GW - 40

REPORTS

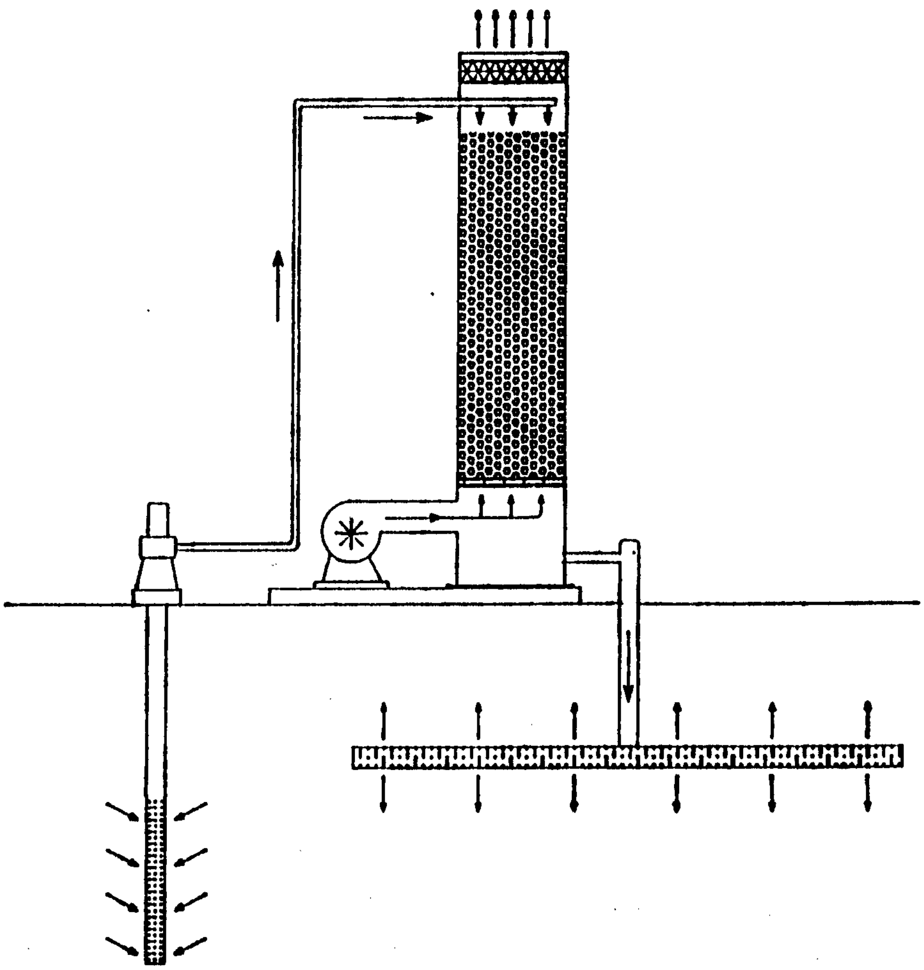
YEAR(S):

1992

GIANT

REFINING CO.

BLOOMFIELD REFINERY REMEDIATION PROJECT



Post Office Box 256
606 E. Highway 64
Farmington, New Mexico 87401

(505) 632-3306
FAX (505) 632-2487

RECEIVED

MAR 16 1992

OIL CONSERVATION DIV.
SANTA FE

Effectiveness of Off-Site Recovery and Monitoring System

March 12, 1992

Prepared for:

Giant Industries Arizona, Inc.
P.O. Box 256
Farmington, New Mexico 87499

Prepared by:

H^+GCL

ALBUQUERQUE OFFICE
505 Marquette Avenue, NW
Suite 1100
Albuquerque, New Mexico 87102
(505) 842-0001
FAX (505) 842-0595

Effectiveness of Off-Site Recovery and Monitoring System

SUBMITTED BY:

H⁺GCL Author

H⁺GCL QA Officer

H⁺GCL Technical Editor

DATE:

3/12/92

3/12/92

3/12/92

Table of Contents

List of Figures

Figure

List of Tables

Table

1.0 Executive Summary

Giant Industries Arizona, Inc. (Giant) has been conducting remedial activities south of their Bloomfield, New Mexico refinery since 1989. Since that time, twelve ground-water monitor wells and four ground-water recovery wells have been installed in the Lee Acres area, south of the refinery. Monitor and recovery well locations are shown on figure 1. Giant initiated ground-water recovery operations in April of 1991.

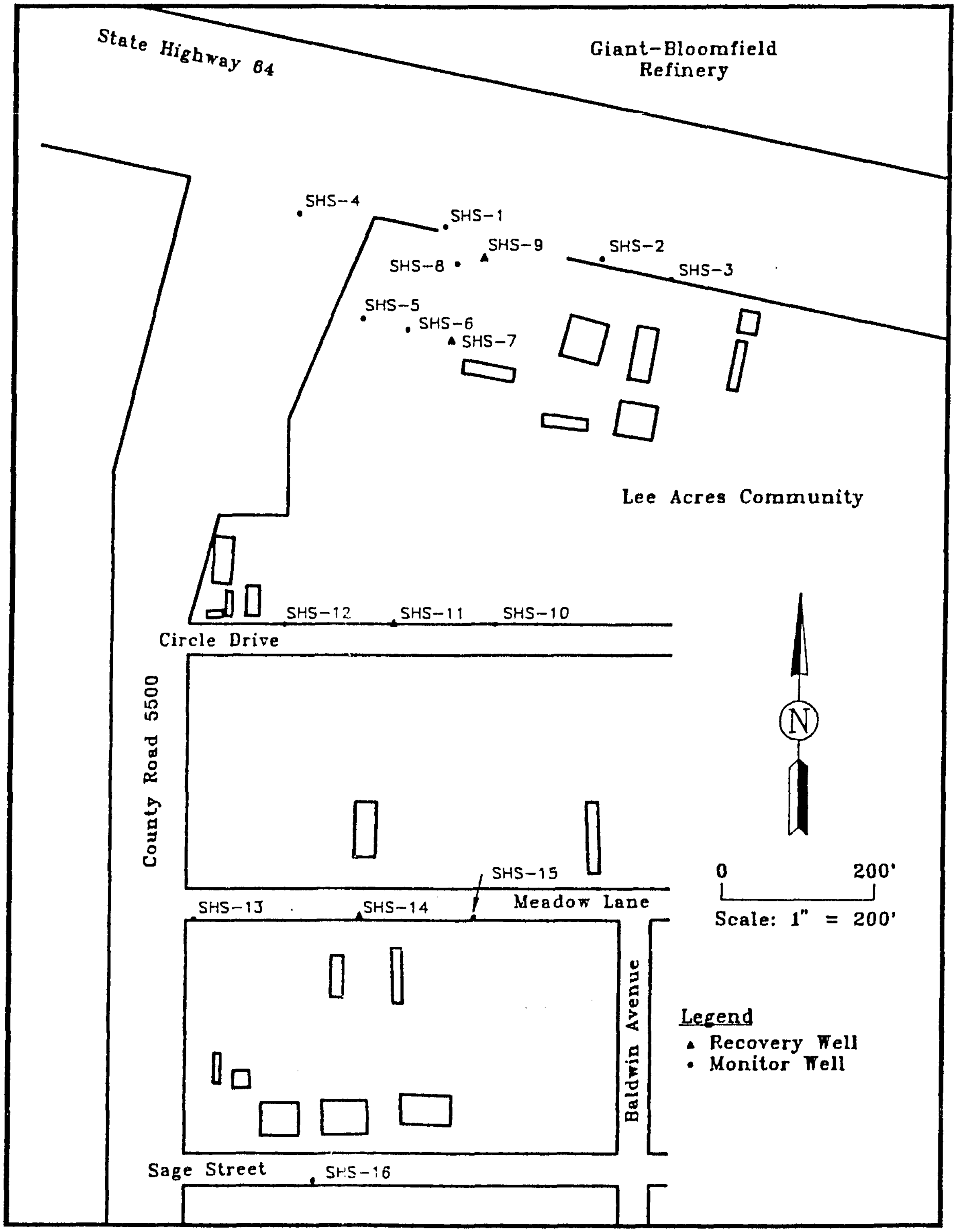
Giant performs monthly depth-to-water measurements, quarterly and semi-annual ground-water sampling, and produced ground-water volume tabulations. Additionally, Giant submits quarterly reports to the New Mexico Oil Conservation Division (NMOCD), the lead regulatory agency for the site.

Separate-phase hydrocarbons have been eliminated from recovery wells since initiation of pumping. Also, there has been a reduction in the concentration of dissolved-phase benzene, toluene, ethylbenzene, and xylene (BTEX) constituents to non-detectable concentrations at all monitor wells except one, which shows a drastic decrease in concentration with time.

H^+GCL recommends continuing with current remedial and monitoring activities. Additionally, the now out-of-service recovery well, SHS-11, should be replaced.

Figure 1

Monitor And Recovery Well Location Map



2.0 Introduction

Giant has been conducting a subsurface investigation/ground-water remediation program south of its Bloomfield refinery since February, 1989. The following is a brief scenario of events describing Giant's involvement.

- July 7, 1989: Giant submits a proposal for a hydrogeologic investigation south of Highway 64.
- October 20, 1989: Giant submits "First Report of Off-Site Investigation" to the NMOCD. This report presents the results of a limited soil-vapor survey and ground-water sample analyses from two new ground-water monitor wells and seven existing monitor wells (GCL, 1989).
- February 23, 1990: Giant submits "Second Report of Off-Site Investigation" to the NMOCD. This report presents the results of ground-water sample analyses from five existing ground-water monitor wells and four new monitor wells (GCL, 1990a).
- November 1, 1990: Giant submits "Third Report of Off-Site Investigation" to the NMOCD. This report presents the results of an exploratory boring program, ground-water monitor well installation program, ground-water sample analyses, and an aquifer analysis study and remedial strategy plan (GCL, 1990b).
- December 6, 1990: NMOCD approves Giant's proposed remedial strategy plan.
- March 1991: Giant initiates ground-water recovery operations.

To date, Giant has installed 16 wells, SHS-1 through SHS-16, south of NM 64 (figure 1) as part of the off-site investigation. Four of the sixteen wells were proposed as recovery wells, SHS-7, SHS-9, SHS-11, and SHS-14. SHS-7 has not been used as a recovery well because of property access issues (Giant, 1991a). SHS-9, SHS-11, and SHS-14 pump dissolved and/or separate phase hydrocarbons from south of the highway north to the refinery for treatment.

Giant agreed to submit a report evaluating the effectiveness of the off-site ground-water recovery and monitoring system to the NMOCD. The scope and purpose of this report is to review the existing data and evaluate the effectiveness of the off-site recovery and monitoring system.

3.0 Review of Existing Data

Throughout 1991, Giant has collected physical and chemical data about the ground-water and separate-phase hydrocarbon recovery operations south of Highway 64. These data include the following:

- Physical data such as monthly depth to ground-water/separate-phase hydrocarbon measurements in all SHS monitor wells and tabulation of the volume of ground-water produced monthly from each of the recovery wells, SHS-7, SHS-9, SHS-11, and SHS-14.

- Analytical data on ground-water samples collected quarterly from monitor wells SHS-3, SHS-6, SHS-10, SHS-12, SHS-13, SHS-15, and SHS-16. Analytical data from ground-water samples collected semi-annually from recovery wells SHS-7, SHS-9, SHS-11, and SHS-14, if no separate-phase hydrocarbons are present.

3.1 Physical Data

Monthly, Giant collects depth to ground-water/separate-phase hydrocarbon measurements at all SHS monitor wells. This data is presented in quarterly reports as depth to ground-water/separate-phase hydrocarbon measurements, adjusted water surface elevations (adjusted for floating hydrocarbons using a hydrocarbon density of 0.80), and separate-phase hydrocarbon thickness. Additionally, a potentiometric surface map is presented for each month in the quarterly reports (Giant, 1991a,b,c,d,).

Table 1 summarizes the potentiometric surface elevation and separate-phase thickness data. Figure 2 provides hydrographs of water surface elevations versus time for all SHS monitor and recovery wells. Figures 3, 4, 5, 6, and 7 are plots of product thickness versus time for wells SHS-1, SHS-2, SHS-7, SHS-8, and SHS-11, respectively. Table 2 summarizes the volume of ground water pumped during 1991 by off-site recovery wells. It should be noted that recovery well SHS-11 has not been operational since December 1991 when the well silted in.

Table 1

Potentiometric Surface Elevation/Separate-Phase Hydrocarbon Thickness Data

	SHS-1		SHS-2		SHS-3		SHS-4		SHS-5		SHS-6	
Date	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)
Feb-90	5343.12	0.00	5344.71	0.00	5347.13	ND	5343.02	ND	5340.58	ND	5340.49	ND
Sep-90	5342.32	0.11	5344.48	0.45	5347.47	ND	5342.27	ND	5339.92	ND	5339.62	ND
Jan-91	5342.14	0.13	5344.00	0.68	5346.52	ND	5342.12	ND	5339.89	ND	5339.29	ND
Feb-91	5342.08	0.13	5343.99	0.67	5346.45	ND	5342.10	ND	5339.87	ND	5339.32	ND
Mar-91	5342.03	0.02	5343.96	0.66	5346.41	ND	5342.04	ND	5339.85	ND	5339.28	ND
Apr-91	5341.94	0.15	5343.94	0.65	5346.23	ND	5341.97	ND	5339.81	ND	5339.43	ND
May-91	5342.32	0.08	5344.09	0.58	5346.55	ND	5342.34	ND	5340.09	ND	5339.74	ND
Jun-91	5342.42	0.08	5344.30	0.19	5346.93	ND	5342.44	ND	5340.13	ND	5339.61	ND
Jul-91	5342.64	0.02	5344.51	0.00	5347.25	ND	5342.64	ND	5340.26	ND	5339.93	ND
Aug-91	5342.69	0.02	5344.86	0.00	5347.73	ND	5342.68	ND	5340.23	ND	5339.90	ND
Sep-91	5342.72	0.02	5344.92	0.00	5347.83	ND	5342.69	ND	5340.17	ND	5339.89	ND
Oct-91	5342.58	0.08	5344.86	0.00	5347.53	ND	5342.61	ND	5340.07	ND	5342.77	ND
Nov-91	5342.50	0.12	5344.78	0.00	5347.51	ND	5342.49	ND	5339.98	ND	5339.68	ND
Dec-91	5342.55	0.10	5344.72	0.00	5347.31	ND	5342.52	ND	5340.05	ND	5339.74	ND

Table 1 (cont'd)

Potentiometric Surface Elevation/Separate-Phase Hydrocarbon Thickness Data

Date	SHS-7		SHS-8		SHS-9		SHS-10		SHS-11		SHS-12	
	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)
Feb-90	5340.45	0.00	5342.23	0.00	NM	NM	NM	NM	NM	NM	NM	NM
Sep-90	5339.82	0.00	5341.44	0.03	5342.69	0.00	5336.68	ND	5334.91	1.31	5333.91	ND
Jan-91	5339.71	0.55	5341.32	0.02	5342.40	0.01	5337.18	ND	5335.24	0.41	5334.08	ND
Feb-91	5339.69	0.73	5341.28	0.01	5342.44	0.01	5337.22	ND	5335.21	0.41	5334.52	ND
Mar-91	5339.68	0.86	5341.26	0.00	5342.42	0.01	5337.32	ND	5335.20	0.41	5334.61	ND
Apr-91	5339.65	0.98	5341.18	0.00	5336.14	0.00	5337.40	ND	5324.97	0.00	5334.82	ND
May-91	5339.91	0.80	5341.50	0.01	5335.60	0.01	5337.45	ND	5326.49	0.00	5334.55	ND
Jun-91	5339.94	0.74	5341.57	0.02	5335.89	0.00	5337.34	ND	5332.82	0.02	5334.47	ND
Jul-91	5340.06	0.55	5344.20	0.01	5336.61	0.00	5337.16	ND	5335.17	0.00	5335.35	ND
Aug-91	5340.05	0.60	5341.79	0.01	5338.86	0.00	5334.89	ND	5334.83	0.00	5334.09	ND
Sep-91	5340.01	0.62	5341.75	0.00	5336.99	0.00	5336.70	ND	5332.62	0.00	5333.90	ND
Oct-91	5339.89	0.80	5341.65	0.00	5336.19	0.00	5336.62	ND	5327.05	0.00	5333.72	ND
Nov-91	5339.79	0.92	5341.56	0.00	5336.23	0.00	5336.60	ND	5327.05	0.00	5333.59	ND
Dec-91	5339.86	0.84	5341.62	0.00	5335.89	0.00	5336.79	ND	5334.82	0.00	5333.72	ND

Table 1 (cont'd)

Potentiometric Surface Elevation/Separate-Phase Hydrocarbon Thickness Data

	SHS-13		SHS-14		SHS-15		SHS-16	
Date	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thickness (feet)	Water Elev.	Product Thicknes (feet)
Feb-90	NM	NM	NM	NM	NM	NM	NM	NM
Sep-90	5330.88	ND	5331.79	0.00	5332.02	ND	5330.57	ND
Jan-91	5331.35	ND	5332.39	0.01	5332.76	ND	5331.18	ND
Feb-91	5331.60	ND	5332.36	0.01	5332.81	ND	5331.70	ND
Mar-91	5331.67	ND	5332.34	0.01	5332.93	ND	5332.41	ND
Apr-91	5331.65	ND	5321.87	0.00	5333.21	ND	5332.62	ND
May-91	5331.72	ND	5325.16	0.00	5333.31	ND	5331.70	ND
Jun-91	5331.65	ND	5319.69	0.00	5333.01	ND	5331.58	ND
Jul-91	5331.45	ND	5320.57	0.00	5332.71	ND	5331.32	ND
Aug-91	5331.07	ND	5321.63	0.00	5332.24	ND	5330.87	ND
Sep-91	5330.85	ND	5322.13	0.00	5331.92	ND	5330.60	ND
Oct-91	5330.66	ND	5321.99	0.00	5331.72	ND	5330.40	ND
Nov-91	5330.52	ND	5321.33	0.00	5331.71	ND	5330.34	ND
Dec-91	5330.68	ND	5322.16	0.00	5332.01	ND	5330.31	ND

NM = Not measured.
ND = None detected.

0653/H2O.WQ1

Figure 2

Water Level Elevations over Time
SHS-1 thru SHS-4

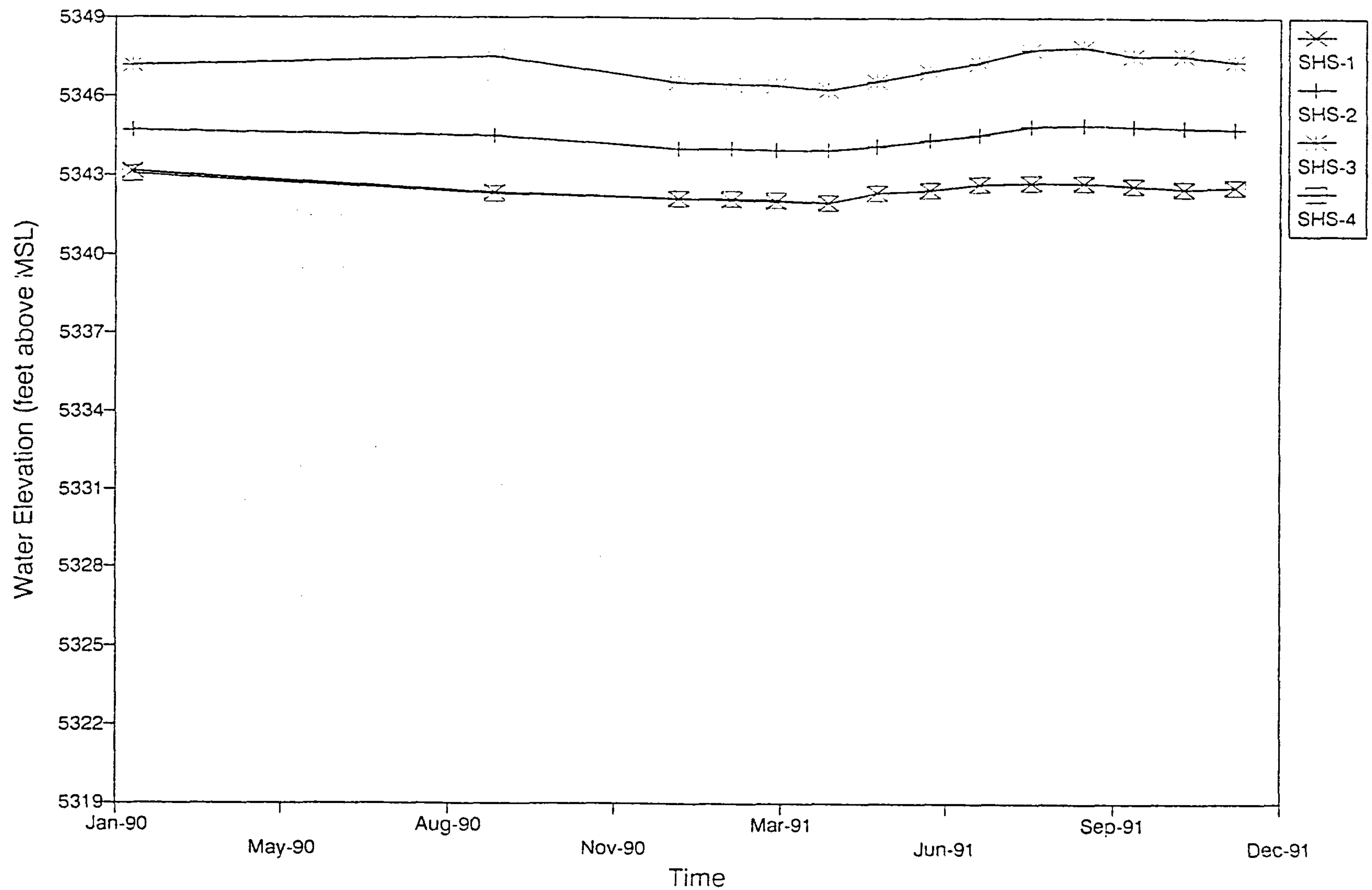


Figure 2 (cont.)

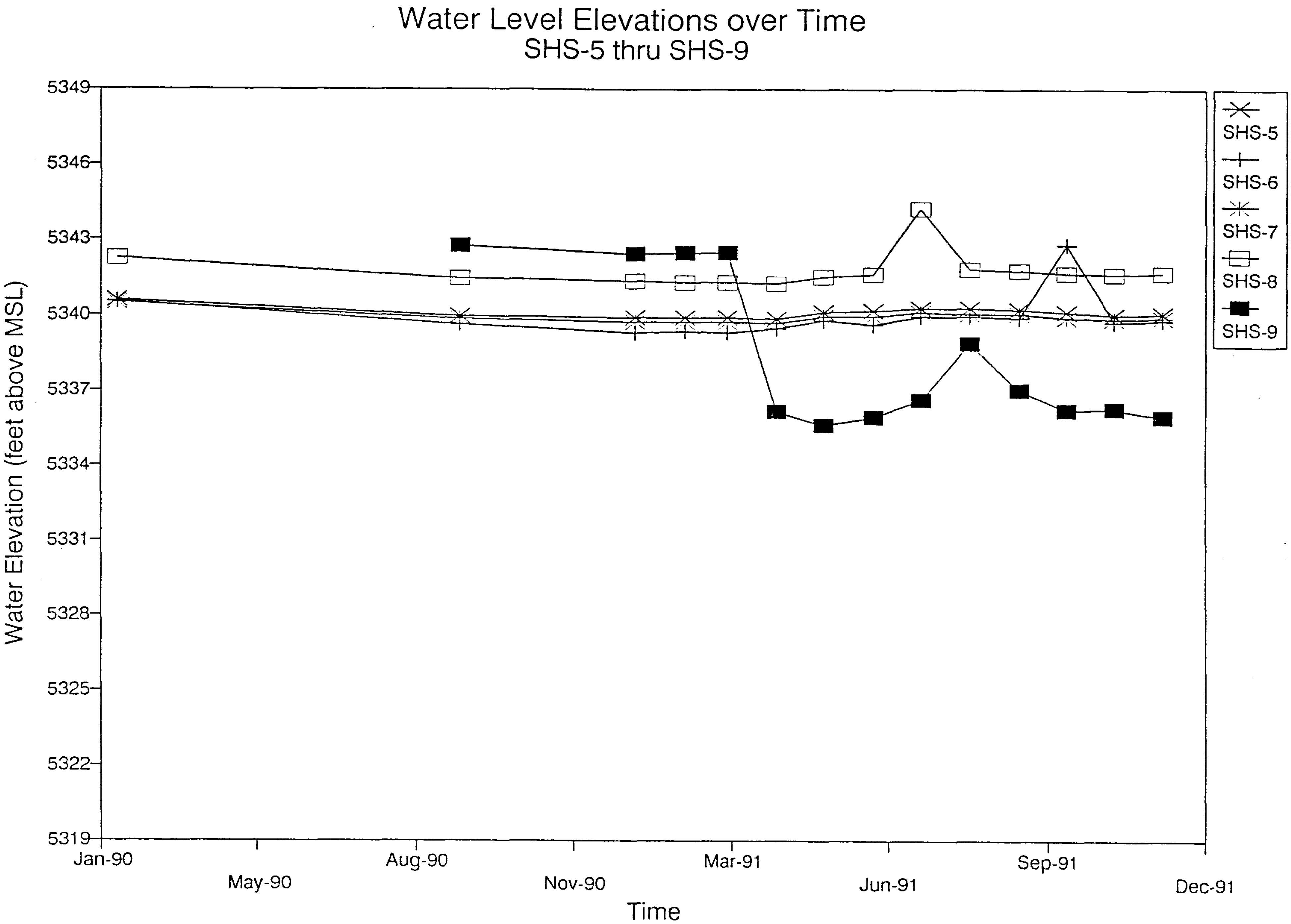


Figure 2 (cont.)

Water Level Elevations over Time
SHS-10 thru SHS-12

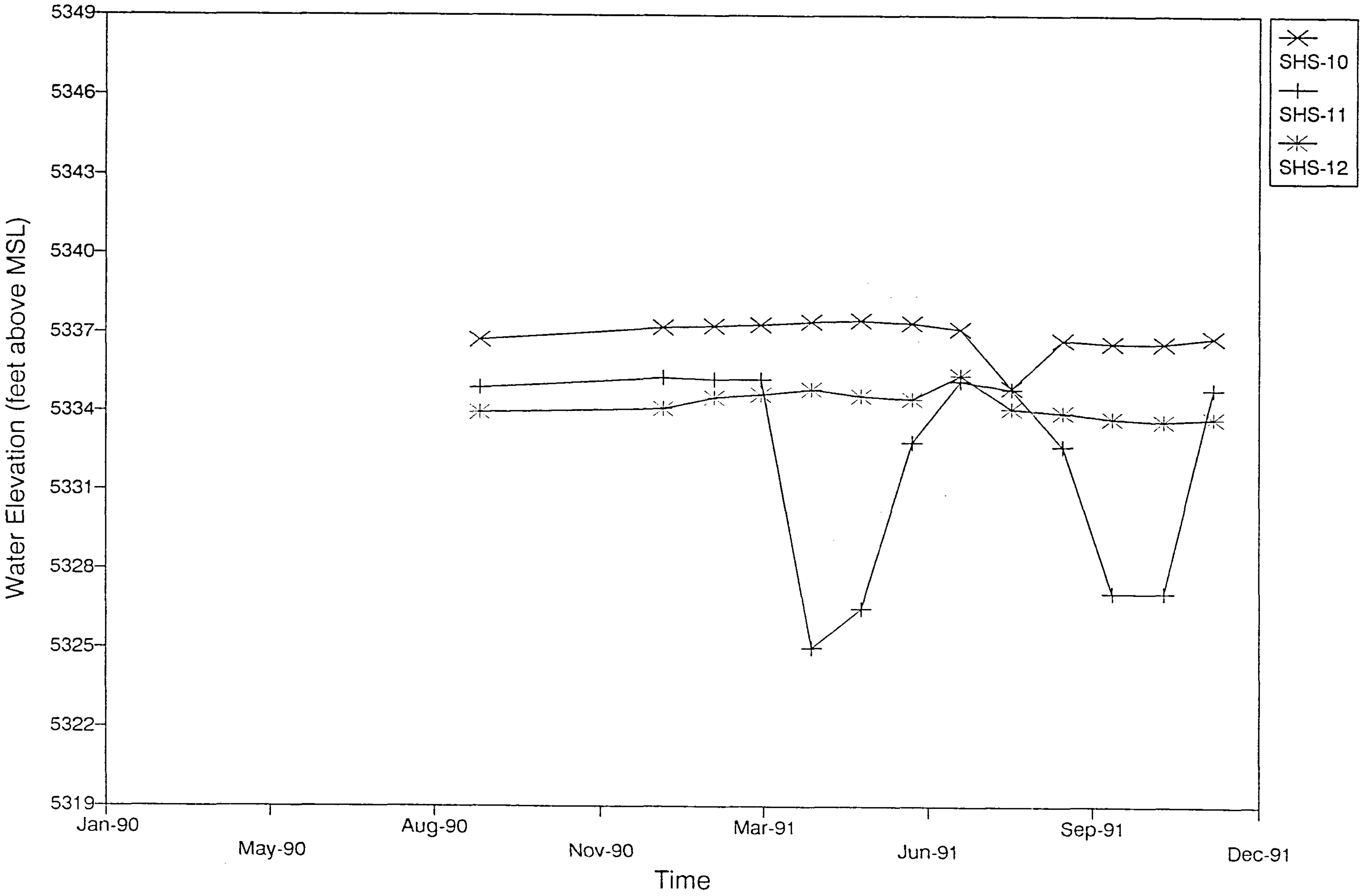


Figure 2 (cont.)

Water Level Elevations over Time
SHS-13 thru SHS-16

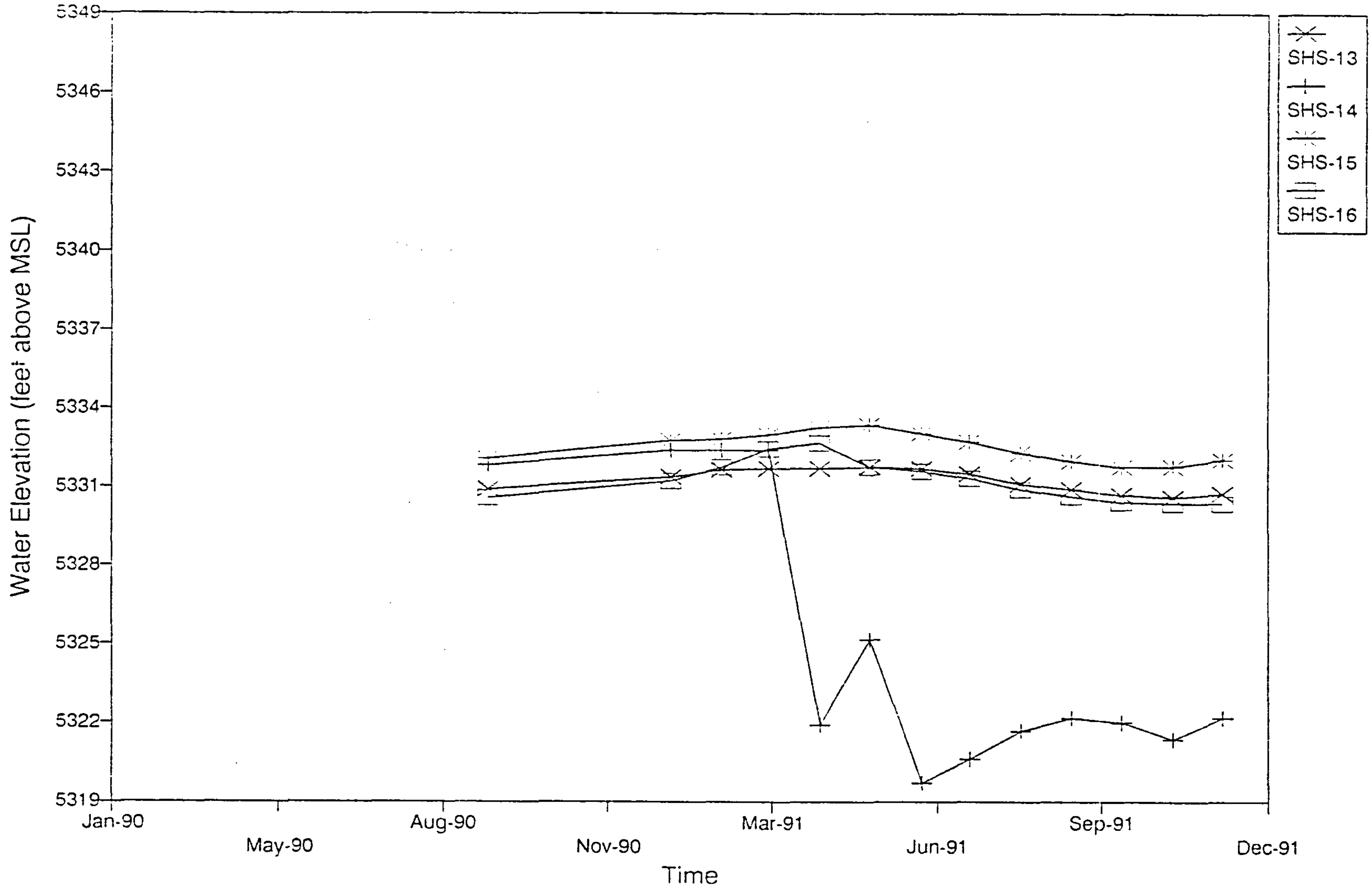


Figure 3

Product Thickness over Time
SHS-1

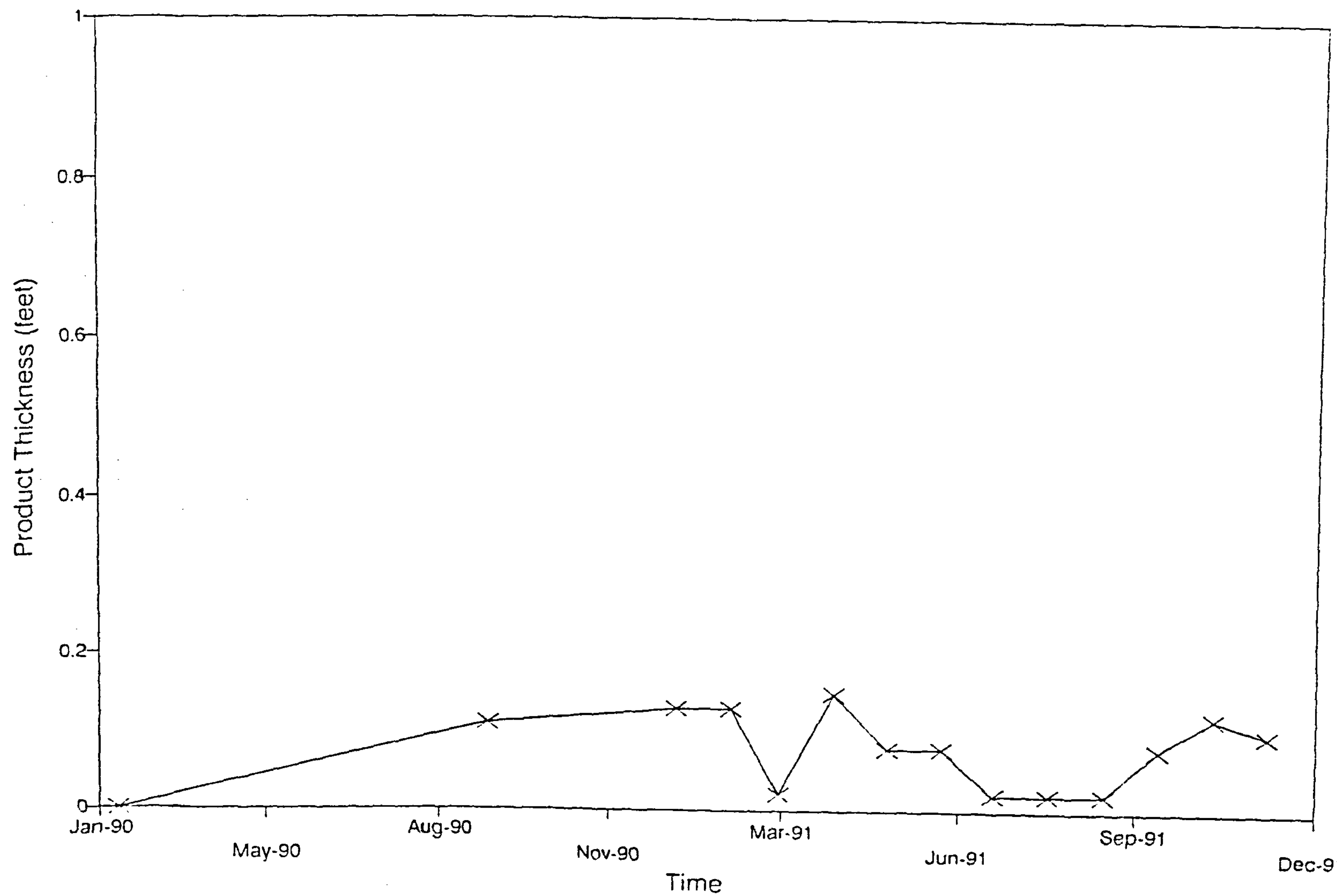


Figure 4

Product Thickness over Time
SHS-2

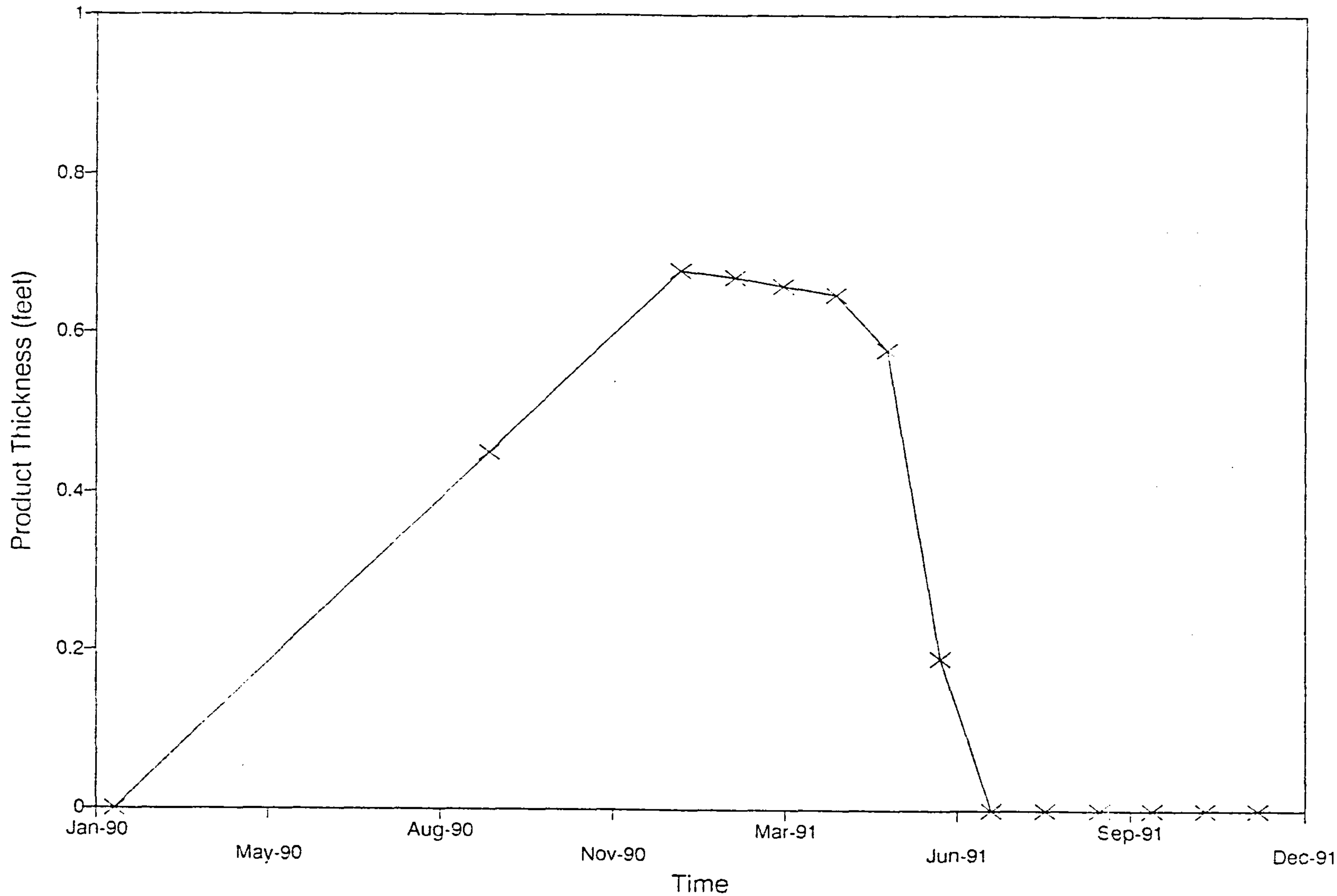
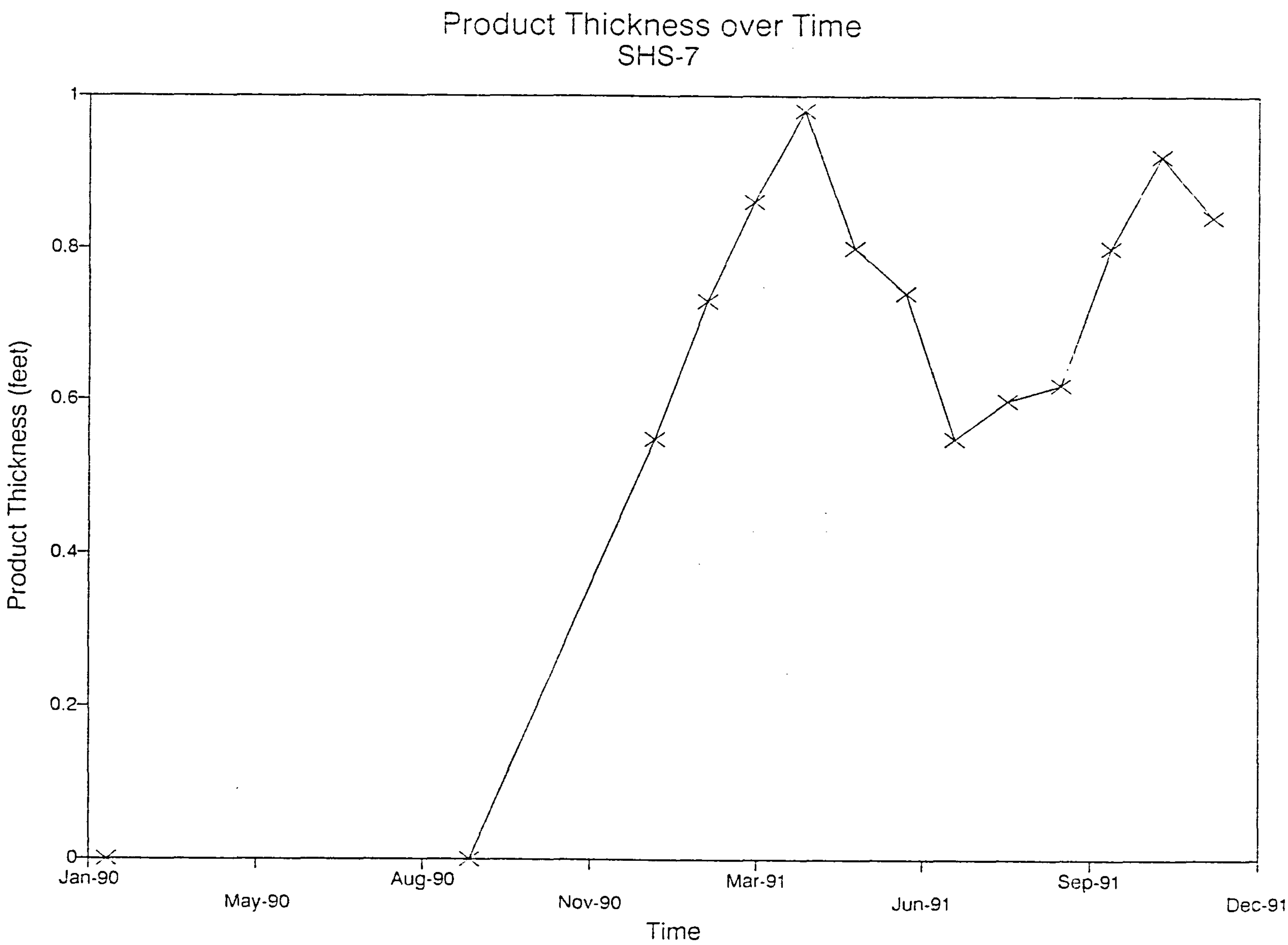


Figure 5



Product Thickness over Time
SHS-7
Product Thickness (feet)
0
0.2
0.4
0.6
0.8
1
Jan-90
May-90
Aug-90
Nov-90
Mar-91
Jun-91
Sep-91
Dec-91
Time

Figure 6

Product Thickness over Time
SHS-8

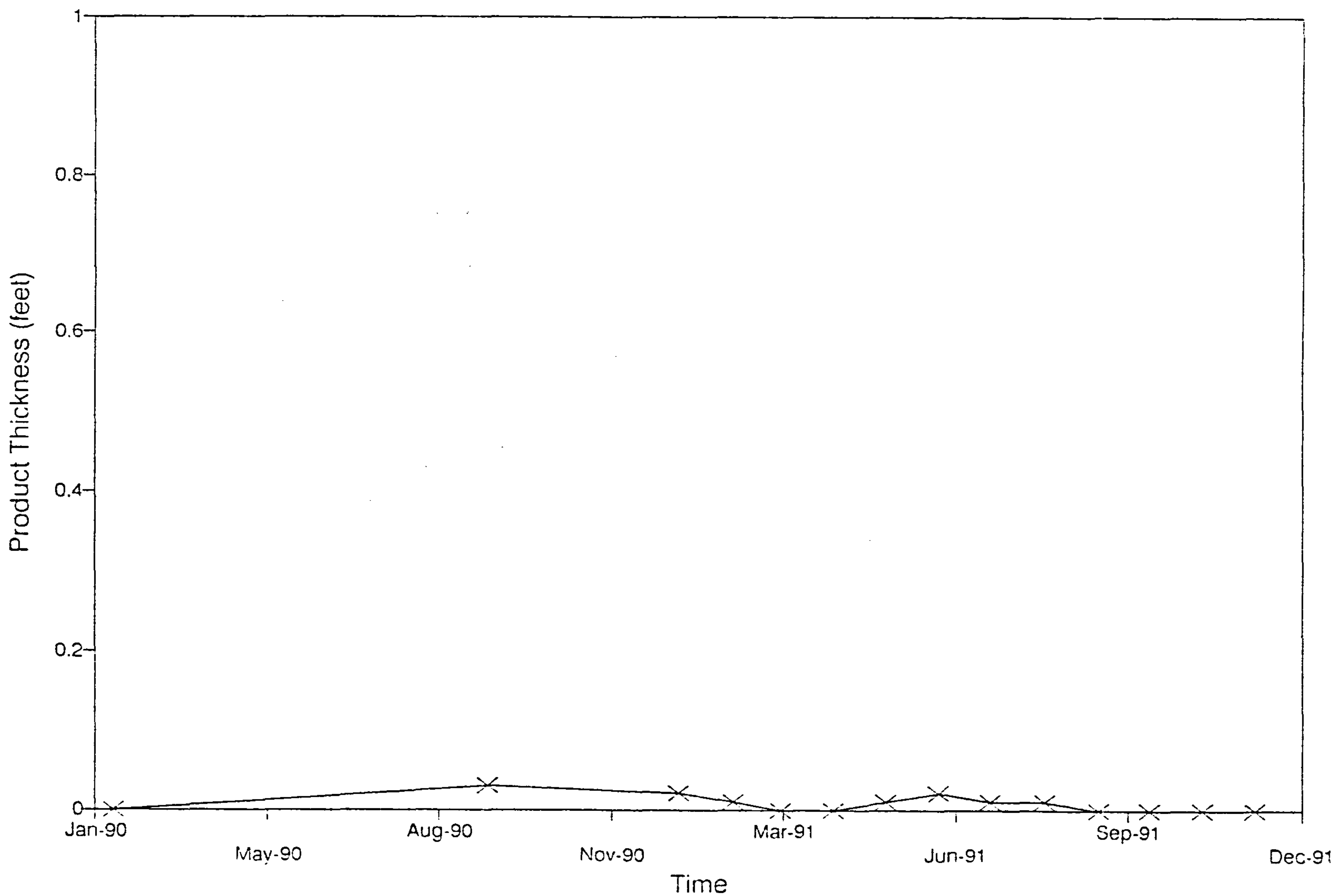
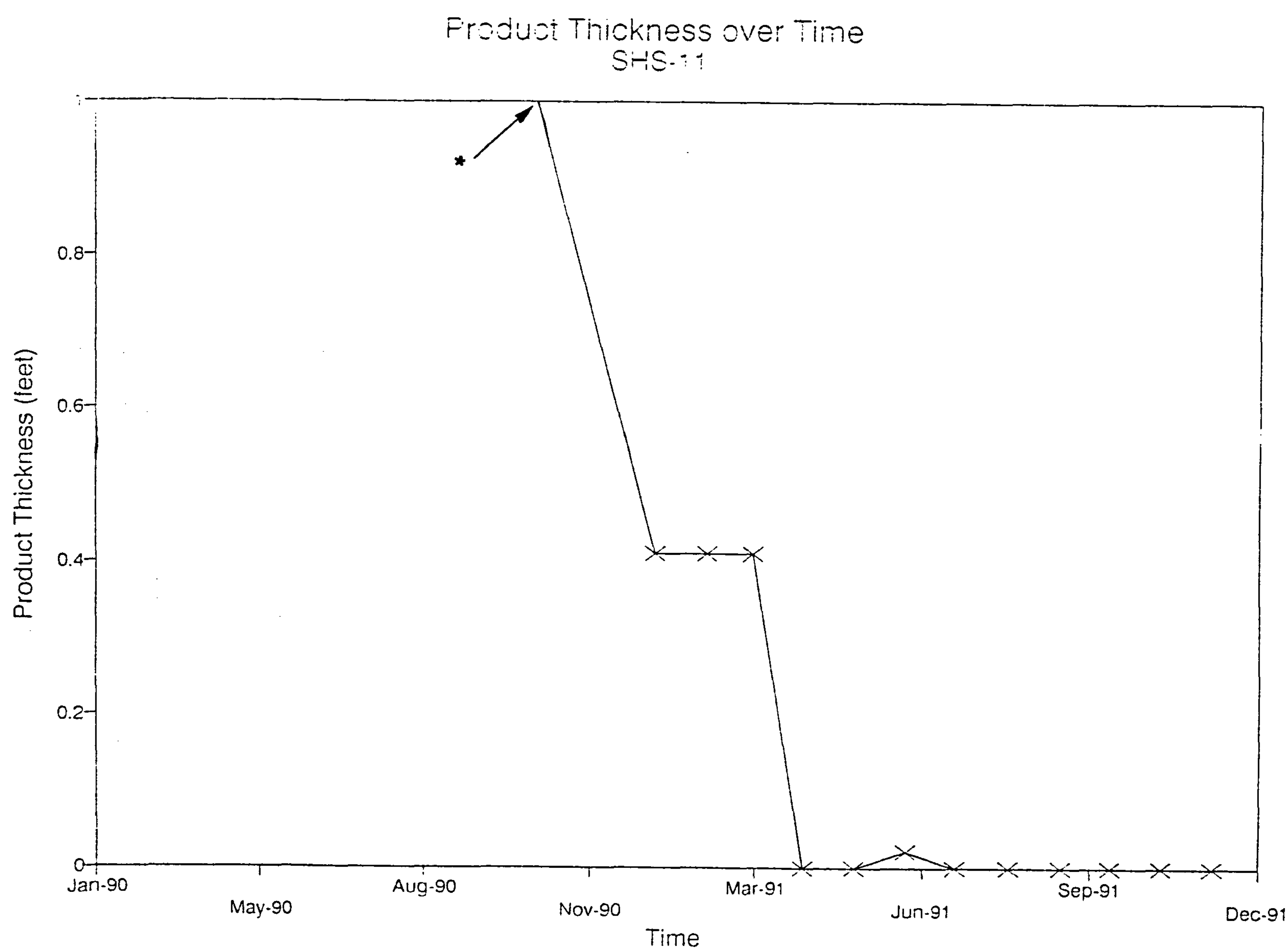


Figure 7



* **Projected To 1.31' Thick On September 1990**

Table 2
Monthly Pumped Volume
SHS Recovery Wells

Date	SHS-9	SHS-11	SHS-14
Apr-91	2,338	1,442	122,829
May-91	3,885	1,839	186,574
Jun-91	4,105	1,126	195,535
Jul-91	5,822	5,635	177,954
Aug-91	6,089	7,571	119,607
Sep-91	7,483	5,683	184,746
Oct-91	6,072	4,133	181,165
Nov-91	5,171	1,664	148,713
Dec-91	5,320	0	159,053
Jan-92	4,091	0	196,956
Total	**50,376**	**29,093**	**1,673,132**

0653/PUMP.WQ1

3.2 Analytical Data

Giant collects quarterly ground-water samples from monitor wells SHS-3, SHS-6, SHS-10, SHS-12, SHS-13, SHS-15, and SHS-16. The samples are analyzed for aromatic and halogenated volatile organic compounds using EPA Methods 601 and 602. Semi-annually the ground water from these monitor wells is also analyzed for major ions and total dissolved solids.

Semi-annually, ground-water samples are collected from the recovery wells that do not contain separate-phase hydrocarbons. These samples are analyzed for aromatic and halogenated volatile organic compounds using EPA Methods 601 and 602. Major ion and TDS concentrations in ground-water samples are also determined semi-annually for these wells.

Table 3 summarizes the analytical history of chloride, TDS, BTEX, and chlorobenzene concentrations in the ground water from all SHS wells. Table 4 summarizes the analytical history of PCE, TCE, TCA 1,1-DCE, 1,2-DCE, 1,1-DCA, 1,2-DCA, and chloroform in the ground water from all SHS wells. Although many other analytes are included in EPA's Methods 601/602 analyte list, those presented in tables 3 and 4 have historically shown concentrations greater than laboratory detection limits.

Table 3

Analytical Results for Chloride, TDS, and Volatile Organic Compounds

Location	Sample Date	Chloride mg/L	TDS mg/L	B	T	E	X	Chlorobenzene
SHS-1	Sep-89	683.92	5326	ND	ND	140	280	ND
	Dec-89	749.41	3304	ND	ND	ND	330	ND
	Jun-90	685.30	3344	ND	ND	57	24	4.4
	Aug-90							
	Jan-91							
	Apr-91*							
	Jul-91							
	Oct-91							
SHS-2	Sep-89	297.35	3242	ND	ND	120	48	ND
	Dec-89	401.47	3002	10	2.2	120	37	ND
	Jun-90	380.70	3394	5.4	19	78	730	230
	Aug-90							
	Jan-91							
	Apr-91*							
	Jul-91							
	Oct-91							
SHS-3	Sep-89							
	Dec-89							
	Jun-90	279.20	3952	ND	ND	ND	ND	ND
	Aug-90							
	Jan-91	254.00	3870	ND	ND	ND	ND	ND
	Apr-91	NA	NA	ND	ND	ND	ND	ND
	Jul-91	230.00	3800	ND	ND	ND	ND	ND
	Oct-91	NA	NA	ND	ND	ND	ND	ND
SHS-4	Sep-89							
	Dec-89							
	Jun-90	25.40	2806	ND	ND	ND	ND	ND
	Aug-90							
	Jan-91							
	Apr-91*							
	Jul-91							
	Oct-91							
SHS-5	Sep-89							
	Dec-89	355.35	2634	ND	ND	ND	ND	ND
	Jun-90	356.80	2804	ND	ND	ND	ND	ND
	Aug-90							
	Jan-91							
	Apr-91*							
	Jul-91							

Table 3 (cont'd)

Analytical Results for Chloride, TDS, and Volatile Organic Compounds

Location	Sample Date	Chloride mg/L	TDS mg/L	B	T	E	X	Chlorobenzene
	Oct-91							
SHS-6	Sep-89							
	Dec-89	172.60	2634	ND	ND	ND	ND	ND
	Jun-90	126.90	2572	ND	ND	ND	ND	ND
	Aug-90							
	Jan-91	120.00	2580	ND	ND	ND	ND	ND
	Apr-91	NA	NA	ND	0.81	ND	ND	ND
	Jul-91	81.20	2580	ND	ND	ND	ND	ND
	Oct-91	NA	NA	ND	ND	ND	ND	ND
SHS-7	Sep-89							
	Dec-89	619.33	2838	190	290	ND	680	ND
	Jun-90	570.80	2280	80	1.1	140	27	4
	Aug-90							
	Jan-91							
	Apr-91*							
	Jul-91							
	Oct-91							
SHS-8	Sep-89							
	Dec-89	751.31	3910	14	ND	85	230	ND
	Jun-90	614.90	2734	ND	ND	ND	3600	ND
	Aug-90							
	Jan-91							
	Apr-91*							
	Jul-91							
	Oct-91							
SHS-9	Sep-89							
	Dec-89							
	Jun-90	430.20	2742	2400	1100	13000	79000	1800
	Aug-90							
	Jan-91							
	Apr-91*							
	Jul-91							
	Oct-91							
SHS-10	Sep-89							
	Dec-89							
	Jun-90	83.90	2078	ND	3.2	69	150	3
	Aug-90							
	Jan-91	80.00	1370	ND	4	106	ND	ND
	Apr-91	NA	NA	ND	ND	100	ND	ND

Table 3 (cont'd)

Analytical Results for Chloride, TDS, and Volatile Organic Compounds

Location	Sample Date	Chloride mg/L	TDS mg/L	B	T	E	X	Chlorobenzene
	Jul-91	64.30	1440	0.5	1.8	47	ND	ND
	Oct-91	NA	NA	ND	ND	37	ND	ND
SHS-11	Sep-89							
	Dec-89							
	Jun-90	624.30	3298	800	ND	1100	5100	ND
	Aug-90							
	Jan-91							
	Apr-91*							
	Jul-91							
	Oct-91							
SHS-12	Sep-89							
	Dec-89							
	Jun-90	288.60	2296	ND	ND	ND	ND	ND
	Jan-91	368.00	2780	ND	1.9	ND	ND	ND
	Apr-91	NA	NA	0.89	ND	ND	ND	ND
	Jul-91	324.00	2810	ND	ND	ND	ND	ND
	Oct-91	NA	NA	ND	ND	ND	ND	ND
SHS-13	Sep-89							
	Dec-89							
	Jun-90							
	Aug-90	402.90	1790	ND	0.79	ND	ND	ND
	Jan-91	434.00	1970	ND	0.95	ND	ND	ND
	Apr-91	NA	NA	ND	ND	ND	ND	ND
	Jul-91	464.00	2050	ND	ND	ND	ND	ND
	Oct-91	NA	NA	ND	ND	ND	ND	ND
SHS-14	Sep-89							
	Dec-89							
	Jun-90							
	Aug-90	46.20	2078	11	31	77	260	ND
	Jan-91							
	Apr-91*							
	Jul-91							
	Oct-91							
SHS-15	Sep-89							
	Dec-89							
	Jun-90							
	Aug-90	33.60	2432	ND	0.33	0.24	0.97	ND
	Jan-91	56.20	1630	ND	ND	ND	ND	ND
	Apr-91	NA	NA	ND	ND	ND	ND	ND

Table 3 (cont'd)

Analytical Results for Chloride, TDS, and Volatile Organic Compounds

Location	Sample Date	Chloride mg/L	TDS mg/L	B	T	E	X	Chlorobenzene
	Jul-91	25.50	1300	ND	ND	ND	ND	ND
	Oct-91	NA	NA	ND	ND	ND	ND	ND
SHS-16	Sep-89							
	Dec-89							
	Jun-90							
	Aug-90	42.00	2714	ND	ND	ND	ND	ND
	Jan-91	56.20	2350	ND	ND	ND	ND	ND
	Apr-91	NA	NA	ND	ND	ND	ND	ND
	Jul-91	36.20	2590	ND	ND	ND	ND	ND
	Oct-91	NA	NA	ND	ND	ND	ND	ND

Giant-Bloomfield Refinery Off-Site Investigations - Analytical Constituents.
All units are ug/L unless otherwise noted 2/13/92.

NA = Not Analyzed.
ND = Not Detected at detection limits.
* = Pumping of recovery wells has begun.

Table 4

Analytical Results for
Halogenated Organic Compounds

Location	Sample Date	PCE	TCE	TCA	1,1-DCE	1,2-DCE	1,1-DCA	1,2-DCA	Chloroform
SHS-1	Sep-89	ND	22	ND	ND	ND	ND	ND	ND
	Dec-89	ND	ND	ND	ND	NA	0.72	7.1	5.7
	Jun-90	1.2	2.9	ND	ND	NA	ND	7.1	ND
	Aug-90								
	Jan-91								
	Apr-91*								
	Jul-91								
	Oct-91								
SHS-2	Sep-89	13	ND	ND	ND	ND	ND	68	ND
	Dec-89	1.7	ND	ND	ND	NA	ND	ND	ND
	Jun-90	2.1	ND	ND	ND	NA	ND	ND	ND
	Aug-90								
	Jan-91								
	Apr-91*								
	Jul-91								
	Oct-91								
SHS-3	Sep-89								
	Dec-89								
	Jun-90	ND	ND	ND	ND	NA	ND	ND	ND
	Aug-90								
	Jan-91	ND	ND	ND	NA	ND	ND	ND	ND
	Apr-91	ND	ND	ND	NA	ND	ND	ND	ND
	Jul-91	ND	ND	ND	NA	ND	ND	ND	ND
	Oct-91	ND	ND	ND	NA	ND	ND	ND	ND
SHS-4	Sep-89								
	Dec-89								
	Jun-90	ND	ND	ND	ND	NA	ND	ND	ND
	Aug-90								
	Jan-91								
	Apr-91*								
	Jul-91								
	Oct-91								
SHS-5	Sep-89								
	Dec-89	1.3	1.8	0.88	ND	NA	ND	ND	ND
	Jun-90	2.7	3	ND	ND	NA	ND	ND	ND
	Aug-90								
	Jan-91								
	Apr-91*								
	Jul-91								

Table 4 (cont'd)

Analytical Results for
Halogenated Organic Compounds

Location	Sample Date	PCE	TCE	TCA	1,1-DCE	1,2-DCE	1,1-DCA	1,2-DCA	Chloroform
	Oct-91								
SHS-6	Sep-89								
	Dec-89	0.45	ND	ND	0.93	NA	ND	ND	ND
	Jun-90	0.42	ND	0.35	ND	NA	ND	ND	ND
	Aug-90								
	Jan-91	ND	ND	ND	NA	ND	ND	ND	ND
	Apr-91	ND	ND	ND	NA	ND	ND	ND	ND
	Jul-91	ND	ND	ND	NA	ND	ND	ND	ND
	Oct-91	ND	ND	ND	NA	0.6	ND	ND	ND
SHS-7	Sep-89								
	Dec-89	ND	ND	ND	ND	NA	ND	ND	ND
	Jun-90	ND	0.28	ND	ND	NA	2.2	5.2	ND
	Aug-90								
	Jan-91								
	Apr-91*								
	Jul-91								
	Oct-91								
SHS-8	Sep-89								
	Dec-89	ND	4.7	6.2	ND	NA	ND	ND	ND
	Jun-90	ND	3200	ND	ND	NA	ND	ND	ND
	Aug-90								
	Jan-91								
	Apr-91*								
	Jul-91								
	Oct-91								
SHS-9	Sep-89								
	Dec-89								
	Jun-90	ND	ND	ND	ND	NA	ND	ND	ND
	Aug-90								
	Jan-91								
	Apr-91*								
	Jul-91								
	Oct-91								
SHS-10	Sep-89								
	Dec-89								
	Jun-90	ND	ND	ND	ND	NA	ND	ND	4.3
	Aug-90								
	Jan-91	ND	ND	ND	NA	ND	ND	ND	ND
	Apr-91	ND	ND	ND	NA	ND	ND	ND	ND

Table 4 (cont'd)

Analytical Results for
Halogenated Organic Compounds

Location	Sample Date	PCE	TCE	TCA	1,1-DCE	1,2-DCE	1,1-DCA	1,2-DCA	Chloroform
	Jul-91	ND	ND	ND	NA	ND	ND	ND	ND
	Oct-91	0.2	ND	ND	NA	ND	ND	ND	ND
SHS-11	Sep-89								
	Dec-89								
	Jun-90	ND	ND	ND	ND	NA	ND	ND	ND
	Aug-90								
	Jan-91								
	Apr-91*								
	Jul-91								
	Oct-91								
SHS-12	Sep-89								
	Dec-89								
	Jun-90	3.1	2	ND	ND	NA	ND	ND	5.6
	Jan-91	1.3	0.74	ND	NA	4.7	0.41	0.39	0.8
	Apr-91	1.2	0.58	ND	NA	7	0.44	0.47	0.25
	Jul-91	0.7	0.4	ND	NA	6.9	1.2	ND	ND
	Oct-91	0.9	0.4	ND	NA	3.2	0.6	ND	0.3
SHS-13	Sep-89								
	Dec-89								
	Jun-90								
	Aug-90	0.34	0.26	ND	ND	0.28	0.53	11	ND
	Jan-91	ND	ND	ND	NA	ND	1	3.8	ND
	Apr-91	ND	ND	ND	NA	ND	0.83	3.9	ND
	Jul-91	ND	ND	ND	NA	ND	0.9	ND	ND
	Oct-91	ND	ND	ND	NA	0.4	0.9	ND	ND
SHS-14	Sep-89								
	Dec-89								
	Jun-90								
	Aug-90	4.6	ND	ND	2	ND	ND	ND	ND
	Jan-91								
	Apr-91*								
	Jul-91								
	Oct-91								
SHS-15	Sep-89								
	Dec-89								
	Jun-90								
	Aug-90	0.4	ND	ND	ND	ND	ND	ND	ND
	Jan-91	ND	ND	ND	NA	ND	ND	ND	ND
	Apr-91	ND	ND	ND	NA	ND	ND	ND	0.6

Table 4 (cont'd)

Analytical Results for
Halogenated Organic Compounds

Location	Sample Date	PCE	TCE	TCA	1,1-DCE	1,2-DCE	1,1-DCA	1,2-DCA	Chloroform
	Jul-91	ND	ND	ND	NA	ND	ND	ND	11.8
	Oct-91	ND	ND	ND	NA	ND	ND	ND	6.5
SHS-16	Sep-89								
	Dec-89								
	Jun-90								
	Aug-90	ND	ND	ND	ND	0.34	ND	ND	0.17
	Jan-91	ND	ND	ND	NA	ND	ND	ND	ND
	Apr-91	ND	ND	ND	NA	ND	ND	ND	0.4
	Jul-91	ND	ND	ND	NA	ND	ND	ND	ND
	Oct-91	ND	ND	ND	NA	ND	ND	ND	ND

Giant-Bloomfield Refinery Off-Site Investigations - Analytical Constituents.
All units are ug/L unless otherwise noted 2/13/92.

NA = Not Analyzed.
ND = Not Detected at detection limits.
* = Pumping of recovery wells has begun.

4.0 Discussion

4.1 Site Ground-Water Characteristics

The maximum depth to ground water is found at monitor well SHS-1, in the northern part of the study area, and is approximately 39 feet beneath ground surface. The minimum depth to ground water is found at monitor well SHS-16, in the southern part of the study area, and is approximately 30 feet beneath ground surface. The average depth to ground water in the study area is approximately 37.5 feet beneath ground surface. The hydraulic gradient is approximately .014 feet of vertical drop per foot of horizontal distance.

Figure 2 shows a decrease in the ground-water surface elevations at monitor wells SHS-1, SHS-2, SHS-3, and SHS-4 from August 1990 to April 1991, followed by an increase in water surface elevation until September 1991 when elevations level off for the remainder of the year. Monitor wells SHS-1, SHS-2, SHS-3, and SHS-4 are located in the northern portion of the study area. Figure 2 also shows an increase in the ground-water surface elevations at monitor wells SHS-13, SHS-15, and SHS-16, from August 1990 to May 1991, followed by a decrease in water surface elevation until October 1991 when elevations increase until the end of the year. Monitor wells SHS-13, SHS-15, and SHS-16 are located in the southern portion of the study area. Figure 2 indicates that the water surface elevations in the remainder of the monitor wells, located in the central portion of the study area, have remained fairly level throughout the monitoring period.

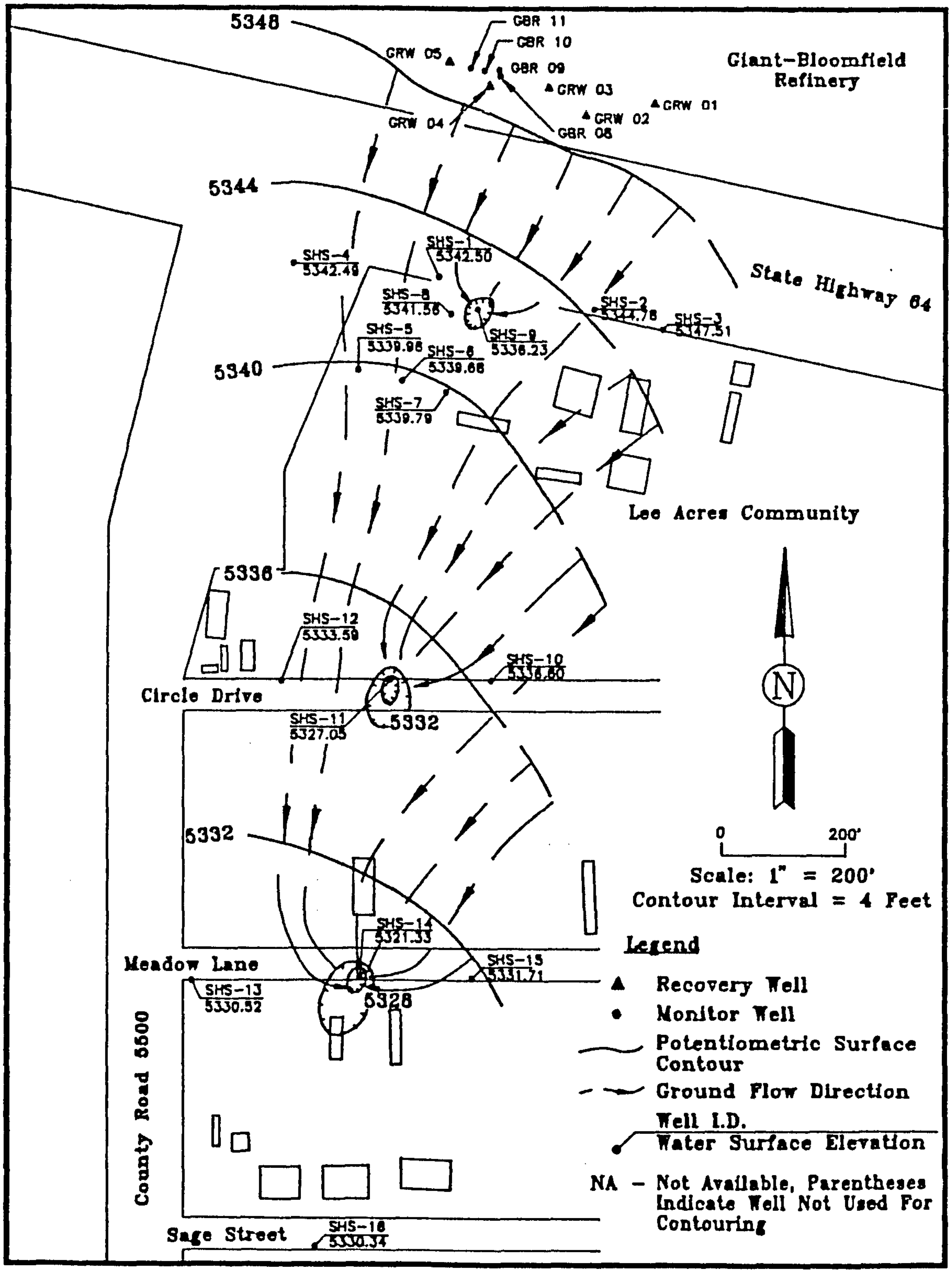
Figure 8 depicts the potentiometric surface south of Highway 64 for the month of November 1991. The response to pumping at each recovery well is apparent in figures 2 and 7. The maximum drawdowns observed at recovery wells SHS-9, SHS-11, and SHS-14 are 6.8 feet, 10.27 feet, and 12.12 feet, respectively. The magnitude of response to recovery operations in monitor wells is, as expected, a function of distance from the pumping well. The available data history is insufficient to distinguish between hydraulic variations at monitor wells due to seasonal fluctuations and those due to recovery operations. Installation of a monitor well down-gradient of SHS-14 could provide useful information.

4.2 Recovery Operations

The volume of water pumped during 1991 is approximately 1,752,600 gallons or 4 gallons per minute combined flow rate from three recovery wells. The volumes pumped by each well are shown on table 2.

Figure 8

Potentiometric Surface Map
November 1991



The separate-phase thickness measured at most wells has decreased over time, as shown in figures 3 through 7. The most dramatic decrease is in SHS-11; figure 7 shows a reduction in hydrocarbon thickness from 1.31 feet in September 1990 to 0 feet in July 1991. Separate-phase hydrocarbons are found to be 0.1-feet and 0.84-feet thick at monitor wells SHS-1 and SHS-7, respectively in December 1991. Monitoring separate-phase thickness in BLM's monitor well BLM-37 would provide useful information.

The volume of water produced from recovery well SHS-9 is notably less than the volume of water produced from SHS-14. One reason for this is that the composition of the alluvial aquifer at SHS-9 is a sandy clay, much less transmissive than the sands found at recovery well SHS-14. Another reason for the low flow rate is that the alluvial aquifer is approximately 6.5 feet thick at SHS-9, whereas the saturated thickness of the alluvial aquifer at SHS-14 is, at a minimum, 20 feet thick. As a result of the greater saturated thickness, the saturated screened interval is longer in SHS-14 than in SHS-9, allowing greater production.

After reviewing the lithologic log for SHS-11 (GCL, 1990b), we believe that it should have produced as much water as well SHS-14. Data from the slug tests indicate that the hydraulic conductivity at well SHS-11 is an order of magnitude less than at well SHS-14. For recovery well SHS-11 to produce a volume of water equivalent to well SHS-14, the hydraulic conductivities of the aquifers at the two wells would have to be approximately equal, since well constructions are similar. We can only speculate about reasons for the difference in flow rate between SHS-11 and SHS-14. Grout may have infiltrated the filterpack shortly after installation, or the well screen may have broken during well or pump installation. Undetected smearing of clay along the borehole wall during drilling may have impeded flow into the well.

Because SHS-11 is inoperable, it should be replaced. Existing recovery well SHS-11 should be converted into a monitor well to provide additional data in this area. If the replacement well is located close to the existing well the existing well can be used to observe the hydraulic effects of pumping on the aquifer.

4.3 Analytical Results

In monitor wells where BTEX constituents have been detected, the analytical results from ground-water samples indicate a consistent decrease of BTEX concentrations since the beginning of recovery operations (table 2). The ground water from monitor wells SHS-10, SHS-12, SHS-13, and SHS-15 has historically contained BTEX constituents. After pumping of recovery wells SHS-9, SHS-11, and SHS-14 began in April 1991, the ground water in all wells, except SHS-10, showed a decrease in the concentration of BTEX constituents to non-detectable quantities. The concentration of ethylbenzene, the highest BTEX constituent in the ground water from SHS-10, decreased from 106 μg/l to 37 μg/l after three months of pumping. BTEX concentrations for the month of October 1991 are shown on figure 9.

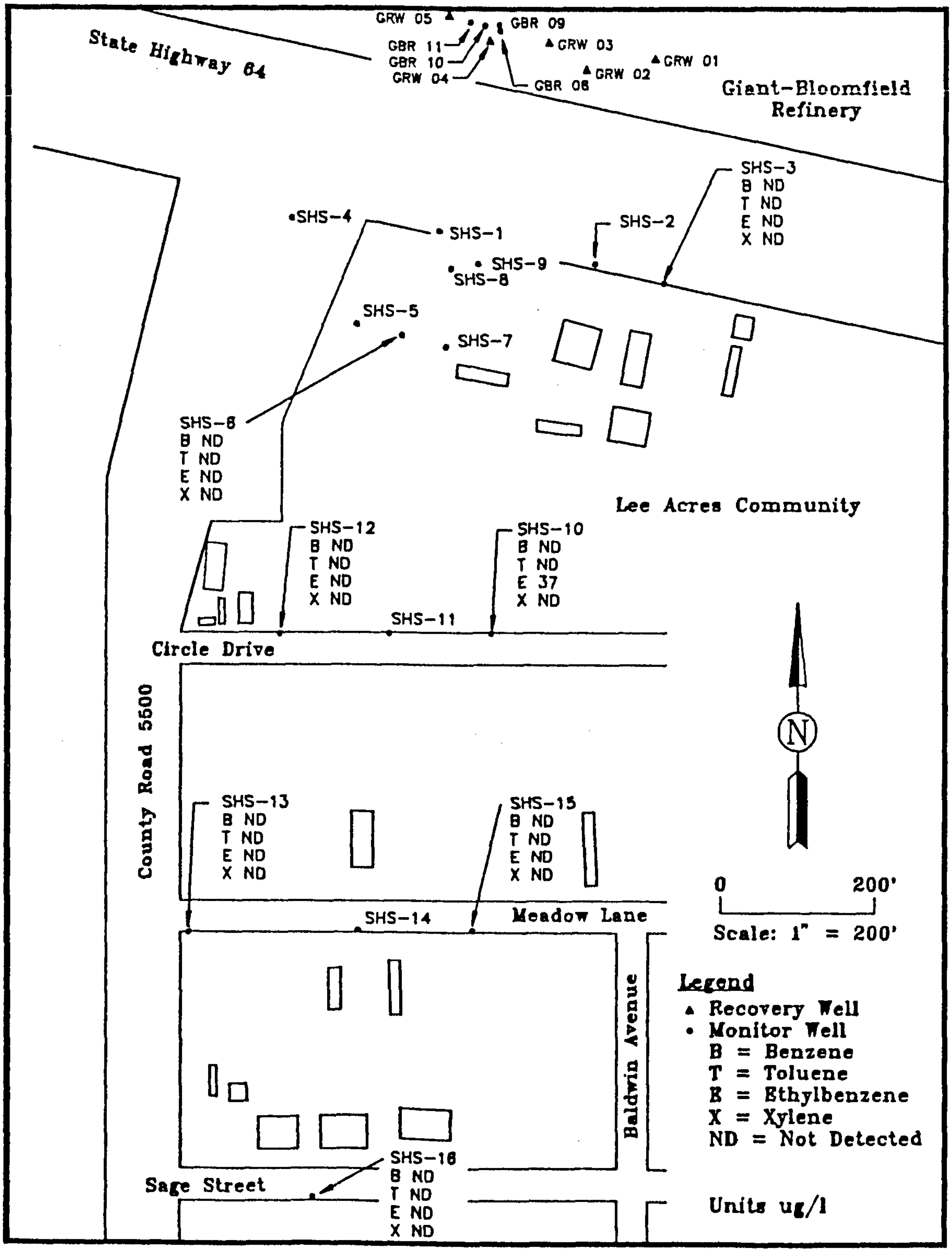
Possible explanations for decreasing BTEX concentrations are as follows: 1) source capture and high concentration ground-water recovery is succeeding; 2) the radius of influence is pulling less contaminated water into the periphery of the plume; 3) as the plume shrinks, and due to the induced movement of oxygenated ground water, in situ biodegradation is enhanced, thereby further decreasing BTEX concentrations.

The concentrations of chloride and TDS have been variable since initiation of recovery operations. The concentrations in some wells show a slight increase and others show a slight decrease over time.

All SHS wells sampled on the quarterly schedule, except SHS-10, have shown consistent non-detect results for BTEX analysis. The general chemistry constituents of TDS and chloride remain consistent. For these reasons, all monitoring wells currently sampled should be rescheduled to be sampled on a semi-annual basis along with the recovery wells. The analytes for the semi-annual sampling should include EPA Methods 601/602 and Giant's current general chemistry suite. One additional monitor well should be installed directly downgradient of monitor well SHS-14 and sampled on a semi-annual schedule.

Figure 9

BTEX Concentrations In Ground Water
October 1991



5.0 Conclusions

Based on the sources of information and references cited herein, we offer the following conclusions.

- The recovery operations are effectively reducing the concentrations of dissolved-phase BTEX constituents in the ground water.

- The recovery operations are effectively eliminating the separate-phase hydrocarbons.

- Initiation of ground-water recovery operations at well SHS-7 would remove additional separate-phase hydrocarbons.

- The greater discharge rate at recovery well SHS-14, as compared to well SHS-9, appears to be due to the greater saturated thickness and coarser grained sediment of the alluvial aquifer in the southern part of the study area.

- By replacing SHS-11, higher flow rates should be realized.

- The proposed semi-annual ground-water sampling schedule should be more than adequate to monitor the site since analytical results have remained consistent.

- Physical and chemical data gained from the installation of an additional monitor well, SHS-17, downgradient of monitor well SHS-14 would be useful.

6.0 Recommendations

Based on the sources of information and references cited herein, we offer the following recommendations.

- Replace recovery well SHS-11.
- Continue recovery operations.
- Change the sampling frequency from quarterly to semi-annual sampling.
- Continue to pursue adding well SHS-7 to recovery operations. This will enhance current operations.
- Obtain depth to ground water/separate-phase hydrocarbon measurements for BLM-37 semi-annually.
- Ground water monitor well SHS-17 could be installed directly downgradient of recovery well SHS-14 and sampled on a semi-annual schedule.

7.0 References

GCL, 1989, First Report of Off-Site Investigation, Prepared for Giant Industries Arizona, Inc., Geoscience Consultants Ltd., Albuquerque, NM, October 20, 1989

GCL, 1990a, Second Report of Off-Site Investigation, Prepared for Giant Industries Arizona, Inc., Geoscience Consultants Ltd., Albuquerque, NM, February 23, 1990

GCL, 1990b, Third Report of Off-Site Investigation, Prepared for Giant Industries Arizona, Inc., Geoscience Consultants Ltd., Albuquerque, NM, November 1, 1990

Giant, 1991a, Quarterly Data Report Giant Bloomfield Refinery, First Quarter, 1991, Giant Industries Arizona, Inc., Submitted to the New Mexico Oil Conservation Division, May 14, 1991.

Giant, 1991b, Quarterly Data Report Giant Bloomfield Refinery, Second Quarter, 1991, Giant Industries Arizona, Inc., Submitted to the New Mexico Oil Conservation Division, August 7, 1991.

Giant, 1991c, Quarterly Data Report Giant Bloomfield Refinery, Third Quarter, 1991, Giant Industries Arizona, Inc., Submitted to the New Mexico Oil Conservation Division, October 29, 1991.

Giant, 1991d, Quarterly Data Report Giant Bloomfield Refinery, Fourth Quarter, 1991, Giant Industries Arizona, Inc., Submitted to the New Mexico Oil Conservation Division, February 19, 1991.

NMOCD, 1990, New Mexico Oil Conservation Division, December 6, 1990, certified letter from William C. Olson, Hydrogeologist to Timothy A. Kinney, Giant Refining Company, re: Off-Site Hydrogeologic Investigation and Remediation Giant Bloomfield Refinery