

AP - 011

# ANNUAL MONITORING REPORT

YEAR(S):

2000

ARCADIS GERAGHTY & MILLER

**Year 2000 Annual  
Groundwater Monitoring  
Report  
Former Bertha Barber Tank  
Battery**

Lea County, New Mexico

Prepared for:  
Marathon Oil Company

Prepared by:  
ARCADIS Geraghty & Miller Inc  
1030 Andrews Hwy., Suite 120  
Suite 120  
Midland  
Texas 79701  
Tel 915 699 1381  
Fax 915 699 1978

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**Year 2000 Annual Groundwater Monitoring Report  
Former Bertha Barber Tank Battery  
Lea County, New Mexico**

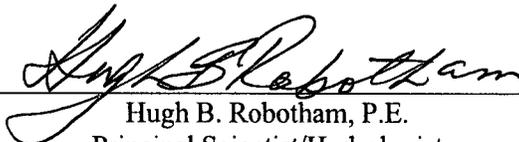
May 9, 2001

*Prepared by ARCADIS G&M, INC.*



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Alan J. Reed, Jr., P.E.  
Project Manager



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Hugh B. Robotham, P.E.  
Principal Scientist/Hydrologist



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Allan T. Schmidt  
Vice President/Area Manager

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## Introduction

Lea County, New Mexico

ARCADIS Geraghty & Miller, Inc. (AG&M) prepared this Year 2000 Annual Groundwater Monitoring Report on behalf of Marathon Oil Company (Marathon) to present the results of quarterly groundwater monitoring conducted at the former Bertha Barber Tank Battery (site) in Lea County, New Mexico. Figure 1 shows the location of the site situated in Section 5, Township 20 South, Range 37 East. Quarterly groundwater monitoring was conducted in March, June, September and December as recommended in the Site Investigation Report, and approved by the New Mexico Energy, Minerals, and Natural Resources Department, Oil Conservation Division (OCD).

## Geology/Hydrogeology

Thirteen monitor wells are located at the former Bertha Barber Tank Battery facility. The monitor wells were installed during the course of a site-wide assessment performed in 1999 by AG&M. Soil boring logs from the wells indicate that the site is underlain by sand of varying colors, grain sizes, and sorting. At most locations, the sand is mixed with some gravel, the presence of which tends to increase with depth. In the northern and eastern portions of the site, the surficial sands and gravel are underlain by caliche at depths ranging from 4 to 9 feet below land surface. Groundwater at the site is generally found between 35 and 40 feet below ground level.

## Field Activities

Quarterly groundwater monitoring events were conducted in March, June, September and December 2000. During each monitoring event, a site-wide gauging event was completed prior to sampling. All thirteen monitor wells located at the site were included in the gauging events. After gauging was completed, all wells found to be free of measurable amounts of phase separate hydrocarbons were sampled.

Three wetted casing volumes of water were removed from each well prior to sample collection. The fluid was removed from each well using a submersible pump and dedicated tubing or a dedicated disposable bailer. In some cases, the wells were pumped (or bailed) dry, and were allowed to recover prior to sampling. When a submersible pump was utilized, it was decontaminated by washing with water and laboratory grade detergent followed by a clean water rinse.

During each quarterly monitoring event, groundwater samples were collected and analyzed for BTEX (benzene, toluene, ethylbenzene and total xylene) using EPA

Method 8021B. During the September and December events, groundwater samples were collected and analyzed for chloride using EPA Method 325.2. Besides BTEX and chloride, groundwater samples were also collected and analyzed for total dissolved solids (TDS) using EPA Method 160.1, three dissolved metals (iron, manganese and barium) using EPA Method 6010B, and polynuclear aromatic hydrocarbons (PAH's) using EPA Method 8310 during the December event. In addition to the above samples, one rinsate sample (field blank) and one replicate sample were submitted during each sampling event, and a trip blank sample was included in each cooler utilized to transport samples for BTEX analysis to the laboratory. All samples were preserved with ice immediately after collection, and shipped within 24 hours to Severn Trent Laboratories in Valparaiso, Indiana for analysis.

### Gauging Results and Groundwater Flow

Fluid levels were gauged in all monitor wells during each quarterly groundwater monitoring event. Table 1 contains historical fluid level data for all monitor wells at the site. Figure 2 is a map showing groundwater elevation contours based on gauging data collected during the March 2000 event. After the March 2000 event, passive skimmers (absorbent booms) were placed in monitor wells MW-1, MW-2, MW-7 and MW-10 to recover phase separate hydrocarbons. Phase separate hydrocarbons ranged between 0.01 to 0.07 feet in MW-1, between 0.01 and 0.02 feet in MW-2 and between 0.01 and 0.18 feet in MW-7 during the four quarterly events. Phase separate hydrocarbons found in MW-10 were approximately 0.01 feet thick during each of the four quarterly events.

Based on the groundwater elevation contours shown on Figure 2, the local groundwater gradient is generally to the east and northeast. This is somewhat contradictory to earlier documentation at the site that suggested that the gradient was to the east and southeast. The earlier site documentation was based on a limited history of groundwater measurements, and with a very flat gradient, it was difficult to determine whether questionable data points were valid.

With more available data, and based on the Figure 2 contouring, it appears that there may be a zone of poor or impaired permeability in the vicinity of the old pits (monitor wells MW-1 and MW-2). The poor or impaired permeability causes water entering the site from the west and/or southwest to stagnate in the vicinity of the old pits. This, in turn, causes the groundwater to be diverted around the pit areas to the northeast and to the southeast causing a slight trough in the water table north of the pits, and a more pronounced trough in the water table south of the pits. The off-site livestock water well may also affect the local gradient by pulling groundwater toward it.

## Sampling Results

BTEX samples were collected from each well (except for MW-1, MW-2, MW-7 and MW-10 which contained measurable phase separate hydrocarbons) during each quarterly event. The results are summarized in Table 2 along with historical results from each well. Based on the historical BTEX database, the following observations were made:

- Monitor wells MW-3, MW-4, MW-5, MW-6, MW-9 and MW-10 have at least one measurement of benzene that exceeds the New Mexico Water Quality Control Commission Ground Water Standards (WQCC) of 10 micrograms per liter (ug/L). However, the concentrations appear to be stable, and in some cases declining.
- MW-10 is the only monitor well that contains toluene above the WQCC standard of 750 ug/L based on sampling in 1999.
- No wells contain ethylbenzene or total xylenes above the WQCC standards of 750 ug/L and 620 ug/L, respectively.
- MW-6 did not have a history of containing benzene until the September and December 2000 monitoring events when benzene was reported at 11 ug/L and 14 ug/L, respectively. Condensate released from a pipeline break northwest of the site is most likely the source of benzene in MW-6, since MW-10, located up-gradient from MW-6, currently contains condensate.

The concentration of benzene in the groundwater was mapped for each quarterly event conducted in 2000 (Figures 3 through 6). Figure 7 shows the apparent net change in benzene concentration from March to December 2000. It should be noted that monitor wells MW-1, MW-2, MW-7 and MW-10 were not sampled during any of the quarterly events, because they contained phase separate hydrocarbons. However, historical data from MW-1, MW-2 and MW-7 do not show benzene above WQCC standards indicating a weathered hydrocarbon source. The quarterly benzene data, as summarized on the quarterly benzene maps showed the following:

- In March 2000, only MW-4 and MW-5 contained benzene in levels exceeding WQCC standards. The concentration of benzene in MW-4 was 54 ug/L and 50 ug/L in MW-5. It is important to note that a replicate sample was collected from MW-3 during the event. However, the results did not duplicate the

original sample from MW-3, and instead appeared to be more consistent with results from MW-4. Therefore, this analysis was flagged as questionable.

- During the June 2000 sampling event, benzene was detected in MW-12 as well as MW-4 and MW-5. The concentration of benzene in MW-12 (7.3 ug/L) was less than the WQCC standard. Monitor well MW-4 contained benzene of 19 ug/L and MW-5 contained benzene of 140 ug/L.
- In September 2000, benzene was detected in MW-4 (66 ug/L) and MW-5 (110 ug/L), but was once again below detection limits in MW-12. During the event, benzene was detected in MW-6 at 11 ug/L. As stated previously, it appears that the source of benzene in MW-6 may be condensate that is present in MW-10.
- During the December 2000 sampling event, benzene was again detected in MW-4 (46 ug/L), MW-5 (169 ug/L) and MW-6 (14 ug/L). The continued presence (and apparent increase in benzene concentration) in MW-6 provides evidence that condensate from the up-gradient pipeline break may be migrating toward the site, and has the possibility of eventually contaminating the off-site livestock water well located north of the site.
- Figure 7 shows three monitor wells sampled during the year where benzene concentrations had a net change between March and December 2000. MW-4 showed a decrease in benzene concentration of 8 ug/L during the year. MW-5 and MW-6 showed increases in benzene concentration of 119 ug/L and 9 ug/L, respectively, during the year. The other monitor wells at the site were either not sampled because they contained PSH throughout the year, or had no net change in benzene concentration during the year.

During the December 2000 sampling event, samples were collected and analyzed for chloride, TDS, the dissolved metals – iron, manganese and barium, and PAH's. Chlorides were also analyzed during the September event. Chloride, TDS and dissolved metal data are summarized in Table 3. PAH data is presented in Table 4.

Chloride and TDS data collected during Year 2000 monitoring confirmed the poor quality of the groundwater in and around the site. Although some wells had lower reported chloride and TDS values as compared to data collected in 1999, the values were all above WQCC standards of 250 milligrams per liter (mg/L) chlorides and 1,000 mg/L TDS.

Dissolved metals data collected during the Year 2000 contained only one sample (MW-6) with manganese detected above the WQCC standard of 0.2 mg/L, and only two samples (MW-4 and MW-5) with barium reported above the WQCC standard of 1.0 mg/L. The manganese level in MW-6 during the December sampling event was 0.4 mg/L. The barium levels found in MW-4 and MW-5 were 2.07 mg/L and 2.84 mg/L, respectively.

PAH's were detected only in monitor well MW-4 during the December sampling event. The PAH's detected included fluorene (1.5 ug/L), phenanthrene (1.6 ug/L) and fluoranthene (4.2 ug/L). All values were consistent with previous detections of PAH's in MW-4 in April 1999.

### Conclusions / Recommendations

Several conclusions can be made from the sampling data collected through the Year 2000. The conclusions are summarized as follows:

- The local groundwater gradient apparently is to the east and northeast, which is contradictory to earlier documentation at the site.
- Monitor wells MW-1, MW-2, MW-7 and MW-10 contained phase separate hydrocarbons during each quarterly monitoring event in 2000.
- MW-6 may be impacted by benzene resulting from condensate that is present in MW-10. This is a concern, because of the apparent groundwater gradient and location of the off-site livestock water well.
- With the local gradient to the east and northeast, and with the off-site livestock water well pulling groundwater from the site toward it, there is some concern that on-site contamination may migrate toward the well.
- Chloride and TDS data in the area shows levels well above WQCC standards, however, some wells have shown a decrease in concentration over the last year.
- Dissolved metal data for iron, manganese and barium, and PAH data is limited to only two events. However, recent data indicates that these constituents exceed WQCC standards only in monitor wells MW-4, MW-5 and MW-6.

Based on the above conclusions the following recommendations are made:

Lea County, New Mexico

- Passive skimmers should be maintained in monitor wells MW-1, MW-2, MW-7 and MW-10 as long as they contain phase separate hydrocarbons. The skimmers should be removed several days prior to each monitoring event to allow fluid levels to stabilize prior to gauging.
- It is recommended that the off-site livestock water well be sampled during future events for BTEX in order to evaluate if it is impacted by hydrocarbons from the site or from the off-site condensate. If possible, the well should also be surveyed so that it can be incorporated in future gauging events.
- It is recommended to continue the groundwater monitoring plan as originally proposed in the Site Investigation Report for at least one more year. After another year of data is collected, the monitoring plan will be evaluated to determine if it is still necessary to sample for chloride, TDS, dissolved metals and PAH's.

Table 1. Historical Fluid Level Data  
Marathon Oil Company, Former Bertha Barber Tank Battery, Lea County, New Mexico

Well ID	Date	Measuring Point Elevation (feet-amsl)	Depth to Product (feet)	Depth to Water (feet-bmp)	Product Thickness (feet-condensate)	Product Thickness (equiv. feet-water)	Corrected Water Level Elevation (feet-amsl)
MW-1	12/21/00	3561.20	37.13	37.14	0.01	0.01	3524.07
	09/27/00	3561.20	37.65	37.70	0.05	0.04	3523.54
	06/20/00	3561.20	37.70	37.77	0.07	0.05	3523.48
	03/30/00	3561.20	36.19	36.20	0.01	0.01	3525.01
	12/14/99	3561.20	36.00	36.03	0.03	0.02	3525.19
	09/22/99	3561.20		35.79	sheen	sheen	3525.41
	08/27/99	3561.20	35.64	35.66	0.02	0.01	3525.56
	07/16/99	3561.20		35.48	sheen	sheen	3525.72
	03/31/99	3561.20	35.77	35.82	0.05	0.04	3525.42
	12/30/98	3561.20		35.83		0	3525.37
MW-2	12/21/00	3561.69	37.59	37.60	0.01	0.01	3524.10
	09/27/00	3561.69	38.11	38.12	0.01	0.01	3523.58
	06/20/00	3561.69	38.10	38.12	0.02	0.01	3523.59
	03/30/00	3561.69	36.59	36.60	0.01	0.01	3525.10
	12/14/99	3561.69		36.62		0	3525.07
	09/22/99	3561.69		36.27		0	3525.42
	08/27/99	3561.69	36.12	36.13	0.01	0.01	3525.57
	07/16/99	3561.69		35.95		0	3525.74
	03/31/99	3561.69		36.33		0	3525.36
	12/30/98	3561.69		36.34		0	3525.35
MW-3	12/21/00	3563.00		38.11		0	3524.89
	09/27/00	3563.00		37.88		0	3525.12
	06/20/00	3563.00		38.56		0	3524.44
	03/30/00	3563.00		38.10		0	3524.90
	12/14/99	3563.00		38.10		0	3524.90
	09/22/99	3563.00		37.59		0	3525.41
	08/27/99	3563.00		37.48		0	3525.52
	07/16/99	3563.00		37.31		0	3525.69
	03/31/99	3563.00		37.67		0	3525.33
	12/30/98	3563.00		37.65		0	3525.35
MW-4	12/21/00	3563.01		38.10		0	3524.91
	09/27/00	3563.01		37.86		0	3525.15
	06/20/00	3563.01		38.26		0	3524.75
	03/30/00	3563.01		38.10		0	3524.91
	12/14/99	3563.01		37.85		0	3525.16
	09/22/99	3563.01		37.57		0	3525.44
	08/27/99	3563.01		37.46		0	3525.55
	07/16/99	3563.01		37.28		0	3525.73
	03/31/99	3563.01		37.66		0	3525.35
	12/30/98	3563.01		37.66		0	3525.35

Notes:

Water level elevations corrected for condensate using a specific gravity of 0.75.

feet-amsl = Feet above mean sea level

feet-bmp = Feet below measuring point

Table 1. Historical Fluid Level Data  
Marathon Oil Company, Former Bertha Barber Tank Battery, Lea County, New Mexico

Well ID	Date	Measuring Point Elevation (feet-amsl)	Depth to Product (feet)	Depth to Water (feet-bmp)	Product Thickness (feet-condensate)	Product Thickness (equiv. feet-water)	Corrected Water Level Elevation (feet-amsl)
MW-5	12/21/00	3561.10		36.15		0	3524.95
	09/27/00	3561.10		35.98		0	3525.12
	06/20/00	3561.10		36.34		0	3524.76
	03/30/00	3561.10		36.10		0	3525.00
	12/14/99	3561.10		35.95		0	3525.15
	09/22/99	3561.10		35.68		0	3525.42
	08/27/99	3561.10		35.56		0	3525.54
	07/16/99	3561.10		35.38		0	3525.72
	03/31/99	3561.10		35.75		0	3525.35
12/30/98	3561.10		35.73		0	3525.37	
MW-6	12/21/00	3561.25		36.13		0	3525.12
	09/27/00	3561.25		36.06		0	3525.19
	06/20/00	3561.25		36.39		0	3524.86
	03/30/00	3561.25		36.29		0	3524.96
	12/14/99	3561.25		36.10		0	3525.15
	09/22/99	3561.25		35.75		0	3525.50
	08/27/99	3561.25		35.69		0	3525.56
MW-7	12/21/00	3562.44	37.65	37.70	0.05	0.04	3524.78
	09/27/00	3562.44	37.75	37.76	0.01	0.01	3524.69
	06/20/00	3562.44	37.73	37.91	0.18	0.14	3524.67
	03/30/00	3562.44	37.55	37.60	0.05	0.04	3524.88
	12/14/99	3562.44		37.51		0	3524.93
	09/22/99	3562.44		38.20		0	3524.24
	08/27/99	3562.44		38.15		0	3524.29
MW-8	12/21/00	3561.39		36.50		0	3524.89
	09/27/00	3561.39		36.61		0	3524.78
	06/20/00	3561.39		36.88		0	3524.51
	03/30/00	3561.39		36.65		0	3524.74
	12/14/99	3561.39		36.44		0	3524.95
	09/22/99	3561.39		37.26		0	3524.13
	08/27/99	3561.39		37.21		0	3524.18
MW-9	12/21/00	3563.59		38.60		0	3524.99
	09/27/00	3563.59		38.60		0	3524.99
	06/20/00	3563.59		38.89		0	3524.70
	03/30/00	3563.59		38.70		0	3524.89
	12/14/99	3563.59		38.48		0	3525.11
	09/22/99	3563.59		36.23		0	3527.36
	08/27/99	3563.59		36.14		0	3527.45

Notes:

Water level elevations corrected for condensate using a specific gravity of 0.75.

feet-amsl = Feet above mean sea level

feet-bmp = Feet below measuring point

Table 1. Historical Fluid Level Data  
Marathon Oil Company, Former Bertha Barber Tank Battery, Lea County, New Mexico

Well ID	Date	Measuring Point Elevation (feet-amsl)	Depth to Product (feet)	Depth to Water (feet-bmp)	Product Thickness (feet-condensate)	Product Thickness (equiv. feet-water)	Corrected Water Level Elevation (feet-amsl)
MW-10	12/21/00	3560.51	35.52	35.53	0.01	0.01	3524.99
	09/27/00	3560.51	35.55	35.56	0.01	0.01	3524.96
	06/20/00	3560.51	35.54	35.55	0.01	0.01	3524.97
	03/30/00	3560.51	35.49	35.50	0.01	0.01	3525.02
	12/14/99	3560.51		35.33		0	3525.18
	09/22/99	3560.51		34.96		0	3525.55
	08/27/99	3560.51		34.87		0	3525.64
MW-11	12/21/00	3565.44		40.01		0	3525.43
	09/27/00	3565.44		39.82		0	3525.62
	06/20/00	3565.44		40.10		0	3525.34
	03/30/00	3565.44		39.80		0	3525.64
	12/14/99	3565.44		40.61		0	3524.83
	09/22/99	3565.44		40.37		0	3525.07
	08/27/99	3565.44		40.34		0	3525.10
MW-12 (PZ-2)	12/21/00	3562.11		37.23		0	3524.88
	09/27/00	3562.11		37.09		0	3525.02
	06/20/00	3562.11		37.34		0	3524.77
	03/30/00	3562.11		37.23		0	3524.88
	12/14/99	3562.11		36.95		0	3525.16
	09/22/99	3562.11		36.69		0	3525.42
	08/27/99	3562.11		36.65		0	3525.46
MW-13 (PZ-1)	12/21/00	3559.67		34.75		0	3524.92
	09/27/00	3559.67		34.49		0	3525.18
	06/20/00	3559.67		34.90		0	3524.77
	03/30/00	3559.67		34.80		0	3524.87
	12/14/99	3559.67		34.96		0	3524.71
	09/22/99	3559.67		34.20		0	3525.47
	08/27/99	3559.67		34.09		0	3525.58

Notes:

Water level elevations corrected for condensate using a specific gravity of 0.75.

feet-amsl = Feet above mean sea level

feet-bmp = Feet below measuring point

Table 2. Historical BTEX Analytical Data  
Former Bertha Barber Tank Battery, Lea County, New Mexico

WELL ID	Sample Date	Benzene (ug/L)	Ethylbenzene (ug/L)	Toluene (ug/L)	o-Xylene (ug/L)	m&p-Xylenes (ug/L)	Total Xylenes (ug/L)	Total BTEX (ug/L)
WQCC	----	10	750	750	----	----	620	----
MW-1	4/9/99	5	<5	<5	NS	NS	<10	5
	7/15/99	<500	<500	<500	NS	NS	<1000	ND
MW-2	4/9/99	<5	<5	<5	NS	NS	<10	ND
	7/15/99	<5	<5	<5	NS	NS	<10	ND
	9/23/99	<5	<5	<5	NS	NS	<10	ND
MW-3	4/9/99	100	14	<5	NS	NS	<10	114
	7/15/99	<5	<5	<5	NS	NS	<10	ND
	9/23/99	<5	<5	<5	NS	NS	<10	ND
	3/30/00	<5	<5	11	<5	<10	ND	11
(Duplicate)**	3/30/00	54	8.6	<5	<5	<10	ND	62.6
	6/20/00	<5	<5	<5	<5	<10	<10	ND
	9/28/00	<5	<5.0	<5	<5	<10	<10	ND
	12/21/00	<5	<5	<5	NS	NS	10	10
MW-4	4/9/99	121	77	43	NS	NS	60	301
	7/15/99	43	28	<5	NS	NS	<10	71
	9/23/99	18	12	<5	NS	NS	<10	30
	3/30/00	54	7.5	8.7	<5	<10	ND	70.2
	6/20/00	19	<5.0	<5	<5	<10	<10	19
	9/28/00	66	13	<5	<5	<10	<10	79
(Duplicate)	9/28/00	51	<5.0	<5	<5	<10	11	62
	12/21/00	46	10	<5	NS	NS	20	76
MW-5	4/9/99	53	<5	<5	NS	NS	<10	53
	7/15/99	470	43	<5	NS	NS	10	523
	9/22/99	156	6	<5	NS	NS	<10	162
	3/30/00	50	<5	9.7	<5	<10	ND	59.7
	6/20/00	140	<5	<5	<5	<10	<10	140
	9/28/00	110	<5	<5	<5	<10	<10	110
	12/21/00	169	5	<5	NS	NS	20	194
MW-6	8/17/99	<5	<5	<5	NS	NS	<10	ND
	9/22/99	<5	<5	<5	NS	NS	<10	ND
	3/30/00	<5	<5	<5	<5	<10	ND	ND
	6/20/00	<5	<5	<5	<5	<10	<10	ND
	9/28/00	11	<5	<5	<5	<10	<10	11
	12/21/00	14	<5	<5	NS	NS	10	24
MW-7	8/17/99	<5	<5	<5	NS	NS	<10	ND
	9/22/99	<5	<5	<5	NS	NS	<10	ND
MW-8	8/17/99	<5	<5	<5	NS	NS	<10	ND
	9/23/99	<5	<5	<5	NS	NS	<10	ND
	3/30/00	<5	<5	11	<5	<10	ND	11
	6/20/00	<5	<5	<5	<5	<10	<10	ND
	9/28/00	<5	<5	<5	<5	<10	<10	ND
	12/21/00	<5	<5	<5	NS	NS	<10	ND

Table 2. Historical BTEX Analytical Data  
Former Bertha Barber Tank Battery, Lea County, New Mexico

WELL ID	Sample Date	Benzene (ug/L)	Ethylbenzene (ug/L)	Toluene (ug/L)	o-Xylene (ug/L)	m&p-Xylenes (ug/L)	Total Xylenes (ug/L)	Total BTEX (ug/L)
WQCC	-----	10	750	750	-----	-----	620	-----
MW-9	8/17/99	20	<5	<5	NS	NS	<10	20
	9/23/99	8	<5	<5	NS	NS	<10	ND
	3/30/00	<5	<5	9.3	<5	<5	ND	9.3
	6/20/00*	<5	<5	<5	<5	<10	<10	ND
	9/28/00*	<5	<5	<5	<5	<10	<10	ND
	12/21/00*	<5	<5	<5	NS	NS	<10	ND
MW-10	8/17/99	12100	160	1730	NS	NS	400	14390
	9/22/99	2900	520	800	NS	NS	600	4820
MW-11	8/17/99	<5	<5	<5	NS	NS	<10	ND
	9/23/99	<5	<5	<5	<5	<10	<10	ND
	3/30/00	<5	<5	<5	<5	<10	ND	ND
	6/20/00	<5	<5	<5	<5	<10	<10	ND
(Duplicate)	6/20/00	<5	<5	<5	<5	<10	<10	ND
	9/28/00	<5	<5	<5	<5	<10	<10	ND
	12/21/00	<5	<5	<5	NS	NS	20	20
MW-12 (PZ-2)	8/17/99	<5	<5	<5	NS	NS	<10	ND
	9/22/99	<5	<5	<5	NS	NS	<10	ND
	3/30/00	<5	<5	<5	<5	<10	ND	ND
	6/20/00	7.3	<5	<5	<5	<10	<10	7.3
	9/28/00	<5	<5	<5	<5	<10	<10	ND
	12/21/00	<5	<5	<5	NS	NS	20	20
MW-13 (PZ-1)	8/17/99	<5	<5	<5	NS	NS	<10	ND
	9/23/99	<5	<5	<5	NS	NS	<10	ND
	3/30/00	<5	5	<5	<5	<10	ND	5
	6/20/00	<5	<5	<5	<5	<10	<10	ND
	9/28/00	<5	<5	<5	<5	<10	<10	ND
	12/21/00	<5	<5	<5	NS	NS	<10	ND

Footnotes:

WQCC - New Mexico Water Quality Control Commission Ground Water Standards.

BTEX - Benzene, Toluene, Ethylbenzene and Total Xylenes.

ug/L - micrograms per liter.

NS - Constituent not sampled during the sampling event.

ND - Constituent was not detected during laboratory testing, and laboratory reporting limits are variable.

\* - Data was originally labeled as MW-7, but is actually MW-9.

MW-7 was not sampled in 2000 due to the presence of phase separate hydrocarbon (PSH).

\*\* - Question data because it appears to be more representative of the sample for MW-4 for the same event.

Table 3. Historical Analytical Data for Selected Dissolved Metals, Chlorides and TDS  
Former Bertha Barber Tank Battery, Lea County, New Mexico

WELL ID	Sample Date	Dissolved Metals			Chloride (mg/L)	TDS (mg/L)
		Iron (mg/L)	Manganese (mg/L)	Barium (mg/L)		
WQCC	----	1.0	0.2	1.0	250	1,000
MW-1	4/9/99	3.86	0.48	2.74	3600	6,100
MW-2	4/9/99	1.54	0.26	0.39	2700	4,400
	9/23/99	NS	NS	NS	2500	NS
MW-3	4/9/99	4.66	0.37	0.69	2000	3,500
	9/23/99	NS	NS	NS	1300	NS
	9/28/00	NS	NS	NS	400	NS
	12/21/00	0.07	0.05	0.13	490	1,300
MW-4	4/9/99	1.46	0.32	1.63	800	1,900
	9/23/99	NS	NS	NS	510	NS
	9/28/00	NS	NS	NS	600	NS
	(Duplicate) 9/28/00	NS	NS	NS	760	NS
	12/21/00	<0.05	0.06	2.07	350	1,100
MW-5	4/9/99	47.2	0.97	15.3	2400	4,000
	9/22/99	NS	NS	NS	860	NS
	9/28/00	NS	NS	NS	1200	NS
	12/21/00	0.27	0.06	2.84	760	1,700
MW-6	8/17/99	<0.05	0.21	0.14	2460	4,700
	9/22/99	NS	NS	NS	2400	NS
	9/28/00	NS	NS	NS	1200	NS
	12/21/00	0.37	0.4	0.14	1300	2,400
MW-7	8/17/99	<0.05	0.06	0.44	1400	2,800
	9/22/99	NS	NS	NS	1100	NS
MW-8	8/17/99	0.8	0.34	6.16	1860	3,300
	9/23/99	NS	NS	NS	1900	NS
	9/28/00	NS	NS	NS	1300	NS
	12/21/00	0.32	0.12	0.14	1000	2,100
MW-9	8/17/99	0.11	0.22	0.21	1100	2,300
	9/23/99	NS	NS	NS	1100	NS
	9/28/00*	NS	NS	NS	820	NS
	12/21/00*	<0.05	0.04	0.26	520	1,400
MW-10	8/17/99	0.61	0.17	0.14	2370	4,400
	9/22/99	NS	NS	NS	2200	NS
MW-11	8/17/99	<0.05	0.17	0.14	1020	2,300
	9/23/99	NS	NS	NS	1100	NS
	9/28/00	NS	NS	NS	1300	NS
	12/21/00	<0.05	0.09	0.14	1400	2,700
MW-12 (PZ-2)	8/17/99	0.11	0.13	0.16	4160	7,100
	9/22/99	NS	NS	NS	4400	NS
	9/28/00	NS	NS	NS	3800	NS
	12/21/00	0.1	0.05	0.15	4000	6,100
MW-13 (PZ-1)	8/17/99	<0.05	0.09	0.16	1920	3,500
	9/23/99	NS	NS	NS	1600	NS
	9/28/00	NS	NS	NS	2200	NS
	12/21/00	0.06	0.02	0.05	1700	2,900

Footnotes:

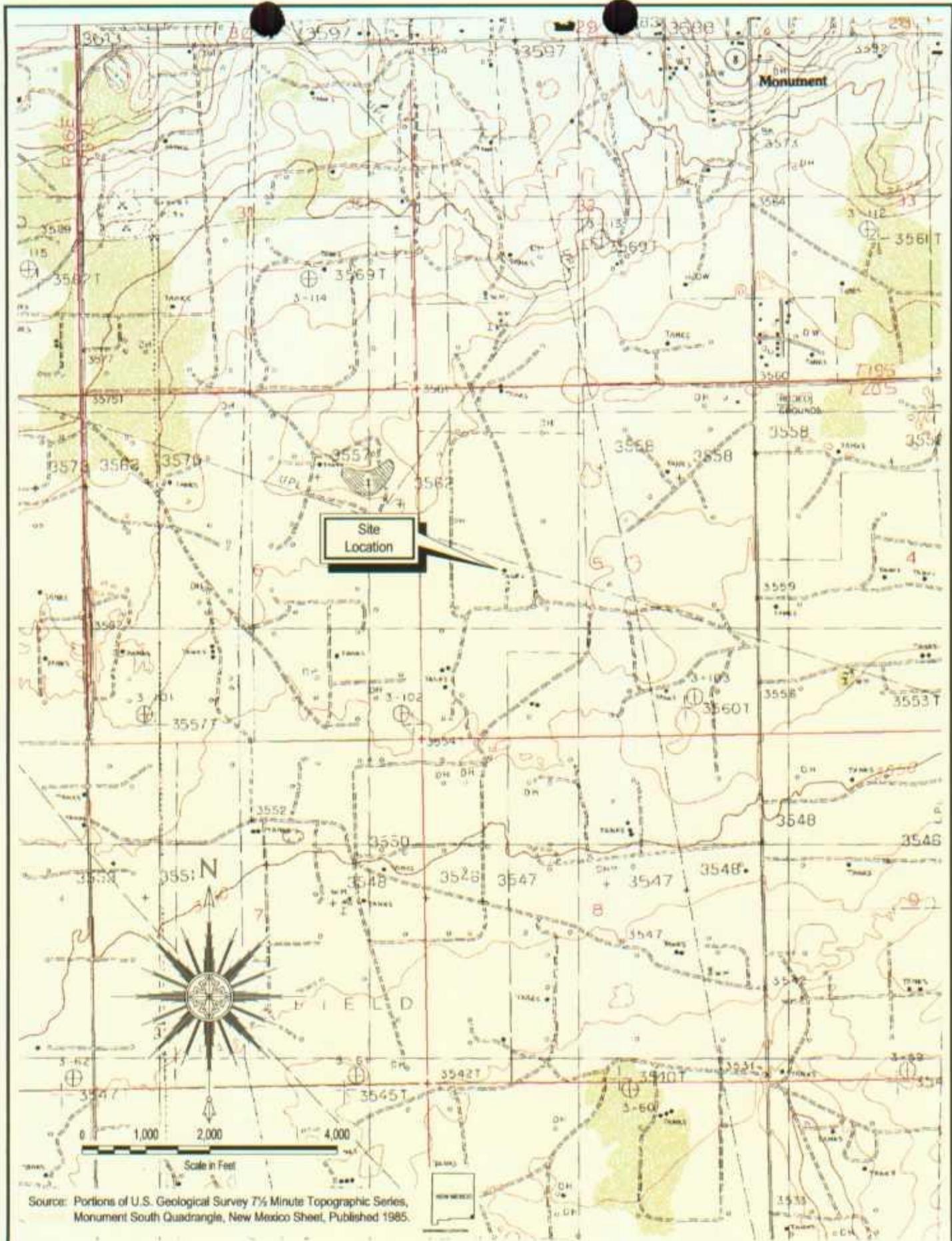
- WQCC - New Mexico Water Quality Control Commission Ground Water Standards.
- TDS - Total Dissolved Solids.
- mg/L - milligrams per liter.
- NS - Constituent not sampled during the sampling event.
- \* - Data was originally labeled as MW-7, but is actually MW-9.
- MW-7 was not sampled in 2000 due to the presence of phase separate hydrocarbon (PSH).

Table 4. Historical PAH Analytical Data  
Former Bertha Barber Tank Battery, Lea County, New Mexico

WELL ID	Sample Date	Fluorene (ug/L)	Indeno(1,2,3-cd)pyrene (ug/L)	Naphthalene (ug/L)	Phenanthrene (ug/L)	Pyrene (ug/L)	Anthracene (ug/L)	Benzo(b)fluoranthene (ug/L)	Fluoranthene (ug/L)	Chrysene (ug/L)	Benzo(a)anthracene (ug/L)	Benzo(a)pyrene (ug/L)	Benzo(ghi)perylene (ug/L)	Acenaphthylene (ug/L)	Acenaphthene (ug/L)	Dibenzo(a,h)anthracene (ug/L)	Benzo(k)fluoranthene (ug/L)
MW-1	4/9/99	<15	<1.5	<75	<15	<15	<15	1.6	<41	<15	6.5	<1.5	<1.5	<75	<75	<1.5	<1.5
MW-2	4/9/99	<1.0	<0.1	<5	<1.0	<1.0	<1	<0.1	<1.0	<1.0	<0.10	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-3	4/9/99	<1.0	<0.1	<5.0	<1.0	<1.0	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
	12/21/00	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-4	4/9/99	1.2	<0.1	18.1	1	<1.0	<1.0	<0.1	1.4	<1.0	0.12	<0.1	<0.1	<5	<5	<0.1	<0.1
	12/21/00	1.5	<0.1	<5.0	1.6	<1	<1.0	<0.1	4.2	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-5	4/9/99	<1.0	<0.1	<5.0	<1.0	<1.0	<1	<0.1	<1.0	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
	12/21/00	<1	<0.1	<5.0	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-6	8/17/99	<1	<0.1	<5	<1	<1.0	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
	12/21/00	<1	<0.1	<5	<1	<1.0	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-7	8/17/99	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-8	8/17/99	<1.0	<0.1	<5	<1.0	<1.0	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
	12/21/00	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-9	8/17/99	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
	12/21/00*	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-10	8/17/99	<1	<0.1	<5.0	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-11	8/17/99	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
	12/21/00	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-12 (PZ-2)	8/17/99	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
	12/21/00	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
MW-13 (PZ-1)	8/17/99	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1
	12/21/00	<1	<0.1	<5	<1	<1	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<5	<5	<0.1	<0.1

Footnotes:

- PAH - Polynuclear aromatic hydrocarbons.
- ug/L - micrograms per liter.
- NS - Constituent not sampled during the sampling event.
- ND - Constituent was not detected during laboratory testing, and laboratory reporting limits are variable.
- \* - Data was originally labeled as MW-7, but is actually MW-9.



Source: Portions of U.S. Geological Survey 7 1/2 Minute Topographic Series, Monument South Quadrangle, New Mexico Sheet, Published 1985.

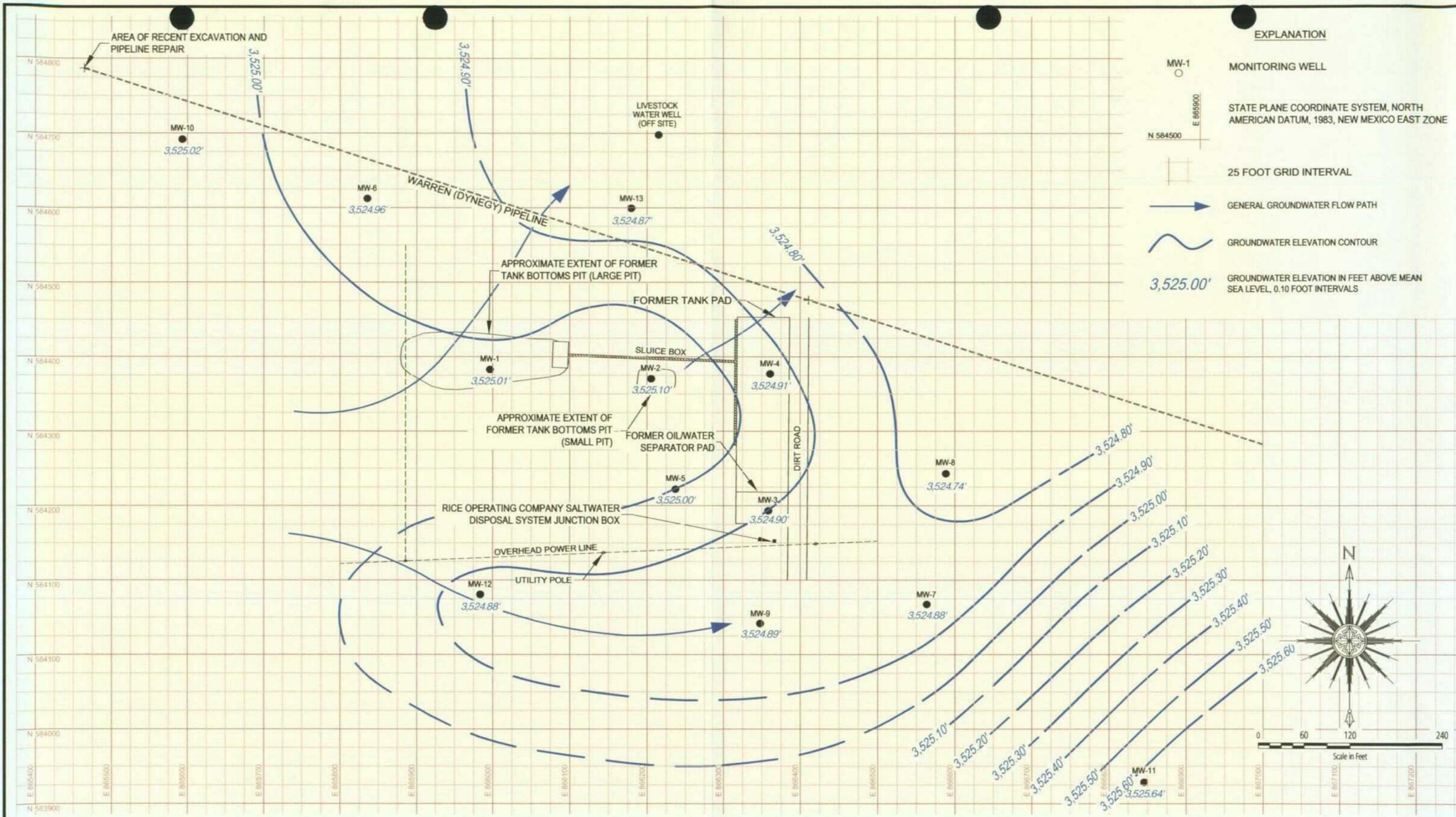
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1030 Andrews Highway Suite 120, Midland, TX 79701-3872 Tel: 915/699-1381 Fax: 915/699-1978



DATE MARCH 29, 2001	COMPILED BY A. J. REED, JR.	PROJECT MANAGER A. J. REED, JR.	AREA MANAGER A. SCHMIDT
MARATHON OIL COMPANY YEAR 2000 ANNUAL GROUNDWATER MONITORING REPORT SITE LOCATION MAP FORMER BERTHA BARBER TANK BATTERY LEA COUNTY, NEW MEXICO		FILE NAME MTR89101.DWG	UNIQUE NUMBER 31-014-00229
		PROJECT NUMBER MT000689.0001	FIGURE 1



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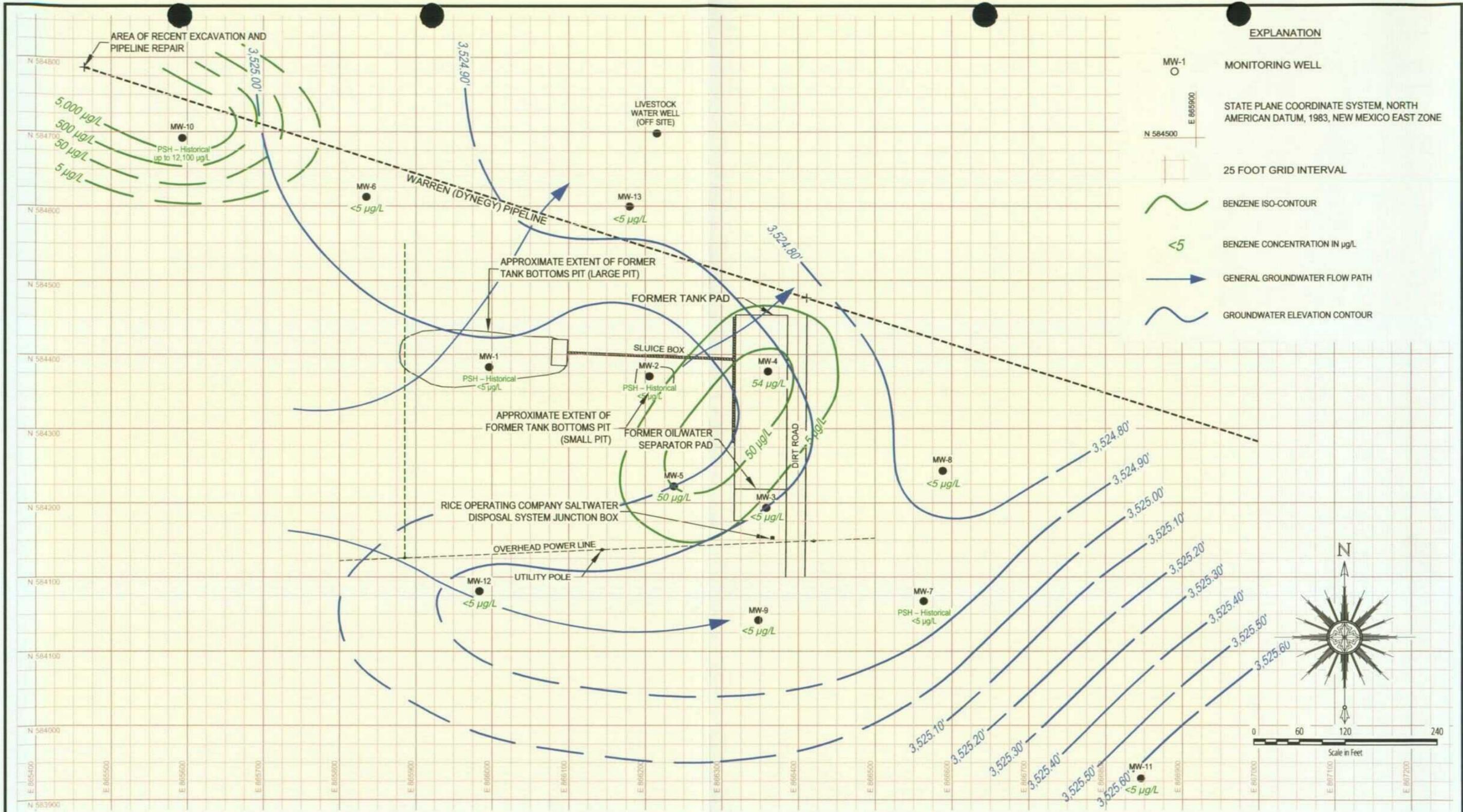
NO.	DATE	REVISION DESCRIPTION	BY	CHKD

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DATE MARCH 29, 2001	FILE NAME MT689102.DWG	FILE LOCATION IDWGMARATHON OIL\MT000689.001	UNIQUE NUMBER 31-014-00230	PROJECT MANAGER A. J. REED, JR.	AREA MANAGER A. SCHMIDT
MARATHON OIL COMPANY YEAR 2000 ANNUAL GROUNDWATER MONITORING REPORT GROUNDWATER ELEVATION CONTOURS MARCH, 2000 FORMER BERTHA BARBER TANK BATTERY LEA COUNTY, NEW MEXICO			COMPILER A. J. REED, JR.	CHECKED S. TISCHER	
PROJECT NUMBER MT000689.0001			FIGURE 2		



- EXPLANATION**
- MW-1 ○ MONITORING WELL
  - E 865900 STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM, 1983, NEW MEXICO EAST ZONE
  - N 584500
  - 25 FOOT GRID INTERVAL
  - BENZENE ISO-CONTOUR
  - <5 BENZENE CONCENTRATION IN µg/L
  - GENERAL GROUNDWATER FLOW PATH
  - GROUNDWATER ELEVATION CONTOUR

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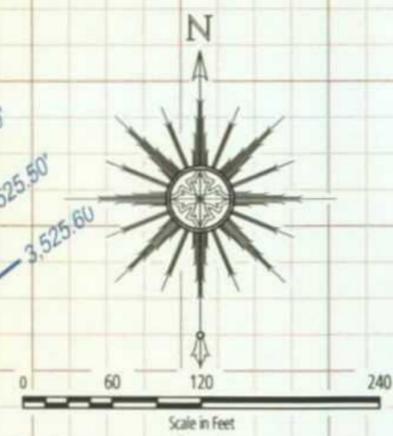
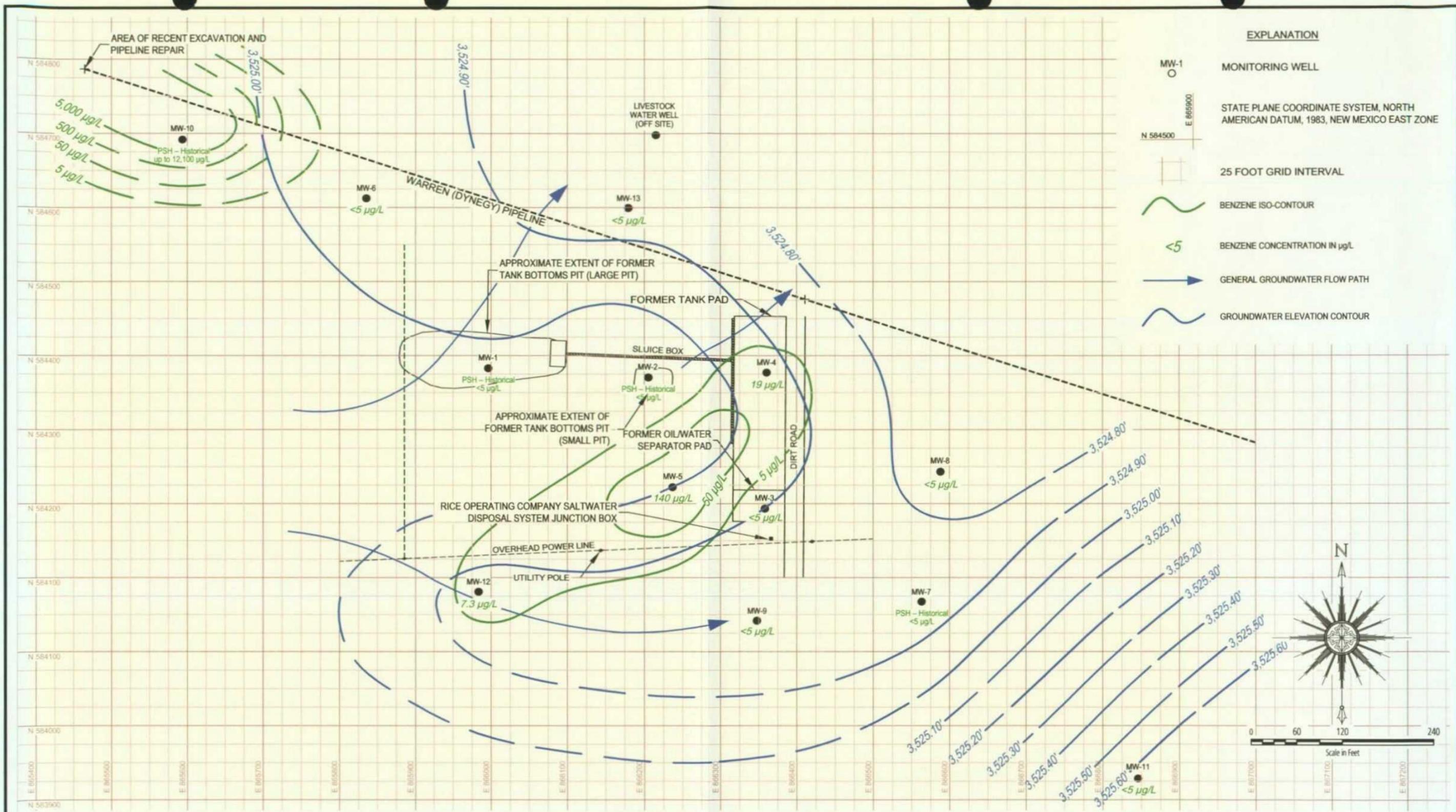
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DATE MARCH 29, 2001	FILE NAME MT689103.DWG	FILE LOCATION IDWGMARATHON OIL\MT000689.001	UNIQUE NUMBER 31-014-00231	PROJECT MANAGER A. J. REED, JR.	AREA MANAGER A. SCHMIDT
MARATHON OIL COMPANY YEAR 2000 ANNUAL GROUNDWATER MONITORING REPORT BENZENE CONCENTRATIONS IN GROUNDWATER MARCH, 2000 FORMER BERTHA BARBER TANK BATTERY LEA COUNTY, NEW MEXICO			PROJECT NUMBER MT000689.0001	CHECKED S. TISCHER	FIGURE 3

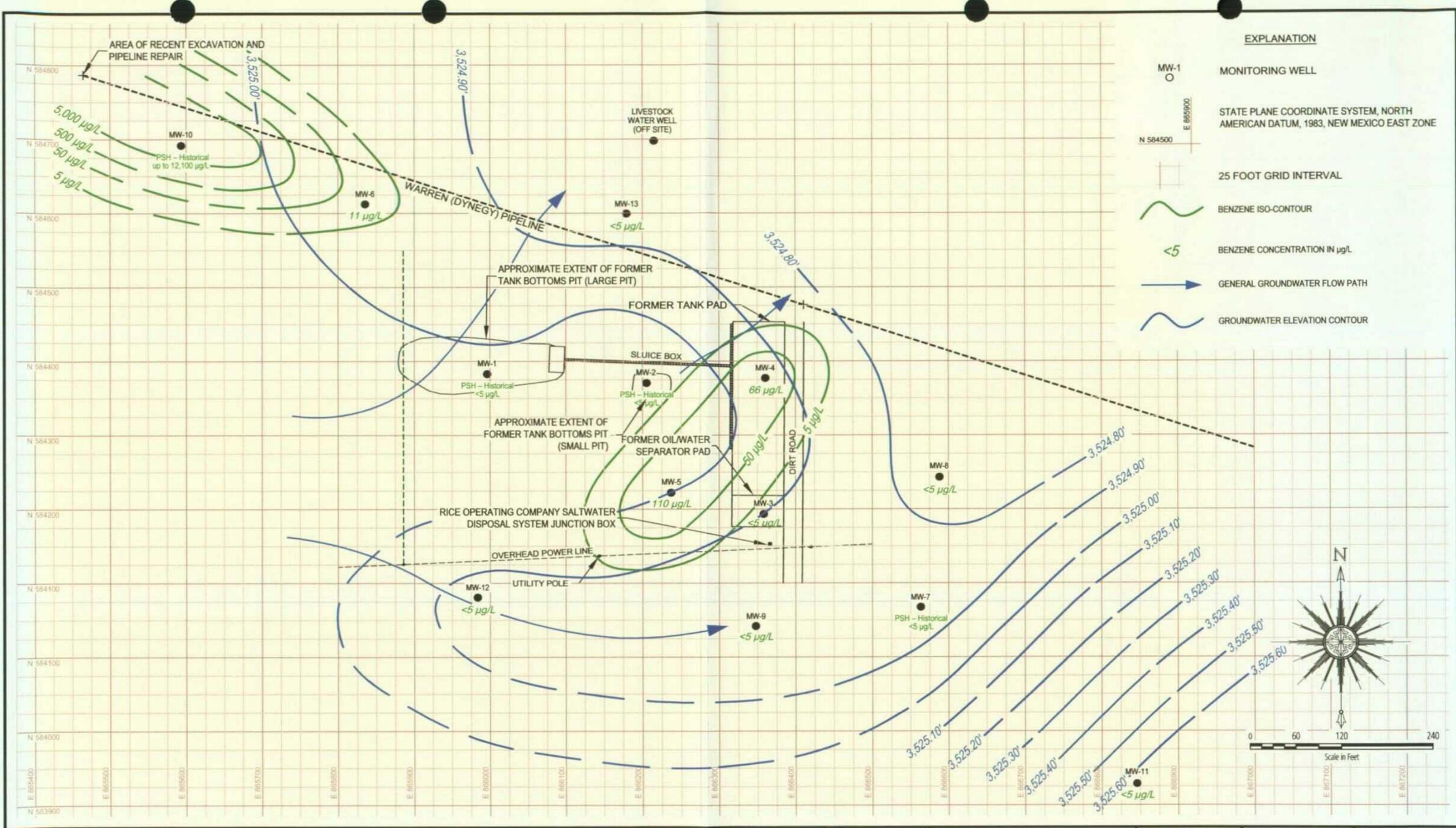


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DATE MARCH 29, 2001	FILE NAME MT689104.DWG	FILE LOCATION IDWGMARATHON OIL\MT000689.001	UNIQUE NUMBER 31-014-00232	PROJECT MANAGER A. J. REED, JR.	AREA MANAGER A. SCHMIDT
MARATHON OIL COMPANY YEAR 2000 ANNUAL GROUNDWATER MONITORING REPORT BENZENE CONCENTRATIONS IN GROUNDWATER FORMER BERTHA BARBER TANK BATTERY LEA COUNTY, NEW MEXICO			JUNE, 2000		
PROJECT NUMBER MT000689.0001				FIGURE 4	



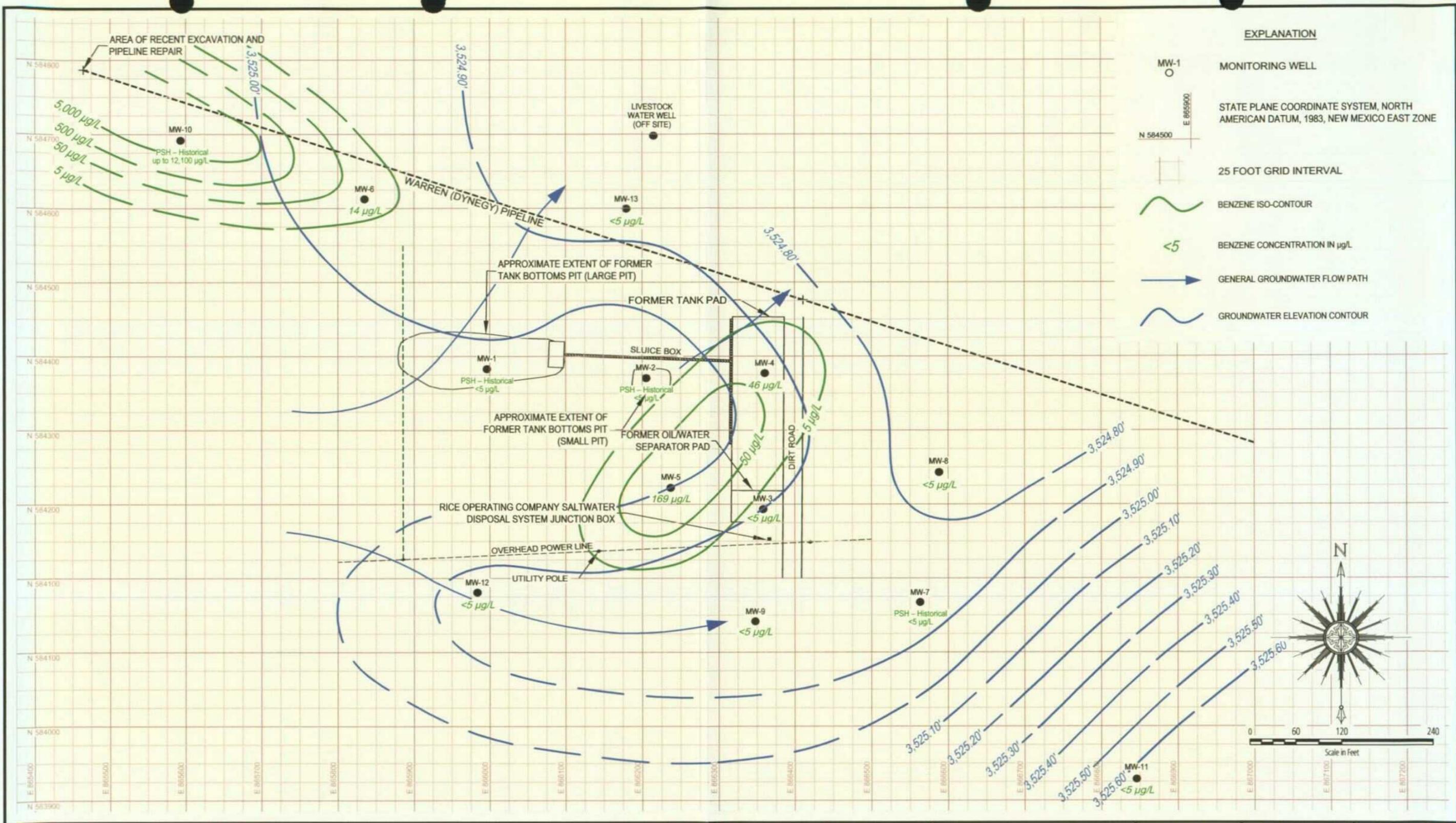
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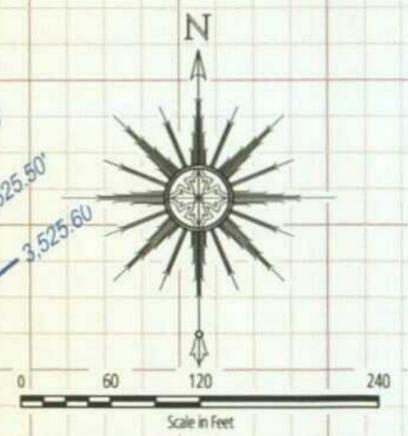
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DATE MARCH 29, 2001	FILE NAME MT689105.DWG	FILE LOCATION IDWGMARATHON OIL\MT000689.001	UNIQUE NUMBER 31-014-00233	PROJECT MANAGER A. J. REED, JR.	AREA MANAGER A. SCHMIDT
MARATHON OIL COMPANY YEAR 2000 ANNUAL GROUNDWATER MONITORING REPORT BENZENE CONCENTRATIONS IN GROUNDWATER SEPTEMBER, 2000 FORMER BERTHA BARBER TANK BATTERY LEA COUNTY, NEW MEXICO			COMPILER A. J. REED, JR.	CHECKED S. TISCHER	PROJECT NUMBER MT000689.0001
				FIGURE 5	



- EXPLANATION**
- MW-1 ○ MONITORING WELL
  - N 584500 E 8665000 STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM, 1983, NEW MEXICO EAST ZONE
  - 25 FOOT GRID INTERVAL
  - BENZENE ISO-CONTOUR
  - <math><5\ \mu\text{g/L}</math> BENZENE CONCENTRATION IN  $\mu\text{g/L}$
  - GENERAL GROUNDWATER FLOW PATH
  - GROUNDWATER ELEVATION CONTOUR



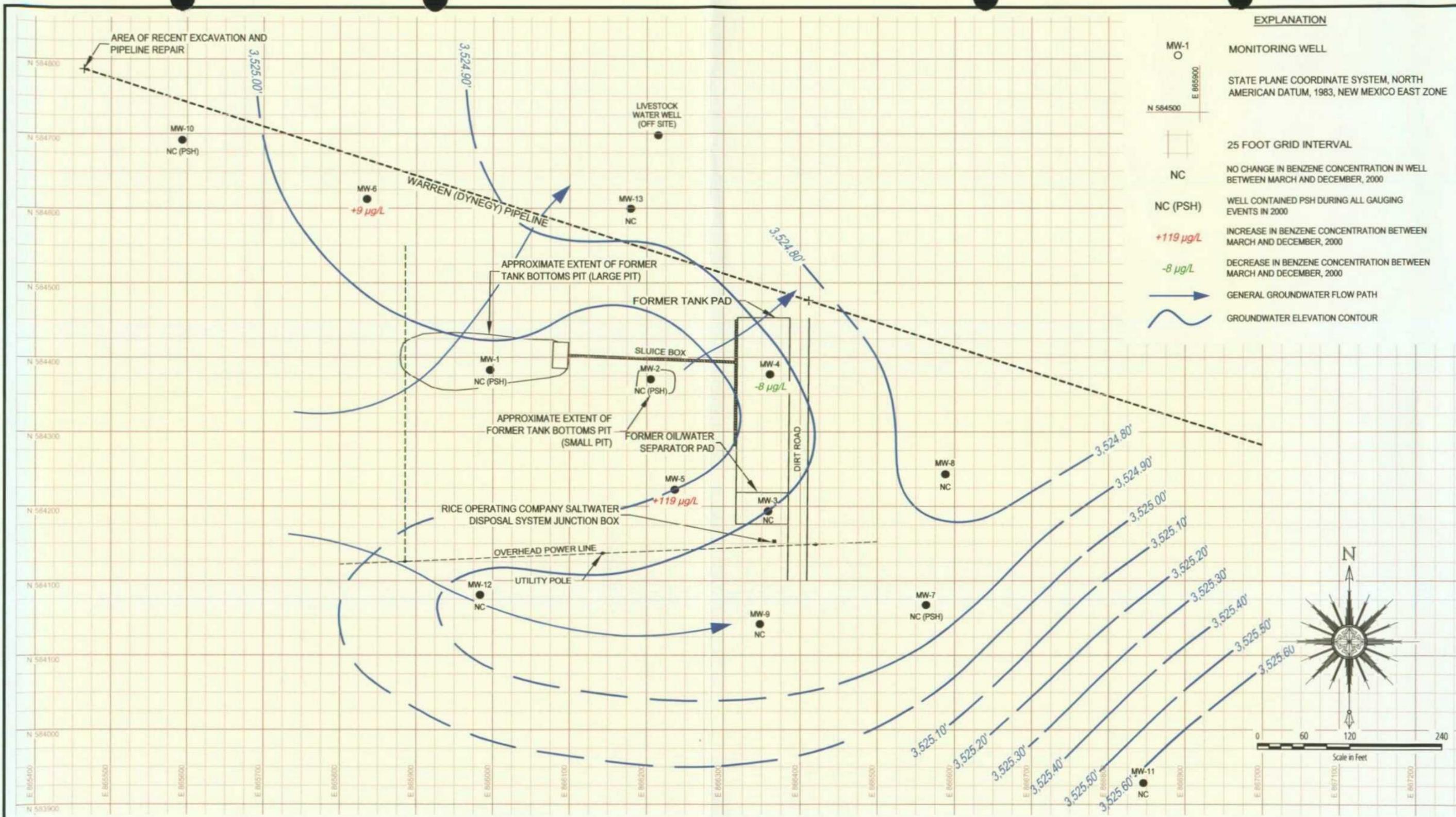
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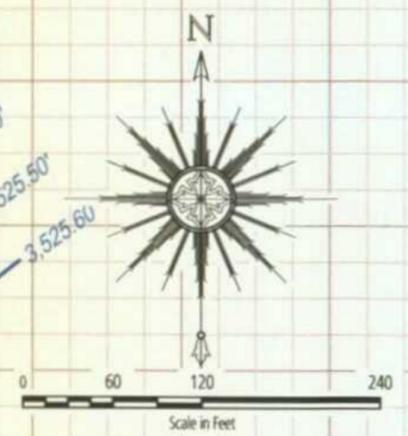


DATE MARCH 29, 2001	FILE NAME MT689106.DWG	FILE LOCATION IDW\GIM\ARATHON OIL\MT000689.001	UNIQUE NUMBER 31-014-00234	PROJECT MANAGER A. J. REED, JR.	AREA MANAGER A. SCHMIDT
MARATHON OIL COMPANY YEAR 2000 ANNUAL GROUNDWATER MONITORING REPORT BENZENE CONCENTRATIONS IN GROUNDWATER DECEMBER, 2000 FORMER BERTHA BARBER TANK BATTERY LEA COUNTY, NEW MEXICO			COMPILER A. J. REED, JR.	CHECKED S. TISCHER	PROJECT NUMBER MT000689.0001
				FIGURE 6	



**EXPLANATION**

MW-1 ○	MONITORING WELL
N 584500 E 865900	STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM, 1983, NEW MEXICO EAST ZONE
□	25 FOOT GRID INTERVAL
NC	NO CHANGE IN BENZENE CONCENTRATION IN WELL BETWEEN MARCH AND DECEMBER, 2000
NC (PSH)	WELL CONTAINED PSH DURING ALL GAUGING EVENTS IN 2000
+119 µg/L	INCREASE IN BENZENE CONCENTRATION BETWEEN MARCH AND DECEMBER, 2000
-8 µg/L	DECREASE IN BENZENE CONCENTRATION BETWEEN MARCH AND DECEMBER, 2000
→	GENERAL GROUNDWATER FLOW PATH
~	GROUNDWATER ELEVATION CONTOUR



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DATE MAY 2, 2001	FILE NAME MT689107.DWG	FILE LOCATION IDWGMARATHON OIL\MT000689.001	UNIQUE NUMBER 31-014-00235	PROJECT MANAGER A. J. REED, JR.	AREA MANAGER A. SCHMIDT
MARATHON OIL COMPANY YEAR 2000 ANNUAL GROUNDWATER MONITORING REPORT APPARENT NET CHANGE IN BENZENE CONCENTRATIONS FROM MARCH TO DECEMBER, 2000 LEA COUNTY, NEW MEXICO				COMPILER A. J. REED, JR.	CHECKED S. TISCHER
				PROJECT NUMBER MT000689.0001	FIGURE 7