

KERR-MCGEE CORPORATION



SEMI-ANNUAL PERFORMANCE REPORT CHROMIUM MITIGATION PROGRAM

**KERR-MCGEE CHEMICAL LLC
HENDERSON, NEVADA**

**JULY-DECEMBER 1999
January 26, 2000**

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**SEMI-ANNUAL CHROMIUM MITIGATION
PERFORMANCE REPORT
KERR-MCGEE CHEMICAL LLC
HENDERSON, NEVADA**

JULY - DECEMBER 1999

Submitted in Accordance with:

Chromium Mitigation Program
Consent Order
September 9, 1986

Prepared by:

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January 26, 2000

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INTRODUCTION

In accordance with the Consent Order for remediation of chromium contaminated groundwater at the Henderson facility, finalized September 9, 1986, Kerr-McGee Chemical LLC (KMCLLC) submits this semi-annual performance report to the Nevada Department of Environmental Protection. This report, covering the period July through December, 1999, summarizes performance data for the groundwater treatment plant and evaluates the effectiveness of the groundwater interception and treatment system installed to carry out the chromium remediation program.

GROUNDWATER SURFACE CONFIGURATION

Figure 1 illustrates the Consent Order monitoring area as defined in Appendix D of the Consent Order, and shows the locations of all groundwater interceptor and monitor wells installed by KMCLLC within this area. Appendix A of this report lists monthly/quarterly groundwater elevations recorded since December 1994 in wells within the Consent Order area. The water table configuration is presented as potentiometric surface maps for the second half of 1999, reflecting quarterly groundwater level measurements.

Figure 2 shows the potentiometric surface within the Consent Order monitoring area for the third quarter of 1999. Groundwater elevation data were recorded on August 9, 1999. Figure 3 presents the same type map for the fourth quarter of 1999, based on groundwater elevation data recorded on November 8, 1999. Groundwater elevations

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continue to confirm that water levels in the Consent Order monitoring area have stabilized since the discharge of cooling water to the beta ditch was discontinued in November 1987.

INTERCEPTOR SYSTEM PERFORMANCE

Figures 2 and 3 show the potentiometric surface configuration in the interceptor area during the second half of 1999. Although the potentiometric surface maps do not generally show overlapping drawdown cones along the entire interceptor line, the majority of interceptor wells are drawn down to or below the top of the Muddy Creek Formation. Drawdowns to this degree indicate that the alluvial aquifer is locally being depleted of water and that interception of groundwater has been maximized with this recovery system.

In May 1990, KMCLLC began analyses for chromium in several wells not required for sampling by the Consent Order. They are located both upgradient and downgradient from the recharge trench. The resulting data is shown in Table 1, and presented graphically as Figures 4 and 5. The M-70 series wells presented in Figure 4 are located upgradient from the recharge trench. The M-80 series wells presented in Figure 5 are located downgradient from the recharge trench.

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Two of the upgradient M-70 series well, M-71 and M-72, show increases of chromium concentrations over the last six months. Groundwater interceptor wells I-P and I-Q were recently installed upgradient from this area. Groundwater recovery in this area has been hampered by chronically low groundwater levels which impact recovery efficiencies. Well M-73 has shown a gradual increase in chromium concentration during this same time period.

Two of the downgradient M-80 series wells, M-84 and M-86, are also exhibiting increases in chromium concentrations during the second half of 1999. This is also a result of less efficient interceptor well recoveries in response to low groundwater levels.

Chromium concentration data from the five Consent Order Appendix J wells (see Figure 6) are contained in Table 3. Figure 7 presents this data graphically. Well M-11, closest to the historic upgradient source of the chromium impact, has steadily declined in chromium concentration since September 1993. Chromium impact is now at the lowest concentration in M-11 since 1987. Conversely, well M-36, further downgradient from M-11 but upgradient from the recovery well line, is still increasing in chromium concentration. This chromium decline in M-11 apparently represents the tail end of a chromium plume, mobilized in the past, moving beyond M-11, and still moving through M-36. Future sampling should continue to confirm this phenomenon.

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KMCLLC instituted a management program to assure maximization of groundwater removal at the individual well locations along the interceptor line by focusing on those wells showing the highest chromium concentrations. Figure 8 portrays chromium concentration for each interceptor well for the past year. Discharge rates for each well are monitored and adjusted to provide maximum recovery of chromium based on the potentiometric surface configuration, chromium concentration, and well production capability. Table 2 lists the pumping rate of each interceptor well for the months of December 1994 through 1998, as compared to December 1999.

It should be noted in Figure 8 that chromium concentrations moving into the interceptor well system in November 1999 show an increase over concentrations for December 1998 in the vicinity of wells I-F through I-O. This increase in chromium concentrations is consistent with that seen in well M-36 previously described in the Appendix J well discussion. This portion of the interceptor well line is apparently receiving the bulk of the chromium inventory moving downgradient from the Unit 4 area.

RECOVERY/TREATMENT SYSTEM MAINTENANCE

Approximately every twelve days, the electrodes in the treatment plant's electrolytic cells require replacement. During electrode replacement, a backup cell is placed in active service in the circuit to maintain groundwater treatment.

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The interceptor wells utilize a time-marking device that shuts the pump off for a pre-determined amount of time if the well runs dry. If a pump spends a significant amount of time shut down, overall recovery can be increased by decreasing the pump rate, allowing a smaller discharge to occur a greater percentage of the time. Well discharge rates are adjusted periodically, based on either a continuous pumping or low flow scenario.

All interceptor wells are checked for operation each day; flow rates are recorded for each well twice weekly. Flowmeter readings (total volume) are recorded for each time-marking well twice weekly. These records indicate when a pump needs to be replaced or a flow rate adjusted. In addition, other maintenance associated with maintaining treatment plant operations was performed. During the second half of 1999, maintenance work was performed on the pumping systems in recovery wells I-F and I-G (9/16). General repairs were made to the plant system itself on 9/13, 9/27 - 10/5, 10/22, 11/2, and 12/10.

CONCLUSIONS

Groundwater recovery volumes from the interceptor wells have continued to decline over time. No adverse impacts to downgradient groundwater levels have been observed as a result of returning treated groundwater to the near-surface aquifer via the recharge galleries. Chromium concentrations in monitor wells immediately

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downgradient from key areas along the interceptor line may be indicative of incomplete capture.

Since December 30, 1998, groundwater recovered and treated by the chromium mitigation system is discharged to an onsite 11-acre pond. This change was instituted to halt recharge of perchlorate-impacted groundwater back to the subsurface groundwater system. Untreated Lake Mead water is now being reinjected into the groundwater system via the recharge trenches in volumes at or below the rate of groundwater extracted by the interceptor wells. Replacing the recovered groundwater with a like volume of lake water has maintained the groundwater flow gradient and potentiometric pattern. However, replacing the recovered groundwater with a larger volume of lake water may serve as a slight mounding to aid in upgradient recovery of the impacted groundwater.

PROPOSED FUTURE ACTIVITIES

KMCLLC will continue to record water levels in the Consent Order area on a quarterly basis. Quarterly potentiometric surface maps will be developed. Any additional monitor well data required in the approved UIC permit will be incorporated in the map preparation. The apparent breakthrough of impacted groundwater along the interceptor well line has continued, in spite of the five new interceptor wells installed and put on line during the first half of 1999. These wells have reduce the well spacing to approximately

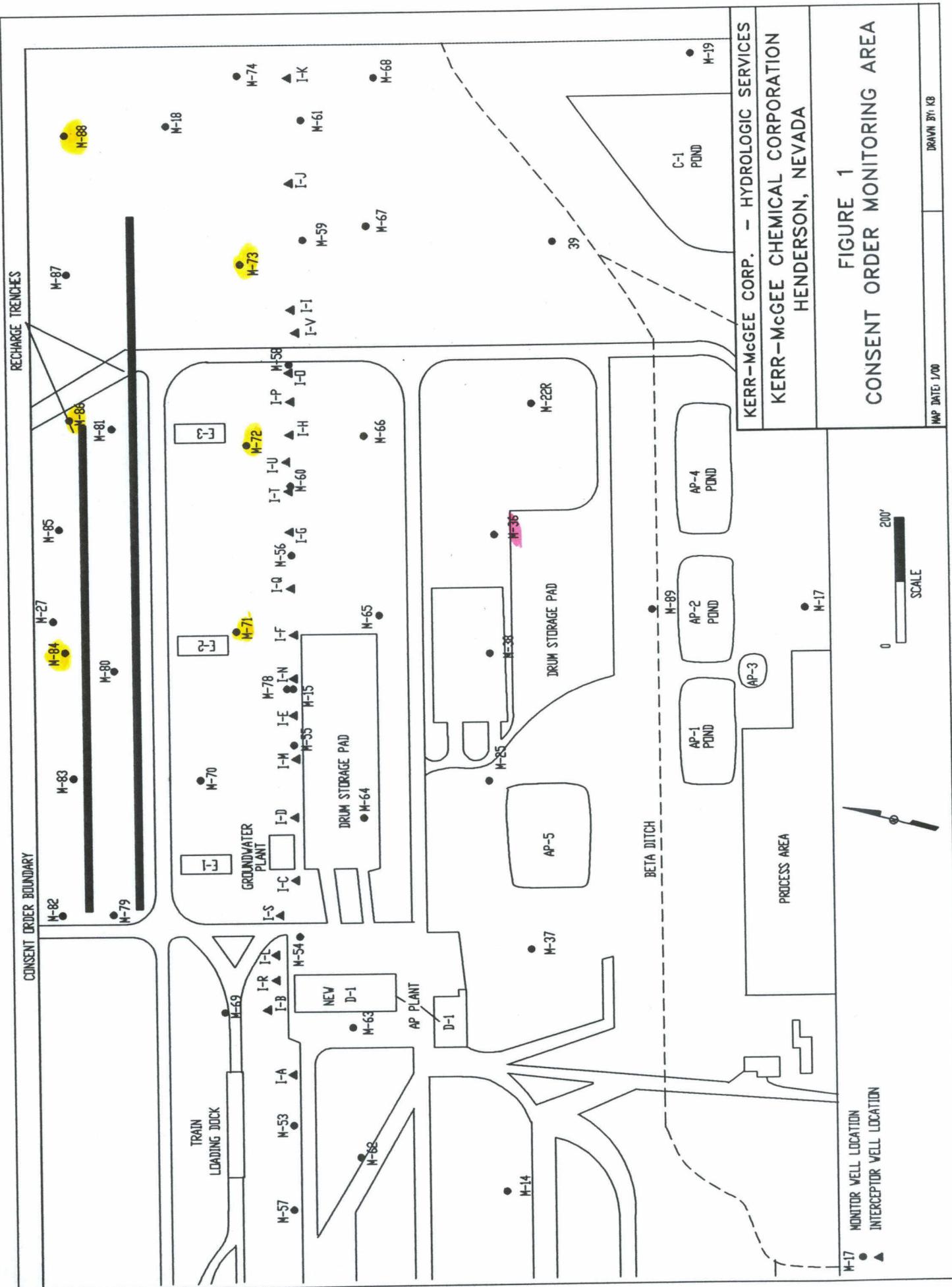
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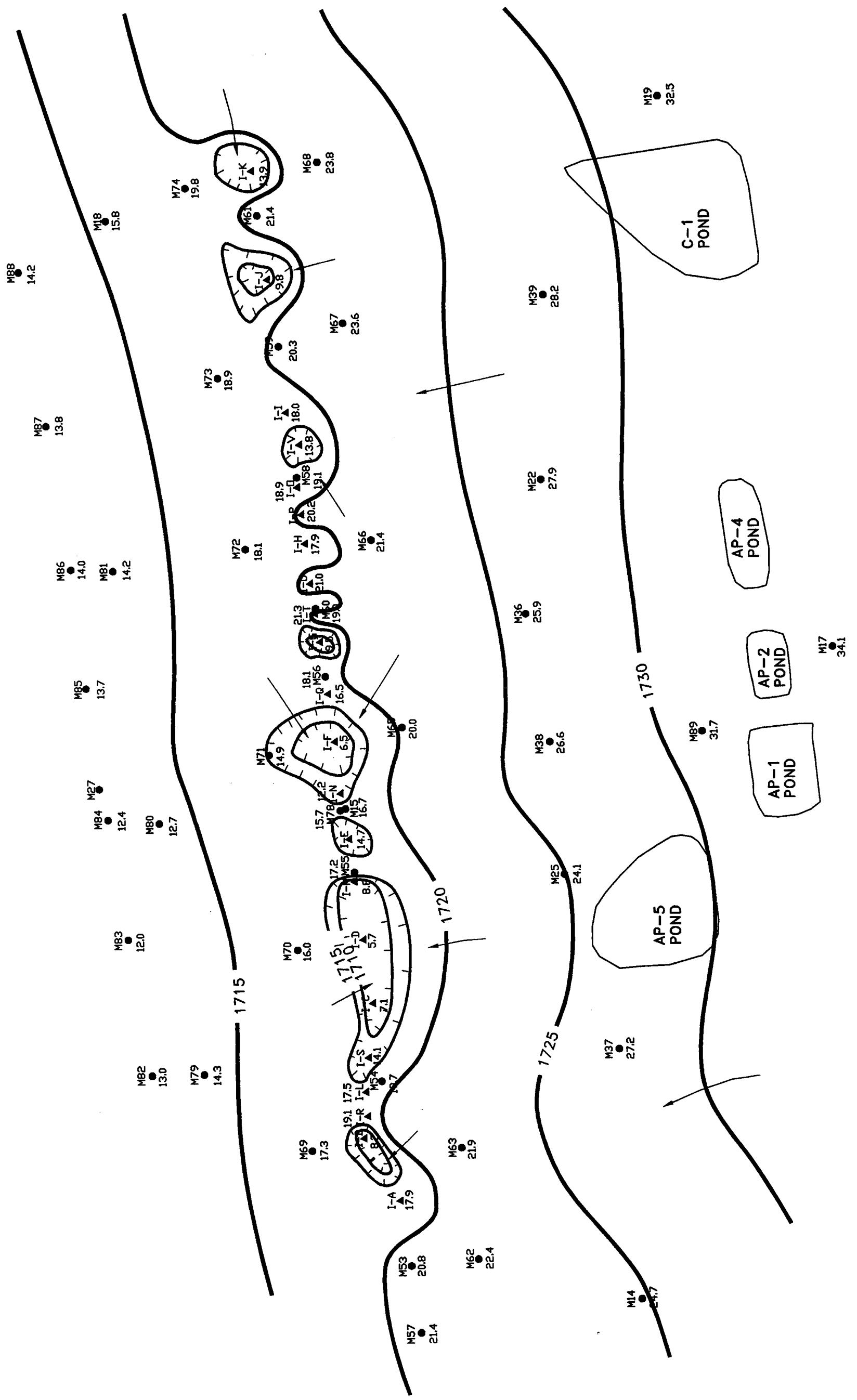
50 feet over the majority of the interceptor well line. KMCLLC is planning to install conductivity probe high and low water level switches in the interceptor wells to fine-tune the recovery pump operation. The pumps currently operate on a timer system which allows groundwater recovery in the well for a certain period of time prior to the pump start-up. Conductivity probe switches will create a more efficient pumping process which is expected to improve recovery of the available groundwater.

If groundwater recovery continues to diminish due to a chronic decline of groundwater in the alluvium, KMCLLC proposes to supplement the groundwater system to help deliver chromium-impacted water to the interceptor system. This can be done utilizing a provision in the KMCLLC NPDES Permit for discharge of once-through cooling water. The discharged once-through cooling water flows through an unlined channel which intersects the groundwater flow direction and recharges the general area upgradient of the recovery well line. This upgradient recharge could provide additional groundwater in the recovery well area to improve recovery efficiency.

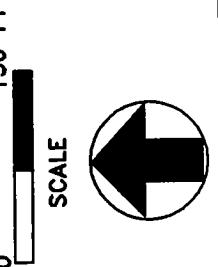
*Extraction from
up gradient wells
to improve source
reduction ??*

FIGURES

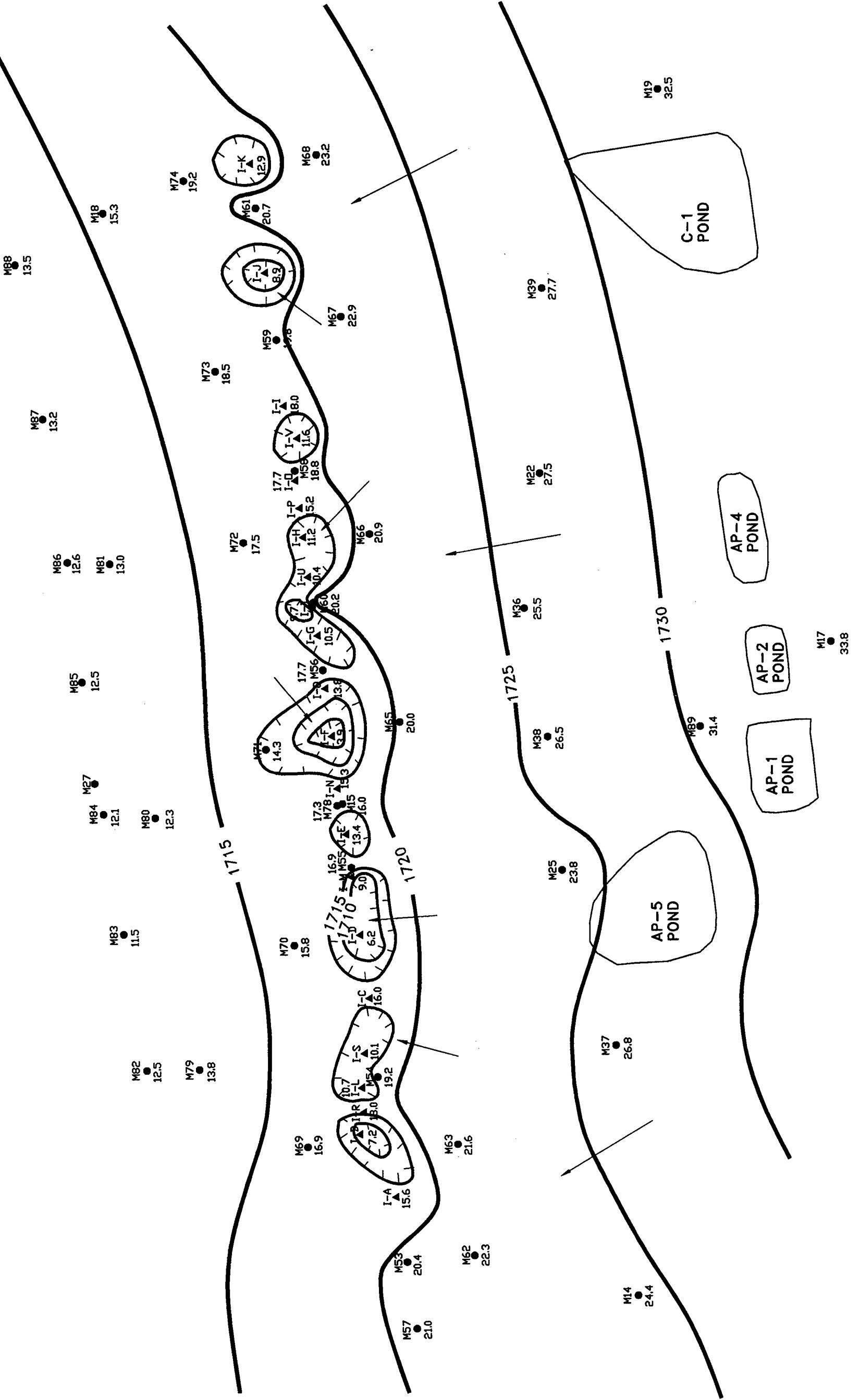




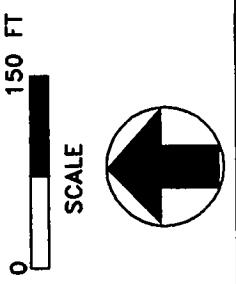
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HENDERSON, NEVADA
FIGURE 2
CONSENT ORDER MONITORING AREA
POTENTIOMETRIC SURFACE MAP
AUGUST 9, 1999



26.3
 ● WATER LEVEL WELL LOCATION (REF. 1700 FT, MSL)
 ▲ INTERCEPTOR WELL LOCATION
 - POTENTIOMETRIC SURFACE CONTOUR
 LINE (FT MSL) CONTOUR INTERVAL = 5 FT
 WATER LEVEL DATA RECORDED AUGUST 9, 1999
 DIRECTION OF GROUNDWATER FLOW

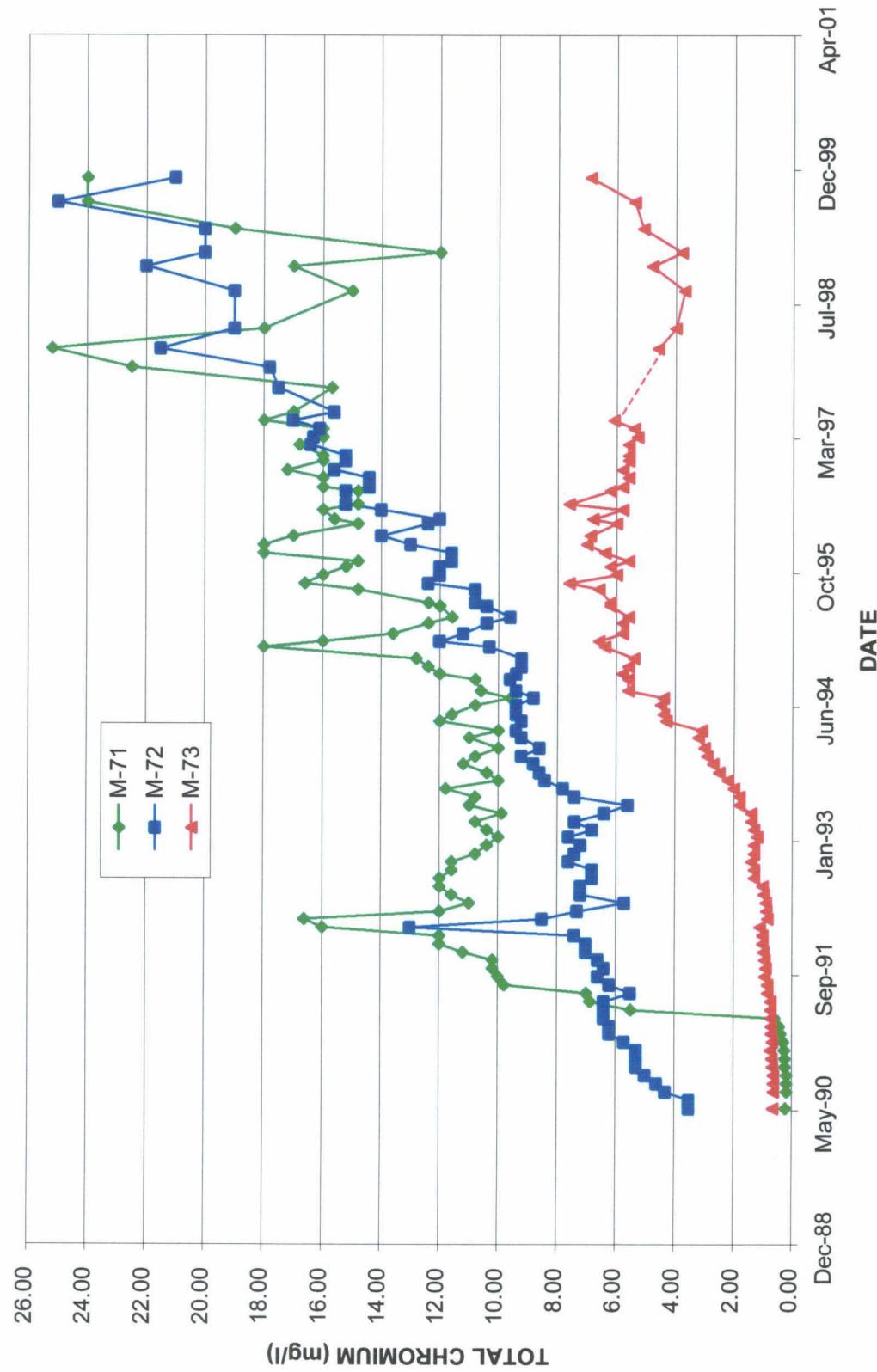


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FIGURE 3
CONSENT ORDER MONITORING AREA
POTENTIOMETRIC SURFACE MAP
NOVEMBER 8, 1999



26.3
 ● WATER LEVEL WELL LOCATION (REF. 1700 FT, MSL)
 ▲ INTERCEPTOR WELL LOCATION
 — POTENTIOMETRIC SURFACE CONTOUR
 LINE (FT MSL) CONTOUR INTERVAL = 5 FT
 → WATER LEVEL DATA RECORDED NOVEMBER 8, 1999
 → DIRECTION OF GROUNDWATER FLOW

**FIGURE 4: UPGRADEMENT MONITOR WELLS
KMCLLC HENDERSON, NEVADA FACILITY**



**FIGURE 5: DOWNGRADIENT MONITOR WELLS
KMC LLC HENDERSON, NEVADA FACILITY**

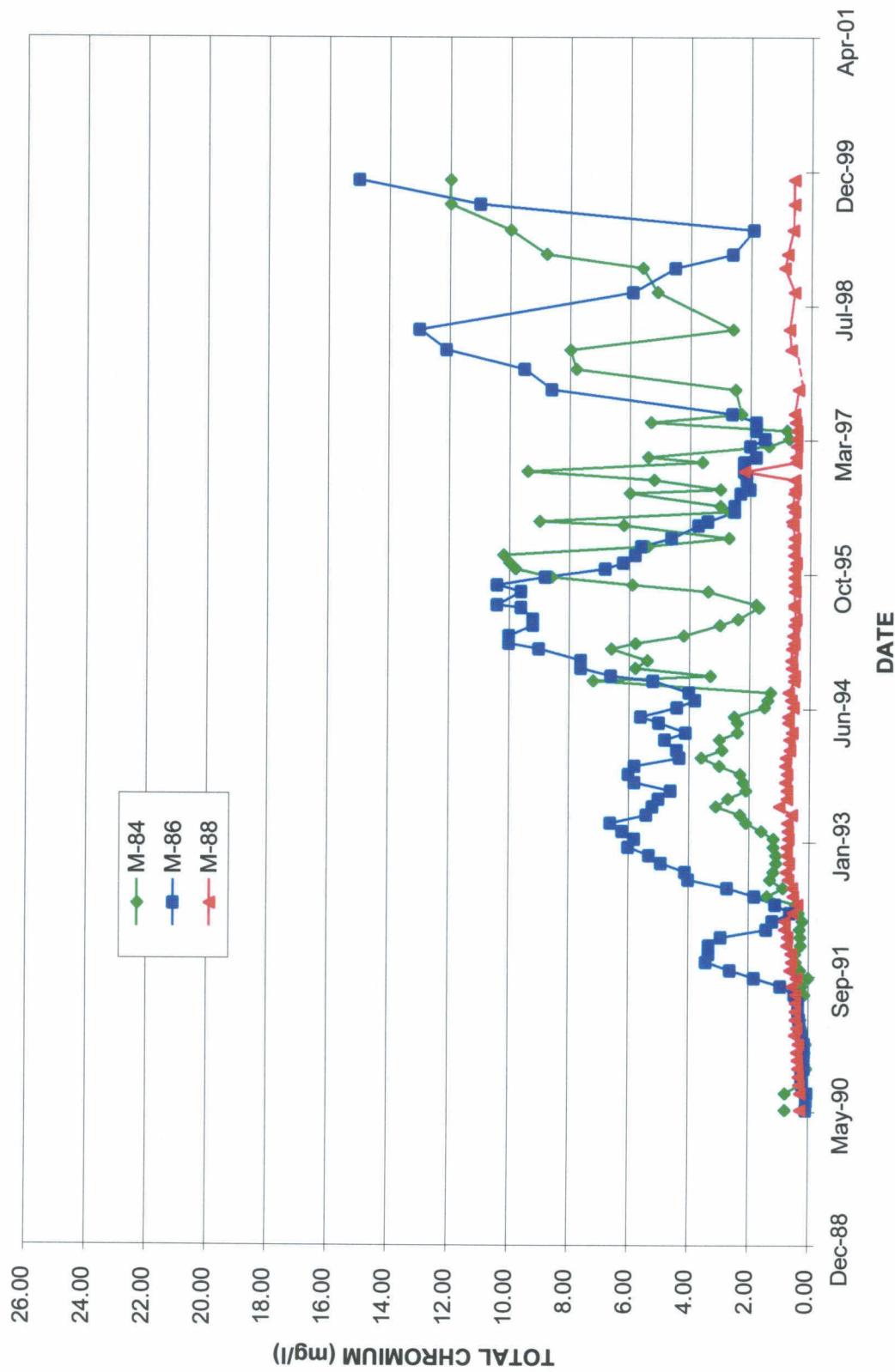
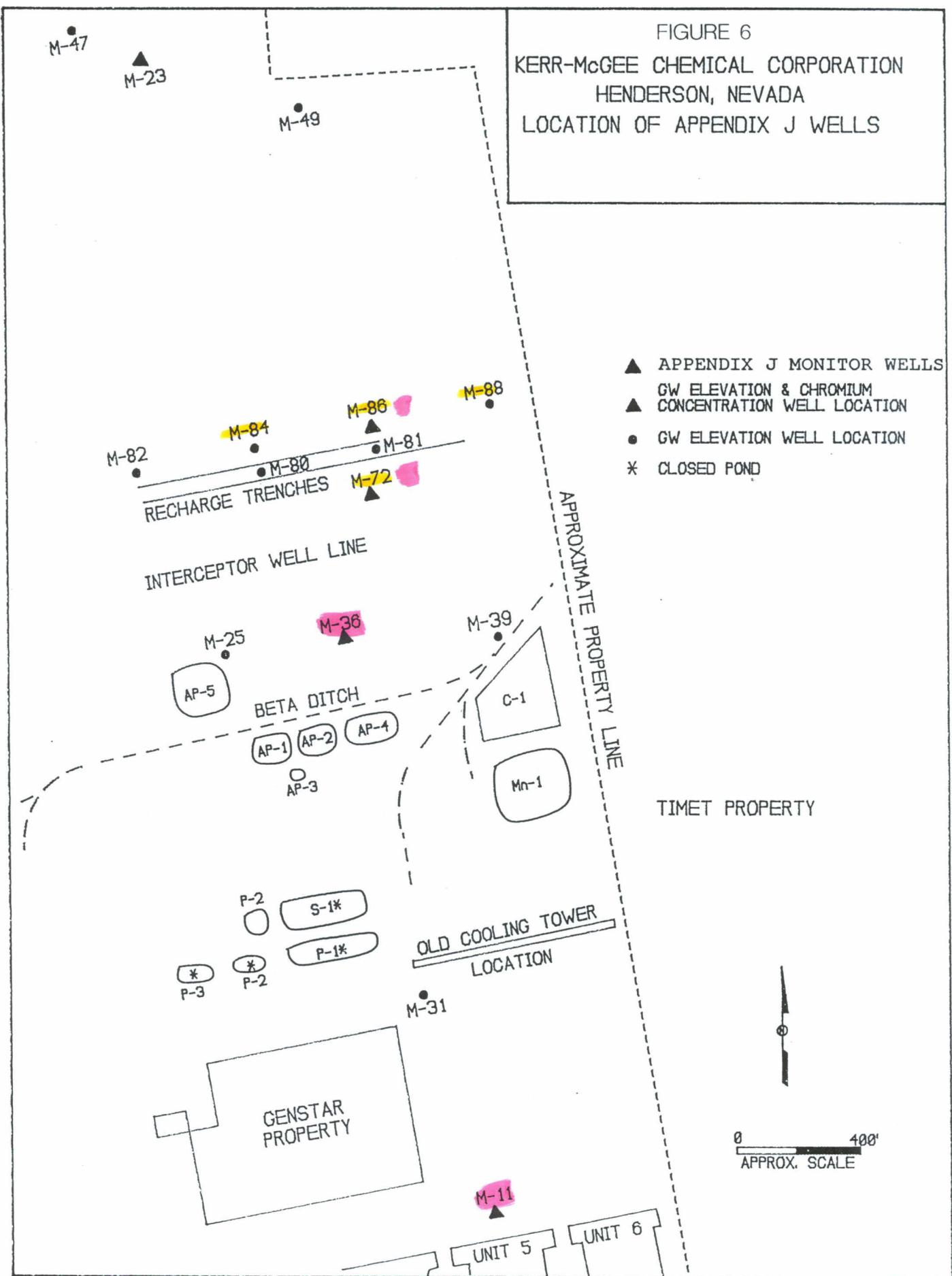
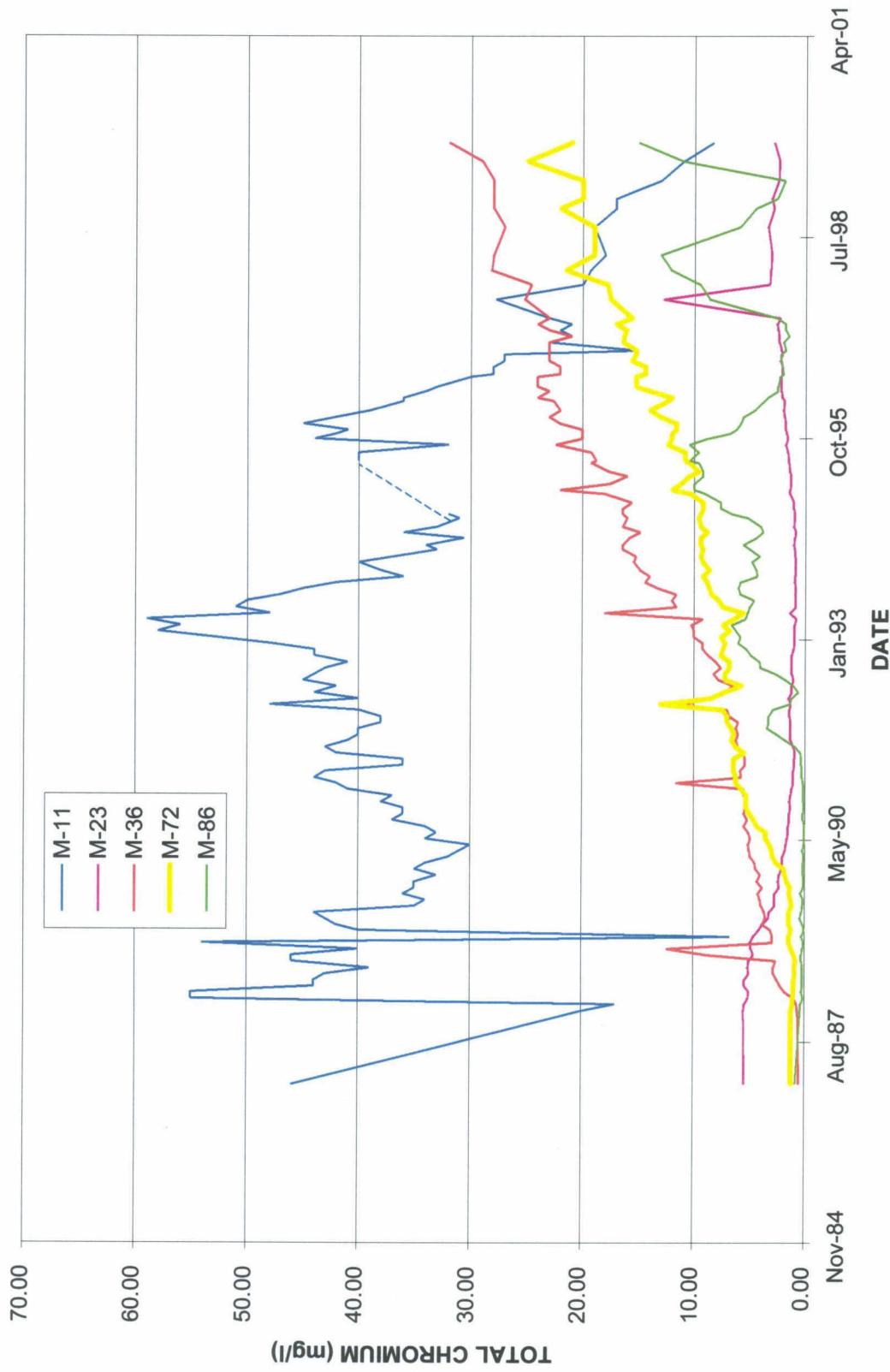


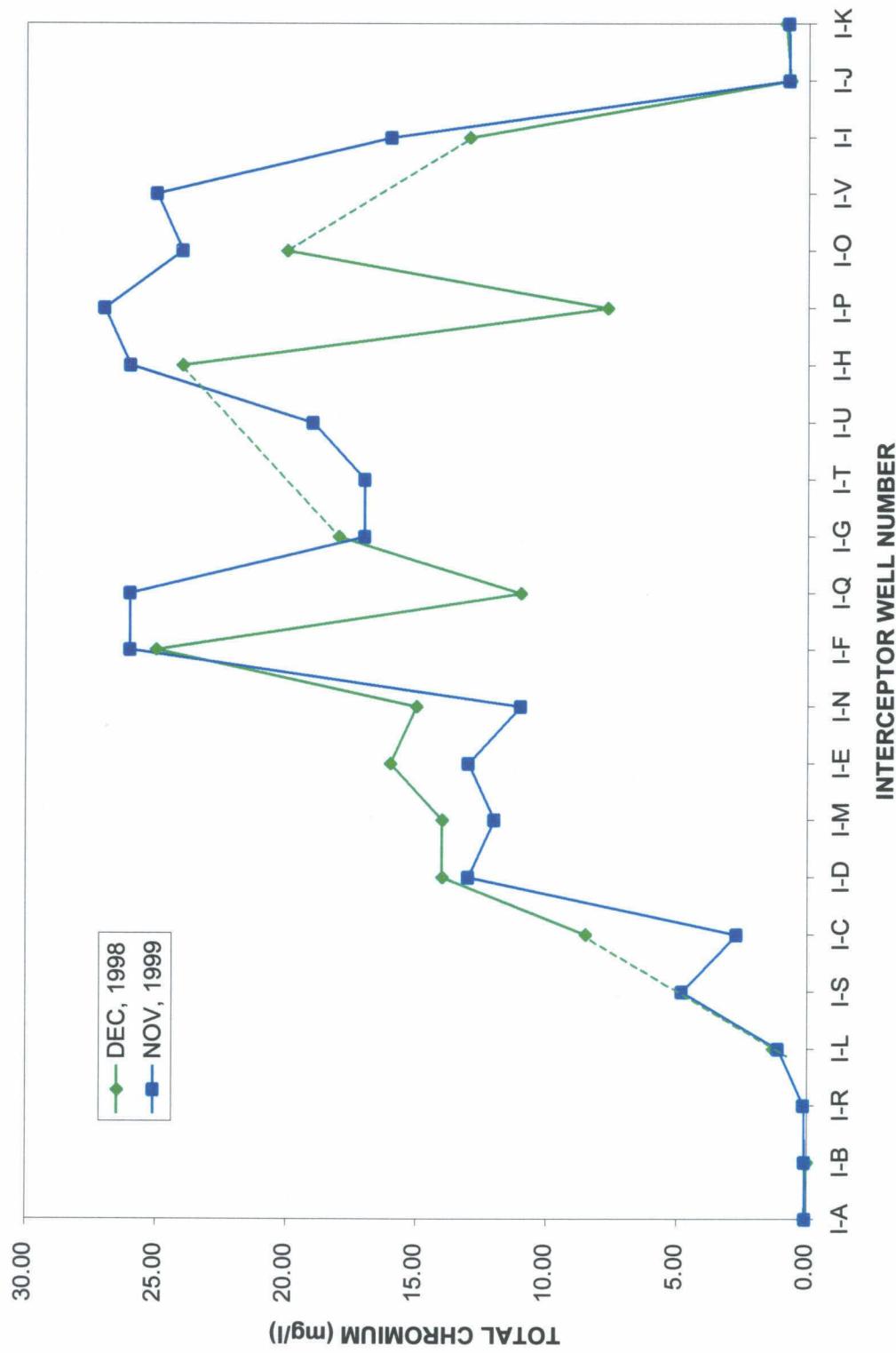
FIGURE 6
KERR-MCGEE CHEMICAL CORPORATION
HENDERSON, NEVADA
LOCATION OF APPENDIX J WELLS



**FIGURE 7: APPENDIX J WELLS
KMC LLC HENDERSON, NEVADA FACILITY**



**FIGURE 8: INTERCEPTOR WELL LINE GRAPH
KMCLLC HENDERSON, NEVADA FACILITY**



TABLES

TABLE 1

TOTAL CHROMIUM (mg/l)
IN SELECTED MONITOR WELLS
KMCLLC HENDERSON NEVADA

DATE	WELL #			
	M-71	M-73	M-84	M-88
Dec-94	12.80	5.40	5.40	0.62
Jan-95	18.00	6.40	6.60	0.60
Feb-95	16.00	6.60	5.80	0.52
Mar-95	13.60	5.80	4.20	0.57
Apr-95	12.40	5.80	3.00	0.52
May-95	11.60	5.60	2.40	0.48
Jun-95	12.00	6.20	1.70	0.52
Jul-95	12.40	6.20	1.80	0.52
Aug-95	14.80	6.60	3.40	0.51
Sep-95	16.60	7.60	5.90	0.52
Oct-95	16.00	6.00	8.60	0.52
Nov-95	15.20	6.20	9.80	0.53
Dec-95	14.80	5.60	10.00	0.47
Jan-96	18.00	6.40	10.20	0.54
Feb-96	18.00	7.00	5.40	0.55
Mar-96	17.00	6.90	2.70	0.53
Apr-96	14.80	6.00	6.20	0.59
May-96	15.60	6.80	9.00	0.61
Jun-96	16.00	5.80	2.70	0.53
Jul-96	14.80	7.60	3.00	0.60
Aug-96	14.80	6.20	6.00	0.55
Sep-96	16.00	5.80	3.00	0.51
Oct-96	16.00	5.60	5.20	0.53
Nov-96	17.20	5.80	9.40	2.20
Dec-96	16.00	5.60	3.60	0.49
Jan-97	16.00	5.60	5.40	0.49
Feb-97	16.80	5.60	1.40	0.47
Mar-97	16.00	5.30	0.72	0.48
Apr-97	16.00	5.40	0.80	0.48
May-97	18.00	6.10	5.30	0.50
Jun-97	17.00		2.30	0.54
Sep-97	15.70		2.50	0.42
Dec-97	22.50		7.80	
Feb-98	25.20	4.60	8.00	0.68
Apr-98	18.00	4.00	2.60	0.73
Sep-98	15.00	3.70	5.10	0.56
Dec-98	17.00	4.80	5.60	0.89
Feb-99	12.00	3.80	8.80	0.80
May-99	19.00	5.10	10.00	0.62
Aug-99	24.00	5.40	12.00	0.58
Nov-99	24.00	6.90	12.00	0.59

TABLE 2
INTERCEPTOR WELL DISCHARGE RATES
DISCHARGE RATE (GPM)

WELL #	DEC. 1994	DEC. 1995	DEC. 1996	DEC. 1997	DEC. 1998	DEC. 1999
I-A	2.7	2.2	2.1	1.0	0.9	0.8
I-B	2.3	1.6	1.4	1.5	1.3	0.9
I-C	1.1	3.1	2.8	2.0	2.7	1.9
I-D	0.7	0.9	0.7	0.9	0.6	0.5
I-E	0.8	0.8	0.5	0.4	0.2	0.5
I-F	4.2	5.2	6.6	0.7	7.0	2.2
I-G	0.2	0.5	0.6	0.1	0.1	0.1
I-H	0.7	1.0	0.9	0.6	0.6	0.4
I-I	5.8	7.0	6.0	6.1	4.8	3.5
I-J	3.9	3.8	4.2	3.2	4.5	3.5
I-K	3.0	2.4	1.8	2.4	3.2	2.5
I-L	1.7	1.4	1.2	1.2	1.0	0.4
I-M	2.7	2.8	2.7	2.2	2.5	2.0
I-N	1.7	2.9	0.3	2.3	2.0	0.1
I-O	<u>0.3</u>	<u>1.8</u>	<u>1.5</u>	<u>1.7</u>	2.2	0.2
I-P					0.8	0.4
I-Q					<u>0.4</u>	0.3
I-R						0.4
I-S						0.8
I-T						0.2
I-U						0.5
I-V						<u>2.3</u>
TOTAL	31.8	37.4	33.3	26.3	34.8	24.4

APPENDICES

APPENDIX A

GROUNDWATER ELEVATIONS

**KERR-MCGEE CHEMICAL LLC
HENDERSON, NEVADA FACILITY
GROUNDWATER ELEVATIONS**

TOC→	M-98		M-99		M-100		M-101		PC-37		PC-54		PC-71		PC-72		PC-73		
	DTW	ELEV																	
04-Feb-99	25.62	1706.29	25.64	1705.10	22.80	1708.13	22.80	1708.01	30.12	1710.12	23.06	1684.66	12.16	1692.27	23.32	1675.42	31.00	1668.43	36.10
24-Mar-99	26.22	1705.69	25.90	1704.84	24.46	1706.47	23.32	1707.49	30.75	1709.49	22.90	1684.82	12.02	1692.41	23.25	1675.49	30.89	1668.34	35.97
04-May-99	27.00	1704.91	26.29	1704.46	24.85	1706.08	23.71	1707.10	31.06	1709.18	23.07	1684.65	12.23	1692.20	23.10	1675.84	30.72	1668.71	36.64
09-Aug-99	28.68	1703.23	27.34	1703.40	26.75	1705.18	24.53	1706.28	31.70	1708.54	23.07	1684.37	12.62	1691.81	23.32	1675.42	30.70	1668.73	35.73
08-Nov-99	29.10	1702.81	28.35	1702.39	26.79	1704.14	25.22	1705.59	32.42	1707.82	23.35								

