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TRIDENT ENVIRONMENTAL

December 22, 2010

Mr. Glenn Von Gonten
New Mexico Energy, Minerals and Natural Resources Department
Oil Conservation Division – Environmental Bureau
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

SUBJECT: 2010 ANNUAL GROUNDWATER MONITORING REPORT
FORMER UNOCAL SOUTH VACUUM UNIT
NMOCD CASE NO. 1R-277
SECTION 35, TOWNSHIP 18 SOUTH, RANGE 35 EAST
LEA COUNTY, NEW MEXICO

Dear Mr. Von Gonten:

Enclosed is the *2010 Annual Groundwater Monitoring Report* for the Former Unocal South Vacuum Unit site located in Lea County, New Mexico (hard copy and compact disk). Chevron Environmental Management Company has been managing the groundwater monitoring activities for the site since their acquisition of Unocal Corporation in 2005.

Please contact me at 432-638-8740, Mr. John MacLeod (Chevron EMC) at 925-842 2477, or Allen Just (Arcadis) at 714-730-9052 Ext. 38 if you have any questions or comments.

Sincerely,

Gilbert J. Van Deventer, REM, PG
Trident Environmental – Midland, TX

Attachments

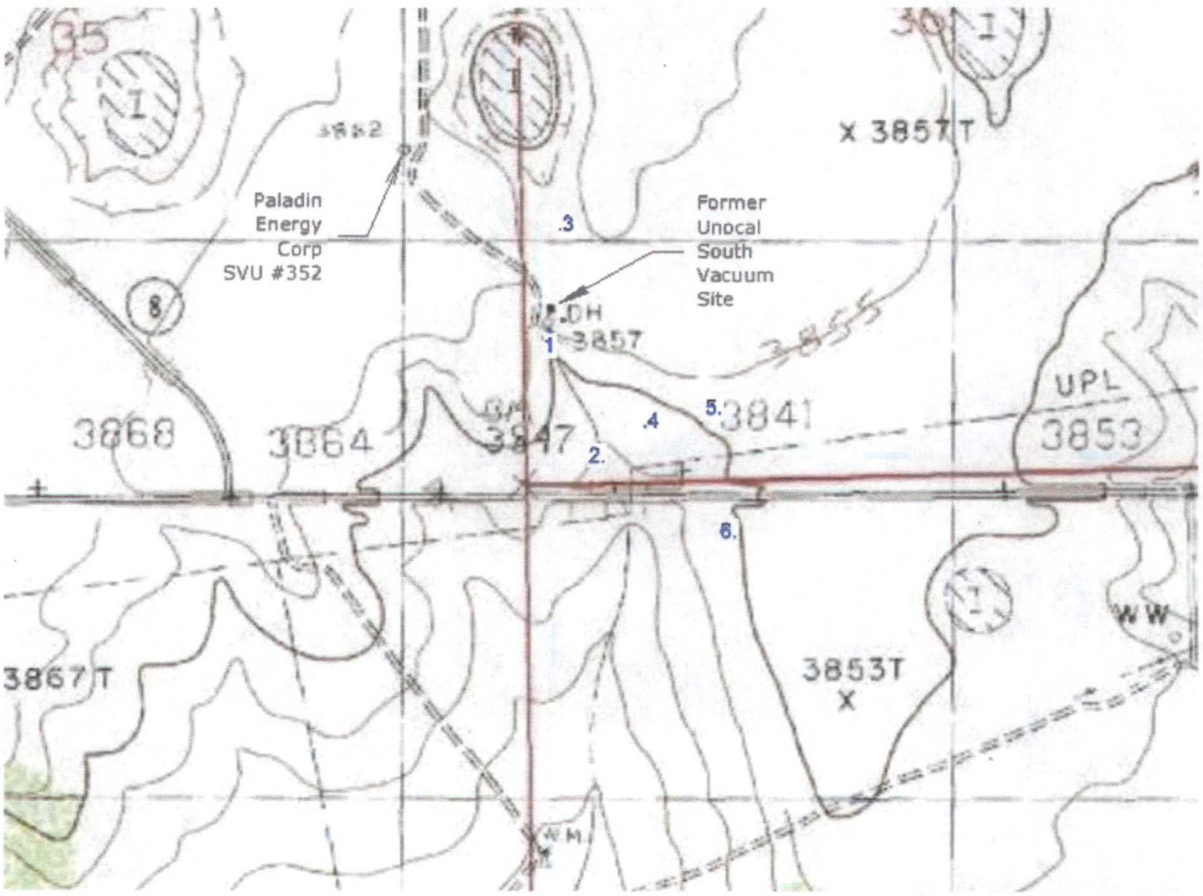
xc: John MacLeod, Chevron EMC (San Ramon CA)
Allen Just, Arcadis (Irvine CA)

2010 Annual Groundwater Monitoring Report
Former Unocal South Vacuum Unit
NMOCD Case No. 1R-277
Section 36, Township 18 South, Range 35 East
Lea County, New Mexico

DECEMBER 22, 2010

Prepared For:

Chevron Environmental
Management Company
6111 Bollinger Canyon Rd.
San Ramon, CA 94583



Prepared By:

TRIDENT
ENVIRONMENTAL

P. O. Box 12177
Odessa, Texas 79768

2010 Annual Groundwater Monitoring Report
Former Unocal South Vacuum Unit
NMOCD Case NO. 1R-277
Section 36, Township 18 South, Range 35 East
Lea County, New Mexico

Prepared for:

Chevron Environmental Management Company
6111 Bollinger Canyon Road
San Ramon, CA 94583

Prepared by:

Trident Environmental
P. O. Box 12177
Odessa, Texas 79768
(432) 638-8740
FAX (413) 403-9968

SUBMITTED BY:

Gilbert J. Van Deventer, PG, REM
Project Manager

DATE: December 22, 2010

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 Executive Summary

Trident Environmental (Trident) was retained by ARCADIS, on behalf of Chevron Environmental Management Company (Chevron EMC), to perform the 2010 annual groundwater sampling and monitoring operations at the Former Unocal South Vacuum Unit (site), which is located at township 18 south, range 35 east, section 36 in Lea County, New Mexico. Chevron EMC is managing Unocal's environmental liability at the site. This report documents the 2010 annual sampling event performed by Trident at the site on July 13, 2010. This report contains the historical groundwater elevation and analytical data from monitoring wells MW-1 through MW-6. The sampling event was conducted in accordance with the November 2, 2000 Groundwater Remediation Plan submitted by Unocal and the requirements specified in the New Mexico Oil and Conservation Division (OCD) letter dated February 8, 2001.

Based on the sampling and monitoring data to date, the following conclusions relevant to groundwater conditions at the Former Unocal South Vacuum Unit are evident:

- Chloride and total dissolved solids (TDS) concentrations in MW-1, near the source area, have generally decreased since 1996 with the exception of some fluctuations since the 2004 sampling event. Similarly, chloride and TDS levels have decreased in the closest downgradient well, MW-4, since 1999 when that well was installed. Chloride and TDS concentrations in well MW-3 have shown slight but steadily increasing trends indicating an upgradient contributing source of these constituents. Chloride and TDS concentrations in the remaining wells (MW-2, MW-5, and MW-6) have remained relatively consistent with previous levels.

- The fate and transport modeling results continue to support the conclusion that the chloride and TDS plume is not likely to impact existing sources of water supply, the closest of which, a livestock (windmill) well (permit number L 05339) lies over one-half mile south of the source. The windmill has been dismantled and is no longer in operation due to declining water levels in the area.

- According to conservative model simulations, the chloride plume will travel a maximum of 3,400 feet southeast of the source in approximately 147 years before concentrations return to levels below the New Mexico Water Quality Control Commission (WQCC) standard of 250 mg/L. The same analysis indicates that the TDS plume will travel only 2,300 feet in approximately 84 years before concentrations return to levels below the WQCC standard of 1,000 mg/L.

- Based on the modeling results and predicted natural attenuation processes (advection and dispersion), there will be no adverse impact to human health and the environment nor will the livestock well exceed WQCC standards for chlorides or TDS due to the plume originating and traveling southeast, versus south, from the former saltwater disposal pit.

- Groundwater elevations have steadily decreased at a rate of approximately 0.4 feet per year since the initial sampling event of monitoring well MW-1 in January 1995; with the exception of the 2005 sampling event due to higher than normal rainfall during 2004 and 2005. The decreasing groundwater elevation trend has resumed since 2005.

Exemplary remedial actions were performed to the source area by Unocal, which include plugging of the SWD well in 1971 and encapsulating the former saltwater disposal pit with solidification material in 1995, thus eliminating the threat of any continued release from the source. Based on the identified potential receptor and fate and transport modeling results, the chloride/TDS plume at the site presents low risk to human health and the environment; therefore Trident recommends the following actions for site closure:

- Continue the annual monitoring program with groundwater sampling and analysis of chloride and TDS concentrations for each of the six monitoring wells.

- Update flow and transport model to confirm the plume is naturally attenuating as described.

- Submit the 2011 annual groundwater monitoring report to OCD in January 2012 to document natural attenuation conditions.

2.0 Groundwater Sampling Procedures

On July 13, 2010, each of the six monitoring wells, MW-1 through MW-6, was gauged for depth to groundwater using a Solinst Model 101 electronic water indicator immediately prior to purging operations. A total of 32 gallons of groundwater was purged from the site monitoring wells (3 to 10 gallons per well) using a 3-stage submersible pump which was decontaminated using an Alconox solution and a distilled water rinse between sampling points. Groundwater parameters (pH, temperature, and conductivity) were measured using a Hanna Model 98130 multimeter until a minimum of three wells volumes was purged from each well. Water samples for each monitoring well were collected with a new 2-inch diameter poly bailer and transferred into 1,000 milliliter (ml) plastic containers for laboratory analysis of chloride using EPA Method SM-4500-Cl-C and TDS using EPA Method SM-2541. For each set of samples, chain of custody forms documenting sample identification numbers, collection times, and delivery times to the laboratory were completed. All water samples were placed in an ice-filled cooler immediately after collection and transported to Lancaster Laboratories (Lancaster, PA) for analysis.

3.0 Groundwater Elevations, Hydraulic Gradient and Flow Direction

Depth to groundwater varies from approximately 49 ft at MW-2 to 70 feet at MW-6 below ground surface. Groundwater elevations are summarized in Table 1. A groundwater gradient map depicting the direction of groundwater flow is illustrated in Figure 1. A historical groundwater elevation graph is shown in Figure 2. The groundwater gradient direction is to the southeast with a hydraulic gradient of approximately 0.004 ft/ft. According to published reports (*Ground-Water Conditions in Northern Lea County, New Mexico*, Ash, 1963 and *Geology and Ground-Water Conditions in Southern Lea County, New Mexico*, Nicholson and Clebsch, 1961) the groundwater encountered at the site is that of the Tertiary Ogallala Formation. The Ogallala Formation unconformably overlies the impermeable red-beds of the Triassic Chinle Formation at an elevation of approximately 3,700 feet above mean sea level (AMSL). Based on the current groundwater elevations measured on site and published data referenced, the saturated thickness of the Ogallala Formation at the site ranges from approximately 87 to 96 feet.

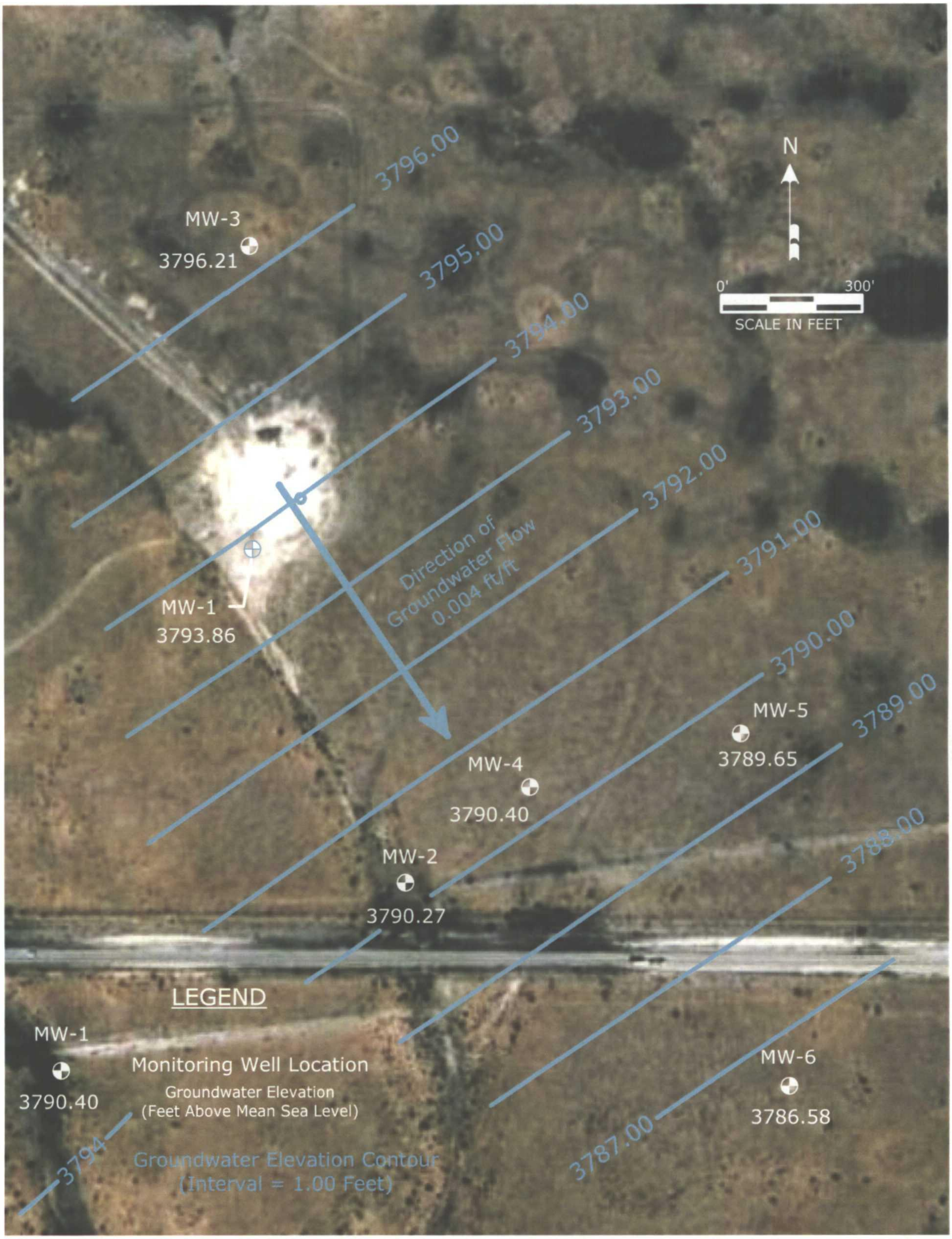


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FIGURE 1
Former Unocal South Vacuum Unit
Groundwater Gradient Map
July 13, 2010

Figure 2
Historical Groundwater Elevations

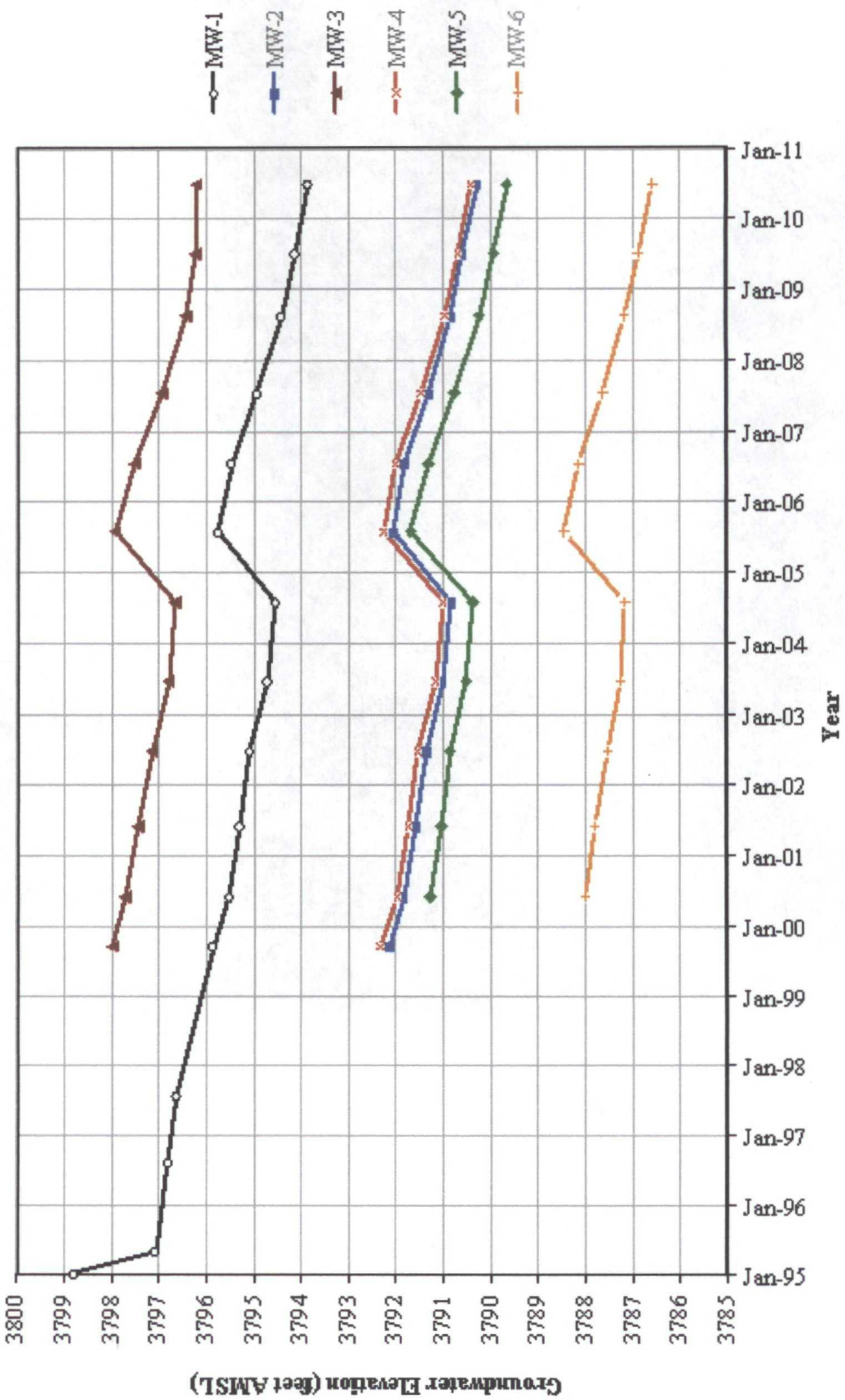

Table 1
Summary of Groundwater Sampling Results

Monitoring Well	Sampling Date	Chloride (mg/L)	TDS (mg/L)	Depth to Groundwater (feet BTOC)	Top of Casing Elevation (feet AMSL)	Groundwater Elevation (feet AMSL)
MW-1	01/27/1995	**1174**	**2250**	59.57	3858.37	3798.80
	05/18/1995	**983**	**2251**	61.30	3858.37	3797.07
	08/28/1996	**1420**	**2730**	61.57	3858.37	3796.80
	08/13/1997	**1400**	**2800**	61.75	3858.37	3796.62
	09/30/1999	**1094**	**2318**	62.51	3858.37	3795.86
	06/14/2000	**927**	**2040**	62.85	3858.37	3795.52
	06/18/2001	**813**	**1790**	63.07	3858.37	3795.30
	07/11/2002	**784**	**1680**	63.28	3858.37	3795.09
	07/02/2003	**715**	**2090**	63.66	3858.37	3794.71
	08/12/2004	**628**	**2050**	63.83	3858.37	3794.54
	08/10/2005	**774**	**1830**	62.62	3858.37	3795.75
	07/31/2006	**860**	**2010**	62.90	3858.37	3795.47
	07/27/2007	**732**	**1790**	63.43	3858.37	3794.94
	08/26/2008	**895**	**1960**	63.95	3858.37	3794.42
	07/15/2009	**852**	**2300**	64.25	3858.37	3794.12
	07/13/2010	**934**	**2590**	64.51	3858.37	3793.86
MW-2	09/30/1999	**298**	922	49.51	3841.64	3792.13
	06/14/2000	**317**	852	49.81	3841.64	3791.83
	06/18/2001	**288**	878	50.06	3841.64	3791.58
	07/11/2002	**284**	808	50.29	3841.64	3791.35
	07/02/2003	**268**	859	50.63	3841.64	3791.01
	08/12/2004	**451**	931	50.81	3841.64	3790.83
	08/10/2005	**355**	844	49.58	3841.64	3792.06
	07/31/2006	**401**	922	49.83	3841.64	3791.81
	07/27/2007	**430**	984	50.33	3841.64	3791.31
	08/26/2008	**354**	980	50.80	3841.64	3790.84
	07/15/2009	**482**	**1060**	51.04	3841.64	3790.60
	07/13/2010	**494**	**1070**	51.37	3841.64	3790.27
MW-3	09/30/1999	73.6	427	66.74	3864.73	3797.99
	06/14/2000	75.5	433	67.01	3864.73	3797.72
	06/18/2001	86.4	495	67.29	3864.73	3797.44
	07/11/2002	103	509	67.59	3864.73	3797.14
	07/02/2003	98.3	588	67.94	3864.73	3796.79
	08/12/2004	111	605	68.07	3864.73	3796.66
	08/10/2005	122	533	66.81	3864.73	3797.92
	07/31/2006	141	619	67.21	3864.73	3797.52
	07/27/2007	164	705	67.79	3864.73	3796.94
	08/26/2008	185	592	68.30	3864.73	3796.43
	07/15/2009	199	766	68.50	3864.73	3796.23
	07/13/2010	207	859	68.52	3864.73	3796.21

Continued on next page

Table 1

Summary of Groundwater Sampling Results

Monitoring Well	Sampling Date	Chloride (mg/L)	TDS (mg/L)	Depth to Groundwater (feet BTOC)	Top of Casing Elevation (feet AMSL)	Groundwater Elevation (feet AMSL)
MW-4	09/30/1999	**1576**	**2981**	60.18	3852.51	3792.33
	06/14/2000	**1500**	**2910**	60.55	3852.51	3791.96
	06/18/2001	**1530**	**3180**	60.78	3852.51	3791.73
	07/11/2002	**1290**	**2660**	60.98	3852.51	3791.53
	07/02/2003	**1250**	**2610**	61.34	3852.51	3791.17
	08/12/2004	**1130**	**2480**	61.50	3852.51	3791.01
	08/10/2005	**1050**	**2230**	60.25	3852.51	3792.26
	07/31/2006	**926**	**2030**	60.51	3852.51	3792.00
	07/27/2007	**758**	**1940**	61.04	3852.51	3791.47
	08/26/2008	**720**	**1790**	61.55	3852.51	3790.96
	07/15/2009	**632**	**1780**	61.83	3852.51	3790.68
	07/13/2010	**687**	**1750**	62.11	3852.51	3790.40
MW-5	06/14/2000	13.7	274	68.57	3859.84	3791.27
	06/18/2001	13.6	322	68.80	3859.84	3791.04
	07/11/2002	15.5	308	68.98	3859.84	3790.86
	07/02/2003	12.5	359	69.32	3859.84	3790.52
	08/12/2004	15.3	375	69.46	3859.84	3790.38
	08/10/2005	14.9	309	68.15	3859.84	3791.69
	07/31/2006	13.3	290	68.52	3859.84	3791.32
	07/27/2007	14.9	296	69.07	3859.84	3790.77
	08/26/2008	13.6	296	69.61	3859.84	3790.23
	07/15/2009	13.4	291	69.91	3859.84	3789.93
	07/13/2010	12.6	291	70.19	3859.84	3789.65
MW-6	06/14/2000	48.0	382	70.79	3858.78	3787.99
	06/18/2001	50.8	431	70.98	3858.78	3787.80
	07/11/2002	50.0	422	71.26	3858.78	3787.52
	07/02/2003	46.5	471	71.52	3858.78	3787.26
	08/12/2004	55.1	410	71.62	3858.78	3787.16
	08/10/2005	55.0	391	70.33	3858.78	3788.45
	07/31/2006	52.4	412	70.64	3858.78	3788.14
	07/27/2007	75.3	516	71.15	3858.78	3787.63
	08/26/2008	88.5	548	71.61	3858.78	3787.17
	07/15/2009	81.4	532	71.90	3858.78	3786.88
	07/13/2010	84.1	545	72.20	3858.78	3786.58
WQCC Standards		250	1000			

Total Dissolved Soilds (TDS) and chloride concentrations listed in milligrams per liter (mg/L)
Analyses performed by Trace Analysis Inc. (1995-1998), SPL, Inc. (1999-2005), and Lancaster Laboratories (2006-2010).
Values in boldface type indicate concentrations exceed New Mexico Water Quality Commission (WQCC) standards.
AMSL - Above Mean Sea Level; BTOC - Below Top of Casing
Groundwater flow direction is to the southeast with a gradient of approx. 0.004 ft/ft.
Elevations and state plane coordinates surveyed by Basin Surveys, Hobbs, NM.

4.0 Groundwater Quality Conditions

Groundwater sample analytical results are presented in Table 1 with the WQCC standards shown for comparison. Those constituents that recorded concentrations above the WQCC standards are highlighted in boldface type. The WQCC standard of 250 mg/L for chloride was exceeded in MW-1 (934 mg/L), MW-2 (494 mg/L), and MW-4 (687 mg/L). The WQCC standard of 1,000 mg/L for TDS was exceeded in MW-1 (2,590 mg/L), MW-2 (1,070 mg/L), and MW-4 (1,750 mg/L). The groundwater samples obtained from upgradient monitoring well MW-3 and downgradient wells MW-5 and MW-6 had chloride and TDS concentrations below WQCC standards.

The chloride and TDS concentrations are depicted graphically in Figure 3 and 4, respectively. Graphs depicting historical TDS and chloride concentrations in monitoring wells MW-1 through MW-6 are shown in Figures 5 and 6.

Chloride and total dissolved solids (TDS) concentrations in MW-1, near the source area, have generally decreased since 1996 with the exception of some fluctuations since the 2004 sampling event. Similarly, chloride and TDS levels have steadily decreased in the closest downgradient well, MW-4, since 1999 when that well was installed. This indicates that encapsulating the former saltwater disposal pit with solidification material in 1995, has eliminated the threat of any continued release from the source.

Monitoring well MW-3 continues to exhibit slight but steady increases in chloride and TDS concentrations since 2000, which suggests a possible offsite source of chlorides and TDS located upgradient (northwest) from the site. Chloride and TDS levels in MW-2, MW-5, and MW-6 have remained relatively consistent with previous years.

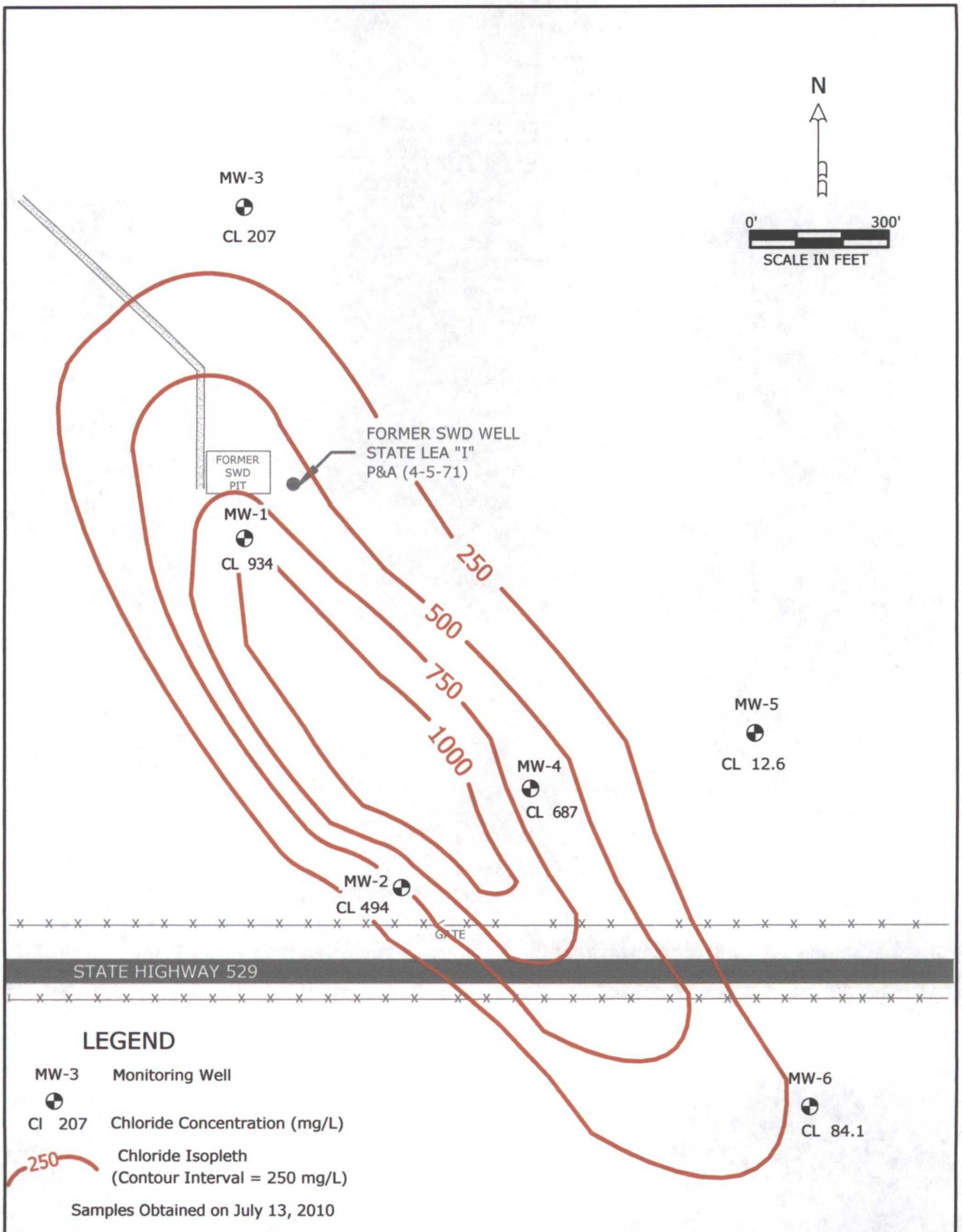

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FIGURE 3

Former Unocal South Vacuum Unit
Chloride Concentration Map
Current Conditions (2010)

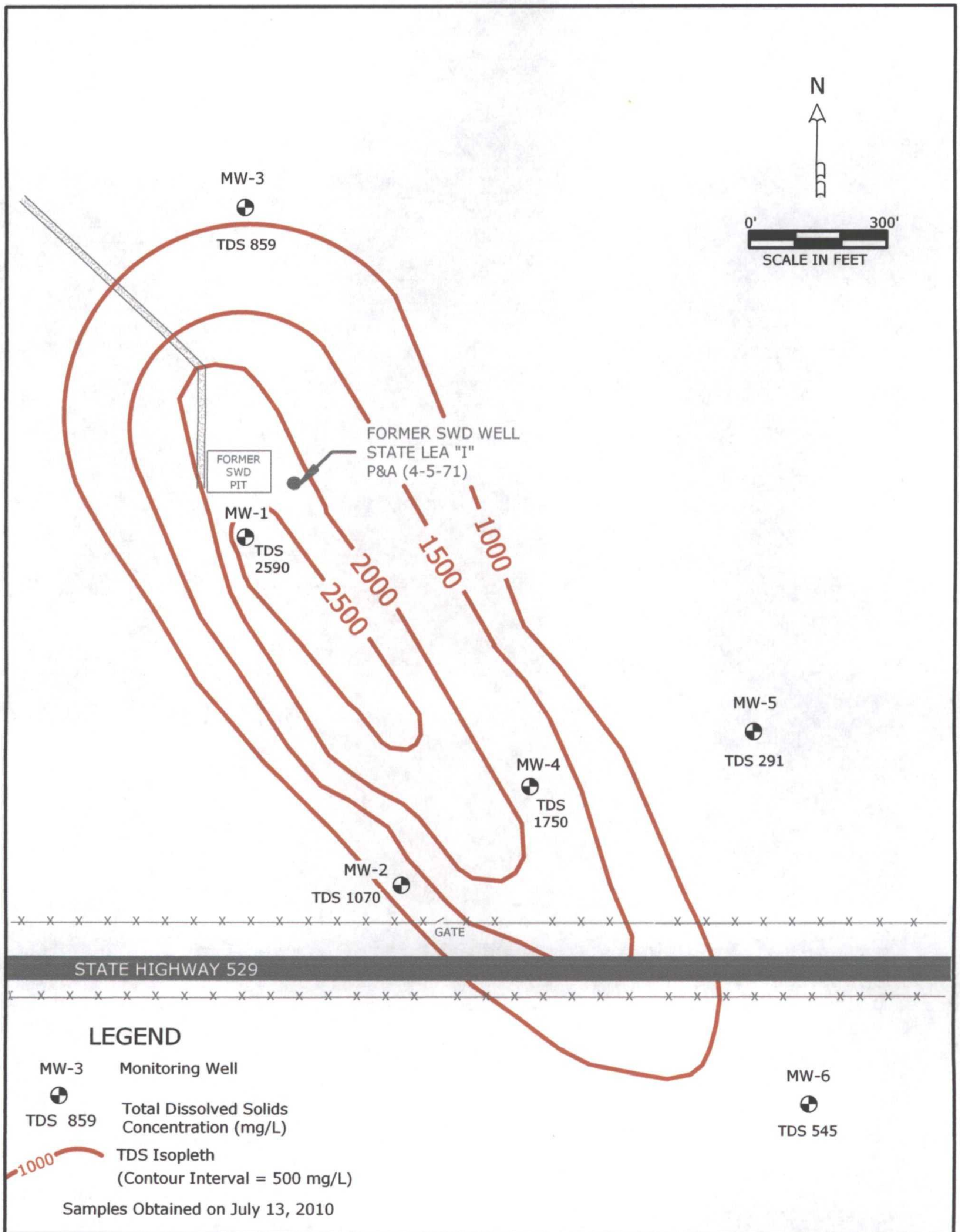

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FIGURE 4

Former Unocal South Vacuum Unit
TDS Concentration Map
Current Conditions (2010)

Figure 5
Chloride Concentrations Versus Time Graph

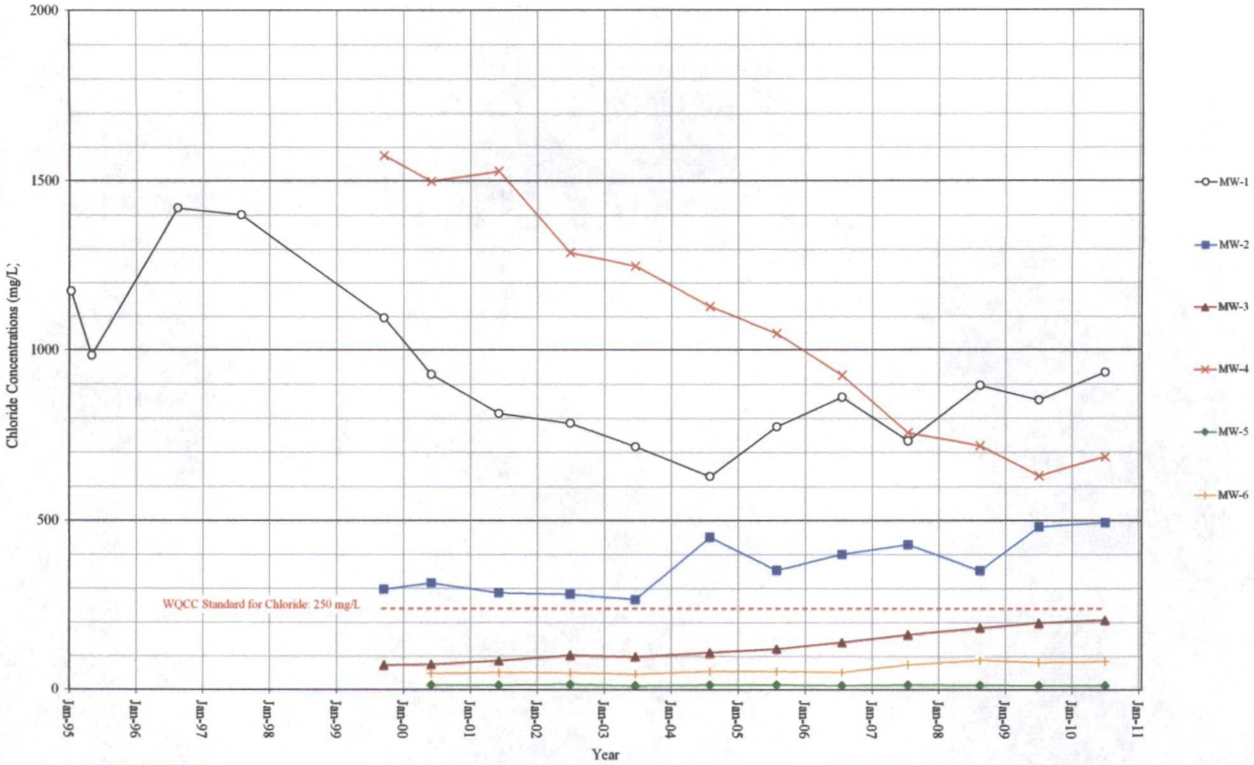
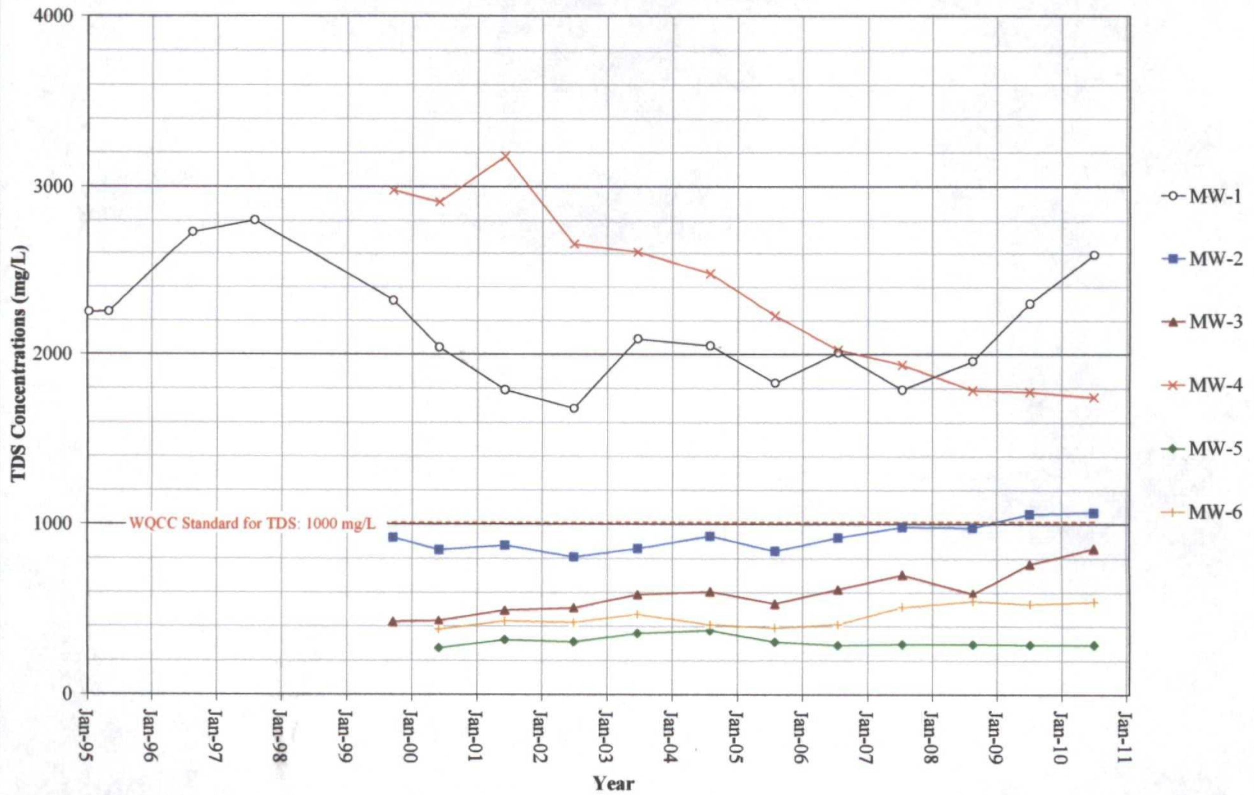


Figure 6
Total Dissolved Solids Concentrations Versus Time Graph



5.0 Fate and Transport Modeling Results

Fate and transport modeling was performed by Trident to simulate the movement of the chloride and TDS groundwater plume over time. Simulations were conducted using the two-dimensional groundwater flow and contaminant transport model WinTran, version 1.03 (1995) designed and distributed by Environmental Simulations, Inc. (ESI) of Herndon, Virginia. WinTran is built around a steady-state analytical element flow model, linked to a finite element contaminant transport model. A more detailed discussion of the flow and transport parameters used, assumptions, model calibrations, and simulation results are described in Appendix D.

Figures displaying modeled simulations of the chloride and TDS plumes over various time increments are included in Appendix C. Advective flow moves the center of plume mass downgradient as depicted in the simulations. The simulations also demonstrate how hydrodynamic dispersion serves to broaden the dimensions of the plume while reducing the concentrations in the middle of the plume.

Continued attenuation by dilution and dispersion of the plume, after the maximum chloride and TDS concentrations decrease to levels below WQCC standards, are shown in the final simulation for each constituent of concern (year 2157 for chloride and year 2094 for TDS, respectively). The center of the chloride plume is approximately 3,400 ft away from the pit and well source in the year 2157. The center of the TDS plume is approximately 2,300 ft away from the pit and well source in the year 2094.

The portions of the chloride and TDS plumes that are above WQCC standards do not reach any of the identified potential receptors at any time during their attenuation. The results of the updated fate and transport model are consistent with those determined in previous annual reports.

6.0 Conclusions

Conclusions relevant to groundwater conditions and the remediation performance at the Former Unocal South Vacuum Unit are presented below.

- Chloride and total dissolved solids (TDS) concentrations in MW-1, near the source area, have generally decreased since 1996 with the exception of some fluctuations since the 2004 sampling event. Similarly, chloride and TDS levels have significantly decreased in the closest downgradient well, MW-4, since 1999 when that well was installed. Chloride and TDS concentrations in well MW-3 have shown slight but steadily increasing trends indicating an upgradient contributing source of these constituents. Chloride and TDS concentrations in the remaining wells (MW-2, MW-5, and MW-6) have remained relatively consistent with previous levels.
- The fate and transport modeling results continue to support the contention that the chloride and TDS plume is not likely to impact existing sources of water supply, the closest of which, a livestock (windmill) well (permit number L 05339) lies over one-half mile south of the source. Operation of the windmill well has been discontinued due to declining water levels in the area and the shallow depth of the well.
- According to conservative model simulations, the chloride plume will travel a maximum of 3,400 feet southeast of the source in approximately 147 years before concentrations return to levels below the WQCC standard of 250 mg/L. The same analysis indicates that the TDS plume will travel only 2,300 feet in approximately 84 years before concentrations return to levels below the WQCC standard of 1,000 mg/L.
- Based on the modeling results and predicted natural attenuation processes (dispersion and dilution), there will be no adverse impact to human health and the environment nor will the livestock well exceed WQCC standards for chlorides or TDS due to the plume originating and traveling southeast, versus south, from the former emergency overflow pit.
- Groundwater elevations had steadily decreased at a rate of approximately 0.3 feet per year since the initial sampling event of monitoring well MW-1 in January 1995; however during 2005 the groundwater table increased to an elevation similar to the 1999 level. The recent rise may be attributed to higher than normal rainfall during 2004 and 2005. The decreasing groundwater elevation trend has resumed since 2005.

7.0 Recommendations

Chevron EMC has performed exemplary remedial actions to the source area, including plugging of the SWD well in 1971 and encapsulating the former saltwater disposal pit with solidification material in 1995, thus eliminating the threat of any continued release from the source. Based on the identified potential receptor and fate and transport modeling results, the chloride/TDS plume at the site presents low risk to human health and the environment; therefore Trident recommends the following actions for site closure:

- Continue the natural attenuation annual monitoring program with groundwater sampling and analysis of chloride and TDS concentrations for each of the six monitoring wells.

- Update flow and transport model to confirm the plume is naturally attenuating as described.

- Submit the 2011 annual groundwater monitoring report to OCD in January 2012 to document natural attenuation conditions.

APPENDIX A

Laboratory Analytical Reports
And
Chain-of-Custody Documentation

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

ANALYTICAL RESULTS

Prepared by:	Prepared for:
Lancaster Laboratories 2425 New Holland Pike Lancaster, PA 17605-2425	Chevron Environmental Mgmt Co 6111 Bollinger Canyon Road BR1Y / 3354 San Ramon CA 94583

July 16, 2010

Project: Former Unocal South Vacuum Unit, Lea County, NM

Submittal Date: 07/14/2010
Group Number: 1202874
PO Number: 0015061176
Release Number: MACLEOD
State of Sample Origin: NM

Client Sample Description	Lancaster Labs (LLI) #
MW-1 Grab Water Sample	6031121
MW-2 Grab Water Sample	6031122
MW-3 Grab Water Sample	6031123
MW-4 Grab Water Sample	6031124
MW-5 Grab Water Sample	6031125
MW-6 Grab Water Sample	6031126

The specific methodologies used in obtaining the enclosed analytical results are indicated on the Laboratory Sample Analysis Record.

ELECTRONIC COPY TO	ARCADIS	Attn: Mark M. Miller
ELECTRONIC COPY TO	ARCADIS	Attn: Allen Just
ELECTRONIC COPY TO	Trident Environmental	Attn: Gilbert Van Deventer
ELECTRONIC COPY TO	ARCADIS	Attn: Dana Koschel
ELECTRONIC COPY TO	ARCADIS	Attn: Sarah Huff
ELECTRONIC COPY TO	ARCADIS	Attn: Robin Simon

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Questions? Contact your Client Services Representative
Katherine A Klinefelter at (717) 656-2300 Ext. 1566

Respectfully Submitted,

Robert Heisey

Robert Heisey
Senior Specialist

Lancaster Laboratories
2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Analysis Report

Sample Description: MW-1 Grab Water Sample
Former Unocal South Vacuum Unit
Lea County, NM

LLI Sample # WW 6031121
LLI Group # 1202874
Account # 11969

Project Name: Former Unocal South Vacuum Unit, Lea County, NM

Collected: 07/13/2010 12:30 by GV

Submitted: 07/14/2010 09:20
Reported: 07/16/2010 16:00
Discard: 08/16/2010

Chevron Environmental Mgmt Co
6111 Bollinger Canyon Road
BR1Y / 3354
San Ramon CA 94583

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Dilution Factor
Wet Chemistry	**SM20 2540 C**		mg/l	mg/l	mg/l	
00212	Total Dissolved Solids	n.a.	2,590	77.6	240	1
	SM20 4500 Cl C		mg/l	mg/l	mg/l	
01124	Chloride (titrimetric)	16887-00-6	934	20.0	100	50

General Sample Comments

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
00212	Total Dissolved Solids	SM20 2540 C	1	10196021201B	07/15/2010 09:40	Susan E Hibner	1
01124	Chloride (titrimetric)	SM20 4500 Cl C	1	10196112402A	07/15/2010 14:05	Susan A Engle	50

*=This limit was used in the evaluation of the final result

Lancaster Laboratories
2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Analysis Report

Sample Description: MW-2 Grab Water Sample
Former Unocal South Vacuum Unit
Lea County, NM

LLI Sample # WW 6031122
LLI Group # 1202874
Account # 11969

Project Name: Former Unocal South Vacuum Unit, Lea County, NM

Collected: 07/13/2010 13:00 by GV

Submitted: 07/14/2010 09:20
Reported: 07/16/2010 16:00
Discard: 08/16/2010

Chevron Environmental Mgmt Co
6111 Bollinger Canyon Road
BR1Y / 3354
San Ramon CA 94583

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Dilution Factor
Wet Chemistry	SM20 2540 C		mg/l	mg/l	mg/l	
00212	Total Dissolved Solids	n.a.	1,070	38.8	120	1
	SM20 4500 Cl C		mg/l	mg/l	mg/l	
01124	Chloride (titrimetric)	16887-00-6	494	8.0	40.0	20

General Sample Comments

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
00212	Total Dissolved Solids	SM20 2540 C	1	10196021201B	07/15/2010 09:40	Susan E Hibner	1
01124	Chloride (titrimetric)	SM20 4500 Cl C	1	10196112402A	07/15/2010 14:05	Susan A Engle	20

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

Analysis Report

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Sample Description: MW-3 Grab Water Sample
Former Unocal South Vacuum Unit
Lea County, NM

LLI Sample # WW 6031123
LLI Group # 1202874
Account # 11969

Project Name: Former Unocal South Vacuum Unit, Lea County, NM

Collected: 07/13/2010 09:55 by GV

Submitted: 07/14/2010 09:20
Reported: 07/16/2010 16:00
Discard: 08/16/2010

Chevron Environmental Mgmt Co
6111 Bollinger Canyon Road
BR1Y / 3354
San Ramon CA 94583

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Dilution Factor
Wet Chemistry	SM20 2540 C		mg/l	mg/l	mg/l	
00212	Total Dissolved Solids	n.a.	859	19.4	60.0	1
	SM20 4500 Cl C		mg/l	mg/l	mg/l	
01124	Chloride (titrimetric)	16887-00-6	207	4.0	20.0	10

General Sample Comments

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
00212	Total Dissolved Solids	SM20 2540 C	1	10196021201B	07/15/2010 09:40	Susan E Hibner	1
01124	Chloride (titrimetric)	SM20 4500 Cl C	1	10196112402A	07/15/2010 14:05	Susan A Engle	10

Lancaster Laboratories

Analysis Report

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Sample Description: MW-4 Grab Water Sample
Former Unocal South Vacuum Unit
Lea County, NM

LLI Sample # WW 6031124
LLI Group # 1202874
Account # 11969

Project Name: Former Unocal South Vacuum Unit, Lea County, NM

Collected: 07/13/2010 11:30 by GV

Submitted: 07/14/2010 09:20
Reported: 07/16/2010 16:00
Discard: 08/16/2010

Chevron Environmental Mgmt Co
6111 Bollinger Canyon Road
BR1Y / 3354
San Ramon CA 94583

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Dilution Factor
Wet Chemistry	**SM20 2540 C**		mg/l	mg/l	mg/l	
00212	Total Dissolved Solids	n.a.	1,750	77.6	240	1
	SM20 4500 Cl C		mg/l	mg/l	mg/l	
01124	Chloride (titrimetric)	16887-00-6	687	20.0	100	50

General Sample Comments

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
00212	Total Dissolved Solids	SM20 2540 C	1	10196021201B	07/15/2010 09:40	Susan E Hibner	1
01124	Chloride (titrimetric)	SM20 4500 Cl C	1	10196112402A	07/15/2010 14:05	Susan A Engle	50

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

Analysis Report

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Sample Description: MW-5 Grab Water Sample
Former Unocal South Vacuum Unit
Lea County, NM

LLI Sample # WW 6031125
LLI Group # 1202874
Account # 11969

Project Name: Former Unocal South Vacuum Unit, Lea County, NM

Collected: 07/13/2010 10:45 by GV

Submitted: 07/14/2010 09:20
Reported: 07/16/2010 16:00
Discard: 08/16/2010

Chevron Environmental Mgmt Co
6111 Bollinger Canyon Road
BR1Y / 3354
San Ramon CA 94583

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Dilution Factor
Wet Chemistry	SM20 2540 C		mg/l	mg/l	mg/l	
00212	Total Dissolved Solids	n.a.	291	9.7	30.0	1
	SM20 4500 Cl C		mg/l	mg/l	mg/l	
01124	Chloride (titrimetric)	16887-00-6	12.6	0.80	4.0	2

General Sample Comments

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
00212	Total Dissolved Solids	SM20 2540 C	1	10196021201B	07/15/2010 09:40	Susan E Hibner	1
01124	Chloride (titrimetric)	SM20 4500 Cl C	1	10196112402A	07/15/2010 14:05	Susan A Engle	2

*=This limit was used in the evaluation of the final result

Lancaster Laboratories
2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Analysis Report

Sample Description: MW-6 Grab Water Sample
Former Unocal South Vacuum Unit
Lea County, NM

LLI Sample # WW 6031126
LLI Group # 1202874
Account # 11969

Project Name: Former Unocal South Vacuum Unit, Lea County, NM

Collected: 07/13/2010 14:00 by GV
Submitted: 07/14/2010 09:20
Reported: 07/16/2010 16:00
Discard: 08/16/2010

Chevron Environmental Mgmt Co
6111 Bollinger Canyon Road
BR1Y / 3354
San Ramon CA 94583

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Dilution Factor
Wet Chemistry	SM20 2540 C		mg/l	mg/l	mg/l	
00212	Total Dissolved Solids	n.a.	545	9.7	30.0	1
	SM20 4500 Cl C		mg/l	mg/l	mg/l	
01124	Chloride (titrimetric)	16887-00-6	84.1	0.80	4.0	2

General Sample Comments

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
00212	Total Dissolved Solids	SM20 2540 C	1	10196021201B	07/15/2010 09:40	Susan E Hibner	1
01124	Chloride (titrimetric)	SM20 4500 Cl C	1	10196112402A	07/15/2010 14:05	Susan A Engle	2

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

Analysis Report

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Quality Control Summary

Client Name: Chevron Environmental Mgmt Co
Reported: 07/16/10 at 04:00 PM

Group Number: 1202874

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Laboratory Compliance Quality Control

Analysis Name	Blank Result	Blank MDL**	Blank LOQ	Report Units	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
Batch number: 10196021201B	Sample number(s): 6031121-6031126								
Total Dissolved Solids	N.D.	9.7	30.0	mg/l	100		80-120		
Batch number: 10196112402A	Sample number(s): 6031121-6031126								
Chloride (titrimetric)					98		95-103		

Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 10196021201B	Sample number(s): 6031121-6031126 UNSPK: P031054 BKG: P031972								
Total Dissolved Solids	100		62-135			990	980	1	9
Batch number: 10196112402A	Sample number(s): 6031121-6031126 UNSPK: P029530 BKG: P029530								
Chloride (titrimetric)	97	96	85-110	1	3	70.0	68.0	3 (1)	5

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

Analysis Request/Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only
Acct. # 11969 Group# 1202874 Sample # 6031121-26

COC # 242876

Please print. Instructions on reverse side correspond with circled numbers.

For Lab Use Only
FSC:
SCR#: 92786

(1) Client: Chevron EMC Acct. #:
Project Name/#: Former Unocal S. Vacuum Unit PWSID #:
Project Manager: John MacLeod (Chevron EMC) Allen Just (Arcadis) P.O.#:
Sampler: Gil Van Deventer (Trident Env) Quote #:
Name of state where samples were collected: NM

Matrix: ☐ Potable ☐ NPDES — Check if Applicable

(5) Analyses Requested / Preservation Codes

Preservation Codes: H=HCl, T=Thiosulfate, N=HNO_3, B=NaOH, S=H_2SO_4, O=Other

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	Soil	Water	Other	(4) Total # of Containers	Chloride	TDS								Remarks	(6) Temperature of samples upon receipt (if requested)
MW-1	7-13-10	1230	✓			✓		1											1.9°C
MW-2	7-13-10	1300	✓			✓		1											
MW-3	7-13-10	0955	✓			✓		1											
MW-4	7-13-10	1130	✓			✓		1											
MW-5	7-13-10	1045	✓			✓		1											
MW-6	7-13-10	1400	✓			✓		1											
																		Email results to:	
																		gil@trident-environmental.com	

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ) Site-specific QC (MS/MSD/Dup)? Yes No
Type IV (CLP SOW) (If yes, indicate QC sample and submit triplicate volume.)
Type VI (Raw Data Only) Internal COC Required? Yes / No

SDG Complete? Yes No

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
S. Muckle	7/6/10	9:20	Gil Van Deventer	7/7/10	10:30
Gil Van Deventer	7/13/10	4:45			
			Kristin [illegible]	7/14/10	0920

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

Issued by Dept. 6042 Management 2102.05

Lancaster Laboratories

Environmental Sample Administration
Receipt Documentation Log

Client/Project: Chevron EMC

Date of Receipt: 7-14-10

Time of Receipt: 0920

Source Code: 50-1

Unpacker Emp. No.: 2123

Shipping Container Sealed: YES NO

Custody Seal Present * : YES NO

* Custody seal was intact unless otherwise noted in the discrepancy section

Package: Chilled Not Chilled

Temperature of Shipping Containers							
Cooler #	Thermometer ID	Temperature (°C)	Temp Bottle (TB) or Surface Temp (ST)	Wet Ice (WI) or Dry Ice (DI) or Ice Packs (IP)	Ice Present? Y/N	Loose (L) Bagged Ice (B) or NA	Comments
1	9422	1.9°	TB	WI	Y	L	
2							
3							
4							
5							
6							

Number of Trip Blanks received NOT listed on chain of custody: 0

Paperwork Discrepancy/Unpacking Problems:

Sample Administration Internal Chain of Custody			
Name	Date	Time	Reason for Transfer
Kristin Nagle	7-14-10	1050	Unpacking
Annelise H. Owens	7/14/10	1110	Place in Storage or Entry
			Entry
			Entry

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

RL	Reporting Limit	**BMQL**	Below Minimum Quantitation Level
N.D.	none detected	**MPN**	Most Probable Number
TNTC	Too Numerous To Count	**CP Units**	cobalt-chloroplatinate units
IU	International Units	**NTU**	nephelometric turbidity units
umhos/cm	micromhos/cm	**ng**	nanogram(s)
C	degrees Celsius	**F**	degrees Fahrenheit
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< less than - The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

> greater than

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

ppm parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

ppb parts per billion

Dry weight basis Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers

A	TIC is a possible aldol-condensation product
B	Analyte was also detected in the blank
C	Pesticide result confirmed by GC/MS
D	Compound quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
N	Presumptive evidence of a compound (TICs only)
P	Concentration difference between primary and confirmation columns >25%
U	Compound was not detected
X,Y,Z	Defined in case narrative

Inorganic Qualifiers

B	Value is <CRDL, but ≥IDL
E	Estimated due to interference
M	Duplicate injection precision not met
N	Spike sample not within control limits
S	Method of standard additions (MSA) used for calculation
U	Compound was not detected
W	Post digestion spike out of control limits
*	Duplicate analysis not within control limits
+	Correlation coefficient for MSA <0.995

Analytical test results meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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APPENDIX B

Monitoring Well Sampling Data Form

WELL SAMPLING DATA FORM

TRIDENT ENVIRONMENTAL

CLIENT: Chevron Environmental Management Corp.
SITE NAME: Former Unocal South Vacuum Unit (1R-277)
ꞩITE LOCATION: T18S - R35E - Sec 35, Lea County, NM
SAMPLER: Gil Van Deventer

PURGING METHOD: ☐ Hand Bailed ☑ Pump, Type: Proactive Super Twister 3-Stage Pump
SAMPLING METHOD: ☑ Disposable Bailer ☐ Direct from Discharge Hose ☐ Other: ______
ꞩPOSAL METHOD OF PURGE WATER: ☐ On-site Drum ☐ Drums ☑ SWD Disposal Facility

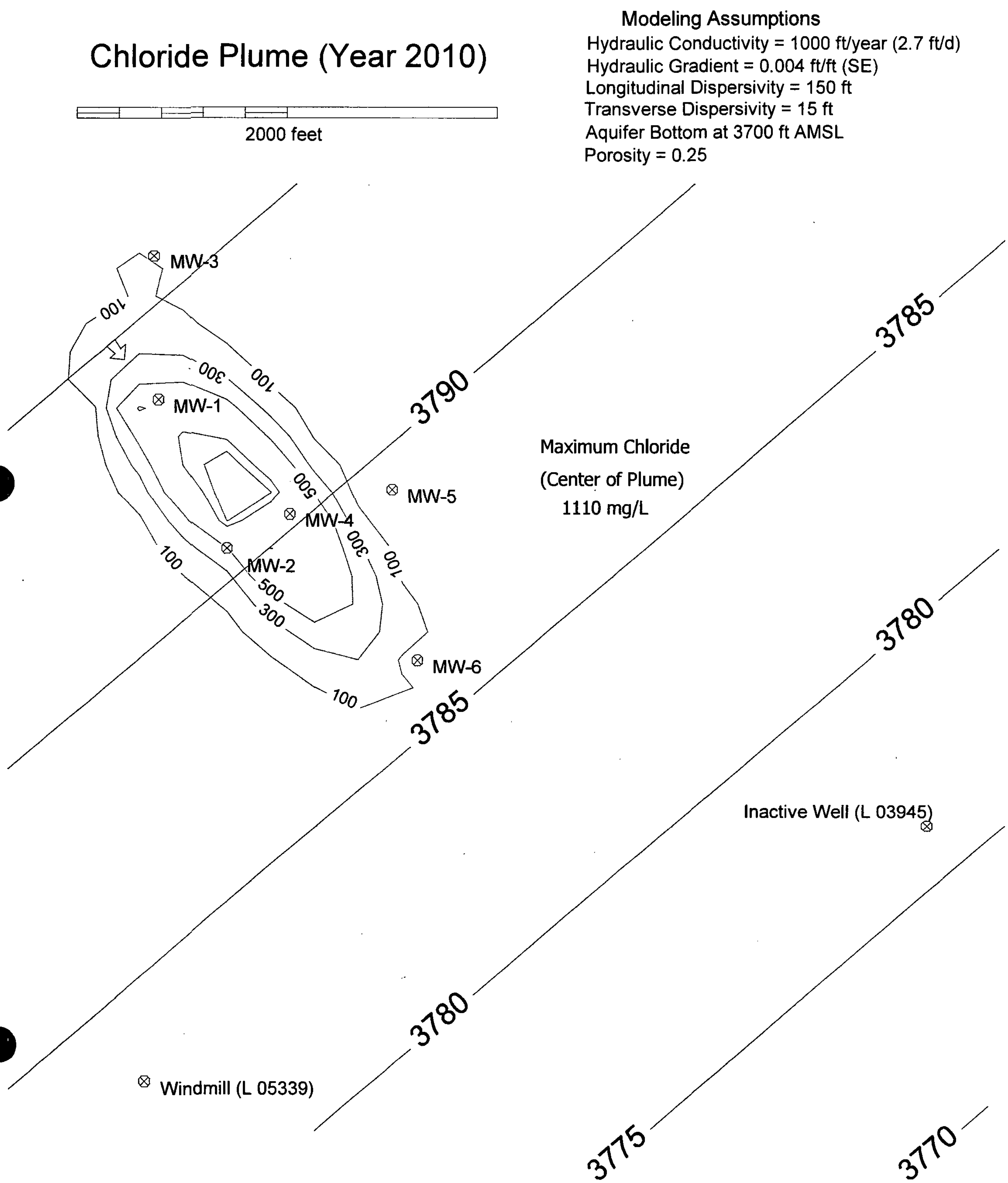
Date	Time	Monitoring Well No.	Depth to Water (ft btoc)	Total Depth (ft)	Water Column Height (ft)	Well Factor 2"=.16 4"=.65	Calc. Well Vol. (gal)	Volume Purged (gal)	No. of Well Volumes Purged	Temp. °C	Cond. mS/cm	pH	PHYSICAL APPEARANCE AND REMARKS
07/13/10	12:30	MW-1	64.51	70.00	5.49	0.16	0.9	4	4.6	20.9	3.31	7.7	Clear
07/13/10	13:00	MW-2	51.37	71.00	19.63	0.16	3.1	10	3.2	20.3	1.92	8.2	Clear
07/13/10	9:55	MW-3	68.52	77.00	8.48	0.16	1.4	5	3.7	20.1	1.00	7.6	Clear
07/13/10	11:30	MW-4	62.11	71.00	8.89	0.16	1.4	5	3.5	21.3	2.95	8.1	Clear
07/13/10	10:45	MW-5	70.19	79.00	8.81	0.16	1.4	5	3.5	19.8	0.42	7.5	Clear
07/13/10	14:00	MW-6	72.20	77.20	5.00	0.16	0.8	3	3.8	20.8	0.82	7.8	Clear

COMMENTS: Equipment decontamination consists of gloves, Alconox, and Distilled Water Rinse.
Hanna Model 98130 instrument used to obtain pH, conductivity, and temperature measurements.
Shipped samples via FedEx to Lancaster Laboratories for chloride and TDS analysis.

APPENDIX C

Chloride and TDS Plume Simulations

WinTran Fate & Transport Modeling Results
Former Unocal South Vacuum Unit Site

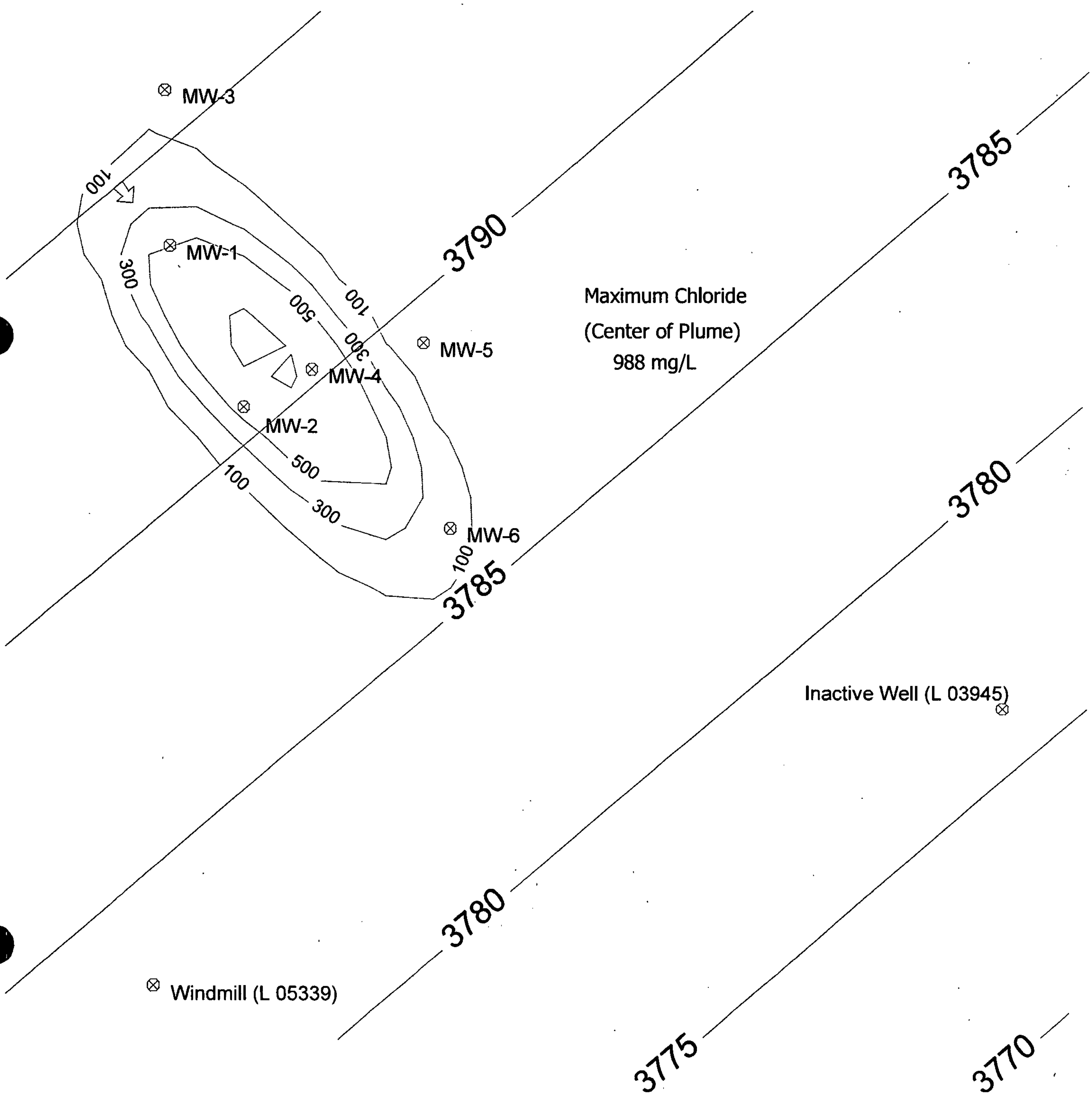


WinTran Fate & Transport Modeling Results
Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2015)

2000 feet

Modeling Assumptions
Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25

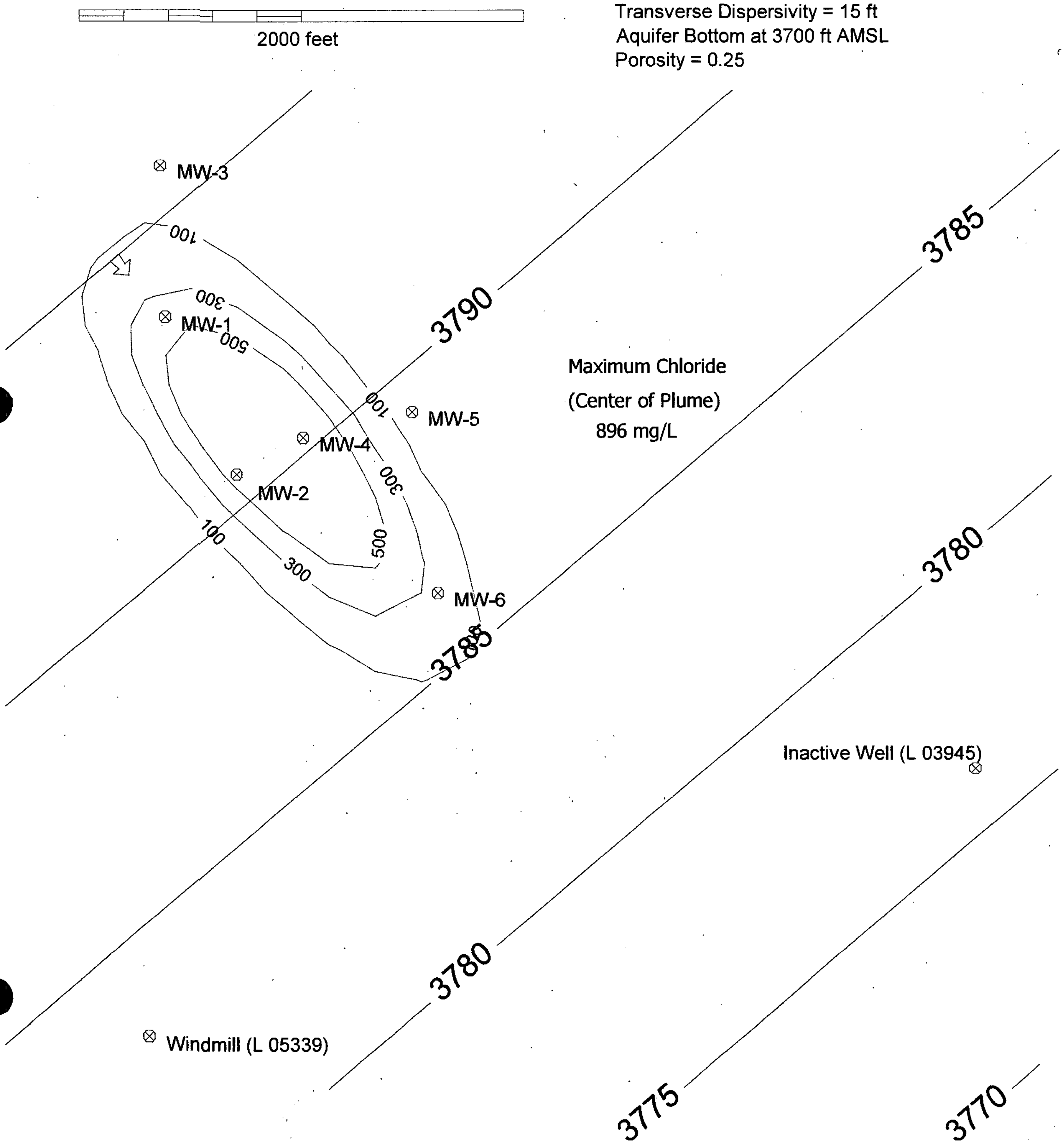


WinTran Fate & Transport Modeling Results
Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2020)

Modeling Assumptions

Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



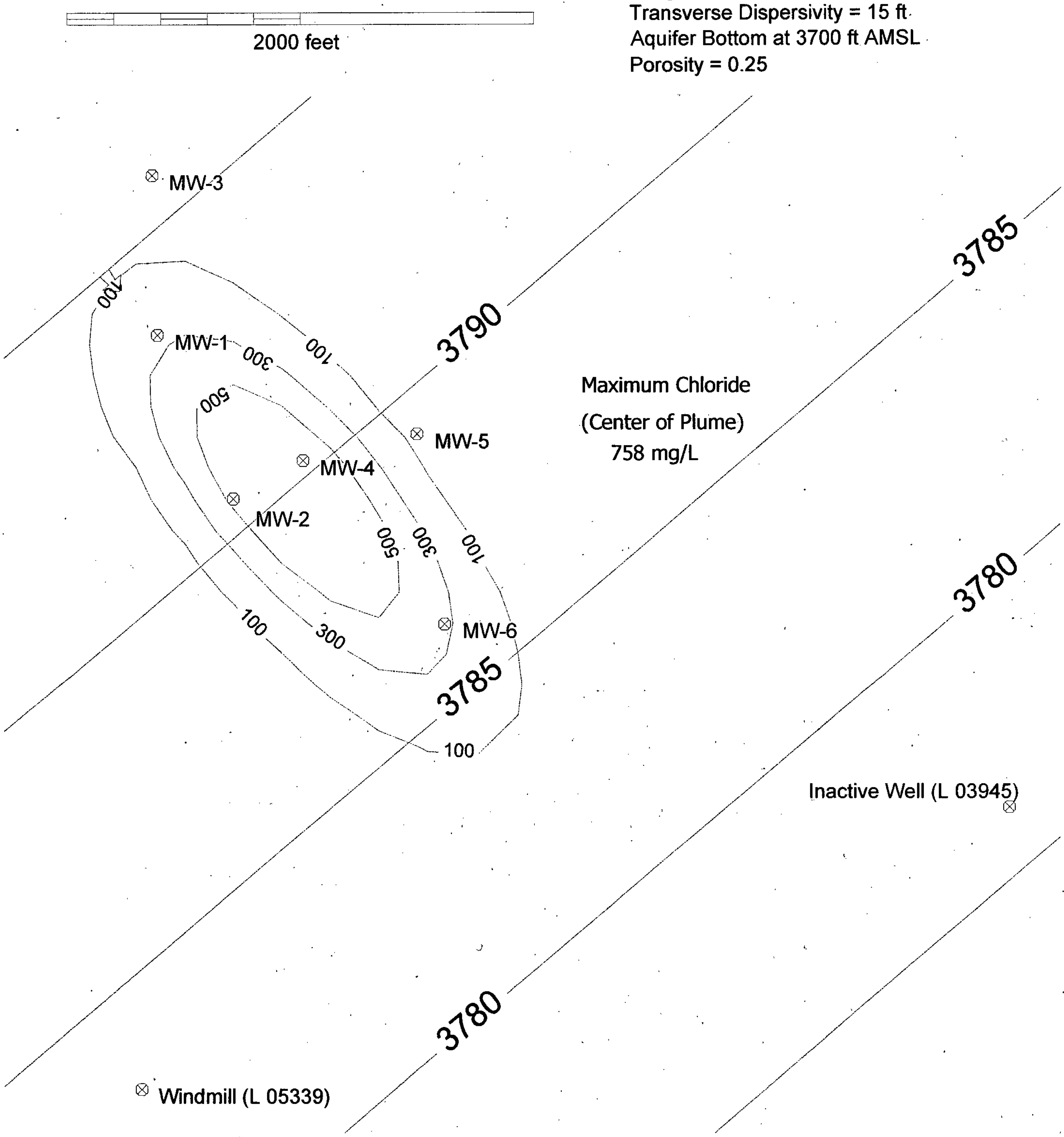
WinTran Fate & Transport Modeling Results

Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2030)

Modeling Assumptions

Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25

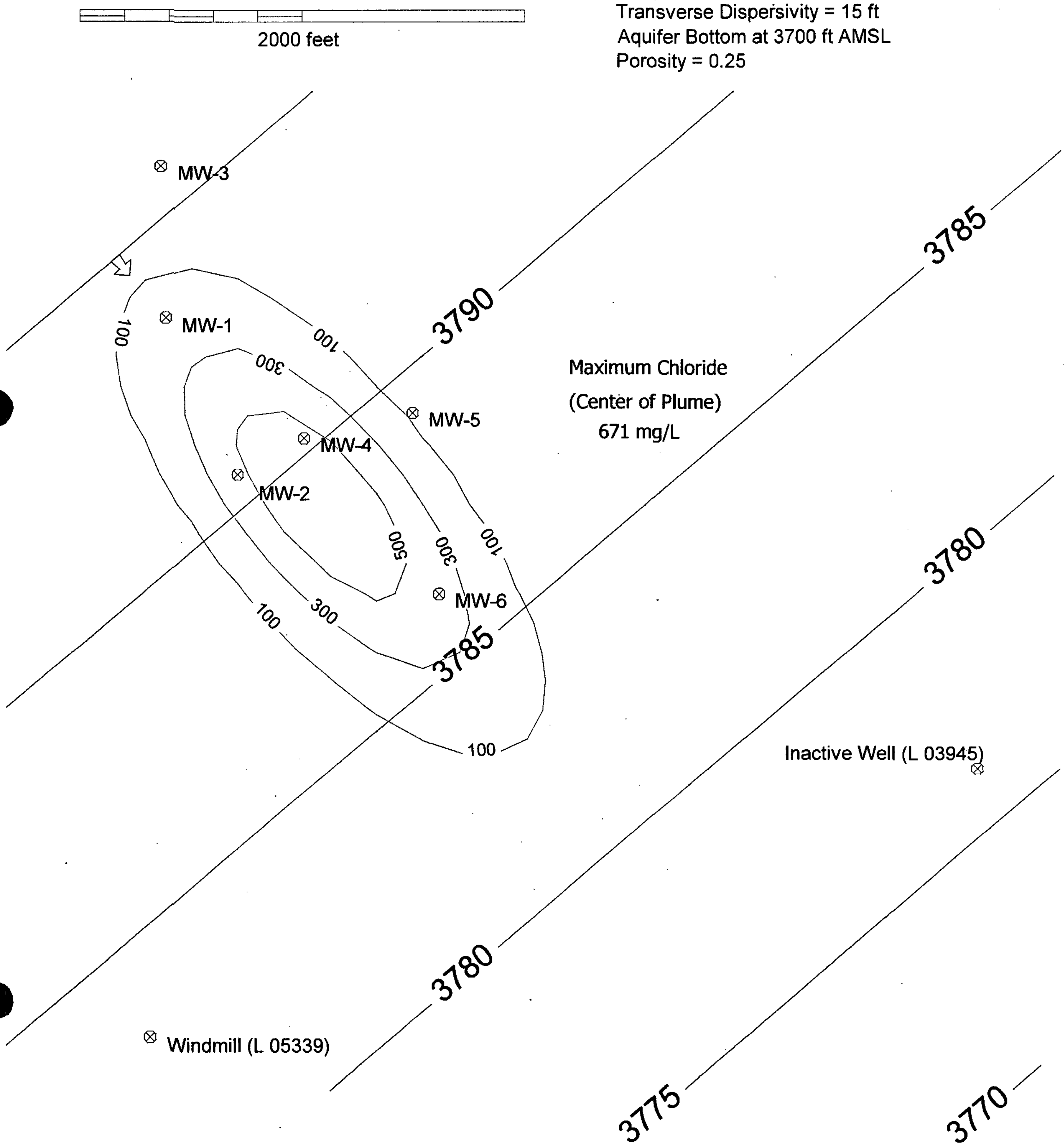


WinTran Fate & Transport Modeling Results
Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2040)

Modeling Assumptions

Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



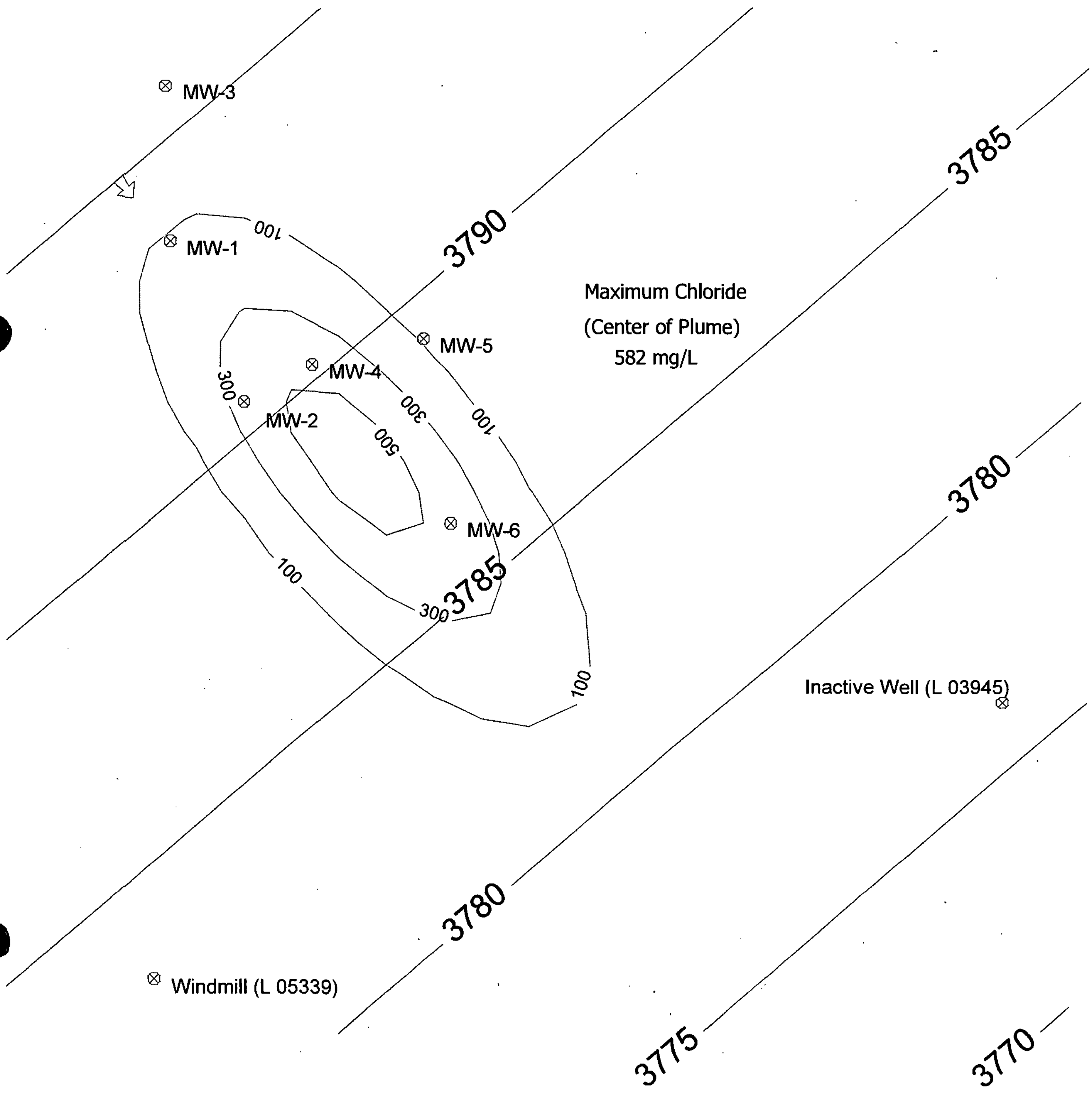
WinTran Fate & Transport Modeling Results
Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2050)

2000 feet

Modeling Assumptions

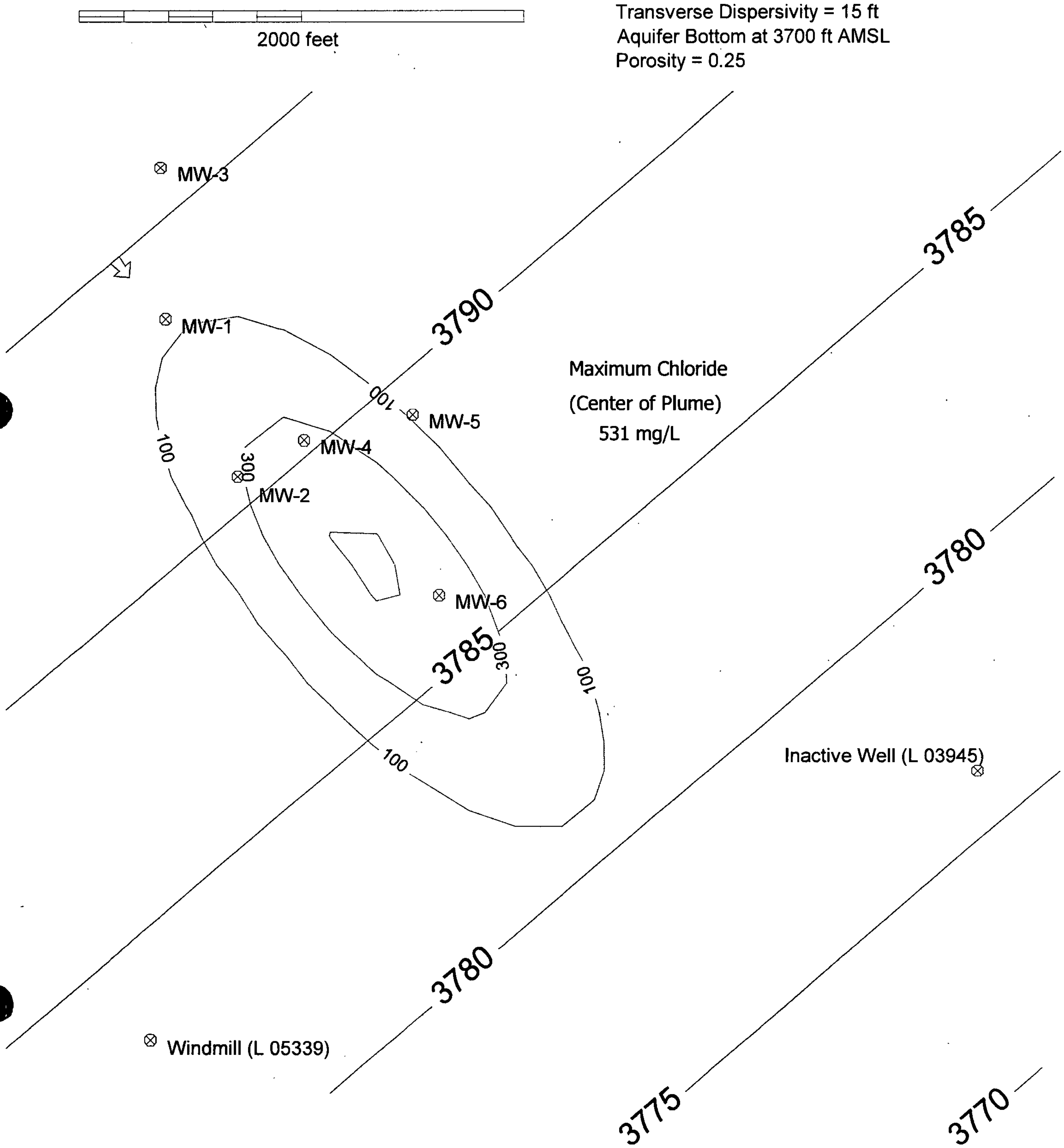
Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



WinTran Fate & Transport Modeling Results
Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2060)

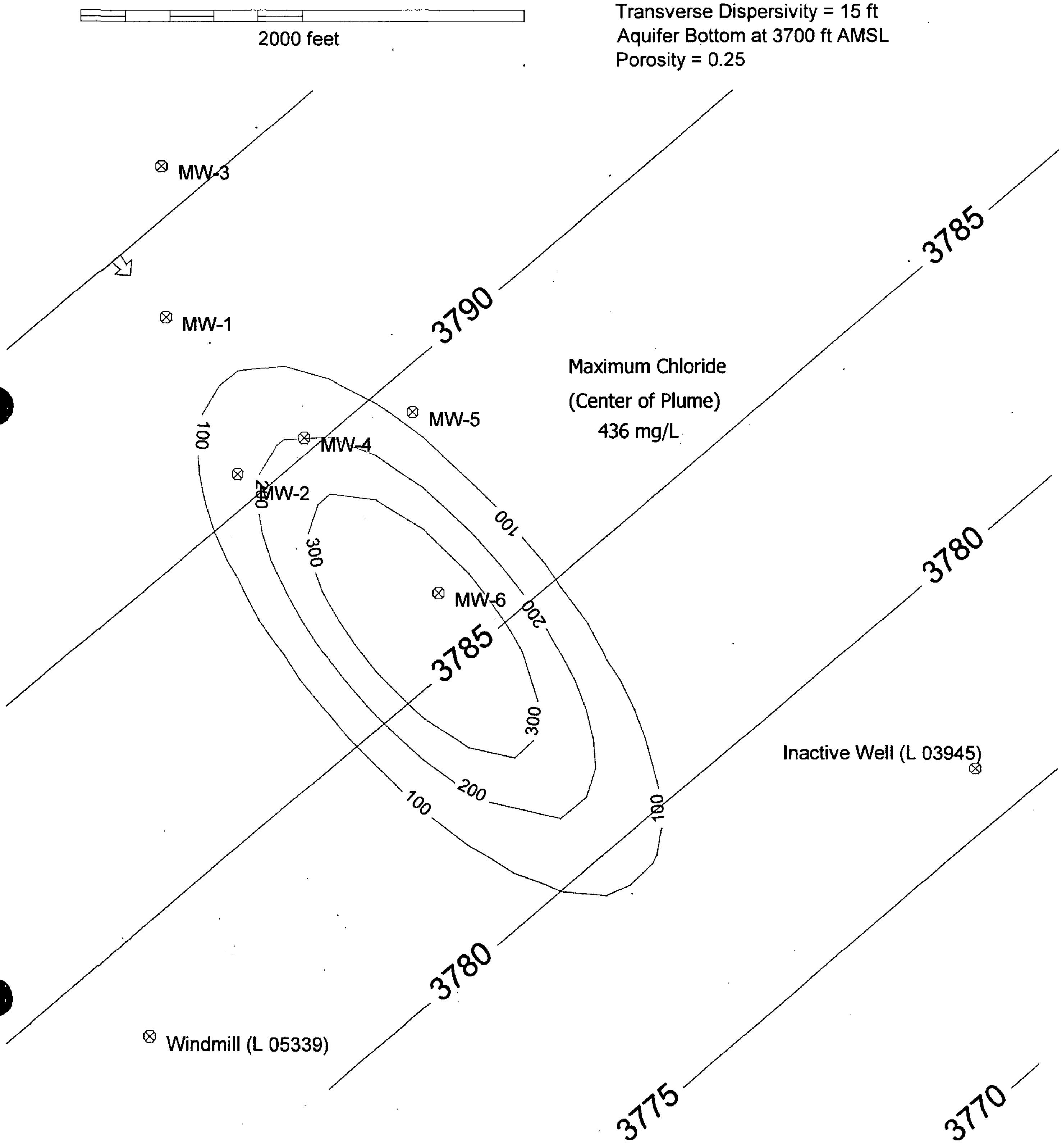
Modeling Assumptions
Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



WinTran Fate & Transport Modeling Results
Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2080)

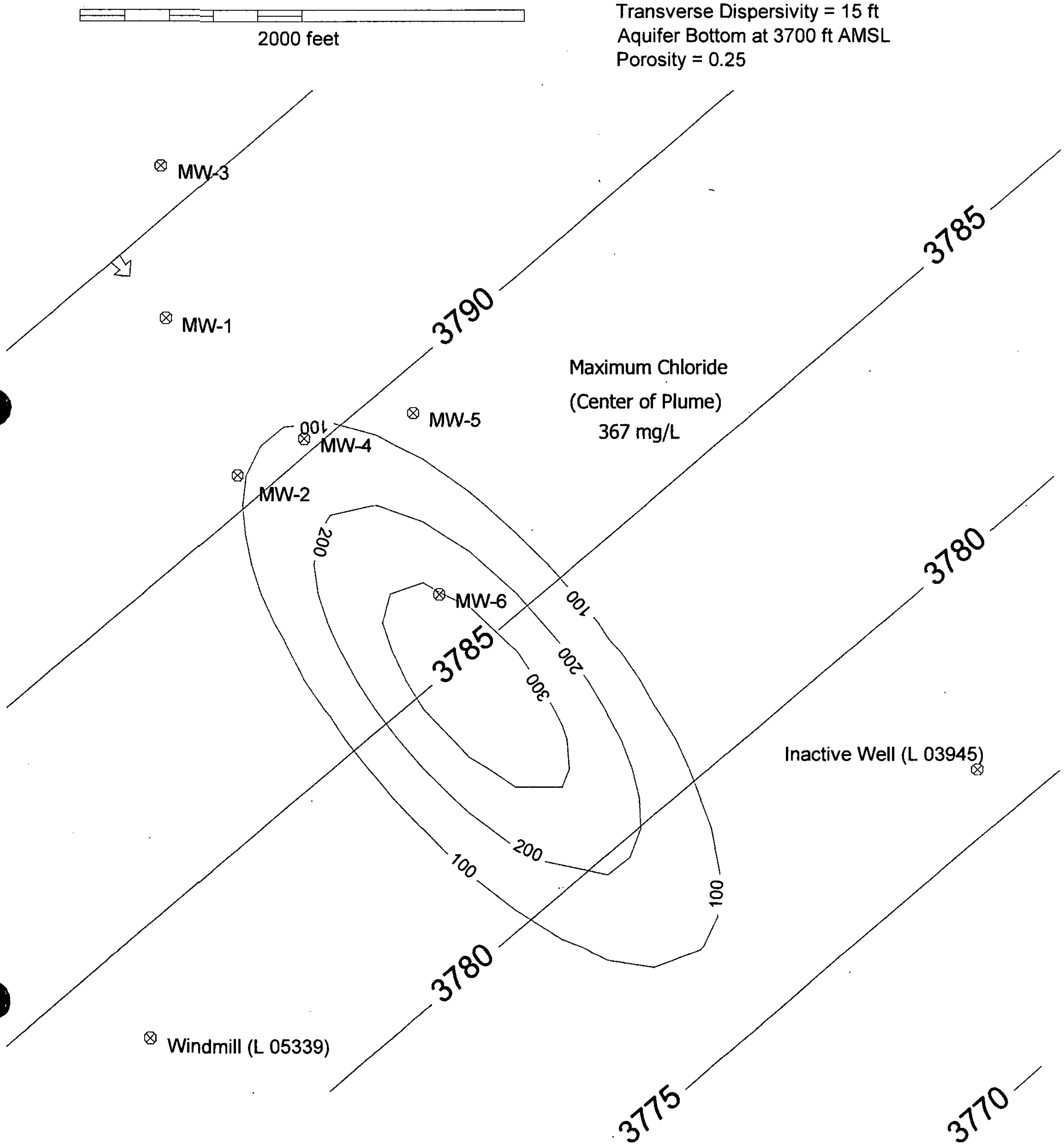
Modeling Assumptions
Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



WinTran Fate & Transport Modeling Results
Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2100)

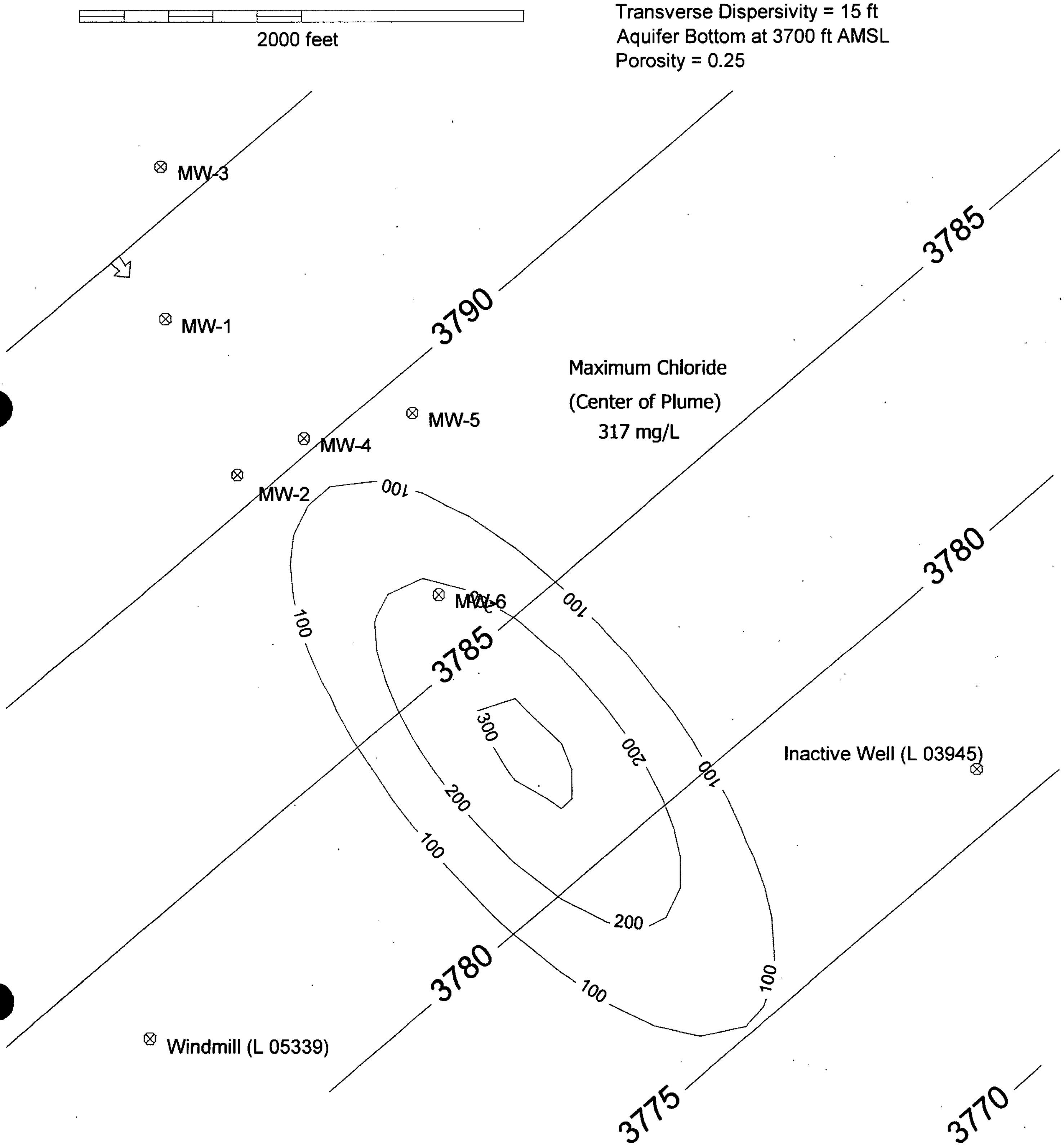
Modeling Assumptions
Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



WinTran Fate & Transport Modeling Results
Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2120)

Modeling Assumptions
Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



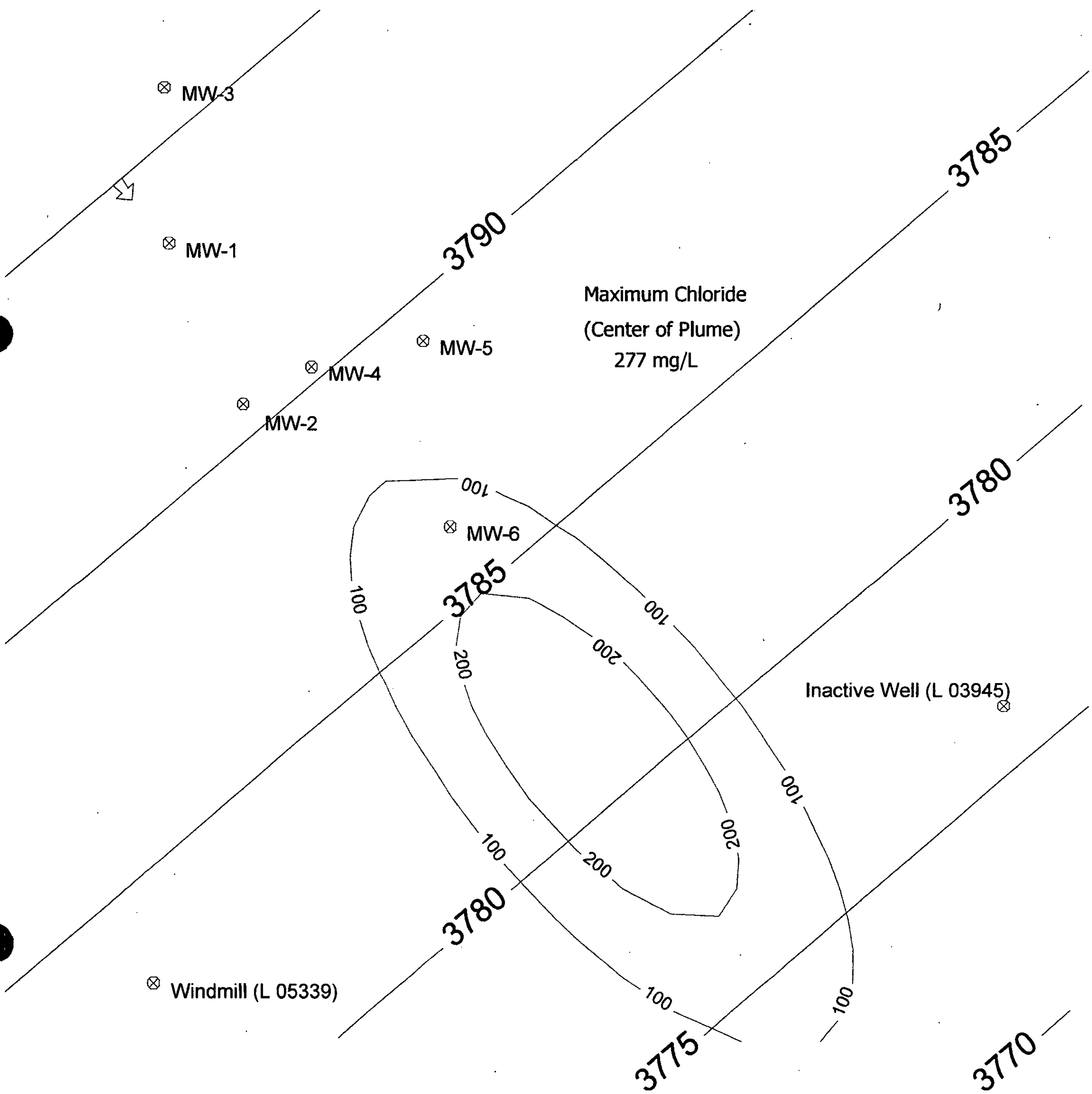
WinTran Fate & Transport Modeling Results
Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2140)

2000 feet

Modeling Assumptions

Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



WinTran Fate & Transport Modeling Results

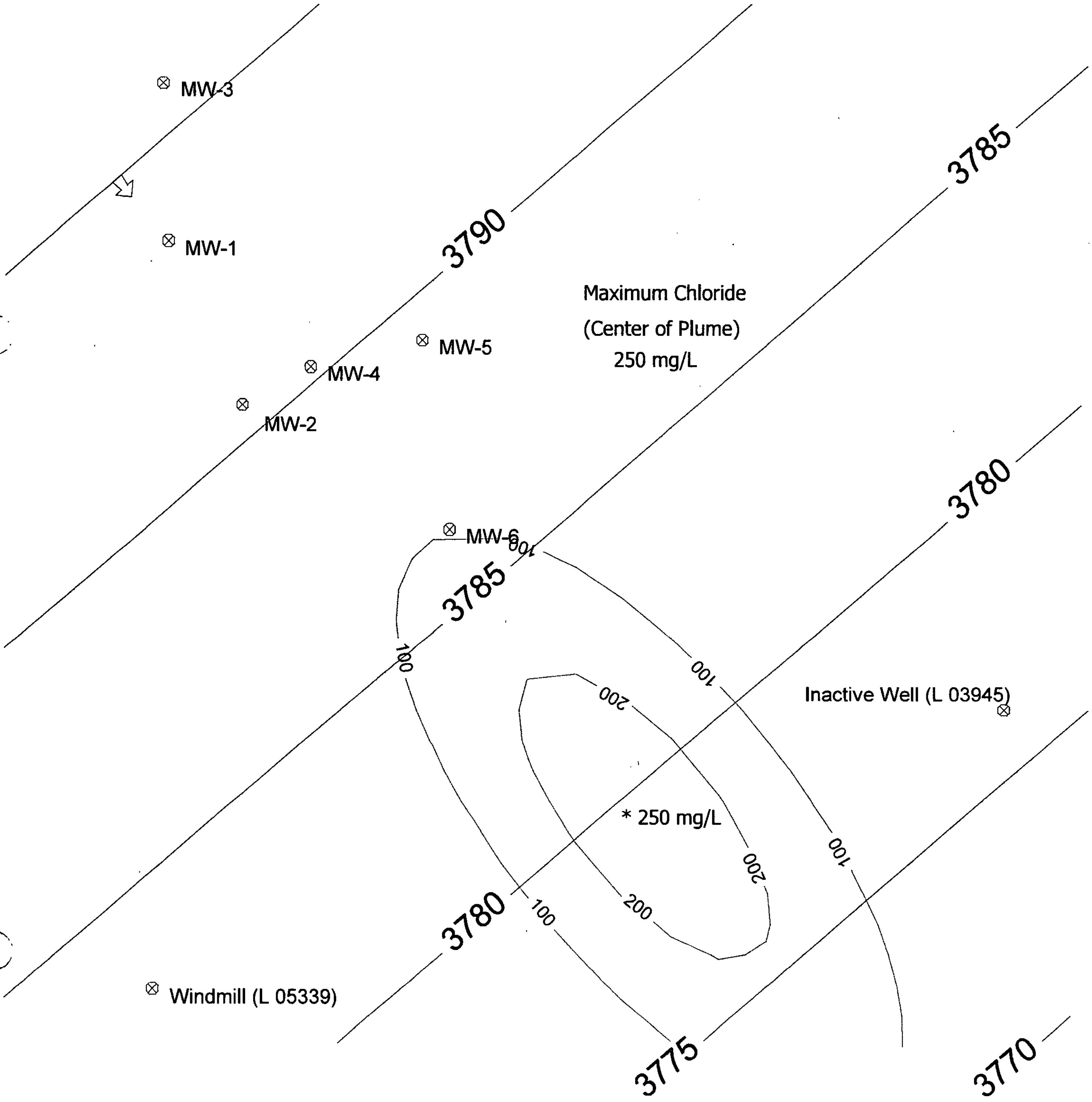
Former Unocal South Vacuum Unit Site

Chloride Plume (Year 2157)

2000 feet

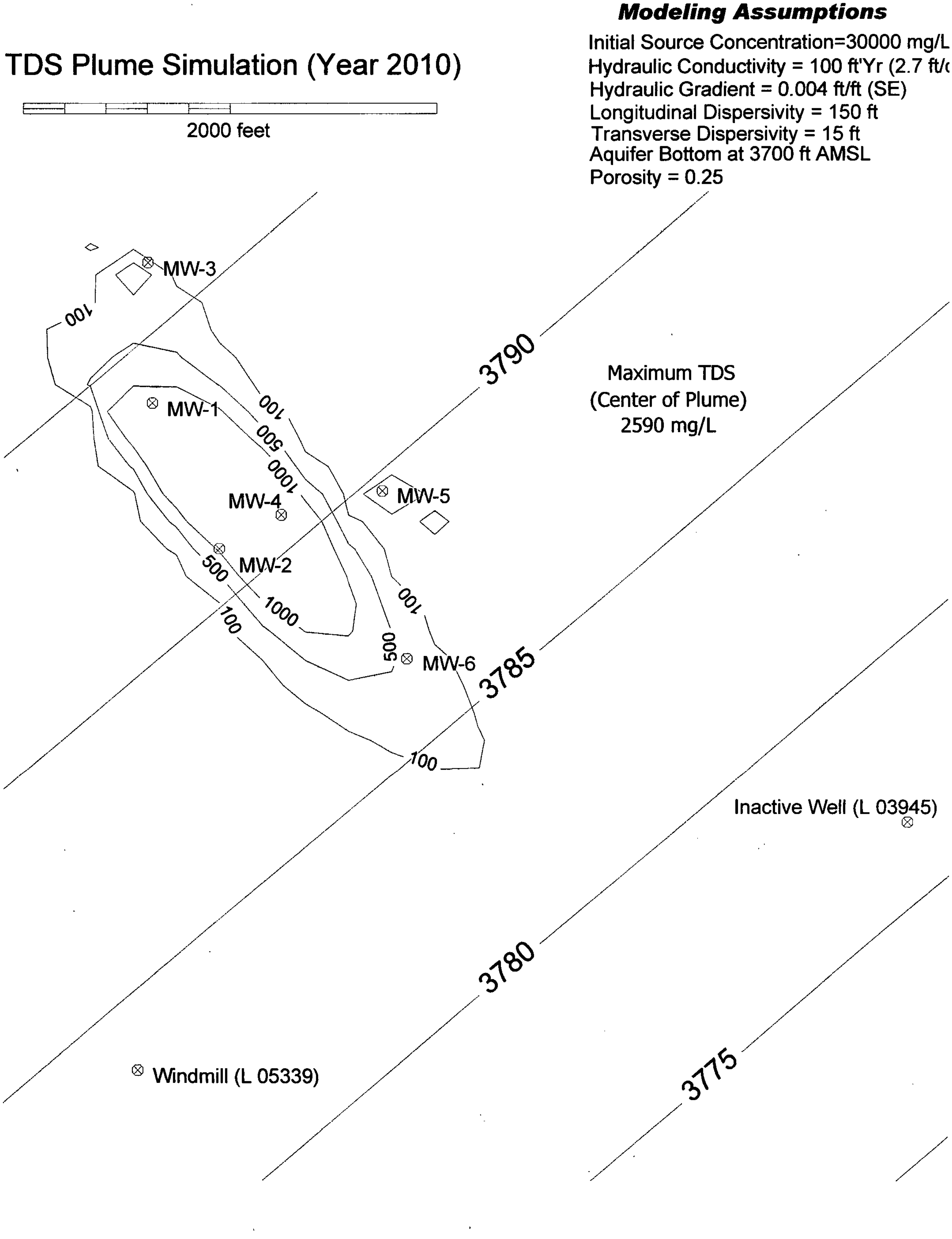
Modeling Assumptions

Hydraulic Conductivity = 1000 ft/year (2.7 ft/d)
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



WinTran Fate & Transport Modeling Results

Former Unocal South Vacuum Unit



WinTran Fate & Transport Modeling Results

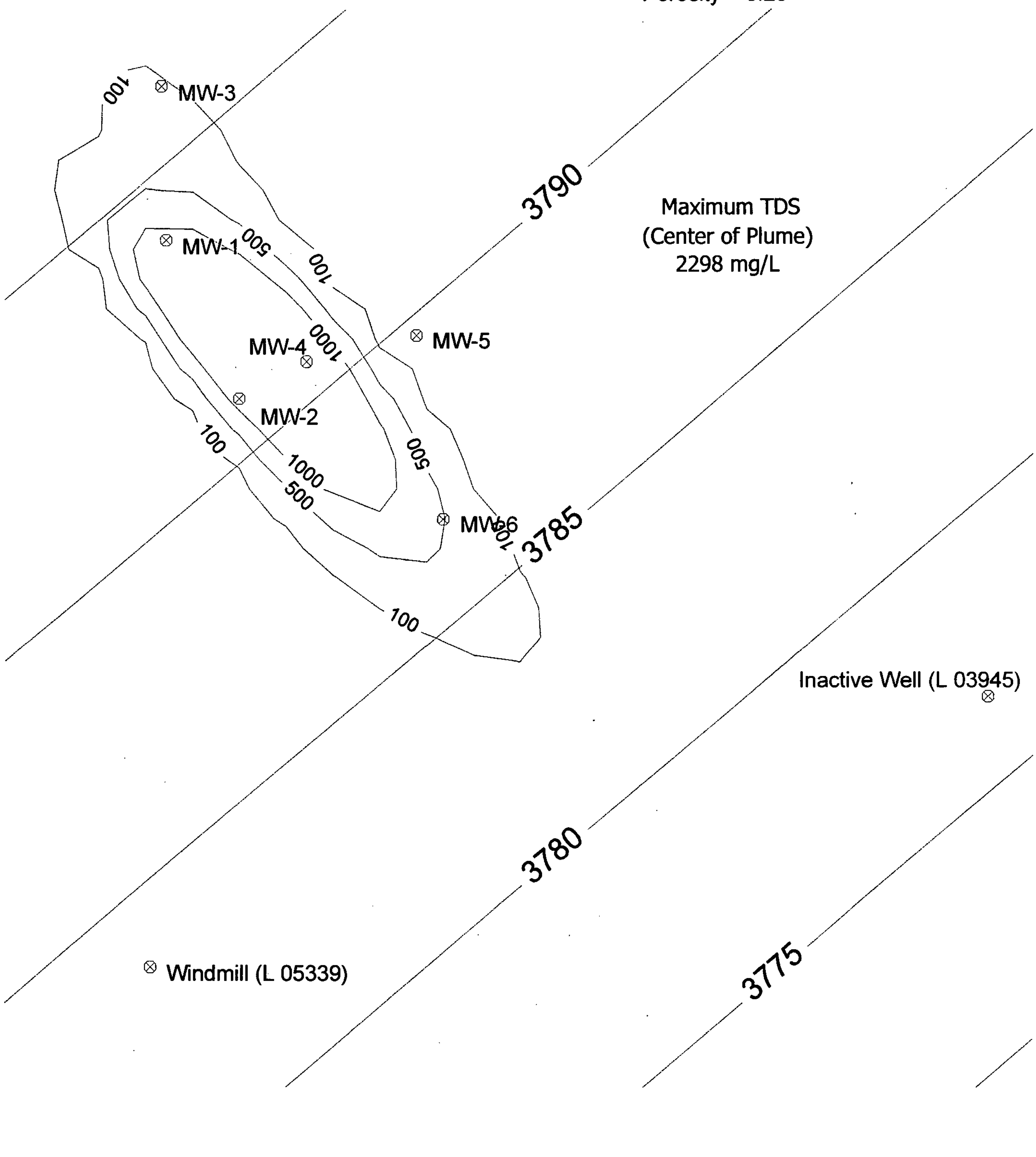
Former Unocal South Vacuum Unit

Modeling Assumptions

Initial Source Concentration=30000 mg/L
Hydraulic Conductivity = 100 ft'Yr (2.7 ft/
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25

TDS Plume Simulation (Year 2015)

2000 feet



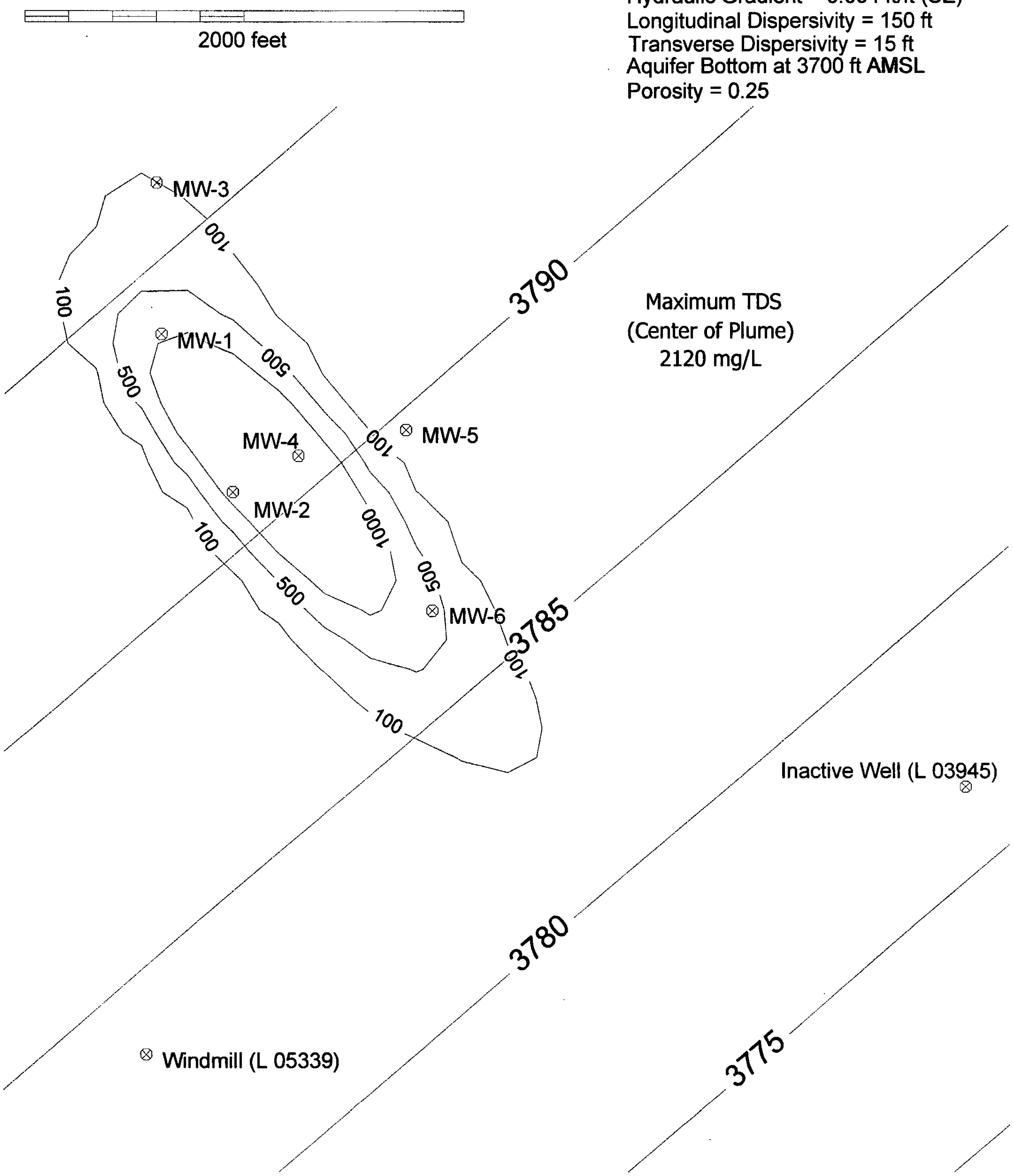
WinTran Fate & Transport Modeling Results

Former Unocal South Vacuum Unit

TDS Plume Simulation (Year 2020)

Modeling Assumptions

Initial Source Concentration=30000 mg/L
Hydraulic Conductivity = 100 ft'Yr (2.7 ft/(
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



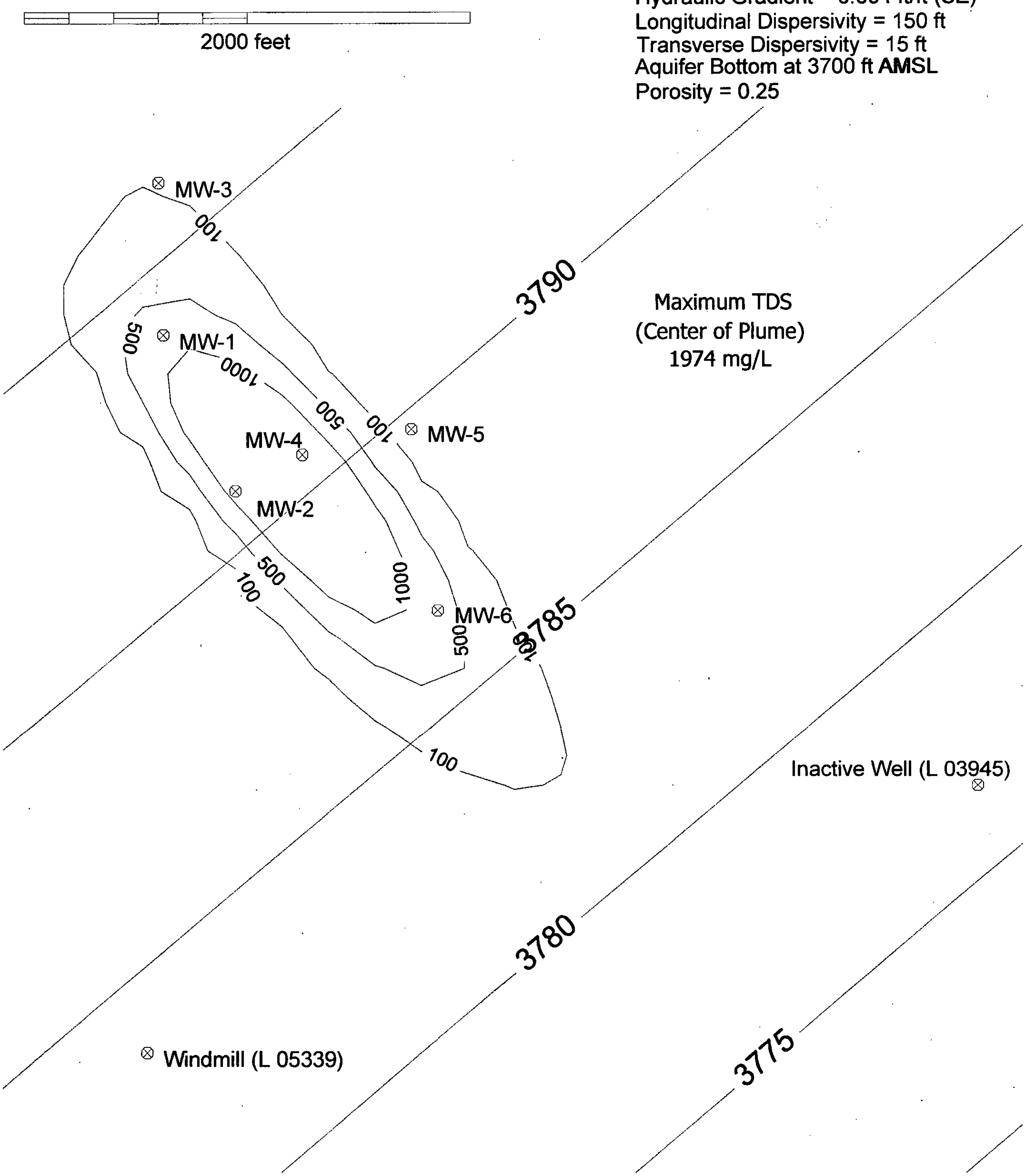
WinTran Fate & Transport Modeling Results

Former Unocal South Vacuum Unit

Modeling Assumptions

Initial Source Concentration=30000 mg/L
Hydraulic Conductivity = 100 ft'Yr (2.7 ft/c
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25

TDS Plume Simulation (Year 2025)



WinTran Fate & Transport Modeling Results

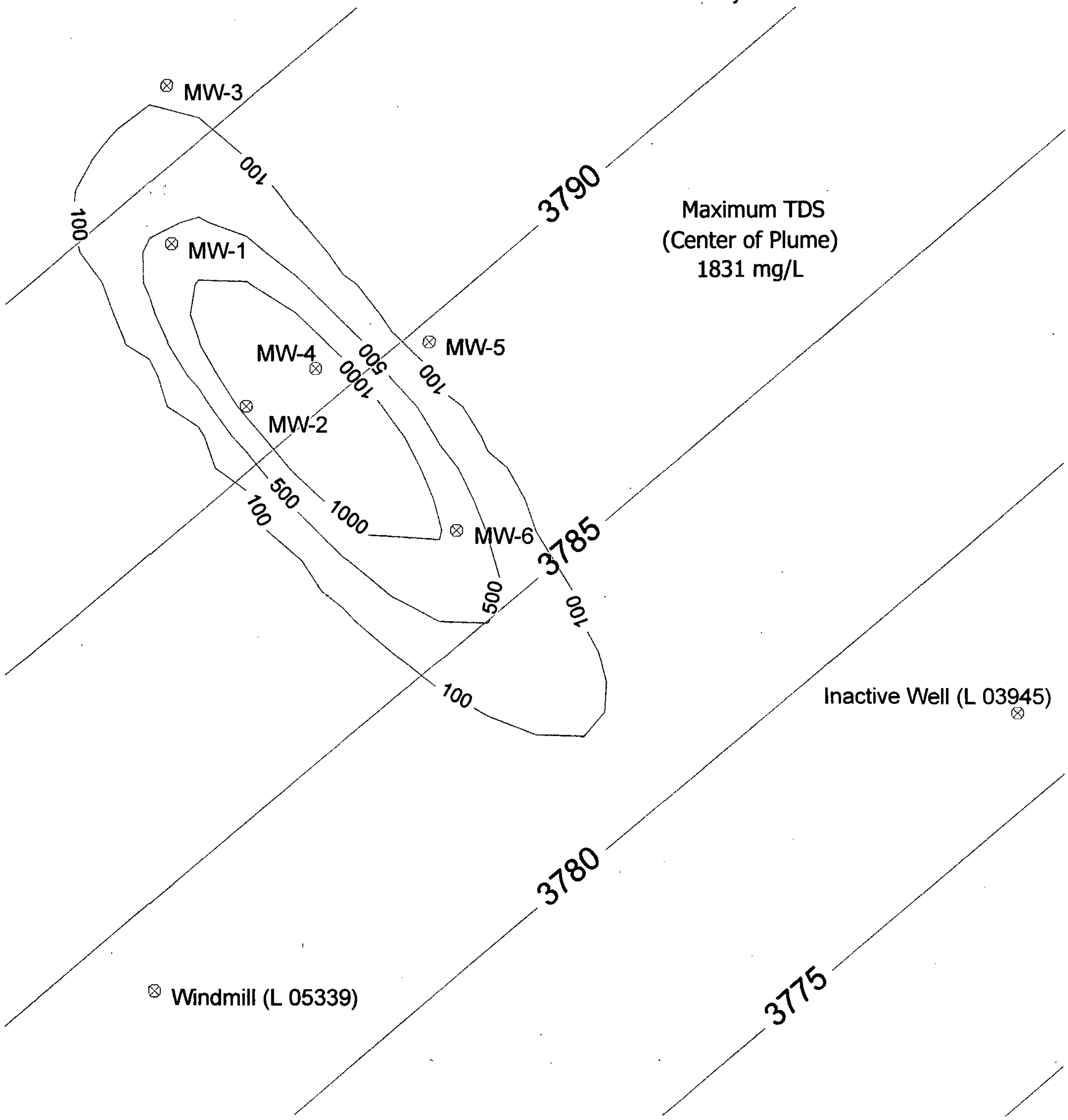
Former Unocal South Vacuum Unit

TDS Plume Simulation (Year 2030)

2000 feet

Modeling Assumptions

Initial Source Concentration=30000 mg/L
Hydraulic Conductivity = 100 ft'Yr (2.7 ft/
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25



WinTran Fate & Transport Modeling Results

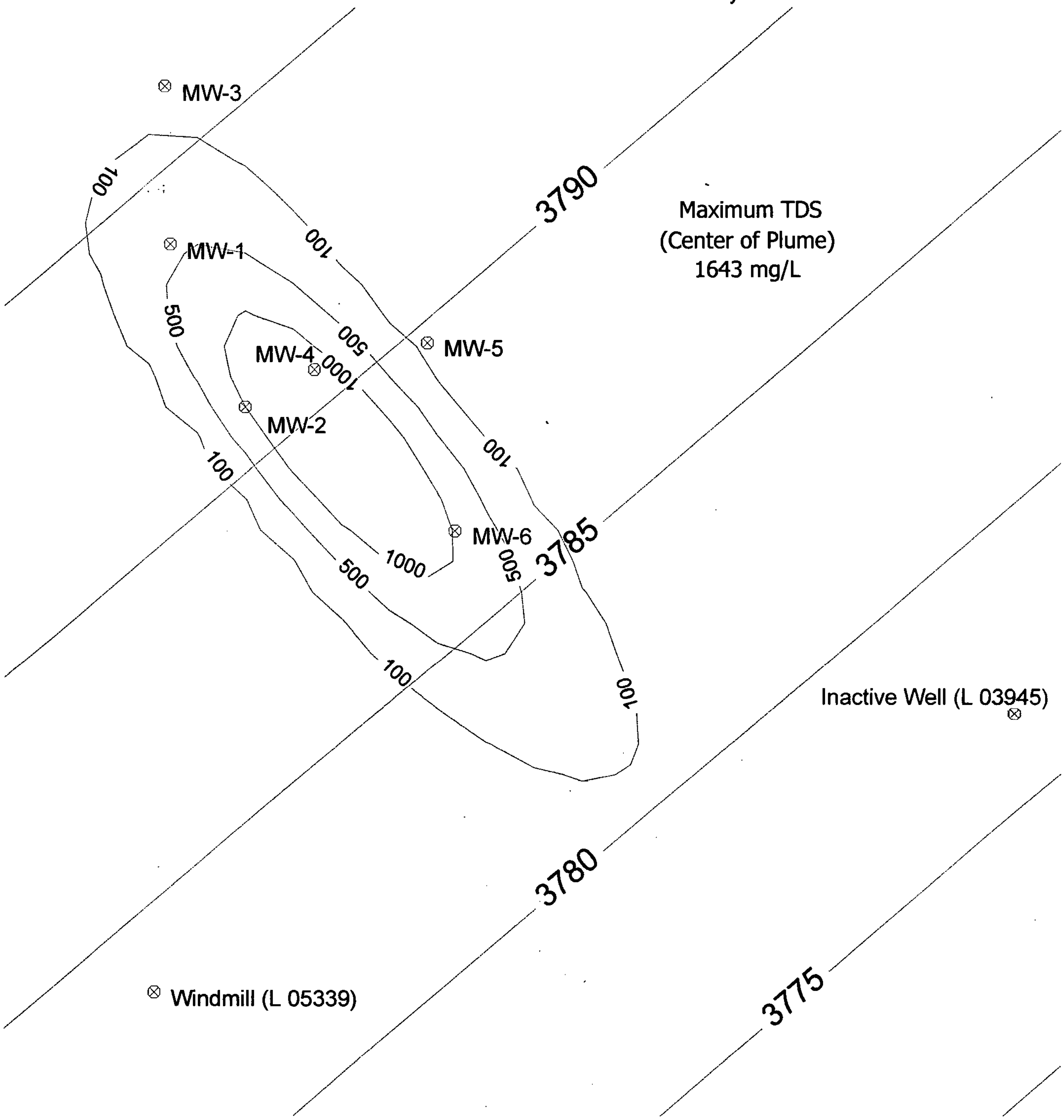
Former Unocal South Vacuum Unit

Modeling Assumptions

Initial Source Concentration=30000 mg/L
Hydraulic Conductivity = 100 ft'Yr (2.7 ft/c
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25

TDS Plume Simulation (Year 2040)

2000 feet



WinTran Fate & Transport Modeling Results

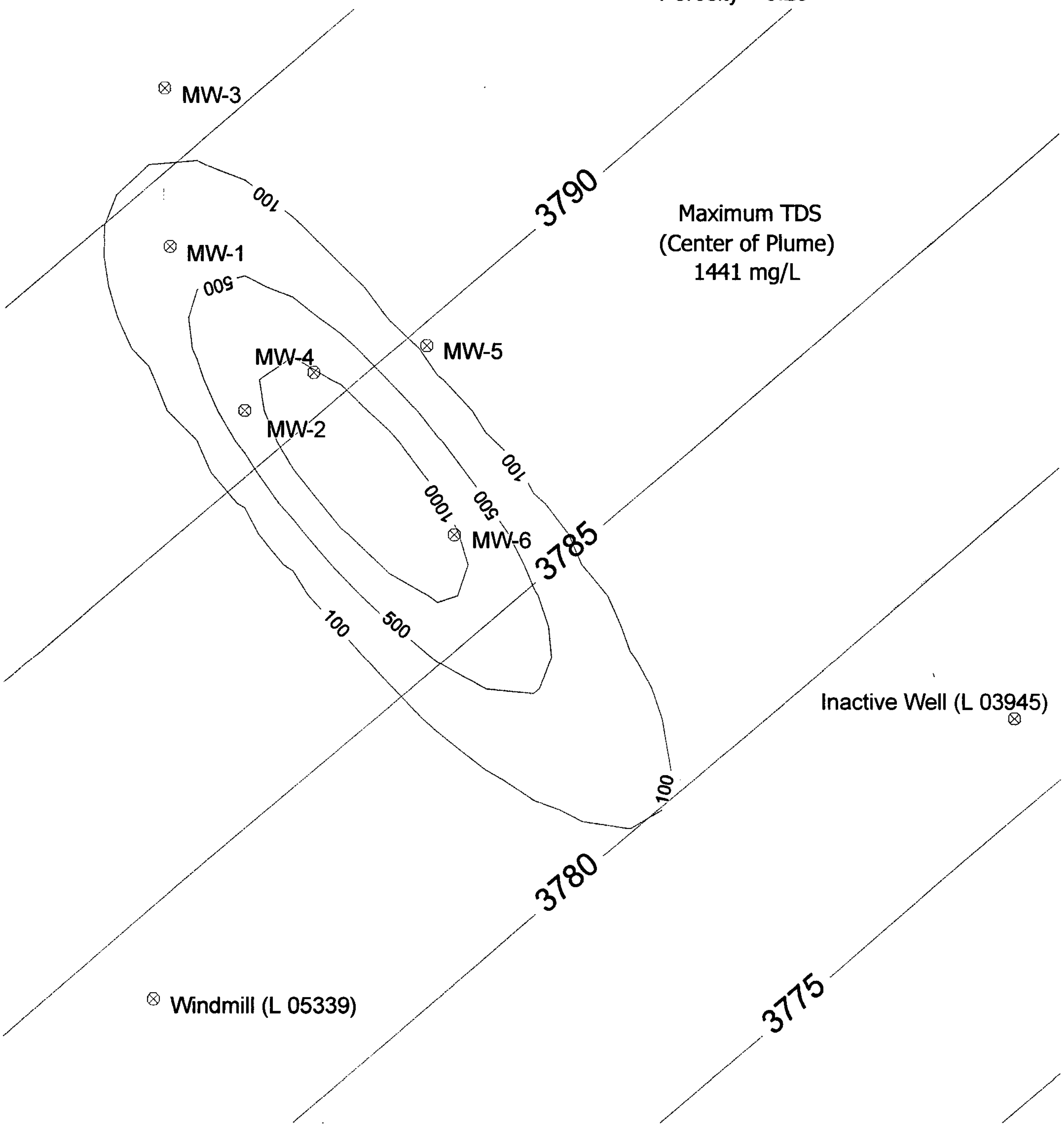
Former Unocal South Vacuum Unit

Modeling Assumptions

Initial Source Concentration=30000 mg/L
Hydraulic Conductivity = 100 ft'Yr (2.7 ft/
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25

TDS Plume Simulation (Year 2050)

2000 feet



WinTran Fate & Transport Modeling Results

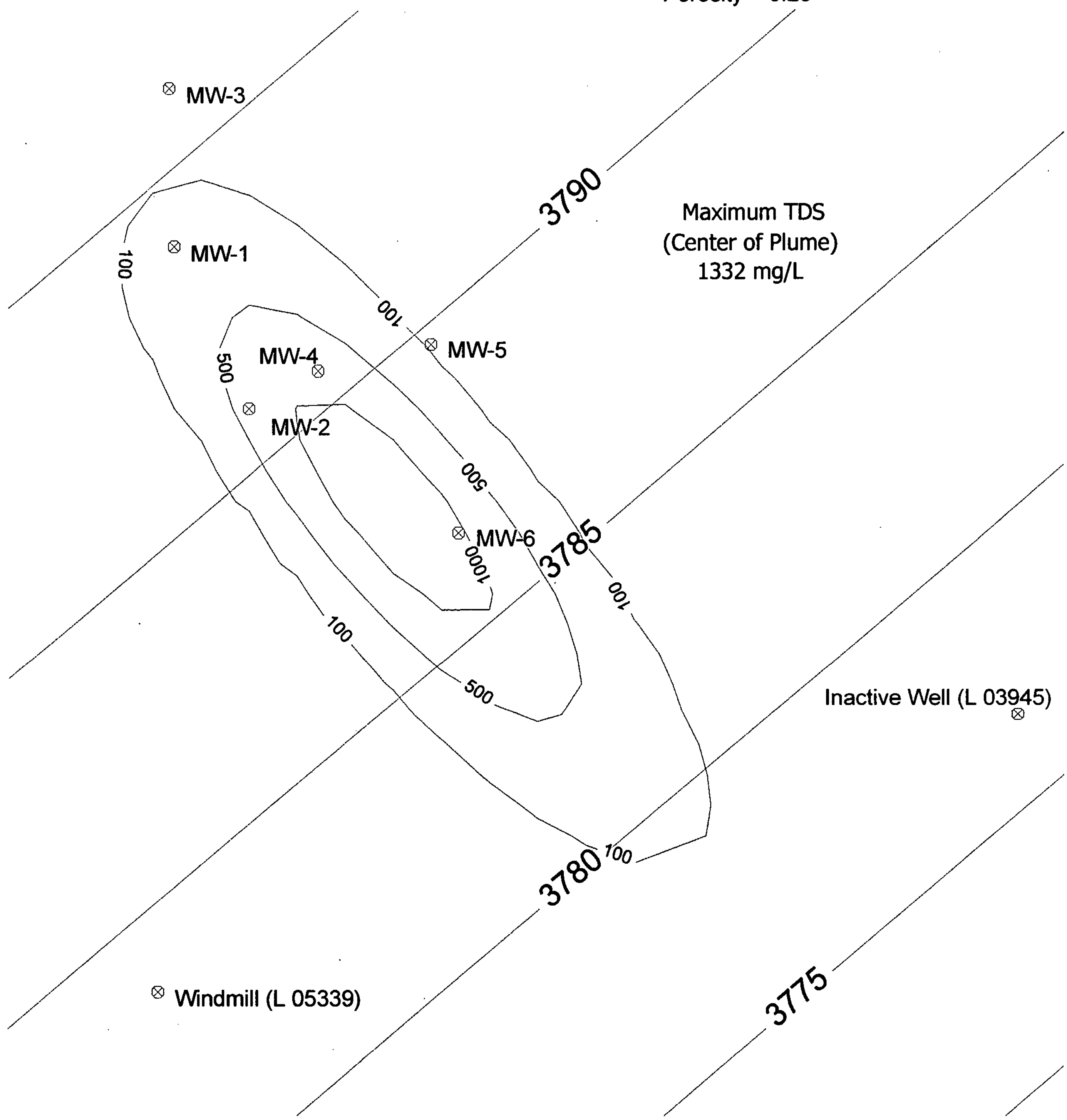
Former Unocal South Vacuum Unit

Modeling Assumptions

Initial Source Concentration=30000 mg/L
Hydraulic Conductivity = 100 ft'Yr (2.7 ft/
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25

TDS Plume Simulation (Year 2060)

2000 feet



WinTran Fate & Transport Modeling Results

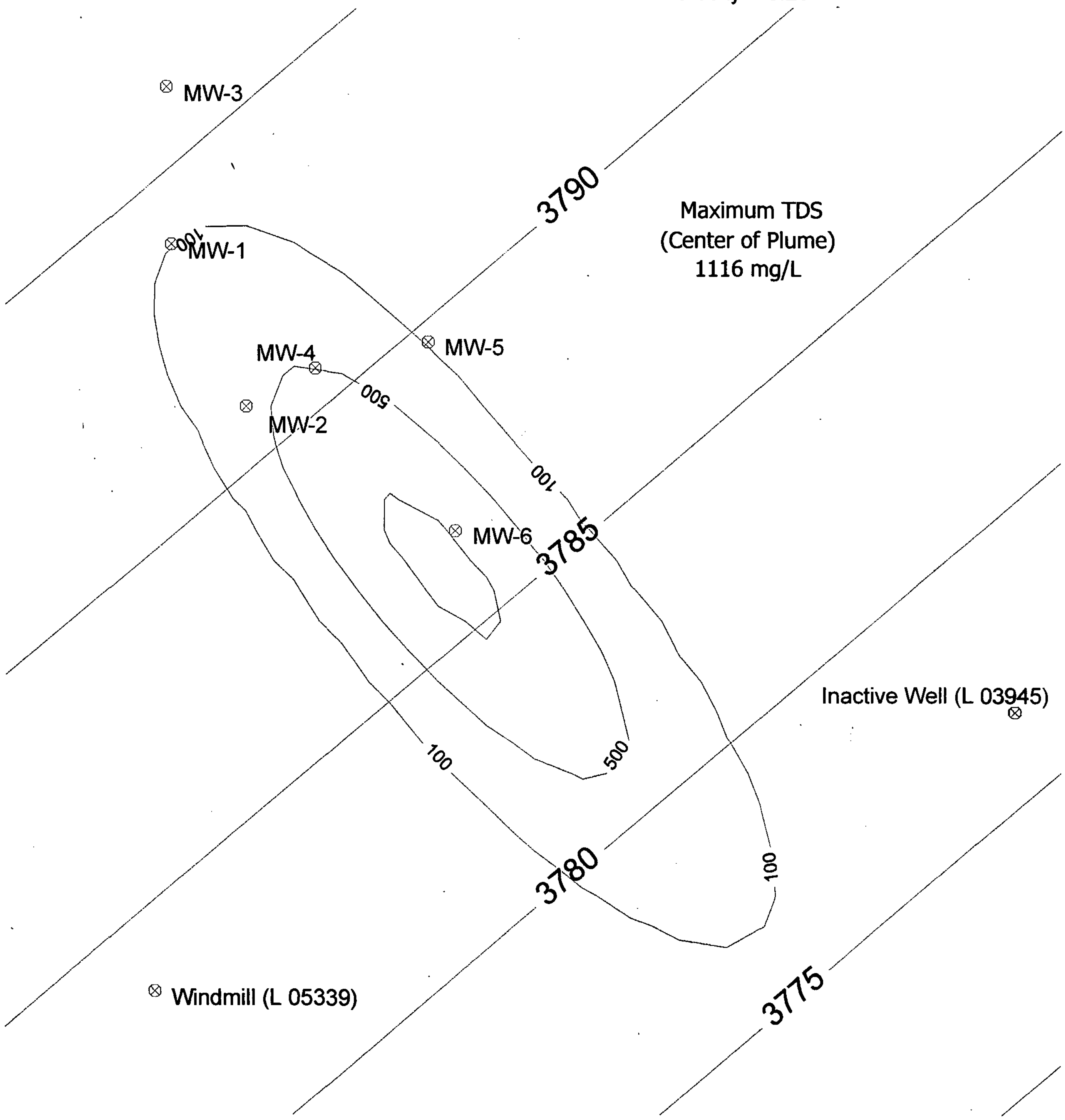
Former Unocal South Vacuum Unit

Modeling Assumptions

Initial Source Concentration=30000 mg/L
Hydraulic Conductivity = 100 ft'Yr (2.7 ft/
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25

TDS Plume Simulation (Year 2080)

2000 feet



WinTran Fate & Transport Modeling Results

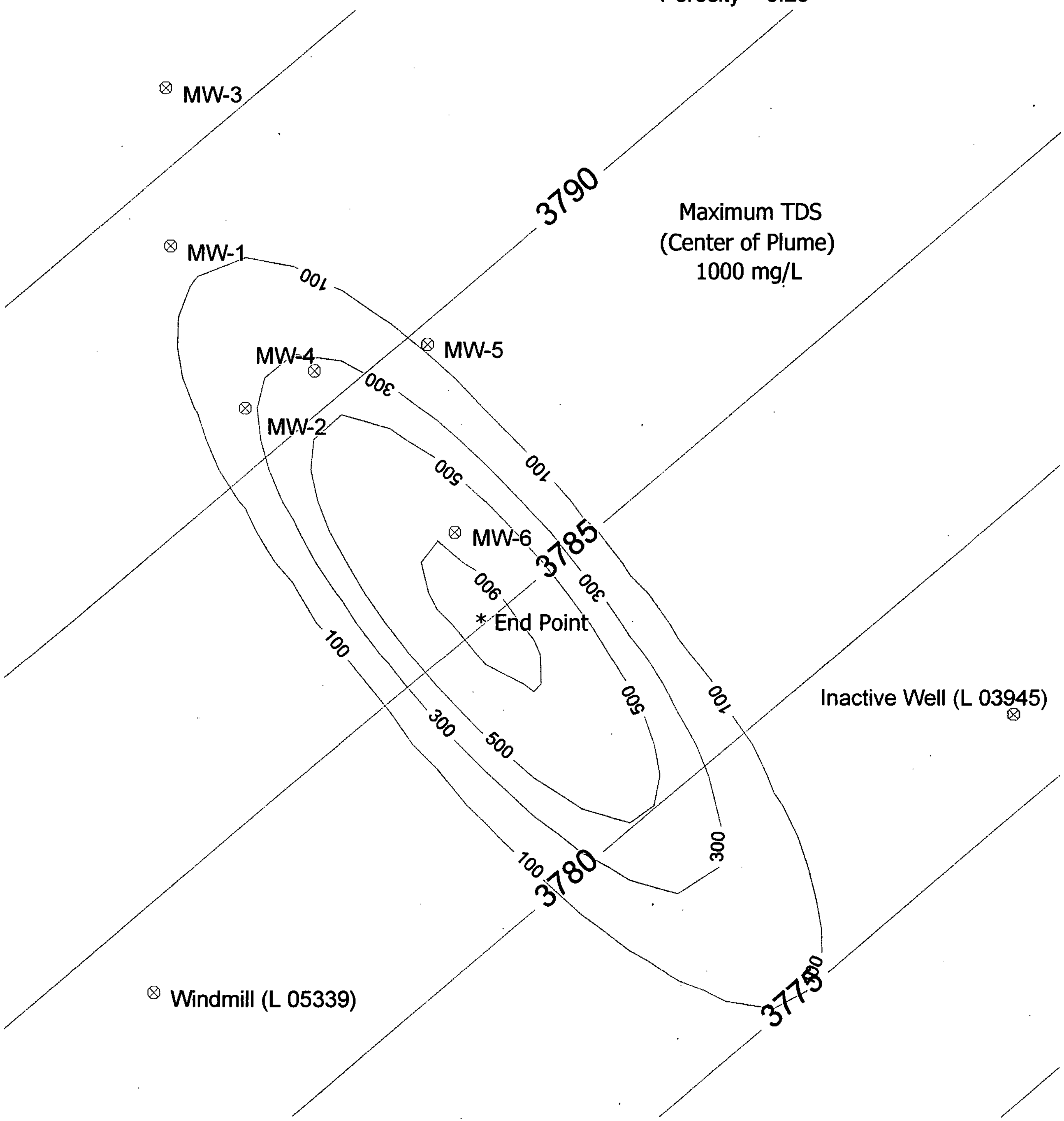
Former Unocal South Vacuum Unit

Modeling Assumptions

Initial Source Concentration=30000 mg/L
Hydraulic Conductivity = 100 ft'Yr (2.7 ft/
Hydraulic Gradient = 0.004 ft/ft (SE)
Longitudinal Dispersivity = 150 ft
Transverse Dispersivity = 15 ft
Aquifer Bottom at 3700 ft AMSL
Porosity = 0.25

TDS Plume Simulation (Year 2094)

2000 feet



APPENDIX D

Description of Fate and Transport Modeling
And
Input/Output Data

Conceptual Model

Produced water containing high concentrations of chloride, and resultant high levels of total dissolved solids (TDS), was reportedly discharged into a surface pit for a period of about 10 years. A dry hole (State Lea "I" No. 1), adjacent to the former pit, was approved for injection of produced water in 1962, however it was not used for that purpose since it was determined to be impractical; therefore it was later plugged in 1971. A chloride and TDS plume in groundwater continued to migrate southeastwards for the next approximately 29 years after the source input was stopped by encapsulation of the pit in 2000, producing the configuration and constituent concentration distribution observed currently. Extrapolating from current conditions for decades into the future, taking account of both advective flow and attenuation by hydrodynamic dispersion, enables prediction of the probable distance that the residual plume will travel as well as the gradually declining concentrations in the plume.

Basic Site Data

Information about site conditions was obtained from data in a TRW Inc. "Report of Additional Groundwater Investigation, Former Unocal South Vacuum Unit, Lea County, New Mexico" (July 18, 2000). This included lithologic records from well installations, water level data, and water quality analytical results.

Simulation Model

Simulations were conducted with the two-dimensional groundwater flow and contaminant transport model WinTran, version 1.03 (1995) designed and distributed by Environmental Simulations, Inc. (ESI) of Herndon, Virginia. WinTran is built around a steady-state analytical element flow model, linked to a finite element contaminant transport model. The Windows interface allows for rapid data input, processing, parameter manipulation and optimization, and output in multiple formats. The fundamental mathematics of the model solutions, model verification (benchmarked against MODFLOW), and use of WinTran is documented in the "Guide to Using WinTran" published by ESI.

Base Map

A simplified site base map was created using the New Mexico State Plane Coordinates for each monitoring well which were determined by a registered surveyor after installation.

Flow Parameters

Input requirements for the steady-state groundwater flow simulation include: hydraulic gradient and direction of flow, hydraulic conductivity, aquifer top and bottom elevations, and reference head. The values used were based on the following sources:

- Hydraulic gradient – measured gradient of 0.004 feet/foot from July 13, 2010 site measurements reported by Trident.

- Direction of flow – measured direction of approximately S 40° E from July 13, 2010 site measurements reported by Trident.

- Hydraulic conductivity – no site measurements were available; therefore, a literature value based on the saturated zone lithology was selected. Typical lithology is described as silty sand and very fine sand. Fetter (1988, Table 4.5, p. 80) cites an average range of 10^{-5} to 10^{-3} cm/sec for hydraulic conductivity of silty sands and fine sands. A conservative upper limit was selected, and converted from S.I. unit to 2.7 ft/day, or approximately 1000 ft/yr.

- Aquifer top and bottom elevations – bottom elevation of Ogallala Formation at 3700 feet reported by Trident. The top elevation for an unconfined aquifer must be greater than the reference head. An elevation of 4,000 feet was assumed.

- Reference head – measured unconfined head of 3,795 feet adjacent to the former pit and upgradient well MW-1 from July 13, 2010 measurements reported by Trident.

Transport Parameters

Input requirements for the contaminant transport numerical simulation include: longitudinal and transverse dispersivity, porosity, diffusion coefficient, contaminant half-life, and retardation coefficient. The values used were based on the following sources:

- Longitudinal and transverse dispersivity – no site measurements were available; therefore, a literature value based on the plume length was selected. Fetter (1993, Section 2.11, pp. 71-77) notes the apparent scale-dependency of longitudinal dispersivity, which typically may be about 0.1 times the flow length. For the current site scale and plume length of approximately 1,500 feet, a value of 150 feet was selected for longitudinal dispersivity. Based on professional judgment, hydrologists commonly assume the longitudinal dispersivity is about one-tenth the length of the plume and 5 to 10 times higher than transverse dispersivity; therefore, a value of 30 feet (i.e., one-fifth of the longitudinal value) was selected for transverse dispersivity.

- Porosity – no site measurements were available; therefore a literature value based on saturated zone lithology was selected. Typical lithology is described as silty sand and very fine sand. A range of 0.25 to 0.50 is typically given for unconsolidated "sand" (e.g., Freeze & Cherry, 1979, Table 2.4, p. 37); however, the Ogallala Formation is predominantly very fine grained, compacted and partly cemented, and may also fit within the range of 0.05 to 0.30 for sandstone. Fetter (1988, Table 4.3 and Figure 4.10, pp. 74-75) cites an average value of 0.20 for the specific yield of very fine sands. Specific retention of silty fine sand is approximately 0.05, for a total porosity of 0.25, which is the value selected for the transport modeling. WinTran uses the porosity term to estimate groundwater velocity, and actually requires an effective porosity value. Fetter (1988, Section 4.4, pp. 84-85) notes that pores of most sediments down to clay size are interconnected and that the effective porosity is virtually equal to the total porosity.

- Diffusion coefficient – this parameter is normally only relevant for very slow fluid movement, and is commonly assumed to be zero for advective-dominated transport, as in the present case.

- Contaminant half-life – this parameter accounts for chemical decay (e.g., radioisotopes, biological transformation of organic molecules); however, the species of interest in the present case are inorganic ions and are not expected to decay to any appreciable extent. A conservative value of 1000 years was used, which produces a negligible decay coefficient of less than 0.001 yr^{-1}.

- Retardation coefficient – this parameter accounts for sorption processes that slow the movement of contaminants relative to the groundwater velocity. Inorganic ions such as chloride are commonly taken as conservative tracers in groundwater and are not considered to be retarded; therefore, a value of 1.0 was selected for the retardation coefficient.

Flow Model Calibration

The vicinity of the site where water level measurements were recorded in July 13, 2010 is simulated closely by the flow model. It is known that groundwater levels in the Ogallala Formation are decreasing slowly (approximately 0.3 ft/yr), but this effect cannot be reproduced in the steady-state flow model. Water levels were probably somewhat higher than the present day during the period of brine disposal and initial transport. Even if the declining trend continues into the future, it does not affect the transport model solution for long extrapolation times, since sufficient saturated thickness remains (i.e., above the assumed aquifer base elevation of 3,700 feet) for a valid flow and transport solution.

The average groundwater velocity may be estimated using the Darcy expression: $v = (k \,.\, i) / n$ where k is the hydraulic conductivity (1,000 ft/yr), i is the hydraulic gradient (0.004 ft/foot), and n is the effective porosity (0.25). The resultant average velocity is 16 ft/yr.

Transport Model Calibration

The objective of the transport modeling was to first obtain a plume configuration with concentration values that closely match current observed values. This was done by simulating an initial contaminant release to groundwater for a period of 11 years (c. 1960 to 1971) with a constant source concentration located at the pit and injection well, then simulating a 28-year transport period (c. 1971 to 1999) with no further contaminant input but restarting the model from the end of Year 11 by retaining the mass of contaminant from the initial plume. An iterative approach was needed to optimize the initial source concentration so that the plume at Year 39 resembled the actual plume conditions in 1999. An initial value of 14,000 mg/L for chloride and 30,000 mg/L for TDS were found to produce the best match. The initial chloride value was also chosen because it is typical of chloride concentrations within the producing formation (Devonian) in the South Vacuum Oil Field according to chemists at Martin Water Laboratories (verbal communication, 12-05-01). Actual disposal concentrations during the 1960s are unknown, and may have been higher than these values, but it is presumed that some attenuation and dilution may have occurred in the vadose zone, which is currently 48 to 68 feet thick. WinTran does not account for vadose zone transport, and the source input is treated as an injection well with instantaneous transfer of contaminant mass to groundwater.

After calibrating the model such that it corresponded to actual 1999 conditions, the model was again run for 11 years (1999 to 2010) at one-year increments after entering in the known concentrations at each monitoring well.

Simulation of Fate and Transport

Estimation of chloride and TDS fate and transport was achieved by restarting the transport model in 2010. Figures displaying modeled simulations of the chloride and TDS plumes over various time increments are included in Appendix C. Advective flow moves the center of plume mass downgradient as depicted in the simulations. The simulations also demonstrate how hydrodynamic dispersion serves to broaden the dimensions of the plume while reducing the concentrations in the middle of the plume.

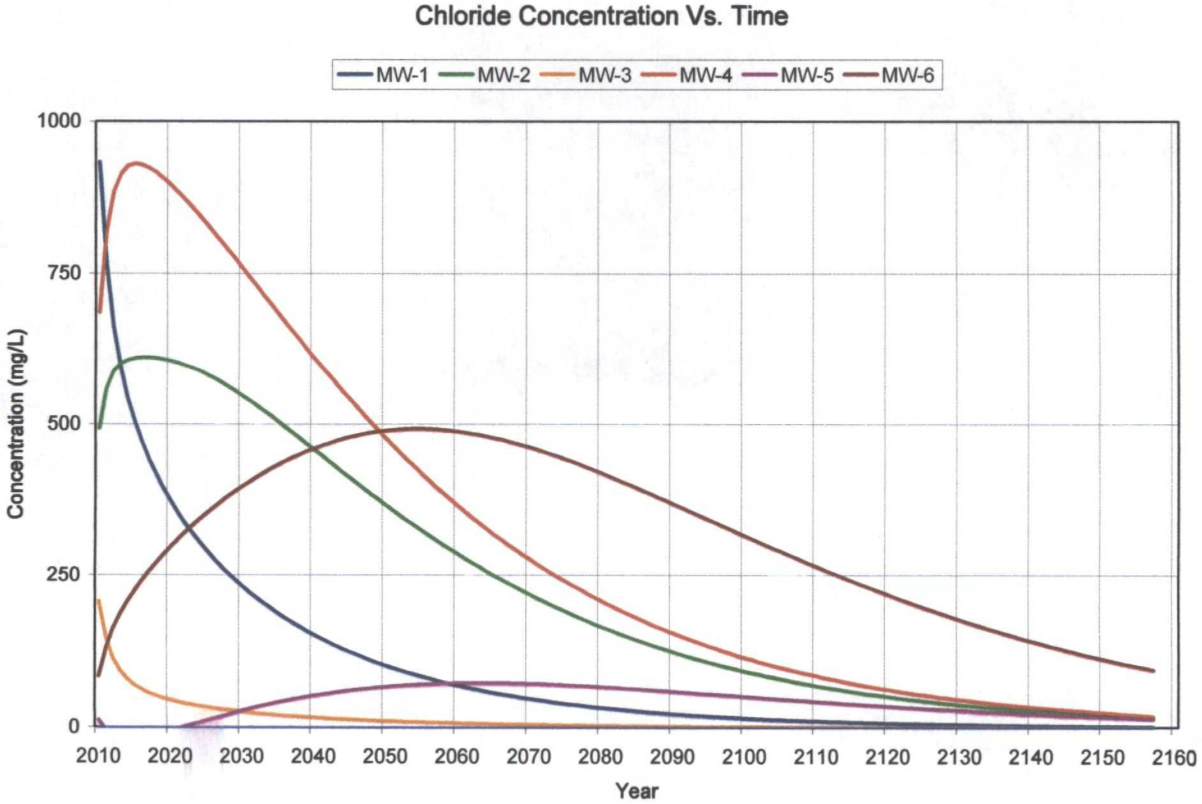
Running the model for 147 years in the future (Year 2157) produces a chloride plume center concentration of 250 mg/L (WQCC standard). The center of the chloride plume is approximately 3,400 ft away from the former pit and well source at that time.

Running the model for 84 years in the future (Year 2094) produces a TDS plume center concentration of 1,000 mg/L (WQCC standard). The center of the TDS plume is approximately 2,300 ft away from the pit and well source at that time.

These results support the conclusion that the chloride and TDS plume is not likely to impact any existing sources of water supply, the closest of which is a windmill (NM File No. L05339) located over one-half mile south of the source. The windmill has been dismantled and is no longer in operation due to declining water levels in the area.

The trend of decreasing concentration is not linear (exponential e^{-kt} function). Interestingly, the center of the plume moves at a greater rate (22 feet/year) over successive time intervals than would be assumed from the groundwater velocity alone (16 feet/year), due to the added effect of dispersion.

```
================================================================================
                                  WinTran
                 Analytical Model of 2D Ground-Water Flow and
                 Finite-Element Contaminant Transport Model

                                Developed by

                           James O. Rumbaugh, III

                           Douglas B. Rumbaugh

                   (c) 1995 Environmental Simulations, Inc.

================================================================================
              Chloride Fate & Transport Simulation run by:
              Gilbert Van Deventer (Trident Environmental)

Date: 11/12/2010
Time: 14:52:39.00


Input File: 2010_CL.WTR
Map File   :
```



==

Model Entities

Number of Wells = 9

```
    MW-1
       Center of Well --  x: 716.000000    y: 5281.000000
       Radius = 1.000000
       Pumping Rate = 0.000000
       Concentration of Injected Water = 934.000000
       Head at Well Radius           = 3793.599226

    MW-2
       Center of Well --  x: 1041.670000   y: 4585.770000
       Radius = 1.000000
       Pumping Rate = 0.000000
       Concentration of Injected Water = 494.000000
       Head at Well Radius           = 3790.536632

    MW-3
       Center of Well --  x: 694.000000    y: 5954.000000
       Radius = 1.000000
       Pumping Rate = 0.000000
       Concentration of Injected Water = 207.000000
       Head at Well Radius           = 3795.725794

    MW-4
       Center of Well --  x: 1341.000000   y: 4747.000000
       Radius = 1.000000
       Pumping Rate = 0.000000
       Concentration of Injected Water = 687.000000
       Head at Well Radius           = 3790.246945

    MW-5
       Center of Well --  x: 1829.000000   y: 4861.000000
       Radius = 1.000000
       Pumping Rate = 0.000000
       Concentration of Injected Water = 12.600000
       Head at Well Radius           = 3789.288647

    MW-6
       Center of Well --  x: 1948.000000   y: 4058.000000
       Radius = 1.000000
       Pumping Rate = 0.000000
       Concentration of Injected Water = 81.100000
       Head at Well Radius           = 3786.294299

    Windmill (L05339)
       Center of Well --  x: 650.000000    y: 2081.000000
       Radius = 1.000000
       Pumping Rate = 10.000000
       Concentration of Injected Water = 0.000000
       Head at Well Radius           = 3783.246027

    Inactive Well (L 03945)
       Center of Well --  x: 4375.000000   y: 3275.550000
       Radius = 1.000000
       Pumping Rate = 0.000000
       Concentration of Injected Water = 0.000000
       Head at Well Radius           = 3776.193966

Reference Head = 3795.000000    Defined at -- x: 490.030000    y: 5545.270000
```

```
================================================================================
                              Aquifer Properties

     .... Steady-State Flow Model ....

     Permeability...............= 1000.000000 [L/T]
     Porosity...................= 0.250000
     Elevation of Aquifer Top....= 4000.000000
     Elevation of Aquifer Bottom.= 3700.000000
     Uniform Regional Gradient...= 0.004000
     Angle of Uniform Gradient...= 310.000000
     Recharge...................= 0.000000


     .... Transient Transport Model ....

     Longitudinal Dispersivity...= 150.000000 [L]
     Transverse Dispersivity.....= 30.000000 [L]
     Diffusion Coefficient.......= 0.000000 [L2/T]
     Contaminant half-life...... = 1000.000000 [T]
     Retardation Coefficient.....= 1.000000
     Upstream Weighting in X.....= 0.000000
     Upstream Weighting in Y.....= 0.000000

     .... Time Stepping Information ....

     Number of time steps........= 1470
     Starting time value.........= 2010.000000
     Initial time step size......= 0.100000
     Time step multiplier....... = 1.000000
     Maximum time step size......= 0.100000
     Time stepping scheme........= Central Differencing

     .... Simulation Summary ....

     Starting time...............= 2010.000000
     Ending time.................= 2157.000000
     Number of time steps........= 1470

     (NOTE: following mass balance errors expressed as percent)
     Transport Mass Balance Error= 0.113227

     Peclet Criterion............= 1.388889
     Courant Number..............= 0.005179
     Flow Model Type.............= Analytic Element
================================================================================
                              Head Contour Matrix

Number of nodes in the X-direction = 49
Number of nodes in the Y-direction = 49

Minimum X Coordinate = 0.000000
Minimum Y Coordinate = 0.000000

Maximum X Coordinate = 10000.000000
Maximum Y Coordinate = 6289.062500

Minimum Head = 3733.926594
```

Direct Chloride Concentration (mg/L) Output from WinTran Simulation

Year	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	Windmill (L 05339)	Inactive Well (L 03945)	End Point
2010	934	494	207	687	12.6	84.1	0	0	0.0
2011	768	559	149	819	-3.9	130	0	0	0.0
2012	662	589	114	885	-13.0	163	0	0	0.0
2013	594	601	93.3	915	-16.8	187	0	0	0.0
2014	544	608	79.8	928	-17.8	207	0	0	0.0
2015	504	611	70.1	932	-17.2	225	0	0	0.0
2016	471	612	62.7	930	-15.7	241	0	0	0.0
2017	442	612	56.9	924	-13.5	257	0	0	0.0
2018	417	611	52.2	917	-10.9	271	0	0	0.0
2019	394	609	48.2	907	-8.0	285	0	0	0.1
2020	374	606	44.8	897	-4.9	298	0	0	0.1
2021	355	603	41.9	885	-1.7	310	0	0	0.1
2022	337	599	39.3	873	1.6	322	0	0	0.1
2023	321	594	37.0	860	4.9	333	0	0	0.2
2024	306	589	34.9	846	8.2	343	0	0	0.2
2025	292	583	33.1	833	11.5	354	0	0	0.3
2026	278	577	31.4	819	14.8	363	0	0	0.4
2027	266	571	29.8	804	18.0	373	0	0	0.5
2028	254	563	28.4	790	21.2	381	0	0	0.6
2029	243	556	27.0	775	24.3	390	0	0	0.7
2030	232	548	25.8	760	27.3	398	0	0	0.8
2031	222	540	24.6	745	30.2	406	0	0	1.0
2032	213	532	23.5	730	33.1	413	0	0	1.2
2033	204	523	22.5	715	35.8	420	0	0	1.4
2034	195	514	21.5	700	38.5	427	0	0	1.7
2035	187	505	20.6	685	41.0	433	0	0	2.0
2036	179	496	19.7	670	43.5	439	0	0	2.3
2037	172	487	18.9	655	45.8	445	0	0	2.7
2038	165	478	18.1	641	48.1	451	0	0	3.1
2039	158	468	17.4	626	50.2	456	0	0	3.6
2040	152	459	16.7	612	52.3	460	0	0	4.1
2041	146	450	16.0	598	54.2	465	0	0	4.7
2042	140	440	15.4	584	56.0	469	0	0	5.3
2043	134	431	14.8	570	57.8	473	0	0	6.0
2044	129	421	14.2	556	59.4	476	0	0	6.8
2045	124	412	13.7	542	60.9	479	0	0	7.6
2046	119	403	13.1	529	62.4	482	0	0	8.5
2047	114	394	12.6	516	63.7	484	0	0	9.5
2048	110	385	12.1	503	64.9	487	0	0	10.6
2049	106	376	11.7	491	66.1	488	0	0	11.7
2050	102	367	11.2	478	67.1	490	0	0	12.9
2051	97.7	358	10.8	466	68.1	491	0	0	14.2
2052	93.9	350	10.4	454	69.0	492	0	0	15.6
2053	90.3	341	10.0	442	69.7	493	0	0	17.1

Direct Chloride Concentration (mg/L) Output from WinTran Simulation

Year	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	Windmill (L 05339)	Inactive Well (L 03945)	End Point
2054	86.9	333	9.6	431	70.4	493	0	0	18.7
2055	83.5	325	9.3	419	71.1	493	0	0	20.4
2056	80.4	317	8.9	408	71.6	492	0	0	22.1
2057	77.3	309	8.6	398	72.1	492	0	0	24.0
2058	74.4	301	8.3	387	72.4	491	0	0	25.9
2059	71.5	293	8.0	377	72.8	490	0	0	28.0
2060	68.8	286	7.7	367	73.0	489	0	0	30.1
2061	66.2	278	7.4	357	73.2	487	0	0	32.3
2062	63.7	271	7.1	347	73.3	485	0	0	34.7
2063	61.4	264	6.8	338	73.3	483	0	0	37.1
2064	59.0	257	6.6	328	73.3	481	0	0	39.6
2065	56.8	250	6.3	319	73.3	478	0	0	42.2
2066	54.7	244	6.1	311	73.1	475	0	0	44.9
2067	52.7	237	5.9	302	73.0	472	0	0	47.6
2068	50.7	231	5.7	294	72.7	469	0	0	50.5
2069	48.8	225	5.5	286	72.5	466	0	0	53.4
2070	47.0	219	5.3	278	72.2	463	0	0	56.4
2071	45.3	213	5.1	270	71.8	459	0	0	59.5
2072	43.6	207	4.9	262	71.4	455	0	0	62.7
2073	42.0	201	4.7	255	70.9	451	0	0	65.9
2074	40.4	196	4.5	248	70.5	447	0	0	69.2
2075	38.9	190	4.4	241	70.0	443	0	0	72.6
2076	37.5	185	4.2	234	69.4	439	0	0	76.0
2077	36.1	180	4.1	227	68.8	434	0	0	79.5
2078	34.8	175	3.9	221	68.2	430	0	0	83.0
2079	33.5	170	3.8	214	67.6	425	0	0	86.6
2080	32.3	165	3.6	208	66.9	420	0	0	90.2
2081	31.1	161	3.5	202	66.3	415	0	0	93.9
2082	30.0	156	3.4	197	65.6	411	0	0	97.6
2083	28.9	152	3.3	191	64.8	406	0	0	101
2084	27.8	148	3.1	185	64.1	401	0	0	105
2085	26.8	143	3.0	180	63.3	395	0	0	109
2086	25.8	139	2.9	175	62.6	390	0	0	113
2087	24.9	135	2.8	170	61.8	385	0	0	116
2088	24.0	132	2.7	165	61.0	380	0	0	120
2089	23.1	128	2.6	160	60.2	375	0	0	124
2090	22.3	124	2.5	155	59.4	369	0	0	128
2091	21.5	121	2.4	151	58.6	364	0	0	132
2092	20.7	117	2.3	146	57.7	359	0	0	136
2093	20.0	114	2.3	142	56.9	353	0	0	140
2094	19.2	110	2.2	138	56.0	348	0	0	143
2095	18.5	107	2.1	134	55.2	343	0	0	147
2096	17.9	104	2.0	130	54.4	337	0	0	151
2097	17.2	101	2.0	126	53.5	332	0	0	155

Direct Chloride Concentration (mg/L) Output from WinTran Simulation

Year	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	Windmill (L 05339)	Inactive Well (L 03945)	End Point
2098	16.6	98.1	1.9	122	52.7	327	0	0	158
2099	16.0	95.3	1.8	119	51.8	321	0	0	162
2100	15.4	92.5	1.7	115	50.9	316	0	0	166
2101	14.9	89.8	1.7	112	50.1	311	0	0	169
2102	14.4	87.1	1.6	108	49.2	306	0	0	173
2103	13.8	84.6	1.6	105	48.4	300	0	0	177
2104	13.3	82.1	1.5	102	47.6	295	0	0	180
2105	12.9	79.7	1.5	99.1	46.7	290	0	0	183
2106	12.4	77.3	1.4	96.1	45.9	285	0	0	187
2107	12.0	75.1	1.4	93.3	45.1	280	0	0	190
2108	11.5	72.8	1.3	90.5	44.2	275	0	0	193
2109	11.1	70.7	1.3	87.8	43.4	270	0	0	197
2110	10.7	68.6	1.2	85.1	42.6	265	0	0	200
2111	10.3	66.6	1.2	82.6	41.8	260	0	0	203
2112	10.0	64.6	1.1	80.1	41.0	255	0	0	206
2113	9.6	62.7	1.1	77.7	40.2	250	0	0	209
2114	9.3	60.8	1.1	75.4	39.4	245	0	0	211
2115	9.0	59.0	1.0	73.1	38.7	241	0	0	214
2116	8.6	57.2	1.0	70.9	37.9	236	0	0	217
2117	8.3	55.5	0.9	68.8	37.2	231	0	0	219
2118	8.0	53.9	0.9	66.7	36.4	227	0	0	222
2119	7.8	52.2	0.9	64.7	35.7	222	0	0	224
2120	7.5	50.7	0.9	62.7	34.9	218	0	0	227
2121	7.2	49.2	0.8	60.8	34.2	214	0	0	229
2122	7.0	47.7	0.8	59.0	33.5	209	0	0	231
2123	6.7	46.2	0.8	57.2	32.8	205	0	0	233
2124	6.5	44.9	0.7	55.5	32.1	201	0	0	235
2125	6.2	43.5	0.7	53.8	31.4	197	0	0	237
2126	6.0	42.2	0.7	52.2	30.8	193	0	0	239
2127	5.8	40.9	0.7	50.6	30.1	189	0	0	240
2128	5.6	39.7	0.6	49.0	29.5	185	0	0	242
2129	5.4	38.5	0.6	47.5	28.8	181	0	0	243
2130	5.2	37.3	0.6	46.1	28.2	177	0	0	245
2131	5.0	36.2	0.6	44.7	27.6	173	0	0	246
2132	4.9	35.1	0.6	43.3	27.0	169	0	0	247
2133	4.7	34.0	0.5	42.0	26.4	166	0	0	248
2134	4.5	33.0	0.5	40.7	25.8	162	0	0	249
2135	4.4	32.0	0.5	39.5	25.2	159	0	0	250
2136	4.2	31.0	0.5	38.3	24.6	155	0	0	251
2137	4.1	30.1	0.5	37.1	24.1	152	0	0	252
2138	3.9	29.2	0.4	36.0	23.5	148	0	0	253
2139	3.8	28.3	0.4	34.9	23.0	145	0	0	253
2140	3.7	27.4	0.4	33.8	22.5	142	0	0	254
2141	3.5	26.6	0.4	32.8	21.9	139	0	0	254

Direct Chloride Concentration (mg/L) Output from WinTran Simulation

Year	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	Windmill (L 05339)	Inactive Well (L 03945)	End Point
2142	3.4	25.8	0.4	31.8	21.4	135	0	0	254
2143	3.3	25.0	0.4	30.8	20.9	132	0	0	254
2144	3.2	24.2	0.4	29.8	20.4	129	0	0	255
2145	3.1	23.5	0.4	28.9	20.0	126	0	0	255
2146	3.0	22.8	0.3	28.0	19.5	124	0	0	255
2147	2.9	22.1	0.3	27.2	19.0	121	0	0	254
2148	2.8	21.4	0.3	26.3	18.6	118	0	0	254
2149	2.7	20.7	0.3	25.5	18.1	115	0	0	254
2150	2.6	20.1	0.3	24.8	17.7	112	0	0	254
2151	2.5	19.5	0.3	24.0	17.3	110	0	0	253
2152	2.4	18.9	0.3	23.3	16.9	107	0	0	253
2153	2.3	18.3	0.3	22.5	16.5	105	0	0	252
2154	2.2	17.7	0.3	21.8	16.1	102	0	0	251
2155	2.2	17.2	0.2	21.2	15.7	100	0	0	251
2156	2.1	16.7	0.2	20.5	15.3	97	0	0	250
2157	2.0	16.2	0.2	19.9	14.9	95	0	0	249

==

WinTran
Analytical Model of 2D Ground-Water Flow and
Finite-Element Contaminant Transport Model

Developed by

James O. Rumbaugh, III

Douglas B. Rumbaugh

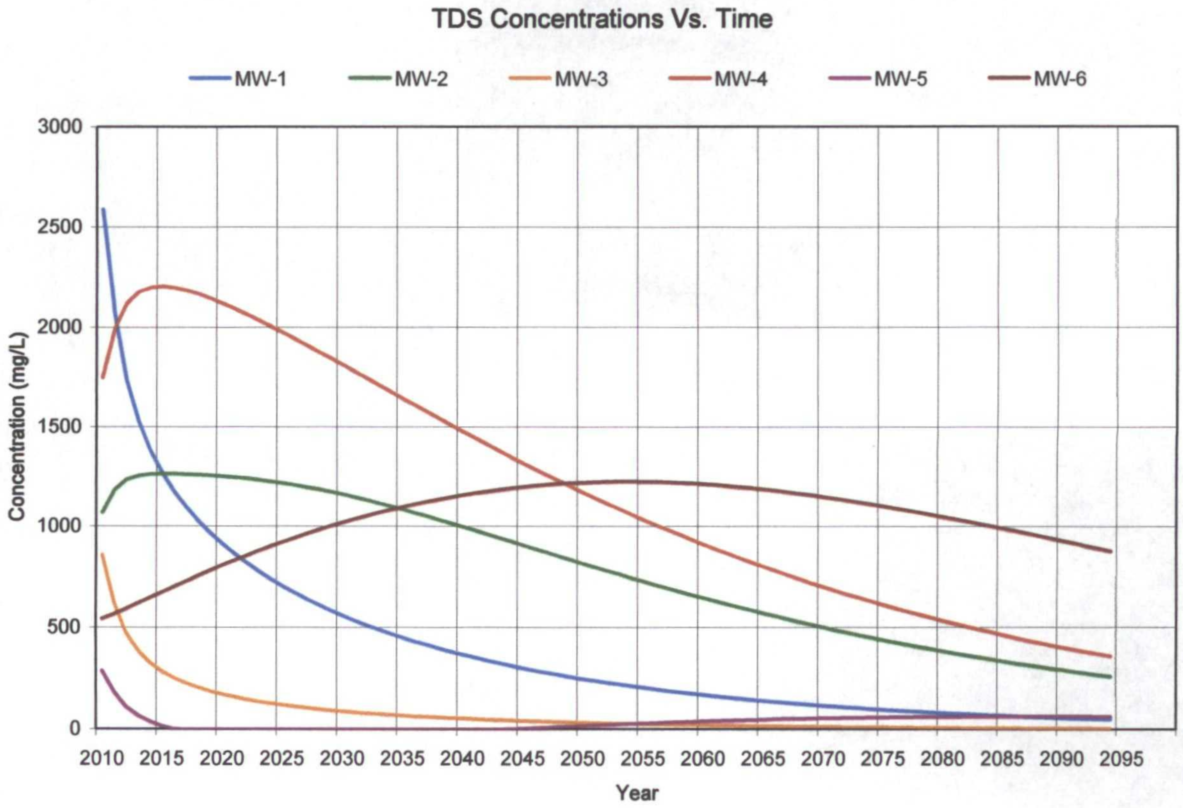
(c) 1995 Environmental Simulations, Inc.

==

TDS Fate & Transport Simulation run by:
Gilbert Van Deventer (Trident Environmental)

Date: 10/12/110
Time: 17:08:14.00

Input File: TDS 2010.WTR
Map File :



```
================================================================================
Number of Wells = 9

     MW-1
        Center of Well --  x: 716.000000   y: 5281.000000
        Radius = 1.000000
        Pumping Rate = 0.000000
        Concentration of Injected Water = 2590.000000
        Head at Well Radius           = 3793.961453

     MW-2
        Center of Well --  x: 1041.670000   y: 4585.770000
        Radius = 1.000000
        Pumping Rate = 0.000000
        Concentration of Injected Water = 1070.000000
        Head at Well Radius           = 3790.910784

     MW-3
        Center of Well --  x: 694.000000   y: 5954.000000
        Radius = 1.000000
        Pumping Rate = 0.000000
        Concentration of Injected Water = 859.000000
        Head at Well Radius           = 3796.080135

     MW-4
        Center of Well --  x: 1341.000000   y: 4747.000000
        Radius = 1.000000
        Pumping Rate = 0.000000
        Concentration of Injected Water = 1750.000000
        Head at Well Radius           = 3790.622276

     MW-5
        Center of Well --  x: 1829.000000   y: 4861.000000
        Radius = 1.000000
        Pumping Rate = 0.000000
        Concentration of Injected Water = 291.000000
        Head at Well Radius           = 3789.668020

     MW-6
        Center of Well --  x: 1948.000000   y: 4058.000000
        Radius = 1.000000
        Pumping Rate = 0.000000
        Concentration of Injected Water = 545.000000
        Head at Well Radius           = 3786.685786

     Windmill (L-05339)
        Center of Well --  x: 650.000000   y: 2081.000000
        Radius = 1.000000
        Pumping Rate = 10.000000
        Concentration of Injected Water = 400.000000
        Head at Well Radius           = 3783.653608

     Inactive Well (L 03945)
        Center of Well --  x: 4375.000000   y: 3275.550000
        Radius = 1.000000
        Pumping Rate = 0.000000
        Concentration of Injected Water = 0.000000
        Head at Well Radius           = 3776.640188

Reference Head = 3795.000000    Defined at -- x: 619.470000   y: 5537.180000
```

```
================================================================================
                              Aquifer Properties

     .... Steady-State Flow Model ....

     Permeability...............= 1000.000000 [L/T]
     Porosity...................= 0.250000
     Elevation of Aquifer Top....= 4000.000000
     Elevation of Aquifer Bottom.= 3700.000000
     Uniform Regional Gradient...= 0.004000
     Angle of Uniform Gradient...= 310.000000
     Recharge...................= 0.000000



     .... Transient Transport Model ....

     Longitudinal Dispersivity...= 150.000000 [L]
     Transverse Dispersivity.....= 15.000000 [L]
     Diffusion Coefficient.......= 0.000000 [L2/T]
     Contaminant half-life...... = 1000.000000 [T]
     Retardation Coefficient.....= 1.000000
     Upstream Weighting in X.....= 0.000000
     Upstream Weighting in Y.....= 0.000000

     .... Time Stepping Information ....

     Number of time steps........= 840
     Starting time value.........= 2010.000000
     Initial time step size......= 0.100000
     Time step multiplier....... = 1.000000
     Maximum time step size......= 0.100000
     Time stepping scheme........= Central Differencing

     .... Simulation Summary ....

     Starting time...............= 2010.000000
     Ending time.................= 2094.000000
     Number of time steps........= 840

     (NOTE: following mass balance errors expressed as percent)
     Flow Mass Balance Error.... = 0.000000
     Transport Mass Balance Error= 0.949256

     Peclet Criterion............= 1.388889
     Courant Number..............= 0.005046
     Flow Model Type.............= Finite Element
================================================================================
                              Head Contour Matrix

Number of nodes in the X-direction = 49
Number of nodes in the Y-direction = 49

Minimum X Coordinate = 0.000000
Minimum Y Coordinate = 0.000000

Maximum X Coordinate = 10000.000000
Maximum Y Coordinate = 6289.062500

Minimum Head = 3734.916002
```

Direct TDS Concentration (mg/L) Output from WinTran Simulation

Year	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	Windmill (L 05339)	Inactive Well (L 03945)	End Point
2010	2590	1070	859	1750	291	545	0	0	0.0
2011	2069	1187	623	1996	183	568	0	0	109
2012	1739	1238	476	2123	113	594	0	0	118
2013	1531	1257	388	2180	68.5	621	0	0	127
2014	1384	1264	329	2203	38.4	648	0	0	137
2015	1270	1266	286	2208	17.0	676	0	0	147
2016	1177	1266	254	2202	1.1	703	0	0	158
2017	1098	1264	228	2188	0	730	0	0	170
2018	1030	1261	207	2169	0	757	0	0	182
2019	969	1258	189	2147	0	783	0	0	194
2020	915	1254	174	2123	0	808	0	0	208
2021	866	1249	161	2096	0	833	0	0	221
2022	821	1243	149	2068	0	857	0	0	236
2023	780	1236	139	2038	0	880	0	0	250
2024	741	1229	130	2008	0	902	0	0	266
2025	706	1220	121	1977	0	924	0	0	281
2026	673	1210	114	1945	0	945	0	0	297
2027	642	1200	107	1913	0	965	0	0	313
2028	613	1188	101	1880	0	985	0	0	330
2029	586	1176	95.4	1847	0	1003	0	0	347
2030	561	1163	90.2	1814	0	1021	0	0	364
2031	536	1149	85.3	1780	0	1038	0	0	381
2032	514	1134	80.8	1747	0	1055	0	0	399
2033	492	1119	76.6	1713	0	1071	0	0	416
2034	472	1103	72.7	1679	0	1086	0	0	434
2035	452	1087	69.1	1645	0	1100	0	0	452
2036	434	1070	65.7	1612	0	1113	0	0	469
2037	416	1053	62.5	1578	0	1126	0	0	487
2038	399	1035	59.5	1545	0	1138	0	0	505
2039	384	1017	56.7	1512	0	1149	0	0	522
2040	368	999	54.0	1480	0	1160	0	0	539
2041	354	981	51.5	1447	0	1170	0	0	557
2042	340	962	49.2	1415	0	1179	0	0	574
2043	327	944	47.0	1383	0	1187	0	0	591
2044	314	925	44.9	1352	0.9	1194	0	0	607
2045	302	907	42.9	1321	3.8	1201	0	0	624
2046	291	888	41.0	1291	6.7	1207	0	0	640
2047	280	870	39.2	1260	9.6	1212	0	0	656
2048	269	852	37.5	1231	12.4	1216	0	0	672
2049	259	833	35.9	1202	15.2	1220	0	0	687
2050	250	815	34.4	1173	18.0	1223	0	0	703
2051	240	797	32.9	1145	20.7	1225	0	0	717
2052	231	780	31.5	1117	23.3	1227	0	0	732
2053	223	762	30.2	1090	25.9	1227	0	0	746

Direct TDS Concentration (mg/L) Output from WinTran Simulation

Year	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	Windmill (L 05339)	Inactive Well (L 03945)	End Point
2054	215	745	29.0	1063	28.4	1228	0	0	760
2055	207	728	27.8	1037	30.9	1227	0	0	773
2056	199	711	26.6	1011	33.2	1226	0	0	786
2057	192	694	25.5	986	35.5	1224	0	0	799
2058	185	677	24.5	961	37.7	1222	0	0	811
2059	178	661	23.5	937	39.8	1219	0	0	823
2060	172	645	22.6	913	41.9	1215	0	0	834
2061	166	630	21.7	890	43.8	1211	0	0	845
2062	160	614	20.8	867	45.7	1206	0	0	855
2063	154	599	20.0	845	47.5	1201	0	0	865
2064	148	584	19.2	823	49.2	1195	0	0	875
2065	143	570	18.4	802	50.8	1189	0	0	884
2066	138	556	17.7	781	52.4	1183	0	0	892
2067	133	542	17.0	760	53.8	1175	0	0	901
2068	128	528	16.4	740	55.2	1168	0	0	908
2069	124	515	15.7	721	56.4	1160	0	0	915
2070	120	501	15.1	702	57.6	1152	0	0	922
2071	115	488	14.6	683	58.7	1143	0	0	928
2072	111	476	14.0	665	59.8	1134	0	0	934
2073	107	464	13.5	647	60.7	1124	0	0	939
2074	104	451	13.0	630	61.6	1114	0	0	944
2075	99.9	440	12.5	613	62.4	1104	0	0	948
2076	96.4	428	12.0	597	63.1	1094	0	0	952
2077	93.1	417	11.5	580	63.7	1084	0	0	955
2078	89.8	406	11.1	565	64.3	1073	0	0	958
2079	86.7	395	10.7	549	64.8	1062	0	0	961
2080	83.7	385	10.3	534	65.2	1050	0	0	963
2081	80.8	374	9.9	520	65.6	1039	0	0	964
2082	78.0	364	9.5	506	65.9	1027	0	0	965
2083	75.2	355	9.2	492	66.1	1015	0	0	966
2084	72.6	345	8.8	478	66.3	1003	0	0	966
2085	70.1	336	8.5	465	66.4	991	0	0	966
2086	67.7	327	8.2	452	66.5	979	0	0	965
2087	65.4	318	7.9	440	66.5	967	0	0	964
2088	63.1	309	7.6	428	66.4	954	0	0	963
2089	60.9	301	7.3	416	66.4	942	0	0	961
2090	58.8	293	7.1	404	66.2	929	0	0	959
2091	56.8	285	6.8	393	66.1	916	0	0	956
2092	54.8	277	6.6	382	65.8	904	0	0	953
2093	53.0	269	6.3	371	65.6	891	0	0	950
2094	51.1	262	6.1	361	65.3	878	0	0	946