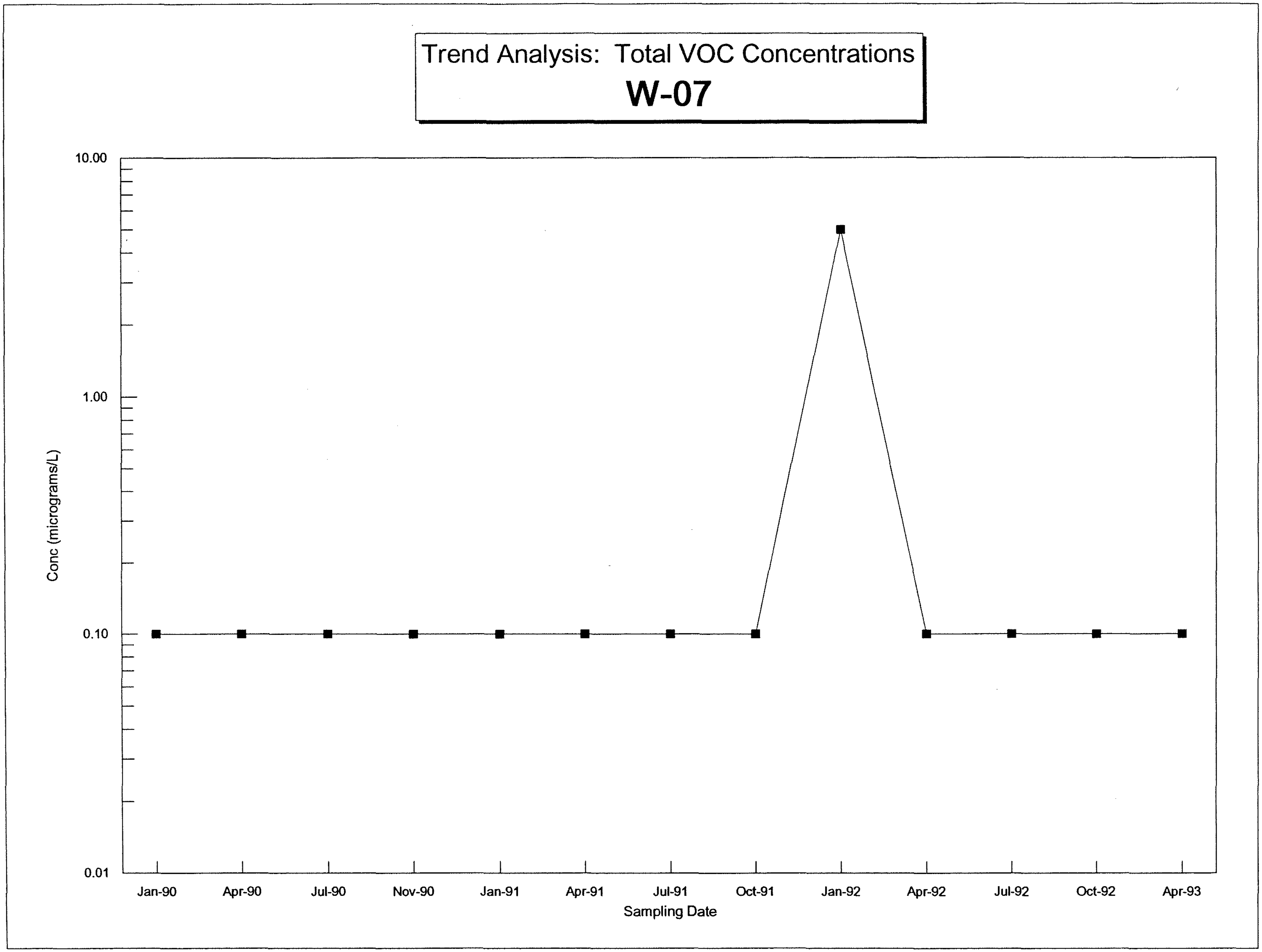

Trend Analysis: Total VOC Concentration
MW-02
100.00
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date

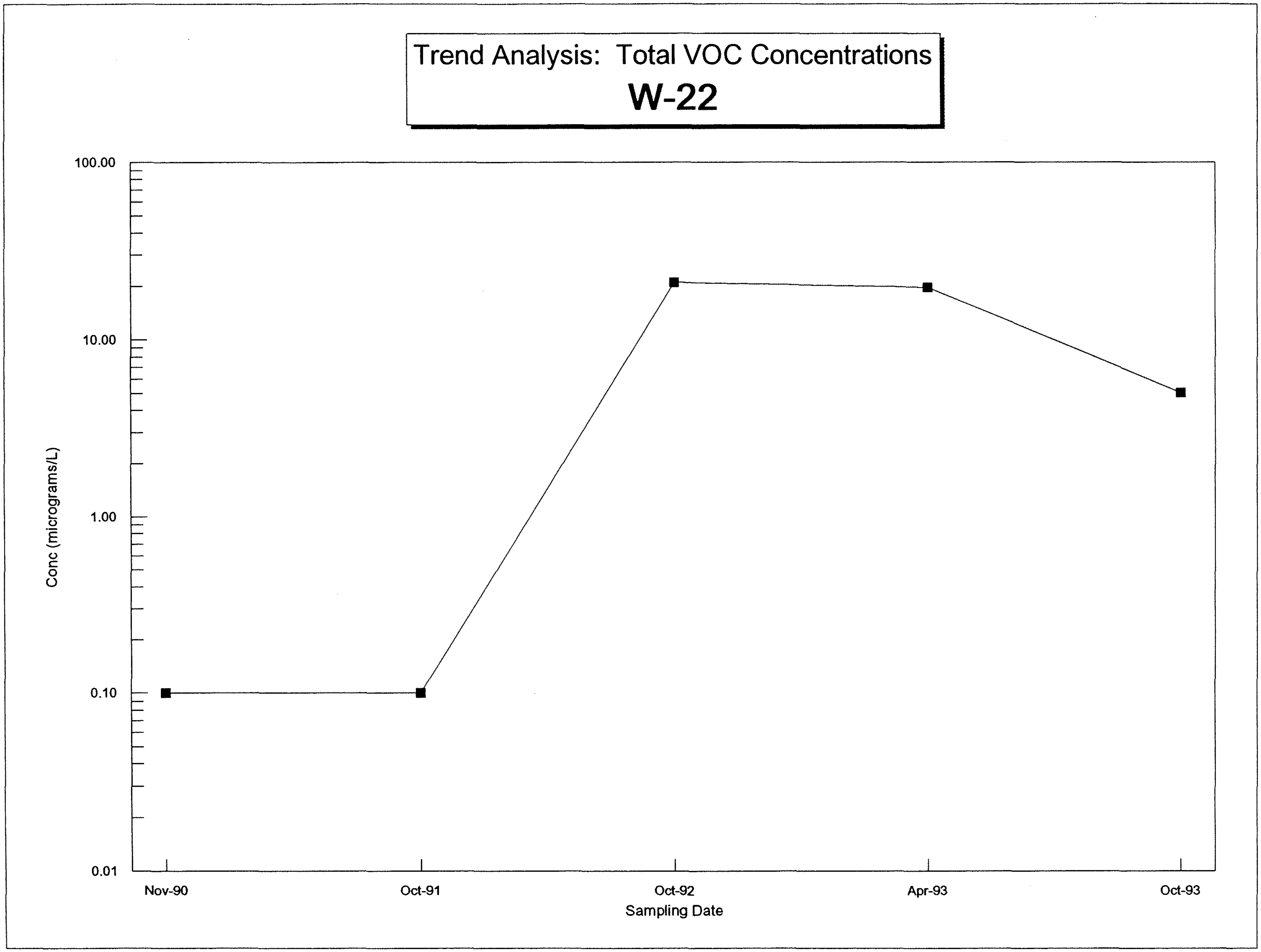

Trend Analysis: Total VOC Concentrations
MW-03
100.00
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Jan-92
Apr-92
Jul-92
Oct-92
Jan-93
Apr-93
Jul-93
Oct-93
Sampling Date

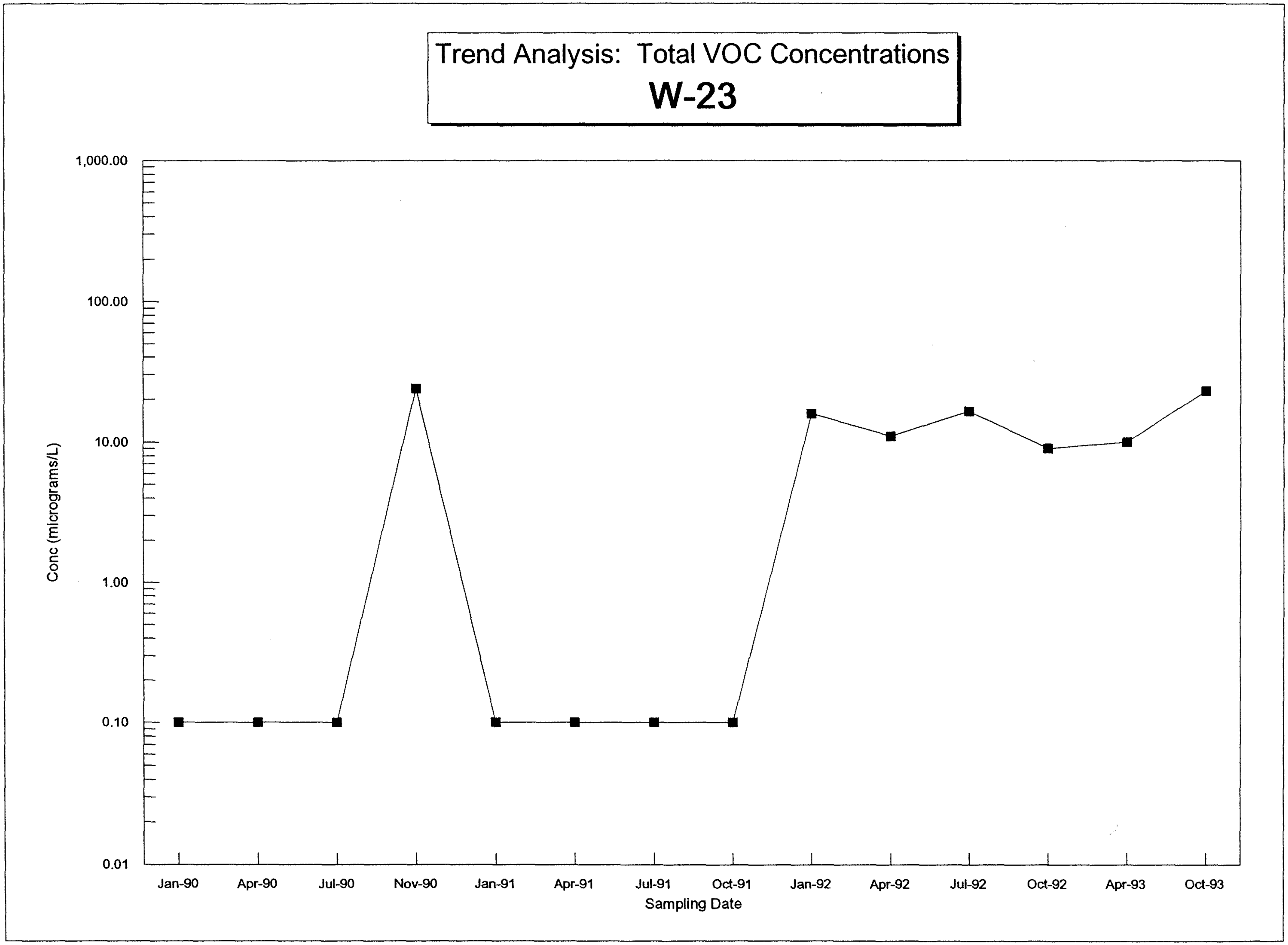

Trend Analysis: Total VOC Concentrations
MW-04
Conc (micrograms/L)
100.00
10.00
1.00
0.10
0.01
Nov-90
Oct-91
Oct-92
Jan-93
Apr-93
Jul-93
Oct-93
Sampling Date



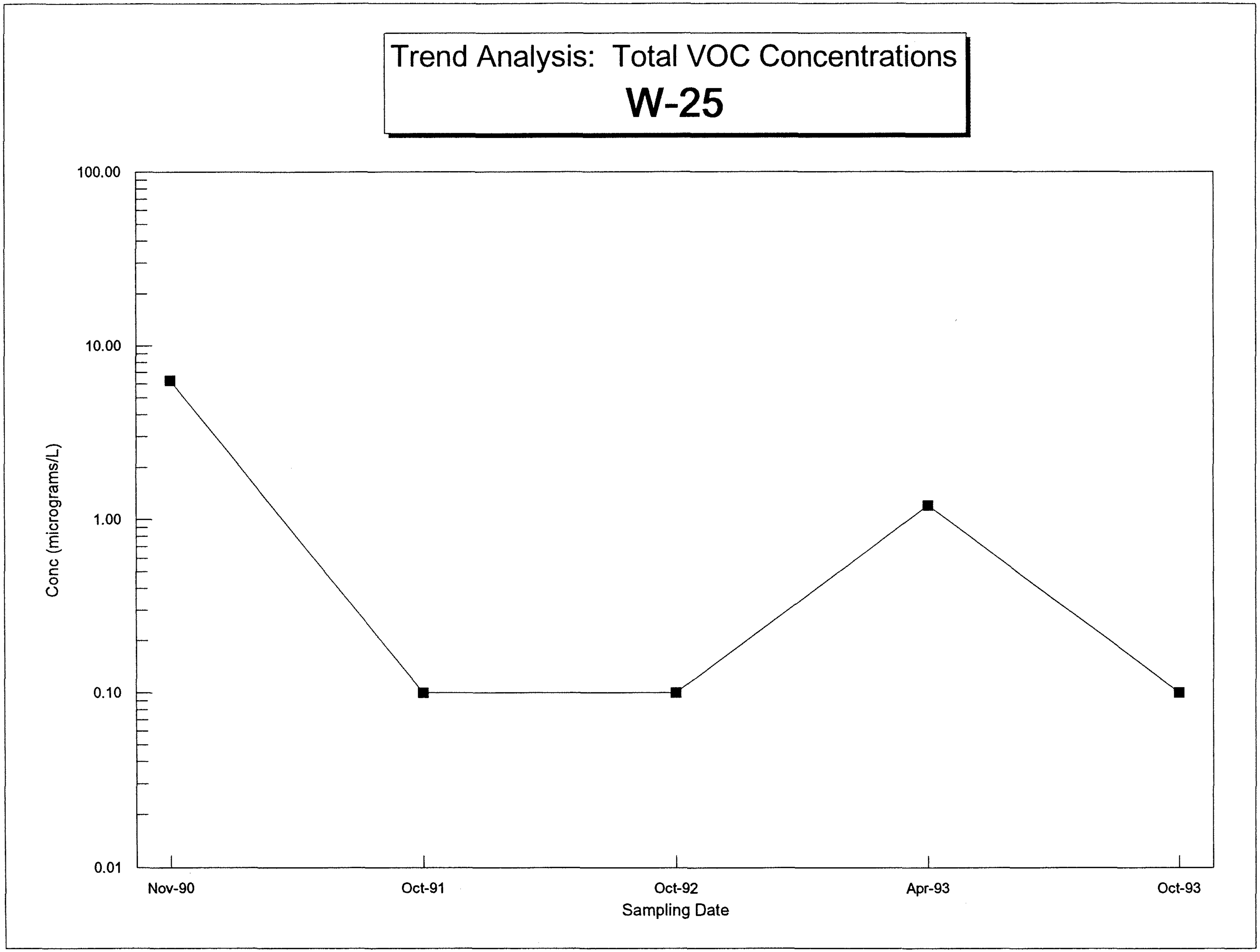
Trend Analysis: Total VOC Concentrations
W-03A
100.00
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Apr-93
Oct-93
Sampling Date


Trend Analysis: Total VOC Concentrations
W-07
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Apr-93
Sampling Date

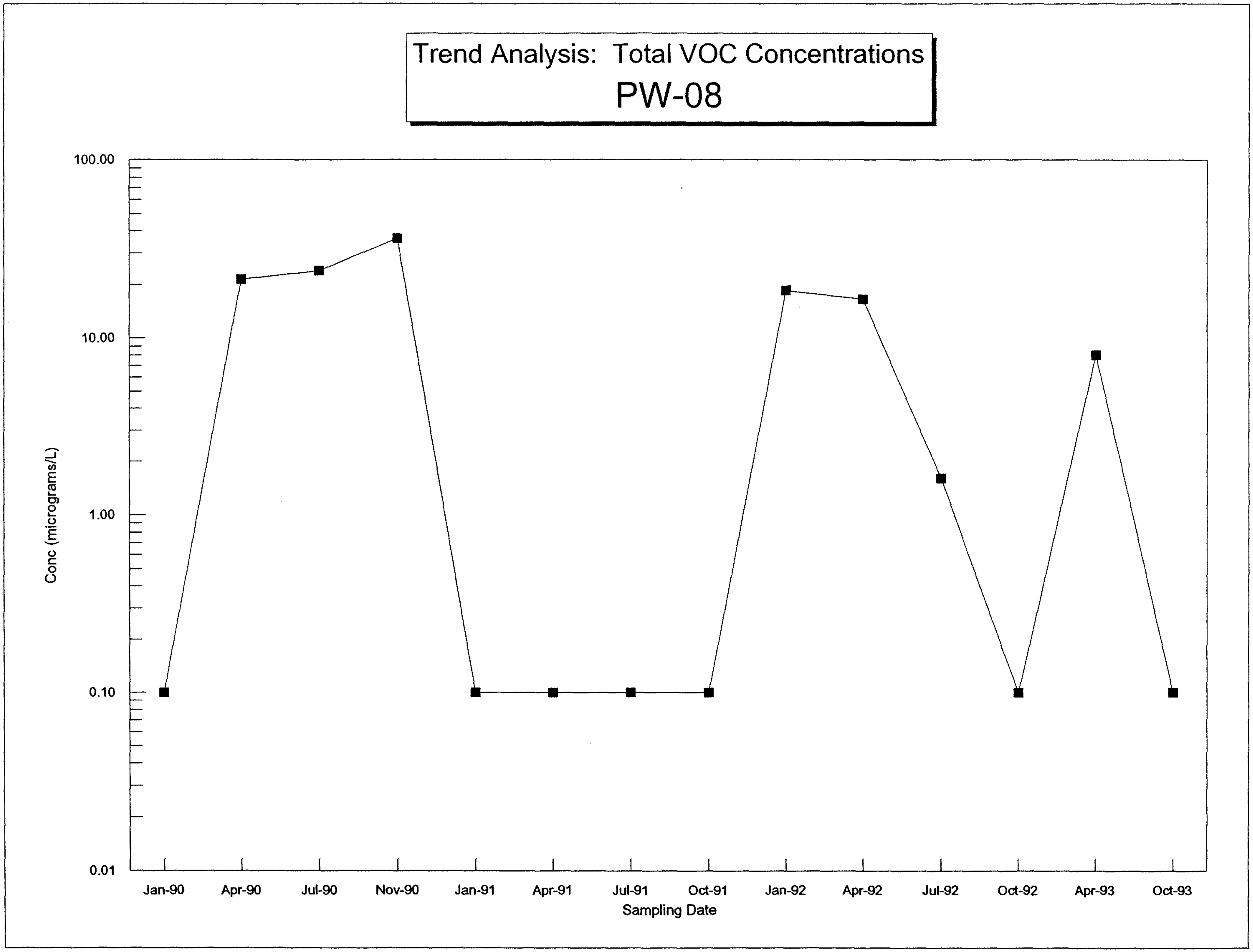

Trend Analysis: Total VOC Concentrations
W-22
100.00
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Nov-90
Oct-91
Oct-92
Apr-93
Oct-93
Sampling Date

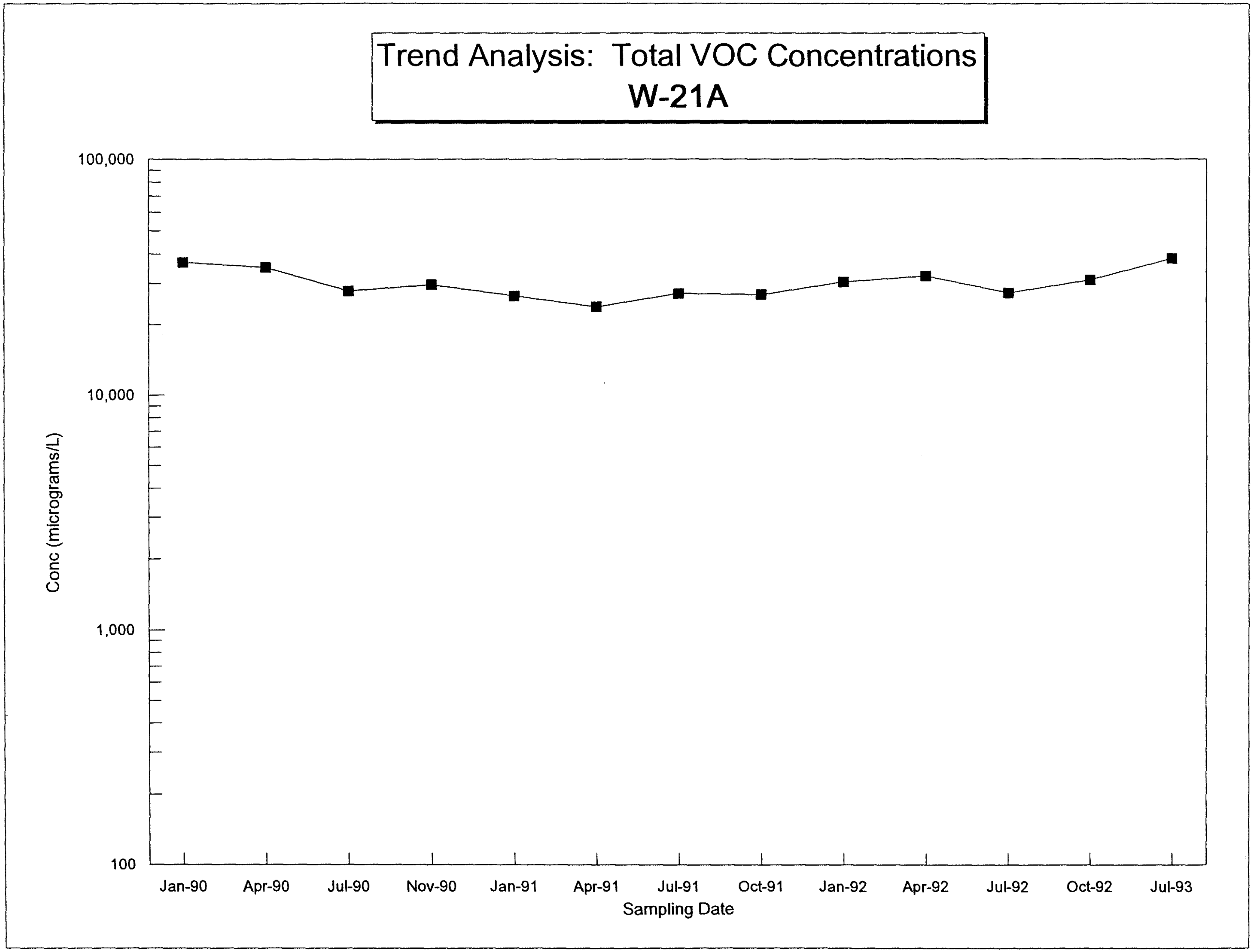


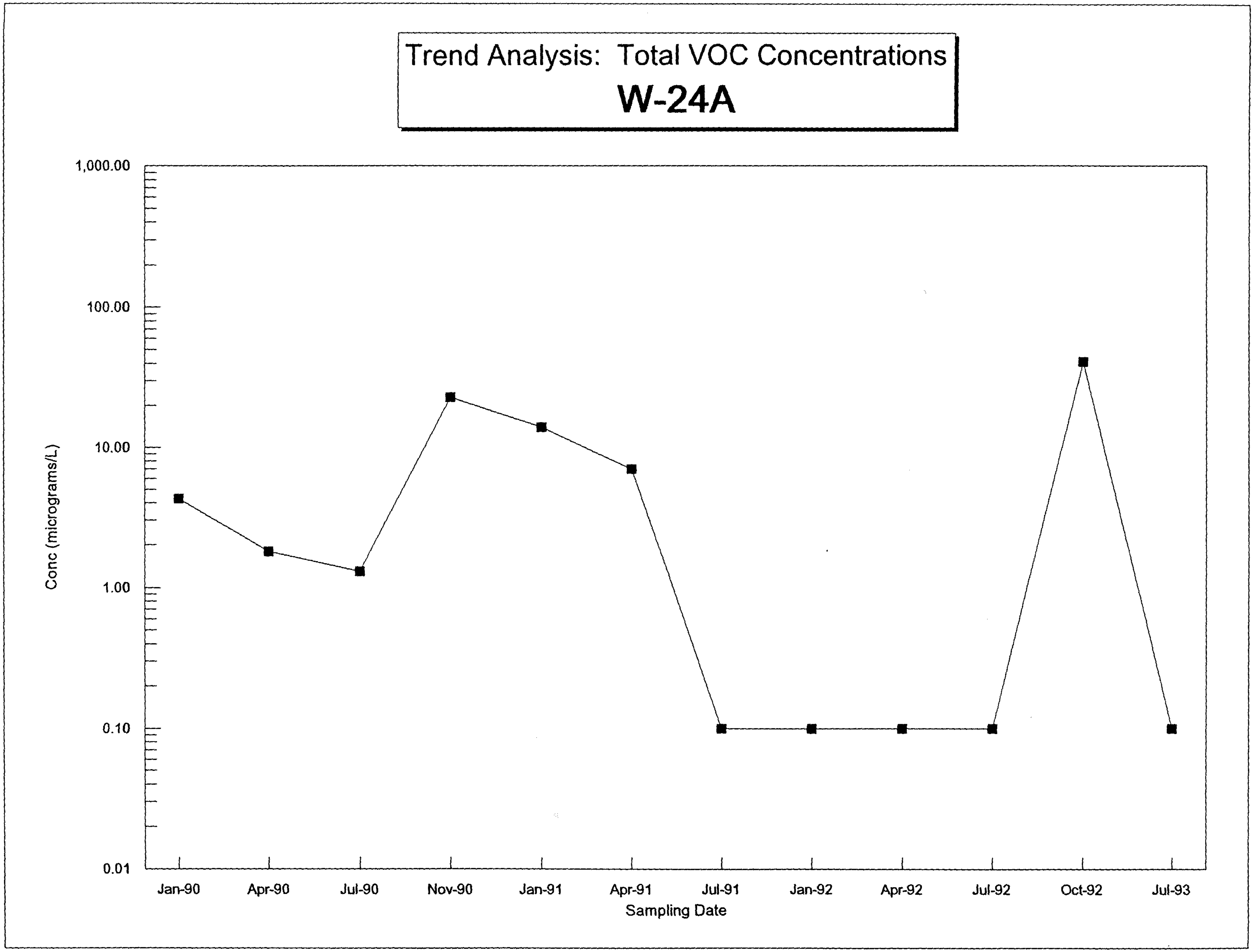
Trend Analysis: Total VOC Concentrations
W-23
1,000.00
100.00
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Apr-93
Oct-93
Sampling Date

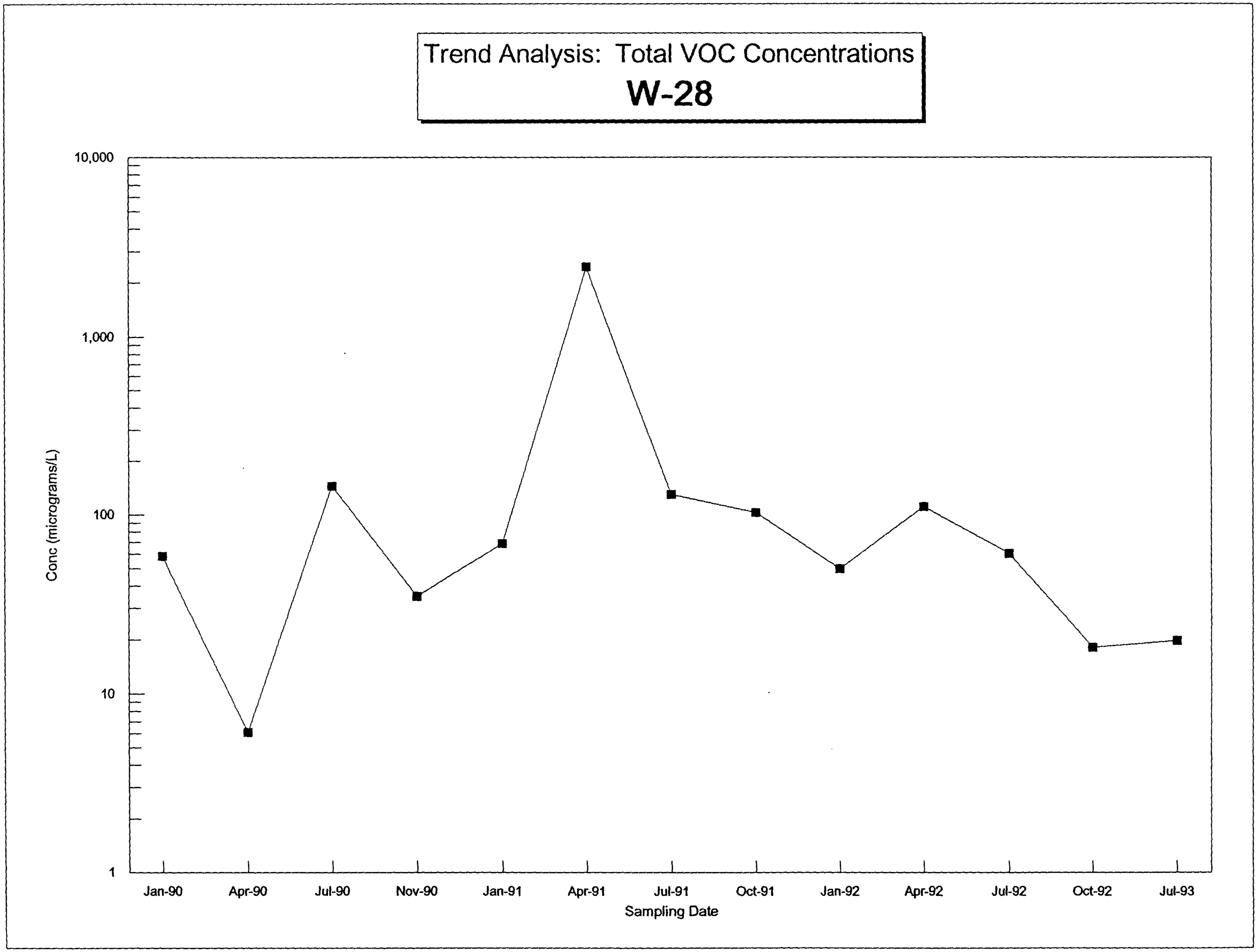


Trend Analysis: Total VOC Concentrations
W-25
100.00
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Nov-90
Oct-91
Oct-92
Apr-93
Oct-93
Sampling Date

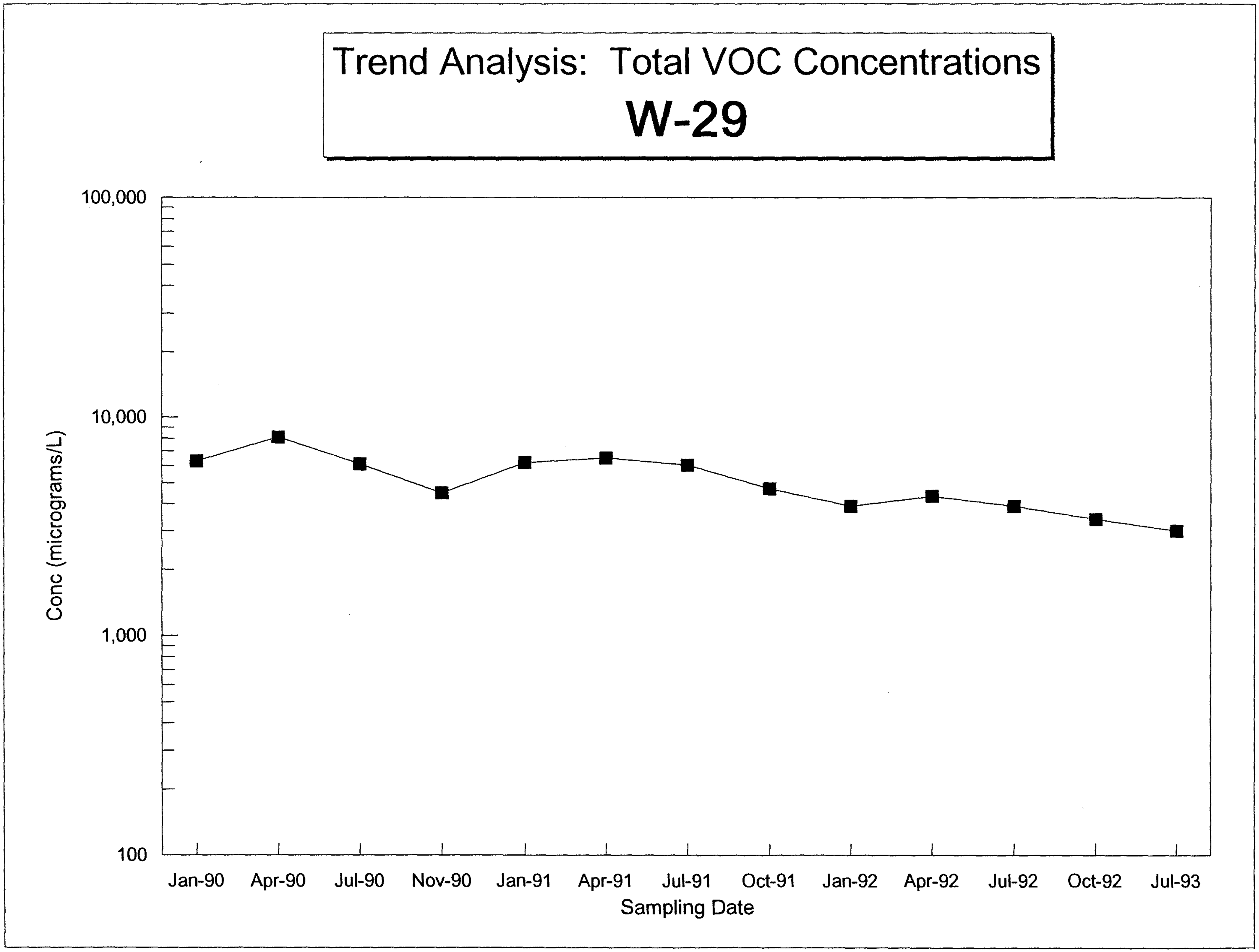

Trend Analysis: Total VOC Concentrations
PW-08
Conc (micrograms/L)
100.00
10.00
1.00
0.10
0.01
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Apr-93
Oct-93
Sampling Date


Trend Analysis: Total VOC Concentrations
W-21A
100,000
10,000
1,000
100
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date

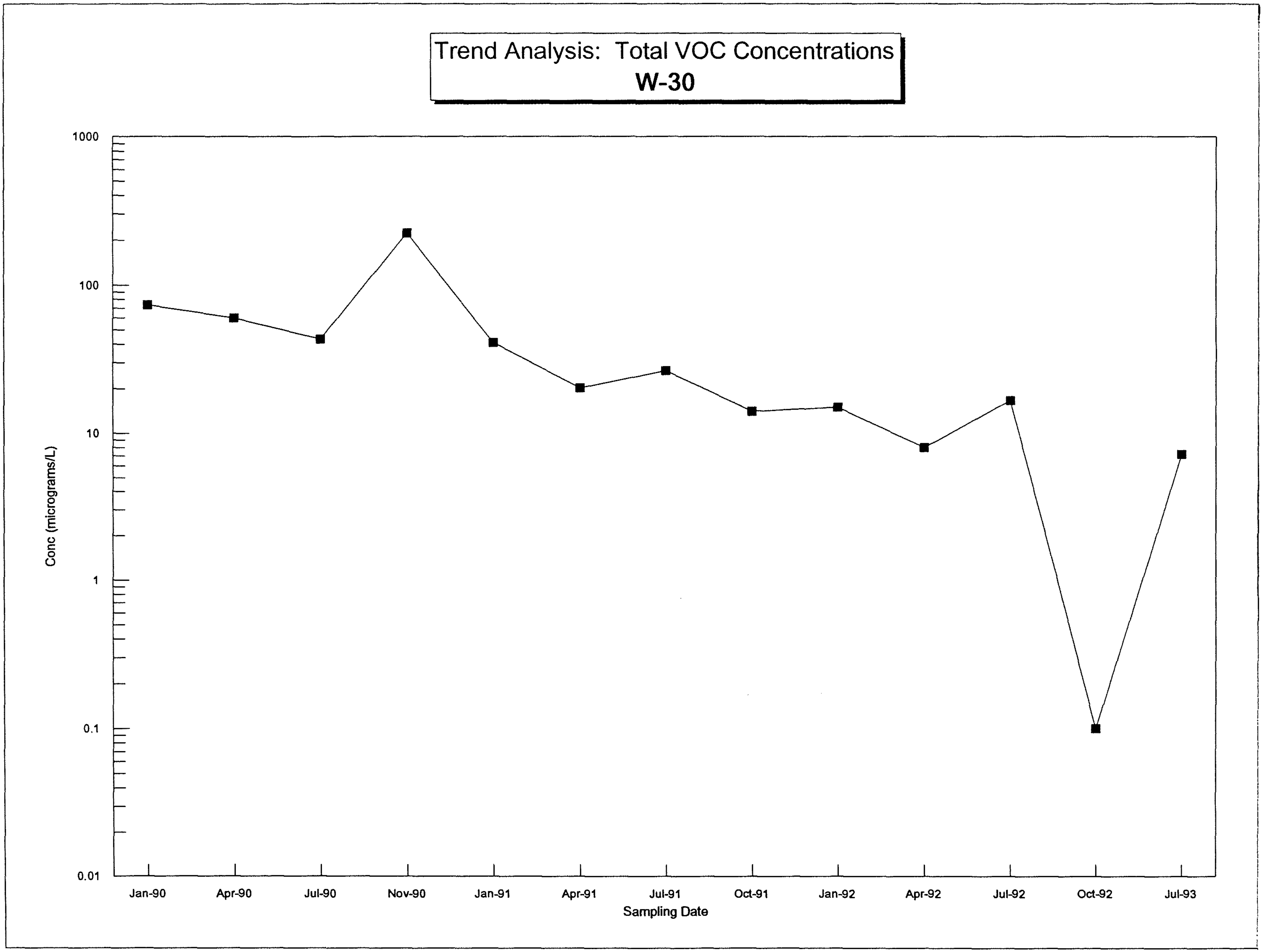

Trend Analysis: Total VOC Concentrations
W-24A
1,000.00
100.00
10.00
1.00
0.10
0.01
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date

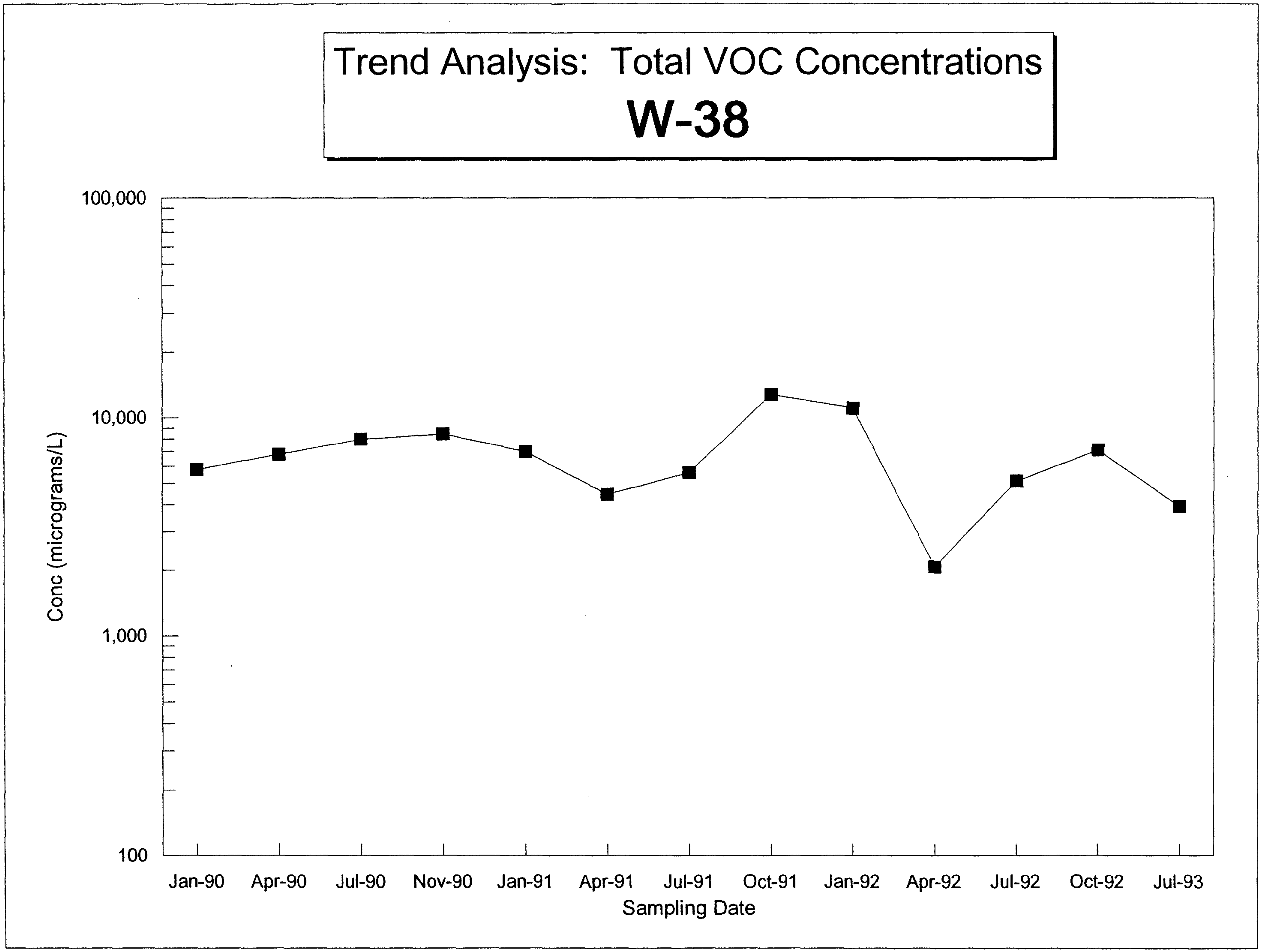


Trend Analysis: Total VOC Concentrations
W-28
10,000
1,000
100
10
1
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date



Trend Analysis: Total VOC Concentrations
W-29
100,000
10,000
1,000
100
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date


Trend Analysis: Total VOC Concentrations
W-30
1000
100
10
1
0.1
0.01
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date


Trend Analysis: Total VOC Concentrations
W-38
100,000
10,000
1,000
100
Conc (micrograms/L)
Jan-90
Apr-90
Jul-90
Nov-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jul-93
Sampling Date